

# An update on Earth System Grid Federation use in CMIP6, model performance metrics, input4MIPs and **obs4MIPs**

WDAC8, Marrakesh, 20-21 March 2019



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Program for Climate Model Diagnosis and Intercomparison (PCMDI)

LLNL-PRES-954476

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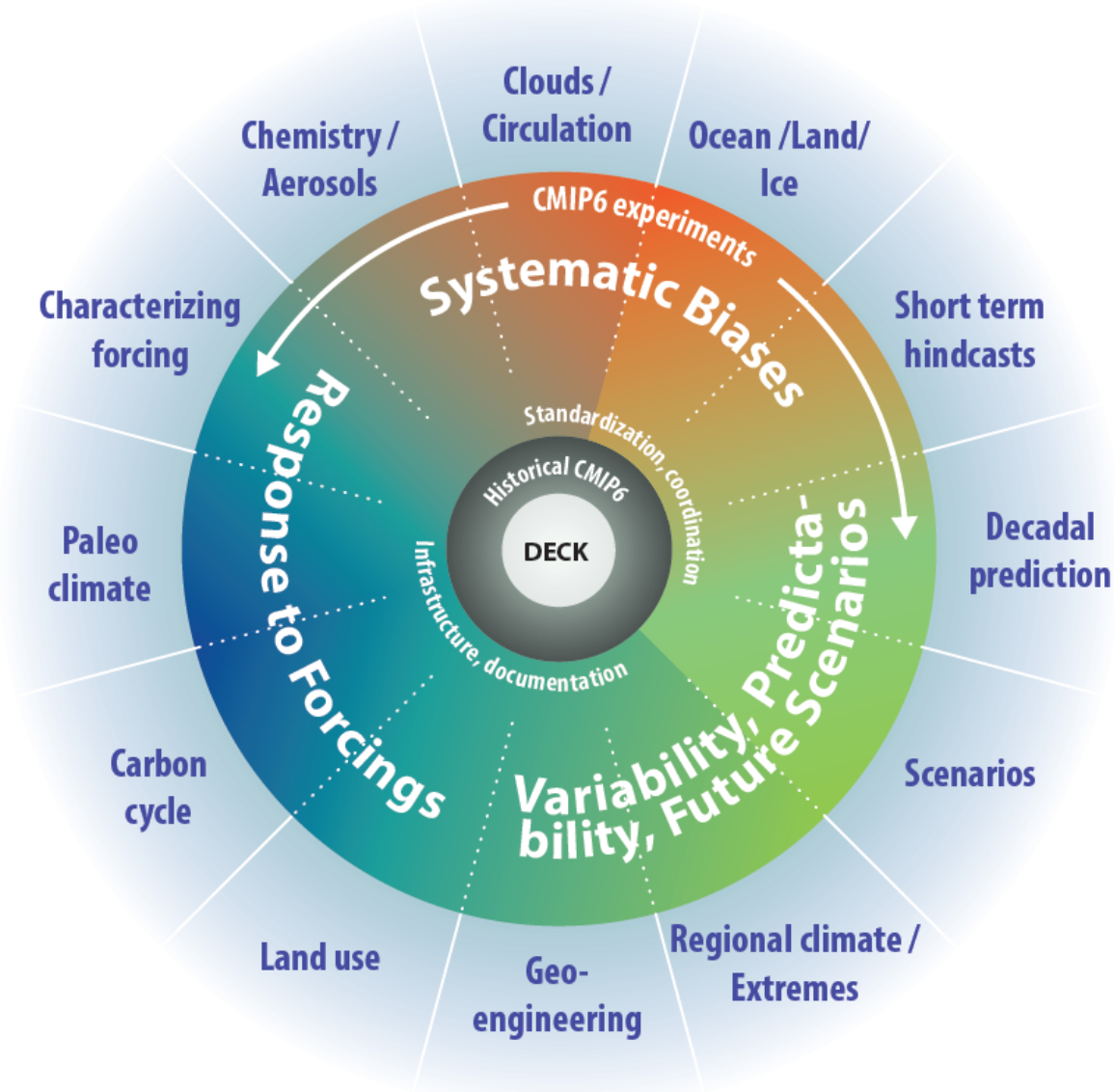
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# CMIP and related activities support a large body of climate research

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- Agencies may find it difficult to justify use of “research funds” to support the essential CMIP infrastructure: coordination, leadership, model output post-processing and publishing.
- The value of CMIP is that it *enables* fundamental research
  - Users now expect easy access to multi-model simulation output
  - 100’s of research papers relied on CMIP3 output
  - 1000’s of research papers rely on CMIP5 output
- We should ensure sufficient resources are invested in CMIP infrastructure to continue this record of scientific impact.

# CMIP6 design overview:



## DECK

- Small set of benchmark runs
- To evolve only slowly (e.g. OMIP, LUMIP)

## Historical CMIPx

- Forcing to be updated for each new phase

## CMIP6-endorsed MIPs

- An evolving collection to address specific scientific issues

# CMIP5/6 evolution: More institutions, more models, more experiments, more data

Thanks to Karl Taylor and Paul Durack for input on CMIP6

- 44 institutions/consortia have registered (CMIP5: 31 inst.)
- 101 models are registered (CMIP5: 59 models)
- 287 experiments defined; 102 tier 1 (CMIP5: 33; 14 tier 1 exps.)
- order **20 PB** of model output expected (CMIP5: ~2 PB)

## CMIP6\_CVs

[https://github.com/WCRP-CMIP/CMIP6\\_CVs](https://github.com/WCRP-CMIP/CMIP6_CVs)

Core Controlled Vocabularies (CVs) for use in CMIP6

### Registering Institutions, Models, or requesting changes to CVs:

To register your institution or model or to request changes to a CV, please submit an issue/ticket following the instructions on the [CMIP6\\_CVs issue page](#).

