

**General information**

Except as otherwise noted near each table and summarized in the last two spreadsheets ("CFMIP output" and "other output"), each output field should be saved for the entire duration of each and every run.

The specifications for archiving model output, as described in the following tables, assume the following (please advise us if the assumptions are incorrect):

1. Sea ice fields and ocean biogeochemistry fields will be archived on the same grid as ocean fields.
2. Land fields (including ice and snow on land) and land biogeochemistry fields will be archived on the same grid as the atmosphere.

The following rules and recommendations for how to calculate quantities should be followed unless a different method is explicitly indicated in the notes that appear in the following tables.

1. It is recommended that ocean and sea-ice output (including Oclim, Oyr, Omon, and OImon) be reported on the ocean's native grid. Unless noted otherwise in the tables, all other output should be reported on the atmospheric grid.
2. Unless otherwise specified, the ocean and sea-ice output (including Oclim, Oyr, Omon, and OImon) represents a mean over only the sea portion of each grid cell (i.e., it is interpreted as "where ocean over ocean"), and a value of 0.0 should be reported where the sea fraction is 0.
3. Unless otherwise specified, the land output (in the Lmon and LImon tables) represents a mean over only the land portion of each grid cell (i.e., it is interpreted as "where land over land"), and a value of 0.0 should be reported where the land fraction is 0.
4. The default interpretation of a OImon field is that the quantity is averaged over the entire ocean portion of each grid-cell (with a value of zero applying anywhere the quantity is absent in this portion of the cell) and then averaged in time.
4. The default interpretation of a LImon field is that the quantity is averaged over the entire land portion of each grid-cell (with a value of zero applying anywhere the quantity is absent in this portion of the cell) and then averaged in time.

**A note on priorities.**

The priorities noted in the tables have been largely set by scientists who have participated in model intercomparison activities and have needed these variables in their own research. Since the priorities in different tables were set by different groups of scientists, the priorities in one table may have a different meaning from the priorities in another table. We hope that the vast majority of fields listed in all the tables will be archived by all the modeling groups, but in many cases where a group has not saved a particular field in the past, this may require non-trivial effort. The priorities listed here, along with the participating group's expert judgement should be considered when deciding which fields to save. Please make every effort to save as many of the fields as possible. For lower priority variables, if you can't save them for all the experiments and realizations, please consider saving them for a subset that you think might be of most interest.

**Key**

|  |  |
|--|--|
|  | questions                                      |
|  | need standard name                             |
|  | modified between 20 May 2010 and 21 June 2010  |
|  | modified between 21 June 2010 and 25 July 2010 |
|  | modified after 25 July 2010                    |
|  | modified after 17 September 2010               |

## CMOR Dimensions

| CMOR table(s)   | CMOR dimension | output dimension name | description   | standard name | long name                      | axis | units         | index axis? | coords_attrib | bounds? | stored direction |
|---|----------------|-----------------------|---|---------------|--------------------------------|------|---------------|-------------|---------------|---------|------------------|
| fx, Amon, Lmon, LImon, OImon, aero, day, 6hrLev, 6hrPlev, 3hr, Oclim, Oyr, Omon, cfMon, cfOff, cfDay, cf3hr | longitude      | lon                   |   | longitude     | longitude                      | X    | degrees_east  |             |               | yes     | increasing       |
| fx, Amon, Lmon, LImon, OImon, aero, day, 6hrLev, 6hrPlev, 3hr, Oclim, Oyr, Omon, cfMon, cfOff, cfDay, cf3hr | latitude       | lat                   |   | latitude      | latitude                       | Y    | degrees_north |             |               | yes     | increasing       |
| Amon  | plevs          | plev                  | There are 17 mandatory levels and up to 6 additional levels requested of models with sufficient resolution in the stratosphere. | air_pressure  | pressure                       | Z    | Pa            |             |               | no      | decreasing       |
| day   | plev8          | plev                  |   | air_pressure  | pressure                       | Z    | Pa            |             |               | no      | decreasing       |
| 6hrPlev   | plev3          | plev                  |   | air_pressure  | pressure                       | Z    | Pa            |             |               | no      | decreasing       |
| cfMon, cfDay  | plev7          | plev                  | 7 pressure layers defined by ISCCP simulator  | air_pressure  | pressure                       | Z    | Pa            |             |               | yes     | decreasing       |
| cfDay   | p500           | plev                  | 500 hPa   | air_pressure  | pressure                       | Z    | Pa            |             |               | no      | decreasing       |
| cfDay   | p700           | plev                  | 700 hPa   | air_pressure  | pressure                       | Z    | Pa            |             |               | no      | decreasing       |
| cfMon, cfOff, cf3hr   | p220           | plev                  | pressure layer of high-level cloud in ISCCP simulator   | air_pressure  | pressure                       | Z    | Pa            |             |               | no      | decreasing       |
| cfMon, cfOff, cf3hr   | p560           | plev                  | pressure layer of mid-level cloud in ISCCP simulator  | air_pressure  | pressure                       | Z    | Pa            |             |               | no      | decreasing       |
| cfMon, cfOff, cf3hr   | p840           | plev                  | pressure layer of low-level cloud in ISCCP simulator  | air_pressure  | pressure                       | Z    | Pa            |             |               | no      | decreasing       |
| Amon, aero, 6hrLev, cfMon, cfDay, cf3hr, cfSites  | alevel         | lev                   | generic atmospheric model vertical coordinate (nondimensional or dimensional)   |               | atmospheric model level        | Z    |               | ok          |               | yes     |                  |
| Amon, cfMon, cfDay, cf3hr, cfSites  | alevhalf       | lev                   | atmospheric model "half" level  |               | atmospheric model half-level   | Z    |               | ok          |               | no      |                  |
| aero  | alev1          | lev                   | atmospheric model's lowest level  |               | lowest atmospheric model level | Z    |               | ok          |               | yes     |                  |

| valid_min | valid_max | type   | positive | value  | bounds_values     | requested  | bounds_requested   | tol_on_requests:<br>variance from<br>requested values that<br>is tolerated | grid? |
|-----------|-----------|--------|----------|--------|-------------------|--|--|--|-------|
| 0         | 360       | double |          |        |                   |  |  |  |       |
| -90       | 90        | double |          |        |                   |  |  |  |       |
|           |           | double | down     |        |                   | 100000. 92500. 85000. 70000. 60000. 50000. 40000.<br>30000. 25000. 20000. 15000. 10000. 7000. 5000. 3000.<br>2000. 1000. |  | 0.001  |       |
|           |           | double | down     |        |                   | 100000. 85000. 70000. 50000. 25000. 10000. 5000.<br>1000.  |  | 0.001  |       |
|           |           | double | down     |        |                   | 85000. 50000. 25000.   |  | 0.001  |       |
|           |           | double | down     |        |                   | 90000. 74000. 62000. 50000. 37500. 24500. 9000.  | 100000. 80000. 80000. 68000. 68000.<br>56000. 56000. 44000. 44000. 31000. 31000.<br>18000. 18000. 0. | 0.001  |       |
|           |           | double | down     | 50000. |                   |  |  |  |       |
|           |           | double | down     | 70000. |                   |  |  |  |       |
|           |           | double | down     | 22000. | 44000. 0.0        |  |  |  |       |
|           |           | double | down     | 56000. | 68000.<br>44000.  |  |  |  |       |
|           |           | double | down     | 84000. | 100000.<br>68000. |  |  |  |       |
|           |           | double | up       |        |                   |  |  |  |       |
|           |           | double | up       |        |                   |  |  |  |       |
|           |           | double |          |        |                   |  |  |  |       |

|   |           |           |   |   |   |   |                    |     |            |
|---|-----------|-----------|---|---|---|---|--------------------|-----|------------|
| cfMon, cfOff, cfDay, cf3hr  | alt40     | alt40     | CloudSat vertical coordinate heights  | altitude                                  | altitude  | Z | m                  | yes | increasing |
| Oyr, Amon, Lmon, LImon, Olmon, aero, day, 3hr, Omon, cfMon, cfOff, cfDay, cf3hr | time      | time      | for time-mean fields  | time                                      | time  | T | days since ?       | yes | increasing |
| 6hrLev, 6hrPlev, 3hr, cf3hr, cfSites  | time1     | time      | synoptic times (for fields that are not time-means)                                 | time                                      | time  | T | days since ?       | no  | increasing |
| Oclim, Amon   | time2     | time      | climatological times  | time                                      | time  | T | days since ?       | yes | increasing |
| Amon, day, 3hr, cf3hr, cfSites  | height2m  | height    | ~2 m standard surface air temperature and surface humidity height                   | height                                    | height  | Z | m                  | no  | increasing |
| Amon, day, 3hr, cf3hr, cfSites  | height10m | height    | ~10 m standard wind speed height  | height                                    | height  | Z | m                  | no  | increasing |
| Lmon, LImon   | sdepth    | depth     | coordinate values for soil layers (depth)   | depth                                     | depth   | Z | m                  | yes | increasing |
| Lmon, day, 3hr  | sdepth1   | depth     | coordinate value for topmost 0.1 meter layer of soil                                | depth                                     | depth   | Z | m                  | yes | increasing |
| cfMon, cfDay  | tau       | tau       | isccp optical depth categories  | atmosphere_optical_thickness_due_to_cloud | cloud optical thickness                                 |   | 1                  | yes | increasing |
| cfOff, cf3hr  | scatratio | scatratio | 15 bins of scattering ratio for the CALIPSO simulator CFAD                          | backscattering_ratio                      | lidar backscattering ratio                              |   | 1                  | yes | increasing |
| cfOff, cf3hr  | dbze      | dbze      | 15 bins of radar reflectivity for CloudSat simulator CFAD                           | equivalent_reflectivity_factor            | CloudSat simulator equivalent radar reflectivity factor |   | dBZ                | yes | increasing |
| cfMon, cfOff, cfDay, cf3hr  | sza5      | sza       | 5 solar zenith angles for PARASOL reflectances                                      | solar_zenith_angle                        | solar zenith angle                                      |   | degree             | no  | increasing |
| cfSites   | site      | site      | an integer assigned to each of 119 stations (standard) and 73 stations (aquaplanet) |   | site index  |   | 1 ok               | no  |            |
| Omon  | basin     | basin     |   | region                                    | ocean basin   |   | 1 region           | no  |            |
| Omon  | rho       | rho       | density? Potential density++++? Check units   |   | density++++?  | Z | kg m <sup>-3</sup> | yes | decreasing |
| fx, Oclim, Oyr, Omon  | olevel    | lev       | generic ocean model vertical coordinate (nondimensional or dimensional)             |   | ocean model level                                       | Z | ok                 | yes |            |



|       |            |       |   |           |                       |   |                  |    |            |
|-------|------------|-------|---|-----------|-----------------------|---|------------------|----|------------|
| Omon  | oline      | line  | opening, passage, strait, channel, etc.   | region    | ocean passage         | 1 | passage          | no |            |
| cf3hr | location   | loc   | COSP profile in instantaneous curtain mode  |           | location index        | 1 | ok               | no | increasing |
| Lmon  | vegtype    | type  | plant functional type. Several plant functional types have been defined in the area_type table available at: <a href="http://cf-pcmdi.llnl.gov/documents/cf-standard-names/area-type-table/current/">cf-pcmdi.llnl.gov/documents/cf-standard-names/area-type-table/current/</a> | area_type | plant functional type | 1 | type_description | no |            |
| Lmon  | typebare   | type  |   | area_type | surface type          | 1 | type_description | no |            |
| Lmon  | typepdec   | type  |   | area_type | surface type          | 1 | type_description | no |            |
| Lmon  | typepever  | type  |   | area_type | surface type          | 1 | type_description | no |            |
| Lmon  | typesdec   | type  |   | area_type | surface type          | 1 | type_description | no |            |
| Lmon  | typesever  | type  |   | area_type | surface type          | 1 | type_description | no |            |
| Lmon  | typec3pft  | type  |   | area_type | surface type          | 1 | type_description | no |            |
| Lmon  | typec4pft  | type  |   | area_type | surface type          | 1 | type_description | no |            |
| Omon  | olayer100m | depth | coordinate for 100 m ocean surface layer  | depth     | depth                 | Z | m                | no | increasing |
| Omon  | depth100m  | depth | coordinate value for 100 m ocean depth  | depth     | depth                 | Z | m                | no | increasing |
| Omon  | depth0m    | depth | vertical coordinate for ocean surface   | depth     | depth                 | Z | m                | no | increasing |

|           |     |        |      |  |         |     |
|-----------|-----|--------|------|--|---------|-----|
| character |     |        |      | barents_opening bering_strait canadian_archipelago<br>denmark_strait drake_passage english_channel<br>pacific_equatorial_undercurrent<br>faroe_scotland_channel florida_bahamas_strait<br>fram_strait iceland_faroe_channel<br>indonesian_thoughflow mozambique_channel<br>taiwan_luzon_straits windward_passage |         |     |
| integer   |     |        |      |  |         | yes |
| character |     |        |      |  |         |     |
| character |     |        |      | bare_ground  |         |     |
| character |     |        |      | primary_deciduous_trees  |         |     |
| character |     |        |      | primary_evergreen_trees  |         |     |
| character |     |        |      | secondary_deciduous_trees  |         |     |
| character |     |        |      | secondary_evergreen_trees  |         |     |
| character |     |        |      | c3_plant_functional_types  |         |     |
| character |     |        |      | c4_plant_functional_types  |         |     |
| 0         | 100 | double | down | 50.  | 0. 100. |     |
| 80        | 120 | double | down | 100.   |         |     |
| 0         | 100 | double | down | 0.   |         |     |

## CMOR Table fx: Time-Invariant Fields

fx

fx

on atmospheric grid

Atmospheric and land fields may be submitted on a (single) grid of the modeling group's choosing. We expect most groups will elect to save output on the native grid. If data is "interpolated" to a different grid, it is important to preserve certain global mean properties (e.g., the total surface fluxes of heat, momentum, and water mass).

| Priority | long name                                  | units              | comment   | questions | output variable name | standard name                           |
|----------|--|--------------------|---|-----------|----------------------|---|
| 1        | Atmosphere Grid-Cell Area                  | m <sup>2</sup>     | For atmospheres with more than 1 mesh (e.g., staggered grids), report areas that apply to surface vertical fluxes of energy.  |           | areacella            | cell_area                               |
| 1        | Surface Altitude                           | m                  | height above the geoid; as defined here, "the geoid" is a surface of constant geopotential that, if the ocean were at rest, would coincide with mean sea level. Under this definition, the geoid changes as the mean volume of the ocean changes (e.g., due to glacial melt, or global warming of the ocean). Report here the height above the present-day geoid. Over ocean, report as 0.0 |           | orog                 | surface_altitude                        |
| 1        | Land Area Fraction                         | %                  | For atmospheres with more than 1 mesh (e.g., staggered grids), report areas that apply to surface vertical fluxes of energy.  |           | sftlf                | land_area_fraction                      |
| 1        | Fraction of Grid Cell Covered with Glacier | %                  | fraction of grid cell occupied by "permanent" ice (i.e., glaciers). If time varying, report annual values for each year of simulation. For atmospheres with more than 1 mesh (e.g., staggered grids), report areas that apply to surface vertical fluxes of energy.   |           | sftgif               | land_ice_area_fraction                  |
| 1        | Capacity of Soil to Store Water            | kg m <sup>-2</sup> | "where land": divide the total water holding capacity of all the soil in the grid cell by the land area in the grid cell; report as "missing" where the land fraction is 0.   |           | mrsofc               | soil_moisture_content_at_field_capacity |
| 1        | Maximum Root Depth                         | m                  | report the maximum soil depth reachable by plant roots (if defined in model), i.e., the maximum soil depth from which they can extract moisture; report as "missing" where the land fraction is 0.  |           | rootd                | root_depth                              |



| <b>unformatted</b> |                     |                 |             |                        | <b>CMOR</b>          |              |                  |                      |                    |                      |
|--------------------|---------------------|-----------------|-------------|------------------------|----------------------|--------------|------------------|----------------------|--------------------|----------------------|
| <b>units</b>       | <b>cell_methods</b> | <b>positive</b> | <b>type</b> | <b>CMOR dimensions</b> | <b>variable name</b> | <b>realm</b> | <b>frequency</b> | <b>cell_measures</b> | <b>flag_values</b> | <b>flag_meanings</b> |
| m2                 |                     |                 | real        | longitude latitude     | areacella            | atmos land   |                  |                      |                    |                      |
| m                  |                     |                 | real        | longitude latitude     | orog                 | atmos        |                  | area: areacella      |                    |                      |
| %                  |                     |                 | real        | longitude latitude     | sftlf                | atmos        |                  | area: areacella      |                    |                      |
| %                  |                     |                 | real        | longitude latitude     | sftgif               | land         |                  | area: areacella      |                    |                      |
| kg m-2             |                     |                 | real        | longitude latitude     | mrsofc               | land         |                  | area: areacella      |                    |                      |
| m                  |                     |                 | real        | longitude latitude     | rootd                | land         |                  | area: areacella      |                    |                      |

### on ocean grid

The WGOMD has recommended that all ocean fields be saved on the model's native ocean grid. Many groups will also elect to save the sea ice fields on the ocean grid. (The alternative is to save sea ice fields on the atmosphere grid.) If data is "interpolated" from its native grid, it is important to preserve certain global mean properties (e.g., the total surface fluxes of heat, momentum, and water mass into the ocean).

| Priority | long name              | units          | comment   | questions                                       | output variable |                             |
|----------|------------------------|----------------|---|---|-----------------|-----------------------------|
|          |                        |                |   |   | name            | standard name               |
| 1        | Sea Floor Depth        | m              | Ocean bathymetry. Report here the sea floor depth for present day. Report as missing for land grid cells.   |   | deptho          | sea_floor_depth_below_geoid |
| 1        | Ocean Grid-Cell Volume | m <sup>3</sup> | 3-D field: grid-cell volume ca. 2000. For oceans with more than 1 mesh, report for on grid that applies to temperature  |   | volcello        | ocean_volume                |
| 1        | Ocean Grid-Cell Area   | m <sup>2</sup> | For oceans with more than 1 mesh (e.g., staggered grids), report areas that apply to surface vertical fluxes of energy.   |   | areacello       | cell_area                   |
| 1        | Sea Area Fraction      | %              | Report on the same grid that ocean fields are reported (i.e., the ocean native grid, or the grid that ocean data has been provided to CMIP. For completeness, provide this even if the ocean grid is the same as the atmospheric grid. This is the area fraction at the ocean surface.  | Should this be recorded as a function of depth? | sftof           | sea_area_fraction           |
| 1        | Region Selection Index | 1              | Report on the same grid as the temperature field. flag_values=0,1,2,3,4,5,6,7,8,9,10 corresponding to flag_meanings=global_land, southern_ocean, atlantic_ocean, pacific_ocean, arctic_ocean, indian_ocean, mediterranean_sea, black_sea, hudson_bay, baltic_sea, red_sea. Report on the grid used for the temperature field. |   | basin           | region                      |
|          |                        |                | eliminated basinv because it can be estimated from basin; also some models would also need a basinu for completeness  |   |                 |                             |

| unformatted |              |          |         |                           | CMOR          |       |           |                 |                           |   |  |
|-------------|--------------|----------|---------|---------------------------|---------------|-------|-----------|-----------------|---------------------------|---|--|
| units       | cell_methods | positive | type    | CMOR dimensions           | variable name | realm | frequency | cell_measures   | flag_values               | flag_meanings   |  |
| m           |              |          | real    | longitude latitude        | deptho        | ocean |           | area: areacello |                           |   |  |
| m3          |              |          | real    | longitude latitude olevel | volcello      | ocean |           |                 |                           |   |  |
| m2          |              |          | real    | longitude latitude        | areacello     | ocean |           |                 |                           |   |  |
| %           |              |          | real    | longitude latitude        | sftof         | ocean |           | area: areacello |                           |   |  |
| 1           |              |          | integer | longitude latitude        | basin         | ocean |           | area: areacello | 0 1 2 3 4 5 6 7<br>8 9 10 | global_land southern_ocean<br>atlantic_ocean pacific_ocean<br>arctic_ocean indian_ocean<br>mediterranean_sea black_sea<br>hudson_bay baltic_sea red_sea |  |

**CMOR Table Oclim: Monthly Mean Ocean Climatology (Jan. 1986-Dec. 2005 of historical run)**  
**(All Saved on the Ocean Grid)**

Oclim

monClim

**Further explanation of the fields in the following tables can be found in Griffies et al., available at [http://eprints.soton.ac.uk/65415/01/137\\_WGOMD\\_ModelOutput.pdf](http://eprints.soton.ac.uk/65415/01/137_WGOMD_ModelOutput.pdf) . Some of the information in that document will be transcribed into the "comment" column of this spreadsheet.**

**In CMOR Table Oclim: WGOMD Table 2.9**

| <i>Priority</i> | long name  | units                      | comment | questions | output variable name | standard name  |
|-----------------|--|----------------------------|---------|-----------|----------------------|--|
| 3               | Ocean Vertical Heat Diffusivity                              | $\text{m}^2 \text{s}^{-1}$ |         |           | difvho               | ocean_vertical_heat_diffusivity                              |
| 3               | Ocean Vertical Salt Diffusivity                              | $\text{m}^2 \text{s}^{-1}$ |         |           | difvso               | ocean_vertical_salt_diffusivity                              |
| 3               | Ocean Vertical Tracer Diffusivity due to Background          | $\text{m}^2 \text{s}^{-1}$ |         |           | difvtrbo             | ocean_vertical_tracer_diffusivity_due_to_background          |
| 3               | Ocean Vertical Tracer Diffusivity due to Tides               | $\text{m}^2 \text{s}^{-1}$ |         |           | difvtrto             | ocean_vertical_tracer_diffusivity_due_to_tides               |
| 3               | Tendency of Ocean Potential Energy Content                   | $\text{W m}^{-2}$          |         |           | tnpeo                | tendency_of_ocean_potential_energy_content                   |
| 3               | Tendency of Ocean Potential Energy Content due to Tides      | $\text{W m}^{-2}$          |         |           | tnpeot               | tendency_of_ocean_potential_energy_content_due_to_tides      |
| 3               | Tendency of Ocean Potential Energy Content due to Background | $\text{W m}^{-2}$          |         |           | tnpeotb              | tendency_of_ocean_potential_energy_content_due_to_background |
| 3               | Ocean Vertical Momentum Diffusivity                          | $\text{m}^2 \text{s}^{-1}$ |         |           | difvmo               | ocean_vertical_momentum_diffusivity                          |
| 3               | Ocean Vertical Momentum Diffusivity due to Background        | $\text{m}^2 \text{s}^{-1}$ |         |           | difvmbo              | ocean_vertical_momentum_diffusivity_due_to_background        |

| unformatted | cell_methods                                     | positive | type | CMOR dimensions                    | CMOR variable name | realm | frequency | cell_measures                       | flag_values | flag_meanings |
|-------------|--|----------|------|------------------------------------|--------------------|-------|-----------|-------------------------------------|-------------|---------------|
| m2 s-1      | time: mean within years<br>time: mean over years |          | real | longitude latitude olevel<br>time2 | difvho             | ocean |           | area: areacello<br>volume: volcello |             |               |
| m2 s-1      | time: mean within years<br>time: mean over years |          | real | longitude latitude olevel<br>time2 | difvso             | ocean |           | area: areacello<br>volume: volcello |             |               |
| m2 s-1      | time: mean within years<br>time: mean over years |          | real | longitude latitude olevel<br>time2 | difvtrbo           | ocean |           | area: areacello<br>volume: volcello |             |               |
| m2 s-1      | time: mean within years<br>time: mean over years |          | real | longitude latitude olevel<br>time2 | difvtrto           | ocean |           | area: areacello<br>volume: volcello |             |               |
| W m-2       | time: mean within years<br>time: mean over years |          | real | longitude latitude olevel<br>time2 | tnpeo              | ocean |           | area: areacello<br>volume: volcello |             |               |
| W m-2       | time: mean within years<br>time: mean over years |          | real | longitude latitude olevel<br>time2 | tnpeot             | ocean |           | area: areacello<br>volume: volcello |             |               |
| W m-2       | time: mean within years<br>time: mean over years |          | real | longitude latitude olevel<br>time2 | tnpeotb            | ocean |           | area: areacello<br>volume: volcello |             |               |
| m2 s-1      | time: mean within years<br>time: mean over years |          | real | longitude latitude olevel<br>time2 | difvmo             | ocean |           | area: areacello<br>volume: volcello |             |               |
| m2 s-1      | time: mean within years<br>time: mean over years |          | real | longitude latitude olevel<br>time2 | difvmbo            | ocean |           | area: areacello<br>volume: volcello |             |               |

|   |   |                            |          |   |
|---|---|----------------------------|----------|---|
| 3 | Ocean Vertical Momentum Diffusivity due to Tides                        | $\text{m}^2 \text{s}^{-1}$ | difvmto  | ocean_vertical_momentum_diffusivity_due_to_tides                        |
| 3 | Ocean Vertical Momentum Diffusivity due to Form Drag                    | $\text{m}^2 \text{s}^{-1}$ | difvmfdo | ocean_vertical_momentum_diffusivity_due_to_form_drag                    |
| 3 | Ocean Kinetic Energy Dissipation Per Unit Area due to Vertical Friction | $\text{W m}^{-2}$          | dispkvfo | ocean_kinetic_energy_dissipation_per_unit_area_due_to_vertical_friction |

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|        |   |      |                                    |           |       |                                     |
|--------|---|------|------------------------------------|-----------|-------|-------------------------------------|
| m2 s-1 | time: mean within<br>years time: mean<br>over years | real | longitude latitude olevel<br>time2 | difvmto   | ocean | area: areacello<br>volume: volcello |
| m2 s-1 | time: mean within<br>years time: mean<br>over years | real | longitude latitude olevel<br>time2 | difvmfdo  | ocean | area: areacello<br>volume: volcello |
| W m-2  | time: mean within<br>years time: mean<br>over years | real | longitude latitude olevel<br>time2 | dispkevfo | ocean | area: areacello<br>volume: volcello |

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In CMOR Table **Oclim**: WGOMD Table 2.10

| <i>priority</i> | long name  | units                      | comment                  | questions | output variable name | standard name  |
|-----------------|--|----------------------------|--------------------------|-----------|----------------------|--|
| 3               | Ocean Tracer Bolus Laplacian Diffusivity                             | $\text{m}^2 \text{s}^{-1}$ | 3-d time dependent field |           | diftrblo             | ocean_tracer_bolus_laplacian_diffusivity                             |
| 3               | Ocean Tracer Bolus Biharmonic Diffusivity                            | $\text{m}^4 \text{s}^{-1}$ | 3-d time dependent field |           | diftrbbo             | ocean_tracer_bolus_biharmonic_diffusivity                            |
| 3               | Ocean Tracer Epineutral Laplacian Diffusivity                        | $\text{m}^2 \text{s}^{-1}$ | 3-d time dependent field |           | diftrelo             | ocean_tracer_epineutral_laplacian_diffusivity                        |
| 3               | Ocean Tracer Epineutral Biharmonic Diffusivity                       | $\text{m}^4 \text{s}^{-1}$ | 3-d time dependent field |           | diftrebo             | ocean_tracer_epineutral_biharmonic_diffusivity                       |
| 3               | Ocean Tracer XY Laplacian Diffusivity                                | $\text{m}^2 \text{s}^{-1}$ | 3-d time dependent field |           | diftrxylo            | ocean_tracer_xy_laplacian_diffusivity                                |
| 3               | Ocean Tracer XY Biharmonic Diffusivity                               | $\text{m}^4 \text{s}^{-1}$ | 3-d time dependent field |           | diftrxybo            | ocean_tracer_xy_biharmonic_diffusivity                               |
| 3               | Tendency of Ocean Eddy Kinetic Energy Content due to Bolus Transport | $\text{W m}^{-2}$          | 3-d time dependent field |           | tnkebto              | tendency_of_ocean_eddy_kinetic_energy_content_due_to_bolus_transport |
| 3               | Ocean Momentum XY Laplacian Diffusivity                              | $\text{m}^2 \text{s}^{-1}$ | 3-d time dependent field |           | difmxylo             | ocean_momentum_xy_laplacian_diffusivity                              |
| 3               | Ocean Momentum XY Biharmonic Diffusivity                             | $\text{m}^4 \text{s}^{-1}$ | 3-d time dependent field |           | difmxybo             | ocean_momentum_xy_biharmonic_diffusivity                             |
| 3               | Ocean Kinetic Energy Dissipation Per Unit Area due to XY Friction    | $\text{W m}^{-2}$          | 3-d time dependent field |           | dispkexyfo           | ocean_kinetic_energy_dissipation_per_unit_area_due_to_xy_friction    |



| unformatted<br>units | cell_methods  | positive | type | CMOR dimensions                    | CMOR<br>variable<br>name | realm | frequency | cell_measures                       | flag_values | flag_meanings |
|----------------------|---|----------|------|------------------------------------|--------------------------|-------|-----------|-------------------------------------|-------------|---------------|
| m2 s-1               | time: mean within<br>years time: mean<br>over years |          | real | longitude latitude olevel<br>time2 | diftrblo                 | ocean |           | area: areacello<br>volume: volcello |             |               |
| m4 s-1               | time: mean within<br>years time: mean<br>over years |          | real | longitude latitude olevel<br>time2 | diftrbbo                 | ocean |           | area: areacello<br>volume: volcello |             |               |
| m2 s-1               | time: mean within<br>years time: mean<br>over years |          | real | longitude latitude olevel<br>time2 | diftrelo                 | ocean |           | area: areacello<br>volume: volcello |             |               |
| m4 s-1               | time: mean within<br>years time: mean<br>over years |          | real | longitude latitude olevel<br>time2 | diftrebo                 | ocean |           | area: areacello<br>volume: volcello |             |               |
| m2 s-1               | time: mean within<br>years time: mean<br>over years |          | real | longitude latitude olevel<br>time2 | diftrxylo                | ocean |           | area: areacello<br>volume: volcello |             |               |
| m4 s-1               | time: mean within<br>years time: mean<br>over years |          | real | longitude latitude olevel<br>time2 | diftrxybo                | ocean |           | area: areacello<br>volume: volcello |             |               |
| W m-2                | time: mean within<br>years time: mean<br>over years |          | real | longitude latitude olevel<br>time2 | tnkebto                  | ocean |           | area: areacello<br>volume: volcello |             |               |
| m2 s-1               | time: mean within<br>years time: mean<br>over years |          | real | longitude latitude olevel<br>time2 | difmxylo                 | ocean |           | area: areacello<br>volume: volcello |             |               |
| m4 s-1               | time: mean within<br>years time: mean<br>over years |          | real | longitude latitude olevel<br>time2 | difmxybo                 | ocean |           | area: areacello<br>volume: volcello |             |               |
| W m-2                | time: mean within<br>years time: mean<br>over years |          | real | longitude latitude olevel<br>time2 | dispkxyfo                | ocean |           | area: areacello<br>volume: volcello |             |               |

|   |  |                            |                          |           |  |
|---|--|----------------------------|--------------------------|-----------|--|
| 3 | Ocean Tracer Bolus Laplacian Diffusivity                             | $\text{m}^2 \text{s}^{-1}$ | 2-d time dependent field | diftrblo  | ocean_tracer_bolus_laplacian_diffusivity                             |
| 3 | Ocean Tracer Bolus Biharmonic Diffusivity                            | $\text{m}^4 \text{s}^{-1}$ | 2-d time dependent field | diftrbbo  | ocean_tracer_bolus_biharmonic_diffusivity                            |
| 3 | Ocean Tracer Epineutral Laplacian Diffusivity                        | $\text{m}^2 \text{s}^{-1}$ | 2-d time dependent field | diftrelo  | ocean_tracer_epineutral_laplacian_diffusivity                        |
| 3 | Ocean Tracer Epineutral Biharmonic Diffusivity                       | $\text{m}^4 \text{s}^{-1}$ | 2-d time dependent field | diftrebo  | ocean_tracer_epineutral_biharmonic_diffusivity                       |
| 3 | Ocean Tracer XY Laplacian Diffusivity                                | $\text{m}^2 \text{s}^{-1}$ | 2-d time dependent field | diftrxylo | ocean_tracer_xy_laplacian_diffusivity                                |
| 3 | Ocean Tracer XY Biharmonic Diffusivity                               | $\text{m}^4 \text{s}^{-1}$ | 2-d time dependent field | diftrxybo | ocean_tracer_xy_biharmonic_diffusivity                               |
| 3 | Tendency of Ocean Eddy Kinetic Energy Content due to Bolus Transport | $\text{W m}^{-2}$          | 2-d time dependent field | tnkebto   | tendency_of_ocean_eddy_kinetic_energy_content_due_to_bolus_transport |
| 3 | Ocean Momentum XY Laplacian Diffusivity                              | $\text{m}^2 \text{s}^{-1}$ | 2-d time dependent field | difmxylo  | ocean_momentum_xy_laplacian_diffusivity                              |
| 3 | Ocean Momentum XY Biharmonic Diffusivity                             | $\text{m}^4 \text{s}^{-1}$ | 2-d time dependent field | difmxybo  | ocean_momentum_xy_biharmonic_diffusivity                             |
| 3 | Ocean Kinetic Energy Dissipation Per Unit Area due to XY Friction    | $\text{W m}^{-2}$          | 2-d time dependent field | dispkxyfo | ocean_kinetic_energy_dissipation_per_unit_area_due_to_xy_friction    |

|        |   |      |                                    |              |       |                 |
|--------|---|------|------------------------------------|--------------|-------|-----------------|
| m2 s-1 | time: mean within<br>years time: mean<br>over years | real | longitude latitude olevel<br>time2 | diftrblo2d   | ocean | area: areacello |
| m4 s-1 | time: mean within<br>years time: mean<br>over years | real | longitude latitude olevel<br>time2 | diftrbbo2d   | ocean | area: areacello |
| m2 s-1 | time: mean within<br>years time: mean<br>over years | real | longitude latitude olevel<br>time2 | diftrlo2d    | ocean | area: areacello |
| m4 s-1 | time: mean within<br>years time: mean<br>over years | real | longitude latitude olevel<br>time2 | diftrbo2d    | ocean | area: areacello |
| m2 s-1 | time: mean within<br>years time: mean<br>over years | real | longitude latitude olevel<br>time2 | diftrxylo2d  | ocean | area: areacello |
| m4 s-1 | time: mean within<br>years time: mean<br>over years | real | longitude latitude olevel<br>time2 | diftrxybo2d  | ocean | area: areacello |
| W m-2  | time: mean within<br>years time: mean<br>over years | real | longitude latitude olevel<br>time2 | tnkebto2d    | ocean | area: areacello |
| m2 s-1 | time: mean within<br>years time: mean<br>over years | real | longitude latitude olevel<br>time2 | difmxylo2d   | ocean | area: areacello |
| m4 s-1 | time: mean within<br>years time: mean<br>over years | real | longitude latitude olevel<br>time2 | difmxybo2d   | ocean | area: areacello |
| W m-2  | time: mean within<br>years time: mean<br>over years | real | longitude latitude olevel<br>time2 | dispkexyfo2d | ocean | area: areacello |

## CMOR Table Oyr: Annual Mean Ocean Fields, Including Biogeochemical Fields

Oyr

yr

(All Saved on the Ocean Grid)

## In CMOR Table Oyr: 3-D Marine Biogeochemical Tracer Fields

| Priority | long name  | units               | comment  | questions | output variable |  |
|----------|--|---------------------|--|-----------|-----------------|--|
|          |  |                     |  |           | name            | standard name  |
| 1        | Dissolved Inorganic Carbon Concentration   | mol m <sup>-3</sup> | Dissolved inorganic carbon (CO <sub>3</sub> +HCO <sub>3</sub> +H <sub>2</sub> CO <sub>3</sub> ) concentration  |           | dissic          | mole_concentration_of_dissolved_inorganic_carbon_in_sea_water                      |
| 2        | Dissolved Organic Carbon Concentration   | mol m <sup>-3</sup> | Dissolved organic carbon concentration   |           | dissoc          | mole_concentration_of_dissolved_organic_carbon_in_sea_water                        |
| 2        | Phytoplankton Carbon Concentration   | mol m <sup>-3</sup> | sum of phytoplankton carbon component concentrations. In most (all?) cases this is the sum of phycciat and phymisc (i.e., "Diatom Carbon Concentration" and "Non-Diatom Phytoplankton Carbon Concentration") |           | phyc            | mole_concentration_of_phytoplankton_expressed_as_carbon_in_sea_water               |
| 2        | Zooplankton Carbon Concentration   | mol m <sup>-3</sup> | sum of zooplankton carbon component concentrations   |           | zooc            | mole_concentration_of_zooplankton_expressed_as_carbon_in_sea_water                 |
| 3        | Bacterial Carbon Concentration   | mol m <sup>-3</sup> | sum of bacterial carbon component concentrations   |           | bacc            | mole_concentration_of_bacteria_expressed_as_carbon_in_sea_water                    |
| 2        | Detrital Organic Carbon Concentration  | mol m <sup>-3</sup> | sum of detrital organic carbon component concentrations  |           | detoc           | mole_concentration_of_organic_detritus_expressed_as_carbon_in_sea_water            |
| 2        | Calcite Concentration  | mol m <sup>-3</sup> | sum of particulate calcite component concentrations (e.g. Phytoplankton, Detrital, etc.)   |           | calc            | mole_concentration_of_calcite_expressed_as_carbon_in_sea_water                     |
| 2        | Aragonite Concentration  | mol m <sup>-3</sup> | sum of particulate aragonite components (e.g. Phytoplankton, Detrital, etc.)   |           | arag            | mole_concentration_of_aragonite_expressed_as_carbon_in_sea_water                   |
| 3        | Mole Concentration of Diatoms expressed as Carbon in Sea Water                     | mol m <sup>-3</sup> | carbon from the diatom phytoplankton component concentration alone   |           | phycciat        | mole_concentration_of_diatoms_expressed_as_carbon_in_sea_water                     |
| 3        | Mole Concentration of Diazotrophs Expressed as Carbon in Sea Water                 | mol m <sup>-3</sup> | carbon concentration from the diazotrophic phytoplankton component alone   |           | phycciaz        | mole_concentration_of_diazotrophs_expressed_as_carbon_in_sea_water                 |
| 3        | Mole Concentration of Calcareous Phytoplankton expressed as Carbon in Sea Water    | mol m <sup>-3</sup> | carbon concentration from calcareous (calcite-producing) phytoplankton component alone   |           | phycalc         | mole_concentration_of_calcareous_phytoplankton_expressed_as_carbon_in_sea_water    |
| 3        | Mole Concentration of Picophytoplankton expressed as Carbon in Sea Water           | mol m <sup>-3</sup> | carbon concentration from the picophytoplankton (<2 um) component alone  |           | phypico         | mole_concentration_of_picophytoplankton_expressed_as_carbon_in_sea_water           |
| 3        | Mole Concentration of Miscellaneous Phytoplankton expressed as Carbon in Sea Water | mol m <sup>-3</sup> | carbon concentration from additional phytoplankton component alone   |           | phymisc         | mole_concentration_of_miscellaneous_phytoplankton_expressed_as_carbon_in_sea_water |
| 3        | Mole Concentration of Microzooplankton expressed as Carbon in Sea Water            | mol m <sup>-3</sup> | carbon concentration from the microzooplankton (<20 um) component alone  |           | zmicro          | mole_concentration_of_microzooplankton_expressed_as_carbon_in_sea_water            |
| 3        | Mole Concentration of Mesozooplankton expressed as Carbon in Sea Water             | mol m <sup>-3</sup> | carbon concentration from mesozooplankton (20-200 um) component alone  |           | zmeso           | mole_concentration_of_mesozooplankton_expressed_as_carbon_in_sea_water             |

| <b>unformatted</b> |                                    |                 |             |                                | <b>CMOR</b>     |              |                  |                                     |                    |                      |
|--------------------|------------------------------------|-----------------|-------------|--------------------------------|-----------------|--------------|------------------|-------------------------------------|--------------------|----------------------|
| <b>units</b>       | <b>cell_methods</b>                | <b>positive</b> | <b>type</b> | <b>CMOR dimensions</b>         | <b>variable</b> | <b>realm</b> | <b>frequency</b> | <b>cell_measures</b>                | <b>flag_values</b> | <b>flag_meanings</b> |
| mol m-3            | time: mean area:<br>mean where sea |                 | real        | longitude latitude olevel time | dissic          | ocnBgchem    |                  | area: areacello<br>volume: volcello |                    |                      |
| mol m-3            | time: mean area:<br>mean where sea |                 | real        | longitude latitude olevel time | dissoc          | ocnBgchem    |                  | area: areacello<br>volume: volcello |                    |                      |
| mol m-3            | time: mean area:<br>mean where sea |                 | real        | longitude latitude olevel time | phyc            | ocnBgchem    |                  | area: areacello<br>volume: volcello |                    |                      |
| mol m-3            | time: mean area:<br>mean where sea |                 | real        | longitude latitude olevel time | zooc            | ocnBgchem    |                  | area: areacello<br>volume: volcello |                    |                      |
| mol m-3            | time: mean area:<br>mean where sea |                 | real        | longitude latitude olevel time | bacc            | ocnBgchem    |                  | area: areacello<br>volume: volcello |                    |                      |
| mol m-3            | time: mean area:<br>mean where sea |                 | real        | longitude latitude olevel time | detoc           | ocnBgchem    |                  | area: areacello<br>volume: volcello |                    |                      |
| mol m-3            | time: mean area:<br>mean where sea |                 | real        | longitude latitude olevel time | calc            | ocnBgchem    |                  | area: areacello<br>volume: volcello |                    |                      |
| mol m-3            | time: mean area:<br>mean where sea |                 | real        | longitude latitude olevel time | arag            | ocnBgchem    |                  | area: areacello<br>volume: volcello |                    |                      |
| mol m-3            | time: mean area:<br>mean where sea |                 | real        | longitude latitude olevel time | phydiat         | ocnBgchem    |                  | area: areacello<br>volume: volcello |                    |                      |
| mol m-3            | time: mean area:<br>mean where sea |                 | real        | longitude latitude olevel time | phydiaz         | ocnBgchem    |                  | area: areacello<br>volume: volcello |                    |                      |
| mol m-3            | time: mean area:<br>mean where sea |                 | real        | longitude latitude olevel time | phycalc         | ocnBgchem    |                  | area: areacello<br>volume: volcello |                    |                      |
| mol m-3            | time: mean area:<br>mean where sea |                 | real        | longitude latitude olevel time | phypico         | ocnBgchem    |                  | area: areacello<br>volume: volcello |                    |                      |
| mol m-3            | time: mean area:<br>mean where sea |                 | real        | longitude latitude olevel time | phymisc         | ocnBgchem    |                  | area: areacello<br>volume: volcello |                    |                      |
| mol m-3            | time: mean area:<br>mean where sea |                 | real        | longitude latitude olevel time | zmicro          | ocnBgchem    |                  | area: areacello<br>volume: volcello |                    |                      |
| mol m-3            | time: mean area:<br>mean where sea |                 | real        | longitude latitude olevel time | zmeso           | ocnBgchem    |                  | area: areacello<br>volume: volcello |                    |                      |

|   |  |                     |   |         |   |
|---|--|---------------------|---|---------|---|
| 3 | Other Zooplankton Carbon Concentration   | mol m <sup>-3</sup> | carbon from additional zooplankton component concentrations alone (e.g. Micro, meso). Since the models all have different numbers of components, this variable has been included to provide a check for intercomparison between models since some phytoplankton groups are supersets. | zoomisc | mole_concentration_of_miscellaneous_zooplankton_expressed_as_carbon_in_sea_water        |
| 1 | Total Alkalinity   | mol m <sup>-3</sup> | total alkalinity equivalent concentration (including carbonate, nitrogen, silicate, and borate components)  | talk    | sea_water_alkalinity_expressed_as_mole_equivalent                                       |
| 1 | pH   | 1                   | negative log of hydrogen ion concentration with the concentration expressed as mol H kg <sup>-1</sup> .   | ph      | sea_water_ph_reported_on_total_scale  |
| 1 | Dissolve Oxygen Concentration  | mol m <sup>-3</sup> | dissolved oxygen gas concentration in sea water   | o2      | mole_concentration_of_molecular_oxygen_in_sea_water                                     |
| 1 | Dissolved Nitrate Concentration  | mol m <sup>-3</sup> | dissolved nitrate concentration in sea water  | no3     | mole_concentration_of_nitrate_in_sea_water  |
| 2 | Dissolved Ammonium Concentration   | mol m <sup>-3</sup> | dissolved ammonium concentration in sea water   | nh4     | mole_concentration_of_ammonium_in_sea_water   |
| 1 | Dissolved Phosphate Concentration  | mol m <sup>-3</sup> | dissolved Phosphate concentration in sea water  | po4     | mole_concentration_of_phosphate_in_sea_water  |
| 1 | Dissolved Iron Concentration   | mol m <sup>-3</sup> | dissolved iron in sea water is meant to include both Fe <sup>2+</sup> and Fe <sup>3+</sup> ions (but not, e.g., particulate detrital iron)  | dfe     | mole_concentration_of_dissolved_iron_in_sea_water                                       |
| 1 | Dissolved Silicate Concentration   | mol m <sup>-3</sup> | dissolved silicate concentration in sea water   | si      | mole_concentration_of_silicate_in_sea_water   |
| 1 | Total Chlorophyll Mass Concentration   | kg m <sup>-3</sup>  | sum of chlorophyll from all phytoplankton group concentrations. In most models this is equal to chldiat+chlmisc, that is the sum of "Diatom Chlorophyll Mass Concentration" plus "Other Phytoplankton Chlorophyll Mass Concentration"   | chl     | mass_concentration_of_phytoplankton_expressed_as_chlorophyll_in_sea_water               |
| 3 | Diatom Chlorophyll Mass Concentration  | kg m <sup>-3</sup>  | chlorophyll from diatom phytoplankton component concentration alone   | chldiat | mass_concentration_of_diatoms_expressed_as_chlorophyll_in_sea_water                     |
| 3 | Mass Concentration of Diazotrophs expressed as Chlorophyll in Sea Water              | kg m <sup>-3</sup>  | chlorophyll concentration from the diazotrophic phytoplankton component alone   | chldiaz | mass_concentration_of_diazotrophs_expressed_as_chlorophyll_in_sea_water                 |
| 3 | Mass Concentration of Calcareous Phytoplankton expressed as Chlorophyll in Sea Water | kg m <sup>-3</sup>  | chlorophyll concentration from the calcite-producing phytoplankton component alone  | chlcalc | mass_concentration_of_calcareous_phytoplankton_expressed_as_chlorophyll_in_sea_water    |
| 3 | Mass Concentration of Picophytoplankton expressed as Chlorophyll in Sea Water        | kg m <sup>-3</sup>  | chlorophyll concentration from the picophytoplankton (<2 um) component alone  | chlpico | mass_concentration_of_picophytoplankton_expressed_as_chlorophyll_in_sea_water           |
| 3 | Other Phytoplankton Chlorophyll Mass Concentration                                   | kg m <sup>-3</sup>  | chlorophyll from additional phytoplankton component concentrations alone  | chlmisc | mass_concentration_of_miscellaneous_phytoplankton_expressed_as_chlorophyll_in_sea_water |
| 3 | Particulate Organic Nitrogen Concentration   | mol m <sup>-3</sup> | sum of particulate organic nitrogen component concentrations  | pon     | mole_concentration_of_particulate_organic_matter_expressed_as_nitrogen_in_sea_water     |
| 3 | Particulate Organic Phosphorus Concentration   | mol m <sup>-3</sup> | sum of particulate organic phosphorus component concentrations  | pop     | mole_concentration_of_particulate_organic_matter_expressed_as_phosphorus_in_sea_water   |
| 3 | Particulate Biogenic Iron Concentration  | mol m <sup>-3</sup> | sum of particulate organic iron component concentrations  | bfe     | mole_concentration_of_particulate_organic_matter_expressed_as_iron_in_sea_water         |
| 3 | Particulate Biogenic Silica Concentration  | mol m <sup>-3</sup> | sum of particulate silica component concentrations  | bsi     | mole_concentration_of_particulate_matter_expressed_as_silicon_in_sea_water              |
| 3 | Phytoplankton Nitrogen Concentration   | mol m <sup>-3</sup> | sum of phytoplankton nitrogen component concentrations  | phyn    | mole_concentration_of_phytoplankton_expressed_as_nitrogen_in_sea_water                  |
| 3 | Phytoplankton Phosphorus Concentration   | mol m <sup>-3</sup> | sum of phytoplankton phosphorus components  | phyp    | mole_concentration_of_phytoplankton_expressed_as_phosphorus_in_sea_water                |

|         |                                    |      |                                |          |           |                                     |
|---------|------------------------------------|------|--------------------------------|----------|-----------|-------------------------------------|
| mol m-3 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | zoocmisc | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | talk     | ocnBgchem | area: areacello<br>volume: volcello |
| 1       | time: mean area:<br>mean where sea | real | longitude latitude olevel time | ph       | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | o2       | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | no3      | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | nh4      | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | po4      | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | dfc      | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | si       | ocnBgchem | area: areacello<br>volume: volcello |
| kg m-3  | time: mean area:<br>mean where sea | real | longitude latitude olevel time | chl      | ocnBgchem | area: areacello<br>volume: volcello |
| kg m-3  | time: mean area:<br>mean where sea | real | longitude latitude olevel time | chldiat  | ocnBgchem | area: areacello<br>volume: volcello |
| kg m-3  | time: mean area:<br>mean where sea | real | longitude latitude olevel time | chldiaz  | ocnBgchem | area: areacello<br>volume: volcello |
| kg m-3  | time: mean area:<br>mean where sea | real | longitude latitude olevel time | chlcalc  | ocnBgchem | area: areacello<br>volume: volcello |
| kg m-3  | time: mean area:<br>mean where sea | real | longitude latitude olevel time | chlpico  | ocnBgchem | area: areacello<br>volume: volcello |
| kg m-3  | time: mean area:<br>mean where sea | real | longitude latitude olevel time | chlmisc  | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | pon      | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | pop      | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | bfe      | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | bsi      | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | phyn     | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | phyp     | ocnBgchem | area: areacello<br>volume: volcello |

|   |  |                     |  |  |            |  |
|---|--|---------------------|--|--|------------|--|
| 3 | Phytoplankton Iron Concentration   | mol m <sup>-3</sup> | sum of phytoplankton iron component concentrations           |  | phyfe      | mole_concentration_of_phytoplankton_expressed_as_iron_in_sea_water             |
| 3 | Phytoplankton Silica Concentration   | mol m <sup>-3</sup> | sum of phytoplankton silica component concentrations         |  | physi      | mole_concentration_of_phytoplankton_expressed_as_silicon_in_sea_water          |
| 3 | Dimethyl Sulphide Concentration  | mol m <sup>-3</sup> | dimethyl sulphide concentration                              |  | dms        | mole_concentration_of_dimethyl_sulfide_in_sea_water                            |
| 2 | Mole Concentration of Carbonate expressed as Carbon in Sea Water               | mol m <sup>-3</sup> | carbonate ion concentration                                  |  | co3        | mole_concentration_of_carbonate_expressed_as_carbon_in_sea_water               |
| 2 | Mole Concentration of Calcite expressed as Carbon in Sea Water at Saturation   | mol m <sup>-3</sup> | carbonate ion concentration at calcite solution saturation   |  | co3satcalc | mole_concentration_of_calcite_expressed_as_carbon_in_sea_water_at_saturation   |
| 2 | Mole Concentration of Aragonite expressed as Carbon in Sea Water at Saturation | mol m <sup>-3</sup> | carbonate ion concentration at aragonite solution saturation |  | co3satarag | mole_concentration_of_aragonite_expressed_as_carbon_in_sea_water_at_saturation |



|         |                                    |      |                                |            |           |                                     |
|---------|------------------------------------|------|--------------------------------|------------|-----------|-------------------------------------|
| mol m-3 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | phyfe      | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | physi      | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | dms        | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | co3        | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | co3satcalc | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | co3satarag | ocnBgchem | area: areacello<br>volume: volcello |

