Federal Ministry of Education and Research

CMIP6 compliant processing and climate extremes indices with CDO's

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https://c6dreq.dkrz.de

CDO and the CMIP standard

The Climate Data Operators tool (CDO) is a collection of command line operators to manipulate and analyse gridded model data. The data standard of the Coupled Model Intercomparison Project (CMIP) is widely used and simplifies the analysis and comparison of climate models.

The CDO's metadata model has been adapted to the CMIP standard so that CDO is able to process all CMIP related information.

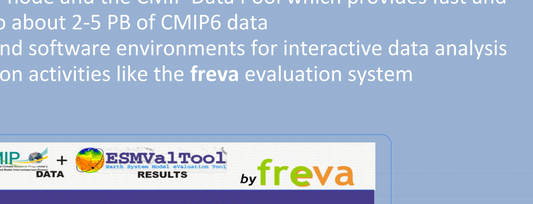
With the **cdo cmor** operator 1 ,
CDO can now be used for any step of the project's data workflow consisting of *data production*, *data standardisation* as well as *data analysis*. The Climate Model Output Rewriter (CMOR) is a software package which rewrites climate data CMIP compliant.

cdo cmor operator 1

The user interface

```
cdo cmor,MIP-table,\
            info=          config_table 2 \
  mapping_table=           mapping_table 3 \
                 infile
  "File stored in:         $DRS/outfile   "
```

The metadata workflow



CDO highlights

Brackets, pipes and expressions

"Merge a time series and multiply with 3!"

```
cdo mergetime \
 infile1 infile2  tempfile
cdo mulc,3 tempfile outfile
```

```
cdo -P 8 cmor,Amon,info=info.txt \
  -expr,"tas=3*invar" \
[ -mergetime infile1 infile2 ]
outfile
```

1. A number of OpenMP threads can be set
2. **cdo cmor** standardizes the input.
3. **cdo expr** evaluates an expression which can substitute operator tasks
4. Operators that process an arbitrary number of inputs (e.g. **mergetime**) can be piped by using brackets
5. Pipes minimize I/O

Mapping table 3

cdo cmor can map model output variables to CMOR Variables by reading a mapping table. A CMOR Variable is the unique combination of a MIP-table and a `cmor_name`. The mapping table contains all required variable attributes and enables the processing of more than one variable at once.

The c6dreq WebGUI can attach a database per model which stores mapping information for all possible CMOR Variables. Different users can edit simultaneously and all changes are logged. Updates in the data standard of variables are displayed. A mapping table can be downloaded whenever needed.

CMIP6 Data Request WebGUI

Availability	Model Variable Name	Model Variable Units
Available	temp2	degC

mapping_table

Entry key	Model variable	CMOR variable
&parameter	name=temp2	units=degC cmor_name=tas pmt=Amon
&parameter	name=P2M	units=hPa cmor_name=ps pmt=Amon
&parameter		units=degC cmor_name=ts pmt=Amon

Select Project

CMIP6 Select

Model	Edit or Generate Mapping-Table Files	
MPI-ESM MPI-M Earth System Model	Edit	Generate

Short Name	Table	Last Edited	Edit
tas	Amon	03.04.2018, 12:32 by sfjm	Edit
ts	Amon	03.04.2018, 13:58 by fw	Edit
tasmin	Amon	03.04.2018, 12:33 by ms	Edit

Config table 2

CMIP6_CV.json #Controlled Vocabulary

```
"required_global_
attributes":{
"institution_id",
"activity_id",
"institution",
"mip_era",...
```

Required attributes — CMIP6 Data Request WebGUI — Setting — Unset all

institution_id — X DWD

activity_id — X ScenarioMIP

institution — X Deutscher Wetterdienst, Offenbach am Main 63067, Germany

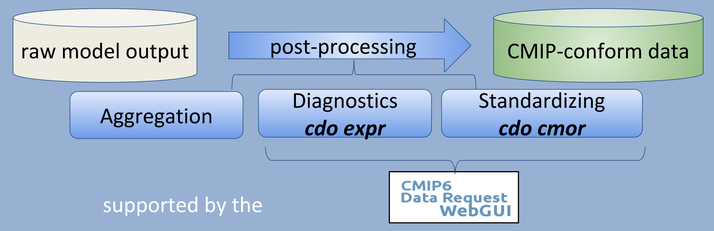
mip_era — X CMIP6

Create config table

config_table

```
institution_id="DWD"
activity_id="ScenarioMIP"
mip_era="CMIP6" ...
```

Integration into the CMIP6 post-processing workflow



supported by the CMIP6 Data Request WebGUI

A highly modular infrastructure allows the user to customize the post-processing. The GUI supplies the user with tools to easily configure and automate the generation of parts of the post-processing. The post-processing interface requires specific raw model output file names.

CMIP6 services at DKRZ

- Data Quality Assurance
- Data Citation and PID support
- Hosting an ESGF-node and the CMIP Data Pool which provides fast and flexible access to about 2-5 PB of CMIP6 data
- HPC resources and software environments for interactive data analysis
- Hosting evaluation activities like the **freva** evaluation system

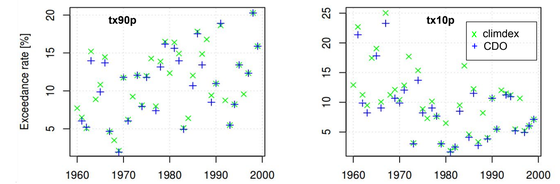
CMIP DATA + ESMValTool RESULTS by freva

Home Result-Browser CMIP6 Results

CDO and Climate Extremes Indices

CDO's climate extremes indices operators are validated with the results of the software climdex which is recommended by the Expert Team on Climate Change Detection and Indices (ETCCDI).

CDO calculations differ from climdex because climdex...



- applies Bootstrapping for a base period (1960-1989)
- uses a specific percentile estimation method
- ignores the 29th of all februaries

DKRZ DEUTSCHES KLIMARECHENZENTRUM

References

Schulzweida, U.(2019): CDO User Guide.
Nadeu, D. (2018): CMOR
Schupfner, M. (2019): The CMIP6 Data Request WebGUI.
Eyring, v. et. al (2016): Overview of the Coupled Model Intercomparison Project Phase 6 (CMIP6) experimental design and organization.