Some support for CMIP participating modeling groups is available: [pcmdi-cmip@llnl.gov](mailto:pcmdi-cmip@llnl.gov)

To view the current `experiment_id` entries point your browser to [CMIP6\\_experiment\\_id.html](#)

To view the current `institution_id` entries point your browser to [CMIP6\\_institution\\_id.html](#)

To view the current `source_id` entries point your browser to [CMIP6\\_source\\_id.html](#)

The CVs build on logic that is described in the [CMIP6 Global Attributes, DRS, Filenames, Directory Structure, and CV's document](#)

### Lists of registered:

- experiments
- institutions
- models



# IPCC timeline

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<b>2019</b>		
January 7	Second Lead Author Meeting	
April 29	First order draft expert review	
August 26	Third Lead Author Meeting	
<b>2020</b>		← 31 December 2019: Journal articles submitted
March 2	Second order draft expert review	
June 1	Fourth Lead Author Meeting	
October 18	Submission of final draft	← 30 September 2020: Journal articles accepted
<b>2021</b>		
April 16	IPCC acceptance/adoption/approval	

## CMIP6 Model Analysis Workshop

**25-28 March 2019, Barcelona Supercomputing Center (BSC), Barcelona (Spain)**

The Coupled Model Intercomparison Project Phase 6 (CMIP6) Model Analysis workshop is jointly organized by the WCRP Working Group on Coupled Modelling (WGCM) CMIP Panel and the European Commission Horizon 2020 projects PRIMAVERA (PRocess-based climate sIMulation: AdVances in high-resolution modelling and European climate Risk Assessment) and EUCP (EUropean Climate Prediction system). Following the format of the WCRP CMIP5 model analysis workshop held in 2012, the workshop focus will be on:

- Multi-model CMIP6 analyses and evaluation that take advantage of the large suite of CMIP6 experiments
- Efforts to connect model development and analysis to identify Earth system model improvements that help reduce systematic biases and/or increase the realism of models
- Methods for multi-model analysis
- Climate change impacts

The workshop will be structured around the three scientific questions:

1. How does the Earth system respond to forcing?
2. What are the origins and consequences of systematic model biases?
3. How can we assess future climate change given climate variability, predictability, and uncertainty in scenarios?

### Workshop approach: Short-presentation/poster format

The workshop will consist of a series of seven half-day sessions of three hours each. Each session will begin with 20-25 presenters given a 3-minute time slot to show no more than one slide summarizing the main conclusions of their poster. The rest of the half-day session will consist of viewing posters of that session. In addition, there will be a plenary talk each day.

Participation is limited by the size of the venue (~200 people) and format of the workshop. Abstracts will be accepted based on relevance to the workshop focus.

### WCRP News

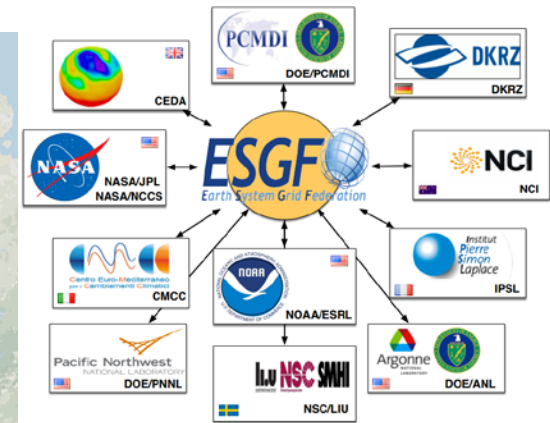
- WCRP News
- WCRP Highlights
- WCRP Newsletter
  - WCRP News Articles
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### WCRP News Archive

- December, 2018
- November, 2018
- October, 2018
- September, 2018
- August, 2018
- July, 2018
- June, 2018
- May, 2018
- April, 2018
- March, 2018
- February, 2018
- January, 2018

**Next week!**

# The Earth System Grid Federation (ESGF) is being used for CMIP6 and other WCRP projects ESGF data is distributed across 22 nodes



# CMIP6 status: data availability (as of 15 March)

[https://pcmdi.llnl.gov/CMIP6/ArchiveStatistics/esgf\\_data\\_holdings/](https://pcmdi.llnl.gov/CMIP6/ArchiveStatistics/esgf_data_holdings/)

- Model output now being served by ESGF from 10 institutions (15 models) and 21 experiments
- Much more output to be made available over the next year

# of datasets archived

source_id	# of expts	historical	piControl	1pctCO2	amip	abrupt-4xCO2
<b># of models</b>	<b>44</b>	<b>10</b>	<b>10</b>	<b>7</b>	<b>10</b>	<b>7</b>
BCC-CSM2-MR	4	578	147	148		147
BCC-ESM1	2	542	137			
CESM2	2	8760			421	
CESM2-WACCM	2	2514			1409	
CNRM-CM6-1	5	4079	302	387	500	1818
CNRM-ESM2-1	5	2951	440	1515	564	1462
E3SM-1-0	1		17			
FGOALS-f3-L	1				1	
GFDL-AM4	1				69	
GFDL-CM4	1		356			
GISS-E2-1-G	5	1711	176	166	665	166
IPSL-CM6A-ATM-HR	0					
IPSL-CM6A-LR	5	22648	2490	835	3373	9441
MIROC6	5	1090	109	109	930	109
MRI-ESM2-0	5	270	54	54	162	702



# All available CMIP6 data is exposed at 3 data portals

- Each portal currently federates the 8 data nodes:
  - PCMDI (USA) <https://esgf-node.llnl.gov/search/cmip6/>
  - CEDA (UK) <https://esgf-index1.ceda.ac.uk/search/cmip6-ceda/>
  - IPSL (France) <https://esgf-node.ipsl.upmc.fr/search/cmip6-ipsl/>
  - coming soon: DKRZ (Germany), GFDL (USA)
- The search interface provides up-to-date listing of available models and experiments

**Data Node** -

- aims3.llnl.gov (13433)
- esgf.lasg.ac.cn (1)
- esg1.umr-cnrm.fr (8174)
- esgdata.gfdl.noaa.gov (250)
- esgf-data2.diasjp.net (538)
- esgf.nccs.nasa.gov (5859)
- esgf3.dkrz.de (1547)
- vesg.ipsl.upmc.fr (5670)

**Source ID** -

- CNRM-CM6-1 (6716)
- CNRM-ESM2-1 (7362)
- FGOALS-f3-L (1)
- GFDL-AM4 (69)
- GFDL-CM4 (181)
- GISS-E2-1-G (10318)
- IPSL-CM6A-LR (10287)
- MIROC6 (538)



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**Home**

MIP Era +

Activity -

CFMIP (863)

Model Cohort +

Product +

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Display  results per page
 [\[ More Search Options \]](#)

Show All Replicas
  Show All Versions
  Search Local Node Only (Including All Replicas)

Search Constraints: ✖ CFMIP

Total Number of Results: 863  
-1- 2 3 4 5 6 Next >>

[Add all displayed results to Data Cart.](#)
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Expert Users: you may display the search URL and return results as XML or return results as JSON