**In CMOR Table Oyr: Marine Biogeochemical 3-D Fields: Rates of Production and Removal**

| priority | long name  | units                             | comment  | questions | output variable name | standard name   |
|----------|--|-----------------------------------|--|-----------|----------------------|---|
| 3        | Primary Carbon Production by Phytoplankton   | $\text{mol m}^{-3} \text{s}^{-1}$ | total primary (organic carbon) production by phytoplankton                                 |           | pp                   | tendency_of_mole_concentration_of_particulate_organic_matter_expressed_as_carbon_in_sea_water_due_to_net_primary_production                             |
| 3        | Primary Carbon Production by Phytoplankton due to Nitrate Uptake Alone   | $\text{mol m}^{-3} \text{s}^{-1}$ | Primary (organic carbon) production by phytoplankton due to nitrate uptake alone           |           | pnitrate             | tendency_of_mole_concentration_of_particulate_organic_matter_expressed_as_carbon_in_sea_water_due_to_nitrate_utilization                                |
| 3        | Biogenic Iron Production   | $\text{mol m}^{-3} \text{s}^{-1}$ | Biogenic iron production   |           | pbfe                 | tendency_of_mole_concentration_of_iron_in_sea_water_due_to_biological_production  |
| 3        | Biogenic Silica Production   | $\text{mol m}^{-3} \text{s}^{-1}$ | Biogenic silica production   |           | pbsi                 | tendency_of_mole_concentration_of_silicon_in_sea_water_due_to_biological_production   |
| 3        | Calcite Production   | $\text{mol m}^{-3} \text{s}^{-1}$ | calcite production   |           | pcalc                | tendency_of_mole_concentration_of_calcite_expressed_as_carbon_in_sea_water_due_to_biological_production   |
| 3        | Aragonite Production   | $\text{mol m}^{-3} \text{s}^{-1}$ | aragonite production   |           | parag                | tendency_of_mole_concentration_of_aragonite_expressed_as_carbon_in_sea_water_due_to_biological_production   |
| 3        | Sinking Particulate Organic Carbon Flux  | $\text{mol m}^{-2} \text{s}^{-1}$ | sinking flux of organic carbon   |           | expc                 | sinking_mole_flux_of_particulate_organic_matter_expressed_as_carbon_in_sea_water  |
| 3        | Sinking Particulate Organic Nitrogen Flux  | $\text{mol m}^{-2} \text{s}^{-1}$ | sinking flux of organic nitrogen   |           | expn                 | sinking_mole_flux_of_particulate_organic_nitrogen_in_sea_water  |
| 3        | Sinking Particulate Organic Phosphorus Flux  | $\text{mol m}^{-2} \text{s}^{-1}$ | sinking flux of organic phosphorus   |           | expp                 | sinking_mole_flux_of_particulate_organic_phosphorus_in_sea_water  |
| 3        | Sinking Particulate Iron Flux  | $\text{mol m}^{-2} \text{s}^{-1}$ | sinking flux of iron   |           | expcfe               | sinking_mole_flux_of_particulate_iron_in_sea_water  |
| 3        | Sinking Particulate Silica Flux  | $\text{mol m}^{-2} \text{s}^{-1}$ | sinking flux of silica   |           | expsi                | sinking_mole_flux_of_particulate_silicon_in_sea_water   |
| 3        | Sinking Calcite Flux   | $\text{mol m}^{-2} \text{s}^{-1}$ | sinking flux of calcite  |           | expcalc              | sinking_mole_flux_of_calcite_expressed_as_carbon_in_sea_water   |
| 3        | Sinking Aragonite Flux   | $\text{mol m}^{-2} \text{s}^{-1}$ | sinking flux of aragonite  |           | exparag              | sinking_mole_flux_of_aragonite_expressed_as_carbon_in_sea_water   |
| 3        | Calcite Dissolution  | $\text{mol m}^{-3} \text{s}^{-1}$ | calcite dissolution  |           | dcalc                | tendency_of_mole_concentration_of_calcite_expressed_as_carbon_in_sea_water_due_to_dissolution   |
| 3        | Aragonite Dissolution  | $\text{mol m}^{-3} \text{s}^{-1}$ | aragonite dissolution  |           | darag                | tendency_of_mole_concentration_of_aragonite_expressed_as_carbon_in_sea_water_due_to_dissolution   |
| 3        | Diatom Primary Carbon Production   | $\text{mol m}^{-3} \text{s}^{-1}$ | Primary (organic carbon) production by the diatom component alone                          |           | pdi                  | tendency_of_mole_concentration_of_particulate_organic_matter_expressed_as_carbon_in_sea_water_due_to_net_primary_production_by_diatoms                  |
| 3        | Tendency of Mole Concentration of Organic Carbon in Sea Water due to Net Primary Production by Diazotrophs       | $\text{mol m}^{-3} \text{s}^{-1}$ | Primary (organic carbon) production by the diazotrophic phytoplankton component alone      |           | dpocdtdiaz           | tendency_of_mole_concentration_of_particulate_organic_matter_expressed_as_carbon_in_sea_water_due_to_net_primary_production_by_diazotrophs              |
| 3        | Tendency of Mole Concentration of Organic Carbon in Sea Water due to Net Primary Production by Picophytoplankton | $\text{mol m}^{-3} \text{s}^{-1}$ | Primary (organic carbon) production by the calcite-producing phytoplankton component alone |           | dpocdtcalc           | tendency_of_mole_concentration_of_particulate_organic_matter_expressed_as_carbon_in_sea_water_due_to_net_primary_production_by_calcareous_phytoplankton |

| unformatted<br>units | cell_methods                       | positive | type | CMOR dimensions                | CMOR<br>variable |  | realm     | frequency | cell_measures                       | flag_values | flag_meanings |
|----------------------|------------------------------------|----------|------|--------------------------------|------------------|--|-----------|-----------|-------------------------------------|-------------|---------------|
|                      |                                    |          |      |                                | name             |  |           |           |                                     |             |               |
| mol m-3 s-1          | time: mean area:<br>mean where sea |          | real | longitude latitude olevel time | pp               |  | ocnBgchem |           | area: areacello<br>volume: volcello |             |               |
| mol m-3 s-1          | time: mean area:<br>mean where sea |          | real | longitude latitude olevel time | pnitrate         |  | ocnBgchem |           | area: areacello<br>volume: volcello |             |               |
| mol m-3 s-1          | time: mean area:<br>mean where sea |          | real | longitude latitude olevel time | pbfe             |  | ocnBgchem |           | area: areacello<br>volume: volcello |             |               |
| mol m-3 s-1          | time: mean area:<br>mean where sea |          | real | longitude latitude olevel time | pbsi             |  | ocnBgchem |           | area: areacello<br>volume: volcello |             |               |
| mol m-3 s-1          | time: mean area:<br>mean where sea |          | real | longitude latitude olevel time | pcalc            |  | ocnBgchem |           | area: areacello<br>volume: volcello |             |               |
| mol m-3 s-1          | time: mean area:<br>mean where sea |          | real | longitude latitude olevel time | parag            |  | ocnBgchem |           | area: areacello<br>volume: volcello |             |               |
| mol m-2 s-1          | time: mean area:<br>mean where sea | down     | real | longitude latitude olevel time | expc             |  | ocnBgchem |           | area: areacello<br>volume: volcello |             |               |
| mol m-2 s-1          | time: mean area:<br>mean where sea | down     | real | longitude latitude olevel time | expn             |  | ocnBgchem |           | area: areacello<br>volume: volcello |             |               |
| mol m-2 s-1          | time: mean area:<br>mean where sea | down     | real | longitude latitude olevel time | expp             |  | ocnBgchem |           |                                     |             |               |
| mol m-2 s-1          | time: mean area:<br>mean where sea | down     | real | longitude latitude olevel time | expcfe           |  | ocnBgchem |           |                                     |             |               |
| mol m-2 s-1          | time: mean area:<br>mean where sea | down     | real | longitude latitude olevel time | expsi            |  | ocnBgchem |           | area: areacello<br>volume: volcello |             |               |
| mol m-2 s-1          | time: mean area:<br>mean where sea | down     | real | longitude latitude olevel time | expcalc          |  | ocnBgchem |           | area: areacello<br>volume: volcello |             |               |
| mol m-2 s-1          | time: mean area:<br>mean where sea | down     | real | longitude latitude olevel time | exparag          |  | ocnBgchem |           | area: areacello<br>volume: volcello |             |               |
| mol m-3 s-1          | time: mean area:<br>mean where sea |          | real | longitude latitude olevel time | dcalc            |  | ocnBgchem |           | area: areacello<br>volume: volcello |             |               |
| mol m-3 s-1          | time: mean area:<br>mean where sea |          | real | longitude latitude olevel time | darag            |  | ocnBgchem |           | area: areacello<br>volume: volcello |             |               |
| mol m-3 s-1          | time: mean area:<br>mean where sea |          | real | longitude latitude olevel time | pdi              |  | ocnBgchem |           | area: areacello<br>volume: volcello |             |               |
| mol m-3 s-1          | time: mean area:<br>mean where sea |          | real | longitude latitude olevel time | dpocdtiaz        |  | ocnBgchem |           | area: areacello<br>volume: volcello |             |               |
| mol m-3 s-1          | time: mean area:<br>mean where sea |          | real | longitude latitude olevel time | dpocdtcalc       |  | ocnBgchem |           | area: areacello<br>volume: volcello |             |               |

|   |  |                                    |   |  |           |  |
|---|--|------------------------------------|---|--|-----------|--|
| 3 | Tendency of Mole Concentration of Organic Carbon in Sea Water due to Net Primary Production by Picophytoplankton | $\text{mol m}^{-3} \text{ s}^{-1}$ | Primary (organic carbon) production by the picophytoplankton (<2 um) component alone                          |  | dpcdtpico | tendency_of_mole_concentration_of_particulate_organic_matter_expressed_as_carbon_in_sea_water_due_to_net_primary_production_by_picophytoplankton           |
| 3 | Other Phytoplankton Carbon Production  | $\text{mol m}^{-3} \text{ s}^{-1}$ | Primary (organic carbon) production by other phytoplankton components alone                                   | I think this variable is unnecessary since it can be gotten by subtracting diatom primary carbon production from pp. | phypmisc  | tendency_of_mole_concentration_of_particulate_organic_matter_expressed_as_carbon_in_sea_water_due_to_net_primary_production_by_miscellaneous_phytoplankton |
| 3 | Rate of Change of Dissolved Inorganic Carbon due to Biological Activity  | $\text{mol m}^{-3} \text{ s}^{-1}$ | Net of biological terms in time rate of change of dissolved inorganic carbon                                  |  | bddtdic   | tendency_of_mole_concentration_of_dissolved_inorganic_carbon_in_sea_water_due_to_biological_processes  |
| 3 | Rate of Change of Nitrogen Nutrient due to Biological Activity   | $\text{mol m}^{-3} \text{ s}^{-1}$ | Net of biological terms in time rate of change of nitrogen nutrients (e.g. NO <sub>3</sub> +NH <sub>4</sub> ) |  | bddtdin   | tendency_of_mole_concentration_of_dissolved_inorganic_nitrogen_in_sea_water_due_to_biological_processes  |
| 3 | Rate of Change of Dissolved Phosphate due to Biological Activity   | $\text{mol m}^{-3} \text{ s}^{-1}$ | Net of biological terms in time rate of change of dissolved phosphate   |  | bddtdip   | tendency_of_mole_concentration_of_dissolved_inorganic_phosphate_in_sea_water_due_to_biological_processes   |
| 3 | Rate of Change of Dissolved Inorganic Iron due to Biological Activity  | $\text{mol m}^{-3} \text{ s}^{-1}$ | Net of biological terms in time rate of change of dissolved inorganic iron                                    |  | bddtdife  | tendency_of_mole_concentration_of_dissolved_inorganic_iron_in_sea_water_due_to_biological_processes  |
| 3 | Rate of Change of Dissolved Inorganic Silicate due to Biological Activity  | $\text{mol m}^{-3} \text{ s}^{-1}$ | Net of biological terms in time rate of change of dissolved inorganic silicate                                |  | bddtdisi  | tendency_of_mole_concentration_of_dissolved_inorganic_silicate_in_sea_water_due_to_biological_processes  |
| 3 | Rate of Change of Alkalinity due to Biological Activity  | $\text{mol m}^{-3} \text{ s}^{-1}$ | Net of biological terms in time rate of change of alkalinity  |  | bddtalk   | tendency_of_sea_water_alkalinity_expressed_as_mole_equivalent_due_to_biological_processes  |
| 3 | Nonbiogenic Iron Scavenging  | $\text{mol m}^{-3} \text{ s}^{-1}$ | Dissolved Fe removed through nonbiogenic scavenging onto particles  |  | fescav    | tendency_of_mole_concentration_of_dissolved_iron_in_sea_water_due_to_scavenging_by_inorganic_particles   |
| 3 | Particle Source of Dissolved Iron  | $\text{mol m}^{-3} \text{ s}^{-1}$ | Dissolution, remineralization and desorption of iron back to the dissolved phase                              |  | fediss    | tendency_of_mole_concentration_of_dissolved_iron_in_sea_water_due_to_dissolution_from_inorganic_particles  |
| 3 | Total Grazing of Phytoplankton by Zooplankton  | $\text{mol m}^{-3} \text{ s}^{-1}$ | Total grazing of phytoplankton by zooplankton   |  | graz      | tendency_of_mole_concentration_of_dissolved_iron_in_sea_water_due_to_grazing_of_phytoplankton  |

|             |                                    |      |                                |            |           |                                     |
|-------------|------------------------------------|------|--------------------------------|------------|-----------|-------------------------------------|
| mol m-3 s-1 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | dpocdtpico | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 s-1 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | phypmisc   | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 s-1 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | bddtdic    | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 s-1 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | bddtdin    | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 s-1 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | bddtdip    | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 s-1 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | bddtdife   | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 s-1 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | bddtdisi   | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 s-1 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | bddtalk    | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 s-1 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | fescav     | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 s-1 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | fediss     | ocnBgchem | area: areacello<br>volume: volcello |
| mol m-3 s-1 | time: mean area:<br>mean where sea | real | longitude latitude olevel time | graz       | ocnBgchem | area: areacello<br>volume: volcello |

## CMOR Table Amon: Monthly Mean Atmospheric Fields and Some Surface Fields

Amon

mon

(All Saved on the Atmospheric Grid)

In CMOR Table **Amon**: 2-D fields on atmospheric grid

| Priority | long name                                  | units                              | comment  | questions | output variable |                                  |
|----------|--|------------------------------------|--|-----------|-----------------|----------------------------------|
|          |  |                                    |  |           | name            | standard name                    |
| 1        | Near-Surface Air Temperature               | K                                  | near-surface (usually, 2 meter) air temperature.   |           | tas             | air_temperature                  |
| 1        | Surface Temperature                        | K                                  | "skin" temperature (i.e., SST for open ocean)  |           | ts              | surface_temperature              |
| 1        | Daily Minimum Near-Surface Air Temperature | K                                  | monthly mean of the daily-minimum near-surface (usually, 2 meter) air temperature.   |           | tasmin          | air_temperature                  |
| 1        | Daily Maximum Near-Surface Air Temperature | K                                  | monthly mean of the daily-maximum near-surface (usually, 2 meter) air temperature.   |           | tasmax          | air_temperature                  |
| 1        | Sea Level Pressure                         | Pa                                 | not, in general, the same as surface pressure  |           | psl             | air_pressure_at_sea_level        |
| 1        | Surface Air Pressure                       | Pa                                 | not, in general, the same as mean sea-level pressure   |           | ps              | surface_air_pressure             |
| 1        | Eastward Near-Surface Wind                 | m s <sup>-1</sup>                  | near-surface (usually, 10 meters) eastward component of wind.  |           | uas             | eastward_wind                    |
| 1        | Northward Near-Surface Wind                | m s <sup>-1</sup>                  | near-surface (usually, 10 meters) northward component of wind.   |           | vas             | northward_wind                   |
| 1        | Near-Surface Wind Speed                    | m s <sup>-1</sup>                  | near-surface (usually, 10 meters) wind speed. This is the mean of the speed, not the speed computed from the mean u and v components of wind   |           | sfcWind         | wind_speed                       |
| 1        | Near-Surface Relative Humidity             | %                                  | near-surface (usually, 2meters) relative humidity expressed as a percentage. This is the relative humidity with respect to liquid water for T> 0 C, and with respect to ice for T<0 C.   |           | hurs            | relative_humidity                |
| 1        | Near-Surface Specific Humidity             | 1                                  | near-surface (usually, 2 meters) specific humidity.  |           | huss            | specific_humidity                |
| 1        | Precipitation                              | kg m <sup>-2</sup> s <sup>-1</sup> | at surface; includes both liquid and solid phases from all types of clouds (both large-scale and convective)   |           | pr              | precipitation_flux               |
| 1        | Snowfall Flux                              | kg m <sup>-2</sup> s <sup>-1</sup> | at surface; includes precipitation of all forms of water in the solid phase  |           | prsn            | snowfall_flux                    |
| 1        | Convective Precipitation                   | kg m <sup>-2</sup> s <sup>-1</sup> | at surface; includes both liquid and solid phases.   |           | prc             | convective_precipitation_flux    |
| 1        | Evaporation                                | kg m <sup>-2</sup> s <sup>-1</sup> | at surface; flux of water into the atmosphere due to conversion of both liquid and solid phases to vapor (from underlying surface and vegetation)  |           | evspsbl         | water_evaporation_flux           |
| 1        | Surface Snow and Ice Sublimation Flux      | kg m <sup>-2</sup> s <sup>-1</sup> | The snow and ice sublimation flux is the loss of snow and ice mass from the surface resulting from their conversion to water vapor that enters the atmosphere. This differs from sbl appearing in table Limon in that the flux is averaged over the entire grid cell, not just the land portion. |           | sbl             | water_sublimation_flux           |
| 1        | Surface Downward Eastward Wind Stress      | Pa                                 |  |           | tauu            | surface_downward_eastward_stress |

| unformatted | units      | cell_methods                                   | positive | type | CMOR dimensions                   | CMOR variable name | realm | frequency | cell_measures   | flag_values | flag_meanings |
|-------------|------------|--|----------|------|-----------------------------------|--------------------|-------|-----------|-----------------|-------------|---------------|
|             | K          | time: mean                                     |          | real | longitude latitude time height2m  | tas                | atmos |           | area: areacella |             |               |
|             | K          | time: mean                                     |          | real | longitude latitude time           | ts                 | atmos |           | area: areacella |             |               |
|             | K          | time: minimum within days time: mean over days |          | real | longitude latitude time height2m  | tasmin             | atmos |           | area: areacella |             |               |
|             | K          | time: maximum within days time: mean over days |          | real | longitude latitude time height2m  | tasmax             | atmos |           | area: areacella |             |               |
|             | Pa         | time: mean                                     |          | real | longitude latitude time           | psl                | atmos |           | area: areacella |             |               |
|             | Pa         | time: mean                                     |          | real | longitude latitude time           | ps                 | atmos |           | area: areacella |             |               |
|             | m s-1      | time: mean                                     |          | real | longitude latitude time height10m | uas                | atmos |           |                 |             |               |
|             | m s-1      | time: mean                                     |          | real | longitude latitude time height10m | vas                | atmos |           |                 |             |               |
|             | m s-1      | time: mean                                     |          | real | longitude latitude time height10m | sfcWind            | atmos |           |                 |             |               |
|             | %          | time: mean                                     |          | real | longitude latitude time height2m  | hurs               | atmos |           | area: areacella |             |               |
|             | 1          | time: mean                                     |          | real | longitude latitude time height2m  | huss               | atmos |           | area: areacella |             |               |
|             | kg m-2 s-1 | time: mean                                     |          | real | longitude latitude time           | pr                 | atmos |           | area: areacella |             |               |
|             | kg m-2 s-1 | time: mean                                     |          | real | longitude latitude time           | prsn               | atmos |           | area: areacella |             |               |
|             | kg m-2 s-1 | time: mean                                     |          | real | longitude latitude time           | prc                | atmos |           | area: areacella |             |               |
|             | kg m-2 s-1 | time: mean                                     |          | real | longitude latitude time           | evspsbl            | atmos |           | area: areacella |             |               |
|             | kg m-2 s-1 | time: mean                                     |          | real | longitude latitude time           | sbl                | atmos |           | area: areacella |             |               |
|             | Pa         | time: mean                                     | down     | real | longitude latitude time           | tauu               | atmos |           | area: areacella |             |               |

|   |   |             |  |          |  |
|---|---|-------------|--|----------|--|
| 1 | Surface Downward Northward Wind Stress            | Pa          |  | tauv     | surface_downward_northward_stress                            |
| 1 | Surface Upward Latent Heat Flux                   | $W m^{-2}$  | includes both evaporation and sublimation  | hfls     | surface_upward_latent_heat_flux                              |
| 1 | Surface Upward Sensible Heat Flux                 | $W m^{-2}$  |  | hfss     | surface_upward_sensible_heat_flux                            |
| 1 | Surface Downwelling Longwave Radiation            | $W m^{-2}$  |  | rlds     | surface_downwelling_longwave_flux_in_air                     |
| 1 | Surface Upwelling Longwave Radiation              | $W m^{-2}$  |  | rlus     | surface_upwelling_longwave_flux_in_air                       |
| 1 | Surface Downwelling Shortwave Radiation           | $W m^{-2}$  |  | rsds     | surface_downwelling_shortwave_flux_in_air                    |
| 1 | Surface Upwelling Shortwave Radiation             | $W m^{-2}$  |  | rsus     | surface_upwelling_shortwave_flux_in_air                      |
| 1 | Surface Downwelling Clear-Sky Shortwave Radiation | $W m^{-2}$  |  | rsdscs   | surface_downwelling_shortwave_flux_in_air_assuming_clear_sky |
| 1 | Surface Upwelling Clear-Sky Shortwave Radiation   | $W m^{-2}$  |  | rsuscscs | surface_upwelling_shortwave_flux_in_air_assuming_clear_sky   |
| 1 | Surface Downwelling Clear-Sky Longwave Radiation  | $W m^{-2}$  |  | rldsescs | surface_downwelling_longwave_flux_in_air_assuming_clear_sky  |
| 1 | TOA Incident Shortwave Radiation                  | $W m^{-2}$  | incident shortwave at the top of the atmosphere  | rsdt     | toa_incoming_shortwave_flux                                  |
| 1 | TOA Outgoing Shortwave Radiation                  | $W m^{-2}$  | at the top of the atmosphere   | rsut     | toa_outgoing_shortwave_flux                                  |
| 1 | TOA Outgoing Longwave Radiation                   | $W m^{-2}$  | at the top of the atmosphere (to be compared with satellite measurements)  | rlut     | toa_outgoing_longwave_flux                                   |
| 1 | TOA Outgoing Clear-Sky Longwave Radiation         | $W m^{-2}$  |  | rlutcs   | toa_outgoing_longwave_flux_assuming_clear_sky                |
| 1 | TOA Outgoing Clear-Sky Shortwave Radiation        | $W m^{-2}$  |  | rsutcs   | toa_outgoing_shortwave_flux_assuming_clear_sky               |
| 1 | Water Vapor Path                                  | $kg m^{-2}$ | vertically integrated through the atmospheric column   | prw      | atmosphere_water_vapor_content                               |
| 1 | Total Cloud Fraction                              | %           | for the whole atmospheric column, as seen from the surface or the top of the atmosphere. Include both large-scale and convective cloud.  | clt      | cloud_area_fraction  |
| 1 | Condensed Water Path                              | $kg m^{-2}$ | calculate mass of condensed (liquid + ice) water in the column divided by the area of the column (not just the area of the cloudy portion of the column). Include precipitating hydrometeors ONLY if the precipitating hydrometeor affects the calculation of radiative transfer in model. | clwvi    | atmosphere_cloud_condensed_water_content                     |
| 1 | Ice Water Path                                    | $kg m^{-2}$ | calculate mass of ice water in the column divided by the area of the column (not just the area of the cloudy portion of the column). Include precipitating frozen hydrometeors ONLY if the precipitating hydrometeor affects the calculation of radiative transfer in model.               | clivi    | atmosphere_cloud_ice_content                                 |
| 1 | Net Downward Flux at Top of Model                 | $W m^{-2}$  | i.e., at the top of that portion of the atmosphere where dynamics are explicitly treated by the model. Report only if this differs from the net downward radiative flux at the top of the atmosphere.  | rtmt     | net_downward_radiative_flux_at_top_of_atmosphere_model       |
| 1 | Air Pressure at Convective Cloud Base             | Pa          |  | ccb      | air_pressure_at_convective_cloud_base                        |
| 1 | Air Pressure at Convective Cloud Top              | Pa          |  | cct      | air_pressure_at_convective_cloud_top                         |



|        |            |      |      |                         |        |       |                 |
|--------|------------|------|------|-------------------------|--------|-------|-----------------|
| Pa     | time: mean | down | real | longitude latitude time | tauv   | atmos |                 |
|        |            |      |      |                         |        | atmos | area: areacella |
| W m-2  | time: mean | up   | real | longitude latitude time | hfls   | atmos | area: areacella |
| W m-2  | time: mean | up   | real | longitude latitude time | hfss   | atmos | area: areacella |
| W m-2  | time: mean | down | real | longitude latitude time | rlds   | atmos | area: areacella |
| W m-2  | time: mean | up   | real | longitude latitude time | rlus   | atmos | area: areacella |
| W m-2  | time: mean | down | real | longitude latitude time | rsds   | atmos | area: areacella |
| W m-2  | time: mean | up   | real | longitude latitude time | rsus   | atmos | area: areacella |
| W m-2  | time: mean | down | real | longitude latitude time | rsdscs | atmos | area: areacella |
| W m-2  | time: mean | up   | real | longitude latitude time | rsuscs | atmos | area: areacella |
| W m-2  | time: mean | down | real | longitude latitude time | rldscs | atmos | area: areacella |
|        |            |      |      |                         |        | atmos | area: areacella |
| W m-2  | time: mean | down | real | longitude latitude time | rsdt   | atmos | area: areacella |
| W m-2  | time: mean | up   | real | longitude latitude time | rsut   | atmos | area: areacella |
| W m-2  | time: mean | up   | real | longitude latitude time | rlut   | atmos | area: areacella |
| W m-2  | time: mean | up   | real | longitude latitude time | rlutcs | atmos | area: areacella |
| W m-2  | time: mean | up   | real | longitude latitude time | rsutcs | atmos | area: areacella |
|        |            |      | real |                         |        | atmos | area: areacella |
| kg m-2 | time: mean |      | real | longitude latitude time | prw    | atmos | area: areacella |
| %      | time: mean |      | real | longitude latitude time | clt    | atmos | area: areacella |
| kg m-2 | time: mean |      | real | longitude latitude time | clwvi  | atmos | area: areacella |
| kg m-2 | time: mean |      | real | longitude latitude time | clivi  | atmos | area: areacella |
|        |            |      |      |                         |        | atmos | area: areacella |
| W m-2  | time: mean | down | real | longitude latitude time | rtmt   | atmos | area: areacella |
| Pa     | time: mean |      | real | longitude latitude time | ccb    | atmos | area: areacella |
| Pa     | time: mean |      | real | longitude latitude time | cct    | atmos | area: areacella |

|   |  |                                    |  |         |   |
|---|--|------------------------------------|--|---------|---|
| 1 | Fraction of Time Convection Occurs   | 1                                  | Fraction of time that convection occurs in the grid cell .   | ci      | convection_time_fraction  |
| 1 | Fraction of Time Shallow Convection Occurs                                 | 1                                  | Fraction of time that shallow convection occurs in the grid cell. ( For models with a distinct shallow convection scheme only)   | sci     | shallow_convection_time_fraction  |
| 1 | Carbon Mass Flux into Atmosphere Due to All Anthropogenic Emissions of CO2 | kg m <sup>-2</sup> s <sup>-1</sup> | This is requested only for the emission-driven coupled carbon climate model runs. Do not include natural fire sources, but include all anthropogenic sources, including fossil fuel use, cement production, agricultural burning, and sources associated with anthropogenic land use change excluding forest regrowth.   | fco2ant | tendency_of_atmosphere_mass_content_of_carbon_dioxide_expressed_as_carbon_due_to_anthropogenic_emission               |
| 1 | Carbon Mass Flux into Atmosphere Due to Fossil Fuel Emissions of CO2       | kg m <sup>-2</sup> s <sup>-1</sup> | This is requested only for the emission-driven coupled carbon climate model runs. Report the prescribed anthropogenic CO2 flux from fossil fuel use, including cement production, and flaring (but not from land-use changes, agricultural burning, forest regrowth, etc.)   | fco2fos | tendency_of_atmosphere_mass_content_of_carbon_dioxide_expressed_as_carbon_due_to_emission_from_fossil_fuel_combustion |
| 1 | Surface Carbon Mass Flux into the Atmosphere Due to Natural Sources        | kg m <sup>-2</sup> s <sup>-1</sup> | Report from all simulations (both emission-driven and concentration-driven) performed by models with fully interactive and responsive carbon cycles. This is what the atmosphere sees ( <i>on its own grid</i> ). This field should be equivalent to the combined natural fluxes of carbon (requested in the L_mon and O_mon tables) that account for natural exchanges between the atmosphere and land or ocean reservoirs (i.e., "net ecosystem biospheric productivity", for land, and "air to sea CO2 flux", for ocean.) | fco2nat | surface_upward_mass_flux_of_carbon_dioxide_expressed_as_carbon_due_to_emission_from_natural_sources                   |

|            |            |    |      |                         |          |       |                 |
|------------|------------|----|------|-------------------------|----------|-------|-----------------|
| 1          | time: mean |    | real | longitude latitude time | ci       | atmos | area: areacella |
| 1          | time: mean |    | real | longitude latitude time | sci      | atmos | area: areacella |
|            |            |    |      |                         |          |       | area: areacella |
| kg m-2 s-1 | time: mean | up | real | longitude latitude time | fco2antt | atmos | area: areacella |
| kg m-2 s-1 | time: mean | up | real | longitude latitude time | fco2fos  | atmos | area: areacella |
| kg m-2 s-1 | time: mean | up | real | longitude latitude time | fco2nat  | atmos | area: areacella |

In CMOR Table **Amon**: *Atmospheric 3-D fields on standard pressure levels, except 4 cloud fields which are on model levels.*

Include the following mandatory pressure levels (which are available from all available reanalyses and CMIP3): 1000, 925, 850, 700, 600, 500, 400, 300, 250, 200, 150, 100, 70, 50, 30, 20, and 10 hPa; Also include, when appropriate, output on the following additional pressure levels: 7, 5, 3, 2, 1 and 0.4 hPa.

| priority | long name                           | units                              | comment   | questions | output variable name | standard name                              |
|----------|-------------------------------------|------------------------------------|---|-----------|----------------------|--|
| 1        | Cloud Area Fraction                 | %                                  | Report on model layers (not standard pressures). Include both large-scale and convective cloud.   |           | cl                   | cloud_area_fraction_in_atmosphere_layer    |
| 1        | Mass Fraction of Cloud Liquid Water | 1                                  | Report on model layers (not standard pressures). Include both large-scale and convective cloud. Calculate as the mass of cloud liquid water in the grid cell divided by the mass of air (including the water in all phases) in the grid cells. Include precipitating hydrometeors ONLY if the precipitating hydrometeor affects the calculation of radiative transfer in model. |           | clw                  | mass_fraction_of_cloud_liquid_water_in_air |
| 1        | Mass Fraction of Cloud Ice          | 1                                  | Report on model layers (not standard pressures). Include both large-scale and convective cloud. Calculate as the mass of cloud ice in the grid cell divided by the mass of air (including the water in all phases) in the grid cell. Include precipitating hydrometeors ONLY if the precipitating hydrometeor affects the calculation of radiative transfer in model.           |           | cli                  | mass_fraction_of_cloud_ice_in_air          |
| 1        | Convective Mass Flux                | kg m <sup>-2</sup> s <sup>-1</sup> | Report on model half-levels (i.e., model layer bounds and not standard pressures). The net mass flux should represent the difference between the updraft and downdraft components. The flux is computed as the mass divided by the area of the grid cell.   |           | mc                   | atmosphere_net_upward_convective_mass_flux |
| 1        | Air Temperature                     | K                                  |   |           | ta                   | air_temperature                            |
| 1        | Eastward Wind                       | m s <sup>-1</sup>                  |   |           | ua                   | eastward_wind                              |
| 1        | Northward Wind                      | m s <sup>-1</sup>                  |   |           | va                   | northward_wind                             |
| 1        | Specific Humidity                   | 1                                  |   |           | hus                  | specific_humidity                          |
| 1        | Relative Humidity                   | %                                  | This is the relative humidity with respect to liquid water for T > 0 C, and with respect to ice for T < 0 C.  |           | hur                  | relative_humidity                          |
| 1        | omega (=dp/dt)                      | Pa s <sup>-1</sup>                 | commonly referred to as "omega", this represents the vertical component of velocity in pressure coordinates (positive down)   |           | wap                  | lagrangian_tendency_of_air_pressure        |
| 1        | Geopotential Height                 | m                                  |   |           | zg                   | geopotential_height                        |

| unformatted<br>units | cell_methods | positive | type | CMOR dimensions                     | CMOR<br>variable<br>name | realm | frequency | cell_measures   | flag_values | flag_meanings |
|----------------------|--------------|----------|------|-------------------------------------|--------------------------|-------|-----------|-----------------|-------------|---------------|
| %                    | time: mean   |          | real | longitude latitude alevel time      | cl                       | atmos |           | area: areacella |             |               |
| 1                    | time: mean   |          | real | longitude latitude alevel time      | clw                      | atmos |           | area: areacella |             |               |
| 1                    | time: mean   |          | real | longitude latitude alevel time      | cli                      | atmos |           | area: areacella |             |               |
| kg m-2 s-1           | time: mean   |          | real | longitude latitude alevhalf<br>time | mc                       | atmos |           | area: areacella |             |               |
| K                    | time: mean   | up       | real | longitude latitude plevs time       | ta                       | atmos |           | area: areacella |             |               |
| m s-1                | time: mean   |          | real | longitude latitude plevs time       | ua                       | atmos |           |                 |             |               |
| m s-1                | time: mean   |          | real | longitude latitude plevs time       | va                       | atmos |           |                 |             |               |
| 1                    | time: mean   |          | real | longitude latitude plevs time       | hus                      | atmos |           | area: areacella |             |               |
| %                    | time: mean   |          | real | longitude latitude plevs time       | hur                      | atmos |           | area: areacella |             |               |
| Pa s-1               | time: mean   |          | real | longitude latitude plevs time       | wap                      | atmos |           | area: areacella |             |               |
| m                    | time: mean   |          | real | longitude latitude plevs time       | zg                       | atmos |           | area: areacella |             |               |

|   |                               |      |  |  |         |  |
|---|-------------------------------|------|--|--|---------|--|
| 1 | Mole Fraction of O3           | 1e-9 | If this does not change over time (except possibly to vary identically over each annual cycle), report instead the variable described in the next table entry.   | Are these the preferred units or should it be a unitless fraction? Should this field be reported instead on model levels? Or should we also require either the vertically integrated mole fraction (or mass?) of this species or the vertically integrated globally averaged mole fraction (or mass?)? | tro3    | mole_fraction_of_ozone_in_air          |
| 1 | Mole Fraction of O3           | 1e-9 | If O3 does not vary from one year to the next, report 12 months, starting with January. (Note: include all 12 months even if the values don't vary seasonally.) When calling CMOR, identify this variable as tro3Clim, not tro3. If the O3 varies from one year to the next, then report instead the field described in the previous table entry.  | Are these the preferred units or should it be a unitless fraction? Should this field be reported instead on model levels? Or should we also require either the vertically integrated mole fraction (or mass?) of this species or the vertically integrated globally averaged mole fraction (or mass?)? | tro3    | mole_fraction_of_ozone_in_air          |
| 1 | Mole Fraction of CO2          | 1e-6 | For some simulations (e.g., prescribed concentration pi-control run), this will not vary from one year to the next, and so report instead the variable described in the next table entry. If spatially uniform, omit this field, but report Total Atmospheric Mass of CO2 (see the table entry after the next one).  | Are these the preferred units or should it be a unitless fraction? Should this field be reported instead on model levels? Or should we also require either the vertically integrated mole fraction (or mass?) of this species or the vertically integrated globally averaged mole fraction (or mass?)? | co2     | mole_fraction_of_carbon_dioxide_in_air |
| 1 | Mole Fraction of CO2          | 1e-6 | Report only for simulations (e.g., prescribed concentration pi-control run), in which the CO2 does not vary from one year to the next. Report 12 monthly values, starting with January, even if the values don't vary seasonally. When calling CMOR, identify this variable as co2Clim, not co2. If CO2 is spatially uniform, omit this field, but report Total Atmospheric Mass of CO2 (see the table entry after the next).            | Are these the preferred units or should it be a unitless fraction? Should this field be reported instead on model levels? Or should we also require either the vertically integrated mole fraction (or mass?) of this species or the vertically integrated globally averaged mole fraction (or mass?)? | co2     | mole_fraction_of_carbon_dioxide_in_air |
| 1 | Total Atmospheric Mass of CO2 | kg   | For some simulations (e.g., prescribed concentration pi-control run), this will not vary from one year to the next, and so report instead the variable described in the next table entry. If CO2 is spatially nonuniform, omit this field, but report Mole Fraction of CO2 (see the table entry before the previous one).  |  | co2mass | atmosphere_mass_of_carbon_dioxide      |
| 1 | Total Atmospheric Mass of CO2 | kg   | Report only for simulations (e.g., prescribed concentration pi-control run), in which the CO2 does not vary from one year to the next. Report 12 monthly values, starting with January, even if the values don't vary seasonally. When calling CMOR, identify this variable as co2massClim, not co2mass. If CO2 is spatially nonuniform, omit this field, but report Mole Fraction of CO2 (see the table entry before the previous one). |  | co2mass | atmosphere_mass_of_carbon_dioxide      |

1e-9      time: mean      real      longitude latitude plevs time      tro3      atmos  
atmosChem      area: areacella

1e-9      time: mean within  
years time: mean  
over years      real      longitude latitude plevs  
time2      tro3Clim      atmos  
atmosChem      monClim      area: areacella

1e-6      time: mean      real      longitude latitude plevs time      co2      atmos      area: areacella

1e-6      time: mean within  
years time: mean  
over years      real      longitude latitude plevs  
time2      co2Clim      atmos      monClim      area: areacella

kg      time: mean      real      time      co2mass      atmos

kg      time: mean within  
years time: mean  
over years      real      time2      co2massClim      atmos      monClim

|   |                                  |      |  |  |           |                                       |
|---|----------------------------------|------|--|--|-----------|---------------------------------------|
| 1 | Mole Fraction of CH4             | 1e-9 | For some simulations (e.g., prescribed concentration pi-control run), this will not vary from one year to the next, and so report instead the variable described in the next table entry. If CH4 is spatially uniform, omit this field, but report Global Mean Mole Fraction of CH4 (see the table entry after the next one).  | Are these the preferred units or should it be a unitless fraction? Should this field be reported instead on model levels? Or should we also require either the vertically integrated mole fraction (or mass?) of this species or the vertically integrated globally averaged mole fraction (or mass?)? | ch4       | mole_fraction_of_methane_in_air       |
| 1 | Mole Fraction of CH4             | 1e-9 | Report only for simulations (e.g., prescribed concentration pi-control run), in which the CH4 does not vary from one year to the next. Report 12 monthly values, starting with January, even if the values don't vary seasonally. When calling CMOR, identify this variable as ch4global, not ch4. If CH4 is spatially uniform, omit this field, but report Global Mean Mole Fraction of CH4 (see the table entry after the next).                       | Are these the preferred units or should it be a unitless fraction? Should this field be reported instead on model levels? Or should we also require either the vertically integrated mole fraction (or mass?) of this species or the vertically integrated globally averaged mole fraction (or mass?)? | ch4       | mole_fraction_of_methane_in_air       |
| 1 | Global Mean Mole Fraction of CH4 | 1e-9 | For some simulations (e.g., prescribed concentration pi-control run), this will not vary from one year to the next, and so report instead the variable described in the next table entry. If CH4 is spatially nonuniform, omit this field, but report Mole Fraction of CH4 (see the table entry before the previous one).  | Are these the preferred units or should it be a unitless fraction? Should this field be reported instead on model levels? Or should we also require either the vertically integrated mole fraction (or mass?) of this species or the vertically integrated globally averaged mole fraction (or mass?)? | ch4global | mole_fraction_of_methane_in_air       |
| 1 | Global Mean Mole Fraction of CH4 | 1e-9 | Report only for simulations (e.g., prescribed concentration pi-control run), in which the CH4 does not vary from one year to the next. Report 12 monthly values, starting with January, even if the values don't vary seasonally. When calling CMOR, identify this variable as ch4globalClim, not ch4global. If CH4 is spatially nonuniform, omit this field, but report Global Mean Mole Fraction of CH4 (see the table entry before the previous one). | Are these the preferred units or should it be a unitless fraction? Should this field be reported instead on model levels? Or should we also require either the vertically integrated mole fraction (or mass?) of this species or the vertically integrated globally averaged mole fraction (or mass?)? | ch4global | mole_fraction_of_methane_in_air       |
| 1 | Mole Fraction of N2O             | 1e-9 | For some simulations (e.g., prescribed concentration pi-control run), this will not vary from one year to the next, and so report instead the variable described in the next table entry. If N2O is spatially uniform, omit this field, but report Global Mean Mole Fraction of N2O (see the table entry after the next one).  | Are these the preferred units or should it be a unitless fraction? Should this field be reported instead on model levels? Or should we also require either the vertically integrated mole fraction (or mass?) of this species or the vertically integrated globally averaged mole fraction (or mass?)? | n2o       | mole_fraction_of_nitrous_oxide_in_air |



|      |            |      |                               |     |                    |                 |
|------|------------|------|-------------------------------|-----|--------------------|-----------------|
| 1e-9 | time: mean | real | longitude latitude plevs time | ch4 | atmos<br>atmosChem | area: areacella |
|------|------------|------|-------------------------------|-----|--------------------|-----------------|

|      |   |      |                                   |         |                    |         |                 |
|------|---|------|-----------------------------------|---------|--------------------|---------|-----------------|
| 1e-9 | time: mean within<br>years time: mean<br>over years | real | longitude latitude plevs<br>time2 | ch4Clim | atmos<br>atmosChem | monClim | area: areacella |
|------|---|------|-----------------------------------|---------|--------------------|---------|-----------------|

|      |            |      |      |           |                    |
|------|------------|------|------|-----------|--------------------|
| 1e-9 | time: mean | real | time | ch4global | atmos<br>atmosChem |
|------|------------|------|------|-----------|--------------------|

|      |   |      |       |               |                    |         |
|------|---|------|-------|---------------|--------------------|---------|
| 1e-9 | time: mean within<br>years time: mean<br>over years | real | time2 | ch4globalClim | atmos<br>atmosChem | monClim |
|------|---|------|-------|---------------|--------------------|---------|

|      |            |      |                               |     |                    |                 |
|------|------------|------|-------------------------------|-----|--------------------|-----------------|
| 1e-9 | time: mean | real | longitude latitude plevs time | n2o | atmos<br>atmosChem | area: areacella |
|------|------------|------|-------------------------------|-----|--------------------|-----------------|

|   |   |       |  |  |              |                                       |
|---|---|-------|--|--|--------------|---------------------------------------|
| 1 | Mole Fraction of N2O  | 1e-9  | Report only for simulations (e.g., prescribed concentration pi-control run), in which the N2O does not vary from one year to the next. Report 12 monthly values, starting with January, even if the values don't vary seasonally. When calling CMOR, identify this variable as n2oglobal, not n2o. If N2O is spatially uniform, omit this field, but report Global Mean Mole Fraction of N2O (see the table entry after the next).                       | Are these the preferred units or should it be a unitless fraction? Should this field be reported instead on model levels? Or should we also require either the vertically integrated mole fraction (or mass?) of this species or the vertically integrated globally averaged mole fraction (or mass?)? | n2o          | mole_fraction_of_nitrous_oxide_in_air |
| 1 | Global Mean Mole Fraction of N2O  | 1e-9  | For some simulations (e.g., prescribed concentration pi-control run), this will not vary from one year to the next, and so report instead the variable described in the next table entry. If N2O is spatially nonuniform, omit this field, but report Mole Fraction of N2O (see the table entry before the previous one).  | Are these the preferred units or should it be a unitless fraction? Should this field be reported instead on model levels? Or should we also require either the vertically integrated mole fraction (or mass?) of this species or the vertically integrated globally averaged mole fraction (or mass?)? | n2oglobal    | mole_fraction_of_nitrous_oxide_in_air |
| 1 | Global Mean Mole Fraction of N2O  | 1e-9  | Report only for simulations (e.g., prescribed concentration pi-control run), in which the N2O does not vary from one year to the next. Report 12 monthly values, starting with January, even if the values don't vary seasonally. When calling CMOR, identify this variable as ch4globalClim, not ch4global. If N2O is spatially nonuniform, omit this field, but report Global Mean Mole Fraction of N2O (see the table entry before the previous one). | Are these the preferred units or should it be a unitless fraction? Should this field be reported instead on model levels? Or should we also require either the vertically integrated mole fraction (or mass?) of this species or the vertically integrated globally averaged mole fraction (or mass?)? | n2oglobal    | mole_fraction_of_nitrous_oxide_in_air |
| 3 | Global Mean Mole Fraction of CFC11  | 1e-12 |  |  | cfc11global  | mole_fraction_of_cfc11_in_air         |
| 3 | Global Mean Mole Fraction of CFC12  | 1e-12 |  |  | cfc12global  | mole_fraction_of_cfc12_in_air         |
| 3 | Global Mean Mole Fraction of HCFC22   | 1e-12 |  |  | hcfc22global | mole_fraction_of_hcfc22_in_air        |
| 3 | Global Mean Mole Fraction of CFC113   | 1e-12 |  |  | cfc113global | mole_fraction_of_cfc113_in_air        |
| 1 | Mole Fraction of Other Radiatively Important Trace Gases (That Are Evolving in Time). | 1     | If assumed spatially uniform, report only time-series of the single value. For some simulations (e.g., prescribed concentration pi-control run), this will not vary from one year to the next, and so report values for only 12 months (starting with January. (Note: include all 12 months even if the values don't vary seasonally.))  | Please let me know what (if any) other trace gas concentrations should be included.  |              |                                       |

