

CMOR-ization and ESGF publication of NorESM2 simulations

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Why CMOR-izing?

- post-processing step that rewrites raw climate model output in standardized CMIP format using PCMDI's Climate Model Output Rewriter (CMOR) library
- reorganization of output file structure (single record, multiple variables -> multiple records, single variables)
- basic annotation and quality control
- computation of derived products (linear combination, spatial integration, etc)

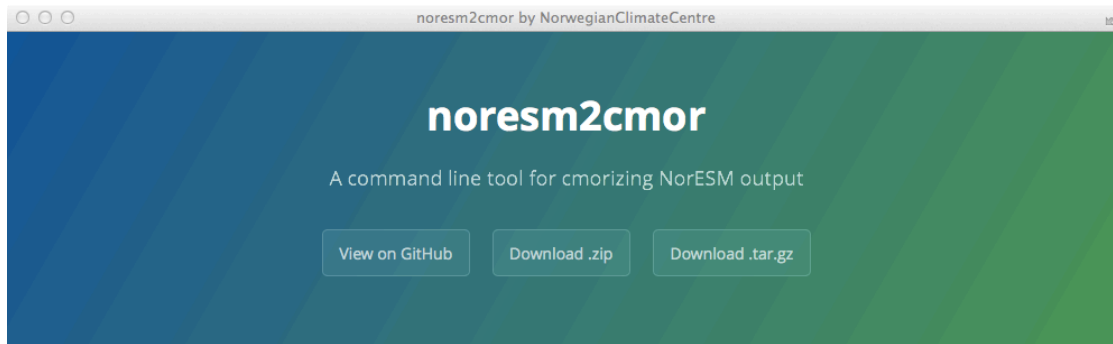
Upcoming CMOR-ization of NorESM output

| Project | Extended title | Volume | When | NorESM contact |
|--------------|---|--------|--------|--------------------------------------|
| NON-CMIP | | | | |
| GeoMIP | Geoengineering MIP | ?? TB | 2016- | Helene Muri (UiO) |
| CDR-MIP | Carbon Dioxide Removal MIP | ?? TB | 2016- | Helene Muri (UiO) |
| EXPECT | Exploring the potential and side effects of climate engineering | ?? TB | 2016 | Alf Grini (MET) Helene Muri (UiO) |
| CMIP6 | | | | |
| DECK | Diagnosis, Evaluation, and Charact. of Klima | 200 TB | 2016 | Seland (MET), Bethke (UNI) |
| AerChemMIP | Aerosols Chemistry MIP | 32 TB | 2017 | Dirk Olivie |
| C4MIP | Coupled Climate Carbon Cycle MIP | 5 TB | 2017 | Christoph Heinze (UiB) |
| CFMIP | Cloud Feedback MIP | 5 TB | 2017 | Alf Grini (MET) |
| DAMIP | Detection and Attribution MIP | 38 TB | 2016/7 | Seland (MET), Bethke (UNI) |
| DCPP | Decadal Climate Prediction Project | 100 TB | 2017 | Noel Keenlyside (UiB) |
| OMIP | Ocean MIP | 21 TB | 2016 | Mats Bentsen (UNI) |
| PDRMIP | Precipitation Driver Response MIP | 37 TB | 2017 | Alf Kirkevåg (MET) |
| PMIP | Paleoclimate MIP | 30 TB | 2017 | Zhongshi Zhang (UNI) |
| RFMIP | Radiative Forcing MIP | 15 TB | 2017 | Alf Kirkevåg (MET) |
| ScenarioMIP | Scenario MIP | 16 TB | 2016/7 | Iversen (MET), Heinze (UiB) |
| VolMIP | MIP on the Response to Volcanic Forcing | 5 TB | 2017 | Odd Helge Otterå |
| GeoMIP CMIP6 | Geoengineering MIP | 21 TB | 2017 | Muri (UiO), Kristjansson (UiO) |
| HighResMIP | High Resolution MIP | ??? TB | 2017/8 | Alok Gupta (UNI) |

Post-processing challenges in CMIP6

- many MIPS=many experiments to process
 - new output diagnostics (~1200 variables in total)
 - more model configurations
 - big data volume (CMIP6 ~ 10 X CMIP5)
- **high demands on post-processing tools**

The CMOR-ization tool for NorESM output



Welcome to noesm2cmor's project page

noesm2cmor is a FORTRAN based command line tool for post-processing NorESM output using the Climate Model Output Rewriter libraries.

Support or Contact

For any questions, please write to [ingo.bethke\[at\]juni.no](mailto:ingo.bethke@juni.no).

Sponsors

The development of the tool has been funded by the Research Council of Norway through the projects **Integrated Earth System Approach to Explore Natural Variability and Climate Sensitivity (EarthClim)** and **Earth system modelling of climate Variations in the Anthropocene (EVA)**.

noesm2cmor is maintained by [NorwegianClimateCentre](#).

This page was generated by [GitHub Pages](#) using the [Cayman theme](#) by Jason Long.