1. **CMIP6.CFMIP.IPSL.IPSL-CM6A-LR.abrupt-0p5xCO2.r11p1f1.CFmon.albisccp.gr**  
 Data Node: vesg.ipsl.upmc.fr  
 Version: 20180605  
 Total Number of Files (for all variables): 1  
 Full Dataset Services: [\[ Show Metadata \]](#) [\[ List Files \]](#) [\[ THREDDS Catalog \]](#) [\[ WGET Script \]](#) [\[ LAS \]](#) [\[ Show Citation \]](#) [\[ PID \]](#) [\[ Globus Download \]](#)  
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4. **CMIP6.CFMIP.IPSL.IPSL-CM6A-LR.abrupt-0p5xCO2.r11p1f1.3hr.rds.gr**  
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DKRZ (Germany), GFDL (USA)

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- esg.lasg.ac.cn (1)
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- esgdata.gfdl.noaa.gov (250)
- esgf-data2.diasjp.net (538)
- esgf.nccs.nasa.gov (5859)
- esgf3.dkrz.de (1547)
- vesg.ipsl.upmc.fr (5670)

**Experiment ID**

- 1pctCO2 (5433)
- 1pctCO2-4xext (166)
- 1pctCO2-bgc (788)
- 1pctCO2-rad (660)
- G1 (979)
- abrupt-0p5xCO2 (443)
- abrupt-2xCO2 (614)
- abrupt-4xCO2 (6569)
- abrupt-solp4p (790)
- amip (1376)
- esm-piControl-spinup (558)
- hist-GHG (830)
- hist-aer (2490)
- hist-nat (830)
- hist-sol (1660)
- historical (5169)
- lig127k (407)
- midHolocene (1221)
- piControl (3183)
- piControl-spinup (1306)



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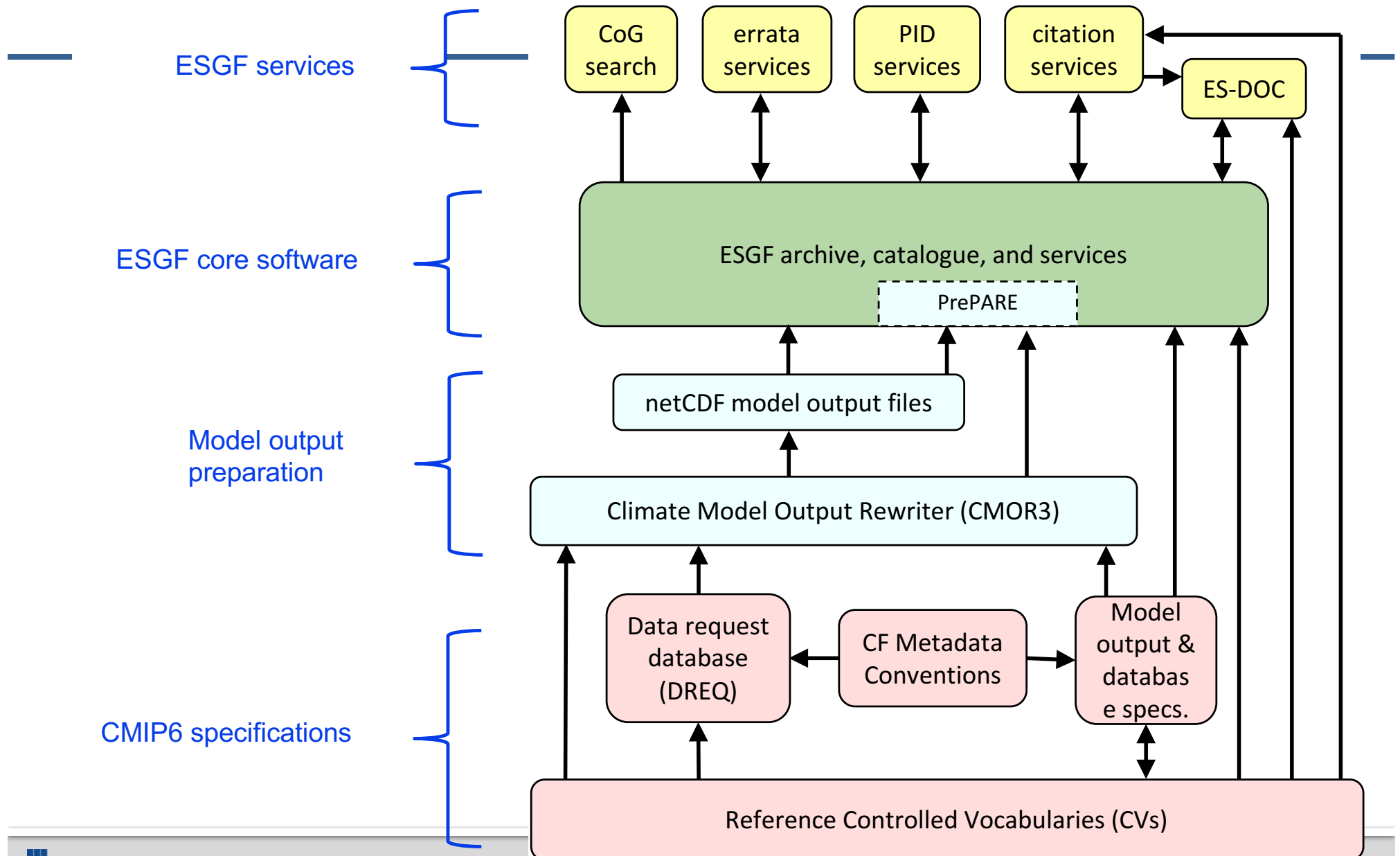
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Data Node: vesg.ipsl.upmc.fr  
Version: 20180605

# ESGF core software stack

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- Supports a federated data archive hosting the CMIP6 data
- Status: **In place and operational!**
- Replication procedure is working
  - As of March 15 2019 PCMDI has replicated ~85% of available datasets

# Infrastructure components and dependencies





# A major advance for CMIP6: “controlled vocabularies” (CVs) now machine readable for use across infrastructure components

- CVs allow users and individual infrastructure elements to communicate.
- Recorded in JSON files
- Status: **all needed CV's defined**, including activity, Institution, model, experiment, sub-experiment, realm, frequency, .....