In CMOR Table **Amon**: *Climatological atmospheric 3-D pressure fields*

|      |   |      |                                   |         |                    |         |                 |
|------|---|------|-----------------------------------|---------|--------------------|---------|-----------------|
| 1e-9 | time: mean within<br>years time: mean<br>over years | real | longitude latitude plevs<br>time2 | n2oClim | atmos<br>atmosChem | monClim | area: areacella |
|------|---|------|-----------------------------------|---------|--------------------|---------|-----------------|

|      |            |      |      |           |                    |  |  |
|------|------------|------|------|-----------|--------------------|--|--|
| 1e-9 | time: mean | real | time | n2oGlobal | atmos<br>atmosChem |  |  |
|------|------------|------|------|-----------|--------------------|--|--|

|      |   |      |       |               |                    |         |  |
|------|---|------|-------|---------------|--------------------|---------|--|
| 1e-9 | time: mean within<br>years time: mean<br>over years | real | time2 | n2oGlobalClim | atmos<br>atmosChem | monClim |  |
|------|---|------|-------|---------------|--------------------|---------|--|

|       |            |      |      |              |                    |  |  |
|-------|------------|------|------|--------------|--------------------|--|--|
| 1e-12 | time: mean | real | time | cfc11Global  | atmos<br>atmosChem |  |  |
| 1e-12 | time: mean | real | time | cfc12Global  | atmos<br>atmosChem |  |  |
| 1e-12 | time: mean | real | time | hfc22Global  | atmos<br>atmosChem |  |  |
| 1e-12 | time: mean | real | time | cfc113Global | atmos<br>atmosChem |  |  |

|   |  |      |                               |   |                    |  |                 |
|---|--|------|-------------------------------|---|--------------------|--|-----------------|
| 1 |  | real | longitude latitude plevs time | 0 | atmos<br>atmosChem |  | area: areacella |
|---|--|------|-------------------------------|---|--------------------|--|-----------------|

These fields are requested *only for models in which the pressure can't be calculated from the vertical coordinate information stored already for each variable*. Thus, the pressures on each model level are needed for height or theta-coordinate models, for example, but not sigma- or eta-coordinate models. The annual cycle climatology (computed from an appropriate segment of the pre-industrial control run) should be reported on model levels and half levels. **DO NOT REPORT ALL MONTHS FOR ALL EXPERIMENTS: Report only 12 months of data representing the climatology of the pre-industrial control run.**

| <i>priority</i> | <b>long name</b>              | <b>units</b> | <b>comment</b> | <b>questions</b> | <b>output variable name</b> | <b>standard name</b> |
|-----------------|-------------------------------|--------------|----------------|------------------|-----------------------------|----------------------|
| 1               | Pressure on Model Levels      | Pa           |                |                  | pfull                       | air_pressure         |
| 1               | Pressure on Model Half-Levels | Pa           |                |                  | phalf                       | air_pressure         |

| <b>unformatted<br/>units</b> | <b>cell_methods</b>                                 | <b>positive</b> | <b>type</b> | <b>CMOR dimensions</b>               | <b>CMOR<br/>variable<br/>name</b> | <b>realm</b> | <b>frequency</b> | <b>cell_measures</b> | <b>flag_values</b> | <b>flag_meanings</b> |
|------------------------------|---|-----------------|-------------|--------------------------------------|-----------------------------------|--------------|------------------|----------------------|--------------------|----------------------|
| Pa                           | time: mean within<br>years time: mean<br>over years |                 | real        | longitude latitude alevel<br>time2   | pfull                             | atmos        | monClim          | area: areacella      |                    |                      |
| Pa                           | time: mean within<br>years time: mean<br>over years |                 | real        | longitude latitude alevhalf<br>time2 | phalf                             | atmos        | monClim          | area: areacella      |                    |                      |

## CMOR Table Omon: Monthly Mean Ocean Fields, Including Biogeochemical Fields

Omon

mon

(All Saved on the Ocean Grid)

In CMOR Table **Omon**: Marine Biogeochemical 2-D Fields

| Priority | long name  | units  | comment  | questions | output variable name   | standard name  |
|----------|--|--|--|-----------|------------------------|--|
| 2        | Surface Concentration of (+name of tracer)                                       | mol m <sup>-3</sup> or kg m <sup>-3</sup> or 1, consistent with first table in Oyr | Concentrations of all 3D tracers in the uppermost ocean layer. See first table in Oyr for a complete list of these tracers. "Tracer" concentrations should be reported even if they are diagnosed rather than prognostically calculated. |           | include Oyr 3D tracers |  |
| 1        | Primary Organic Carbon Production by All Types of Phytoplankton                  | mol m <sup>-2</sup> s <sup>-1</sup>  | Vertically integrated total primary (organic carbon) production by phytoplankton. This should equal the sum of intpdiat+intpphymisc, but those individual components may be unavailable in some models.                                  |           | intpp                  | net_primary_mole_productivity_of_carbon_by_phytoplankton                                     |
| 2        | Primary Organic Carbon Production by Phytoplankton Based on Nitrate Uptake Alone | mol m <sup>-2</sup> s <sup>-1</sup>  | Vertically integrated primary (organic carbon) production by phytoplankton based on nitrate uptake alone   |           | intpnitrate            | net_primary_mole_productivity_of_carbon_due_to_nitrate_utilization                           |
| 2        | Primary Organic Carbon Production by Diatoms                                     | mol m <sup>-2</sup> s <sup>-1</sup>  | Vertically integrated primary (organic carbon) production by the diatom phytoplankton component alone  |           | intpdiat               | net_primary_mole_productivity_of_carbon_by_diatoms   |
| 3        | Net Primary Mole Productivity of Carbon by Diazotrophs                           | mol m <sup>-2</sup> s <sup>-1</sup>  |  |           | intpdiaz               | net_primary_mole_productivity_of_carbon_by_diazotrophs                                       |
| 3        | Net Primary Mole Productivity of Carbon by Calcareous Phytoplankton              | mol m <sup>-2</sup> s <sup>-1</sup>  |  |           | intpcalc               | net_primary_mole_productivity_of_carbon_by_calcareous_phytoplankton                          |
| 3        | Net Primary Mole Productivity of Carbon by Picophytoplankton                     | mol m <sup>-2</sup> s <sup>-1</sup>  |  |           | intppico               | net_primary_mole_productivity_of_carbon_by_picophytoplankton                                 |
| 3        | Primary Organic Carbon Production by Other Phytoplankton                         | mol m <sup>-2</sup> s <sup>-1</sup>  | Vertically integrated total primary (organic carbon) production by other phytoplankton components alone  |           | intpmisc               | net_primary_mole_productivity_of_carbon_by_miscellaneous_phytoplankton                       |
| 3        | Iron Production  | mol m <sup>-2</sup> s <sup>-1</sup>  | Vertically integrated biogenic iron production   |           | intpbfe                | tendency_of_ocean_mole_content_of_iron_due_to_biological_production                          |
| 3        | Silica Production  | mol m <sup>-2</sup> s <sup>-1</sup>  | Vertically integrated biogenic silica production   |           | intpbsi                | tendency_of_ocean_mole_content_of_silicon_due_to_biological_production                       |
| 3        | Calcite Production   | mol m <sup>-2</sup> s <sup>-1</sup>  | Vertically integrated calcite production   |           | intpcalcite            | tendency_of_ocean_mole_content_of_calcite_expressed_as_carbon_due_to_biological_production   |
| 3        | Aragonite Production   | mol m <sup>-2</sup> s <sup>-1</sup>  | Vertically integrated aragonite production   |           | intparag               | tendency_of_ocean_mole_content_of_aragonite_expressed_as_carbon_due_to_biological_production |
| 1        | Downward Flux of Particle Organic Carbon at 100M                                 | mol m <sup>-2</sup> s <sup>-1</sup>  | sinking flux of organic carbon at 100m   |           | epc100                 | sinking_mole_flux_of_particulate_organic_matter_expressed_as_carbon_in_sea_water             |
| 3        | Downward Flux of Particulate Iron at 100M  | mol m <sup>-2</sup> s <sup>-1</sup>  | sinking flux of biogenic and scavenged iron at 100m  |           | epfe100                | sinking_mole_flux_of_particulate_iron_in_sea_water   |
| 3        | Downward Flux of Particulate Silica at 100M                                      | mol m <sup>-2</sup> s <sup>-1</sup>  | sinking flux of biogenic silica at 100m  |           | epsi100                | sinking_mole_flux_of_particulate_silicon_in_sea_water  |
| 1        | Downward Flux of Calcite at 100M   | mol m <sup>-2</sup> s <sup>-1</sup>  | sinking flux of calcite at 100m  |           | epcalc100              | sinking_mole_flux_of_calcite_expressed_as_carbon_in_sea_water                                |

| unformatted<br>units                                       | cell_methods                    | positive | type | CMOR dimensions                   | CMOR<br>variable<br>name | realm     | frequency | cell_measures   | flag_values | flag_meanings |
|--|---------------------------------|----------|------|-----------------------------------|--------------------------|-----------|-----------|-----------------|-------------|---------------|
| mol m-3 or kg m-3 or 1, consistent with first table in Oyr | time: mean area: mean where sea |          | real | longitude latitude time depth0m   |                          | ocnBgchem |           | area: areacello |             |               |
| mol m-2 s-1  | time: mean area: mean where sea |          | real | longitude latitude time           | intpp                    | ocnBgchem |           | area: areacello |             |               |
| mol m-2 s-1  | time: mean area: where sea      |          | real | longitude latitude time           | intpnitrate              | ocnBgchem |           | area: areacello |             |               |
| mol m-2 s-1  | time: mean area: mean where sea |          | real | longitude latitude time           | intpdiat                 | ocnBgchem |           | area: areacello |             |               |
| mol m-2 s-1  | time: mean area: where sea      |          | real | longitude latitude time           | intpdiaz                 | ocnBgchem |           | area: areacello |             |               |
| mol m-2 s-1  | time: mean area: where sea      |          | real | longitude latitude time           | intpcalc                 | ocnBgchem |           | area: areacello |             |               |
| mol m-2 s-1  | time: mean area: where sea      |          | real | longitude latitude time           | intppico                 | ocnBgchem |           | area: areacello |             |               |
| mol m-2 s-1  | time: mean area: where sea      |          | real | longitude latitude time           | intpmisc                 | ocnBgchem |           | area: areacello |             |               |
| mol m-2 s-1  | time: mean area: mean where sea |          | real | longitude latitude time           | intpbfe                  | ocnBgchem |           | area: areacello |             |               |
| mol m-2 s-1  | time: mean area: where sea      |          | real | longitude latitude time           | intpbsi                  | ocnBgchem |           | area: areacello |             |               |
| mol m-2 s-1  | time: mean area: mean where sea |          | real | longitude latitude time           | intpcalcite              | ocnBgchem |           | area: areacello |             |               |
| mol m-2 s-1  | time: mean area: where sea      |          | real | longitude latitude time           | intparag                 | ocnBgchem |           | area: areacello |             |               |
| mol m-2 s-1  | time: mean area: mean where sea | down     | real | longitude latitude time depth100m | epc100                   | ocnBgchem |           | area: areacello |             |               |
| mol m-2 s-1  | time: mean area: where sea      | down     | real | longitude latitude time depth100m | epfe100                  | ocnBgchem |           | area: areacello |             |               |
| mol m-2 s-1  | time: mean area: mean where sea | down     | real | longitude latitude time depth100m | epsi100                  | ocnBgchem |           | area: areacello |             |               |
| mol m-2 s-1  | time: mean area: where sea      | down     | real | longitude latitude time depth100m | epcalc100                | ocnBgchem |           | area: areacello |             |               |

|   |  |                                     |   |   |           |  |
|---|--|-------------------------------------|---|---|-----------|--|
| 1 | Downward Flux of Aragonite at 100M                                   | mol m <sup>-2</sup> s <sup>-1</sup> | sinking flux of aragonite at 100m   |   | eparag100 | sinking_mole_flux_of_aragonite_expressed_as_carbon_in_sea_water  |
| 2 | Dissolved Inorganic Carbon Content                                   | kg m <sup>-2</sup>                  | Vertically integrated DIC   |   | intdic    | ocean_mass_content_of_dissolved_inorganic_carbon   |
| 1 | Surface Aqueous Partial Pressure of CO2                              | Pa                                  | Surface aqueous partial pressure of CO2   | For consistency with other fluxes, shouldn't this have units of mol m <sup>-2</sup> s <sup>-1</sup> . No it is better in these units for direct comparison with surface fluxes of CO2 on land | spco2     | surface_partial_pressure_of_carbon_dioxide_in_sea_water  |
| 3 | Delta PCO2   | Pa                                  | Difference between atmospheric and oceanic partial pressure of CO2 (positive meaning ocean > atmosphere)  |   | dpc2      | surface_carbon_dioxide_partial_pressure_difference_between_sea_water_and_air   |
| 3 | Delta PO2  | Pa                                  | Difference between atmospheric and oceanic partial pressure of O2 (positive meaning ocean > atmosphere)   |   | dpo2      | surface_molecular_oxygen_partial_pressure_difference_between_sea_water_and_air   |
| 1 | Surface Downward CO2 Flux  | kg m <sup>-2</sup> s <sup>-1</sup>  | Gas exchange flux of CO2 (positive into ocean)  |   | fgco2     | surface_downward_mass_flux_of_carbon_dioxide_expressed_as_carbon   |
| 1 | Surface Downward O2 Flux   | mol m <sup>-2</sup> s <sup>-1</sup> | Gas exchange flux of O2 (positive into ocean)   |   | fgo2      | surface_downward_mole_flux_of_molecular_oxygen   |
| 3 | Surface Upward DMS Flux  | mol m <sup>-2</sup> s <sup>-1</sup> | Gas exchange flux of DMS (positive into atmosphere)   |   | fgdms     | surface_upward_mole_flux_of_dimethyl_sulfide   |
| 3 | Flux of Carbon Into Ocean Surface by Runoff and Sediment Dissolution | mol m <sup>-2</sup> s <sup>-1</sup> | Carbon supply to ocean through runoff and sediment dissolution (neglects gas exchange)                    |   | fsc       | tendency_of_ocean_mole_content_of_carbon_due_to_runoff_and_sediment_dissolution  |
| 3 | Downward Carbon Flux at Ocean Bottom                                 | mol m <sup>-2</sup> s <sup>-1</sup> | Carbon loss to sediments  |   | frc       | tendency_of_ocean_mole_content_of_carbon_due_to_sedimentation  |
| 3 | Nitrogen Fixation Rate in Ocean                                      | mol m <sup>-2</sup> s <sup>-1</sup> | Vertically integrated nitrogen fixation   |   | intpn2    | tendency_of_ocean_mole_content_of_elemental_nitrogen_due_to_fixation   |
| 3 | Surface Downward Net Flux of Nitrogen                                | mol m <sup>-2</sup> s <sup>-1</sup> | N supply through deposition flux onto sea surface, nitrogen fixation, and runoff                          |   | fsn       | tendency_of_ocean_mole_content_of_elemental_nitrogen_due_to_deposition_and_fixation_and_runoff                         |
| 3 | Nitrogen Loss to Sediments and through Denitrification               | mol m <sup>-2</sup> s <sup>-1</sup> | N loss to sediment and water column denitrification   |   | frn       | tendency_of_ocean_mole_content_of_elemental_nitrogen_due_to_denitrification_and_sedimentation                          |
| 3 | Surface Downward Net Flux of Iron                                    | mol m <sup>-2</sup> s <sup>-1</sup> | Iron supply through deposition flux onto sea surface, runoff, coasts, sediments, etc                      |   | fsfe      | tendency_of_ocean_mole_content_of_iron_due_to_deposition_and_runoff_and_sediment_dissolution                           |
| 3 | Iron Loss to Sediments   | mol m <sup>-2</sup> s <sup>-1</sup> | Iron loss to sediments  |   | frfe      | tendency_of_ocean_mole_content_of_iron_due_to_sedimentation  |
| 3 | Oxygen Minimum Concentration   | mol m <sup>-5</sup>                 | Vertical minimum concentration of dissolved oxygen gas  |   | o2min     | mole_concentration_of_dissolved_molecular_oxygen_in_sea_water_at_shallowest_local_minimum_in_vertical_profile          |
| 3 | Depth of Oxygen Minimum Concentration                                | m                                   | Depth of vertical minimum concentration of dissolved oxygen gas (if two, then the shallower)              |   | zo2min    | depth_at_shallowest_local_minimum_in_vertical_profile_of_mole_concentration_of_dissolved_molecular_oxygen_in_sea_water |
| 3 | Calcite Saturation Depth   | m                                   | Depth of calcite saturation horizon (0 if < surface, "missing" if > bottom, if two, then the shallower)   |   | zsatcalc  | minimum_depth_of_calcite_undersaturation_in_sea_water  |
| 3 | Aragonite Saturation Depth   | m                                   | Depth of aragonite saturation horizon (0 if < surface, "missing" if > bottom, if two, then the shallower) |   | zsatarag  | minimum_depth_of_aragonite_undersaturation_in_sea_water  |
| 3 | Rate of Change in Upper 100 m of Net Dissolved Inorganic Carbon      | mol m <sup>-2</sup> s <sup>-1</sup> | Net time rate of change of dissolved inorganic carbon in upper 100m                                       |   | fdtdic    | tendency_of_ocean_mole_content_of_dissolved_inorganic_carbon   |
| 3 | Rate of Change in Upper 100 m of Net Dissolved Inorganic Nitrogen    | mol m <sup>-2</sup> s <sup>-1</sup> | Net time rate of change of nitrogen nutrients (e.g. NO3+NH4) in upper 100m                                |   | fdtdin    | tendency_of_ocean_mole_content_of_dissolved_inorganic_nitrogen   |
| 3 | Rate of Change in Upper 100 m of Net Dissolved Inorganic Phosphate   | mol m <sup>-2</sup> s <sup>-1</sup> | vertical integral of net time rate of change of phosphate in upper 100m                                   |   | fdtdip    | tendency_of_ocean_mole_content_of_dissolved_inorganic_phosphorus   |
| 3 | Rate of Change in Upper 100 m of Net Dissolved Inorganic Iron        | mol m <sup>-2</sup> s <sup>-1</sup> | vertical integral of net time rate of change of dissolved inorganic iron in upper 100m                    |   | fdtdife   | tendency_of_ocean_mole_content_of_dissolved_inorganic_iron   |



|             |   |      |      |                                       |           |           |                 |
|-------------|---|------|------|---------------------------------------|-----------|-----------|-----------------|
| mol m-2 s-1 | time: mean area:<br>mean where sea              | down | real | longitude latitude time<br>depth100m  | eparag100 | ocnBgchem | area: areacello |
| kg m-2      | time: mean area:<br>where sea                   |      | real | longitude latitude time               | intdic    | ocnBgchem | area: areacello |
| Pa          | time: mean area:<br>mean where sea              |      | real | longitude latitude time               | spco2     | ocnBgchem | area: areacello |
| Pa          | time: mean area:<br>where sea                   |      | real | longitude latitude time               | dpcO2     | ocnBgchem | area: areacello |
| Pa          | time: mean area:<br>mean where sea              |      | real | longitude latitude time               | dpo2      | ocnBgchem | area: areacello |
| kg m-2 s-1  | time: mean area:<br>where sea                   | down | real | longitude latitude time               | fgco2     | ocnBgchem | area: areacello |
| mol m-2 s-1 | time: mean area:<br>mean where sea              | down | real | longitude latitude time               | fgo2      | ocnBgchem | area: areacello |
| mol m-2 s-1 | time: mean area:<br>where sea                   | up   | real | longitude latitude time               | fgdms     | ocnBgchem | area: areacello |
| mol m-2 s-1 | time: mean area:<br>mean where sea              |      | real | longitude latitude time               | fsc       | ocnBgchem | area: areacello |
| mol m-2 s-1 | time: mean area:<br>where sea                   | down | real | longitude latitude time               | frc       | ocnBgchem | area: areacello |
| mol m-2 s-1 | time: mean area:<br>mean where sea              |      | real | longitude latitude time               | intpn2    | ocnBgchem | area: areacello |
| mol m-2 s-1 | time: mean area:<br>where sea                   | down | real | longitude latitude time               | fsn       | ocnBgchem | area: areacello |
| mol m-2 s-1 | time: mean area:<br>mean where sea              |      | real | longitude latitude time               | frn       | ocnBgchem | area: areacello |
| mol m-2 s-1 | time: mean area:<br>where sea                   | down | real | longitude latitude time               | fsfe      | ocnBgchem | area: areacello |
| mol m-2 s-1 | time: mean area:<br>mean where sea              |      | real | longitude latitude time               | frfe      | ocnBgchem | area: areacello |
| mol m-3     | time: mean area:<br>where sea depth:<br>minimum |      | real | longitude latitude time               | o2min     | ocnBgchem | area: areacello |
| m           | time: mean area:<br>mean where sea              |      | real | longitude latitude time               | zo2min    | ocnBgchem | area: areacello |
| m           | time: mean area:<br>where sea                   |      | real | longitude latitude time               | zsatcalc  | ocnBgchem | area: areacello |
| m           | time: mean area:<br>mean where sea              |      | real | longitude latitude time               | zsatarag  | ocnBgchem | area: areacello |
| mol m-2 s-1 | time: mean area:<br>where sea                   |      | real | longitude latitude time<br>olayer100m | fddtdic   | ocnBgchem | area: areacello |
| mol m-2 s-1 | time: mean area:<br>mean where sea              |      | real | longitude latitude time<br>olayer100m | fddtdin   | ocnBgchem | area: areacello |
| mol m-2 s-1 | time: mean area:<br>where sea                   |      | real | longitude latitude time<br>olayer100m | fddtdip   | ocnBgchem | area: areacello |
| mol m-2 s-1 | time: mean area:<br>mean where sea              |      | real | longitude latitude time<br>olayer100m | fddtdife  | ocnBgchem | area: areacello |

|   |   |                                   |  |           |   |
|---|---|-----------------------------------|--|-----------|---|
| 3 | Rate of Change in Upper 100 m of Net Dissolved Inorganic Silicate                         | $\text{mol m}^{-2} \text{s}^{-1}$ | vertical integral of net time rate of change of dissolved inorganic silicate in upper 100m   | fddtdisi  | tendency_of_ocean_mole_content_of_dissolved_inorganic_silicon   |
| 3 | Rate of Change in Upper 100 m of Alkalinity   | $\text{mol m}^{-2} \text{s}^{-1}$ | vertical integral of net time rate of change of alkalinity in upper 100m   | fddtalk   | integral_wrt_depth_of_tendency_of_sea_water_alkalinity_expressed_as_mole_equivalent                             |
| 3 | Rate of Change in Upper 100 m of Dissolved Inorganic Carbon due to Biological Activity    | $\text{mol m}^{-2} \text{s}^{-1}$ | vertical integral of net biological terms in time rate of change of dissolved inorganic carbon in upper 100m                           | fbddtdic  | tendency_of_ocean_mole_content_of_dissolved_inorganic_carbon_due_to_biological_processes                        |
| 3 | Rate of Change in Upper 100 m of Dissolved Inorganic Nitrogen due to Biological Activity  | $\text{mol m}^{-2} \text{s}^{-1}$ | vertical integral of net biological terms in time rate of change of nitrogen nutrients (e.g. $\text{NO}_3+\text{NH}_4$ ) in upper 100m | fbddtdin  | tendency_of_ocean_mole_content_of_dissolved_inorganic_nitrogen_due_to_biological_processes                      |
| 3 | Rate of Change in Upper 100 m of Dissolved Inorganic Phosphate due to Biological Activity | $\text{mol m}^{-2} \text{s}^{-1}$ | vertical integral of net biological terms in time rate of change of phosphate in upper 100m  | fbddtdip  | tendency_of_ocean_mole_content_of_dissolved_inorganic_phosphorus_due_to_biological_processes                    |
| 3 | Rate of Change in Upper 100 m of Dissolved Inorganic Iron due to Biological Activity      | $\text{mol m}^{-2} \text{s}^{-1}$ | vertical integral of net biological terms in time rate of change of dissolved inorganic iron in upper 100m                             | fbddtdife | tendency_of_ocean_mole_content_of_dissolved_inorganic_iron_due_to_biological_processes                          |
| 3 | Rate of Change in Upper 100 m of Dissolved Inorganic Silicate due to Biological Activity  | $\text{mol m}^{-2} \text{s}^{-1}$ | vertical integral of net biological terms in time rate of change of dissolved inorganic silicate in upper 100m                         | fbddtdisi | tendency_of_ocean_mole_content_of_dissolved_inorganic_silicon_due_to_biological_processes                       |
| 3 | Rate of Change in Upper 100 m of Biological Alkalinity due to Biological Activity         | $\text{mol m}^{-2} \text{s}^{-1}$ | vertical integral of net biological terms in time rate of change of alkalinity in upper 100m   | fbddtalk  | integral_wrt_depth_of_tendency_of_sea_water_alkalinity_expressed_as_mole_equivalent_due_to_biological_processes |

|             |                                    |      |                                       |           |           |                 |
|-------------|------------------------------------|------|---------------------------------------|-----------|-----------|-----------------|
| mol m-2 s-1 | time: mean area:<br>where sea      | real | longitude latitude time<br>olayer100m | fddtdisi  | ocnBgchem | area: areacello |
| mol m-2 s-1 | time: mean area:<br>mean where sea | real | longitude latitude time<br>olayer100m | fddtalk   | ocnBgchem | area: areacello |
| mol m-2 s-1 | time: mean area:<br>where sea      | real | longitude latitude time<br>olayer100m | fbddtdic  | ocnBgchem | area: areacello |
| mol m-2 s-1 | time: mean area:<br>mean where sea | real | longitude latitude time<br>olayer100m | fbddtdin  | ocnBgchem | area: areacello |
| mol m-2 s-1 | time: mean area:<br>where sea      | real | longitude latitude time<br>olayer100m | fbddtdip  | ocnBgchem | area: areacello |
| mol m-2 s-1 | time: mean area:<br>mean where sea | real | longitude latitude time<br>olayer100m | fbddtdife | ocnBgchem | area: areacello |
| mol m-2 s-1 | time: mean area:<br>where sea      | real | longitude latitude time<br>olayer100m | fbddtdisi | ocnBgchem | area: areacello |
| mol m-2 s-1 | time: mean area:<br>mean where sea | real | longitude latitude time<br>olayer100m | fbddtalk  | ocnBgchem | area: areacello |

Further explanation of the fields in the following tables can be found in Griffies et al., available at [http://eprints.soton.ac.uk/65415/01/137\\_WGOMD\\_ModelOutput.pdf](http://eprints.soton.ac.uk/65415/01/137_WGOMD_ModelOutput.pdf).

In CMOR Table **Omon**: *WGOMD Table 2.2*

| Priority | long name                                      | units                | comment   | questions | output variable |  |
|----------|--|----------------------|---|-----------|-----------------|--|
|          |  |                      |   |           | name            | standard name                                |
| 1        | Sea Water Mass                                 | kg                   |   |           | masso           | sea_water_mass                               |
| 1        | Sea Water Pressure at Sea floor                | dbar                 |   |           | pbo             | sea_water_pressure_at_sea_floor              |
| 2        | Sea Water Pressure at Sea Water Surface        | dbar                 |   |           | pso             | sea_water_pressure_at_sea_water_surface      |
| 1        | Sea Water Volume                               | m <sup>3</sup>       |   |           | volo            | sea_water_volume                             |
| 1        | Sea Surface Height Above Geoid                 | m                    |   |           | zos             | sea_surface_height_above_geoid               |
| 3        | Square of Sea Surface Height Above Geoid       | m <sup>2</sup>       |   |           | zossq           | square_of_sea_surface_height_above_geoid     |
| 1        | Global Average Sea Level Change                | m                    |   |           | zosga           | global_average_sea_level_change              |
| 1        | Global Average Steric Sea Level Change         | m                    |   |           | zossga          | global_average_steric_sea_level_change       |
| 1        | Global Average Thermosteric Sea Level Change   | m                    |   |           | zostoga         | global_average_thermosteric_sea_level_change |
| 1        | Sea Water Mass Per Unit Area                   | kg m <sup>-2</sup>   |   |           | masscello       | sea_water_mass_per_unit_area                 |
| 1        | Ocean Model Cell Thickness                     | m                    |   |           | thkcello        | cell_thickness                               |
| 1        | Sea Water Potential Temperature                | K                    |   |           | thetao          | sea_water_potential_temperature              |
| 1        | Global Average Sea Water Potential Temperature | K                    |   |           | thetaoga        | sea_water_potential_temperature              |
| 2        | Sea Surface Temperature                        | K                    | this may differ from "surface temperature" in regions of sea ice. |           | tos             | sea_surface_temperature                      |
| 3        | Square of Sea Surface Temperature              | K <sup>2</sup>       |   |           | tossq           | square_of_sea_surface_temperature            |
| 1        | Sea Water Salinity                             | psu                  |   |           | so              | sea_water_salinity                           |
| 1        | Global Mean Sea Water Salinity                 | psu                  |   |           | soga            | sea_water_salinity                           |
| 2        | Sea Surface Salinity                           | psu                  |   |           | sos             | sea_surface_salinity                         |
| 3        | Sea Water Potential Density                    | kg m <sup>-3</sup>   |   |           | rhopot          | sea_water_potential_density                  |
| 3        | Sea Water Age Since Surface Contact            | yr                   |   |           | agessc          | sea_water_age_since_surface_contact          |
| 3        | Moles Per Unit Mass of CFC-11 in Sea Water     | mol kg <sup>-1</sup> |   |           | cfc11           | moles_of_cfc11_per_unit_mass_in_sea_water    |

| unformatted | CMOR                               |          |      |                                   |               |       |           |                                     |             |               |
|-------------|------------------------------------|----------|------|-----------------------------------|---------------|-------|-----------|-------------------------------------|-------------|---------------|
| units       | cell_methods                       | positive | type | CMOR dimensions                   | variable name | realm | frequency | cell_measures                       | flag_values | flag_meanings |
| kg          | time: mean area:<br>sum where sea  |          | real | time                              | masso         | ocean |           |                                     |             |               |
| dbar        | time: mean                         |          | real | longitude latitude time           | pbo           | ocean |           | area: areacello                     |             |               |
| dbar        | time: mean                         |          | real | longitude latitude time           | pso           | ocean |           | area: areacello                     |             |               |
| m3          | time: mean area:<br>sum where sea  |          | real | time                              | volo          | ocean |           |                                     |             |               |
| m           | time: mean                         |          | real | longitude latitude time           | zos           | ocean |           | area: areacello                     |             |               |
| m2          | time: mean                         |          | real | longitude latitude time           | zossq         | ocean |           | area: areacello                     |             |               |
| m           | time: mean area:<br>mean where sea |          | real | time                              | zosga         | ocean |           |                                     |             |               |
| m           | time: mean area:<br>mean where sea |          | real | time                              | zossqa        | ocean |           |                                     |             |               |
| m           | time: mean area:<br>mean where sea |          | real | time                              | zostoga       | ocean |           |                                     |             |               |
| kg m-2      | time: mean                         |          | real | longitude latitude olevel<br>time | masscello     | ocean |           | area: areacello<br>volume: volcello |             |               |
| m           | time: mean                         |          | real | longitude latitude olevel<br>time | thkcello      | ocean |           | area: areacello<br>volume: volcello |             |               |
| K           | time: mean                         |          | real | longitude latitude olevel<br>time | thetao        | ocean |           | area: areacello<br>volume: volcello |             |               |
| K           | time: mean area:<br>mean where sea |          | real | time                              | thetaoga      | ocean |           |                                     |             |               |
| K           | time: mean                         |          | real | longitude latitude time           | tos           | ocean |           | area: areacello                     |             |               |
| K2          | time: mean                         |          | real | longitude latitude time           | tossq         | ocean |           | area: areacello                     |             |               |
| psu         | time: mean                         |          | real | longitude latitude olevel<br>time | so            | ocean |           | area: areacello<br>volume: volcello |             |               |
| psu         | time: mean area:<br>mean where sea |          | real | time                              | soga          | ocean |           |                                     |             |               |
| psu         | time: mean                         |          | real | longitude latitude time           | sos           | ocean |           | area: areacello                     |             |               |
| kg m-3      | time: mean                         |          | real | longitude latitude olevel<br>time | rhopot        | ocean |           | area: areacello<br>volume: volcello |             |               |
| yr          | time: mean                         |          | real | longitude latitude olevel<br>time | agessc        | ocean |           | area: areacello<br>volume: volcello |             |               |
| mol kg-1    | time: mean                         |          | real | longitude latitude olevel<br>time | cfc11         | ocean |           | area: areacello<br>volume: volcello |             |               |

|   |   |                    |  |           |  |
|---|---|--------------------|--|-----------|--|
| 3 | Ocean Barotropic Mass Streamfunction                                    | kg s <sup>-1</sup> | differs from CMIP3 because it includes mass. | msftbarot | ocean_barotropic_mass_streamfunction                     |
| 3 | Ocean Mixed Layer Thickness Defined by Sigma T                          | m                  |  | mloitst   | ocean_mixed_layer_thickness_defined_by_sigma_t           |
| 3 | Square of Ocean Mixed Layer Thickness Defined by Sigma T                | m <sup>2</sup>     |  | mloitstsq | square_of_ocean_mixed_layer_thickness_defined_by_sigma_t |
| 3 | Mean Daily Maximum Ocean Mixed Layer Thickness Defined by Mixing Scheme | m                  |  | omldamax  | ocean_mixed_layer_thickness_defined_by_mixing_scheme     |
| 3 | Monthly Maximum Ocean Mixed Layer Thickness Defined by Mixing Scheme    | m                  |  | omlmax    | ocean_mixed_layer_thickness_defined_by_mixing_scheme     |

In CMOR Table **Omon**: *WGOMD Table 2.3*

| Priority | long name   | units                           | comment  | questions | output variable |   |
|----------|---|---------------------------------|--|-----------|-----------------|---|
|          |   |                                 |  |           | name            | standard name   |
| 1        | Sea Water X Velocity  | m s <sup>-1</sup>               |  |           | uo              | sea_water_x_velocity  |
| 1        | Sea Water Y Velocity  | m s <sup>-1</sup>               |  |           | vo              | sea_water_y_velocity  |
| 1        | Upward Ocean Mass Transport   | kg s <sup>-1</sup>              | differs from CMIP3, which only had upward velocity.  |           | wmo             | upward_ocean_mass_transport   |
| 1        | Square of Upward Ocean Mass Transport                                   | kg <sup>2</sup> s <sup>-2</sup> |  |           | wmosq           | square_of_upward_ocean_mass_transport                                   |
| 2        | Ocean Mass X Transport  | kg s <sup>-1</sup>              |  |           | umo             | ocean_mass_x_transport  |
| 2        | Ocean Mass Y Transport  | kg s <sup>-1</sup>              |  |           | vmo             | ocean_mass_y_transport  |
| 2        | Ocean Meridional Overturning Mass Streamfunction                        | kg s <sup>-1</sup>              | function of latitude, Z, basin. differs from CMIP3 because it includes mass. For a model with a cartesian latlon grid, this is the same as the "Ocean Y Overturning Mass Streamfunction", listed a few lines down, which should in this case be omitted. For other models, this transport should be approximated as the transport along zig-zag paths corresponding to latitudes with spacing between latitudes appropriate to the model's resolution. |           | msftmyz         | ocean_meridional_overturning_mass_streamfunction                        |
| 2        | Ocean Meridional Overturning Mass Streamfunction                        | kg s <sup>-1</sup>              | function of of latitude, rho, basin. Also see note above.  |           | msftmrhoz       | ocean_meridional_overturning_mass_streamfunction                        |
| 2        | Ocean Y Overturning Mass Streamfunction                                 | kg s <sup>-1</sup>              | function of Y, Z, basin. Also see note above.  |           | msftyyz         | ocean_y_overturning_mass_streamfunction                                 |
| 2        | Ocean Y Overturning Mass Streamfunction                                 | kg s <sup>-1</sup>              | function of Y, rho, basin. Also see note above.  |           | msftyrhoz       | ocean_y_overturning_mass_streamfunction                                 |
| 3        | Ocean Meridional Overturning Mass Streamfunction due to Bolus Advection | kg s <sup>-1</sup>              | function of latitude, Z, basin. Also see note above.   |           | msftmyzba       | ocean_meridional_overturning_mass_streamfunction_due_to_bolus_advection |
| 3        | Ocean Meridional Overturning Mass Streamfunction due to Bolus Advection | kg s <sup>-1</sup>              | function of latitude, rho, basin. Also see note above.   |           | msftmrhozba     | ocean_meridional_overturning_mass_streamfunction_due_to_bolus_advection |
| 3        | Ocean Y Overturning Mass Streamfunction due to Bolus Advection          | kg s <sup>-1</sup>              | function of Y, Z, basin. Also see note above.  |           | msftyyzba       | ocean_y_overturning_mass_streamfunction_due_to_bolus_advection          |
| 3        | Ocean Y Overturning Mass Streamfunction due to Bolus Advection          | kg s <sup>-1</sup>              | function of Y, rho, basin. Also see note above.  |           | msftyrhozba     | ocean_y_overturning_mass_streamfunction_due_to_bolus_advection          |

|        |  |      |                         |           |       |                 |
|--------|--|------|-------------------------|-----------|-------|-----------------|
| kg s-1 | time: mean   | real | longitude latitude time | msftbarot | ocean | area: areacello |
| m      | time: mean   | real | longitude latitude time | mlost     | ocean | area: areacello |
| m2     | time: mean   | real | longitude latitude time | mlostsq   | ocean | area: areacello |
| m      | time: maximum<br>within days time:<br>mean over days | real | longitude latitude time | omldamax  | ocean | area: areacello |
| m      | time: maximum  | real | longitude latitude time | omlmax    | ocean | area: areacello |

| unformatted | cell_methods                  | positive | type | CMOR dimensions                | CMOR variable name | realm | frequency | cell_measures                       | flag_values | flag_meanings |
|-------------|-------------------------------|----------|------|--------------------------------|--------------------|-------|-----------|-------------------------------------|-------------|---------------|
| m s-1       | time: mean                    |          | real | longitude latitude olevel time | uo                 | ocean |           |                                     |             |               |
| m s-1       | time: mean                    |          | real | longitude latitude olevel time | vo                 | ocean |           |                                     |             |               |
| kg s-1      | time: mean                    |          | real | longitude latitude olevel time | wmo                | ocean |           | area: areacello<br>volume: volcello |             |               |
| kg2 s-2     | time: mean                    |          | real | longitude latitude olevel time | wmosq              | ocean |           | area: areacello<br>volume: volcello |             |               |
| kg s-1      | time: mean                    |          | real | longitude latitude olevel time | umo                | ocean |           |                                     |             |               |
| kg s-1      | time: mean                    |          | real | longitude latitude olevel time | vmo                | ocean |           |                                     |             |               |
| kg s-1      | time: mean<br>longitude: mean |          | real | latitude olevel basin time     | msftmyz            | ocean |           |                                     |             |               |
| kg s-1      | time: mean<br>longitude: mean |          | real | latitude rho basin time        | msftmrhoz          | ocean |           |                                     |             |               |
| kg s-1      | time: mean<br>longitude: mean |          | real | latitude olevel basin time     | msftyyz            | ocean |           |                                     |             |               |
| kg s-1      | time: mean<br>longitude: mean |          | real | latitude rho basin time        | msftyrhoz          | ocean |           |                                     |             |               |
| kg s-1      | time: mean<br>longitude: mean |          | real | latitude olevel basin time     | msftmyzba          | ocean |           |                                     |             |               |
| kg s-1      | time: mean<br>longitude: mean |          | real | latitude rho basin time        | msftmrhozba        | ocean |           |                                     |             |               |
| kg s-1      | time: mean<br>longitude: mean |          | real | latitude olevel basin time     | msftyzba           | ocean |           |                                     |             |               |
| kg s-1      | time: mean<br>longitude: mean |          | real | latitude rho basin time        | msftyrhozba        | ocean |           |                                     |             |               |

|   |   |                    |   |             |   |
|---|---|--------------------|---|-------------|---|
| 2 | Northward Ocean Heat Transport                        | W                  | For a model with a cartesian latxlon grid, this is the same as the "Ocean Heat Y Transport", listed a few lines down, which should in this case be omitted. For other models, this transport should be approximated as the transport along zig-zag paths corresponding to latitudes with spacing between latitudes appropriate to the model's resolution. | hfnorth     | northward_ocean_heat_transport                        |
| 3 | Northward Ocean Heat Transport due to Bolus Advection | W                  | see note above.   | hfnorthba   | northward_ocean_heat_transport_due_to_bolus_advection |
| 3 | Northward Ocean Heat Transport due to Diffusion       | W                  | see note above.   | hfnorthdiff | northward_ocean_heat_transport_due_to_diffusion       |
| 2 | Ocean Heat X Transport                                | W                  |   | hfx         | ocean_heat_x_transport                                |
| 2 | Ocean Heat Y Transport                                | W                  | For a model with a cartesian latxlon grid, this is the same as the "Northward Ocean Heat Transport", listed a few lines above, which should be saved instead of this.   | hfy         | ocean_heat_y_transport                                |
| 3 | Ocean Heat Y Transport due to Bolus Advection         | W                  | see note above.   | hfyba       | ocean_heat_y_transport_due_to_bolus_advection         |
| 3 | Ocean Heat Y Transport due to Diffusion               | W                  | see note above.   | hfydiff     | ocean_heat_y_transport_due_to_diffusion               |
| 3 | Ocean Heat X Transport due to Bolus Advection         | W                  |   | hfxba       | ocean_heat_x_transport_due_to_bolus_advection         |
| 3 | Ocean Heat X Transport due to Diffusion               | W                  |   | hfxdiff     | ocean_heat_x_transport_due_to_diffusion               |
| 2 | Northward Ocean Heat Transport                        | W                  | This differs from a similar, previous entry in that northward transport across individual basins is called for, rather than the fully gridded fields..  | hfbasin     | northward_ocean_heat_transport                        |
| 3 | Northward Ocean Heat Transport due to Bolus Advection | W                  |   | hfbasinba   | northward_ocean_heat_transport_due_to_bolus_advection |
| 3 | Northward Ocean Heat Transport due to Diffusion       | W                  |   | hfbasindiff | northward_ocean_heat_transport_due_to_diffusion       |
| 2 | Northward Ocean Heat Transport due to Gyre            | W                  | function of latitude, basin   | htovgyre    | northward_ocean_heat_transport_due_to_gyre            |
| 2 | Northward Ocean Heat Transport due to Overturning     | W                  | function of latitude, basin   | htovovrt    | northward_ocean_heat_transport_due_to_overturning     |
| 2 | Northward Ocean Salt Transport due to Gyre            | kg s <sup>-1</sup> | function of latitude, basin   | sltovgyre   | northward_ocean_salt_transport_due_to_gyre            |
| 2 | Northward Ocean Salt Transport due to Overturning     | kg s <sup>-1</sup> | function of latitude, basin   | sltovovrt   | northward_ocean_salt_transport_due_to_overturning     |



|        |                               |      |                         |             |       |  |
|--------|-------------------------------|------|-------------------------|-------------|-------|--|
| W      | time: mean                    | real | longitude latitude time | hfnorth     | ocean |  |
| W      | time: mean                    | real | longitude latitude time | hfnorthba   | ocean |  |
| W      | time: mean                    | real | longitude latitude time | hfnorthdiff | ocean |  |
| W      | time: mean                    | real | longitude latitude time | hfx         | ocean |  |
| W      | time: mean                    | real | longitude latitude time | hfy         | ocean |  |
| W      | time: mean                    | real | longitude latitude time | hfyba       | ocean |  |
| W      | time: mean                    | real | longitude latitude time | hfydiff     | ocean |  |
| W      | time: mean                    | real | longitude latitude time | hfxba       | ocean |  |
| W      | time: mean                    | real | longitude latitude time | hfxdiff     | ocean |  |
| W      | time: mean<br>longitude: mean | real | latitude basin time     | hfbasin     | ocean |  |
| W      | time: mean<br>longitude: mean | real | latitude basin time     | hfbasinba   | ocean |  |
| W      | time: mean<br>longitude: mean | real | latitude basin time     | hfbasindiff | ocean |  |
| W      | time: mean<br>longitude: mean | real | latitude basin time     | htovgyre    | ocean |  |
| W      | time: mean<br>longitude: mean | real | latitude basin time     | htovovrt    | ocean |  |
| kg s-1 | time: mean<br>longitude: mean | real | latitude basin time     | sltovgyre   | ocean |  |
| kg s-1 | time: mean<br>longitude: mean | real | latitude basin time     | sltovovrt   | ocean |  |

**In CMOR Table Omon: WGOMD Table 2.4**

sea water transport through (or associated with) the following straits, openings, channels, passages, etc.: barents\_opening, bering\_strait, canadian\_archipelago, denmark\_strait, drake\_passage, english\_channel, pacific\_equatorial\_undercurrent, faroe\_scotland\_channel, florida\_bahamas\_strait, fram\_strait, iceland\_faroe\_channel, indonesian\_thoughflow, mozambique\_channel, taiwan\_luzon\_straits, and windward\_passage. For definitions see WGOMD document referenced above. All transports will be stored in a single variable with a dimension that covers the set of regions listed here.

| <i>Priority</i> | long name           | units              | comment | questions | output variable name | standard name                   |
|-----------------|---------------------|--------------------|---------|-----------|----------------------|---------------------------------|
| 2               | Sea Water Transport | kg s <sup>-1</sup> |         |           | mfo                  | sea_water_transport_across_line |

**In CMOR Table Omon: WGOMD Table 2.5**

| <i>Priority</i> | long name   | units                              | comment   | questions   | output variable name | standard name   |
|-----------------|---|------------------------------------|---|---|----------------------|---|
| 2               | Rainfall Flux where Ice Free Ocean over Sea             | kg m <sup>-2</sup> s <sup>-1</sup> | compute as the total mass of liquid water falling as liquid rain into the ice-free portion of the ocean divided by the area of the ocean portion of the grid cell.                    |   | pr                   | rainfall_flux   |
| 2               | Snowfall Flux where Ice Free Ocean over Sea             | kg m <sup>-2</sup> s <sup>-1</sup> | compute as the total mass of ice directly falling as snow into the ice-free portion of the ocean divided by the area of the ocean portion of the grid cell.                           |   | prsn                 | snowfall_flux   |
| 2               | Water Evaporation Flux Where Ice Free Ocean over Sea    | kg m <sup>-2</sup> s <sup>-1</sup> | compute as the total mass of water vapor evaporating from the ice-free portion of the ocean divided by the area of the ocean portion of the grid cell.                                |   | evs                  | water_evaporation_flux                                  |
| 2               | Water Flux into Sea Water From Rivers                   | kg m <sup>-2</sup> s <sup>-1</sup> | compute as the river flux of water into the ocean divided by the area of the ocean portion of the grid cell.  |   | friver               | water_flux_into_sea_water_from_rivers                   |
| 2               | Water Flux into Sea Water From Icebergs                 | kg m <sup>-2</sup> s <sup>-1</sup> | compute as the iceberg melt water flux into the ocean divided by the area of the ocean portion of the grid cell.  |   | ficeberg             | water_flux_into_sea_water_from_icebergs                 |
| 1               | Water Flux into Sea Water due to Sea Ice Thermodynamics | kg m <sup>-2</sup> s <sup>-1</sup> | compute as the sea ice thermodynamic water flux into the ocean divided by the area of the ocean portion of the grid cell.   | The priority set by the WGOMD was 2 for this field. The sea-ice folks requested that the priority be raised to 1. | fsitherm             | water_flux_into_sea_water_due_to_sea_ice_thermodynamics |
| 2               | Water Flux into Sea Water                               | kg m <sup>-2</sup> s <sup>-1</sup> | compute as the water flux into the ocean divided by the area of the ocean portion of the grid cell. This is the sum of the next two variables in this table.                          |   | wfo                  | water_flux_into_sea_water                               |
| 2               | Water Flux into Sea Water Without Flux Correction       | kg m <sup>-2</sup> s <sup>-1</sup> | compute as the water flux (without flux correction) into the ocean divided by the area of the ocean portion of the grid cell. This is the sum of the first 6 variables in this table? |   | wfonocorr            | water_flux_into_sea_water_without_flux_correction       |

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|-------------|--------------|----------|------|-----------------|----------|-------|-----------|---------------|-------------|---------------|
| units       | cell_methods | positive | type | CMOR dimensions | variable | realm | frequency | cell_measures | flag_values | flag_meanings |
| kg s-1      | time: mean   |          | real | oline time      | mfo      | ocean |           |               |             |               |

| unformatted |  |          |      |                                   | CMOR      |              |           |                                     |             |               |
|-------------|--|----------|------|-----------------------------------|-----------|--------------|-----------|-------------------------------------|-------------|---------------|
| units       | cell_methods   | positive | type | CMOR dimensions                   | variable  | realm        | frequency | cell_measures                       | flag_values | flag_meanings |
| kg m-2 s-1  | time: mean area:<br>mean where<br>ice_free_sea over<br>sea |          | real | longitude latitude time           | pr        | ocean        |           | area: areacello                     |             |               |
| kg m-2 s-1  | time: mean area:<br>mean where<br>ice_free_sea over<br>sea |          | real | longitude latitude time           | prsn      | ocean        |           | area: areacello                     |             |               |
| kg m-2 s-1  | time: mean area:<br>mean where<br>ice_free_sea over<br>sea |          | real | longitude latitude time           | evs       | ocean        |           | area: areacello                     |             |               |
| kg m-2 s-1  | time: mean area:<br>mean where sea                         |          | real | longitude latitude time           | friver    | ocean        |           | area: areacello                     |             |               |
| kg m-2 s-1  | time: mean area:<br>mean where sea                         |          | real | longitude latitude olevel<br>time | ficeberg  | ocean        |           | area: areacello<br>volume: volcello |             |               |
| kg m-2 s-1  | time: mean area:<br>mean where sea                         |          | real | longitude latitude time           | fsitherm  | ocean seaIce |           | area: areacello                     |             |               |
| kg m-2 s-1  | time: mean area:<br>mean where sea                         |          | real | longitude latitude time           | wfo       | ocean        |           | area: areacello                     |             |               |
| kg m-2 s-1  | time: mean area:<br>mean where sea                         |          | real | longitude latitude time           | wfonocorr | ocean        |           | area: areacello                     |             |               |

|   |                       |                                   |   |        |                       |
|---|-----------------------|-----------------------------------|---|--------|-----------------------|
| 2 | Water Flux Correction | $\text{kg m}^{-2} \text{ s}^{-1}$ | If this does not vary from one year to the next, report only a single year. Positive flux implies correction adds water to ocean. | wfcorr | water_flux_correction |
|---|-----------------------|-----------------------------------|---|--------|-----------------------|