<https://github.com/NorwegianClimateCentre/noesm2cmor>

Basic features

- FORTRAN based command line tool
- uses namelist input file (info about system, model, experiment and output)
- performs various tasks (renaming, unit conversion, vector rotation, global integration, computation of derived variables, annotation)
- processes either **single** or all variables

Advanced features

- vertical interpolation from hybrid to pressure
- advanced file scanning -> *allows post-processing in a single step*
- “easy” cmor-ization setup for non-MIP simulations (only for CMIP5 standard)
- MPI-parallelization along variable dimension
- CMOR2 (CMIP5-format) and **CMOR3 (CMIP6-format) capable**

Installation

Download code

```
git clone https://github.com/NorwegianClimateCentre/noesm2cmor
```

Build code (creates executables in noesm2cmor/bin)

```
cd noesm2cmor/build  
make -f Makefile_cmor2.nird_intel  
make -f Makefile_cmor3.nird_intel
```

Install grid data (1.6 GB) and CMIP5 sample model output (15 GB)

```
noesm2cmor/scripts/install_griddata.sh <local path for storing grid data>  
noesm2cmor/scripts/install_sampledata.sh <local path for storing sample output>
```

Configure path where CMOR-ized output is to be stored

```
noesm2cmor/scripts/install_cmorout.sh <local path where cmor-output to be stored>
```

Test on CMIP5 output

```
noesm2cmor/scripts/cmorize_sampledata.sh
```

<https://github.com/NorwegianClimateCentre/noesm2cmor/blob/master/README>

Usage

Direct use

Syntax

```
./noresm2cmor <path to experiment namelist file>
```

```
./noresm2cmor3 <path to experiment namelist file>
```

Example

```
./noresm2cmor CMIP5_NorESM1-M_historical_r1i1p1.nml
```

```
./noresm2cmor3 noresm2cmor3_CMIP6_NorESM2-LM_piControl_r1i1p1_CRESCENDO-V1.nml
```

Wrapper use (creates input namelist; CMOR2 and CMIP5-based “generic” tables)

Syntax

```
./cmorize_generic.sh <absolute path to NorESM output folder> <start year> <last year>
```

Example

```
./cmorize_generic.sh /work/ingo/sampleddata/N20TRAERCN_f19_g16_01 2000 2000
```

Moving to CMIP6 cmor-ization using cmor3

Status

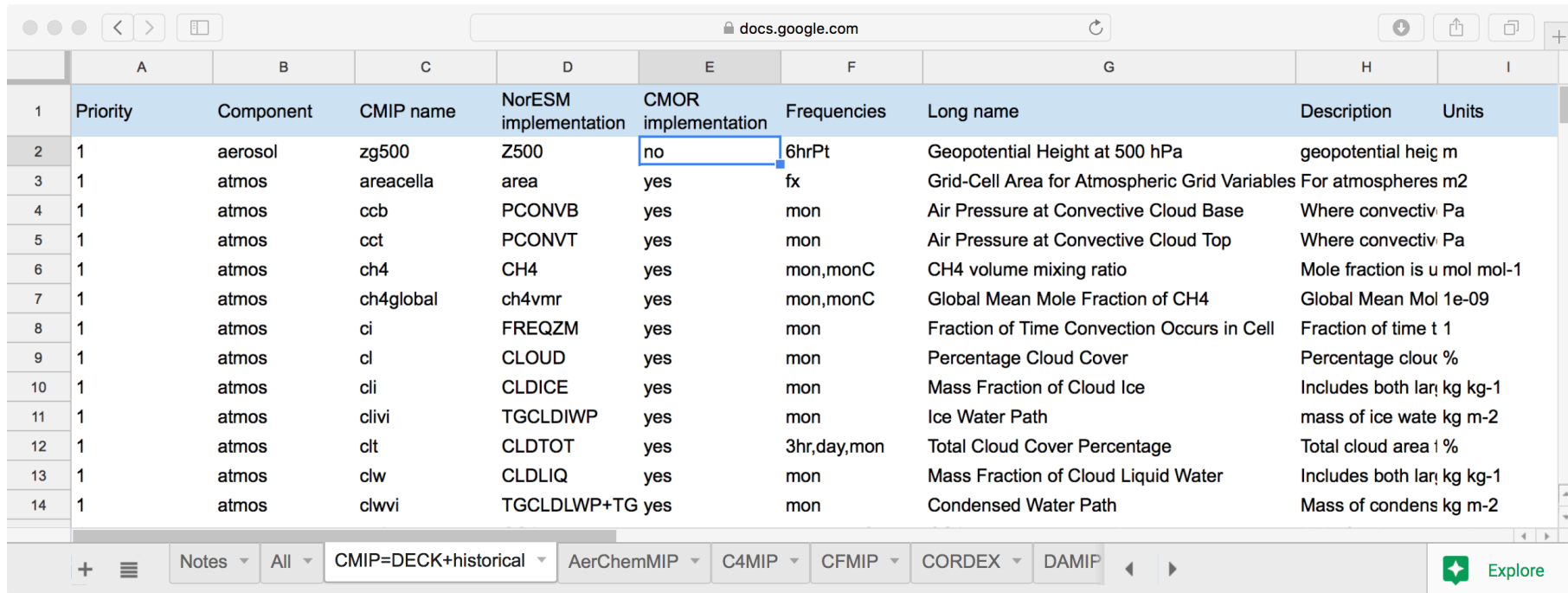
- completed upgrade to CMOR3 (CMIP6-compliant) library
- support for basic output groups and ~250 CMIP5 variables
- successful cmor-ization of NorESM2 test output with cmor3 library
/projects/NS2345K/www/cmor/NorESM2_sample_output_for_CRESCENDO_v1