[https://github.com/WCRP-CMIP/CMIP6\\_CVs](https://github.com/WCRP-CMIP/CMIP6_CVs)

WCRP-CMIP / CMIP6\_CVs

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Code Issues 14 Pull requests 0 Projects 0 Wiki Pulse Graphs Settings

Controlled Vocabularies (CVs) for use in CMIP6 — Edit

828 commits 1 branch 1 release 5 contributors

Branch: master New pull request Create new file Upload files Find file Clone or download

durack1 committed on GitHub Issue156 durack1 revise source\_id NorESM various (#167) Latest commit b6f52dd 6 days ago

.github	Source_id format reorder	a month ago
src	Issue156 durack1 revise source_id NorESM various (#167)	6 days ago
.gitignore	Further formatting - deal with xlsx quirks	5 months ago
CMIP6_activity_id.json	Issue156 durack1 revise source_id NorESM various (#167)	6 days ago
CMIP6_experiment_id.json	Issue156 durack1 revise source_id NorESM various (#167)	6 days ago
CMIP6_frequency.json	Issue156 durack1 revise source_id NorESM various (#167)	6 days ago
CMIP6_grid_label.json	Issue156 durack1 revise source_id NorESM various (#167)	6 days ago
CMIP6_institution_id.json	Issue156 durack1 revise source_id NorESM various (#167)	6 days ago
CMIP6_license.json	Issue156 durack1 revise source_id NorESM various (#167)	6 days ago
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CMIP6_realm.json	Issue156 durack1 revise source_id NorESM various (#167)	6 days ago
CMIP6_required_global_attributes.json	Issue156 durack1 revise source_id NorESM various (#167)	6 days ago
CMIP6_source_id.json	Issue156 durack1 revise source_id NorESM various (#167)	6 days ago
CMIP6_source_type.json	Issue156 durack1 revise source_id NorESM various (#167)	6 days ago
CMIP6_table_id.json	Issue156 durack1 revise source_id NorESM various (#167)	6 days ago
README.md	Added source_id html	15 days ago
mip_era.json	Issue156 durack1 revise source_id NorESM various (#167)	6 days ago

README.md

# Climate Model Output Rewriter (CMOR3) released with new module for verifying metadata

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- CMOR is used by many modeling groups to ensure their model output meets CMIP6 requirements
- PrePARE is a new module that
  - checks that CMIP6 output *not* processed by CMOR meets CMIP6 requirements
  - is executed by the ESGF publisher to ensure only CMIP6 compliant files are published.
- Status: **in place and in use!**
  - Code available at <https://github.com/PCMDI/cmor>
  - Documentation available at <http://cmor.llnl.gov/>
  - Development phase is complete
  - Bugs corrected when discovered

Remember this one for obs4MIPs discussion

# Data citation services are linked to CoG search interface

Show Citation

1. CMIP6.CFMIP.IPSL.IPSL-CM6A-LR.abrupt-0p5xCO2.r1i1p1f1.CFmon.albiscpp.gr

Data Node: vesg.ipsl.upmc.fr

Version: 20180605

Total Number of Files (for all variables): 1

Full Dataset Services: [ Show Metadata ] [ List Files ] [ THREDDS Catalog ] [ WGET Script ] [ LAS ] [ Show Citation ] [ PID ] [ Globus Download ] [ Further Info ]

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Version: 20180605

# Citation page



## Metadata for 'CMIP6.CFMIP.IPSL.IPSL-CM6A-LR.abrupt-0p5xCO2'

### General Information

#### General Information

**Name** CMIP6.CFMIP.IPSL.IPSL-CM6A-LR.abrupt-0p5xCO2  
**Abstract** Coupled Model Intercomparison Project Phase 6 (CMIP6) data sets. These data includes all datasets published for 'CMIP6.CFMIP.IPSL.IPSL-CM6A-LR.abrupt-0p5xCO2' according to the Data Reference Syntax defined as 'mip\_era.activity\_id.institution\_id.source\_id.experiment\_id.member\_id.table\_id.variable\_id.grid\_label.version'.  
  
The Earth System Model IPSL-CM6A-LR, released in 2017, includes the components:  
atmos: LMDZ (NPv6, N96; 144 x 143 longitude/latitude; 79 levels; top level 40000 m), land: ORCHIDEE (v2.0, Water/Carbon/Energy mode), ocean: NEMO-OPA (eORCA1.3, tripolar primarily 1deg; 362 x 332 longitude/latitude; 75 levels; top grid cell 0-2 m), ocnBgchem: NEMO-PISCES, seaIce: NEMO-LIM3.  
The model was run by the Institut Pierre Simon Laplace, Paris 75252, France (IPSL) in native nominal resolutions: atmos: 250 km, land: 250 km, ocean: 100 km, ocnBgchem: 100 km, seaIce: 100 km.  
  
Project: These data have been generated as part of the internationally-coordinated Coupled Model Intercomparison Project Phase 6 (CMIP6); see also CMD Special Issue: [http://www.geosci-model-dev.net/special\\_issue500.html](http://www.geosci-model-dev.net/special_issue500.html). The

### Cite this data

**Citation** (2018). *IPSL IPSL-CM6A-LR model output prepared for CMIP6 CFMIP abrupt-0p5xCO2*. Earth System Grid Federation. <http://cera-www.dkrz.de/WDCC/meta/CMIP6/CMIP6.CFMIP.IPSL.IPSL-CM6A-LR.abrupt-0p5xCO2>





# Model and experiment documentation linked to CoG search interface

1. **CMIP6.CFMIP.IPSL.IPSL-CM6A-LR.abrupt-0p5xCO2.r1i1p1f1.CFmon.albisccp.gr**  
Data Node: vesg.ipsl.upmc.fr  
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Filter sidebar:  
MIP Era [+]  
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Activity:  CFMIP (863)  
Model Cohort [+]  
Product [+]  
Source ID [+]  
Institution ID [+]  
Source Type [+]  
Nominal Resolution [+]  
Experiment ID [+]  
Sub-Experiment [+]  
Variant Label [+]  
Grid Label [+]  
Table ID [+]  
Frequency [+]  
Realm [+]  
Variable [+]  
CF Standard Name [+]  
Data Node [+]

# Model and experiment documentation by es-doc



CMIP6 Further Information v0.5.0.0

Support

Help

Further Info URL: <https://furtherinfo.es-doc.org/CMIP6.IPSL.IPSL-CM6A-LR.abrupt-0p5xCO2.none.r1i1p1f1>

## ES-DOC Documentation

MIP Era	<a href="#">CMIP6</a>
Institution	<a href="#">IPSL</a>
Model	IPSL-CM6A-LR
Experiment	<a href="#">abrupt-0p5xCO2</a>
Ensemble Description	N/A
Machine Performance	N/A

## Dataset Documentation

Dataset ESGF Search	N/A
Dataset Errata	N/A
Dataset Citation(s)	<a href="https://cera-www.dkrz.de/WDCC/meta/CMIP6/CMIP6.CFMIP.IPSL.IPSL-CM6A-LR.abrupt-0p5xCO2">https://cera-www.dkrz.de/WDCC/meta/CMIP6/CMIP6.CFMIP.IPSL.IPSL-CM6A-LR.abrupt-0p5xCO2</a>

## Other Documentation

WCRP CMIP6 Homepage	<a href="https://www.wcrp-climate.org/wgcm-cmip/wgcm-cmip6">https://www.wcrp-climate.org/wgcm-cmip/wgcm-cmip6</a>
ES-DOC CMIP6 Homepage	<a href="https://es-doc.org/cmip6">https://es-doc.org/cmip6</a>

# Summary:

---

- The major CMIP6 infrastructure elements are in place and working satisfactorily.
- ESGF expected to serve data through CMIP6 research cycle (>5 yrs)
- High priorities:
  - Enable globus gridftp at all data nodes
  - Provide server-side computation capability at some portals
  - Encourage modeling groups to provide documentation through ES-DOCS
- Major issue: No funding available for user-support
- Consider establishing a distributed “facility”, supported by multiple agencies and internationally, to fund CMIP infrastructure and operations.