In CMOR Table **Omon**: *WGOMD Table 2.6*

| priority | long name  | units                             | comment  | questions   | output variable |  |
|----------|--|-----------------------------------|--|---|-----------------|--|
|          |  |                                   |  |   | name            | standard name  |
| 2        | Virtual Salt Flux into Sea Water due to Rainfall               | $\text{kg m}^{-2} \text{ s}^{-1}$ |  |   | vsfpr           | virtual_salt_flux_into_sea_water_due_to_rainfall               |
| 2        | Virtual Salt Flux into Sea Water due to Evaporation            | $\text{kg m}^{-2} \text{ s}^{-1}$ |  |   | vsfevap         | virtual_salt_flux_into_sea_water_due_to_evaporation            |
| 2        | Virtual Salt Flux into Sea Water From Rivers                   | $\text{kg m}^{-2} \text{ s}^{-1}$ |  |   | vsfriver        | virtual_salt_flux_into_sea_water_from_rivers                   |
| 1        | Virtual Salt Flux into Sea Water due to Sea Ice Thermodynamics | $\text{kg m}^{-2} \text{ s}^{-1}$ | This variable measures the virtual salt flux into sea water due to the melting of sea ice. It is set to zero in models which receive a real water flux.  | The priority set by the WGOMD was 2 for this field. The sea-ice folks requested that the priority be raised to 1. | vsfsit          | virtual_salt_flux_into_sea_water_due_to_sea_ice_thermodynamics |
| 2        | Virtual Salt Flux into Sea Water                               | $\text{kg m}^{-2} \text{ s}^{-1}$ | If this does not vary from one year to the next, report only a single year. Positive flux implies correction increases salinity of water. This includes all virtual salt flux, including that due to a salt flux correction. |   | vsf             | virtual_salt_flux_into_sea_water                               |
| 2        | Virtual Salt Flux Correction                                   | $\text{kg m}^{-2} \text{ s}^{-1}$ |  |   | vsfcorr         | virtual_salt_flux_correction                                   |
| 1        | Downward Sea Ice Basal Salt Flux                               | $\text{kg m}^{-2} \text{ s}^{-1}$ | This field is physical, and it arises since sea ice has a nonzero salt content, so it exchanges salt with the liquid ocean upon melting and freezing.  | The priority set by the WGOMD was 2 for this field. The sea-ice folks requested that the priority be raised to 1. | sfdsi           | downward_sea_ice_basal_salt_flux                               |
| 2        | Salt Flux into Sea Water from Rivers                           | $\text{kg m}^{-2} \text{ s}^{-1}$ |  |   | sfriver         | salt_flux_into_sea_water_from_rivers                           |

|            |                                    |      |      |                         |        |       |  |                 |  |  |
|------------|------------------------------------|------|------|-------------------------|--------|-------|--|-----------------|--|--|
| kg m-2 s-1 | time: mean area:<br>mean where sea | down | real | longitude latitude time | wfcorr | ocean |  | area: areacello |  |  |
|------------|------------------------------------|------|------|-------------------------|--------|-------|--|-----------------|--|--|

| <b>unformatted</b> |                                    |                 |             |                         | <b>CMOR</b>          |              |                  |                      |                    |                      |
|--------------------|------------------------------------|-----------------|-------------|-------------------------|----------------------|--------------|------------------|----------------------|--------------------|----------------------|
| <b>units</b>       | <b>cell_methods</b>                | <b>positive</b> | <b>type</b> | <b>CMOR dimensions</b>  | <b>variable name</b> | <b>realm</b> | <b>frequency</b> | <b>cell_measures</b> | <b>flag_values</b> | <b>flag_meanings</b> |
| kg m-2 s-1         | time: mean area:<br>mean where sea |                 | real        | longitude latitude time | vsfpr                | ocean        |                  | area: areacello      |                    |                      |
| kg m-2 s-1         | time: mean area:<br>mean where sea |                 | real        | longitude latitude time | vsfevap              | ocean        |                  | area: areacello      |                    |                      |
| kg m-2 s-1         | time: mean area:<br>mean where sea |                 | real        | longitude latitude time | vsfriver             | ocean        |                  | area: areacello      |                    |                      |
| kg m-2 s-1         | time: mean area:<br>mean where sea |                 | real        | longitude latitude time | vsfsit               | ocean seaIce |                  | area: areacello      |                    |                      |
| kg m-2 s-1         | time: mean area:<br>mean where sea |                 | real        | longitude latitude time | vsf                  | ocean        |                  | area: areacello      |                    |                      |
| kg m-2 s-1         | time: mean area:<br>mean where sea |                 | real        | longitude latitude time | vsfcorr              | ocean        |                  | area: areacello      |                    |                      |
| kg m-2 s-1         | time: mean area:<br>mean where sea |                 | real        | longitude latitude time | sfdsi                | ocean seaIce |                  | area: areacello      |                    |                      |
| kg m-2 s-1         | time: mean area:<br>mean where sea |                 | real        | longitude latitude time | sfriver              | ocean        |                  | area: areacello      |                    |                      |

In CMOR Table **Omon**: *WGOMD Table 2.7*

| <i>Priority</i> | <b>long name</b>  | <b>units</b> | <b>comment</b>   | <b>questions</b>  | <b>output variable name</b> | <b>standard name</b>  |
|-----------------|---|--------------|--|---|-----------------------------|---|
| 2               | Upward Geothermal Heat Flux at Sea Floor                                    | $W m^{-2}$   |  |   | hfgeou                      | upward_geothermal_heat_flux_at_sea_floor                                    |
| 2               | Temperature Flux due to Rainfall Expressed as Heat Flux into Sea Water      | $W m^{-2}$   | This is defined as "where ice_free_sea over sea"; i.e., compute the total flux (considered here) entering the ice-free portion of the grid cell divided by the area of the ocean portion of the grid cell.   |   | hfrainds                    | temperature_flux_due_to_rainfall_expressed_as_heat_flux_into_sea_water      |
| 2               | Temperature Flux due to Evaporation Expressed as Heat Flux Out of Sea Water | $W m^{-2}$   | This is defined as "where ice_free_sea over sea"   |   | hfevapds                    | temperature_flux_due_to_evaporation_expressed_as_heat_flux_out_of_sea_water |
| 2               | Temperature Flux due to Runoff Expressed as Heat Flux into Sea Water        | $W m^{-2}$   | In general this should be reported as a function of depth, (i.e., it will be a function of the generic "XYZ" dimensions). Include enough depth levels to represent the non-zero values of this field everywhere on the globe.  |   | hfrunoffds                  | temperature_flux_due_to_runoff_expressed_as_heat_flux_into_sea_water        |
| 2               | Heat Flux into Sea Water due to Snow Thermodynamics                         | $W m^{-2}$   | In general this should be reported as a function of depth, (i.e., it will be a function of the generic "XYZ" dimensions). Include enough depth levels to represent the non-zero values of this field everywhere on the globe.  |   | hfsnthermds                 | heat_flux_into_sea_water_due_to_snow_thermodynamics                         |
| 1               | Heat Flux into Sea Water due to Frazil Ice Formation                        | $W m^{-2}$   | As of May 2010, the WGOMD document recommends that this field should be saved instead of the field listed immediately below. In general this should be reported as a function of depth, (i.e., it will be a function of the generic "XYZ" dimensions). Include enough depth levels to represent the non-zero values of this field everywhere on the globe.                 |   | hfsifrazil                  | heat_flux_into_sea_water_due_to_freezing_of_frazil_ice                      |
| 1               | Heat Flux into Sea Water due to Sea Ice Thermodynamics                      | $W m^{-2}$   | As of May 2010, the WGOMD document recommends that instead of saving this field, the field listed immediately above should be saved instead. In general this should be reported as a function of depth, (i.e., it will be a function of the generic "XYZ" dimensions). Include enough depth levels to represent the non-zero values of this field everywhere on the globe. | The priority set by the WGOMD was 2 for this field. The sea-ice folks requested that the priority be raised to 1. | hfsithermds                 | heat_flux_into_sea_water_due_to_sea_ice_thermodynamics                      |
| 2               | Heat Flux into Sea Water due to Iceberg Thermodynamics                      | $W m^{-2}$   | In general this should be reported as a function of depth, (i.e., it will be a function of the generic "XYZ" dimensions). Include enough depth levels to represent the non-zero values of this field everywhere on the globe.  |   | hfibthermds                 | heat_flux_into_sea_water_due_to_iceberg_thermodynamics                      |
| 2               | Surface Net Downward Longwave Radiation                                     | $W m^{-2}$   | This is defined as "where ice_free_sea over sea"   |   | rlds                        | surface_net_downward_longwave_flux  |
| 2               | Surface Downward Latent Heat Flux   | $W m^{-2}$   | This is defined as "where ice_free_sea over sea"   |   | hfls                        | surface_downward_latent_heat_flux   |

| <b>unformatted</b> |  |                 |             |                                   | <b>CMOR</b>          |              |                  |                                     |                    |                      |
|--------------------|--|-----------------|-------------|-----------------------------------|----------------------|--------------|------------------|-------------------------------------|--------------------|----------------------|
| <b>units</b>       | <b>cell_methods</b>  | <b>positive</b> | <b>type</b> | <b>CMOR dimensions</b>            | <b>variable name</b> | <b>realm</b> | <b>frequency</b> | <b>cell_measures</b>                | <b>flag_values</b> | <b>flag_meanings</b> |
| W m-2              | time: mean area:<br>whre sea                               | up              | real        | longitude latitude time           | hfgeou               | ocean        |                  | area: areacello                     |                    |                      |
| W m-2              | time: mean area:<br>mean where<br>ice_free_sea over<br>sea | down            | real        | longitude latitude time           | hfrainds             | ocean        |                  | area: areacello                     |                    |                      |
| W m-2              | time: mean area:<br>mean where<br>ice_free_sea over<br>sea | up              | real        | longitude latitude time           | hfevapds             | ocean        |                  | area: areacello                     |                    |                      |
| W m-2              | time: mean area:<br>mean where sea                         |                 | real        | longitude latitude olevel<br>time | hfrunoffds           | ocean        |                  | area: areacello<br>volume: volcello |                    |                      |
| W m-2              | time: mean area:<br>mean where sea                         |                 | real        | longitude latitude olevel<br>time | hfsnthermds          | ocean        |                  | area: areacello<br>volume: volcello |                    |                      |
| W m-2              | time: mean area:<br>mean where sea                         |                 | real        | longitude latitude olevel<br>time | hfsifrazil           | ocean seaIce |                  | area: areacello<br>volume: volcello |                    |                      |
| W m-2              | time: mean area:<br>mean where sea                         |                 | real        | longitude latitude olevel<br>time | hfsithermds          | ocean seaIce |                  | area: areacello<br>volume: volcello |                    |                      |
| W m-2              | time: mean area:<br>mean where sea                         |                 | real        | longitude latitude olevel<br>time | hfibthermds          | ocean        |                  | area: areacello<br>volume: volcello |                    |                      |
| W m-2              | time: mean area:<br>mean where<br>ice_free_sea over<br>sea | down            | real        | longitude latitude time           | rlds                 | ocean        |                  | area: areacello                     |                    |                      |
| W m-2              | time: mean area:<br>mean where<br>ice_free_sea over<br>sea | down            | real        | longitude latitude time           | hfls                 | ocean        |                  | area: areacello                     |                    |                      |

|   |   |            |   |        |  |
|---|---|------------|---|--------|--|
| 2 | Surface Downward Sensible Heat Flux                   | $W m^{-2}$ | This is defined as "where ice_free_sea over sea"  | hfss   | surface_downward_sensible_heat_flux              |
| 2 | Net Downward Shortwave Radiation at Sea Water Surface | $W m^{-2}$ | This is the flux into the surface of liquid sea water only. This excludes shortwave flux absorbed by sea ice, but includes any light that passes through the ice and is absorbed by the ocean.  | rsntds | net_downward_shortwave_flux_at_sea_water_surface |
| 2 | Downwelling Shortwave Radiation in Sea Water          | $W m^{-2}$ | In general the shortwave flux should be reported as a function of ocean depth, (i.e., it will be a function of the generic "XYZ" dimensions). Include enough depth levels to represent the non-zero values of this field everywhere on the globe. | rsds   | downwelling_shortwave_flux_in_sea_water          |
| 2 | Heat Flux Correction                                  | $W m^{-2}$ | If this does not vary from one year to the next, report only a single year. Positive indicates correction adds heat to ocean.   | hfcorr | heat_flux_correction                             |
| 1 | Downward Heat Flux at Sea Water Surface               | $W m^{-2}$ | This is the net flux of heat entering the liquid water column through its upper surface (excluding any "flux adjustment") .   | hfds   | surface_downward_heat_flux_in_sea_water          |

In CMOR Table **Omon**: *WGOMD Table 2.8*

| <i>priority</i> | long name                            | units      | comment  | questions | output variable name | standard name                        |
|-----------------|--------------------------------------|------------|--|-----------|----------------------|--------------------------------------|
| 2               | Surface Downward X Stress            | $N m^{-2}$ | This is the stress on the liquid ocean from overlying atmosphere, sea ice, ice shelf, etc.   |           | tauuo                | surface_downward_x_stress            |
| 2               | Surface Downward Y Stress            | $N m^{-2}$ | This is the stress on the liquid ocean from overlying atmosphere, sea ice, ice shelf, etc.   |           | tauvo                | surface_downward_y_stress            |
| 2               | Surface Downward X Stress Correction | $N m^{-2}$ | This is the stress on the liquid ocean from overlying atmosphere, sea ice, ice shelf, etc. If this does not vary from one year to the next, report only a single year. |           | tauucorr             | surface_downward_x_stress_correction |
| 2               | Surface Downward Y Stress Correction | $N m^{-2}$ | This is the stress on the liquid ocean from overlying atmosphere, sea ice, ice shelf, etc. If this does not vary from one year to the next, report only a single year. |           | tauvcorr             | surface_downward_y_stress_correction |



|       |   |      |      |                                   |        |       |                                     |
|-------|---|------|------|-----------------------------------|--------|-------|-------------------------------------|
| W m-2 | time: mean area:<br>ice_free_sea over<br>mean where sea | down | real | longitude latitude time           | hfss   | ocean | area: areacello                     |
| W m-2 | time: mean area:<br>mean where sea                      | down | real | longitude latitude time           | rsntds | ocean | area: areacello                     |
| W m-2 | time: mean area:<br>mean where sea                      | down | real | longitude latitude olevel<br>time | rsds   | ocean | area: areacello<br>volume: volcello |
| W m-2 | time: mean area:<br>mean where sea                      | down | real | longitude latitude time           | hfcorr | ocean | area: areacello                     |
| W m-2 | time: mean area:<br>mean where sea                      | down | real | longitude latitude time           | hfds   | ocean | area: areacello                     |

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|-------------|------------------------------------|----------|------|-------------------------|---------------|-------|-----------|---------------|-------------|---------------|
| units       | cell_methods                       | positive | type | CMOR dimensions         | variable name | realm | frequency | cell_measures | flag_values | flag_meanings |
| N m-2       | time: mean area:<br>mean where sea | down     | real | longitude latitude time | tauuo         | ocean |           |               |             |               |
| N m-2       | time: mean area:<br>mean where sea | down     | real | longitude latitude time | tauvo         | ocean |           |               |             |               |
| N m-2       | time: mean area:<br>mean where sea | down     | real | longitude latitude time | taucorr       | ocean |           |               |             |               |
| N m-2       | time: mean area:<br>mean where sea | down     | real | longitude latitude time | tauvcorr      | ocean |           |               |             |               |

## CMOR Table Lmon: Monthly Mean Land Fields, Including

Lmon

mon

*Physical, Vegetation, Soil, and Biogeochemical Variables*

(All fields should be saved on the atmospheric grid; unless otherwise indicated, values are averaged over only the land portion of each grid cell and report 0.0 where land fraction is 0.)

| Priority | long name                              | units                              | comment   | questions  | output variable |                                    |
|----------|--|------------------------------------|---|--|-----------------|------------------------------------|
|          |  |                                    |   |  | name            | standard name                      |
| 1        | Moisture in Upper 0.1 m of Soil Column | kg m <sup>-2</sup>                 | Compute the mass of water in all phases in the upper 0.1 meters of soil.  |  | mrsos           | moisture_content_of_soil_layer     |
| 1        | Total Soil Moisture Content            | kg m <sup>-2</sup>                 | Compute the mass per unit area (summed over all soil layers) of water in all phases.  |  | mrso            | soil_moisture_content              |
| 1        | Soil Frozen Water Content              | kg m <sup>-2</sup>                 | Compute the mass (summed over all all layers) of frozen water.  |  | mrfs0           | soil_frozen_water_content          |
| 1        | Surface Runoff                         | kg m <sup>-2</sup> s <sup>-1</sup> | Compute the total surface runoff leaving the land portion of the grid cell.   |  | mrros           | surface_runoff_flux                |
| 1        | Total Runoff                           | kg m <sup>-2</sup> s <sup>-1</sup> | compute the total runoff (including "drainage" through the base of the soil model) leaving the land portion of the grid cell. |  | mrro            | runoff_flux                        |
| 2        | Precipitation onto Canopy              | kg m <sup>-2</sup> s <sup>-1</sup> | Report the precipitation flux that is intercepted by the vegetation canopy (if present in model) before reaching the ground.  |  | prveg           | precipitation_flux_onto_canopy     |
| 1        | Evaporation from Canopy                | kg m <sup>-2</sup> s <sup>-1</sup> | Report the canopy evaporation+sublimation (if present in model).  |  | evspsblveg      | water_evaporation_flux_from_canopy |
| 1        | Water Evaporation from Soil            | kg m <sup>-2</sup> s <sup>-1</sup> | includes sublimation.   |  | evspsblsoi      | water_evaporation_flux_from_soil   |
| 1        | Transpiration                          | kg m <sup>-2</sup> s <sup>-1</sup> |   |  | tran            | transpiration_flux                 |
| 1        | Water Content of Soil Layer            | kg m <sup>-2</sup>                 | in each soil layer, the mass of water in all phases, including ice.   |  | mrsl            | moisture_content_of_soil_layer     |
| 2        | Temperature of Soil                    | K                                  | Temperature of each soil layer. Report as "missing" for grid cells occupied entirely by "sea".                                |  | tsl             | soil_temperature                   |
| 1        | Tree Cover Fraction                    | %                                  | fraction of entire grid cell that is covered by trees.  | add scalar coordinate typetree and add "tree" to the CF area type table.           | treeFrac        | area_fraction                      |
| 1        | Natural Grass Fraction                 | %                                  | fraction of entire grid cell that is covered by natural grass.  | add scalar coordinate typegrass and add "natural_grass" to the CF area type table. | grassFrac       | area_fraction                      |
| 1        | Shrub Fraction                         | %                                  | fraction of entire grid cell that is covered by shrub.  | add scalar coordinate typeshrub and add "shrub" to the CF area type table.         | shrubFrac       | area_fraction                      |
| 1        | Crop Fraction                          | %                                  | fraction of entire grid cell that is covered by crop.   | add scalar coordinate typecrop and add "crop" to the CF area type table.           | cropFrac        | area_fraction                      |
| 1        | Anthropogenic Pasture Fraction         | %                                  | fraction of entire grid cell that is covered by anthropogenic pasture.  | add scalar coordinate typepasture and add "pasture" to the CF area type table.     | pastureFrac     | area_fraction                      |
| 1        | Bare Soil Fraction                     | %                                  | fraction of entire grid cell that is covered by bare soil.  |  | baresoilFrac    | area_fraction                      |

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|-------------|-------------------------------------|----------|------|-------------------------------------|---------------|--------------|-----------|------------------------------------|-------------|---------------|
| units       | cell_methods                        | positive | type | CMOR dimensions                     | name          | realm        | frequency | cell_measures                      | flag_values | flag_meanings |
| kg m-2      | time: mean area:<br>mean where land |          | real | longitude latitude time<br>sdepth1  | mrsos         | land         |           | area: areacella                    |             |               |
| kg m-2      | time: mean area:<br>mean where land |          | real | longitude latitude time             | mrso          | land         |           | area: areacella                    |             |               |
| kg m-2      | time: mean area:<br>mean where land |          | real | longitude latitude time             | mrfso         | land landIce |           | area: areacella                    |             |               |
| kg m-2 s-1  | time: mean area:<br>mean where land |          | real | longitude latitude time             | mrros         | land         |           | area: areacella                    |             |               |
| kg m-2 s-1  | time: mean area:<br>mean where land |          | real | longitude latitude time             | mrro          | land         |           | area: areacella                    |             |               |
| kg m-2 s-1  | time: mean area:<br>mean where land |          | real | longitude latitude time             | prveg         | land         |           | area: areacella                    |             |               |
| kg m-2 s-1  | time: mean area:<br>mean where land | up       | real | longitude latitude time             | evspsblveg    | land         |           | area: areacella<br>area: areacella |             |               |
| kg m-2 s-1  | time: mean area:<br>mean where land | up       | real | longitude latitude time             | evspsblsoi    | land         |           | area: areacella                    |             |               |
| kg m-2 s-1  | time: mean area:<br>mean where land | up       | real | longitude latitude time             | tran          | land         |           | area: areacella                    |             |               |
| kg m-2      | time: mean area:<br>mean where land |          | real | longitude latitude sdepth<br>time   | mrlsl         | land         |           | area: areacella                    |             |               |
| K           | time: mean                          |          | real | longitude latitude sdepth<br>time   | tsl           | land         |           | area: areacella                    |             |               |
| %           | time: mean                          |          | real | longitude latitude time             | treeFrac      | land         |           | area: areacella                    |             |               |
| %           | time: mean                          |          | real | longitude latitude time             | grassFrac     | land         |           | area: areacella                    |             |               |
| %           | time: mean                          |          | real | longitude latitude time             | shrubFrac     | land         |           | area: areacella                    |             |               |
| %           | time: mean                          |          | real | longitude latitude time             | cropFrac      | land         |           | area: areacella                    |             |               |
| %           | time: mean                          |          | real | longitude latitude time             | pastureFrac   | land         |           | area: areacella                    |             |               |
| %           | time: mean                          |          | real | longitude latitude time<br>typebare | baresoilFrac  | land         |           | area: areacella                    |             |               |

|  |   |                                    |   |   |              |   |
|--|---|------------------------------------|---|---|--------------|---|
| 1  | Fraction of Grid Cell that is Land but Neither Vegetation-Covered nor Bare Soil | %                                  | fraction of entire grid cell that is land and is covered by "non-vegetation" and "non-bare-soil" (e.g., urban, ice, lakes, etc.)  | add scalar coordinate type???and add "???" to the CF area type table.                 | residualFrac | area_fraction   |
| 1  | Burnt Area Fraction   | %                                  | fraction of entire grid cell that is covered by burnt vegetation.   | add scalar coordinate typeburnt and add "burnt_vegetation" to the CF area type table. | burntArea    | area_fraction   |
| <b>Land Carbon &amp; Biogeochemistry</b> |   |                                    |   |   |              |   |
| 1  | Carbon Mass in Vegetation   | kg m <sup>-2</sup>                 |   |   | cVeg         | vegetation_carbon_content   |
| 1  | Carbon Mass in Litter Pool  | kg m <sup>-2</sup>                 |   |   | cLitter      | litter_carbon_content   |
| 1  | Carbon Mass in Soil Pool  | kg m <sup>-2</sup>                 |   |   | cSoil        | soil_carbon_content   |
| 1  | Carbon Mass in Products of Land Use Change                                      | kg m <sup>-2</sup>                 |   |   | cProduct     | carbon_content_of_products_of_anthropogenic_land_use_change   |
| 1  | Leaf Area Index   | 1                                  | projected leaf area per unit of ground area (i.e., only the land portion of the grid cell), expressed as a proper fraction (not a percentage)   |   | lai          | leaf_area_index   |
| 1  | Carbon Mass Flux out of Atmosphere due to Gross Primary Production on Land      | kg m <sup>-2</sup> s <sup>-1</sup> |   |   | gpp          | gross_primary_productivity_of_carbon  |
| 1  | Carbon Mass Flux into Atmosphere due to Autotrophic (Plant) Respiration on Land | kg m <sup>-2</sup> s <sup>-1</sup> |   |   | ra           | plant_respiration_carbon_flux   |
| 1  | Carbon Mass Flux out of Atmosphere due to Net Primary Production on Land        | kg m <sup>-2</sup> s <sup>-1</sup> | needed for models that do not compute GPP (if any)  | should this be "into Atmosphere " rather than "out of Atmosphere"?                    | npp          | net_primary_productivity_of_carbon  |
| 1  | Carbon Mass Flux into Atmosphere due to Heterotrophic Respiration on Land       | kg m <sup>-2</sup> s <sup>-1</sup> |   |   | rh           | heterotrophic_respiration_carbon_flux   |
| 1  | Carbon Mass Flux into Atmosphere due to CO2 Emission from Fire                  | kg m <sup>-2</sup> s <sup>-1</sup> | CO2 emissions (expressed as a carbon mass flux) from natural fires + human ignition fires as calculated by the fire module of the DGVM, but excluding any CO2 flux from fire included in fLuc, defined below (CO2 Flux to Atmosphere from Land Use Change). |   | fFire        | surface_upward_mass_flux_of_carbon_dioxide_expressed_as_carbon_due_to_emission_from_fires_excluding_anthropogenic_land_use_change |
| 1  | Carbon Mass Flux into Atmosphere due to Grazing on Land                         | kg m <sup>-2</sup> s <sup>-1</sup> |   |   | fGrazing     | surface_upward_mass_flux_of_carbon_dioxide_expressed_as_carbon_due_to_emission_from_grazing                                       |
| 1  | Carbon Mass Flux into Atmosphere due to Crop Harvesting                         | kg m <sup>-2</sup> s <sup>-1</sup> |   |   | fHarvest     | surface_upward_mass_flux_of_carbon_dioxide_expressed_as_carbon_due_to_emission_from_crop_harvesting                               |
| 1  | Net Carbon Mass Flux into Atmosphere due to Land Use Change                     | kg m <sup>-2</sup> s <sup>-1</sup> | human changes to land (excluding forest regrowth) accounting possibly for different time-scales related to fate of the wood, for example.   |   | fLuc         | surface_net_upward_mass_flux_of_carbon_dioxide_expressed_as_carbon_due_to_emission_from_anthropogenic_land_use_change             |
| 1  | Carbon Mass Flux out of Atmosphere due to Net Biospheric Production on Land     | kg m <sup>-2</sup> s <sup>-1</sup> | This is the net mass flux of carbon between land and atmosphere calculated as photosynthesis MINUS the sum of plant and soil respiration, carbonfluxes from fire, harvest, grazing and land use change. Positive flux is into the land.                     |   | nbp          | surface_net_downward_mass_flux_of_carbon_dioxide_expressed_as_carbon_due_to_all_land_processes                                    |
| 1  | Total Carbon Mass Flux from Vegetation to Litter                                | kg m <sup>-2</sup> s <sup>-1</sup> |   |   | fVegLitter   | litter_carbon_flux  |
| 1  | Total Carbon Mass Flux from Litter to Soil                                      | kg m <sup>-2</sup> s <sup>-1</sup> |   |   | fLitterSoil  | carbon_mass_flux_into_soil_from_litter  |

|            |                                     |      |      |                         |              |      |                 |
|------------|-------------------------------------|------|------|-------------------------|--------------|------|-----------------|
| %          | time: mean                          |      | real | longitude latitude time | residualFrac | land | area: areacella |
| %          | time: mean                          |      | real | longitude latitude time | burntArea    | land | area: areacella |
|            |                                     |      |      |                         |              | land | area: areacella |
| kg m-2     | time: mean area:<br>mean where land |      | real | longitude latitude time | cVeg         | land | area: areacella |
| kg m-2     | time: mean area:<br>mean where land |      | real | longitude latitude time | cLitter      | land | area: areacella |
| kg m-2     | time: mean area:<br>mean where land |      | real | longitude latitude time | cSoil        | land | area: areacella |
| kg m-2     | time: mean area:<br>mean where land |      | real | longitude latitude time | cProduct     | land | area: areacella |
| 1          | time: mean area:<br>mean where land |      | real | longitude latitude time | lai          | land | area: areacella |
| kg m-2 s-1 | time: mean area:<br>mean where land | down | real | longitude latitude time | gpp          | land | area: areacella |
| kg m-2 s-1 | time: mean area:<br>mean where land | up   | real | longitude latitude time | ra           | land | area: areacella |
| kg m-2 s-1 | time: mean area:<br>mean where land | down | real | longitude latitude time | npp          | land | area: areacella |
| kg m-2 s-1 | time: mean area:<br>mean where land | up   | real | longitude latitude time | rh           | land | area: areacella |
| kg m-2 s-1 | time: mean area:<br>mean where land | up   | real | longitude latitude time | fFire        | land | area: areacella |
| kg m-2 s-1 | time: mean area:<br>mean where land | up   | real | longitude latitude time | fGrazing     | land | area: areacella |
| kg m-2 s-1 | time: mean area:<br>mean where land | up   | real | longitude latitude time | fHarvest     | land | area: areacella |
| kg m-2 s-1 | time: mean area:<br>mean where land | up   | real | longitude latitude time | fLuc         | land | area: areacella |
| kg m-2 s-1 | time: mean area:<br>mean where land | down | real | longitude latitude time | nbp          | land | area: areacella |
| kg m-2 s-1 | time: mean area:<br>mean where land |      | real | longitude latitude time | fVegLitter   | land | area: areacella |
| kg m-2 s-1 | time: mean area:<br>mean where land |      | real | longitude latitude time | fLitterSoil  | land | area: areacella |

|   |  |                                   |   |  |   |               |
|---|--|-----------------------------------|---|--|---|---------------|
| 1 | Total Carbon Mass Flux from Vegetation Directly to Soil                        | $\text{kg m}^{-2} \text{ s}^{-1}$ | In some models part of carbon (e.g., root exudate) can go directly into the soil pool without entering litter.  | rVegSoil                               | carbon_mass_flux_into_soil_from_vegetation_excluding_litter                 |               |
| 2 | Carbon Mass in Leaves  | $\text{kg m}^{-2}$                |   | cLeaf                                  | leaf_carbon_content   |               |
| 2 | Carbon Mass in Wood  | $\text{kg m}^{-2}$                | including sapwood and hardwood.   | cWood                                  | wood_carbon_content   |               |
| 2 | Carbon Mass in Roots   | $\text{kg m}^{-2}$                | including fine and coarse roots.  | cRoot                                  | root_carbon_content   |               |
| 2 | Carbon Mass in Other Living Compartments on Land                               | $\text{kg m}^{-2}$                | e.g., labile, fruits, reserves, etc.  | cMisc                                  | miscellaneous_living_matter_carbon_content                                  |               |
| 2 | Carbon Mass in Coarse Woody Debris   | $\text{kg m}^{-2}$                |   | cCwd                                   | wood_debris_carbon_content  |               |
| 2 | Carbon Mass in Above-Ground Litter   | $\text{kg m}^{-2}$                |   | cLitterAbove                           | surface_litter_carbon_content   |               |
| 2 | Carbon Mass in Below-Ground Litter   | $\text{kg m}^{-2}$                |   | cLitterBelow                           | subsurface_litter_carbon_content  |               |
| 2 | Carbon Mass in Fast Soil Pool  | $\text{kg m}^{-2}$                | fast is meant as lifetime of less than 10 years for reference climate conditions (20 C, no water limitations).  | cSoilFast                              | fast_soil_pool_carbon_content   |               |
| 2 | Carbon Mass in Medium Soil Pool  | $\text{kg m}^{-2}$                | medium is meant as lifetime of more than than 10 years and less than 100 years for reference climate conditions (20 C, no water limitations)  | cSoilMedium                            | medium_soil_pool_carbon_content   |               |
| 2 | Carbon Mass in Slow Soil Pool  | $\text{kg m}^{-2}$                | fast is meant as lifetime of more than 100 years for reference climate conditions (20 C, no water limitations)  | cSoilSlow                              | slow_soil_pool_carbon_content   |               |
| 2 | Plant Functional Type Grid Fraction  | %                                 | using each individual ESM PFT definition. This includes natural PFTs, anthropogenic PFTs, bare soil, lakes, urban areas, etc. Sum of all should equal the fraction of the grid-cell that is land. Note that the "types" will be model dependent and for each type there should be a full description of the PFT (plant functional type). To facilitate model comparison, it is also requested that the aggregated land cover types called for in lines 28 to 35 be archived (but not in this variable). | need to explain how to define vegtype. | landCoverFrac   | area_fraction |
| 2 | Total Primary Deciduous Tree Fraction  | %                                 | Agregation of model PFTs as defined in 1st priority to aid model intercomparison. This is the fraction of the entire grid cell that is covered by "total primary deciduous trees."  | treeFracPrimDec                        | area_fraction   |               |
| 2 | Total Primary Evergreen Tree Cover Fraction                                    | %                                 | fraction of entire grid cell that is covered by primary evergreen trees.  | treeFracPrimEver                       | area_fraction   |               |
| 2 | Total Secondary Deciduous Tree Cover Fraction                                  | %                                 | fraction of entire grid cell that is covered by secondary deciduous trees.  | treeFracSecDec                         | area_fraction   |               |
| 2 | Total Secondary Evergreen Tree Cover Fraction                                  | %                                 | fraction of entire grid cell that is covered by secondary evergreen trees.  | treeFracSecEver                        | area_fraction   |               |
| 2 | Total C3 PFT Cover Fraction  | %                                 | fraction of entire grid cell that is covered by C3 PFTs (including grass, crops, and trees).  | c3PftFrac                              | area_fraction   |               |
| 2 | Total C4 PFT Cover Fraction  | %                                 | fraction of entire grid cell that is covered by C4 PFTs (including grass and crops).  | c4PftFrac                              | area_fraction   |               |
| 2 | Carbon Mass Flux into Atmosphere due to Growth Autotrophic Respiration on Land | $\text{kg m}^{-2} \text{ s}^{-1}$ | This flux and the one in the following row provide a breakdown of the higher priority "Autotrophic (Plant) Respiration" in an earlier row of this table; thus the sum should be identical to that.  | rGrowth                                | surface_upward_carbon_mass_flux_due_to_plant_respiration_for_biomass_growth |               |

|            |                                     |    |      |                                      |                      |      |                 |
|------------|-------------------------------------|----|------|--------------------------------------|----------------------|------|-----------------|
| kg m-2 s-1 | time: mean area:<br>mean where land |    | real | longitude latitude time              | fVegSoil             | land | area: areacella |
| kg m-2     | time: mean area:<br>mean where land |    | real | longitude latitude time              | cLeaf                | land | area: areacella |
| kg m-2     | time: mean area:<br>mean where land |    | real | longitude latitude time              | cWood                | land | area: areacella |
| kg m-2     | time: mean area:<br>mean where land |    | real | longitude latitude time              | cRoot                | land | area: areacella |
| kg m-2     | time: mean area:<br>mean where land |    | real | longitude latitude time              | cMisc                | land | area: areacella |
| kg m-2     | time: mean area:<br>mean where land |    | real | longitude latitude time              | cCwd                 | land | area: areacella |
| kg m-2     | time: mean area:<br>mean where land |    | real | longitude latitude time              | cLitterAbove         | land | area: areacella |
| kg m-2     | time: mean area:<br>mean where land |    | real | longitude latitude time              | cLitterBelow         | land | area: areacella |
| kg m-2     | time: mean area:<br>mean where land |    | real | longitude latitude time              | cSoilFast            | land | area: areacella |
| kg m-2     | time: mean area:<br>mean where land |    | real | longitude latitude time              | cSoilMedium          | land | area: areacella |
| kg m-2     | time: mean area:<br>mean where land |    | real | longitude latitude time              | cSoilSlow            | land | area: areacella |
| %          | time: mean                          |    | real | longitude latitude vegtype<br>time   | landCoverFra<br>c    | land | area: areacella |
| %          | time: mean                          |    | real | longitude latitude time<br>typepdec  | treeFracPrim<br>Dec  | land | area: areacella |
| %          | time: mean                          |    | real | longitude latitude time<br>typepever | treeFracPrim<br>Ever | land | area: areacella |
| %          | time: mean                          |    | real | longitude latitude time<br>typesdec  | treeFracSecD<br>ec   | land | area: areacella |
| %          | time: mean                          |    | real | longitude latitude time<br>typesever | treeFracSecE<br>ver  | land | area: areacella |
| %          | time: mean                          |    | real | longitude latitude time<br>typec3pft | c3PftFrac            | land | area: areacella |
| %          | time: mean                          |    | real | longitude latitude time<br>typec4pft | c4PftFrac            | land | area: areacella |
| kg m-2 s-1 | time: mean area:<br>mean where land | up | real | longitude latitude time              | rGrowth              | land | area: areacella |

|   |   |                                  |   |         |  |
|---|---|----------------------------------|---|---------|--|
| 2 | Carbon Mass Flux into Atmosphere due to Maintenance Autotrophic Respiration on Land | $\text{kg m}^{-2} \text{s}^{-1}$ | This flux and the one in the previous row provide a breakdown of the higher priority "Autotrophic (Plant) Respiration" in an earlier row of this table; thus the sum should be identical to that.   | rMaint  | surface_upward_carbon_mass_flux_due_to_plant_respiration_for_biomass_maintenance   |
| 2 | Carbon Mass Flux due to NPP Allocation to Leaf                                      | $\text{kg m}^{-2} \text{s}^{-1}$ | This is the rate of carbon uptake by leaves due to NPP  | nppLeaf | net_primary_productivity_of_carbon_accumulated_in_leaves   |
| 2 | Carbon Mass Flux due to NPP Allocation to Wood                                      | $\text{kg m}^{-2} \text{s}^{-1}$ | This is the rate of carbon uptake by wood due to NPP  | nppWood | net_primary_productivity_of_carbon_accumulated_in_wood   |
| 2 | Carbon Mass Flux due to NPP Allocation to Roots                                     | $\text{kg m}^{-2} \text{s}^{-1}$ | This is the rate of carbon uptake by roots due to NPP   | nppRoot | net_primary_productivity_of_carbon_accumulated_in_roots  |
| 1 | Net Carbon Mass Flux out of Atmosphere due to Net Ecosystem Productivity on Land.   | $\text{kg m}^{-2} \text{s}^{-1}$ | Natural flux of CO <sub>2</sub> (expressed as a mass flux of carbon) from the atmosphere to the land calculated as the difference between uptake associated with photosynthesis and the release of CO <sub>2</sub> from the sum of plant and soil respiration and fire. Positive flux is into the land. emissions from natural fires + human ignition fires as calculated by the fire module of the DGVM, but excluding any CO <sub>2</sub> flux from fire included in fLuc, defined below (CO <sub>2</sub> Flux to Atmosphere from Land Use Change). | nep     | surface_net_downward_mass_flux_of_carbon_dioxide_expressed_as_carbon_due_to_all_land_processes_excluding_anthropogenic_land_use_change |



|            |                                     |      |      |                         |         |      |                 |
|------------|-------------------------------------|------|------|-------------------------|---------|------|-----------------|
| kg m-2 s-1 | time: mean area:<br>mean where land | up   | real | longitude latitude time | rMaint  | land | area: areacella |
| kg m-2 s-1 | time: mean area:<br>mean where land | down | real | longitude latitude time | nppLeaf | land | area: areacella |
| kg m-2 s-1 | time: mean area:<br>mean where land | down | real | longitude latitude time | nppWood | land | area: areacella |
| kg m-2 s-1 | time: mean area:<br>mean where land | down | real | longitude latitude time | nppRoot | land | area: areacella |
| kg m-2 s-1 | time: mean area:<br>mean where land | down | real | longitude latitude time | nep     | land | area: areacella |

## CMOR Table LImon: Monthly Mean Land Cryosphere Fields

LImon

mon

(All fields should be saved on the atmospheric grid; unless otherwise indicated, values are averaged over only the land portion of each grid cell and report 0.0 where land fraction is 0.)

| Priority | long name                             | units                              | comment   | questions | output variable name | standard name                         |
|----------|---------------------------------------|------------------------------------|---|-----------|----------------------|---------------------------------------|
| 1        | Snow Area Fraction                    | %                                  | Fraction of each grid cell that is occupied by snow that rests on land portion of cell.   |           | snc                  | surface_snow_area_fraction            |
| 1        | Surface Snow Amount                   | kg m <sup>-2</sup>                 | Compute as the mass of surface snow on the land portion of the grid cell divided by the land area in the grid cell; report as 0.0 where the land fraction is 0; exclude snow on vegetation canopy or on sea ice.  |           | snw                  | surface_snow_amount                   |
| 1        | Snow Depth                            | m                                  | where land over land. Compute the mean thickness of snow in the land portion of the grid cell (averaging over the entire land portion, including the snow-free fraction. Report as 0.0 where the land fraction is 0.  |           | snd                  | surface_snow_thickness                |
| 2        | Liquid Water Content of Snow Layer    | kg m <sup>-2</sup>                 | where land over land: compute the total mass of liquid water contained interstitially within the snow layer of the land portion of a grid cell divided by the area of the land portion of the cell.   |           | lwsnl                | liquid_water_content_of_snow_layer    |
| 2        | Snow Soot Content                     | kg m <sup>-2</sup>                 | Consider the entire land portion of the grid cell, with snow soot content set to 0.0 in regions free of snow.   |           | sootsn               | soot_content_of_surface_snow          |
| 1        | Snow Age                              | day                                | When computing the time-mean here, the time samples, weighted by the mass of snow on the land portion of the grid cell, are accumulated and then divided by the sum of the weights. Report as "missing in regions free of snow on land.   |           | agesno               | age_of_surface_snow                   |
| 1        | Snow Internal Temperature             | K                                  | This temperature is averaged over all the snow in the grid cell that rests on land or land ice. When computing the time-mean here, the time samples, the weighted by the mass of snow on the land portion of the grid cell, are accumulated and then divided by the sum of the weights. Report as "missing in regions free of snow on land. |           | tsn                  | temperature_in_surface_snow           |
| 1        | Surface Snow Melt                     | kg m <sup>-2</sup> s <sup>-1</sup> | Compute as the total surface melt water on the land portion of the grid cell divided by the land area in the grid cell; report as 0.0 for snow-free land regions; report as 0.0 where the land fraction is 0.   |           | snm                  | surface_snow_melt_flux                |
| 1        | Surface Snow and Ice Sublimation Flux | kg m <sup>-2</sup> s <sup>-1</sup> | The snow and ice sublimation flux is the loss of snow and ice mass resulting from their conversion to water vapor. Compute as the total sublimation on the land portion of the grid cell divided by the land area in the grid cell; report as 0.0 for snow-free land regions; report as 0.0 where the land fraction is 0.                   |           | sbl                  | surface_snow_and_ice_sublimation_flux |

| unformatted units | cell_methods  | positive | type | CMOR dimensions         | CMOR variable name | realm        | frequency | cell_measures   | flag_values | flag_meanings |
|-------------------|---|----------|------|-------------------------|--------------------|--------------|-----------|-----------------|-------------|---------------|
| %                 | time: mean  |          | real | longitude latitude time | snc                | landIce land |           | area: areacella |             |               |
| kg m-2            | time: mean area:<br>mean where land   |          | real | longitude latitude time | snw                | landIce land |           | area: areacella |             |               |
| m                 | time: mean area:<br>mean where land   |          | real | longitude latitude time | snd                | landIce land |           | area: areacella |             |               |
| kg m-2            | time: mean area:<br>mean where land   |          | real | longitude latitude time | lwsnl              | landIce land |           | area: areacella |             |               |
|                   |   |          |      |                         |                    |              |           | area: areacella |             |               |
| kg m-2            | time: mean area:<br>mean where land   |          | real | longitude latitude time | sootsn             | landIce land |           | area: areacella |             |               |
| day               | time: mean (with<br>samples weighted<br>by snow mass)<br>area: mean where<br>land |          | real | longitude latitude time | agesno             | landIce land |           | area: areacella |             |               |
| K                 | time: mean (with<br>samples weighted<br>by snow mass)<br>area: mean where<br>land |          | real | longitude latitude time | tsn                | landIce land |           | area: areacella |             |               |
|                   |   |          |      |                         |                    |              |           | area: areacella |             |               |
| kg m-2 s-1        | time: mean area:<br>mean where land   |          | real | longitude latitude time | snm                | landIce land |           | area: areacella |             |               |
| kg m-2 s-1        | time: mean area:<br>mean where land   |          | real | longitude latitude time | sbl                | landIce land |           | area: areacella |             |               |

|   |   |             |   |   |  |
|---|---|-------------|---|---|--|
| 1 | Downward Heat Flux into Snow Where Land over Land | $W m^{-2}$  | Compute the net downward heat flux from the atmosphere into the snow that lies on land divided by the land area in the grid cell; report as 0.0 for snow-free land regions or where the land fraction is 0. | hfdsn   | surface_downward_heat_flux_in_snow       |
| 3 | Permafrost Layer Thickness                        | m           | where land over land. Compute the mean thickness of the permafrost layer in the land portion of the grid cell. Report as 0.0 in permafrost-free regions.  | tpf   | permafrost_layer_thickness               |
| 3 | Liquid Water Content of Permafrost Layer          | $kg m^{-2}$ | "where land over land", i.e., this is the total mass of liquid water contained within the permafrost layer within the land portion of a grid cell divided by the area of the land portion of the cell.      | <p>Why do you want to know mass of liquid water? Are you studying the seasonal melting/freezing cycle? Don't you care about how much frozen water is tied up as permafrost?</p> | liquid_water_content_of_permafrost_layer |

|        |                                     |      |      |                         |       |              |                 |
|--------|-------------------------------------|------|------|-------------------------|-------|--------------|-----------------|
| W m-2  | time: mean area:<br>mean where land | down | real | longitude latitude time | hfdsn | landIce land | area: areacella |
| m      | time: mean area:<br>mean where land |      | real | longitude latitude time | tpf   | landIce land | area: areacella |
| kg m-2 | time: mean area:<br>mean where land |      | real | longitude latitude time | pflw  | landIce land | area: areacella |

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## CMOR Table Olmon: Monthly Mean Ocean Cryosphere Fields

Olmon

mon

(All saved on the ocean grid; unless otherwise indicated, values are averaged over only the ocean portion of each grid cell and report 0.0 where ocean fraction is 0.)

