CMOR post-processing of NorESM output

Ingo Bethke (UNI), Alok Gupta (UNI), Helene Muri (UiO) and Alf Grini (MET)
Norwegian Earth System Model (NorESM)

Flavor of NCARs Community Earth System Model version (CESM)

Challenges for post-processing:
- time-varying vertical coordinate in ocean component
- exotic output fields from aerosol-chemistry component
- exotic output fields from ocean biogeochemistry component
Data-flow in a typical NorESM production

1. Model integration & short-term archiving
2. Compression & long-term disk archiving
3. CMOR post-processing & ESG publishing
4. Tape archival (with staging=tar-bundling)
5. Data analysis
Why cmor-izing?

What it does:
• post-processing step in which raw climate model output is rewritten in standardized format ("CMIP" standard)
• reorganization of output file structure (single record, multiple variables -> multiple records, single variables)
• basic annotation and quality control

Advantages:
• facilitates data-sharing of multi-model intercomparison studies through ESG
• facilitates multi-model output analysis and employment of common evaluation tools
• makes output more accessible to climate science community (~500 publications have used NorESM output prepared for CMIP5)
• post-processing tools can be reused in different projects (common output standard not only for models but also for all projects!)

Disadvantages:
• doubling of storage volume if raw output is kept
• cmor-izing takes time, system resources and human resources
### Past cmor-ization of NorESM output

<table>
<thead>
<tr>
<th>Project</th>
<th>Extended title</th>
<th>Model</th>
<th>Volume</th>
<th>When</th>
<th>NorESM contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMIP5</td>
<td>fifth Coupled Model Intercomparison Project</td>
<td>NorESM1-M, NorESM1-ME</td>
<td>~60 TB</td>
<td>2011</td>
<td>Ingo Bethke (UNI)</td>
</tr>
<tr>
<td>GeoMIP</td>
<td>Geoengineering Model Intercomparison Project</td>
<td>NorESM1-M</td>
<td>~10 TB</td>
<td>2011</td>
<td>Helene Muri (UiO), Kari Altersjær (UiO)</td>
</tr>
<tr>
<td>PlioMIP</td>
<td>Pliocene Model Intercomparison Project</td>
<td>NorESM-L</td>
<td>~1 TB</td>
<td>2012</td>
<td>Zhongshi Zhang (UNI)</td>
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</table>

- people with NorESM cmor-izing experience: Ingo Bethke (UNI), Helene Muri (UiO), Kari Altersjær (UiO), Alf Grini (MET), Zhongshi Zhang (UNI), Jerry Tjiputra (UNI), Anna Lewinschal (MISU), Bjørn Samset (CICERO)

- NorESM participation in intercomparison projects that did not require cmor-ization: CMIP2, CMIP3, CORE2, PEGASOS...
### Upcoming cmor-ization of NorESM output

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<td>NON-CMIP</td>
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<td>VolMIP</td>
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*NorESM2 versions: MH, HH, MM, LM, LME, LMEC*
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**CMIP6**

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**Post-processing challenges**

- many MIPS=many experiments to process
- new output diagnostics
- more model configurations (CMIP5=3, CMIP6=6)
- big data volume (CMIP6 ~ 10 X CMIP5)

➢ high demands on post-processing tools
noresm2cmor – the CMOR-ization tool for NorESM output

Basic features
• FORTRAN based command line tool
• uses namelists to define system, model, experiment and output information
• performs various tasks:
  • renaming
  • unit conversion
  • vector rotation
  • vertical interpolation (e.g., from hybrid to pressure level)
  • global integration (e.g., co2mass)
  • computation of derived variables (e.g., barotropic streamfunction)
  • annotation

Basic usage
noresm2cmor CMIP5_NorESM1-M_historical_r1i1p1.nml

Advanced features
• advanced file scanning and handling of time information with no/few requirements on input format (just implemented)
• MPI-parallization along variable dimension (available soon)
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The cmor-ization tool for NorESM output – noresm2cmor

Welcome to noresm2cmor’s project page

noresm2cmor 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]uni.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).

noresm2cmor is maintained by NorwegianClimateCentre.
This page was generated by GitHub Pages using the Cayman theme by Jason Long.

Code available at http://norwegianclimatecentre.github.io/noresm2cmor
Wiki page will come soon...
noresm2cmor – the CMOR-ization tool for NorESM output

Development at [http://github.com/NorwegianClimateCentre/noresm2cmor](http://github.com/NorwegianClimateCentre/noresm2cmor)

Everyone is welcome to join and create their personal/project branches
Transferable knowledge, special competence, etc

- documentation of post-processing tools (lack of competence)
  - exchange of documentation and code
  - common documentation standard for cmor-izing tools of different model systems

- quality control procedures and tools (lack of competence)
  - scaling errors for non-standard variables with no pre-defined typical range
  - scaling errors that lie within the pre-defined typical range (e.g. if the units say concentration but the actual data is written as fraction)
  - sign error in flux variables
  - error in vector direction (e.g. velocities are not correctly rotated to East/North)

- best-practice/infrastructure for correcting output data (moderate competence)
  - collect user feedback (e.g., user reports a bug to support mailing list)
  - bug needs to be fixed in post-processing tool
  - published datasets have to be retracted from ESG (or marked as deficient)
  - affected data has to be reprocessed and republished in new dataset
  - changes have to be documented/reported somewhere (e.g. on erratum page)

- dealing with exotic model grids (moderate/lack of competence)
  - exchange of cmor-izing experience with grids
  - how-to for grid description files