# input4MIPs: CMIP infrastructure enabling science

Planning for future forcing data to drive next generation CMIP simulations

**Paul J. Durack** and Karl E. Taylor

~~Program for Climate Model~~

Diagnosis and Intercomparison (PCMDI)

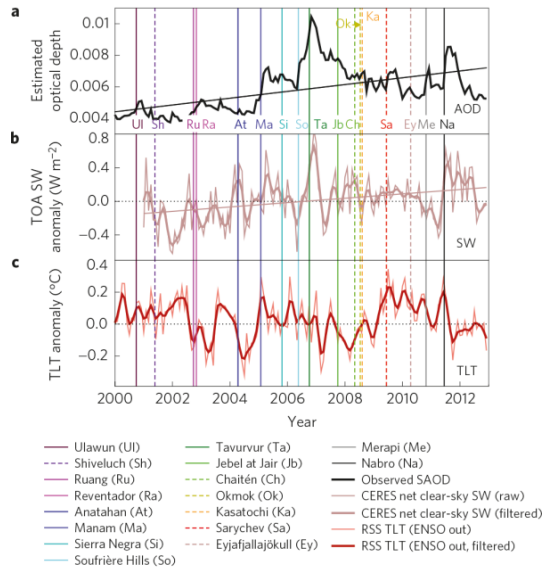


LLNL-PRES-954476

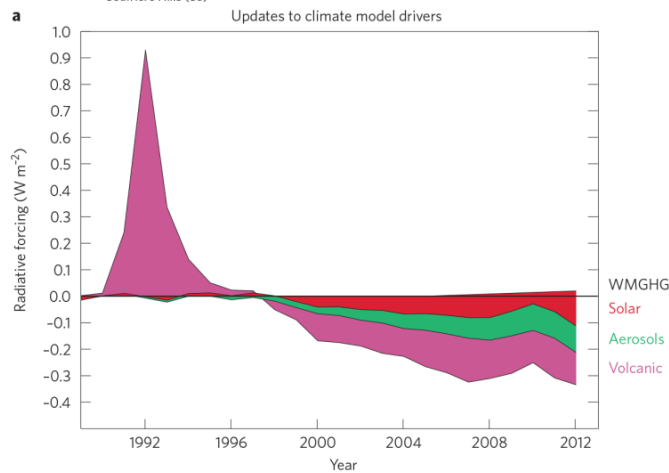
This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344. Lawrence Livermore National Security, LLC



# input4MIPs: motivation



- Improving forcing datasets and their standard usage for CMIPx has been actively discussed for sometime
- After CMIP5 was complete issues were found with the forcing datasets
- Numerous assessments noted discrepancies e.g. with the volcanic forcing data used with a number of forcing-relevant volcanoes omitted from the post-2000 time history (e.g Santer *et al.*, 2014 NATGeo; Schmidt *et al.*, 2014 NATGeo)
- Problems also known for future scenarios
- input4MIPs provides more comprehensive versioning, collating/archiving and documentation of the datasets used for simulations, in particular the *historical* simulations



# Project support



- LLNL contributions are supported by the US Dept. of Energy, Office of Science
  - PCMDI (Science leadership)
  - ESGF/AIMS (infrastructure support)
- DKRZ, Germany provides citation service
- Numerous individuals and their supporting agencies to establish the project
- 18 contributing organizations and their supporting agencies
- 10 contributing countries
- Supporting CMIP6

# CMIP6: input4MIPs-cmor-tables

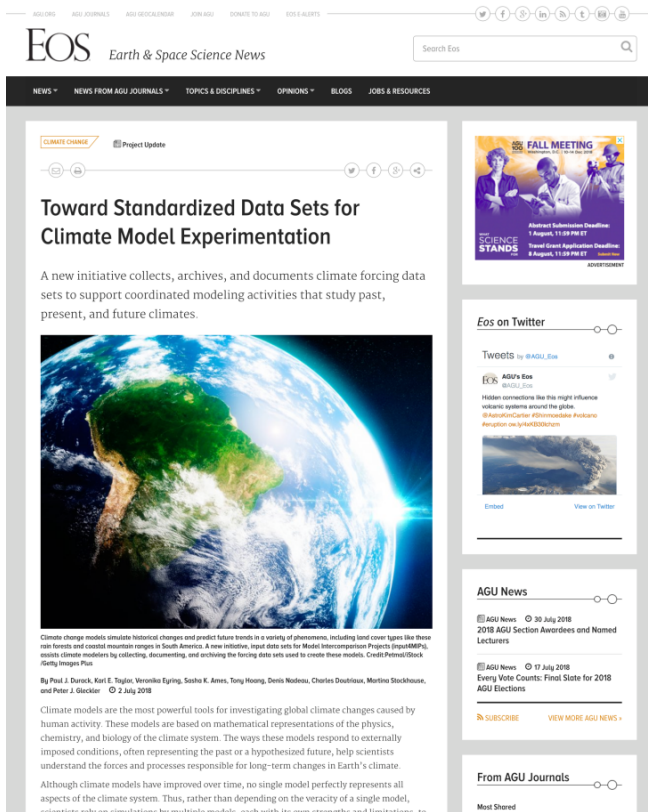
The screenshot displays the GitHub repository page for `PCMDI/input4MIPs-cmor-tables`. The repository is described as "JSON Tables for CMOR3 to create input4MIPs datasets". It shows 112 commits, 1 branch, 5 releases, and 1 contributor. A file named `input4MIPs_institution_id.json` is selected, showing its content. The file is a JSON object with 20 lines and 1.9 KB, containing a list of climate modeling institutions and their locations.

```
1 {
2   "CCCma": "Canadian Centre for Climate Modelling and Analysis, Victoria, BC V8P 5C2, Canada",
3   "CNRM-Cerfacs": "CNRM (Centre National de Recherches Meteorologiques, Toulouse 31057, France), CERFACS (Centre Europeen de
4   "IACETH": "Institute for Atmosphere and Climate, ETH Zurich, Zurich 8092, Switzerland",
5   "IAMC": "Integrated Assessment Modeling Consortium (see www.globalchange.umd.edu/iamc/membership for complete membership).
6   "ImperialCollege": "Imperial College London, South Kensington Campus, London SW7 2AZ, UK",
7   "MOHC": "Met Office Hadley Centre, Fitzroy Road, Exeter, Devon, EX1 3PB, UK",
8   "MPI-M": "Max Planck Institute for Meteorology, Hamburg 20146, Germany",
9   "MRI": "Meteorological Research Institute, Tsukuba, Ibaraki 305-0052, Japan",
10  "NCAR": "National Center for Atmospheric Research, Boulder, CO 80307, USA",
11  "NCAS": "National Centre for Atmospheric Science, University of Reading, Reading RG6 6BB, UK",
12  "PCMDI": "Program for Climate Model Diagnosis and Intercomparison, Lawrence Livermore National Laboratory, Livermore, CA 94
13  "PNNL-JGCRI": "Pacific Northwest National Laboratory - Joint Global Change Research Institute, College Park, MD 20740, USA"
14  "SOLARIS-HEPPA": "SOLARIS-HEPPA, GEOMAR Helmholtz Centre for Ocean Research, Kiel 24105, Germany",
15  "UColorado": "University of Colorado, Boulder, CO 80309, USA",
16  "UReading": "University of Reading, Reading RG6 6UA, UK",
17  "UoM": "Australian-German Climate & Energy College, The University of Melbourne (UoM), Parkville, Victoria 3010, Australia"
18  "UofMD": "University of Maryland (UofMD), College Park, MD 20742, USA",
19  "VUA": "Vrije Universiteit Amsterdam, De Boelelaan 1105, 1081 HV Amsterdam, Netherlands"
20 }
```