| Priority | long name                           | units                              | comment  | questions  | output variable |                                 |
|----------|-------------------------------------|------------------------------------|--|--|-----------------|---------------------------------|
|          |                                     |                                    |  |  | name            | standard name                   |
| 1        | Sea Ice Area Fraction               | %                                  | fraction of grid cell covered by sea ice.  |  | sic             | sea_ice_area_fraction           |
| 1        | Sea Ice Thickness                   | m                                  | Compute the mean thickness of sea ice in the ocean portion of the grid cell (averaging over the entire ocean portion, including the ice-free fraction). Report as 0.0 in regions free of sea ice.  |  | sit             | sea_ice_thickness               |
| 1        | Sea Ice Plus Surface Snow Amount    | kg m <sup>-2</sup>                 | Compute the mass per unit area of sea ice plus snow in the ocean portion of the grid cell (averaging over the entire ocean portion, including the ice-free fraction). Report as 0.0 in regions free of sea ice.  |  | sim             | sea_ice_and_surface_snow_amount |
| 1        | Water Evaporation Flux from Sea Ice | kg m <sup>-2</sup> s <sup>-1</sup> | Compute the average rate that water mass evaporates (or sublimates) from the sea ice surface (i.e., kg/s) divided by the area of the ocean (i.e., open ocean + sea ice) portion of the grid cell. This quantity multiplied both by the ocean area of the grid cell and by the length of the month should yield the total mass of water evaporated (or sublimated) from the sea ice. Report as 0.0 in regions free of sea ice. [This was computed differently in CMIP3] |  | evap            | water_evaporation_flux          |
| 1        | Snow Depth                          | m                                  | Compute the mean thickness of snow in the ocean portion of the grid cell (averaging over the entire ocean portion, including the snow-free ocean fraction). Report as 0.0 in regions free of snow-covered sea ice.   |  | snd             | surface_snow_thickness          |
| 2        | Surface Snow Area Fraction          | %                                  | Fraction of entire grid cell covered by snow that lies on sea ice; exclude snow that lies on land or land ice.   |  | snc             | surface_snow_area_fraction      |
| 1        | Sea Ice Albedo                      | 1                                  | Report as "missing" if there is no sunlight or if a region is free of sea ice.   | This variable may be omitted unless the answers to the following questions are obvious: Will this vary from year to year or is it a property of "bare sea ice" and sun angle? How is the time-mean calculated? | ialb            | sea_ice_albedo                  |
| 3        | Sea Ice Salinity                    | psu                                | When computing the time-mean here, the time-samples, weighted by the mass of sea ice in the grid cell, are accumulated and then divided by the sum of the weights. Report as "missing" in regions free of sea ice.   |  | ssi             | sea_ice_salinity                |
| 1        | Surface Temperature of Sea Ice      | K                                  | When computing the time-mean here, the time-samples, weighted by the area of sea ice in the grid cell, are accumulated and then divided by the sum of the weights. Report as "missing" in regions free of sea ice. Note this will be the surface snow temperature in regions where snow covers the sea ice.  |  | tsice           | surface_temperature             |

| <b>unformatted</b> |  |                 |             |                         | <b>CMOR</b>     |             |              |                  |                      |                    |                      |
|--------------------|--|-----------------|-------------|-------------------------|-----------------|-------------|--------------|------------------|----------------------|--------------------|----------------------|
| <b>units</b>       | <b>cell_methods</b>                                | <b>positive</b> | <b>type</b> | <b>CMOR dimensions</b>  | <b>variable</b> | <b>name</b> | <b>realm</b> | <b>frequency</b> | <b>cell_measures</b> | <b>flag_values</b> | <b>flag_meanings</b> |
| %                  | time: mean   |                 | real        | longitude latitude time |                 | sic         | seaIce ocean |                  | area: areacello      |                    |                      |
| m                  | time: mean area:<br>mean where sea                 |                 | real        | longitude latitude time |                 | sit         | seaIce ocean |                  | area: areacello      |                    |                      |
| kg m-2             | time: mean area:<br>mean where sea                 |                 | real        | longitude latitude time |                 | sim         | seaIce ocean |                  | area: areacello      |                    |                      |
| kg m-2 s-1         | time: mean area:<br>mean where<br>sea_ice over sea | up              | real        | longitude latitude time |                 | evap        | seaIce       |                  | area: areacello      |                    |                      |
| m                  | time: mean area:<br>mean where sea                 |                 | real        | longitude latitude time |                 | snd         | seaIce       |                  | area: areacello      |                    |                      |
| %                  | time: mean   |                 | real        | longitude latitude time |                 | snc         | seaIce       |                  | area: areacello      |                    |                      |
| 1                  | time: mean area:<br>mean where<br>sea_ice          |                 | real        | longitude latitude time |                 | ialb        | seaIce       |                  | area: areacello      |                    |                      |
|                    |  |                 |             |                         |                 |             |              |                  | area: areacello      |                    |                      |
| psu                | time: mean<br>(weighted by mass<br>of sea ice)     |                 | real        | longitude latitude time |                 | ssi         | seaIce       |                  | area: areacello      |                    |                      |
| K                  | time: mean<br>(weighted by area<br>of sea ice)     |                 | real        | longitude latitude time |                 | tsice       | seaIce       |                  | area: areacello      |                    |                      |

|   |   |                                  |  |           |  |
|---|---|----------------------------------|--|-----------|--|
| 1 | Temperature at Interface Between Sea Ice and Snow               | K                                | When computing the time-mean here, the time-samples, weighted by the area of snow-covered sea ice in the grid cell, are accumulated and then divided by the sum of the weights. Report as "missing" in regions free of snow-covered sea ice.   | tsnint    | sea_ice_surface_temperature  |
| 1 | Surface Rainfall Rate into the Sea Ice Portion of the Grid Cell | $\text{kg m}^{-2} \text{s}^{-1}$ | where sea ice over sea: compute the the water mass per unit time falling as rain onto the sea ice portion of a grid cell divided by the area of the ocean portion of the grid cell (including both ice-free and sea-ice covered fractions). Report as 0. in regions free of sea ice. | pr        | rainfall_flux  |
| 1 | Surface Snowfall Rate into the Sea Ice Portion of the Grid Cell | $\text{kg m}^{-2} \text{s}^{-1}$ | where sea ice over sea: compute the the water mass per unit time falling as snow onto the sea ice portion of a grid cell divided by the area of the ocean portion of the grid cell (including both ice-free and sea-ice covered fractions). Report as 0. in regions free of sea ice. | prsn      | snowfall_flux  |
| 3 | Age of Sea Ice  | years                            | When computing the time-mean here, the time samples, weighted by the mass of sea ice in the grid cell, are accumulated and then divided by the sum of the weights. Report as "missing" in regions free of sea ice.   | ageice    | age_of_sea_ice   |
| 1 | Frazil Sea Ice Growth (Leads) Rate                              | $\text{kg m}^{-2} \text{s}^{-1}$ | Compute the rate of change of sea ice mass due to frazil sea ice formation divided by the area of the ocean portion of the grid cell. Report as 0.0 in regions free of sea ice.  | grFrazil  | tendency_of_sea_ice_amount_due_to_frazil_ice_accumulation_in_leads |
| 1 | Congelation Sea Ice Growth Rate                                 | $\text{kg m}^{-2} \text{s}^{-1}$ | Compute the rate of change of sea ice mass due to congelation sea ice divided by the area of the ocean portion of the grid cell. Report as 0.0 in regions free of sea ice.   | grCongel  | tendency_of_sea_ice_amount_due_to_congelation_ice_accumulation     |
| 1 | Lateral Sea Ice Growth Rate                                     | $\text{kg m}^{-2} \text{s}^{-1}$ | Compute the rate of change of sea ice mass due to lateral growth alone of the sea ice divided by the area of the ocean portion of the grid cell. Report as 0.0 in regions free of sea ice.   | grLateral | tendency_of_sea_ice_amount_due_to_lateral_growth_of_ice_floes      |
| 1 | Snow-Ice Formation Rate   | $\text{kg m}^{-2} \text{s}^{-1}$ | Compute the rate of change of sea ice mass due to transformation of snow to sea ice, divided by the area of the ocean portion of the grid cell. Report as 0.0 in regions free of snow-covered sea ice.   | snoToIce  | tendency_of_sea_ice_amount_due_to_snow_conversion                  |
| 1 | Snow Melt Rate  | $\text{kg m}^{-2} \text{s}^{-1}$ | Compute the rate of change of snow mass due to melting, divided by the area of the ocean portion of the grid cell. Report as 0.0 in regions free of sea ice. Include falling snow that melts on impact with the surface.   | snomelt   | surface_snow_melt_flux   |
| 1 | Rate of Melt at Upper Surface of Sea Ice                        | $\text{kg m}^{-2} \text{s}^{-1}$ | Compute the rate of change of sea ice mass due to melting at its upper surface, divided by the area of the ocean portion of the grid cell. Report as 0.0 in regions free of sea ice. Do not include rate of change of snow mass.   | tmelt     | tendency_of_sea_ice_amount_due_to_surface_melting                  |
| 1 | Rate of Melt at Sea Ice Base                                    | $\text{kg m}^{-2} \text{s}^{-1}$ | Compute the rate of change of sea ice mass due to melting at its lower surface, divided by the area of the ocean portion of the grid cell. Report as 0.0 in regions free of sea ice.   | bmelt     | tendency_of_sea_ice_amount_due_to_basal_melting                    |



|            |  |      |                         |           |        |                 |
|------------|--|------|-------------------------|-----------|--------|-----------------|
| K          | time: mean<br>(weighted by area<br>of snow-covered<br>sea ice) | real | longitude latitude time | tsnint    | seaIce | area: areacello |
| kg m-2 s-1 | time: mean area:<br>mean where<br>sea_ice over sea             | real | longitude latitude time | pr        | seaIce | area: areacello |
| kg m-2 s-1 | time: mean area:<br>mean where<br>sea_ice over sea             | real | longitude latitude time | prsn      | seaIce | area: areacello |
| years      | time: mean<br>(weighted b mass<br>of sea ice)                  | real | longitude latitude time | ageice    | seaIce | area: areacello |
| kg m-2 s-1 | time: mean area:<br>mean where sea                             | real | longitude latitude time | grFrazil  | seaIce | area: areacello |
| kg m-2 s-1 | time: mean area:<br>mean where sea                             | real | longitude latitude time | grCongel  | seaIce | area: areacello |
| kg m-2 s-1 | time: mean area:<br>mean where sea                             | real | longitude latitude time | grLateral | seaIce | area: areacello |
| kg m-2 s-1 | time: mean area:<br>mean where sea                             | real | longitude latitude time | snoToIce  | seaIce | area: areacello |
| kg m-2 s-1 | time: mean area:<br>mean where sea                             | real | longitude latitude time | snomelt   | seaIce | area: areacello |
| kg m-2 s-1 | time: mean area:<br>mean where sea                             | real | longitude latitude time | tmelt     | seaIce | area: areacello |
| kg m-2 s-1 | time: mean area:<br>mean where sea                             | real | longitude latitude time | bmelt     | seaIce | area: areacello |

|   |  |                                  |  |  |   |   |
|---|--|----------------------------------|--|--|---|---|
| 2 | Sea Ice Heat Content                           | $\text{J m}^{-2}$                | Ice at 0 Celsius is assumed taken to have a heat content of 0 J. When averaging over time, this quantity is weighted by the mass of sea ice. Report as "missing in regions free of sea ice. Do not include heat content of snow. | hcice  | integral_of_sea_ice_temperature_wrt_depth_expressed_as_heat_content |   |
| 1 | Downward Shortwave over Sea Ice                | $\text{W m}^{-2}$                | Compute the downward shortwave flux in regions of sea ice divided by the area of the ocean portion of the grid cell.   | priority was raised from 2 to 1 because snow albedo was deleted. | rsdssi  | surface_downwelling_shortwave_flux_in_air |
| 1 | Upward Shortwave over Sea Ice                  | $\text{W m}^{-2}$                | Compute the upward shortwave flux in regions of sea ice divided by the area of the ocean portion of the grid cell.   | priority was raised from 2 to 1 because snow albedo was deleted. | rsussi  | surface_upwelling_shortwave_flux_in_air   |
| 2 | Downward Long Wave over Sea Ice                | $\text{W m}^{-2}$                | Compute the downward longwave flux in regions of sea ice divided by the area of the ocean portion of the grid cell.  |  | rldssi  | surface_downwelling_longwave_flux_in_air  |
| 2 | Upward Long Wave over Sea Ice                  | $\text{W m}^{-2}$                | Compute the upward longwave flux in regions of sea ice divided by the area of the ocean portion of the grid cell.  |  | rlussi  | surface_upwelling_longwave_flux_in_air    |
| 2 | Surface Upward Sensible Heat Flux over Sea Ice | $\text{W m}^{-2}$                | Compute the upward sensible heat flux in regions of sea ice divided by the area of the ocean portion of the grid cell.   |  | hfssi   | surface_upward_sensible_heat_flux         |
| 2 | Surface Upward Latent Heat Flux over Sea Ice   | $\text{W m}^{-2}$                | Compute the upward latent heat flux in regions of sea ice divided by the area of the ocean portion of the grid cell.   |  | hflssi  | surface_upward_latent_heat_flux           |
| 2 | Sublimation over Sea Ice                       | $\text{kg m}^{-2} \text{s}^{-1}$ | Compute the upward flux of water vapor to the atmosphere due to sublimation of snow and sea ice in regions of sea ice divided by the area of the ocean portion of the grid cell.   |  | sbsli   | surface_snow_and_ice_sublimation_flux     |
| 1 | X-Component of Sea Ice Mass Transport          | $\text{kg s}^{-1}$               | The sea ice mass transport is 0.0 in ice-free regions of the ocean. Include snow in calculation of mass.   |  | transix   | sea_ice_x_transport                       |
| 1 | Y-Component of Sea Ice Mass Transport          | $\text{kg s}^{-1}$               | The sea ice mass transport is 0.0 in ice-free regions of the ocean. Include snow in calculation of mass.   |  | transiy   | sea_ice_y_transport                       |
| 2 | Sea Ice Mass Transport Through Fram Strait     | $\text{kg s}^{-1}$               |  |  | transifs  | sea_ice_transport_across_line             |
| 2 | X-Component of Atmospheric Stress On Sea Ice   | $\text{N m}^{-2}$                | When computing the time-mean here, the time samples, weighted by the area of sea ice, are accumulated and then divided by the sum of the weights. Report as "missing" in regions free of sea ice.                                |  | strairx   | surface_downward_x_stress                 |
| 2 | Y-Component of Atmospheric Stress On Sea Ice   | $\text{N m}^{-2}$                | When computing the time-mean here, the time samples, weighted by the area of sea ice, are accumulated and then divided by the sum of the weights. Report as "missing" in regions free of sea ice.                                |  | strairy   | surface_downward_y_stress                 |
| 2 | X-Component of Ocean Stress On Sea Ice         | $\text{N m}^{-2}$                | When computing the time-mean here, the time samples, weighted by the area of sea ice, are accumulated and then divided by the sum of the weights. Report as "missing" in regions free of sea ice.                                |  | strocnx   | upward_x_stress_at_sea_ice_base           |
| 2 | Y-Component of Ocean Stress On Sea Ice         | $\text{N m}^{-2}$                | When computing the time-mean here, the time samples, weighted by the area of sea ice, are accumulated and then divided by the sum of the weights. Report as "missing" in regions free of sea ice.                                |  | strocny   | upward_y_stress_at_sea_ice_base           |
| 2 | Compressive Sea Ice Strength                   | $\text{N m}^{-1}$                | When computing the time-mean here, the time samples, weighted by the area of sea ice, are accumulated and then divided by the sum of the weights. Report as "missing" in regions free of sea ice.                                |  | streng  | compressive_strength_of_sea_ice           |

|            |  |      |      |                         |          |              |                 |
|------------|--|------|------|-------------------------|----------|--------------|-----------------|
| J m-2      | time: mean<br>(weighted by mass<br>of sea ice)     |      | real | longitude latitude time | hcice    | seaIce       | area: areacello |
| W m-2      | time: mean area:<br>mean where<br>sea_ice over sea | down | real | longitude latitude time | rsdssi   | seaIce       | area: areacello |
| W m-2      | time: mean area:<br>mean where<br>sea_ice over sea | up   | real | longitude latitude time | rsussi   | seaIce       | area: areacello |
| W m-2      | time: mean area:<br>mean where<br>sea_ice over sea | down | real | longitude latitude time | rldssi   | seaIce       | area: areacello |
| W m-2      | time: mean area:<br>mean where<br>sea_ice over sea | up   | real | longitude latitude time | rlussi   | seaIce       | area: areacello |
| W m-2      | time: mean area:<br>mean where<br>sea_ice over sea | up   | real | longitude latitude time | hfssi    | seaIce       | area: areacello |
| W m-2      | time: mean area:<br>mean where<br>sea_ice over sea | up   | real | longitude latitude time | hflssi   | seaIce       | area: areacello |
| kg m-2 s-1 | time: mean area:<br>mean where<br>sea_ice over sea | up   | real | longitude latitude time | sblsi    | seaIce       | area: areacello |
| kg s-1     | time: mean   |      | real | longitude latitude time | transix  | seaIce       |                 |
| kg s-1     | time: mean   |      | real | longitude latitude time | transiy  | seaIce       |                 |
| kg s-1     | time: mean   |      | real | time                    | transifs | seaIce       |                 |
| N m-2      | time: mean<br>(weighted by area<br>of sea ice)     | down | real | longitude latitude time | strairx  | seaIce       |                 |
| N m-2      | time: mean<br>(weighted by area<br>of sea ice)     | down | real | longitude latitude time | strairy  | seaIce       |                 |
| N m-2      | time: mean<br>(weighted by area<br>of sea ice)     |      | real | longitude latitude time | strocnx  | seaIce ocean |                 |
| N m-2      | time: mean<br>(weighted by area<br>of sea ice)     |      | real | longitude latitude time | strocnx  | seaIce ocean |                 |
| N m-1      | time: mean<br>(weighted by area<br>of sea ice)     |      | real | longitude latitude time | streng   | seaIce       | area: areacello |



|   |   |          |   |         |   |
|---|---|----------|---|---------|---|
| 2 | Strain Rate Divergence of Sea Ice                 | $s^{-1}$ | When computing the time-mean here, the time samples, weighted by the area of sea ice, are accumulated and then divided by the sum of the weights. Report as "missing" in regions free of sea ice. | divice  | divergence_of_sea_ice velocity                    |
| 2 | Eastward Derivative of Northward Sea Ice Velocity | $s^{-1}$ | When computing the time-mean here, the time samples, weighted by the area of sea ice, are accumulated and then divided by the sum of the weights. Report as "missing" in regions free of sea ice. | eshrice | eastward_derivative_of_northward_sea_ice_velocity |
| 2 | Northward Derivative of Eastward Sea Ice Velocity | $s^{-1}$ | When computing the time-mean here, the time samples, weighted by the area of sea ice, are accumulated and then divided by the sum of the weights. Report as "missing" in regions free of sea ice. | nshrice | northward_derivative_of_eastward_sea_ice_velocity |
| 2 | Sea Ice Ridging Rate                              | $s^{-1}$ | When computing the time-mean here, the time samples, weighted by the area of sea ice, are accumulated and then divided by the sum of the weights. Report as "missing" in regions free of sea ice. | ridgice | tendency_of_sea_ice_area_fraction_due_to_ridging  |

|     |  |      |                         |         |        |                 |
|-----|--|------|-------------------------|---------|--------|-----------------|
| s-1 | time: mean<br>(weighted by area<br>of sea ice) | real | longitude latitude time | divice  | seaIce | area: areacello |
| s-1 | time: mean<br>(weighted by area<br>of sea ice) | real | longitude latitude time | eshrice | seaIce | area: areacello |
| s-1 | time: mean<br>(weighted by area<br>of sea ice) | real | longitude latitude time | nshrice | seaIce | area: areacello |
| s-1 | time: mean<br>(weighted by area<br>of sea ice) | real | longitude latitude time | ridgice | seaIce | area: areacello |

**CMOR Table *aero*: Monthly Mean Aerosol-Related Fields  
(All Saved on the Atmospheric Grid)**

*aero**mon*

In CMOR Table *aero*: 2-D fields on atmospheric grid

| priority               | long name   | units                            | comment  | questions  | output variable |   |
|------------------------|---|----------------------------------|--|--|-----------------|---|
|                        |   |                                  |  |  | name            | standard name   |
| <b>Aerosol Optics</b>  |   |                                  |  |  |                 |   |
| 1                      | Ambient Aerosol Optical Thickness at 550 nm                         | 1                                | AOD from the ambient aerosols (i.e., includes aerosol water). Does not include AOD from stratospheric aerosols if these are prescribed but includes other possible background aerosol types.   |  | od550aer        | atmosphere_optical_thickness_due_to_ambient_aerosol   |
| 1                      | Ambient Fine Aerosol Optical Thickness at 550 nm                    | 1                                | od550 due to particles with wet diameter less than 1 $\mu\text{m}$ ("ambient" means "wetted"). When models do not include explicit size information, it can be assumed that all anthropogenic aerosols and natural secondary aerosols have diameter less than 1 $\mu\text{m}$ .  |  | od550lt1aer     | atmosphere_optical_thickness_due_to_pm1_ambient_aerosol   |
| 1                      | Ambient Aerosol Absorption Optical Thickness at 550 nm              | 1                                |  |  | abs550aer       | atmosphere_absorption_optical_thickness_due_to_ambient_aerosol  |
| 2                      | Ambient Aerosol Optical Thickness at 870 nm                         | 1                                | AOD from the ambient aerosols (i.e., includes aerosol water). Does not include AOD from stratospheric aerosols if these are prescribed but includes other possible background aerosol types.   |  | od870aer        | atmosphere_optical_thickness_due_to_ambient_aerosol   |
| <b>Aerosol Budgets</b> |   |                                  |  |  |                 |   |
| 1                      | Rate of Emission and Production of Dry Aerosol Total Organic Matter | $\text{kg m}^{-2} \text{s}^{-1}$ | tendency of atmosphere mass content of organic matter dry aerosol due to net production and emission. This is the sum of total emission of POA and total production of SOA (see next two entries), and it should only be reported if POA and SOA cannot be separately reported. "Mass" refers to the mass of organic matter, not mass of organic carbon alone. |  | emioa           | tendency_of_atmosphere_mass_content_of_particulate_organic_matter_dry_aerosol_due_to_net_chemical_production_and_emission |
| 1                      | Emission Rate of Dry Aerosol Primary Organic Matter                 | $\text{kg m}^{-2} \text{s}^{-1}$ | tendency of atmosphere mass content of primary organic aerosol due to emission: "mass" refers to the mass of primary organic matter, not mass of organic carbon alone.   | In a previous message you said production referred to SOA, not POA, so I've removed "production" here and only use "emission". Is this o.k.? | emipoa          | tendency_of_atmosphere_mass_content_of_primary_particulate_organic_matter_dry_aerosol_due_to_emission                     |
| 1                      | Production Rate of Dry Aerosol Secondary Organic Matter             | $\text{kg m}^{-2} \text{s}^{-1}$ | tendency of atmosphere mass content of secondary organic matter dry aerosol due to net production: If model lumps SOA emissions with POA, then report the sum of POA and SOA emissions as POA emissions. "mass" refers to the mass of primary organic matter, not mass of organic carbon alone.  |  | chepsoa         | tendency_of_atmosphere_mass_content_of_secondary_particulate_organic_matter_dry_aerosol_due_to_net_chemical_production    |
| 1                      | Emission Rate of Black Carbon Aerosol Mass                          | $\text{kg m}^{-2} \text{s}^{-1}$ |  |  | emibc           | tendency_of_atmosphere_mass_content_of_black_carbon_dry_aerosol_due_to_emission   |
| 3                      | Dry Deposition Rate of Dry Aerosol Organic Matter                   | $\text{kg m}^{-2} \text{s}^{-1}$ | tendency of atmosphere mass content of organic dry aerosol due to dry deposition: This is the sum of dry deposition of POA and dry deposition of SOA (see next two entries), and it should only be reported if POA and SOA cannot be separately reported. "Mass" refers to the mass of organic matter, not mass of organic carbon alone.                       |  | dryoa           | tendency_of_atmosphere_mass_content_of_particulate_organic_matter_dry_aerosol_due_to_dry_deposition                       |

| unformatted<br>units | cell_methods | positive | type | CMOR dimensions         | CMOR<br>variable<br>name | realm   | frequency | cell_measures   | flag_values | flag_meanings |
|----------------------|--------------|----------|------|-------------------------|--------------------------|---------|-----------|-----------------|-------------|---------------|
| 1                    | time: mean   |          | real | longitude latitude time | od550aer                 | aerosol |           | area: areacella |             |               |
| 1                    | time: mean   |          | real | longitude latitude time | od550lt1aer              | aerosol |           | area: areacella |             |               |
| 1                    | time: mean   |          | real | longitude latitude time | abs550aer                | aerosol |           | area: areacella |             |               |
| 1                    | time: mean   |          | real | longitude latitude time | od870aer                 | aerosol |           | area: areacella |             |               |
| kg m-2 s-1           | time: mean   |          | real | longitude latitude time | emioa                    | aerosol |           | area: areacella |             |               |
| kg m-2 s-1           | time: mean   |          | real | longitude latitude time | emipoa                   | aerosol |           | area: areacella |             |               |
| kg m-2 s-1           | time: mean   |          | real | longitude latitude time | chepsoa                  | aerosol |           | area: areacella |             |               |
| kg m-2 s-1           | time: mean   |          | real | longitude latitude time | emibc                    | aerosol |           | area: areacella |             |               |
| kg m-2 s-1           | time: mean   |          | real | longitude latitude time | dryoa                    | aerosol |           | area: areacella |             |               |

|   |   |                                    |  |        |   |
|---|---|------------------------------------|--|--------|---|
| 3 | Dry Deposition Rate of Dry Aerosol Primary Organic Matter   | kg m <sup>-2</sup> s <sup>-1</sup> |  | drypoa | tendency_of_atmosphere_mass_content_of_primary_particulate_organic_matter_dry_aerosol_due_to_dry_deposition   |
| 3 | Dry Deposition Rate of Dry Aerosol Secondary Organic Matter | kg m <sup>-2</sup> s <sup>-1</sup> |  | drysoa | tendency_of_atmosphere_mass_content_of_secondary_particulate_organic_matter_dry_aerosol_due_to_dry_deposition |
| 3 | Dry Deposition Rate of Black Carbon Aerosol Mass            | kg m <sup>-2</sup> s <sup>-1</sup> |  | drybc  | tendency_of_atmosphere_mass_content_of_black_carbon_dry_aerosol_due_to_dry_deposition                         |
| 3 | Wet Deposition Rate of Dry Aerosol Organic Matter           | kg m <sup>-2</sup> s <sup>-1</sup> | tendency of atmosphere mass content of organic matter dry aerosols due to wet deposition: This is the sum of wet deposition of POA and wet deposition of SOA (see next two entries), and it should only be reported if POA and SOA cannot be separately reported. "Mass" refers to the mass of organic matter, not mass of organic carbon alone. | wettoa | tendency_of_atmosphere_mass_content_of_particulate_organic_matter_dry_aerosol_due_to_wet_deposition           |
| 3 | Wet Deposition Rate of Dry Aerosol Primary Organic Matter   | kg m <sup>-2</sup> s <sup>-1</sup> |  | wetpoa | tendency_of_atmosphere_mass_content_of_primary_particulate_organic_matter_dry_aerosol_due_to_wet_deposition   |
| 3 | Wet Deposition Rate of Dry Aerosol Secondary Organic Matter | kg m <sup>-2</sup> s <sup>-1</sup> |  | wetsoa | tendency_of_atmosphere_mass_content_of_secondary_particulate_organic_matter_dry_aerosol_due_to_wet_deposition |
| 3 | Wet Deposition Rate of Black Carbon Aerosol Mass            | kg m <sup>-2</sup> s <sup>-1</sup> |  | wetbc  | tendency_of_atmosphere_mass_content_of_black_carbon_dry_aerosol_due_to_wet_deposition                         |
| 1 | Total Emission of Primary Aerosol from Biomass Burning      | kg m <sup>-2</sup> s <sup>-1</sup> | tendency of atmosphere mass content of primary organic matter dry aerosol due to emission: This does not include sources of secondary aerosols from biomass burning aerosols, such as SO2 or SOA.  | emibb  | tendency_of_atmosphere_mass_content_of_primary_particulate_organic_matter_dry_aerosol_due_to_emission         |
| 1 | Total Emission Rate of SO2                                  | kg m <sup>-2</sup> s <sup>-1</sup> |  | emiso2 | tendency_of_atmosphere_mass_content_of_sulfur_dioxide_due_to_emission   |
| 1 | Total Direct Emission Rate of SO4                           | kg m <sup>-2</sup> s <sup>-1</sup> | expressed as a tendency of atmosphere mass content of SO4. Direct emission does not include secondary sulfate production.  | emiso4 | tendency_of_atmosphere_mass_content_of_sulfate_dry_aerosol_due_to_emission                                    |
| 1 | Total Emission Rate of DMS                                  | kg m <sup>-2</sup> s <sup>-1</sup> |  | emidms | tendency_of_atmosphere_mass_content_of_dimethyl_sulfide_due_to_emission                                       |
| 3 | Dry Deposition Rate of SO2                                  | kg m <sup>-2</sup> s <sup>-1</sup> |  | dryso2 | tendency_of_atmosphere_mass_content_of_sulfur_dioxide_due_to_dry_deposition                                   |
| 1 | Dry Deposition Rate of SO4                                  | kg m <sup>-2</sup> s <sup>-1</sup> |  | dryso4 | tendency_of_atmosphere_mass_content_of_sulfate_dry_aerosol_due_to_dry_deposition                              |
| 3 | Dry Deposition Rate of DMS                                  | kg m <sup>-2</sup> s <sup>-1</sup> | omit if DMS is not dry deposited in the model.   | drydms | tendency_of_atmosphere_mass_content_of_dimethyl_sulfide_due_to_dry_deposition                                 |
| 1 | Wet Deposition Rate of SO4                                  | kg m <sup>-2</sup> s <sup>-1</sup> |  | wetso4 | tendency_of_atmosphere_mass_content_of_sulfate_expressed_as_sulfur_dry_aerosol_due_to_wet_deposition          |
| 3 | Wet Deposition Rate of SO2                                  | kg m <sup>-2</sup> s <sup>-1</sup> |  | wetso2 | tendency_of_atmosphere_mass_content_of_sulfur_dioxide_due_to_wet_deposition                                   |
| 3 | Wet Deposition Rate of DMS                                  | kg m <sup>-2</sup> s <sup>-1</sup> | omit if DMS is not wet deposited in the model.   | wetdms | tendency_of_atmosphere_mass_content_of_dimethyl_sulfide_due_to_wet_deposition                                 |
| 1 | Total Emission Rate of NH3                                  | kg m <sup>-2</sup> s <sup>-1</sup> |  | eminh3 | tendency_of_atmosphere_mass_content_of_ammonia_due_to_emission  |
| 3 | Dry Deposition Rate of NH3                                  | kg m <sup>-2</sup> s <sup>-1</sup> |  | drynh3 | tendency_of_atmosphere_mass_content_of_ammonia_due_to_dry_deposition  |
| 1 | Dry Deposition Rate of NH4                                  | kg m <sup>-2</sup> s <sup>-1</sup> |  | drynh4 | tendency_of_atmosphere_mass_content_of_ammonium_dry_aerosol_due_to_dry_deposition                             |



|            |            |      |                         |        |         |                 |
|------------|------------|------|-------------------------|--------|---------|-----------------|
| kg m-2 s-1 | time: mean | real | longitude latitude time | drypoa | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | drysoa | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | drybc  | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | wetsoa | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | wetpoa | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | wetsoa | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | wetbc  | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | emibb  | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | emiso2 | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | emiso4 | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | emidms | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | dryso2 | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | dryso4 | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | drydms | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | wetso4 | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | wetso2 | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | wetdms | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | eminh3 | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | drynh3 | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | drynh4 | aerosol | area: areacella |

|                      |   |                                    |   |          |   |
|----------------------|---|------------------------------------|---|----------|---|
| 1                    | Wet Deposition Rate of NH <sub>4</sub> +NH <sub>3</sub> | kg m <sup>-2</sup> s <sup>-1</sup> |   | wetnh4   | tendency_of_atmosphere_mass_content_of_ammonium_dry_aerosol_due_to_wet_deposition |
| 1                    | Total Emission Rate of Seasalt                          | kg m <sup>-2</sup> s <sup>-1</sup> |   | emiss    | tendency_of_atmosphere_mass_content_of_seasalt_dry_aerosol_due_to_emission        |
| 3                    | Dry Deposition Rate of Seasalt                          | kg m <sup>-2</sup> s <sup>-1</sup> |   | dryss    | tendency_of_atmosphere_mass_content_of_seasalt_dry_aerosol_due_to_dry_deposition  |
| 3                    | Wet Deposition Rate of Seasalt                          | kg m <sup>-2</sup> s <sup>-1</sup> |   | wetss    | tendency_of_atmosphere_mass_content_of_seasalt_dry_aerosol_due_to_wet_deposition  |
| 1                    | Total Emission Rate of Dust                             | kg m <sup>-2</sup> s <sup>-1</sup> |   | emidust  | tendency_of_atmosphere_mass_content_of_dust_dry_aerosol_due_to_emission           |
| 1                    | Dry Deposition Rate of Dust                             | kg m <sup>-2</sup> s <sup>-1</sup> |   | drydust  | tendency_of_atmosphere_mass_content_of_dust_dry_aerosol_due_to_dry_deposition     |
| 1                    | Wet Deposition Rate of Dust                             | kg m <sup>-2</sup> s <sup>-1</sup> |   | wetdust  | tendency_of_atmosphere_mass_content_of_dust_dry_aerosol_due_to_wet_deposition     |
| <b>Aerosol Loads</b> |   |                                    |   |          |   |
| 1                    | Load of Dry Aerosol Organic Matter                      | kg m <sup>-2</sup>                 | atmosphere dry organic content: This is the vertically integrated sum of atmosphere_primary_organic_content and atmosphere_secondary_organic_content (see next two table entries), and therefore should only be reported if those two components cannot be separately reported. | loadoa   | atmosphere_mass_content_of_particulate_organic_matter_dry_aerosol                 |
| 1                    | Load of Dry Aerosol Primary Organic Matter              | kg m <sup>-2</sup>                 |   | loadpoa  | atmosphere_mass_content_of_primary_particulate_organic_matter_dry_aerosol         |
| 1                    | Load of Dry Aerosol Secondary Organic Matter            | kg m <sup>-2</sup>                 |   | loadsoa  | atmosphere_mass_content_of_secondary_particulate_organic_matter_dry_aerosol       |
| 1                    | Load of Black Carbon Aerosol                            | kg m <sup>-2</sup>                 |   | loadbc   | atmosphere_mass_content_of_black_carbon_dry_aerosol                               |
| 1                    | Load of SO <sub>4</sub>                                 | kg m <sup>-2</sup>                 | Is this "dry" or "ambient"?   | loadso4  | atmosphere_mass_content_of_sulfate_dry_aerosol                                    |
| 1                    | Load of Dust  | kg m <sup>-2</sup>                 |   | loaddust | atmosphere_mass_content_of_dust_dry_aerosol                                       |
| 1                    | Load of Seasalt   | kg m <sup>-2</sup>                 |   | loadss   | atmosphere_mass_content_of_seasalt_dry_aerosol                                    |
| 1                    | Load of NO <sub>3</sub>                                 | kg m <sup>-2</sup>                 |   | loadno3  | atmosphere_mass_content_of_nitrate_dry_aerosol                                    |
| 3                    | Load of NH <sub>4</sub>                                 | kg m <sup>-2</sup>                 |   | loadnh4  | atmosphere_mass_content_of_ammonium_dry_aerosol                                   |

## aero

|            |            |      |                         |          |         |                 |
|------------|------------|------|-------------------------|----------|---------|-----------------|
| kg m-2 s-1 | time: mean | real | longitude latitude time | wetnh4   | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | emiss    | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | dryss    | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | wetss    | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | emidust  | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | drydust  | aerosol | area: areacella |
| kg m-2 s-1 | time: mean | real | longitude latitude time | wetdust  | aerosol | area: areacella |
| kg m-2     | time: mean | real | longitude latitude time | loadoa   | aerosol | area: areacella |
| kg m-2     | time: mean | real | longitude latitude time | loadpoa  | aerosol | area: areacella |
| kg m-2     | time: mean | real | longitude latitude time | loadsoa  | aerosol | area: areacella |
| kg m-2     | time: mean | real | longitude latitude time | loadbc   | aerosol | area: areacella |
| kg m-2     | time: mean | real | longitude latitude time | loadso4  | aerosol | area: areacella |
| kg m-2     | time: mean | real | longitude latitude time | loaddust | aerosol | area: areacella |
| kg m-2     | time: mean | real | longitude latitude time | loadss   | aerosol | area: areacella |
| kg m-2     | time: mean | real | longitude latitude time | loadno3  | aerosol | area: areacella |
| kg m-2     | time: mean | real | longitude latitude time | loadnh4  | aerosol | area: areacella |

| Surface Concentrations |   |                    |   |            |   |
|------------------------|---|--------------------|---|------------|---|
| 3                      | Surface Concentration of Dry Aerosol Organic Matter           | kg m <sup>-3</sup> | mass concentration of particulate organic matter dry aerosol in air in model lowest layer (The location of the model's lowest layer should be recorded in the netCDF output file). This is the sum of concentrations of primary and secondary organic aerosol (see next two table entries), and therefore should only be reported if those two components cannot be separately reported.  | sconcoa    | mass_concentration_of_particulate_organic_matter_dry_aerosol_in_air           |
| 3                      | Surface Concentration of Dry Aerosol Primary Organic Matter   | kg m <sup>-3</sup> | mass concentration of primary particulate organic matter dry aerosol in air in model lowest layer (The location of the model's lowest layer should be recorded in the netCDF output file).  | sconcpoa   | mass_concentration_of_primary_particulate_organic_matter_dry_aerosol_in_air   |
| 3                      | Surface Concentration of Dry Aerosol Secondary Organic Matter | kg m <sup>-3</sup> | mass concentration of secondary particulate organic matter dry aerosol in air in model lowest layer (The location of the model's lowest layer should be recorded in the netCDF output file). If the model lumps SOA with POA, then report their sum as POA.   | sconcscoa  | mass_concentration_of_secondary_particulate_organic_matter_dry_aerosol_in_air |
| 3                      | Surface Concentration of Black Carbon Aerosol                 | kg m <sup>-3</sup> | mass concentration of black carbon dry aerosol in air in model lowest layer (The location of the model's lowest layer should be recorded in the netCDF output file).  | sconcbc    | mass_concentration_of_black_carbon_dry_aerosol_in_air                         |
| 3                      | Surface Concentration of SO4                                  | kg m <sup>-3</sup> | mass concentration of sulfate dry aerosol in air in model lowest layer (The location of the model's lowest layer should be recorded in the netCDF output file).   | sconcsso4  | mass_concentration_of_sulfate_dry_aerosol_in_air                              |
| 3                      | Surface Concentration of Dust                                 | kg m <sup>-3</sup> | mass concentration of dust dry aerosol in air in model lowest layer (The location of the model's lowest layer should be recorded in the netCDF output file).  | sconcdust  | mass_concentration_of_dust_dry_aerosol_in_air                                 |
| 3                      | Surface Concentration of Seasalt                              | kg m <sup>-3</sup> | mass concentration of seasalt dry aerosol in air in model lowest layer (The location of the model's lowest layer should be recorded in the netCDF output file).   | sconcss    | mass_concentration_of_seasalt_dry_aerosol_in_air                              |
| 3                      | Surface Concentration of NO3                                  | kg m <sup>-3</sup> | Mass concentration in model lowest layer (The location of the model's lowest layer should be recorded in the netCDF output file).   | sconcnno3  | mass_concentration_of_nitrate_dry_aerosol_in_air                              |
| 3                      | Surface Concentration of NH4                                  | kg m <sup>-3</sup> | Mass concentration in model lowest layer (The location of the model's lowest layer should be recorded in the netCDF output file).   | sconcnh4   | mass_concentration_of_ammonium_dry_aerosol_in_air                             |
| Clouds and Radiation   |   |                    |   |            |   |
| 2                      | Surface Diffuse Downward Shortwave Radiation                  | W m <sup>-2</sup>  | downwelling_diffuse_shortwave_flux_in_air   | rsdsdiff   | diffuse_downwelling_shortwave_flux_in_air                                     |
| 2                      | Surface Diffuse Downward Clear Sky Shortwave Radiation        | W m <sup>-2</sup>  | downwelling_diffuse_shortwave_flux_in_air_assuming_clear_sky  | rsdscsdiff | diffuse_downwelling_shortwave_flux_in_air_assuming_clear_sky                  |
| 1                      | Cloud-Top Effective Droplet Radius                            | m                  | Droplets are liquid only. Report effective radius "as seen from space" over liquid cloudy portion of grid cell. This is the value from uppermost model layer with liquid cloud or, if available, it is better to sum over all liquid cloud tops, no matter where they occur, as long as they are seen from the top of the atmosphere. Weight by total liquid cloud top fraction of (as seen from TOA) each time sample when computing monthly mean. | reffclwtop | effective_radius_of_cloud_liquid_water_particle_at_liquid_water_cloud_top     |

|        |            |      |                               |            |              |                 |
|--------|------------|------|-------------------------------|------------|--------------|-----------------|
| kg m-3 | time: mean | real | longitude latitude alev1 time | sconcoa    | aerosol      | area: areacella |
| kg m-3 | time: mean | real | longitude latitude alev1 time | sconcpoa   | aerosol      | area: areacella |
| kg m-3 | time: mean | real | longitude latitude alev1 time | sconcooa   | aerosol      | area: areacella |
| kg m-3 | time: mean | real | longitude latitude alev1 time | sconcbc    | aerosol      | area: areacella |
| kg m-3 | time: mean | real | longitude latitude alev1 time | sconco4    | aerosol      | area: areacella |
| kg m-3 | time: mean | real | longitude latitude alev1 time | sconcdust  | aerosol      | area: areacella |
| kg m-3 | time: mean | real | longitude latitude alev1 time | sconcss    | aerosol      | area: areacella |
| kg m-3 | time: mean | real | longitude latitude alev1 time | sconco3    | aerosol      | area: areacella |
| kg m-3 | time: mean | real | longitude latitude alev1 time | sconnh4    | aerosol      | area: areacella |
| W m-2  | time: mean | real | longitude latitude time       | rsdsdiff   | aerosol land | area: areacella |
| W m-2  | time: mean | real | longitude latitude time       | rsdscsdiff | aerosol land | area: areacella |
| m      | time: mean | real | longitude latitude time       | reffclwtop | aerosol      | area: areacella |

|   |  |          |  |        |   |
|---|--|----------|--|--------|---|
| 1 | Cloud Droplet Number Concentration of Cloud Tops | $m^{-3}$ | Droplets are liquid only. Report concentration "as seen from space" over liquid cloudy portion of grid cell. This is the value from uppermost model layer with liquid cloud or, if available, it is better to sum over all liquid cloud tops, no matter where they occur, as long as they are seen from the top of the atmosphere. Weight by total liquid cloud top fraction of (as seen from TOA) each time sample when computing monthly mean. | cldncl | number_concentration_of_cloud_liquid_water_particles_in_air_at_liquid_water_cloud_top |
| 1 | Ice Crystal Number Concentration of Cloud Tops   | $m^{-3}$ | Report concentration "as seen from space" over ice-cloud portion of grid cell. This is the value from uppermost model layer with ice cloud or, if available, it is better to sum over all ice cloud tops, no matter where they occur, as long as they are seen from the top of the atmosphere. Weight by total ice cloud top fraction (as seen from TOA) of each time sample when computing monthly mean.  | cldnci | number_concentration_of_ice_crystals_in_air_at_ice_cloud_top                          |
| 1 | Column Integrated Cloud Droplet Number           | $m^{-2}$ | Droplets are liquid only. Weight by liquid cloud fraction in each layer when vertically integrating. Weight by total liquid cloud fraction (as seen from TOA) when reporting monthly mean  | cldnvi | atmosphere_number_content_of_cloud_droplets   |

|     |            |      |                         |        |         |                 |
|-----|------------|------|-------------------------|--------|---------|-----------------|
| m-3 | time: mean | real | longitude latitude time | cldncl | aerosol | area: areacella |
|-----|------------|------|-------------------------|--------|---------|-----------------|

|     |            |      |                         |        |         |                 |
|-----|------------|------|-------------------------|--------|---------|-----------------|
| m-3 | time: mean | real | longitude latitude time | cldnci | aerosol | area: areacella |
|-----|------------|------|-------------------------|--------|---------|-----------------|

|     |            |      |                         |        |         |                 |
|-----|------------|------|-------------------------|--------|---------|-----------------|
| m-2 | time: mean | real | longitude latitude time | cldnvi | aerosol | area: areacella |
|-----|------------|------|-------------------------|--------|---------|-----------------|

**In CMOR Table *aero*: 3-D aerosol-related concentrations and properties on model levels**

Report 1-year samples for years: 1850, 1870, 1890, ..., 1950, 1960, 1970, ... 2000 of the historical run, and 2010, 2020, 2040, 2060, 2080, 2100 of the RCP runs. For AMIP runs, report 1-year samples every 10 years (1980, 1990, ..., 2010). For 2030 time-slice run, report 1-year sample for year 2035. For decadal runs, report 10th year only for 10-year predictions or hindcasts, and report year 10, 20, and 30 for 30-year predictions and hindcasts. Also report years 2010, 2011, and 2012 for years with hypothetical volcanic eruption in 2010. For the preindustrial control, report the years that correspond to years 1850, 1870, 1890, ..., 1950, 1960, 1970, ... 2000 of the historical run and years 2010, 2040, 2060, 2080, & 2100 of the RCP runs.

| <i>Priority</i> | long name   | units              | comment  | questions | output variable name | standard name   |
|-----------------|---|--------------------|--|-----------|----------------------|---|
| 1               | Ambient Aerosol Extinction at 550 nm                  | m <sup>-1</sup>    | atmosphere_extinction_due_to_ambient_aerosol: "ambient" means "wetted". This and other fields in this table are 3-D.   |           | ec550aer             |   |
| 1               | Concentration of Dry Aerosol Organic Matter           | kg m <sup>-3</sup> | mass_concentration_of_organic_matter_dry_aerosol_in_air<br>mass concentration of organic matter dry aerosol in air: This is the sum of concentrations of primary and secondary organic aerosols (see next two table entries), and therefore should only be reported if those two components cannot be separately reported. |           | concoa               | mass_concentration_of_particulate_organic_matter_dry_aerosol_in_air           |
| 1               | Concentration of Dry Aerosol Primary Organic Matter   | kg m <sup>-3</sup> |  |           | concpoa              | mass_concentration_of_primary_particulate_organic_matter_dry_aerosol_in_air   |
| 1               | Concentration of Dry Aerosol Secondary Organic Matter | kg m <sup>-3</sup> | mass concentration of secondary particulate organic matter dry aerosol in air: If the model lumps SOA with POA, then report their sum as POA.  |           | concooa              | mass_concentration_of_secondary_particulate_organic_matter_dry_aerosol_in_air |
| 1               | Concentration of Biomass Burning Aerosol              | kg m <sup>-3</sup> | mass_concentration_of_biomass_burning_dry_aerosol_in_air   |           | conccb               | mass_concentration_of_biomass_burning_dry_aerosol_in_air                      |
| 1               | Concentration of Black Carbon Aerosol                 | kg m <sup>-3</sup> |  |           | concbc               | mass_concentration_of_black_carbon_dry_aerosol_in_air                         |
| 1               | Concentration of Aerosol Water                        | kg m <sup>-3</sup> | mass concentration of water in ambient aerosol in air: "ambient" means "wetted"  |           | concaer2o            | mass_concentration_of_water_in_ambient_aerosol_in_air                         |
| 1               | Concentration of SO4                                  | kg m <sup>-3</sup> |  |           | conco4               | mass_concentration_of_sulfate_dry_aerosol_in_air                              |
| 1               | Mole Fraction of SO2                                  | 1                  |  |           | conco2               | mole_fraction_of_sulfur_dioxide_in_air  |
| 1               | Mole Fraction of DMS                                  | 1                  |  |           | concdms              | mole_fraction_of_dimethyl_sulfide_in_air                                      |
| 1               | Concentration of NO3 Aerosol                          | kg m <sup>-3</sup> |  |           | concn3               | mass_concentration_of_nitrate_dry_aerosol_in_air                              |
| 1               | Concentration of NH4                                  | kg m <sup>-3</sup> |  |           | concnh4              | mass_concentration_of_ammonium_dry_aerosol_in_air                             |
| 1               | Concentration of Seasalt                              | kg m <sup>-3</sup> |  |           | concss               | mass_concentration_of_seasalt_dry_aerosol_in_air                              |
| 1               | Concentration of Dust                                 | kg m <sup>-3</sup> |  |           | concdust             | mass_concentration_of_dust_dry_aerosol_in_air                                 |
| 2               | Aerosol Number Concentration                          | m <sup>-3</sup>    | number_concentration_of_ambient_aerosol_in_air   |           | conccn               | number_concentration_of_ambient_aerosol_in_air                                |



| unformatted<br>units | cell_methods | positive | type | CMOR dimensions                | CMOR<br>variable<br>name | realm   | frequency | cell_measures   | flag_values | flag_meanings |
|----------------------|--------------|----------|------|--------------------------------|--------------------------|---------|-----------|-----------------|-------------|---------------|
| m-1                  | time: mean   |          |      | longitude latitude alevel time | ec550aer                 | aerosol |           | area: areacella |             |               |
| kg m-3               | time: mean   |          |      | longitude latitude alevel time | concoa                   | aerosol |           | area: areacella |             |               |
| kg m-3               | time: mean   |          |      | longitude latitude alevel time | concpoa                  | aerosol |           | area: areacella |             |               |
| kg m-3               | time: mean   |          |      | longitude latitude alevel time | concsoa                  | aerosol |           | area: areacella |             |               |
| kg m-3               | time: mean   |          |      | longitude latitude alevel time | concbb                   | aerosol |           | area: areacella |             |               |
| kg m-3               | time: mean   |          |      | longitude latitude alevel time | concbc                   | aerosol |           | area: areacella |             |               |
| kg m-3               | time: mean   |          |      | longitude latitude alevel time | concaerh2o               | aerosol |           | area: areacella |             |               |
| kg m-3               | time: mean   |          |      | longitude latitude alevel time | concs04                  | aerosol |           | area: areacella |             |               |
| 1                    | time: mean   |          |      | longitude latitude alevel time | concs02                  | aerosol |           | area: areacella |             |               |
| 1                    | time: mean   |          |      | longitude latitude alevel time | concdms                  | aerosol |           | area: areacella |             |               |
| kg m-3               | time: mean   |          |      | longitude latitude alevel time | concn03                  | aerosol |           | area: areacella |             |               |
| kg m-3               | time: mean   |          |      | longitude latitude alevel time | concnh4                  | aerosol |           | area: areacella |             |               |
| kg m-3               | time: mean   |          |      | longitude latitude alevel time | concess                  | aerosol |           | area: areacella |             |               |
| kg m-3               | time: mean   |          |      | longitude latitude alevel time | concdust                 | aerosol |           | area: areacella |             |               |
| m-3                  | time: mean   |          |      | longitude latitude alevel time | conccn                   | aerosol |           | area: areacella |             |               |

|   |   |                 |  |  |  |   |
|---|---|-----------------|--|--|--|---|
| 3 | Number Concentration of Nucleation Mode Aerosol | m <sup>-3</sup> | number_concentration_of_ambient_aerosol_in_nucleation_mode_in_air: include all particles with diameter smaller than 3 nm   | concnmen                               | number_concentration_of_nucleation_mode_ambient_aerosol_in_air |   |
| 2 | Number Concentration Coarse Mode Aerosol        | m <sup>-3</sup> | number_concentration_of_ambient_aerosol_in_coarse_mode_in_air: include all particles with diameter larger than 1 micron  | concnmen                               | number_concentration_of_coarse_mode_ambient_aerosol_in_air     |   |
| 1 | Stratiform Cloud Droplet Effective Radius       | m               | Droplets are liquid. The effective radius is defined as the ratio of the third moment over the second moment of the particle size distribution and the time-mean should be calculated, weighting the individual samples by the cloudy fraction of the grid cell. | reffclws                               | effective_radius_of_stratiform_cloud_liquid_water_particle     |   |
| 1 | Convective Cloud Droplet Effective Radius       | m               | Droplets are liquid. The effective radius is defined as the ratio of the third moment over the second moment of the particle size distribution and the time-mean should be calculated, weighting the individual samples by the cloudy fraction of the grid cell. | reffclwc                               | effective_radius_of_convective_cloud_liquid_water_particle     |   |
| 1 | Cloud Droplet Number Concentration              | m <sup>-3</sup> | Cloud droplet number concentration in liquid clouds  | Weighted by the liquid cloud fraction. | cdnc   | number_concentration_of_cloud_liquid_water_particles_in_air |
| 1 | Ice Crystal Number Concentration                | m <sup>-3</sup> | Ice Crystal number concentration in ice clouds   | Weighted by the ice cloud fraction.    | inc  | number_concentration_of_ice_crystals_in_air                 |

|     |            |                                |          |         |                 |
|-----|------------|--------------------------------|----------|---------|-----------------|
| m-3 | time: mean | longitude latitude alevel time | concnmcn | aerosol | area: areacella |
| m-3 | time: mean | longitude latitude alevel time | conccmcn | aerosol | area: areacella |
| m   | time: mean | longitude latitude alevel time | reffclws | aerosol | area: areacella |
| m   | time: mean | longitude latitude alevel time | reffclwc | aerosol | area: areacella |
| m-3 | time: mean | longitude latitude alevel time | cdnc     | aerosol | area: areacella |
| m-3 | time: mean | longitude latitude alevel time | inc      | aerosol | area: areacella |