Planned for CMIP6

- support for more output groups (43 in total) and variables (1200 in total)
- support for atmospheric output at “station” locations
- horizontal interpolation to regular grid for ocean/sea ice output
- statistical reductions (zonal means, climatologies of diurnal cycle, etc)

Moving to CMIP6 cmor-ization using cmor3

- Implementation of CMIP6 tables and variables is work in progress
- Use google-sheet to organize effort



The screenshot shows a Google Sheet spreadsheet with the following data:

| | A | B | C | D | E | F | G | H | I |
|----|----------|-----------|-----------|-----------------------|---------------------|-------------|---|------------------------------|-------|
| 1 | Priority | Component | CMIP name | NorESM implementation | CMOR implementation | Frequencies | Long name | Description | Units |
| 2 | 1 | aerosol | zg500 | Z500 | no | 6hrPt | Geopotential Height at 500 hPa | geopotential heig m | |
| 3 | 1 | atmos | areacella | area | yes | fx | Grid-Cell Area for Atmospheric Grid Variables | For atmospheres m2 | |
| 4 | 1 | atmos | ccb | PCONVB | yes | mon | Air Pressure at Convective Cloud Base | Where convectiv Pa | |
| 5 | 1 | atmos | cct | PCONVT | yes | mon | Air Pressure at Convective Cloud Top | Where convectiv Pa | |
| 6 | 1 | atmos | ch4 | CH4 | yes | mon,monC | CH4 volume mixing ratio | Mole fraction is u mol mol-1 | |
| 7 | 1 | atmos | ch4global | ch4vmr | yes | mon,monC | Global Mean Mole Fraction of CH4 | Global Mean Mol 1e-09 | |
| 8 | 1 | atmos | ci | FREQZM | yes | mon | Fraction of Time Convection Occurs in Cell | Fraction of time t 1 | |
| 9 | 1 | atmos | cl | CLOUD | yes | mon | Percentage Cloud Cover | Percentage clou % | |
| 10 | 1 | atmos | cli | CLDICE | yes | mon | Mass Fraction of Cloud Ice | Includes both lar kg kg-1 | |
| 11 | 1 | atmos | clivi | TGCLDIWP | yes | mon | Ice Water Path | mass of ice wate kg m-2 | |
| 12 | 1 | atmos | clt | CLDTOT | yes | 3hr,day,mon | Total Cloud Cover Percentage | Total cloud area 1 % | |
| 13 | 1 | atmos | clw | CLDLIQ | yes | mon | Mass Fraction of Cloud Liquid Water | Includes both lar kg kg-1 | |
| 14 | 1 | atmos | clwvi | TGCLDLWP+TG | yes | mon | Condensed Water Path | Mass of condens kg m-2 | |

<https://docs.google.com/spreadsheets/d/154dL8auLawUQybsKWxLNfiqqdDwAhAgzTQVhw0jXfll/edit?usp=sharing>

NorESM2 output capability and CMOR-ization

- upgraded NorESM post-processing tool to CMIP6 (cmor3) standard
<https://github.com/NorwegianClimateCentre/noresm2cmor>
- prepared cmor-ized NorESM2 output sample for CRESCENDO
http://ns2345k.web.sigma2.no/cmor/NorESM2_sample_output_for_CRESCENDO_v1
- currently only 250 variables supported (those delivered to CMIP5)
- implementation of 1200 requested CMIP6 variables ongoing
<https://docs.google.com/spreadsheets/d/154dL8auLawUQybsKWxLNfiqqdDwAhAgzTQVhw0jXfII/edit?usp=sharing>

Norwegian Earth System Grid (ESG) data-node

- retired old node noresg.norstore.no hosted on Norstore
- installed new node **noresg.nird.sigma2.no** hosted on NIRD
 - data-only Tier-2 installation (no portal/no user administration)
 - collaboration with Swedish Tier-1 node for registration of NorESM data
 - data downloaded from Norwegian node via any Tier-1 node (e.g., esgf-data.dkrz.de)
- Sigma2 ensures node operation and keeps software up-to-date
- CMIP5 data re-published
- **CMIP6 data publication not tested yet but scheduled for October**