<https://github.com/PCMDI/input4MIPs-cmor-tables>

# input4MIPs: current status

- Current dataset collection ver 6.2.18
- 7304 netcdf files
  - 1.5Tb total storage footprint
  - 13 MIPs served
  - Latest information <http://goo.gl/r8up31>
- Datasets being updated/added
  - 6.2.19 (~December 2018) – ScenarioMIP – Future Land Use v2.1f – added\_tree\_cover
  - 6.2.20 (~December 2018) – CMIP – AMIP Boundary forcing v1.1.5
  - 6.2.21 (~January 2019) – CMIP – Stratospheric aerosol v4.0.0
  - 6.2.22 (~March 2019) – ScenarioMIP – ozone (additional experiments)
  - Dataset collection version history <http://goo.gl/r8up31>



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**CLIMATE CHANGE** Project Update

## Toward Standardized Data Sets for Climate Model Experimentation

A new initiative collects, archives, and documents climate forcing data sets to support coordinated modeling activities that study past, present, and future climates.



Climate change models simulate historical changes and predict future trends in a variety of phenomena, including land cover types like trees, forests, and coastal mountain ranges in South America. A new initiative, Input Data Sets for Model Intercomparison Projects (input4MIPs), enables climate modelers by collecting, documenting, and archiving the forcing data sets used to create these models. Credit: PeterM/Stock-Image.com

By Paul J. Durack, Karl E. Taylor, Veronika Eyring, Soshi K. Arnes, Tony Hoang, Denis Rodosou, Charles Doudoukou, Martina Stockhouse, and Peter J. Gleckler | 2 July 2018

Climate models are the most powerful tools for investigating global climate changes caused by human activity. These models are based on mathematical representations of the physics, chemistry, and biology of the climate system. The ways these models respond to externally imposed conditions, often representing the past or a hypothesized future, help scientists understand the forces and processes responsible for long-term changes in Earth's climate. Although climate models have improved over time, no single model perfectly represents all aspects of the climate system. Thus, rather than depending on the veracity of a single model, scientists rely on simulations for multiple models, each with its own strengths and limitations. In

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Hidden connections like this might influence volcanic systems around the globe.  
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#EosReport on.ly/4K0000um

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# CMIP6: input4MIPs ESGF project

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 input4MIPs  
Input Datasets for Model Intercomparison Projects

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Target MIP

Institution ID

Source ID

Source Version

Dataset Category

Variable

Grid Label

Nominal Resolution

Frequency

Realm

Data Node

Status

Enter Text:  [Search](#) [Reset](#) Display 10 results per page [More Search Options](#)

Show All Replicas  Show All Versions  Search Local Node Only (including All Replicas)

Search Constraints:  PCMDI

Total Number of Results: 6  
-1-  
Please login to add search results to your Data Cart  
Expert Users: you may display the search URL and return results as XML or return results as JSON

- input4MIPs.CMIP6.CMIP.PCMDI.PCMDI-AMIP-1-1-4.seaice.mon.slconcbcs.gn**  
Description: PCMDI-AMIP 1.1.4 dataset prepared for input4MIPs  
Data Node: aims3.llnl.gov  
Version: 20180427  
Total Number of Files (for all variables): 1  
Full Dataset Services: [Show Metadata](#) [List Files](#) [THREDDS Catalog](#) [WGET Script](#) [Show Citation](#) [PID](#) [Globus Download](#) [Further Info](#)
- input4MIPs.CMIP6.CMIP.PCMDI.PCMDI-AMIP-1-1-4.ocean.mon.tosbcs.gn**  
Description: PCMDI-AMIP 1.1.4 dataset prepared for input4MIPs  
Data Node: aims3.llnl.gov  
Version: 20180427  
Total Number of Files (for all variables): 1  
Full Dataset Services: [Show Metadata](#) [List Files](#) [THREDDS Catalog](#) [WGET Script](#) [Show Citation](#) [PID](#) [Globus Download](#) [Further Info](#)
- input4MIPs.CMIP6.CMIP.PCMDI.PCMDI-AMIP-1-1-4.seaice.mon.slconcbcs.gn**  
Description: PCMDI-AMIP 1.1.4 dataset prepared for input4MIPs  
Data Node: aims3.llnl.gov  
Version: 20180427  
Total Number of Files (for all variables): 1  
Full Dataset Services: [Show Metadata](#) [Hide Files](#) [THREDDS Catalog](#) [WGET Script](#) [Hide Citation](#) [PID](#) [Globus Download](#) [Further Info](#)