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## CMOR Table day: Daily Mean Atmosphere, Ocean and Surface Fields

day

day

(saved on the model's atmospheric or ocean grid, as appropriate)

In CMOR Table **day**: 2-D daily mean atmospheric and surface fields

The following daily mean variables should be collected for all simulations (for each ensemble member and the full duration of each experiment).

| Priority | long name  | units                              | comment  | questions | output variable |  |
|----------|--|------------------------------------|--|-----------|-----------------|--|
|          |  |                                    |  |           | name            | standard name  |
| 1        | Near-Surface Specific Humidity                                     | 1                                  | near-surface (usually, 2 meter) specific humidity.   |           | huss            | specific_humidity                                    |
| 1        | Daily Minimum Near-Surface Air Temperature                         | K                                  | daily-minimum near-surface (usually, 2 meter) air temperature.   |           | tasmin          | air_temperature                                      |
| 1        | Daily Maximum Near-Surface Air Temperature                         | K                                  | daily-maximum near-surface (usually, 2 meter) air temperature.   |           | tasmax          | air_temperature                                      |
| 1        | Near-Surface Air Temperature                                       | K                                  | daily-mean near-surface (usually, 2 meter) air temperature.  |           | tas             | air_temperature                                      |
| 1        | Precipitation  | kg m <sup>-2</sup> s <sup>-1</sup> | at surface; includes both liquid and solid phases from all types of clouds (both large-scale and convective)                     |           | pr              | precipitation_flux                                   |
| 1        | Sea Level Pressure   | Pa                                 |  |           | psl             | air_pressure_at_sea_level                            |
| 1        | Daily-Mean Near-Surface Wind Speed                                 | m s <sup>-1</sup>                  | near-surface (usually, 10 meters) wind speed.  |           | sfcWind         | wind_speed   |
| 1        | Square of Sea Surface Temperature                                  | K <sup>2</sup>                     | square of temperature of liquid ocean, averaged over the day. Report on the ocean grid. This variable appears in WGOMD Table 2.2 |           | tossq           | square_of_sea_surface_temperature                    |
| 1        | Sea Surface Temperature  | K                                  | temperature of liquid ocean. Report on the ocean grid. This variable appears in WGOMD Table 2.2                                  |           | tos             | surface_temperature                                  |
| 1        | Daily Maximum Ocean Mixed Layer Thickness Defined by Mixing Scheme | m                                  | Report on the ocean grid. This variable appears in WGOMD Table 2.2   |           | omldamax        | ocean_mixed_layer_thickness_defined_by_mixing_scheme |

| <b>unformatted</b> |                     |                 |             |                                      | <b>CMOR</b>     |             |              |                  |                      |                    |                      |
|--------------------|---------------------|-----------------|-------------|--------------------------------------|-----------------|-------------|--------------|------------------|----------------------|--------------------|----------------------|
| <b>units</b>       | <b>cell_methods</b> | <b>positive</b> | <b>type</b> | <b>CMOR dimensions</b>               | <b>variable</b> | <b>name</b> | <b>realm</b> | <b>frequency</b> | <b>cell_measures</b> | <b>flag_values</b> | <b>flag_meanings</b> |
| 1                  | time: mean          |                 | real        | longitude latitude time<br>height2m  |                 | huss        | atmos        |                  | area: areacella      |                    |                      |
| K                  | time: minimum       |                 | real        | longitude latitude time<br>height2m  |                 | tasmin      | atmos        |                  | area: areacella      |                    |                      |
| K                  | time: maximum       |                 | real        | longitude latitude time<br>height2m  |                 | tasmax      | atmos        |                  | area: areacella      |                    |                      |
| K                  | time: mean          |                 | real        | longitude latitude time<br>height2m  |                 | tas         | atmos        |                  | area: areacella      |                    |                      |
| kg m-2 s-1         | time: mean          |                 | real        | longitude latitude time              |                 | pr          | atmos        |                  | area: areacella      |                    |                      |
| Pa                 | time: mean          |                 | real        | longitude latitude time              |                 | psl         | atmos        |                  | area: areacella      |                    |                      |
| m s-1              | time: mean          |                 | real        | longitude latitude time<br>height10m |                 | sfcWind     | atmos        |                  |                      |                    |                      |
| K2                 | time:mean           |                 | real        | longitude latitude time              |                 | tossq       | ocean        |                  | area: areacello      |                    |                      |
| K                  | time: mean          |                 | real        | longitude latitude time              |                 | tos         | ocean        |                  | area: areacello      |                    |                      |
| m                  | time: maximum       |                 | real        | longitude latitude time              |                 | omldamax    | ocean        |                  | area: areacello      |                    |                      |

The rest of the daily mean fields on this spreadsheet should be collected only for a single ensemble member of the following experiments.

| <i>experiment</i>  | <i>time-period requested</i>  |
|--|---|
| pre-industrial controls                                      | 20 years, preferably corresponding to years 1986-2005 of the historical run |
| historical   | Jan 1950 -- Dec 2005  |
| future simulations driven by RCP concentrations or emissions | only years 2006-2100, 2181-2200, and 2281-2300                              |
| AMIP & 2030 time-slice run                                   | all years   |

**CMOR Table day: 2-D daily-mean atmospheric and surface fields** (All fields should be reported on the atmospheric grid except (as noted below) the sea ice fields, which should be reported on the ocean grid.)

| <i>priority</i> | <b>long name</b>                          | <b>units</b>                       | <b>comment</b>  | <b>questions</b> | <b>output variable name</b> | <b>standard name</b>           |
|-----------------|---|------------------------------------|---|------------------|-----------------------------|--------------------------------|
| 1               | Moisture in Upper 0.1 m of Soil Column    | kg m <sup>-2</sup>                 | Compute the mass of water in all phases in the upper 0.1 meters of soil.  |                  | mrsos                       | moisture_content_of_soil_layer |
| 1               | Near-Surface Relative Humidity            | %                                  | near-surface (usually, 2 meter) relative humidity. This is the relative humidity with respect to liquid water for T> 0 C, and with respect to ice for T<0 C.  |                  | rhs                         | relative_humidity              |
| 1               | Surface Daily Minimum Relative Humidity   | %                                  | near-surface (usually, 2 meter) minimum relative humidity. This is the relative humidity with respect to liquid water for T> 0 C, and with respect to ice for T<0 C.  |                  | rhsmin                      | relative_humidity              |
| 1               | Surface Daily Maximum Relative Humidity   | %                                  | near-surface (usually, 2 meter) maximum relative humidity. This is the relative humidity with respect to liquid water for T> 0 C, and with respect to ice for T<0 C.  |                  | rhsmax                      | relative_humidity              |
| 1               | Snow Area Fraction                        | %                                  |   |                  | snc                         | surface_snow_area_fraction     |
| 1               | Total Cloud Fraction                      | %                                  | for the whole atmospheric column, as seen from the surface or the top of the atmosphere. Include both large-scale and convective cloud.   |                  | clt                         | cloud_area_fraction            |
| 1               | Surface Temperature Where Land or Sea Ice | K                                  | "skin" temperature of all surfaces except open ocean.   |                  | tslsi                       | surface_temperature            |
| 1               | Surface Snow Amount                       | kg m <sup>-2</sup>                 | Compute as the mass of surface snow on the land portion of the grid cell divided by the land area in the grid cell; report 0.0 where the land fraction is 0; exclude snow on vegetation canopy or on sea ice. |                  | snw                         | surface_snow_amount            |
| 1               | Convective Precipitation                  | kg m <sup>-2</sup> s <sup>-1</sup> | at surface; includes both liquid and solid phases.  |                  | prc                         | convective_precipitation_flux  |
| 1               | Solid Precipitation                       | kg m <sup>-2</sup> s <sup>-1</sup> | at surface; includes precipitation of all forms of water in the solid phase   |                  | prsn                        | snowfall_flux                  |
| 1               | Total Runoff                              | kg m <sup>-2</sup> s <sup>-1</sup> | compute as the total runoff (including "drainage" through the base of the soil model) leaving the land portion of the grid cell divided by the land area in the grid cell.                                    |                  | mrro                        | runoff_flux                    |
| 1               | Eastward Near-Surface Wind                | m s <sup>-1</sup>                  | near-surface (usually, 10 meters) eastward component of wind.   |                  | uas                         | eastward_wind                  |
| 1               | Northward Near-Surface Wind               | m s <sup>-1</sup>                  | near-surface (usually, 10 meters) northward component of wind.  |                  | vas                         | northward_wind                 |

day

|             |                                     |          |      |                                      |          |       |           |                 |             | CMOR          |
|-------------|-------------------------------------|----------|------|--------------------------------------|----------|-------|-----------|-----------------|-------------|---------------|
| unformatted | cell_methods                        | positive | type | CMOR dimensions                      | variable | realm | frequency | cell_measures   | flag_values | flag_meanings |
| units       |                                     |          |      |                                      | name     |       |           |                 |             |               |
| kg m-2      | time: mean area:<br>mean where land |          | real | longitude latitude time<br>sdepth1   | mrsos    | land  |           | area: areacella |             |               |
| %           | time: mean                          |          | real | longitude latitude time<br>height2m  | rhs      | atmos |           | area: areacella |             |               |
| %           | time: minimum                       |          | real | longitude latitude time<br>height2m  | rhsmin   | atmos |           | area: areacella |             |               |
| %           | time: maximum                       |          | real | longitude latitude time<br>height2m  | rhsmax   | atmos |           | area: areacella |             |               |
| %           | time: mean                          |          | real | longitude latitude time              | snc      | atmos |           | area: areacella |             |               |
| %           | time: mean                          |          | real | longitude latitude time              | clt      | atmos |           | area: areacella |             |               |
| K           | time: mean                          |          | real | longitude latitude time              | tslsi    | land  |           | area: areacella |             |               |
| kg m-2      | time: mean area:<br>mean where land |          | real | longitude latitude time              | snw      | land  |           | area: areacella |             |               |
| kg m-2 s-1  | time: mean                          |          | real | longitude latitude time              | prc      | atmos |           | area: areacella |             |               |
| kg m-2 s-1  | time: mean                          |          | real | longitude latitude time              | prsn     | atmos |           | area: areacella |             |               |
| kg m-2 s-1  | time: mean area:<br>mean where land |          | real | longitude latitude time              | mrro     | land  |           | area: areacella |             |               |
| m s-1       | time: mean                          |          | real | longitude latitude time<br>height10m | uas      | atmos |           |                 |             |               |
| m s-1       | time: mean                          |          | real | longitude latitude time<br>height10m | vas      | atmos |           |                 |             |               |

|   |   |                   |   |            |   |
|---|---|-------------------|---|------------|---|
| 1 | Daily Maximum Near-Surface Wind Speed   | $\text{m s}^{-1}$ | near-surface (usually, 10 meters) wind speed.   | sfcWindmax | wind_speed                                |
| 1 | Surface Upward Latent Heat Flux         | $\text{W m}^{-2}$ |   | hfls       | surface_upward_latent_heat_flux           |
| 1 | Surface Upward Sensible Heat Flux       | $\text{W m}^{-2}$ |   | hfss       | surface_upward_sensible_heat_flux         |
| 1 | Surface Downwelling Longwave Radiation  | $\text{W m}^{-2}$ |   | rlds       | surface_downwelling_longwave_flux_in_air  |
| 1 | Surface Upwelling Longwave Radiation    | $\text{W m}^{-2}$ |   | rlus       | surface_upwelling_longwave_flux_in_air    |
| 1 | Surface Downwelling Shortwave Radiation | $\text{W m}^{-2}$ |   | rsds       | surface_downwelling_shortwave_flux_in_air |
| 1 | Surface Upwelling Shortwave Radiation   | $\text{W m}^{-2}$ |   | rsus       | surface_upwelling_shortwave_flux_in_air   |
| 1 | TOA Outgoing Longwave Radiation         | $\text{W m}^{-2}$ | at the top of the atmosphere.   | rlut       | toa_outgoing_longwave_flux                |
| 1 | X-Component of Sea Ice Velocity         | $\text{m s}^{-1}$ | Report on ocean's grid. Report as "missing" in regions free of sea ice.   | usi        | sea_ice_x_velocity                        |
| 1 | Y-Component of Sea Ice Velocity         | $\text{m s}^{-1}$ | Report on ocean's grid. Report as "missing" in regions free of sea ice.   | vsi        | sea_ice_y_velocity                        |
| 1 | Sea Ice Area Fraction                   | %                 | fraction of grid cell covered by sea ice. Report on ocean's grid.   | sic        | sea_ice_area_fraction                     |
| 1 | Sea Ice Thickness                       | m                 | Report on ocean's grid. Compute the mean thickness of sea ice in the ocean portion of the grid cell (averaging over the entire ocean portion, including the ice-free fraction). Report as 0.0 in regions free of sea ice. | sit        | sea_ice_thickness                         |



day

|       |                                    |      |      |                                      |            |              |                 |  |
|-------|------------------------------------|------|------|--------------------------------------|------------|--------------|-----------------|--|
| m s-1 | time: maximum                      |      | real | longitude latitude time<br>height10m | sfcWindmax | atmos        |                 |  |
| W m-2 | time: mean                         | up   | real | longitude latitude time              | hfls       | atmos        | area: areacella |  |
| W m-2 | time: mean                         | up   | real | longitude latitude time              | hfss       | atmos        | area: areacella |  |
| W m-2 | time: mean                         | down | real | longitude latitude time              | rlds       | atmos        | area: areacella |  |
| W m-2 | time: mean                         | up   | real | longitude latitude time              | rlus       | atmos        | area: areacella |  |
| W m-2 | time: mean                         | down | real | longitude latitude time              | rsds       | atmos        | area: areacella |  |
| W m-2 | time: mean                         | up   | real | longitude latitude time              | rsus       | atmos        | area: areacella |  |
| W m-2 | time: mean                         | up   | real | longitude latitude time              | rlut       | atmos        | area: areacella |  |
|       |                                    |      |      |                                      |            |              |                 |  |
| m s-1 | time: mean                         |      | real | longitude latitude time              | usi        | seaIce ocean |                 |  |
| m s-1 | time: mean                         |      | real | longitude latitude time              | vsi        | seaIce ocean |                 |  |
| %     | time: mean                         |      | real | longitude latitude time              | sic        | seaIce ocean | area: areacella |  |
| m     | time: mean area:<br>mean where sea |      | real | longitude latitude time              | sit        | seaIce ocean | area: areacella |  |

*In CMOR Table day: daily mean 3-D atmospheric fields on the following pressure surfaces: 1000, 850, 700, 500, 250, 100, 50, and 10 hPa*

| <i>priority</i> | <b>long name</b>    | <b>units</b>       | <b>comment</b>  | <b>questions</b> | <b>output variable name</b> | <b>standard name</b>                |
|-----------------|---------------------|--------------------|---|------------------|-----------------------------|-------------------------------------|
| 1               | Air Temperature     | K                  |   |                  | ta                          | air_temperature                     |
| 1               | Relative Humidity   | %                  | This is the relative humidity with respect to liquid water for T> 0 C, and with respect to ice for T<0 C.                   |                  | hur                         | relative_humidity                   |
| 1               | Specific Humidity   | 1                  |   |                  | hus                         | specific_humidity                   |
| 1               | omega (=dp/dt)      | Pa s <sup>-1</sup> | commonly referred to as "omega", this represents the vertical component of velocity in pressure coordinates (positive down) |                  | wap                         | lagrangian_tendency_of_air_pressure |
| 1               | Northward Wind      | m s <sup>-1</sup>  |   |                  | va                          | northward_wind                      |
| 1               | Eastward Wind       | m s <sup>-1</sup>  |   |                  | ua                          | eastward_wind                       |
| 2               | Geopotential Height | m                  |   |                  | zg                          | geopotential_height                 |

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|--------------------|---------------------|-----------------|-------------|-------------------------------|----------------------|--------------|------------------|----------------------|--------------------|----------------------|
| <b>units</b>       | <b>cell_methods</b> | <b>positive</b> | <b>type</b> | <b>CMOR dimensions</b>        | <b>variable name</b> | <b>realm</b> | <b>frequency</b> | <b>cell_measures</b> | <b>flag_values</b> | <b>flag_meanings</b> |
| K                  | time: mean          |                 | real        | longitude latitude plev8 time | ta                   | atmos        |                  | area: areacella      |                    |                      |
| %                  | time: mean          |                 | real        | longitude latitude plev8 time | hur                  | atmos        |                  | area: areacella      |                    |                      |
| 1                  | time: mean          |                 | real        | longitude latitude plev8 time | hus                  | atmos        |                  | area: areacella      |                    |                      |
| Pa s-1             | time: mean          |                 | real        | longitude latitude plev8 time | wap                  | atmos        |                  | area: areacella      |                    |                      |
| m s-1              | time: mean          |                 | real        | longitude latitude plev8 time | va                   | atmos        |                  |                      |                    |                      |
| m s-1              | time: mean          |                 | real        | longitude latitude plev8 time | ua                   | atmos        |                  |                      |                    |                      |
| m                  | time: mean          |                 | real        | longitude latitude plev8 time | zg                   | atmos        |                  | area: areacella      |                    |                      |

## CMOR Table 6hrLev: Fields (Sampled Every 6 Hours) for Driving Regional Models

6hrLev

6hr

The 6-hourly data on model levels should be sampled as "*snapshots*" (*not* as 6-hour means) at 0Z, 6Z, 12Z, and 18Z and should be collected only for the following experiments and years:

| <i>experiment</i>   | <i>reporting time-period</i>                  | <i>ensemble size</i> | <i>priority</i> |
|---|---|----------------------|-----------------|
| historical  | Jan 1950 - Dec 2005                           | 1                    | highest         |
| AMIP  | all years                                     | 1                    | highest         |
| RCP4.5 and RCP8.5   | Jan 2006 - Dec 2100                           | 1 for each expt.     | highest         |
| decadal hindcasts/forecasts runs initialized in late 2005 and late 1980 | late 2016 - Dec 2035 and late 1991 - Dec 2010 | 3 for each period    | lower           |
| decadal hindcasts/forecasts runs initialized in late 1990               | all years                                     | 3                    | lower           |

| <i>priority</i> | <b>long name</b>     | <b>units</b>      | <b>comment</b>                                | <b>questions</b>    | <b>output variable name</b> | <b>standard name</b> |
|-----------------|----------------------|-------------------|---|---------------------|-----------------------------|----------------------|
|                 | 1                    | Air Temperature   | K   | on all model levels |                             | ta                   |
| 1               | Eastward Wind        | m s <sup>-1</sup> | on all model levels                           |                     | ua                          | eastward_wind        |
| 1               | Northward Wind       | m s <sup>-1</sup> | on all model levels                           |                     | va                          | northward_wind       |
| 1               | Specific Humidity    | 1                 | on all model levels                           |                     | hus                         | specific_humidity    |
| 1               | Surface Air Pressure | Pa                | surface pressure, not mean sea level pressure |                     | ps                          | surface_air_pressure |

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|--------------------|---------------------|-----------------|-------------|------------------------------------|-----------------|-------------|--------------|------------------|----------------------|--------------------|----------------------|
| <b>units</b>       | <b>cell_methods</b> | <b>positive</b> | <b>type</b> | <b>CMOR dimensions</b>             | <b>variable</b> | <b>name</b> | <b>realm</b> | <b>frequency</b> | <b>cell_measures</b> | <b>flag_values</b> | <b>flag_meanings</b> |
| K                  |                     |                 | real        | longitude latitude alevel<br>time1 | ta              | atmos       |              |                  | area: areacella      |                    |                      |
| m s-1              |                     |                 | real        | longitude latitude alevel<br>time1 | ua              | atmos       |              |                  |                      |                    |                      |
| m s-1              |                     |                 | real        | longitude latitude alevel<br>time1 | va              | atmos       |              |                  |                      |                    |                      |
| 1                  |                     |                 | real        | longitude latitude alevel<br>time1 | hus             | atmos       |              |                  | area: areacella      |                    |                      |
| Pa                 |                     |                 | real        | longitude latitude time1           | ps              | atmos       |              |                  | area: areacella      |                    |                      |

## CMOR Table 6hrPlev: Fields (Sampled Every 6 Hours) for Storm-Track Analysis and other Advanced Diagnostic Applications

6hrPlev

6hr

The 6-hourly data on pressure levels should be sampled as "*snapshots*" (*not* as 6-hour means) at 0Z, 6Z, 12Z, and 18Z and should be collected only for the following experiments and years.

| <i>experiment</i>              | <i>time-period requested</i>  |
|--------------------------------|---|
| decadal hindcasts/forecasts    | all years   |
| historical                     | Jan 1950 - Dec 2005   |
| AMIP & 2030 time-slice         | all years   |
| RCP4.5 and RCP8.5              | Jan 2006 - Dec 2100   |
| preindustrial control          | 30 years -- preferably<br>corresponding to years 1979-2008<br>of the historical run |
| Last glacial maximum paleo-run | last 30 years   |
| mid-Holocene paleo- run        | last 30 years   |

| <i>Priority</i> | long name          | units             | comment   | questions | output variable |                           |
|-----------------|--------------------|-------------------|---|-----------|-----------------|---------------------------|
|                 |                    |                   |   |           | name            | standard name             |
| 1               | Eastward Wind      | m s <sup>-1</sup> | on the following pressure levels: 850, 500, 250 hPa |           | ua              | eastward_wind             |
| 1               | Northward Wind     | m s <sup>-1</sup> | on the following pressure levels: 850, 500, 250 hPa |           | va              | northward_wind            |
| 1               | Air Temperature    | K                 | on the following pressure levels: 850, 500, 250 hPa |           | ta              | air_temperature           |
| 1               | Sea Level Pressure | Pa                |   |           | psl             | air_pressure_at_sea_level |

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|-------------|--------------|----------|------|-----------------------------------|---------------|-------|-----------|-----------------|-------------|---------------|
| units       | cell_methods | positive | type | CMOR dimensions                   | variable name | realm | frequency | cell_measures   | flag_values | flag_meanings |
| m s-1       |              |          | real | longitude latitude plev3<br>time1 | ua            | atmos |           |                 |             |               |
| m s-1       |              |          | real | longitude latitude plev3<br>time1 | va            | atmos |           |                 |             |               |
| K           |              |          | real | longitude latitude plev3<br>time1 | ta            | atmos |           | area: areacella |             |               |
| Pa          |              |          | real | longitude latitude time1          | psl           | atmos |           | area: areacella |             |               |

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### CMOR Table 3hr: 2-D Atmospheric and Surface Fields Sampled Every 3 Hours

3hr

3hr

All fields are saved on the atmospheric grid. Precipitation, clouds, and all flux variables are averaged over 3-hour intervals (0-3Z, 3-6Z, 6-9Z, 9-12Z, 12-15Z, 15-18Z, 18-21Z, 21-24Z). All other fields are sampled synoptically at 0Z, 3Z, 6Z, 9Z, 12Z, 15Z, 18Z, and 21Z.

The 3-hourly data should be collected only for the following experiments and years:

| <i>experiment</i>  | <i>time-period requested</i>  |
|--|---|
| decadal hindcasts/forecasts  | all years   |
| historical   | Jan 1960 - Dec 2005   |
| AMIP & future 2030 time-slice  | all years   |
| future simulations driven by RCP concentrations or emissions   | Jan 2026 - Dec 2045, Jan 2081-Dec 2100, 2181-2200, and 2281-2300                                |
| pre-industrial control   | 30 years (ideally the years corresponding to the last 30 years of abrupt 4xCO <sub>2</sub> run) |
| 1 percent per year CO <sub>2</sub>   | last 30 years   |
| control SST climatology (6.2a)   | all years   |
| CO <sub>2</sub> forcing (6.2b), anthropogenic aerosol forcing (6.4a), and sulfate aerosol forcing (6.4b) | all years   |
| abrupt 4XCO <sub>2</sub> (6.3)   | first 5 years and last 30 years   |
| abrupt 4XCO <sub>2</sub> ensemble (6.3-E)  | all years   |

| <i>Priority</i> |   |                                    | <b>output variable</b>   |                  |             |   |
|-----------------|---|------------------------------------|--|------------------|-------------|---|
|                 | <b>long name</b>                        | <b>units</b>                       | <b>comment</b>   | <b>questions</b> | <b>name</b> | <b>standard name</b>                      |
| 1               | Precipitation                           | kg m <sup>-2</sup> s <sup>-1</sup> | at surface; includes both liquid and solid phases. This is the 3-hour mean precipitation flux. |                  | pr          | precipitation_flux                        |
| 1               | Air Temperature                         | K                                  | near-surface (usually, 2 meter) air temperature, sampled synoptically.                         |                  | tas         | air_temperature                           |
| 1               | Surface Upward Latent Heat Flux         | W m <sup>-2</sup>                  | This is the 3-hour mean flux.  |                  | hfls        | surface_upward_latent_heat_flux           |
| 1               | Surface Upward Sensible Heat Flux       | W m <sup>-2</sup>                  | This is the 3-hour mean flux.  |                  | hfss        | surface_upward_sensible_heat_flux         |
| 1               | Surface Downwelling Longwave Radiation  | W m <sup>-2</sup>                  | This is the 3-hour mean flux.  |                  | rlds        | surface_downwelling_longwave_flux_in_air  |
| 1               | Surface Upwelling Longwave Radiation    | W m <sup>-2</sup>                  | This is the 3-hour mean flux.  |                  | rlus        | surface_upwelling_longwave_flux_in_air    |
| 1               | Surface Downwelling Shortwave Radiation | W m <sup>-2</sup>                  | This is the 3-hour mean flux.  |                  | rsds        | surface_downwelling_shortwave_flux_in_air |
| 1               | Surface Upwelling Shortwave Radiation   | W m <sup>-2</sup>                  | This is the 3-hour mean flux.  |                  | rsus        | surface_upwelling_shortwave_flux_in_air   |
| 1               | Eastward Near-Surface Wind Speed        | m s <sup>-1</sup>                  | sampled synoptically.  |                  | uas         | eastward_wind                             |
| 1               | Northward Near-Surface Wind Speed       | m s <sup>-1</sup>                  | sampled synoptically.  |                  | vas         | northward_wind                            |



| <b>unformatted</b> | <b>CMOR</b>         |                 |             |                                       |                      |              |                  |                      |                    |                      |
|--------------------|---------------------|-----------------|-------------|---------------------------------------|----------------------|--------------|------------------|----------------------|--------------------|----------------------|
| <b>units</b>       | <b>cell_methods</b> | <b>positive</b> | <b>type</b> | <b>CMOR dimensions</b>                | <b>variable name</b> | <b>realm</b> | <b>frequency</b> | <b>cell_measures</b> | <b>flag_values</b> | <b>flag_meanings</b> |
| kg m-2 s-1         | time:mean           |                 | real        | longitude latitude time               | pr                   | atmos        |                  | area: areacella      |                    |                      |
| K                  | time: point         |                 | real        | longitude latitude time l<br>height2m | tas                  | atmos        |                  | area: areacella      |                    |                      |
| W m-2              | time: mean          | up              | real        | longitude latitude time               | hfls                 | atmos        |                  | area: areacella      |                    |                      |
| W m-2              | time: mean          | up              | real        | longitude latitude time               | hfss                 | atmos        |                  | area: areacella      |                    |                      |
| W m-2              | time: mean          | down            | real        | longitude latitude time               | rlds                 | atmos        |                  | area: areacella      |                    |                      |
| W m-2              | time: mean          | up              | real        | longitude latitude time               | rlus                 | atmos        |                  | area: areacella      |                    |                      |
| W m-2              | time: mean          | down            | real        | longitude latitude time               | rsds                 | atmos        |                  | area: areacella      |                    |                      |
| W m-2              | time: mean          | up              | real        | longitude latitude time               | rsus                 | atmos        |                  | area: areacella      |                    |                      |
|                    |                     |                 |             |                                       |                      | atmos        |                  | area: areacella      |                    |                      |
| m s-1              | time: point         |                 | real        | longitude latitude time l<br>height2m | uas                  | atmos        |                  |                      |                    |                      |
| m s-1              | time: point         |                 | real        | longitude latitude time l<br>height2m | vas                  | atmos        |                  |                      |                    |                      |

|   |   |                                    |  |          |  |
|---|---|------------------------------------|--|----------|--|
| 1 | Near-Surface Specific Humidity                    | 1                                  | near-surface (usually 2 m) specific humidity, sampled synoptically.  | huss     | specific_humidity  |
| 1 | Moisture in Upper 0.1 m of Soil Column            | kg m <sup>-2</sup>                 | Compute the mass of water in all phases in the upper 0.1 meters of soil.   | mrsos    | moisture_content_of_soil_layer                               |
| 1 | Surface Temperature Where Land or Sea Ice         | K                                  | "skin" temperature of all surfaces except open ocean, sampled synoptically.  | tslsi    | surface_temperature  |
| 1 | Sea Surface Temperature                           | K                                  | temperature of surface of open ocean, sampled synoptically.  | tso      | sea_surface_temperature                                      |
| 1 | Convective Precipitation                          | kg m <sup>-2</sup> s <sup>-1</sup> | at surface. This is a 3-hour mean convective precipitation flux.   | prc      | convective_precipitation_flux                                |
| 1 | Snowfall Flux                                     | kg m <sup>-2</sup> s <sup>-1</sup> | at surface. Includes all forms of precipitating solid phase of water. This is the 3-hour mean snowfall flux.   | prsn     | snowfall_flux  |
| 1 | Total Runoff                                      | kg m <sup>-2</sup> s <sup>-1</sup> | compute the total runoff (including "drainage" through the base of the soil model) leaving the land portion of the grid cell divided by the land area in the grid cell, averaged over the 3-hour interval. | mrro     | runoff_flux  |
| 1 | Surface Downwelling Clear-Sky Longwave Radiation  | W m <sup>-2</sup>                  | This is a 3-hour mean flux.  | rldscs   | downwelling_longwave_flux_in_air_assuming_clear_sky          |
| 1 | Surface Downwelling Clear-Sky Shortwave Radiation | W m <sup>-2</sup>                  | This is a 3-hour mean flux.  | rsdscs   | surface_downwelling_shortwave_flux_in_air_assuming_clear_sky |
| 1 | Surface Upwelling Clear-Sky Shortwave Radiation   | W m <sup>-2</sup>                  | This is a 3-hour mean flux.  | rluscs   | surface_upwelling_shortwave_flux_in_air_assuming_clear_sky   |
| 1 | Surface Pressure                                  | Pa                                 | sampled synoptically to diagnose atmospheric tides, this is better than mean sea level pressure.   | ps       | surface_air_pressure   |
| 1 | Total Cloud Fraction                              | %                                  | for the whole atmospheric column, as seen from the surface or the top of the atmosphere. Include both large-scale and convective cloud. This is a 3-hour mean.   | clt      | cloud_area_fraction  |
| 1 | Surface Downward Diffuse Shortwave Radiation      | W m <sup>-2</sup>                  | This is a 3-hour mean flux.  | rsdsdiff | surface_diffuse_downwelling_shortwave_flux_in_air            |

|            |                                      |      |      |                                       |          |       |                 |
|------------|--------------------------------------|------|------|---------------------------------------|----------|-------|-----------------|
| 1          | time: point                          |      | real | longitude latitude time l<br>height2m | huss     | atmos | area: areacella |
| kg m-2     | time: point area:<br>mean where land |      | real | longitude latitude time l<br>sdepth1  | mrsos    | land  | area: areacella |
| K          | time: point                          |      | real | longitude latitude time l             | tslsi    | land  | area: areacella |
| K          | time: point area:<br>mean where sea  |      | real | longitude latitude time l             | tso      | ocean | area: areacella |
| kg m-2 s-1 | time:mean                            |      | real | longitude latitude time               | prc      | atmos | area: areacella |
| kg m-2 s-1 | time:mean                            |      | real | longitude latitude time               | prsn     | atmos | area: areacella |
| kg m-2 s-1 | time: mean area:<br>mean where land  |      | real | longitude latitude time               | mrro     | land  | area: areacella |
| W m-2      | time: mean                           | down | real | longitude latitude time               | rldscs   | atmos | area: areacella |
| W m-2      | time: mean                           | down | real | longitude latitude time               | rsdscs   | atmos | area: areacella |
| W m-2      | time: mean                           | up   | real | longitude latitude time               | rluscs   | atmos | area: areacella |
| Pa         | time: point                          |      | real | longitude latitude time l             | ps       | atmos | area: areacella |
| %          | time: mean                           |      | real | longitude latitude time               | clt      | atmos | area: areacella |
| W m-2      | time: mean                           |      | real | longitude latitude time               | rsdsdiff | atmos | area: areacella |

## CMOR Table cfMon: CFMIP Monthly-Mean Cloud Diagnostic Fields

cfMon

mon

(All Saved on the Atmospheric Grid)

For further guidance, please see <http://www.cfmip.net>

The spread sheet "CFMIP output" specifies the simulations and time-periods for which the cloud diagnostic fields listed on this spread sheet should be saved.

In CMOR Table cfMon: "*CFMIP monthly 3D*"-- *monthly mean 3-D fields on model levels (or half levels in the case of fluxes)*. Different GCMs will have different cloud tendency terms due to different model formulations. Please submit the terms which are necessary to close the stratiform cloud water budget of your model. If your model contains terms not listed here, please email [mark.webb@metoffice.gov.uk](mailto:mark.webb@metoffice.gov.uk) to request an update to the table.

| priority | long name   | units             | comment   | questions | output variable name | standard name   |
|----------|---|-------------------|---|-----------|----------------------|---|
| 1        | Upwelling Longwave Radiation  | W m <sup>-2</sup> | Include also the fluxes at the surface and TOA. |           | rlu                  | upwelling_longwave_flux_in_air  |
| 1        | Upwelling Shortwave Radiation   | W m <sup>-2</sup> | Include also the fluxes at the surface and TOA. |           | rsu                  | upwelling_shortwave_flux_in_air   |
| 1        | Downwelling Longwave Radiation  | W m <sup>-2</sup> | Include also the fluxes at the surface and TOA. |           | rld                  | downwelling_longwave_flux_in_air  |
| 1        | Downwelling Shortwave Radiation   | W m <sup>-2</sup> | Include also the fluxes at the surface and TOA. |           | rsd                  | downwelling_shortwave_flux_in_air   |
| 1        | Upwelling Clear-Sky Longwave Radiation  | W m <sup>-2</sup> | Include also the fluxes at the surface and TOA. |           | rllcs                | upwelling_longwave_flux_in_air_assuming_clear_sky   |
| 1        | Upwelling Clear-Sky Shortwave Radiation   | W m <sup>-2</sup> | Include also the fluxes at the surface and TOA. |           | rsucs                | upwelling_shortwave_flux_in_air_assuming_clear_sky  |
| 1        | Downwelling Clear-Sky Longwave Radiation  | W m <sup>-2</sup> | Include also the fluxes at the surface and TOA. |           | rldcs                | downwelling_longwave_flux_in_air_assuming_clear_sky   |
| 1        | Downwelling Clear-Sky Shortwave Radiation   | W m <sup>-2</sup> | Include also the fluxes at the surface and TOA. |           | rsdcs                | downwelling_shortwave_flux_in_air_assuming_clear_sky  |
| 1        | Air Temperature   | K                 |   |           | ta                   | air_temperature   |
| 1        | Tendency of Air Temperature   | K s <sup>-1</sup> |   |           | tnt                  | tendency_of_air_temperature   |
| 1        | Tendency of Air Temperature due to Advection  | K s <sup>-1</sup> |   |           | tnta                 | tendency_of_air_temperature_due_to_advection  |
| 1        | Tendency of Air Temperature due to Diabatic Processes   | K s <sup>-1</sup> |   |           | tntmp                | tendency_of_air_temperature_due_to_model_physics  |
| 1        | Tendency of Air Temperature Due to Stratiform Cloud and Precipitation and Boundary Layer Mixing | K s <sup>-1</sup> |   |           | tntscpl              | tendency_of_air_temperature_due_to_stratiform_cloud_and_precipitation_and_boundary_layer_mixing |
| 1        | Tendency of Air Temperature due to Radiative Heating  | K s <sup>-1</sup> |   |           | tnttr                | tendency_of_air_temperature_due_to_radiative_heating  |
| 1        | Tendency of Air Temperature due to Moist Convection   | K s <sup>-1</sup> |   |           | tntc                 | tendency_of_air_temperature_due_to_convection   |

| unformatted |              |          |      |                 |          | CMOR     |          |           |                 |             |               |
|-------------|--------------|----------|------|-----------------|----------|----------|----------|-----------|-----------------|-------------|---------------|
| units       | cell_methods | positive | type | CMOR dimensions |          | variable | realm    | frequency | cell_measures   | flag_values | flag_meanings |
| W m-2       | time: mean   | up       | real | longitude       | latitude | alevhalf | rlu      | atmos     | area: areacella |             |               |
| W m-2       | time: mean   | up       | real | longitude       | latitude | alevhalf | rsu      | atmos     | area: areacella |             |               |
| W m-2       | time: mean   | down     | real | longitude       | latitude | alevhalf | rld      | atmos     | area: areacella |             |               |
| W m-2       | time: mean   | down     | real | longitude       | latitude | alevhalf | rsd      | atmos     | area: areacella |             |               |
| W m-2       | time: mean   | up       | real | longitude       | latitude | alevhalf | rlucs    | atmos     | area: areacella |             |               |
| W m-2       | time: mean   | up       | real | longitude       | latitude | alevhalf | rsucs    | atmos     | area: areacella |             |               |
| W m-2       | time: mean   | down     | real | longitude       | latitude | alevhalf | rldcs    | atmos     | area: areacella |             |               |
| W m-2       | time: mean   | down     | real | longitude       | latitude | alevhalf | rsdcs    | atmos     | area: areacella |             |               |
| K           | time: mean   |          | real | longitude       | latitude | alevel   | ta       | atmos     | area: areacella |             |               |
| K s-1       | time: mean   |          | real | longitude       | latitude | alevel   | tnt      | atmos     | area: areacella |             |               |
| K s-1       | time: mean   |          | real | longitude       | latitude | alevel   | tnta     | atmos     | area: areacella |             |               |
| K s-1       | time: mean   |          | real | longitude       | latitude | alevel   | tntmp    | atmos     | area: areacella |             |               |
| K s-1       | time: mean   |          | real | longitude       | latitude | alevel   | tntscpbl | atmos     | area: areacella |             |               |
| K s-1       | time: mean   |          | real | longitude       | latitude | alevel   | tnt      | atmos     | area: areacella |             |               |
| K s-1       | time: mean   |          | real | longitude       | latitude | alevel   | tntc     | atmos     | area: areacella |             |               |

|   |  |                                |   |            |   |
|---|--|--------------------------------|---|------------|---|
| 1 | Specific Humidity  | 1                              |   | hus        | specific_humidity   |
| 1 | Tendency of Specific Humidity  | s <sup>-1</sup>                |   | tnhus      | tendency_of_specific_humidity   |
| 1 | Tendency of Specific Humidity due to Advection                                     | s <sup>-1</sup>                |   | tnhusa     | tendency_of_specific_humidity_due_to_advection  |
| 1 | Tendency of Specific Humidity due to Convection                                    | s <sup>-1</sup>                |   | tnhusc     | tendency_of_specific_humidity_due_to_convection   |
| 1 | Tendency of Specific Humidity due to Diffusion                                     | s <sup>-1</sup>                |   | tnhusd     | tendency_of_specific_humidity_due_to_diffusion  |
| 1 | Tendency of Specific Humidity due to Stratiform Cloud Condensation and Evaporation | s <sup>-1</sup>                |   | tnhusscpbl | tendency_of_specific_humidity_due_to_stratiform_cloud_and_precipitation_and_boundary_layer_mixing |
| 1 | Tendency of Specific Humidity due to Model Physics                                 | s <sup>-1</sup>                | This should include sources and sinks from parametrized physics (e.g. convection, stratiform condensation/evaporation, etc.) and should exclude sources and sinks from resolved dynamics and diffusion.   | tnhusmp    | tendency_of_specific_humidity_due_to_model_physics  |
| 1 | Eddy Viscosity Coefficients for Momentum   | m <sup>2</sup> s <sup>-1</sup> |   | eviscu     | atmosphere_momentum_diffusivity   |
| 1 | Eddy Diffusivity Coefficients for Temperature                                      | m <sup>2</sup> s <sup>-1</sup> |   | evisct     | atmosphere_heat_diffusivity   |
| 2 | Convective Cloud Area Fraction   | %                              |   | clc        | convective_cloud_area_fraction_in_atmosphere_layer  |
| 2 | Mass Fraction of Convective Cloud Liquid Water                                     | 1                              | Calculate as the mass of convective cloud liquid water in the grid cell divided by the mass of air (including the water in all phases) in the grid cell. Include precipitating hydrometeors ONLY if the precipitating hydrometeor affects the calculation of radiative transfer in model. | clwc       | mass_fraction_of_convective_cloud_liquid_water_in_air   |
| 2 | Mass Fraction of Convective Cloud Ice  | 1                              | Calculate as the mass of convective cloud ice in the grid cell divided by the mass of air (including the water in all phases) in the grid cell. Include precipitating hydrometeors ONLY if the precipitating hydrometeor affects the calculation of radiative transfer in model.          | clic       | mass_fraction_of_convective_cloud_ice_in_air  |
| 2 | Stratiform Cloud Area Fraction   | %                              |   | cls        | stratiform_cloud_area_fraction_in_atmosphere_layer  |
| 2 | Mass Fraction of Stratiform Cloud Liquid Water                                     | 1                              | Calculate as the mass of stratiform cloud liquid water in the grid cell divided by the mass of air (including the water in all phases) in the grid cell. Include precipitating hydrometeors ONLY if the precipitating hydrometeor affects the calculation of radiative transfer in model. | clws       | mass_fraction_of_stratiform_cloud_liquid_water_in_air   |
| 2 | Mass Fraction of Stratiform Cloud Ice  | 1                              | Calculate as the mass of stratiform cloud ice in the grid cell divided by the mass of air (including the water in all phases) in the grid cell. Include precipitating hydrometeors ONLY if the precipitating hydrometeor affects the calculation of radiative transfer in model.          | clis       | mass_fraction_of_stratiform_cloud_ice_in_air  |

|        |            |      |                   |          |        |           |       |                 |
|--------|------------|------|-------------------|----------|--------|-----------|-------|-----------------|
| 1      | time: mean | real | longitude<br>time | latitude | alevel | hus       | atmos | area: areacella |
| s-1    | time: mean | real | longitude<br>time | latitude | alevel | tnhus     | atmos | area: areacella |
| s-1    | time: mean | real | longitude<br>time | latitude | alevel | tnhusa    | atmos | area: areacella |
| s-1    | time: mean | real | longitude<br>time | latitude | alevel | tnhusc    | atmos | area: areacella |
| s-1    | time: mean | real | longitude<br>time | latitude | alevel | tnhusd    | atmos | area: areacella |
| s-1    | time: mean | real | longitude<br>time | latitude | alevel | tnhuscpbl | atmos | area: areacella |
| s-1    | time: mean | real | longitude<br>time | latitude | alevel | tnhusmp   | atmos | area: areacella |
|        | time: mean |      |                   |          |        |           |       |                 |
| m2 s-1 | time: mean | real | longitude<br>time | latitude | alevel | eviscu    | atmos | area: areacella |
| m2 s-1 | time: mean | real | longitude<br>time | latitude | alevel | evisct    | atmos | area: areacella |
|        |            |      |                   |          |        |           |       | area: areacella |
| %      | time: mean | real | longitude<br>time | latitude | alevel | clc       | atmos | area: areacella |
| 1      | time: mean | real | longitude<br>time | latitude | alevel | clwc      | atmos | area: areacella |
| 1      | time: mean | real | longitude<br>time | latitude | alevel | clic      | atmos | area: areacella |
| %      | time: mean | real | longitude<br>time | latitude | alevel | cls       | atmos | area: areacella |
| 1      | time: mean | real | longitude<br>time | latitude | alevel | clws      | atmos | area: areacella |
| 1      | time: mean | real | longitude<br>time | latitude | alevel | clis      | atmos | area: areacella |

|   |  |                                  |   |             |  |
|---|--|----------------------------------|---|-------------|--|
| 2 | Updraft Convective Mass Flux   | $\text{kg m}^{-2} \text{s}^{-1}$ | Report on model half-levels (i.e., model layer bounds and not standard pressures). Calculate as the convective mass flux divided by the area of the whole grid cell (not just the area of the cloud).   | mcu         | atmosphere_updraft_convective_mass_flux  |
| 2 | Downdraft Convective Mass Flux   | $\text{kg m}^{-2} \text{s}^{-1}$ | Report on model half-levels (i.e., model layer bounds and not standard pressures). Calculate as the convective mass flux divided by the area of the whole grid cell (not just the area of the cloud).   | mcd         | atmosphere_downdraft_convective_mass_flux  |
| 2 | Shallow Convective Mass Flux   | $\text{kg m}^{-2} \text{s}^{-1}$ | Report on model half-levels (i.e., model layer bounds and not standard pressures). The net mass flux should represent the difference between the updraft and downdraft components. For models with a distinct shallow convection scheme, calculate as the convective mass flux divided by the area of the whole grid cell (not just the area of the cloud). | smc         | atmosphere_net_upward_shallow_convective_mass_flux   |
| 2 | Deep Convective Mass Flux  | $\text{kg m}^{-2} \text{s}^{-1}$ | Report on model half-levels (i.e., model layer bounds and not standard pressures). The net mass flux should represent the difference between the updraft and downdraft components. Calculate as the convective mass flux divided by the area of the whole grid cell (not just the area of the cloud).   | dmc         | atmosphere_net_upward_deep_convective_mass_flux  |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Liquid Water In Air  | $\text{s}^{-1}$                  |   | tnslw       | tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air  |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Liquid Water In Air Due To Cloud Microphysics                      | $\text{s}^{-1}$                  |   | tnslwcm     | tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_cloud_microphysics                      |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Liquid Water In Air Due To Boundary Layer Mixing                   | $\text{s}^{-1}$                  |   | tnslwbl     | tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_boundary_layer_mixing                   |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Liquid Water In Air Due To Bergeron Findeisen Process To Cloud Ice | $\text{s}^{-1}$                  |   | tnslwbfpcli | tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_bergeron_findeisen_process_to_cloud_ice |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Liquid Water due to Condensation and Evaporation                   | $\text{s}^{-1}$                  |   | tnslwce     | tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_condensation_and_evaporation            |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Liquid Water Due to Convective Detrainment                         | $\text{s}^{-1}$                  |   | tnslwcd     | tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_convective_detrainment                  |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Liquid Water due to Homogeneous Nucleation                         | $\text{s}^{-1}$                  |   | tnslwhon    | tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_homogeneous_nucleation                  |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Liquid Water due to Heterogeneous Nucleation                       | $\text{s}^{-1}$                  |   | tnslwhen    | tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_heterogeneous_nucleation                |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Liquid Water due to Riming   | $\text{s}^{-1}$                  |   | tnslwri     | tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_riming                                  |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Liquid Water due to Accretion to Rain                              | $\text{s}^{-1}$                  |   | tnslwar     | tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_accretion_to_rain                       |