Total Number of Files: 1

slconcbcs_input4MIPs_SSTsAndSeaIce_CMIP_PCMDI-AMIP-1-1-4_gn_187081-201712.nc	Single File Access:
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1 size: 31596501	<a href="#">OpenDAP Download</a>
tracking_id: hdl:21.14100f1015dcf-e9fa-4890-98ca-496db94ff04	<a href="#">Globus Download</a>
<a href="#">More File Metadata</a>	

Data Citation (Landing Page)  
**Identifier DOI:** <http://doi.org/10.22033/ESGF/input4MIPs.2204>  
**Creators:** Durack, Paul J.; Taylor, Karl E.  
**Title:** PCMDI AMIP SST and sea-ice boundary conditions version 1.1.4  
**Publisher:** Earth System Grid Federation  
**Publication Year:** 2019

- input4MIPs.CMIP6.CMIP.PCMDI.PCMDI-AMIP-1-1-4.ocean.mon.tos.gn**  
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Data Node: aims3.llnl.gov  
Version: 20180427  
Total Number of Files (for all variables): 1  
Full Dataset Services: [Show Metadata](#) [List Files](#) [THREDDS Catalog](#) [WGET Script](#) [Show Citation](#) [PID](#) [Globus Download](#) [Further Info](#)
- input4MIPs.CMIP6.CMIP.PCMDI.PCMDI-AMIP-1-1-4.ocean.fx.arescello.gn**  
Description: PCMDI-AMIP 1.1.4 dataset prepared for input4MIPs  
Data Node: aims3.llnl.gov  
Version: 20180427  
Total Number of Files (for all variables): 1  
Full Dataset Services: [Show Metadata](#) [List Files](#) [THREDDS Catalog](#) [WGET Script](#) [Show Citation](#) [PID](#) [Globus Download](#) [Further Info](#)
- input4MIPs.CMIP6.CMIP.PCMDI.PCMDI-AMIP-1-1-4.ocean.fx.stof.gn**  
Description: PCMDI-AMIP 1.1.4 dataset prepared for input4MIPs  
Data Node: aims3.llnl.gov  
Version: 20180427  
Total Number of Files (for all variables): 1  
Full Dataset Services: [Show Metadata](#) [List Files](#) [THREDDS Catalog](#) [WGET Script](#) [Show Citation](#) [PID](#) [Globus Download](#) [Further Info](#)

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Input datasets for Model Intercomparison Projects

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Version: 20180427  
Total Number of Files (for all variables): 1  
Full Dataset Services: [Show Metadata](#) [List Files](#) [THREDDS Catalog](#) [WGET Script](#) [Show Citation](#) [PID](#) [Globus Download](#) [Further Info](#)

**3. input4MIPs.CMIP6.CMIP.PCMDI.PCMDI-AMIP-1-1-4.sealce.mon.siconc.gn**  
Description: PCMDI-AMIP 1.1.4 dataset prepared for input4MIPs  
Data Node: aims3.llnl.gov  
Version: 20180427  
Total Number of Files (for all variables): 1  
Full Dataset Services: [Show Metadata](#) [Hide Files](#) [THREDDS Catalog](#) [WGET Script](#) [Hide Citation](#) [PID](#) [Globus Download](#) [Further Info](#)

Total Number of Files: 1	
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checksum: fe7486d1d2c965d40ec2e6ab3fe2ded146205e42c2a9114ce9e1c50d0221c82b	
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<a href="#">More File Metadata</a>	

**Data Citation (Landing Page)**  
Identifier DOI: <http://doi.org/10.22033/ESGF/input4MIPs.2204>  
Creators: Durack, Paul J.; Taylor, Karl E.  
Title: PCMDI AMIP SST and sea-ice boundary conditions version 1.1.4  
Publisher: Earth System Grid Federation  
Publication Year: 2018

**4. input4MIPs.CMIP6.CMIP.PCMDI.PCMDI-AMIP-1-1-4.ocean.mon.tos.gn**  
Description: PCMDI-AMIP 1.1.4 dataset prepared for input4MIPs

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CoG version 3.11  
ESGF P2P Version v2.6.8 master

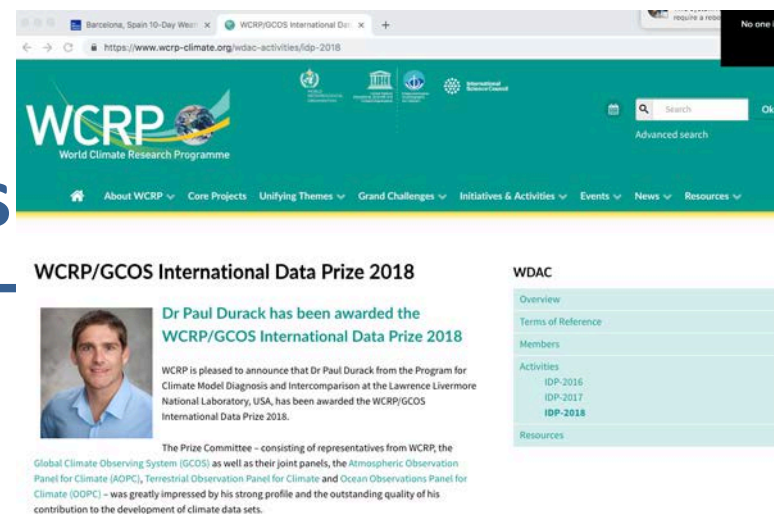
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<https://esgf-node.llnl.gov/search/input4mips/>



# input4MIPs CMIP infrastructure connections



- Datasets used by simulations are curated (with version info)
- As datasets are trace-able they can be documented
  - tracking\_id connects to DKRZ citation service, providing DOI
- ES-DOCs will provide input4MIPs dataset collection info to modeling groups so
  - Datasets and the versions used in simulations can be accurately recorded
  - ES-DOCs picks up tracking\_id/DOI to provide connection to data citation in CMIP6 model documentation
  - DOIs (and tracking\_ids) provide digital connectivity for documentation to leverage

## WDAC Observations for Model Evaluation Task Team

**Peter Gleckler**, co-chair, PCMDI and **Duane Waliser**, co-chair, JPL/NASA

Mike Bosilovich, GSFC/NASA

Helene Chepfer, IPSL

Carol Anne Clayson, WHOI

Veronika Erying, DLR

Robert Ferraro, JPL/NASA

Pierre-Phillipe Mathieu, ESA

Jerry Potter, GSFC

Roger Saunders, UKMO

Jörg Schulz, EUMETSAT

Karl Taylor, PCMDI

Jean-Noël Thépaut, ECMWF

Additional regular contributors: Otis Brown, Michel Rixen

Tsengdar Lee (NASA) and Renu Joseph (DOE)