|            |            |      |      |                   |          |          |             |       |                 |
|------------|------------|------|------|-------------------|----------|----------|-------------|-------|-----------------|
| kg m-2 s-1 | time: mean | up   | real | longitude<br>time | latitude | alevhalf | mcu         | atmos | area: areacella |
| kg m-2 s-1 | time: mean | down | real | longitude<br>time | latitude | alevhalf | mcd         | atmos | area: areacella |
| kg m-2 s-1 | time: mean | up   | real | longitude<br>time | latitude | alevhalf | smc         | atmos | area: areacella |
| kg m-2 s-1 | time: mean | up   | real | longitude<br>time | latitude | alevhalf | dmc         | atmos | area: areacella |
| s-1        | time: mean |      | real | longitude<br>time | latitude | alevel   | tnsclw      | atmos | area: areacella |
| s-1        | time: mean |      | real | longitude<br>time | latitude | alevel   | tnsclwcm    | atmos | area: areacella |
| s-1        | time: mean |      | real | longitude<br>time | latitude | alevel   | tnsclwbl    | atmos | area: areacella |
| s-1        | time: mean |      | real | longitude<br>time | latitude | alevel   | tnsclwbfcli | atmos | area: areacella |
| s-1        | time: mean |      | real | longitude<br>time | latitude | alevel   | tnsclwce    | atmos | area: areacella |
| s-1        | time: mean |      | real | longitude<br>time | latitude | alevel   | tnsclwcd    | atmos | area: areacella |
| s-1        | time: mean |      | real | longitude<br>time | latitude | alevel   | tnsclwhon   | atmos | area: areacella |
| s-1        | time: mean |      | real | longitude<br>time | latitude | alevel   | tnsclwhen   | atmos | area: areacella |
| s-1        | time: mean |      | real | longitude<br>time | latitude | alevel   | tnsclwri    | atmos | area: areacella |
| s-1        | time: mean |      | real | longitude<br>time | latitude | alevel   | tnsclwar    | atmos | area: areacella |

|   |  |                 |   |            |  |
|---|--|-----------------|---|------------|--|
| 2 | Tendency of Mass Fraction of Stratiform Cloud Liquid Water due to Accretion to Snow                          | s <sup>-1</sup> |   | tnsclwas   | tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_accretion_to_snow                       |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Liquid Water due to Melting From Cloud Ice                     | s <sup>-1</sup> |   | tnsclwmi   | tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_melting_from_cloud_ice                  |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Liquid Water due to Autoconversion                             | s <sup>-1</sup> |   | tnsclwac   | tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_autoconversion                          |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Liquid Water due to Advection                                  | s <sup>-1</sup> |   | tnsclwa    | tendency_of_mass_fraction_of_stratiform_cloud_liquid_water_in_air_due_to_advection                               |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Ice In Air   | s <sup>-1</sup> |   | tnscli     | tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air   |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Ice In Air Due To Cloud Microphysics                           | s <sup>-1</sup> |   | tnsclm     | tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_cloud_microphysics                               |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Ice In Air Due To Boundary Layer Mixing                        | s <sup>-1</sup> |   | tnsclibl   | tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_boundary_layer_mixing                            |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Ice In Air Due To Bergeron Findeisen Process from Cloud Liquid | s <sup>-1</sup> |   | tnsclibfpc | tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_bergeron_findeisen_process_from_cloud_liquid     |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Ice Due Convective Detrainment                                 | s <sup>-1</sup> | Tendency of Mass Fraction of Stratiform Cloud Ice Due to Convective Detrainment | tnsclid    | tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_convective_detrainment                           |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Ice due to Homogeneous Nucleation                              | s <sup>-1</sup> |   | tnsclihon  | tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_homogeneous_nucleation                           |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Ice due to Heterogeneous Nucleation From Cloud Liquid          | s <sup>-1</sup> |   | tnsclihenc | tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_heterogeneous_nucleation_from_cloud_liquid_water |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Ice due to Heterogeneous Nucleation From Water Vapor           | s <sup>-1</sup> |   | tnsclihenv | tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_heterogeneous_nucleation_from_water_vapor        |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Ice due to Riming From Cloud Liquid                            | s <sup>-1</sup> |   | tnscliric  | tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_riming_from_cloud_liquid_water                   |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Ice due to Riming From Rain                                    | s <sup>-1</sup> |   | tnsclirir  | tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_riming_from_rain                                 |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Ice due to Deposition and Sublimation                          | s <sup>-1</sup> |   | tnsclids   | tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_deposition_and_sublimation                       |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Ice due to Aggregation   | s <sup>-1</sup> |   | tnscliag   | tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_aggregation                                      |

|     |            |      |                   |          |        |             |       |                 |
|-----|------------|------|-------------------|----------|--------|-------------|-------|-----------------|
| s-1 | time: mean | real | longitude<br>time | latitude | alevel | tnsclwas    | atmos | area: areacella |
| s-1 | time: mean | real | longitude<br>time | latitude | alevel | tnsclwmi    | atmos | area: areacella |
| s-1 | time: mean | real | longitude<br>time | latitude | alevel | tnsclwac    | atmos | area: areacella |
| s-1 | time: mean | real | longitude<br>time | latitude | alevel | tnsclwa     | atmos | area: areacella |
| s-1 | time: mean | real | longitude<br>time | latitude | alevel | tnscli      | atmos | area: areacella |
| s-1 | time: mean | real | longitude<br>time | latitude | alevel | tnsclcm     | atmos | area: areacella |
| s-1 | time: mean | real | longitude<br>time | latitude | alevel | tnsclibl    | atmos | area: areacella |
| s-1 | time: mean | real | longitude<br>time | latitude | alevel | tnsclibfpc1 | atmos | area: areacella |
| s-1 | time: mean | real | longitude<br>time | latitude | alevel | tnsclcd     | atmos | area: areacella |
| s-1 | time: mean | real | longitude<br>time | latitude | alevel | tnsclihon   | atmos | area: areacella |
| s-1 | time: mean | real | longitude<br>time | latitude | alevel | tnsclihenc1 | atmos | area: areacella |
| s-1 | time: mean | real | longitude<br>time | latitude | alevel | tnsclihenv  | atmos | area: areacella |
| s-1 | time: mean | real | longitude<br>time | latitude | alevel | tnscliric1  | atmos | area: areacella |
| s-1 | time: mean | real | longitude<br>time | latitude | alevel | tnsclirir   | atmos | area: areacella |
| s-1 | time: mean | real | longitude<br>time | latitude | alevel | tnsclids    | atmos | area: areacella |
| s-1 | time: mean | real | longitude<br>time | latitude | alevel | tnscliag    | atmos | area: areacella |

|   |   |                 |   |           |  |
|---|---|-----------------|---|-----------|--|
| 2 | Tendency of Mass Fraction of Stratiform Cloud Ice due to Accretion to Snow                        | s <sup>-1</sup> |   | tnsclias  | tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_accretion_to_snow                        |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Ice due to Evaporation of Melting Ice               | s <sup>-1</sup> |   | tnscliemi | tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_evaporation_of_melting_ice               |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Ice due to Melting to Rain                          | s <sup>-1</sup> |   | tnsclimr  | tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_melting_to_rain                          |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Ice due to Melting to Cloud Liquid                  | s <sup>-1</sup> |   | tnsclimcl | tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_melting_to_cloud_liquid_water            |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Ice due to Icefall                                  | s <sup>-1</sup> |   | tnscliif  | tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_icefall                                  |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Ice due to Advection                                | s <sup>-1</sup> |   | tnsclia   | tendency_of_mass_fraction_of_stratiform_cloud_ice_in_air_due_to_advection                                |
|   |   |                 |   |           |  |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Condensed Water In Air                              | s <sup>-1</sup> |   | tnscw     | tendency_of_mass_fraction_of_stratiform_cloud_condensed_water_in_air                                     |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Condensed Water In Air Due To Cloud Microphysics    | s <sup>-1</sup> |   | tnscwcm   | tendency_of_mass_fraction_of_stratiform_cloud_condensed_water_in_air_due_to_cloud_microphysics           |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Condensed Water In Air Due To Boundary Layer Mixing | s <sup>-1</sup> |   | tnscwbl   | tendency_of_mass_fraction_of_stratiform_cloud_condensed_water_in_air_due_to_boundary_layer_mixing        |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Condensed Water due to Condensation and Evaporation | s <sup>-1</sup> | condensed water includes both liquid and ice. | tnscwce   | tendency_of_mass_fraction_of_stratiform_cloud_condensed_water_in_air_due_to_condensation_and_evaporation |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Condensed Water due to Autoconversion to Rain       | s <sup>-1</sup> | condensed water includes both liquid and ice. | tnscwacr  | tendency_of_mass_fraction_of_stratiform_cloud_condensed_water_in_air_due_to_autoconversion_to_rain       |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Condensed Water due to Autoconversion to Snow       | s <sup>-1</sup> | condensed water includes both liquid and ice. | tnscwacs  | tendency_of_mass_fraction_of_stratiform_cloud_condensed_water_in_air_due_to_autoconversion_to_snow       |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Condensed Water due to Icefall                      | s <sup>-1</sup> | condensed water includes both liquid and ice. | tnscwif   | tendency_of_mass_fraction_of_stratiform_cloud_condensed_water_in_air_due_to_icefall                      |
| 2 | Tendency of Mass Fraction of Stratiform Cloud Condensed Water due to Advection                    | s <sup>-1</sup> | condensed water includes both liquid and ice. | tnscwa    | tendency_of_mass_fraction_of_stratiform_cloud_condensed_water_in_air_due_to_advection                    |

|     |            |      |                                   |           |       |                 |
|-----|------------|------|-----------------------------------|-----------|-------|-----------------|
| s-1 | time: mean | real | longitude latitude alevel<br>time | tnsclias  | atmos | area: areacella |
| s-1 | time: mean | real | longitude latitude alevel<br>time | tnscliemi | atmos | area: areacella |
| s-1 | time: mean | real | longitude latitude alevel<br>time | tnsclimr  | atmos | area: areacella |
| s-1 | time: mean | real | longitude latitude alevel<br>time | tnsclimcl | atmos | area: areacella |
| s-1 | time: mean | real | longitude latitude alevel<br>time | tnscliif  | atmos | area: areacella |
| s-1 | time: mean | real | longitude latitude alevel<br>time | tnsclia   | atmos | area: areacella |
|     |            |      |                                   |           |       |                 |
| s-1 | time: mean | real | longitude latitude alevel<br>time | tnscw     | atmos | area: areacella |
| s-1 | time: mean | real | longitude latitude alevel<br>time | tnscwcm   | atmos | area: areacella |
| s-1 | time: mean | real | longitude latitude alevel<br>time | tnscwbl   | atmos | area: areacella |
| s-1 | time: mean | real | longitude latitude alevel<br>time | tnscwce   | atmos | area: areacella |
| s-1 | time: mean | real | longitude latitude alevel<br>time | tnscwacr  | atmos | area: areacella |
| s-1 | time: mean | real | longitude latitude alevel<br>time | tnscwacs  | atmos | area: areacella |
| s-1 | time: mean | real | longitude latitude alevel<br>time | tnscwif   | atmos | area: areacella |
| s-1 | time: mean | real | longitude latitude alevel<br>time | tnscwa    | atmos | area: areacella |

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In CMOR Table **cfMon**: "*CFMIP monthly 4xCO2 2D*" -- *monthly mean 2D TOA radiative fluxes calculated by instantaneously quadrupling CO2.*

| <i>priority</i> | <b>long name</b>  | <b>units</b>      | <b>comment</b> | <b>questions</b> | <b>output variable name</b> | <b>standard name</b>                           |
|-----------------|---|-------------------|----------------|------------------|-----------------------------|--|
| 1               | TOA Outgoing Shortwave Radiation in 4XCO2 Atmosphere        | W m <sup>-2</sup> |                |                  | rsut4co2                    | toa_outgoing_shortwave_flux                    |
| 1               | TOA Outgoing Longwave Radiation 4XCO2 Atmosphere            | W m <sup>-2</sup> |                |                  | rlut4co2                    | toa_outgoing_longwave_flux                     |
| 1               | TOA Outgoing Clear-Sky Shortwave Radiation 4XCO2 Atmosphere | W m <sup>-2</sup> |                |                  | rsutcs4co2                  | toa_outgoing_shortwave_flux_assuming_clear_sky |
| 1               | TOA Outgoing Clear-Sky Longwave Radiation 4XCO2 Atmosphere  | W m <sup>-2</sup> |                |                  | rlutcs4co2                  | toa_outgoing_longwave_flux_assuming_clear_sky  |

In CMOR Table **cfMon**: "*CFMIP monthly 4xCO2 3D*" -- *monthly mean 3-D radiative fluxes calculated by instantaneously quadrupling CO2. On model half levels, including the surface and the Top of the Atmosphere.*

| <i>priority</i> | <b>long name</b>   | <b>units</b>      | <b>comment</b> | <b>questions</b> | <b>output variable name</b> | <b>standard name</b>                                 |
|-----------------|--|-------------------|----------------|------------------|-----------------------------|--|
| 1               | Upwelling Longwave Radiation 4XCO2 Atmosphere              | W m <sup>-2</sup> |                |                  | rlu4co2                     | upwelling_longwave_flux_in_air                       |
| 1               | Upwelling Shortwave Radiation 4XCO2 Atmosphere             | W m <sup>-2</sup> |                |                  | rsu4co2                     | upwelling_shortwave_flux_in_air                      |
| 1               | Downwelling Longwave Radiation 4XCO2 Atmosphere            | W m <sup>-2</sup> |                |                  | rld4co2                     | downwelling_longwave_flux_in_air                     |
| 1               | Downwelling Shortwave Radiation 4XCO2 Atmosphere           | W m <sup>-2</sup> |                |                  | rsd4co2                     | downwelling_shortwave_flux_in_air                    |
| 1               | Upwelling Clear-Sky Longwave Radiation 4XCO2 Atmosphere    | W m <sup>-2</sup> |                |                  | rlucs4co2                   | upwelling_longwave_flux_in_air_assuming_clear_sky    |
| 1               | Upwelling Clear-Sky Shortwave Radiation 4XCO2 Atmosphere   | W m <sup>-2</sup> |                |                  | rsucs4co2                   | upwelling_shortwave_flux_in_air_assuming_clear_sky   |
| 1               | Downwelling Clear-Sky Longwave Radiation 4XCO2 Atmosphere  | W m <sup>-2</sup> |                |                  | rldcs4co2                   | downwelling_longwave_flux_in_air_assuming_clear_sky  |
| 1               | Downwelling Clear-Sky Shortwave Radiation 4XCO2 Atmosphere | W m <sup>-2</sup> |                |                  | rsdcs4co2                   | downwelling_shortwave_flux_in_air_assuming_clear_sky |

| <b>unformatted<br/>units</b> | <b>cell_methods</b> | <b>positive</b> | <b>type</b> | <b>CMOR dimensions</b>  | <b>CMOR<br/>variable<br/>name</b> | <b>realm</b> | <b>frequency</b> | <b>cell_measures</b> | <b>flag_values</b> | <b>flag_meanings</b> |
|------------------------------|---------------------|-----------------|-------------|-------------------------|-----------------------------------|--------------|------------------|----------------------|--------------------|----------------------|
| W m-2                        | time: mean          | up              | real        | longitude latitude time | rsut4co2                          | atmos        |                  | area: areacella      |                    |                      |
| W m-2                        | time: mean          | up              | real        | longitude latitude time | rlut4co2                          | atmos        |                  | area: areacella      |                    |                      |
| W m-2                        | time: mean          | up              | real        | longitude latitude time | rsutcs4co2                        | atmos        |                  | area: areacella      |                    |                      |
| W m-2                        | time: mean          | up              | real        | longitude latitude time | rlutcs4co2                        | atmos        |                  | area: areacella      |                    |                      |

| <b>unformatted<br/>units</b> | <b>cell_methods</b> | <b>positive</b> | <b>type</b> | <b>CMOR dimensions</b>              | <b>CMOR<br/>variable<br/>name</b> | <b>realm</b> | <b>frequency</b> | <b>cell_measures</b> | <b>flag_values</b> | <b>flag_meanings</b> |
|------------------------------|---------------------|-----------------|-------------|-------------------------------------|-----------------------------------|--------------|------------------|----------------------|--------------------|----------------------|
| W m-2                        | time: mean          | up              | real        | longitude latitude alevhalf<br>time | rlu4co2                           | atmos        |                  | area: areacella      |                    |                      |
| W m-2                        | time: mean          | up              | real        | longitude latitude alevhalf<br>time | rsu4co2                           | atmos        |                  | area: areacella      |                    |                      |
| W m-2                        | time: mean          | down            | real        | longitude latitude alevhalf<br>time | rld4co2                           | atmos        |                  | area: areacella      |                    |                      |
| W m-2                        | time: mean          | down            | real        | longitude latitude alevhalf<br>time | rsd4co2                           | atmos        |                  | area: areacella      |                    |                      |
| W m-2                        | time: mean          | up              | real        | longitude latitude alevhalf<br>time | rlucs4co2                         | atmos        |                  | area: areacella      |                    |                      |
| W m-2                        | time: mean          | up              | real        | longitude latitude alevhalf<br>time | rsucs4co2                         | atmos        |                  | area: areacella      |                    |                      |
| W m-2                        | time: mean          | down            | real        | longitude latitude alevhalf<br>time | rldcs4co2                         | atmos        |                  | area: areacella      |                    |                      |
| W m-2                        | time: mean          | down            | real        | longitude latitude alevhalf<br>time | rsdcs4co2                         | atmos        |                  | area: areacella      |                    |                      |

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**In CMOR Table cfMon: "CFMIP monthly inline" -- monthly mean in line ISCCP and CALIPSO/PARASOL simulator output**


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| Priority | long name                         | units | comment   | questions | output variable<br>name | standard name                           |
|----------|-----------------------------------|-------|---|-----------|-------------------------|---|
| 1        | ISCCP Total Cloud Fraction        | %     |   |           | cltisccp                | cloud_area_fraction                     |
| 1        | ISCCP Mean Cloud Albedo           | 1     | When computing time-means, weight by the ISCCP Total Cloud Fraction - see <a href="http://www.cf mip.net/README">http://www.cf mip.net/README</a> |           | albiscpp                | cloud_albedo                            |
| 1        | ISCCP Mean Cloud Top Pressure     | Pa    | When computing time-means, weight by the ISCCP Total Cloud Fraction - see <a href="http://www.cf mip.net/README">http://www.cf mip.net/README</a> |           | ctpisccp                | air_pressure_at_cloud_top               |
| 1        | ISCCP Cloud Area Fraction         | %     | 7 levels x 7 tau  |           | clisccp                 | isccp_cloud_area_fraction               |
| 1        | CALIPSO Total Cloud Fraction      | %     |   |           | cltcalipso              | cloud_area_fraction                     |
| 1        | CALIPSO Low Level Cloud Fraction  | %     |   |           | cllcalipso              | cloud_area_fraction_in_atmosphere_layer |
| 1        | CALIPSO Mid Level Cloud Fraction  | %     |   |           | clmcalipso              | cloud_area_fraction_in_atmosphere_layer |
| 1        | CALIPSO High Level Cloud Fraction | %     |   |           | clhcalipso              | cloud_area_fraction_in_atmosphere_layer |
| 1        | CALIPSO Cloud Fraction            | %     | 40 height levels  |           | clcalipso               | cloud_area_fraction_in_atmosphere_layer |
| 1        | PARASOL Reflectance               | 1     | 5 bins of solar zenith angle. This is reflectance as seen at the top of the atmosphere.   |           | parasolRefl             | toa_bidirectional_reflectance           |



| unformatted | cell_methods | positive | type | CMOR dimensions                      | CMOR variable name | realm | frequency | cell_measures   | flag_values | flag_meanings |
|-------------|--------------|----------|------|--------------------------------------|--------------------|-------|-----------|-----------------|-------------|---------------|
| %           | time: mean   |          | real | longitude latitude time              | cltisccp           | atmos |           | area: areacella |             |               |
| 1           | time: mean   |          | real | longitude latitude time              | albisccp           | atmos |           | area: areacella |             |               |
| Pa          | time: mean   |          | real | longitude latitude time              | ctpisccp           | atmos |           | area: areacella |             |               |
| %           | time: mean   |          | real | longitude latitude plev7<br>tau time | clisccp            | atmos |           | area: areacella |             |               |
| %           | time: mean   |          | real | longitude latitude time              | cltcalipso         | atmos |           | area: areacella |             |               |
| %           | time: mean   |          | real | longitude latitude time<br>p840      | cllcalipso         | atmos |           | area: areacella |             |               |
| %           | time: mean   |          | real | longitude latitude time<br>p560      | clmcalipso         | atmos |           | area: areacella |             |               |
| %           | time: mean   |          | real | longitude latitude time<br>p220      | clhcalipso         | atmos |           | area: areacella |             |               |
| %           | time: mean   |          | real | longitude latitude alt40<br>time     | clcalipso          | atmos |           | area: areacella |             |               |
| 1           | time: mean   |          | real | longitude latitude sza5<br>time      | parasolRef1        | atmos |           | area: areacella |             |               |

## CMOR Table cfOff: "CFMIP monthly offline" Cloud Diagnostic Fields

cfOff

mon

(All Saved on the Atmospheric Grid)

For further guidance, please see <http://www.cfmip.net>

The spread sheet "CFMIP output" specifies the simulations and time-periods for which the cloud diagnostic fields listed on this spread sheet should be saved.

### CMOR Table cfOff: "CFMIP monthly offline" -- monthly mean CloudSat/CALIPSO/PARASOL simulator output

(Calculate monthly means by averaging the orbital curtain output from CFMIP\_orbital\_offline. The difference between similar variables appearing in this and the previous table is in the spatial sampling and time period requested. The previous table builds monthly means from global fields, whereas this table below uses only data along the satellite track for a short period of time (one year). This will enable studies of the impact of the satellite sampling in the comparisons.)

| Priority | long name                                     | units | comment   | questions | output variable |   |
|----------|---|-------|---|-----------|-----------------|---|
|          |   |       |   |           | name            | standard name   |
| 1        | CALIPSO Cloud Fraction                        | %     | (40 height levels)  |           | clcalipso       | cloud_area_fraction_in_atmosphere_layer   |
| 1        | CALIPSO Cloud Fraction Undetected by CloudSat | %     | (40 height levels) Clouds detected by CALIPSO but below the detectability threshold of CloudSat   |           | clcalipso2      | cloud_area_fraction_in_atmosphere_layer   |
| 1        | CloudSat Radar Reflectivity                   | 1     | CFADs (Cloud Frequency Altitude Diagrams) are joint height - radar reflectivity (or lidar scattering ratio) distributions (40 levelsx15 bins) .   |           | cfadDbze94      | histogram_of_equivalent_reflectivity_factor_over_height_above_reference_ellipsoid |
| 1        | CALIPSO Scattering Ratio                      | 1     | CFADs (Cloud Frequency Altitude Diagrams) are joint height - radar reflectivity (or lidar scattering ratio) distributions (40 levelsx15 bins) .   |           | cfadLidarsr532  | histogram_of_backscattering_ratio_over_height_above_reference_ellipsoid           |
| 1        | PARASOL Reflectance                           | 1     | Simulated reflectance from PARASOL as seen at the top of the atmosphere for 5 solar zenith angles. Valid only over ocean and for one viewing direction (viewing zenith angle of 30 degrees and relative azimuth angle 320 degrees). |           | parasolRefl     | toa_bidirectional_reflectance   |
| 1        | CALIPSO Total Cloud Fraction                  | %     |   |           | cltcalipso      | cloud_area_fraction   |
| 1        | CALIPSO Low Level Cloud Fraction              | %     |   |           | cllcalipso      | cloud_area_fraction_in_atmosphere_layer   |
| 1        | CALIPSO Mid Level Cloud Fraction              | %     |   |           | clmcalipso      | cloud_area_fraction_in_atmosphere_layer   |
| 1        | CALIPSO High Level Cloud Fraction             | %     |   |           | clhcalipso      | cloud_area_fraction_in_atmosphere_layer   |

| unformatted |              |          |      | CMOR                                    |                |       |           |                 |             |               |  |
|-------------|--------------|----------|------|---|----------------|-------|-----------|-----------------|-------------|---------------|--|
| units       | cell_methods | positive | type | CMOR dimensions                         | variable name  | realm | frequency | cell_measures   | flag_values | flag_meanings |  |
| %           | time: mean   |          | real | longitude latitude alt40 time           | clcalipso      | atmos |           | area: areacella |             |               |  |
| %           | time: mean   |          | real | longitude latitude alt40 time           | clcalipso2     | atmos |           | area: areacella |             |               |  |
| 1           | time: mean   |          | real | longitude latitude alt40 dbze time      | cfadDbze94     | atmos |           | area: areacella |             |               |  |
| 1           | time: mean   |          | real | longitude latitude alt40 scatratio time | cfadLidarsr532 | atmos |           | area: areacella |             |               |  |
| 1           | time: mean   |          | real | longitude latitude sza5 time            | parasolRefl    | atmos |           | area: areacella |             |               |  |
| %           | time: mean   |          | real | longitude latitude time                 | cltcalipso     | atmos |           | area: areacella |             |               |  |
| %           | time: mean   |          | real | longitude latitude time p840            | cllcalipso     | atmos |           | area: areacella |             |               |  |
| %           | time: mean   |          | real | longitude latitude time p560            | clmcalipso     | atmos |           | area: areacella |             |               |  |
| %           | time: mean   |          | real | longitude latitude time p220            | clhcalipso     | atmos |           | area: areacella |             |               |  |

## CMOR Table cfDay: CFMIP Daily-Mean Cloud Diagnostic Fields

cfDay

day

(All Saved on the Atmospheric Grid)

For further guidance, please see <http://www.cfmip.net>

The spread sheet "CFMIP output" specifies the simulations and time-periods for which the cloud diagnostic fields listed on this spread sheet should be saved.

In CMOR Table cfDay: "CFMIP daily 2D" -- daily mean 2-D fields including inline ISCCP/CloudSat/CALIPSO/ PARASOL simulator output

| priority | long name   | units              | comment  | questions | output variable |  |
|----------|---|--------------------|--|-----------|-----------------|--|
|          |   |                    |  |           | name            | standard name  |
| 1        | Surface Air Pressure                              | Pa                 |  |           | ps              | surface_air_pressure   |
| 1        | TOA Incident Shortwave Radiation                  | W m <sup>-2</sup>  |  |           | rsdt            | toa_incoming_shortwave_flux                                  |
| 1        | TOA Outgoing Shortwave Radiation                  | W m <sup>-2</sup>  |  |           | rsut            | toa_outgoing_shortwave_flux                                  |
| 1        | Surface Downwelling Clear-Sky Shortwave Radiation | W m <sup>-2</sup>  |  |           | rsdscs          | surface_downwelling_shortwave_flux_in_air_assuming_clear_sky |
| 1        | Surface Upwelling Clear-Sky Shortwave Radiation   | W m <sup>-2</sup>  |  |           | rsuscs          | surface_upwelling_shortwave_flux_in_air_assuming_clear_sky   |
| 1        | Surface Downwelling Clear-Sky Longwave Radiation  | W m <sup>-2</sup>  |  |           | rldscs          | surface_downwelling_longwave_flux_in_air_assuming_clear_sky  |
| 1        | TOA Outgoing Clear-Sky Longwave Radiation         | W m <sup>-2</sup>  |  |           | rlutcs          | toa_outgoing_longwave_flux_assuming_clear_sky                |
| 1        | TOA Outgoing Clear-Sky Shortwave Radiation        | W m <sup>-2</sup>  |  |           | rsutcs          | toa_outgoing_shortwave_flux_assuming_clear_sky               |
| 1        | Total Cloud Fraction                              | %                  | for the whole atmospheric column, as seen from the surface or the top of the atmosphere. Include both large-scale and convective cloud.  |           | clt             | cloud_area_fraction  |
| 1        | Condensed Water Path                              | kg m <sup>-2</sup> | calculate mass of condensed (liquid + ice) water in the column divided by the area of the column (not just the area of the cloudy portion of the column). Include precipitating hydrometeors ONLY if the precipitating hydrometeor affects the calculation of radiative transfer in model. |           | clwvi           | atmosphere_cloud_condensed_water_content                     |
| 1        | Ice Water Path                                    | kg m <sup>-2</sup> | calculate mass of ice water in the column divided by the area of the column (not just the area of the cloudy portion of the column). Include precipitating frozen hydrometeors ONLY if the precipitating hydrometeor affects the calculation of radiative transfer in model.               |           | clivi           | atmosphere_cloud_ice_content                                 |
| 1        | omega (=dp/dt)                                    | Pa s <sup>-1</sup> | at 500 hPa level; commonly referred to as "omega", this represents the vertical component of velocity in pressure coordinates (positive down)  |           | wap500          | lagrangian_tendency_of_air_pressure                          |
| 1        | Air Temperature                                   | K                  | at 700 hPa level   |           | ta700           | air_temperature  |
| 1        | Air Pressure at Convective Cloud Base             | Pa                 |  |           | ccb             | air_pressure_at_convective_cloud_base                        |
| 1        | Air Pressure at Convective Cloud Top              | Pa                 |  |           | cct             | air_pressure_at_convective_cloud_top                         |

| <b>unformatted</b> |                     |                 |             |                                 | <b>CMOR</b>     |             |              |                  |                      |                    |                      |
|--------------------|---------------------|-----------------|-------------|---------------------------------|-----------------|-------------|--------------|------------------|----------------------|--------------------|----------------------|
| <b>units</b>       | <b>cell_methods</b> | <b>positive</b> | <b>type</b> | <b>CMOR dimensions</b>          | <b>variable</b> | <b>name</b> | <b>realm</b> | <b>frequency</b> | <b>cell_measures</b> | <b>flag_values</b> | <b>flag_meanings</b> |
| Pa                 | time: mean          |                 | real        | longitude latitude time         |                 | ps          | atmos        |                  | area: areacella      |                    |                      |
| W m-2              | time: mean          | down            | real        | longitude latitude time         |                 | rsdt        | atmos        |                  | area: areacella      |                    |                      |
| W m-2              | time: mean          | up              | real        | longitude latitude time         |                 | rsut        | atmos        |                  | area: areacella      |                    |                      |
| W m-2              | time: mean          | down            | real        | longitude latitude time         |                 | rsdscs      | atmos        |                  | area: areacella      |                    |                      |
| W m-2              | time: mean          | up              | real        | longitude latitude time         |                 | rsuscscs    | atmos        |                  | area: areacella      |                    |                      |
| W m-2              | time: mean          | down            | real        | longitude latitude time         |                 | rldscs      | atmos        |                  | area: areacella      |                    |                      |
| W m-2              | time: mean          | up              | real        | longitude latitude time         |                 | rlutcs      | atmos        |                  | area: areacella      |                    |                      |
| W m-2              | time: mean          | up              | real        | longitude latitude time         |                 | rsutcs      | atmos        |                  | area: areacella      |                    |                      |
| %                  | time: mean          |                 | real        | longitude latitude time         |                 | clt         | atmos        |                  | area: areacella      |                    |                      |
| kg m-2             | time: mean          |                 | real        | longitude latitude time         |                 | clwvi       | atmos        |                  | area: areacella      |                    |                      |
| kg m-2             | time: mean          |                 | real        | longitude latitude time         |                 | clivi       | atmos        |                  | area: areacella      |                    |                      |
| Pa s-1             | time: mean          |                 | real        | longitude latitude time<br>p500 |                 | wap500      | atmos        |                  | area: areacella      |                    |                      |
| K                  | time: mean          |                 | real        | longitude latitude time<br>p700 |                 | ta700       | atmos        |                  | area: areacella      |                    |                      |
| Pa                 | time: mean          |                 | real        | longitude latitude time         |                 | ccb         | atmos        |                  | area: areacella      |                    |                      |
| Pa                 | time: mean          |                 | real        | longitude latitude time         |                 | cct         | atmos        |                  | area: areacella      |                    |                      |

|   |   |                                    |   |             |   |
|---|---|------------------------------------|---|-------------|---|
| 1 | Convective Precipitation                | kg m <sup>-2</sup> s <sup>-1</sup> |   | prc         | convective_precipitation_flux             |
| 1 | Surface Upward Latent Heat Flux         | W m <sup>-2</sup>                  |   | hfls        | surface_upward_latent_heat_flux           |
| 1 | Surface Upward Sensible Heat Flux       | W m <sup>-2</sup>                  |   | hfss        | surface_upward_sensible_heat_flux         |
| 1 | Surface Downwelling Longwave Radiation  | W m <sup>-2</sup>                  |   | rlds        | surface_downwelling_longwave_flux_in_air  |
| 1 | Surface Upwelling Longwave Radiation    | W m <sup>-2</sup>                  |   | rlus        | surface_upwelling_longwave_flux_in_air    |
| 1 | Surface Downwelling Shortwave Radiation | W m <sup>-2</sup>                  |   | rsds        | surface_downwelling_shortwave_flux_in_air |
| 1 | Surface Upwelling Shortwave Radiation   | W m <sup>-2</sup>                  |   | rsus        | surface_upwelling_shortwave_flux_in_air   |
| 1 | TOA Outgoing Longwave Radiation         | W m <sup>-2</sup>                  |   | rlut        | toa_outgoing_longwave_flux                |
| 1 | ISCCP Total Total Cloud Fraction        | %                                  |   | cltiscpp    | cloud_area_fraction                       |
| 1 | ISCCP Mean Cloud Albedo                 | 1                                  | When computing time-means, weight by the ISCCP Total Cloud Fraction - see <a href="http://www.cfmip.net/README">http://www.cfmip.net/README</a>   | albiscpp    | cloud_albedo                              |
| 1 | ISCCP Mean Cloud Top Pressure           | Pa                                 | When computing time-means, weight by the ISCCP Total Cloud Fraction - see <a href="http://www.cfmip.net/README">http://www.cfmip.net/README</a>   | ptiscpp     | air_pressure_at_cloud_top                 |
| 1 | PARASOL Reflectance                     | 1                                  | Simulated reflectance from PARASOL as seen at the top of the atmosphere for 5 solar zenith angles. Valid only over ocean and for one viewing direction (viewing zenith angle of 30 degrees and relative azimuth angle 320 degrees). | parasolRefl | toa_bidirectional_reflectance             |
| 1 | CALIPSO Total Cloud Fraction            | %                                  |   | cltcalipso  | cloud_area_fraction                       |
| 1 | CALIPSO Low Level Cloud Fraction        | %                                  |   | cllcalipso  | cloud_area_fraction_in_atmosphere_layer   |
| 1 | CALIPSO Mid Level Cloud Fraction        | %                                  |   | clmcalipso  | cloud_area_fraction_in_atmosphere_layer   |
| 1 | CALIPSO High Level Cloud Fraction       | %                                  |   | clhcalipso  | cloud_area_fraction_in_atmosphere_layer   |

*In CMOR Table cfDay: "CFMIP daily 3D" --daily mean 3-D fields on model levels plus CALIPSO and ISCCP cloud fractions*

| priority |   |                    |   |           | output variable |   |
|----------|---|--------------------|---|-----------|-----------------|---|
|          | long name                               | units              | comment   | questions | name            | standard name                           |
| 1        | Eastward Wind                           | m s <sup>-1</sup>  |   |           | ua              | eastward_wind                           |
| 1        | Northward Wind                          | m s <sup>-1</sup>  |   |           | va              | northward_wind                          |
| 1        | Air Temperature                         | K                  |   |           | ta              | air_temperature                         |
| 1        | Specific Humidity                       | 1                  |   |           | hus             | specific_humidity                       |
| 1        | omega (=dp/dt)                          | Pa s <sup>-1</sup> | commonly referred to as "omega", this represents the vertical component of velocity in pressure coordinates (positive down) |           | wap             | lagrangian_tendency_of_air_pressure     |
| 1        | Geopotential Height                     | m                  |   |           | zg              | geopotential_height                     |
| 1        | Relative Humidity                       | %                  | This is the relative humidity with respect to liquid water for T>0 C, and with respect to ice for T<0 C.                    |           | hur             | relative_humidity                       |
| 1        | Cloud Area Fraction in Atmosphere Layer | %                  |   |           | cl              | cloud_area_fraction_in_atmosphere_layer |

|            |            |      |      |                                 |             |       |                 |
|------------|------------|------|------|---------------------------------|-------------|-------|-----------------|
| kg m-2 s-1 | time: mean |      | real | longitude latitude time         | prc         | atmos | area: areacella |
| W m-2      | time: mean | up   | real | longitude latitude time         | hfls        | atmos | area: areacella |
| W m-2      | time: mean | up   | real | longitude latitude time         | hfss        | atmos | area: areacella |
| W m-2      | time: mean | down | real | longitude latitude time         | rlds        | atmos | area: areacella |
| W m-2      | time: mean | up   | real | longitude latitude time         | rlus        | atmos | area: areacella |
| W m-2      | time: mean | down | real | longitude latitude time         | rsds        | atmos | area: areacella |
| W m-2      | time: mean | up   | real | longitude latitude time         | rsus        | atmos | area: areacella |
| W m-2      | time: mean | up   | real | longitude latitude time         | rlut        | atmos | area: areacella |
| %          | time: mean |      | real | longitude latitude time         | cltiscpp    | atmos | area: areacella |
| 1          | time: mean |      | real | longitude latitude time         | albiscpp    | atmos | area: areacella |
| Pa         | time: mean |      | real | longitude latitude time         | pctiscpp    | atmos | area: areacella |
| 1          | time: mean |      | real | longitude latitude sza5<br>time | parasolRefl | atmos | area: areacella |
| %          | time: mean |      | real | longitude latitude time         | cltcalipso  | atmos | area: areacella |
| %          | time: mean |      | real | longitude latitude time         | cllcalipso  | atmos | area: areacella |
| %          | time: mean |      | real | longitude latitude time         | clmcalipso  | atmos | area: areacella |
| %          | time: mean |      | real | longitude latitude time         | clhcalipso  | atmos | area: areacella |

| unformatted |              |          |      | CMOR                              |               |       |           |                 |             |               |
|-------------|--------------|----------|------|-----------------------------------|---------------|-------|-----------|-----------------|-------------|---------------|
| units       | cell_methods | positive | type | CMOR dimensions                   | variable name | realm | frequency | cell_measures   | flag_values | flag_meanings |
| m s-1       | time: mean   |          | real | longitude latitude alevel<br>time | ua            | atmos |           |                 |             |               |
| m s-1       | time: mean   |          | real | longitude latitude alevel<br>time | va            | atmos |           |                 |             |               |
| K           | time: mean   |          | real | longitude latitude alevel<br>time | ta            | atmos |           | area: areacella |             |               |
| 1           | time: mean   |          | real | longitude latitude alevel<br>time | hus           | atmos |           | area: areacella |             |               |
| Pa s-1      | time: mean   |          | real | longitude latitude alevel<br>time | wap           | atmos |           | area: areacella |             |               |
| m           | time: mean   |          | real | longitude latitude alevel<br>time | zg            | atmos |           | area: areacella |             |               |
| %           | time: mean   |          | real | longitude latitude alevel<br>time | hur           | atmos |           | area: areacella |             |               |
| %           | time: mean   |          | real | longitude latitude alevel<br>time | cl            | atmos |           | area: areacella |             |               |

|   |                                     |                                  |   |           |  |
|---|-------------------------------------|----------------------------------|---|-----------|--|
| 1 | Mass Fraction of Cloud Liquid Water | 1                                | Calculate as the mass of cloud liquid water in the grid cell divided by the mass of air (including the water in all phases) in the grid cell. Include precipitating hydrometeors ONLY if the precipitating hydrometeor affects the calculation of radiative transfer in model.                        | clw       | mass_fraction_of_cloud_liquid_water_in_air |
| 1 | Mass Fraction of Cloud Ice          | 1                                | Calculate as the mass of cloud ice in the grid cell divided by the mass of air (including the water in all phases) in the grid cell. Include precipitating hydrometeors ONLY if the precipitating hydrometeor affects the calculation of radiative transfer in model.                                 | cli       | mass_fraction_of_cloud_ice_in_air          |
| 1 | Convective Mass Flux                | $\text{kg m}^{-2} \text{s}^{-1}$ | Report on model half-levels (i.e., model layer bounds and not standard pressures). The net mass flux should represent the difference between the updraft and downdraft components. Calculate as the convective mass flux divided by the area of the whole grid cell (not just the area of the cloud). | mc        | atmosphere_net_upward_convective_mass_flux |
| 1 | CALIPSO Cloud Fraction              | %                                | 40 levels   | clcalipso | cloud_area_fraction_in_atmosphere_layer    |
| 1 | ISCCP Cloud Area Fraction           | %                                | 7 levels x 7 tau  | clisccp   | cloud_area_fraction_in_atmosphere_layer    |
| 1 | Pressure on Model Levels            | Pa                               | This field is needed only for models in which the pressure can't be calculated from the vertical coordinate information stored already for each variable. Thus, the pressures are needed for height or theta-coordinate models, for example, but not sigma- or eta-coordinate models.                 | pfull     | air_pressure                               |
| 1 | Pressure on Model Half-Levels       | Pa                               | This field is needed only for models in which the pressure can't be calculated from the vertical coordinate information stored already for each variable. Thus, the pressures are needed for height or theta-coordinate models, for example, but not sigma- or eta-coordinate models.                 | phalf     | air_pressure                               |



|   |            |  |      |                                   |     |       |                 |
|---|------------|--|------|-----------------------------------|-----|-------|-----------------|
| 1 | time: mean |  | real | longitude latitude alevel<br>time | clw | atmos | area: areacella |
|---|------------|--|------|-----------------------------------|-----|-------|-----------------|

|   |            |  |      |                                   |     |       |                 |
|---|------------|--|------|-----------------------------------|-----|-------|-----------------|
| 1 | time: mean |  | real | longitude latitude alevel<br>time | cli | atmos | area: areacella |
|---|------------|--|------|-----------------------------------|-----|-------|-----------------|

|            |            |    |      |                                     |    |       |                 |
|------------|------------|----|------|-------------------------------------|----|-------|-----------------|
| kg m-2 s-1 | time: mean | up | real | longitude latitude alevhalf<br>time | mc | atmos | area: areacella |
|------------|------------|----|------|-------------------------------------|----|-------|-----------------|

|   |            |  |      |                                  |           |       |                 |
|---|------------|--|------|----------------------------------|-----------|-------|-----------------|
| % | time: mean |  | real | longitude latitude alt40<br>time | clcalipso | atmos | area: areacella |
|---|------------|--|------|----------------------------------|-----------|-------|-----------------|

|   |            |  |      |                                      |         |       |                 |
|---|------------|--|------|--------------------------------------|---------|-------|-----------------|
| % | time: mean |  | real | longitude latitude tau<br>plev7 time | clisccp | atmos | area: areacella |
|---|------------|--|------|--------------------------------------|---------|-------|-----------------|

|    |            |  |      |                                   |       |       |                 |
|----|------------|--|------|-----------------------------------|-------|-------|-----------------|
| Pa | time: mean |  | real | longitude latitude alevel<br>time | pfull | atmos | area: areacella |
|----|------------|--|------|-----------------------------------|-------|-------|-----------------|

|    |            |  |      |                                     |       |       |                 |
|----|------------|--|------|-------------------------------------|-------|-------|-----------------|
| Pa | time: mean |  | real | longitude latitude alevhalf<br>time | phalf | atmos | area: areacella |
|----|------------|--|------|-------------------------------------|-------|-------|-----------------|

## CMOR Table cf3hr: CFMIP 3-Hourly Cloud Diagnostic Fields

cf3hr

3hr

(All Saved on the Atmospheric Grid)

For further guidance, please see <http://www.cfmip.net>

The spread sheet "CFMIP output" specifies the simulations and time-periods for which the cloud diagnostic fields listed on this spread sheet should be saved.

In CMOR Table **cf3hr**: "*CFMIP 3-hourly orbital offline*" -- *CloudSat/CALIPSO/PARASOL simulator output in orbital curtain format*

(For most of these variables, extract simulator input variables from models along A-train orbits, and run COSP on these in 'offline' mode.)

| Priority | long name                                     | units         | comment   | questions | output variable |   |
|----------|---|---------------|---|-----------|-----------------|---|
|          |   |               |   |           | name            | standard name   |
| 1        | CALIPSO Cloud Area Fraction                   | %             | (40 height levels)  |           | clcalipso       | cloud_area_fraction_in_atmosphere_layer   |
| 1        | CALIPSO Cloud Fraction Undetected by CloudSat | %             | (40 height levels) Clouds detected by CALIPSO but below the detectability threshold of CloudSat   |           | clcalipso2      | cloud_area_fraction_in_atmosphere_layer   |
| 1        | CloudSat Radar Reflectivity CFAD              | 1             | CFADs (Cloud Frequency Altitude Diagrams) are joint height - radar reflectivity (or lidar scattering ratio) distributions (40 levelsx15 bins) .   |           | cfadDbze94      | histogram_of_equivalent_reflectivity_factor_over_height_above_reference_ellipsoid |
| 1        | CALIPSO Scattering Ratio CFAD                 | 1             | CFADs (Cloud Frequency Altitude Diagrams) are joint height - radar reflectivity (or lidar scattering ratio) distributions (40 levelsx15 bins) .   |           | cfadLidarsr532  | histogram_of_backscattering_ratio_over_height_above_reference_ellipsoid           |
| 1        | PARASOL Reflectance                           | 1             | Simulated reflectance from PARASOL as seen at the top of the atmosphere for 5 solar zenith angles. Valid only over ocean and for one viewing direction (viewing zenith angle of 30 degrees and relative azimuth angle 320 degrees).           |           | parasolRefl     | toa_bidirectional_reflectance   |
| 1        | CALIPSO Total Cloud Fraction                  | %             |   |           | cltcalipso      | cloud_area_fraction   |
| 1        | CALIPSO Low Level Cloud Fraction              | %             |   |           | cllcalipso      | cloud_area_fraction_in_atmosphere_layer   |
| 1        | CALIPSO Mid Level Cloud Fraction              | %             |   |           | clmcalipso      | cloud_area_fraction_in_atmosphere_layer   |
| 1        | CALIPSO High Level Cloud Fraction             | %             |   |           | clhcalipso      | cloud_area_fraction_in_atmosphere_layer   |
| 1        | Longitude                                     | degrees_east  | is a function of time. Note that the CF convention and CMOR2 require that this field will be included in each file that contains a variable that is a function of the "location" dimension, so there is no need to save this field by itself. |           | lon             | longitude   |
| 1        | Latitude                                      | degrees_north | the above comment also applies to latitude.   |           | lat             | latitude  |
| 1        | Offset Time                                   | day           | this "offset time" should be added to the value stored in the "time dimension" to get the actual time. This actual time is the time (UTC) of the corresponding point in the satellite orbit used to extract the model data.                   |           | toffset         | time  |

| unformatted   |              |          |      |                                 | CMOR               |       |           |               |             |               |
|---------------|--------------|----------|------|---------------------------------|--------------------|-------|-----------|---------------|-------------|---------------|
| units         | cell_methods | positive | type | CMOR dimensions                 | variable name      | realm | frequency | cell_measures | flag_values | flag_meanings |
| %             | time: point  |          | real | location alt40 time1            | clcalipso          | atmos |           |               |             |               |
| %             | time: point  |          | real | location alt40 time1            | clcalipso2         | atmos |           |               |             |               |
| 1             | time: point  |          | real | location alt40 dbze time1       | cfadDbze94         | atmos |           |               |             |               |
| 1             | time: point  |          | real | location alt40 scattratio time1 | cfadLidarsr53<br>2 | atmos |           |               |             |               |
| 1             | time: point  |          | real | location sza5 time1             | parasolRefl        | atmos |           |               |             |               |
| %             | time: point  |          | real | location time1                  | cltcalipso         | atmos |           |               |             |               |
| %             | time: point  |          | real | location time1 p840             | cllcalipso         | atmos |           |               |             |               |
| %             | time: point  |          | real | location time1 p560             | clmcalipso         | atmos |           |               |             |               |
| %             | time: point  |          | real | location time1 p220             | clhcalipso         | atmos |           |               |             |               |
| degrees_east  | time: point  |          | real | location time1                  | longitude          | atmos |           |               |             |               |
| degrees_north | time: point  |          | real | location time1                  | latitude           | atmos |           |               |             |               |
| day           |              |          | real | location time1                  | toffset            | atmos |           |               |             |               |

In CMOR Table **cf3hr**: "*CFMIP 3-hourly inline*" -- 2-D fields as specified in the Amon table plus convective cloud fraction and 3-D fields on model levels (or half levels, as indicated) sampled synoptically every 3 hours (i.e., not time-mean) at 0Z, 3Z, 6Z, 9Z, 12Z, 15Z, 18Z, and 21Z.

| priority | long name                                      | units | comment   | questions | output variable name | standard name   |
|----------|--|-------|---|-----------|----------------------|---|
| 1        | (use names for Amon 2D table)                  |       | This table includes all the 2-D variables listed in the Amon table, omitting, however, the daily maximum and minimum temperatures. All variables should be reported as synoptic fields, not daily means.  |           | include Amon 2D      |   |
| 1        | Convective Cloud Fraction                      | %     | for the whole atmospheric column, as seen from the surface or the top of the atmosphere. Include only convective cloud. Besides the quantities from the Amon table, this is the only other 2-D field in this table.   |           | cltc                 | convective_cloud_area_fraction                        |
| 2        | Altitude of Model Full-Levels                  | m     | This is actual height above mean sea level, not geopotential height   |           | zfull                | height_above_reference_ellipsoid                      |
| 2        | Altitude of Model Half-Levels                  | m     | This is actual height above mean sea level, not geopotential height. This is actual height above mean sea level, not geopotential height. Include both the top of the model atmosphere and surface levels.  |           | zhalf                | height_above_reference_ellipsoid                      |
| 2        | Pressure at Model Full-Levels                  | Pa    | provide this field for models in which the pressure can't be calculated from the vertical coordinate information stored already for each variable. Thus, the pressures are needed for height or theta-coordinate models, for example, but not sigma- or eta-coordinate models.            |           | pfull                | air_pressure  |
| 2        | Pressure at Model Half-Levels                  | Pa    | provide this field for models in which the pressure can't be calculated from the vertical coordinate information stored already for each variable. Thus, the pressures are needed for height or theta-coordinate models, for example, but not sigma- or eta-coordinate models.            |           | phalf                | air_pressure  |
| 2        | Air Temperature                                | K     |   |           | ta                   | air_temperature                                       |
| 2        | Mass Fraction of Water                         | 1     | include all phases of water   |           | h2o                  | mass_fraction_of_water_in_air                         |
| 2        | Mass Fraction of Stratiform Cloud Liquid Water | 1     | Calculate as the mass of stratiform cloud liquid water in the grid cell divided by the mass of air (including the water in all phases) in the grid cell. Include precipitating hydrometeors ONLY if the precipitating hydrometeor affects the calculation of radiative transfer in model. |           | clws                 | mass_fraction_of_stratiform_cloud_liquid_water_in_air |
| 2        | Mass Fraction of Stratiform Cloud Ice          | 1     | Calculate as the mass of stratiform cloud ice in the grid cell divided by the mass of air (including the water in all phases) in the grid cell. Include precipitating hydrometeors ONLY if the precipitating hydrometeor affects the calculation of radiative transfer in model.          |           | clis                 | mass_fraction_of_stratiform_cloud_ice_in_air          |
| 2        | Mass Fraction of Convective Cloud Liquid Water | 1     | Calculate as the mass of convective cloud liquid water in the grid cell divided by the mass of air (including the water in all phases) in the grid cell. Include precipitating hydrometeors ONLY if the precipitating hydrometeor affects the calculation of radiative transfer in model. |           | clwc                 | mass_fraction_of_convective_cloud_liquid_water_in_air |

| unformatted<br>units | cell_methods | positive | type | CMOR dimensions                      | CMOR<br>variable<br>name | realm | frequency | cell_measures   | flag_values | flag_meanings |
|----------------------|--------------|----------|------|--------------------------------------|--------------------------|-------|-----------|-----------------|-------------|---------------|
|                      | time: point  |          | real | longitude latitude time1             |                          | atmos |           | area: areacella |             |               |
| %                    | time: point  |          | real | longitude latitude time1             | cltc                     | atmos |           | area: areacella |             |               |
| m                    | time: point  |          | real | longitude latitude alevel<br>time1   | zfull                    | atmos |           | area: areacella |             |               |
| m                    | time: point  |          | real | longitude latitude alevhalf<br>time1 | zhalf                    | atmos |           | area: areacella |             |               |
| Pa                   | time: point  |          | real | longitude latitude alevel<br>time1   | pfull                    | atmos |           | area: areacella |             |               |
| Pa                   | time: point  |          | real | longitude latitude alevhalf<br>time1 | phalf                    | atmos |           | area: areacella |             |               |
| K                    | time: point  |          | real | longitude latitude alevel<br>time1   | ta                       | atmos |           | area: areacella |             |               |
| 1                    | time: point  |          | real | longitude latitude alevel<br>time1   | h2o                      | atmos |           | area: areacella |             |               |
| 1                    | time: point  |          | real | longitude latitude alevel<br>time1   | clws                     | atmos |           | area: areacella |             |               |
| 1                    | time: point  |          | real | longitude latitude alevel<br>time1   | clis                     | atmos |           | area: areacella |             |               |
| 1                    | time: point  |          | real | longitude latitude alevel<br>time1   | clwc                     | atmos |           | area: areacella |             |               |

|   |   |                                    |  |            |  |
|---|---|------------------------------------|--|------------|--|
| 2 | Mass Fraction of Convective Cloud Ice                         | 1                                  | Calculate as the mass of convective cloud ice in the grid cell divided by the mass of air (including the water in all phases) in the grid cell. Include precipitating hydrometeors ONLY if the precipitating hydrometeor affects the calculation of radiative transfer in model. | clic       | mass_fraction_of_convective_cloud_ice_in_air               |
| 2 | Hydrometeor Effective Radius of Stratiform Cloud Liquid Water | m                                  | This is defined as the in-cloud ratio of the third moment over the second moment of the particle size distribution (obtained by considering only the cloudy portion of the grid cell).   | reffclws   | effective_radius_of_stratiform_cloud_liquid_water_particle |
| 2 | Hydrometeor Effective Radius of Stratiform Cloud Ice          | m                                  | This is defined as the in-cloud ratio of the third moment over the second moment of the particle size distribution (obtained by considering only the cloudy portion of the grid cell).   | reffclis   | effective_radius_of_stratiform_cloud_ice_particle          |
| 2 | Hydrometeor Effective Radius of Convective Cloud Liquid Water | m                                  | This is defined as the in-cloud ratio of the third moment over the second moment of the particle size distribution (obtained by considering only the cloudy portion of the grid cell).   | reffclwc   | effective_radius_of_convective_cloud_liquid_water_particle |
| 2 | Hydrometeor Effective Radius of Convective Cloud Ice          | m                                  | This is defined as the in-cloud ratio of the third moment over the second moment of the particle size distribution (obtained by considering only the cloudy portion of the grid cell).   | reffclic   | effective_radius_of_convective_cloud_ice_particle          |
| 2 | Stratiform Graupel Flux                                       | kg m <sup>-2</sup> s <sup>-1</sup> | report on model half-levels  | grp11sprof | large_scale_graupel_flux                                   |
| 2 | Convective Rainfall Flux                                      | kg m <sup>-2</sup> s <sup>-1</sup> | report on model half-levels  | prcprof    | convective_rainfall_flux                                   |
| 2 | Stratiform Rainfall Flux                                      | kg m <sup>-2</sup> s <sup>-1</sup> | report on model half-levels  | prlsprof   | large_scale_rainfall_flux                                  |
| 2 | Convective Snowfall Flux                                      | kg m <sup>-2</sup> s <sup>-1</sup> | report on model half-levels  | prsnrc     | convective_snowfall_flux                                   |
| 2 | Stratiform Snowfall Flux                                      | kg m <sup>-2</sup> s <sup>-1</sup> | report on model half-levels  | prlsns     | large_scale_snowfall_flux                                  |
| 2 | Hydrometeor Effective Radius of Stratiform Graupel            | m                                  | This is defined as the in-cloud ratio of the third moment over the second moment of the particle size distribution (obtained by considering only the cloudy portion of the grid cell).   | reffgrpls  | effective_radius_of_stratiform_cloud_graupel_particle      |
| 2 | Hydrometeor Effective Radius of Convective Rainfall           | m                                  | This is defined as the in-cloud ratio of the third moment over the second moment of the particle size distribution (obtained by considering only the cloudy portion of the grid cell).   | reffrainc  | effective_radius_of_convective_cloud_rain_particle         |
| 2 | Hydrometeor Effective Radius of Stratiform Rainfall           | m                                  | This is defined as the in-cloud ratio of the third moment over the second moment of the particle size distribution (obtained by considering only the cloudy portion of the grid cell).   | reffrains  | effective_radius_of_stratiform_cloud_rain_particle         |
| 2 | Hydrometeor Effective Radius of Convective Snowfall           | m                                  | This is defined as the in-cloud ratio of the third moment over the second moment of the particle size distribution (obtained by considering only the cloudy portion of the grid cell).   | reffsnowc  | effective_radius_of_convective_cloud_snow_particle         |
| 2 | Hydrometeor Effective Radius of Stratiform Snowfall           | m                                  | This is defined as the in-cloud ratio of the third moment over the second moment of the particle size distribution (obtained by considering only the cloudy portion of the grid cell).   | reffsnows  | effective_radius_of_stratiform_cloud_snow_particle         |
| 2 | Stratiform Cloud Optical Depth                                | 1                                  | This is the in-cloud optical depth obtained by considering only the cloudy portion of the grid cell.   | dtaus      | atmosphere_optical_thickness_due_to_stratiform_cloud       |

|            |             |      |                                    |           |       |                 |
|------------|-------------|------|------------------------------------|-----------|-------|-----------------|
| 1          | time: point | real | longitude latitude alevel<br>time1 | clic      | atmos | area: areacella |
| m          | time: point | real | longitude latitude alevel<br>time1 | reffclws  | atmos | area: areacella |
| m          | time: point | real | longitude latitude alevel<br>time1 | reffclis  | atmos | area: areacella |
| m          | time: point | real | longitude latitude alevel<br>time1 | reffclwc  | atmos | area: areacella |
| m          | time: point | real | longitude latitude alevel<br>time1 | reffclis  | atmos | area: areacella |
| kg m-2 s-1 | time: point | real | longitude latitude alevel<br>time1 | grplsprof | atmos | area: areacella |
| kg m-2 s-1 | time: point | real | longitude latitude alevel<br>time1 | prcprof   | atmos | area: areacella |
| kg m-2 s-1 | time: point | real | longitude latitude alevel<br>time1 | prlsprof  | atmos | area: areacella |
| kg m-2 s-1 | time: point | real | longitude latitude alevel<br>time1 | prsnr     | atmos | area: areacella |
| kg m-2 s-1 | time: point | real | longitude latitude alevel<br>time1 | prlsns    | atmos | area: areacella |
| m          | time: point | real | longitude latitude alevel<br>time1 | reffgrpls | atmos | area: areacella |
| m          | time: point | real | longitude latitude alevel<br>time1 | reffrainc | atmos | area: areacella |
| m          | time: point | real | longitude latitude alevel<br>time1 | reffrains | atmos | area: areacella |
| m          | time: point | real | longitude latitude alevel<br>time1 | reffsnowc | atmos | area: areacella |
| m          | time: point | real | longitude latitude alevel<br>time1 | reffsnows | atmos | area: areacella |
| 1          | time: point | real | longitude latitude alevel<br>time1 | dtaus     | atmos | area: areacella |

|   |                                |   |   |       |  |
|---|--------------------------------|---|---|-------|--|
| 2 | Convective Cloud Optical Depth | 1 | This is the in-cloud optical depth obtained by considering only the cloudy portion of the grid cell | dtauc | atmosphere_optical_thickness_due_to_convective_cloud |
| 2 | Stratiform Cloud Emissivity    | 1 | This is the in-cloud emissivity obtained by considering only the cloudy portion of the grid cell.   | dems  | stratiform_cloud_longwave_emissivity                 |
| 2 | Convective Cloud Emissivity    | 1 | This is the in-cloud emissivity obtained by considering only the cloudy portion of the grid cell.   | demc  | convective_cloud_longwave_emissivity                 |
| 2 | Convective Cloud Area Fraction | % |   | clc   | convective_cloud_area_fraction_in_atmosphere_layer   |
| 2 | Stratiform Cloud Area Fraction | % |   | cls   | stratiform_cloud_area_fraction_in_atmosphere_layer   |



|   |             |      |                                    |       |       |                 |
|---|-------------|------|------------------------------------|-------|-------|-----------------|
| 1 | time: point | real | longitude latitude alevel<br>time1 | dtauc | atmos | area: areacella |
| 1 | time: point | real | longitude latitude alevel<br>time1 | dems  | atmos | area: areacella |
| 1 | time: point | real | longitude latitude alevel<br>time1 | demc  | atmos | area: areacella |
| % | time: point | real | longitude latitude alevel<br>time1 | clc   | atmos | area: areacella |
| % | time: point | real | longitude latitude alevel time1    | cls   | atmos | area: areacella |

## CMOR Table cfSites: CFMIP high frequency Cloud Diagnostic Fields

cfSites

subhr

(sampled only at specified locations)

For further guidance, please see <http://www.cfmip.net>

The spread sheet "CFMIP output" specifies the simulations and time-periods for which the cloud diagnostic fields listed on this spread sheet should be saved.

*CMOR Table cfSites: "CFMIP Timestep Station Data" -- 2-D fields from the Amon table and 3-D fields on model levels sampled at 20 to 30 minute intervals at 73 specified locations for aquaplanet experiments and 119 specified locations for other experiments (see <http://cfmip.metoffice.com/cfmip2/pointlocations.txt>). Note that the column labeled "CMOR dimensions" indicates that these variables are a function of longitude and latitude. When writing the data to the netCDF file, however, the axis for the 119 (or 73) locations will be a simple index named "site", and CMOR defines this as a "grid axis" that has associated longitudes and latitudes. See CMOR documentation for instructions on defining a 1-dimensional grid axis of this kind.*

The sampling interval should be the integer multiple of the model time-step that is nearest to 30 minutes and divides into 60 minutes with no remainder. e.g. (30->30,20->20,15->30,10->30). Outputs should be instantaneous (not time mean) and from nearest gridbox (no spatial interpolation.) Note that except for the quantities appearing in the Amon spreadsheet (first line of table below), all other fields are 3-D.

| <i>Priority</i> | long name                           | units                              | comment   | questions | output variable name | standard name                              |
|-----------------|-------------------------------------|------------------------------------|---|-----------|----------------------|--|
| 1               | (use names from Amon 2D table)      |                                    | This table includes the 2-D variables listed in the "Amon" spreadsheet, omitting, however, the daily maximum and minimum temperatures. All variables should be reported as synoptic fields, not daily means.  |           | include Amon 2D      |  |
| 1               | Cloud Area Fraction                 | %                                  | Include both large-scale and convective cloud.  |           | cl                   | cloud_area_fraction_in_atmosphere_layer    |
| 1               | Mass Fraction of Cloud Liquid Water | 1                                  | Include both large-scale and convective cloud. Calculate as the mass of cloud liquid water in the grid cell divided by the mass of air (including the water in all phases) in the grid cell. Include precipitating hydrometeors ONLY if the precipitating hydrometeor affects the calculation of radiative transfer in model. |           | clw                  | mass_fraction_of_cloud_liquid_water_in_air |
| 1               | Mass Fraction of Cloud Ice          | 1                                  | Include both large-scale and convective cloud. Calculate as the mass of cloud ice in the grid cell divided by the mass of air (including the water in all phases) in the grid cell. Include precipitating hydrometeors ONLY if the precipitating hydrometeor affects the calculation of radiative transfer in model.          |           | cli                  | mass_fraction_of_cloud_ice_in_air          |
| 1               | Convective Mass Flux                | kg m <sup>-2</sup> s <sup>-1</sup> | Report on model half-levels (i.e., model layer bounds and not standard pressures). The net mass flux should represent the difference between the updraft and downdraft components. Calculate as the convective mass flux divided by the area of the whole grid cell (not just the area of the updrafts).                      |           | mc                   | atmosphere_net_upward_convective_mass_flux |
| 1               | Air Temperature                     | K                                  |   |           | ta                   | air_temperature                            |

| unformatted |              |          |      |                     | CMOR     |       |           |               |             |               |
|-------------|--------------|----------|------|---------------------|----------|-------|-----------|---------------|-------------|---------------|
| units       | cell_methods | positive | type | CMOR dimensions     | variable | realm | frequency | cell_measures | flag_values | flag_meanings |
|             | time: point  |          | real | site time1          |          | atmos |           |               |             |               |
| %           | time: point  |          | real | alevel site time1   | cl       | atmos |           |               |             |               |
| 1           | time: point  |          | real | alevel site time1   | clw      | atmos |           |               |             |               |
| 1           | time: point  |          | real | alevel site time1   | cli      | atmos |           |               |             |               |
| kg m-2 s-1  | time: point  | up       | real | alevhalf site time1 | mc       | atmos |           |               |             |               |
| K           | time: point  |          | real | alevel site time1   | ta       | atmos |           |               |             |               |

|   |  |                            |  |            |   |
|---|--|----------------------------|--|------------|---|
| 1 | Eastward Wind  | $\text{m s}^{-1}$          |  | ua         | eastward_wind   |
| 1 | Northward Wind   | $\text{m s}^{-1}$          |  | va         | northward_wind  |
| 1 | Specific Humidity  | 1                          |  | hus        | specific_humidity   |
| 1 | Relative Humidity  | %                          | This is the relative humidity with respect to liquid water for $T > 0 \text{ C}$ , and with respect to ice for $T < 0 \text{ C}$ . | hur        | relative_humidity   |
| 1 | omega (=dp/dt)   | $\text{Pa s}^{-1}$         | commonly referred to as "omega", this represents the vertical component of velocity in pressure coordinates (positive down)        | wap        | lagrangian_tendency_of_air_pressure   |
| 1 | Geopotential Height  | m                          |  | zg         | geopotential_height   |
| 1 | Upwelling Longwave Radiation   | $\text{W m}^{-2}$          |  | rлу        | upwelling_longwave_flux_in_air  |
| 1 | Upwelling Shortwave Radiation  | $\text{W m}^{-2}$          |  | rsu        | upwelling_shortwave_flux_in_air   |
| 1 | Downwelling Longwave Radiation   | $\text{W m}^{-2}$          |  | rld        | downwelling_longwave_flux_in_air  |
| 1 | Downwelling Shortwave Radiation  | $\text{W m}^{-2}$          |  | rsd        | downwelling_shortwave_flux_in_air   |
| 1 | Upwelling Clear-Sky Longwave Radiation   | $\text{W m}^{-2}$          |  | rлucс      | upwelling_longwave_flux_in_air_assuming_clear_sky   |
| 1 | Upwelling Clear-Sky Shortwave Radiation  | $\text{W m}^{-2}$          |  | rsucс      | upwelling_shortwave_flux_in_air_assuming_clear_sky  |
| 1 | Downwelling Clear-Sky Longwave Radiation   | $\text{W m}^{-2}$          |  | rldcс      | downwelling_longwave_flux_in_air_assuming_clear_sky   |
| 1 | Downwelling Clear-Sky Shortwave Radiation  | $\text{W m}^{-2}$          |  | rsdcс      | downwelling_shortwave_flux_in_air_assuming_clear_sky  |
| 1 | Tendency of Air Temperature  | $\text{K s}^{-1}$          |  | tnt        | tendency_of_air_temperature   |
| 1 | Tendency of Air Temperature due to Advection                                       | $\text{K s}^{-1}$          |  | tnta       | tendency_of_air_temperature_due_to_advection  |
| 1 | Tendency of Air Temperature due to Diabatic Processes                              | $\text{K s}^{-1}$          |  | tntmp      | tendency_of_air_temperature_due_to_model_physics  |
| 1 | Tendency of Air Temperature due to Stratiform Cloud Condensation and Evaporation   | $\text{K s}^{-1}$          |  | tntscpbl   | tendency_of_air_temperature_due_to_stratiform_cloud_and_precipitation_and_boundary_layer_mixing   |
| 1 | Tendency of Air Temperature due to Radiative Heating                               | $\text{K s}^{-1}$          |  | tnttr      | tendency_of_air_temperature_due_to_radiative_heating  |
| 1 | Tendency of Air Temperature due to Moist Convection                                | $\text{K s}^{-1}$          |  | tntc       | tendency_of_air_temperature_due_to_convection   |
| 1 | Tendency of Specific Humidity  | $\text{s}^{-1}$            |  | tnhus      | tendency_of_specific_humidity   |
| 1 | Tendency of Specific Humidity due to Advection                                     | $\text{s}^{-1}$            |  | tnhusa     | tendency_of_specific_humidity_due_to_advection  |
| 1 | Tendency of Specific Humidity due to Convection                                    | $\text{s}^{-1}$            |  | tnhusc     | tendency_of_specific_humidity_due_to_convection   |
| 1 | Tendency of Specific Humidity due to Diffusion                                     | $\text{s}^{-1}$            |  | tnhusd     | tendency_of_specific_humidity_due_to_diffusion  |
| 1 | Tendency of Specific Humidity due to Stratiform Cloud Condensation and Evaporation | $\text{s}^{-1}$            |  | tnhusscpbl | tendency_of_specific_humidity_due_to_stratiform_cloud_and_precipitation_and_boundary_layer_mixing |
| 1 | Tendency of Specific Humidity due to Model Physics                                 | $\text{s}^{-1}$            |  | tnhusmp    | tendency_of_specific_humidity_due_to_model_physics  |
| 1 | Eddy Viscosity Coefficient for Momentum Variables                                  | $\text{m}^2 \text{s}^{-1}$ |  | evu        | atmosphere_momentum_diffusivity   |
| 1 | Eddy Diffusivity Coefficient for Temperature Variable                              | $\text{m}^2 \text{s}^{-1}$ |  | edt        | atmosphere_heat_diffusivity   |

|        |             |      |      |                    |           |       |
|--------|-------------|------|------|--------------------|-----------|-------|
| m s-1  | time: point |      | real | alevel site time l | ua        | atmos |
| m s-1  | time: point |      | real | alevel site time l | va        | atmos |
| 1      | time: point |      | real | alevel site time l | hus       | atmos |
| %      | time: point |      | real | alevel site time l | hur       | atmos |
| Pa s-1 | time: point |      | real | alevel site time l | wap       | atmos |
| m      | time: point |      | real | alevel site time l | zg        | atmos |
| W m-2  | time: point | up   | real | alevel site time l | rlu       | atmos |
| W m-2  | time: point | up   | real | alevel site time l | rsu       | atmos |
| W m-2  | time: point | down | real | alevel site time l | rld       | atmos |
| W m-2  | time: point | down | real | alevel site time l | rsd       | atmos |
| W m-2  | time: point | up   | real | alevel site time l | rlucs     | atmos |
| W m-2  | time: point | up   | real | alevel site time l | rsucs     | atmos |
| W m-2  | time: point | down | real | alevel site time l | rldcs     | atmos |
| W m-2  | time: point | down | real | alevel site time l | rsdcs     | atmos |
| K s-1  | time: point |      | real | alevel site time l | tnt       | atmos |
| K s-1  | time: point |      | real | alevel site time l | tnta      | atmos |
| K s-1  | time: point |      | real | alevel site time l | tntmp     | atmos |
| K s-1  | time: point |      | real | alevel site time l | tntscpbl  | atmos |
| K s-1  | time: point |      | real | alevel site time l | tnt       | atmos |
| K s-1  | time: point |      | real | alevel site time l | tntc      | atmos |
| s-1    | time: point |      | real | alevel site time l | tnhus     | atmos |
| s-1    | time: point |      | real | alevel site time l | tnhusa    | atmos |
| s-1    | time: point |      | real | alevel site time l | tnhusc    | atmos |
| s-1    | time: point |      | real | alevel site time l | tnhusd    | atmos |
| s-1    | time: point |      | real | alevel site time l | tnhuscpbl | atmos |
| s-1    | time: point |      | real | alevel site time l | tnhusmp   | atmos |
| m2 s-1 | time: point |      | real | alevel site time l | evu       | atmos |
| m2 s-1 | time: point |      | real | alevel site time l | edt       | atmos |

|   |                               |               |  |       |              |
|---|-------------------------------|---------------|--|-------|--------------|
| 1 | Pressure on Model Levels      | Pa            | This field is needed only for models in which the pressure can't be calculated from the vertical coordinate information stored already for each variable. Thus, the pressures are needed for height or theta-coordinate models, for example, but not sigma- or eta-coordinate models.  | pfull | air_pressure |
| 1 | Pressure on Model Half-Levels | Pa            | This field is needed only for models in which the pressure can't be calculated from the vertical coordinate information stored already for each variable. Thus, the pressures are needed for height or theta-coordinate models, for example, but not sigma- or eta-coordinate models.  | phalf | air_pressure |
| 1 | Longitude                     | degrees_east  | Note that the CF convention and CMOR2 require that this field will be included in each file that contains a variable that is a function of the "site" dimension, so there is no need to save this field by itself. It is included here simply to indicate that longitudes should be stored for the site grid in each file written. | lon   | longitude    |
| 1 | Latitude                      | degrees_north | the above comment also applies to latitude.  | lat   | latitude     |

|               |             |      |                    |           |       |
|---------------|-------------|------|--------------------|-----------|-------|
| Pa            | time: point | real | alevel site time l | pfull     | atmos |
| Pa            | time: point | real | alevel site time l | phalf     | atmos |
| degrees_east  | 0           | real | site               | longitude | atmos |
| degrees_north | -90         | real | site               | latitude  | atmos |

Requested output: years requested for each expt./output table combination (see CFMIP output sheet for information on time-periods for saving the special CFMIP-focused output.

red font means output should be reported for only a single member in the case of an ensemble of simulations

blue font means this is a lower priority request

If a cell is shaded yellow, none of the variables will be part of the subset of model output that will be replicated at several locations (except, as noted by \* or \*\* -- see note at right-- this may apply only to lower priority variables)

"all\*" indicates that although all *years* will be included in the "replicated medium priority *variables* will be included in the replicated subset.  
 "all\*\*" indicates that although all *years* will be included in the "replicated priority *variables* will be included in the replicated subset

"decadal" prediction experiments

| Experiment Description Expt. # |  |       | Oclim | Oyr  | Amon | Omon                |       | Lmon | Limon | Oimon | lon x lat |
|--------------------------------|--|-------|-------|------|------|---------------------|-------|------|-------|-------|-----------|
|                                |  |       |       |      |      | lon x lat<br>x olev | other |      |       |       |           |
| 10-year predictions            | 10-year hindcasts/predictions  | 1.1   |       | all* | all  | all**               | all   | all  | all   | all   | all       |
| 30-year predictions            | 30-year hindcasts/predictions  | 1.2   |       | all* | all  | all**               | all   | all  | all   | all   | all       |
| 10-year predictions            | increased ensemble size of 1.1                                       | 1.1-E |       | all* | all  | all**               | all   | all  | all   | all   | all       |
| 30-year predictions            | increased ensemble size of 1.2                                       | 1.2-E |       | all* | all  | all**               | all   | all  | all   | all   | all       |
| 10-year predictions            | additional start dates for expts. 1.1                                | 1.1-I |       | all* | all  | all**               | all   | all  | all   | all   | all       |
| AMIP                           | AMIP (1979-2008)   | 3.3   |       |      | all  |                     |       | all  | all   | all   | all       |
| pre-industrial control         | control run, but possibly as short as 100 years                      | 3.1-S |       | all* | all  | all**               | all   | all  | all   | all   | all       |
| 1 percent per year CO2         | 1% per year CO2 rise imposed   | 6.1-S |       | all* | all  | all**               | all   | all  | all   | all   |           |
| volcano-free hindcasts         | hindcasts but without volcanoes                                      | 1.3   |       | all* | all  | all**               | all   | all  | all   | all   | all       |
| prediction with 2010 volcano   | Pinatubo-like eruption imposed                                       | 1.4   |       | all* | all  | all**               | all   | all  | all   | all   | all       |
| initialization alternatives    | experiments to explore impact of different initialization procedures | 1.5   |       | all* | all  | all**               | all   | all  | all   | all   | all       |
| chemistry-focused runs         | near-term runs with enhanced chemistry/aerosol models                | 1.6   |       |      |      |                     |       |      |       |       |           |



ed" subset, only the high and  
 ated" subset, only the highest

| aero                                    | day  |       | 6hrLev   | 6hrPlev | 3hr       |
|---|--|-------|--|---------|-----------|
| lon x lat x alev                        | subset of fields saved for selected expts. | other |  |         | lon x lat |
| year 10                                 |  | all   | for expts. initialized in late 1980, 1990, and 2005, all years | all     | all       |
| years 10, 20, & 30                      |  | all   | for expts. initialized in late 1980 and 2005, all years        | all     | all       |
| year 10                                 |  | all   |  | all     | all       |
| years 10, 20, & 30                      |  | all   |  | all     | all       |
| year 10                                 |  | all   |  | all     | all       |
| years 1980, 1990, 2000, & possibly 2010 | all  | all   | all  | all     | all       |
| years 20, 40, 60, 80, & 100             |  | all   |  |         | 30        |
|   |  | all   |  |         | last 30   |
| year 10                                 |  | all   |  | all     | all       |
| years 2010, 2011, 2012, and 2015        |  | all   |  | all     | all       |
| year 10                                 |  | all   |  | all     | all       |

experiments focusing on the "longer-term"

| experiments focusing on the "longer-term" |  |         | Oclim                               | Oyr  | Amon | Omon                |       | Lmon | Limon | Oimon |           |
|---|--|---------|-------------------------------------|------|------|---------------------|-------|------|-------|-------|-----------|
| Experiment                                | Description  | Expt. # |                                     |      |      | lon x lat<br>x olev | other |      |       |       | lon x lat |
| pre-industrial control                    | coupled atmosphere/ocean control run                         | 3.1     |                                     | all* | all  | all**               | all   | all  | all   | all   | all       |
| historical                                | simulation of recent past (1850-2005)                        | 3.2     | 1986-2005<br>monthly<br>climatology | all* | all  | all**               | all   | all  | all   | all   | all       |
| AMIP                                      | AMIP (1979-2008)   | 3.3     |                                     |      | all  |                     |       | all  | all   | all   | all       |
| historical                                | increase ensemble size of expt. 3.2                          | 3.2-E   |                                     | all* | all  | all**               | all   | all  | all   | all   | all       |
| AMIP                                      | increase ensemble size of expt. 3.3                          | 3.3-E   |                                     |      | all  |                     |       | all  | all   | all   | all       |
| mid-Holocene                              | consistent with PMIP, impose Mid-Holocene conditions         | 3.4     |                                     | all* | all  | all**               | all   | all  | all   | all   | all       |
| last glacial maximum                      | consistent with PMIP, impose last glacial maximum conditions | 3.5     |                                     | all* | all  | all**               | all   | all  | all   | all   | all       |
| last millennium                           | consistent with PMIP, impose forcing for 850-1850            | 3.6     |                                     | all* | all  | all**               | all   | all  | all   | all   | all       |
| RCP4.5                                    | future projection (2006-2100) forced by RCP4.5               | 4.1     |                                     | all* | all  | all**               | all   | all  | all   | all   | all       |
| RCP8.5                                    | future projection (2006-2100) forced by RCP8.5               | 4.2     |                                     | all* | all  | all**               | all   | all  | all   | all   | all       |
| RCP2.6                                    | future projection (2006-2100) forced by RCP2.6               | 4.3     |                                     | all* | all  | all**               | all   | all  | all   | all   | all       |
| RCP6                                      | future projection (2006-2100) forced by RCP6                 | 4.4     |                                     | all* | all  | all**               | all   | all  | all   | all   | all       |
| RCP4.5                                    | extension of expt. 4.1 through 2300                          | 4.1-L   |                                     | all* | all  | all**               | all   | all  | all   | all   | all       |
| RCP8.5                                    | extension of expt. 4.2 through 2300                          | 4.2-L   |                                     | all* | all  | all**               | all   | all  | all   | all   | all       |
| RCP2.6                                    | extension of expt. 4.3 through 2300                          | 4.3-L   |                                     | all* | all  | all**               | all   | all  | all   | all   | all       |

| aero  | day   |       | 6hrLev    | 6hrPlev   | 3hr  |
|---|---|-------|-----------|---|--|
| lon x lat x alev  | subset of fields saved for selected expts.  | other |           |   |  |
| years corresponding to years 1850, 1870, 1890, . . . , 1950, 1960, 1970, . . . , 2000 of only 1 member of the ensemble of historical run and years 2010, 2020, 2040, 2060, 2080, & 2100 of only 1 member of the ensemble of each of the RCP cases | 20 years corresponding to years 1986-2005 of only 1 member of the ensemble of historical runs | all   |           | 30 years corresponding to 1979-2008 of historical run | 30 years corresponding to years 111-140 of 1pctCO2 |
| years 1850, 1870, 1890, . . . , 1950, 1960, 1970, . . . , 2000  | 1950-2005   | all   | 1950-2005 | 1950-2005   | 1960-2005  |
| 1980, 1990, 2000, & possibly 2010   | all   | all   | all       | all   | all  |
| years 1850, 1870, 1890, . . . , 1950, 1960, 1970, . . . , 2000  |   | all   |           | 1950-2005   | 1960-2005  |
| 1980, 1990, 2000, & possibly 2010   |   | all   |           | all   | all  |
|   |   | all   |           | last 30 years   |  |
|   |   | all   |           | last 30 years   |  |
|   |   | all   |           |   |  |
| 2010, 2020, 2040, 2060, 2080, & 2100  | all   | all   | all       | all   | 2026-2045, 2081-2100                               |
| 2010, 2020, 2040, 2060, 2080, & 2100  | all   | all   | all       | all   | 2026-2045, 2081-2100                               |
| 2010, 2020, 2040, 2060, 2080, & 2100  | all   | all   |           |   | 2026-2045, 2081-2100                               |
| 2010, 2020, 2040, 2060, 2080, & 2100  | all   | all   |           |   | 2026-2045, 2081-2100                               |
| 2010, 2020, 2040, 2060, 2080, & 2100  | 2181-2200, 2281-2300  | all   |           |   | 2181-2200, 2281-2300                               |
| 2010, 2020, 2040, 2060, 2080, & 2100  | 2181-2200, 2281-2300  | all   |           |   | 2181-2200, 2281-2300                               |
| 2010, 2020, 2040, 2060, 2080, & 2100  | 2181-2200, 2281-2300  | all   |           |   | 2181-2200, 2281-2300                               |

|  |  |       |      |     |       |     |     |     |     |     |
|--|--|-------|------|-----|-------|-----|-----|-----|-----|-----|
| ESM pre-industrial control                                       | as in expt. 3.1, but atmospheric CO2 determined by model   | 5.1   | all* | all | all** | all | all | all | all | all |
| Emission-driven historical                                       | as in expt. 3.2, but with atmospheric CO2 determined by model  | 5.2   | all* | all | all** | all | all | all | all | all |
| emission-driven RCP8.5   | as in expt. 4.2, but with atmospheric CO2 determined by model  | 5.3   | all* | all | all** | all | all | all | all | all |
| ESM fixed climate 1  | radiation code "sees" control CO2, but carbon cycle sees 1%/yr rise  | 5.4-1 | all* | all | all** | all | all | all | all | all |
| ESM fixed climate 2  | radiation code "sees" control CO2, but carbon cycle sees historical followed by RCP4.5 rise in CO2                                   | 5.4-2 | all* | all | all** | all | all | all | all | all |
| ESM feedback 1   | carbon cycle "sees" control CO2, but radiation sees 1%/yr rise   | 5.5-1 | all* | all | all** | all | all | all | all | all |
| ESM feedback 2   | carbon cycle "sees" control CO2, but radiation sees historical followed by RCP4.5 rise in CO2  | 5.5-2 | all* | all | all** | all | all | all | all | all |
| 1 percent per year CO2   | imposed 1%/yr increase in CO2 to quadrupling   | 6.1   | all* | all | all** | all | all | all | all |     |
| control SST climatology  | An atmosphere-only run driven by prescribed climatological SST and sea ice.  | 6.2a  |      | all |       |     | all | all | all | all |
| CO2 forcing  | as in expt. 6.2a, but with 4XCO2 imposed   | 6.2b  |      | all |       |     | all | all | all |     |
| abrupt 4XCO2   | impose an instantaneous quadrupling of CO2, then hold fixed  | 6.3   |      | all | all** | all | all | all | all |     |
| abrupt 4XCO2   | generate an ensemble of runs like expt. 6.3, initialized in different months, and terminated after 5 years                           | 6.3-E |      | all | all** | all | all | all | all |     |
| anthropogenic aerosol forcing                                    | as in expt. 6.2a, but with anthropogenic aerosols from year 2000 of expt. 3.2  | 6.4a  |      | all |       |     | all | all | all | all |
| sulfate aerosol forcing  | as in expt. 6.2a, but with sulfate aerosols from year 2000 of expt. 3.2  | 6.4b  |      | all |       |     | all | all | all | all |
| Cloud response to imposed 4xCO2                                  | consistent with CFMIP, impose AMIP (1979-2008) conditions (expt. 3.3) but with 4xCO2   | 6.5   |      | all |       |     | all | all | all |     |
| Cloud response to an imposed change in SST pattern               | consistent with CFMIP, add a patterned SST perturbation to AMIP SSTs of expt. 3.3.   | 6.6   |      | all |       |     | all | all | all |     |
| aqua planet: control run   | consistent with CFMIP, impose zonally uniform SSTs on a planet without continents  | 6.7a  |      | all |       |     |     |     |     |     |
| aqua planet: cloud response to imposed 4xCO2                     | Consistent with CFMIP requirements, impose 4xCO2 on the zonally uniform SSTs of expt. 6.7a   | 6.7b  |      | all |       |     |     |     |     |     |
| Aqua-planet: cloud response to an imposed uniform change in SST. | Consistent with CFMIP requirements, add a uniform +4K to the zonally uniform SSTs of expt. 6.7a (which is the control for this run). | 6.7c  |      | all |       |     |     |     |     |     |

|   |   |     |  |                                  |
|---|---|-----|--|----------------------------------|
| years corresponding to years 1850, 1870, 1890, . . . , 1950, 1960, 1970, . . . , 2000 of the historical run and years 2010, 2020, 2040, 2060, 2080, & 2100 of the RCP run | 20 years corresponding to years 1986-2005 of historical run | all |  |                                  |
| years 1850, 1870, 1890, . . . , 1950, 1960, 1970, . . . , 2000  | 1950-2005   | all |  | 1960-2005                        |
| 2010, 2020, 2040, 2060, 2080, & 2100  | all   | all |  | 2026-2045, 2081-2100             |
|   |   | all |  |                                  |
|   |   | all |  |                                  |
|   |   | all |  |                                  |
|   |   | all |  |                                  |
|   |   | all |  | last 30                          |
|   |   | all |  | all                              |
|   |   | all |  | all                              |
|   |   | all |  | first 20 years and years 121-140 |
|   |   | all |  | all                              |
|   |   | all |  | all                              |
|   |   | all |  | all                              |
|   |   | all |  |                                  |
|   |   | all |  |                                  |
|   |   | all |  |                                  |
|   |   | all |  |                                  |

other output

|  |   |       |  |      |     |       |     |     |     |     |
|--|---|-------|--|------|-----|-------|-----|-----|-----|-----|
| Cloud response to an imposed uniform change in SST | Consistent with CFMIP requirements, add a uniform +4 K SST to the AMIP SSTs of expt. 3.3 (which is the "control" for this run). | 6.8   |  |      | all |       | all | all | all |     |
| natural-only                                       | historical simulation but with natural forcing only   | 7.1   |  | all* | all | all** | all | all | all | all |
| GHG-only   | historical simulation but with greenhouse gas forcing only  | 7.2   |  | all* | all | all** | all | all | all | all |
| other-only   | historical simulation but with other individual forcing agents  | 7.3   |  | all* | all | all** | all | all | all | all |
| natural-only                                       | increase ensemble size of expt. 7.1   | 7.1-E |  | all* | all | all** | all | all | all | all |
| GHG-only   | increase ensemble size of expt. 7.2   | 7.2-E |  | all* | all | all** | all | all | all | all |
| other-only   | increase ensemble size of expt. 7.3   | 7.3-E |  | all* | all | all** | all | all | all | all |

other output

|     |     |  |  |  |
|-----|-----|--|--|--|
| all |     |  |  |  |
|     | all |  |  |  |
|     | all |  |  |  |
|     | all |  |  |  |
|     | all |  |  |  |
|     | all |  |  |  |
|     | all |  |  |  |

atmosphere-only experiments

| atmosphere-only experiments                                      |  |         | Oclim | Oyr | Amon | Omon                |       | Lmon | Limon | Oimon |           |
|--|--|---------|-------|-----|------|---------------------|-------|------|-------|-------|-----------|
| Experiment   | Description  | Expt. # |       |     |      | lon x lat<br>x elev | other |      |       |       | lon x lat |
| AMIP   | AMIP (1979-2008)   | 3.3     |       |     | all  |                     |       | all  | all   | all   | all       |
| 2030 time-slice  | conditions for 2026-2035 imposed   | 2.1     |       |     | all  |                     |       | all  | all   | all   | all       |
| AMIP   | increase ensemble size of expt. 3.3  | 3.3-E   |       |     | all  |                     |       | all  | all   | all   | all       |
| 2030 time-slice  | increase ensemble size of expt. 2.1  | 2.1-E   |       |     | all  |                     |       | all  | all   | all   | all       |
| Cloud response to imposed 4xCO2                                  | consistent with CFMIP, impose AMIP (1979-2008) conditions (expt. 3.3) but with 4xCO2   | 6.5     |       |     | all  |                     |       | all  | all   | all   |           |
| Cloud response to an imposed change in SST pattern               | consistent with CFMIP, add a patterned SST perturbation to AMIP SSTs of expt. 3.3.   | 6.6     |       |     | all  |                     |       | all  | all   | all   |           |
| aqua planet: control run   | consistent with CFMIP, impose zonally uniform SSTs on a planet without continents  | 6.7a    |       |     | all  |                     |       |      |       |       |           |
| aqua planet: cloud response to imposed 4xCO2                     | Consistent with CFMIP requirements, impose 4xCO <sub>2</sub> on the zonally uniform SSTs of expt. 6.7a                               | 6.7b    |       |     | all  |                     |       |      |       |       |           |
| Aqua-planet: cloud response to an imposed uniform change in SST. | Consistent with CFMIP requirements, add a uniform +4K to the zonally uniform SSTs of expt. 6.7a (which is the control for this run). | 6.7c    |       |     | all  |                     |       |      |       |       |           |
| Cloud response to an imposed uniform change in SST               | Consistent with CFMIP requirements, add a uniform +4 K SST to the AMIP SSTs of expt. 3.3 (which is the "control" for this run).      | 6.8     |       |     | all  |                     |       | all  | all   | all   |           |



| aero                                    | day  |       | 6hrLev | 6hrPlev | 3hr |
|---|--|-------|--------|---------|-----|
| lon x lat x alev                        | subset of fields saved for selected expts. | other |        |         |     |
| years 1980, 1990, 2000, & possibly 2010 | all  | all   | all    | all     | all |
| year 2035                               | all  | all   |        | all     | all |
| years 1980, 1990, 2000, & possibly 2010 |  | all   |        | all     | all |
| year 2035                               |  | all   |        |         |     |
|   |  | all   |        |         |     |
|   |  | all   |        |         |     |
|   |  | all   |        |         |     |
|   |  | all   |        |         |     |
|   |  | all   |        |         |     |
|   |  | all   |        |         |     |

If a cell is shaded yellow/tan, none of the variables will be part of the subset of model output that will be replicated at several locations.

### Requested periods for saving special CFMIP model output

| Experiment Name             | Experiment Description   | Experiment number | appearing in cfMon table        |      |                        |      |                        |      |
|-----------------------------|--|-------------------|---------------------------------|------|------------------------|------|------------------------|------|
|                             |  |                   | CFMIP monthly 3D<br>(A1c_cfmip) |      | CFMIP monthly 4xCO2 2D |      | CFMIP monthly 4xCO2 3D |      |
| pre-industrial control      | coupled atmosphere/ocean control run   | 3.1               |                                 |      | 1*                     | 20*  |                        |      |
| pre-industrial control      | coupled atmosphere/ocean control run   | 3.1               |                                 |      |                        |      |                        |      |
| historical                  | simulation of recent past (1850-2005)  | 3.2               |                                 |      |                        |      |                        |      |
| AMIP                        | AMIP (1979-at least 2008)  | 3.3               | 1979                            | 2008 | 1979                   | 2008 | 1979                   | 2008 |
| ESM fixed climate 1         | radiation code "sees" control CO2, but carbon cycle sees 1%/yr rise  | 5.4-1             |                                 |      |                        |      |                        |      |
| ESM feedback 1              | carbon cycle "sees" control CO2, but radiation sees 1%/yr rise   | 5.5-1             |                                 |      |                        |      |                        |      |
| 1 percent per year CO2      | impose a 1%/yr increase in CO2 to quadrupling  | 6.1               |                                 |      |                        |      |                        |      |
| control SST climatology     | control run climatological SSTs & sea ice imposed.   | 6.2a              |                                 |      | 1                      | 30   |                        |      |
| CO2 forcing                 | as in expt. 6.2a, but with 4XCO2 imposed   | 6.2b              |                                 |      |                        |      |                        |      |
| abrupt 4XCO2                | impose an instantaneous quadrupling of CO2, then hold fixed  | 6.3               |                                 |      |                        |      |                        |      |
| abrupt 4XCO2                | impose an instantaneous quadrupling of CO2, then hold fixed  | 6.3               |                                 |      |                        |      |                        |      |
| abrupt 4XCO2                | generate an ensemble of runs like expt. 6.3, initialized in different months, and terminated after 5 years | 6.3-E             |                                 |      |                        |      |                        |      |
| all aerosol forcing         | as in expt. 6.2a, but with aerosols from year 2000 of expt. 3.2  | 6.4a              |                                 |      |                        |      |                        |      |
| sulfate aerosol forcing     | as in expt. 6.2a, but with sulfate aerosols from year 2000 of expt. 3.2                                    | 6.4b              |                                 |      |                        |      |                        |      |
| 4xCO2 AMIP                  | AMIP (1979-2008) conditions (expt. 3.3) but with 4xCO2   | 6.5               | 1979                            | 2008 |                        |      |                        |      |
| AMIP plus patterned anomaly | consistent with CFMIP, patterned SST anomalies added to AMIP conditions (expt. 3.3)                        | 6.6               | 1979                            | 2008 |                        |      |                        |      |
| aqua planet control         | consistent with CFMIP, zonally uniform SSTs for ocean-covered earth  | 6.7a              | 1                               | 5    | 1                      | 5    | 1                      | 5    |
| 4xCO2 aqua planet           | as in expt. 6.7a, but with 4XCO2   | 6.7b              | 1                               | 5    |                        |      |                        |      |
| aqua planet plus 4K anomaly | as in expt. 6.7a, but with a uniform 4K increase in SST  | 6.7c              | 1                               | 5    |                        |      |                        |      |
| AMIP plus 4K anomaly        | as in expt. 3.3, but with a uniform 4K increase in SST   | 6.8               | 1979                            | 2008 |                        |      |                        |      |

|  | <u>appearing in cfOff</u>           |  | <u>appearing in cfDay</u>        |                                  | <u>appearing in cf3hr</u>                        |                                    | <u>appearing in cfSites</u> |   |
|--|-------------------------------------|--|----------------------------------|----------------------------------|--|------------------------------------|-----------------------------|---|
| <i>CFMIP monthly inline<br/>(A.1d.f.g)</i> | <i>CFMIP monthly offline (A.1e)</i> |  | <i>CFMIP daily 2D (A.2a,c,f)</i> | <i>CFMIP daily 3D (A.2b,d,g)</i> | <i>CFMIP 3-hourly orbital<br/>offline (A.2e)</i> | <i>CFMIP 3-hourly inline (A.4)</i> |                             | <i>CFMIP time-step station data<br/>(A.3)</i> |
| 1* 20*                                     |                                     |  | 1* 20*                           |                                  |  |                                    |                             |   |
| 121* 140*                                  |                                     |  | 121* 140*                        | 121* 140*                        |  |                                    |                             |   |
| 1979 2005                                  |                                     |  | 1979 2005                        |                                  |  |                                    |                             |   |
| 1979 2008                                  | 2008 2008                           |  | 1979 2008                        | 1979 2008                        | 2008 2008  | 2008 2008                          | 2008 2008                   | 1979 2008                                     |
| 121 140                                    |                                     |  | 121 140                          |                                  |  |                                    |                             |   |
| 121 140                                    |                                     |  | 121 140                          |                                  |  |                                    |                             |   |
| 121 140                                    |                                     |  | 121 140                          | 121 140                          |  |                                    |                             |   |
| 1 30                                       |                                     |  | 1 30                             |                                  |  |                                    |                             |   |
| 1 30                                       |                                     |  | 1 30                             |                                  |  |                                    |                             |   |
| 1 20                                       |                                     |  | 1 20                             |                                  |  |                                    |                             |   |
| 121 140                                    |                                     |  | 121 140                          | 121 140                          |  |                                    |                             |   |
| 1 5  |                                     |  | 1 5                              |                                  |  |                                    |                             |   |
| 1 30                                       |                                     |  | 1 30                             |                                  |  |                                    |                             |   |
| 1 30                                       |                                     |  | 1 30                             |                                  |  |                                    |                             |   |
| 1979 2008                                  | 2008 2008                           |  | 1979 2008                        | 1979 2008                        | 2008 2008  | 2008 2008                          |                             | 1979 2008                                     |
| 1979 2008                                  | 2008 2008                           |  | 1979 2008                        | 1979 2008                        | 2008 2008  | 2008 2008                          |                             | 1979 2008                                     |
| 1 5  |                                     |  | 1 5                              | 1 5                              |  |                                    |                             | 1 5   |
| 1 5  |                                     |  | 1 5                              | 1 5                              |  |                                    |                             | 1 5   |
| 1 5  |                                     |  | 1 5                              | 1 5                              |  |                                    |                             | 1 5   |
| 1979 2008                                  | 2008 2008                           |  | 1979 2008                        | 1979 2008                        | 2008 2008  | 2008 2008                          |                             | 1979 2008                                     |

## CFMIP output

\* The years specified for the pre-industrial experiment are relative to the point in the control where expts. 6.1 and 6.3 were initiated. 6.1 and 6.3 should be initiated from the same point in the control run, so that the control run sampled output can be compared directly to each of these runs, and any drift in the control can be accounted for.