Luca Cinquini (JPL) – CoG technical support

Denis Nadeu (PCMDI) – CMOR development

Paul Durack (PCMDI) – Data specifications

Sophie Cloché (IPSL) – CFMIP archive

Jim Biard (NCEI) and Matthias Tuma (WCRP) – beta testers

... and many others

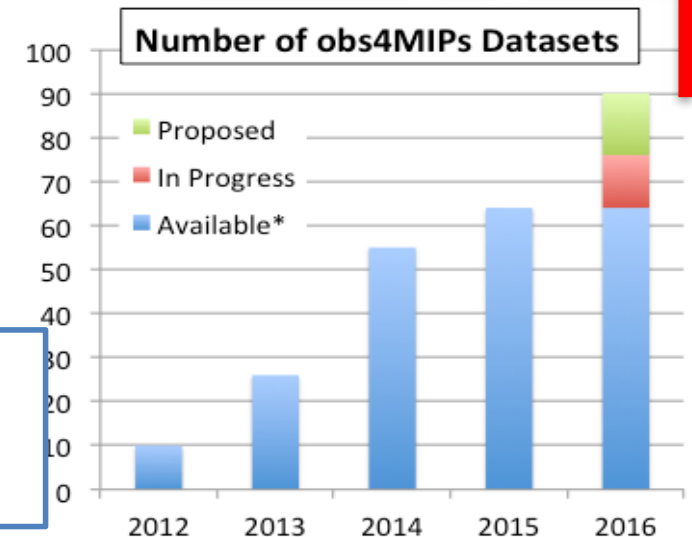
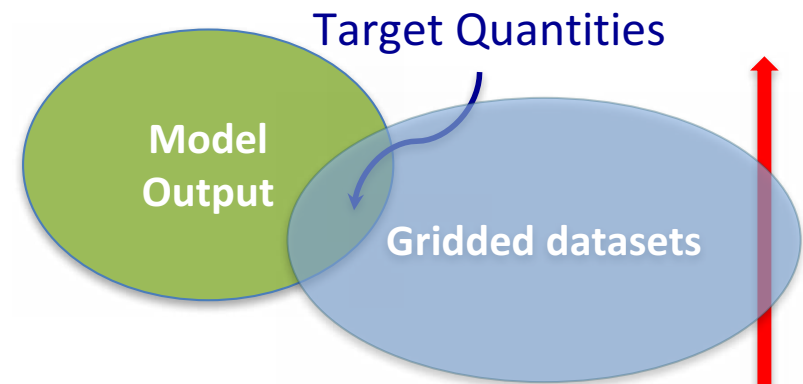
## WDAC8, Marrakesh, 20-21 March 2019

# obs4MIPs

<https://www.earthsystemcog.org/projects/obs4mips>



- A project for identifying, documenting and disseminating observations for climate model evaluation in WCRP model intercomparisons, notably CMIP.
- Data (and tech notes) accessible with the distributed CMIP model output via ESGF, adhering to same conventions
- Guided by the WCRP Data Advisory Council obs4MIPs Task Team



**Complete (~125)**  
**In Progress\* (~15)**  
**Proposals from Data Call (~100)**

.... and growing!



# MOTIVATION



Initially,

- obs4MIPs was envisioned as a vehicle to provide 1000s of CMIP analysts access to satellite/gridded products that are technically aligned with model output along with added value information. This is still the primary motivation, however...

More recently,

- As efforts to systematically and routinely evaluate models advances, it is clear that the obs4MIPs protocols will be invaluable

# Towards systematic evaluation of the CMIP DECK and historical simulations

---

Peer-reviewed CMIP based publications will remain the primary way the research is documented. However, there are pressing reasons to more efficiently produce, summarize, and make well-established model evaluation results available:

- Inform national assessments, the IPCC process, stakeholders, and public
- More directly contribute to model development (via useful quick feedback)
- Advance science more efficiently (provide routine summaries, less re-inventing)

**Community-based model evaluation capabilities are becoming a reality, thanks to the design target provided by the CMIP/obs4MIPs standards. Examples include CMEC (Coordinated Model Evaluation Capabilities) and ESMValTool, both which entrain multiple analysis tools.**

# obs4MIPs planning meeting for CMIP6

April 2014, NASA HQ but still relevant!



---

## Selected consensus recommendations

- **Expand the inventory**
- **Include more higher frequency** data (a “golden period”?)
- Reliable and defensible **error characterization**/estimation of observations
- Include datasets in support of **off-line simulators** (prime example: COSP— [CFMIP] Observation Simulator Package)
- **Collocated observations, including in-situ** for processes level diagnostics
- **Precise definitions of data products** (what’s actually being reported), including biases, and precise definitions of the model output variables are required

[Ferraro et al. \(2015\) BAMS and full meeting report on CoG website](#)



# Progress since WDAC7



- obs4MIPs data specifications (ODS2.1) now being used!
- Primary CoG site migrated (with content updates) to PCMDI
- Prototyping ESGF publication transition with new standards
- New search facets implemented (March 01 2019)
- Contributions are actively being augmented and expanded by:  
NASA JPL, NASA Goddard, NOAA NCEI, ESA and others
- Two papers about ready to submit (Overview and data standards)
- 4 smaller task team telecons

# Coordinated CMIP/obs4MIPs global attributes, controlled vocabulary (CV), Registered Content (RC), and Data Reference Syntax (DRS)

Some predefined global attributes (there are many others)

Variable ID #	'sfcWind'
Source_id +	'NOAA-NCEI-SeaWinds-1-2'
Institution_id +	'NOAA-NCEI'
Region #	'global ocean'
Nominal_resolution #	'1x1 degree'

+ Registered Content (RC)

# CV with pre-defined options [maintained on github](#)



## Expanded search capabilities

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You are at the *ESGF@DOE/LLNL* node  
 Technical Support

- Source ID +
- Product +
- Realm +
- Variable +
- Variable Long Name +
- CF Standard Name +
- Data Node +

Once all the obs4MIPs data is updated to the new data standards, the search facet pairs for selecting Institution and Frequency will each be merged.

Enter Text:    Display 10 results per page [\[ More Search Options \]](#)

- Show All Replicas  Show All Versions  Search Local Node Only (Including All Replicas)

The search returned 0 results.

- CMIP5-era
- Institute +
  - Time Frequency +

- CMIP6-era
- Institution ID +
  - Frequency +
  - Grid Label +
  - Nominal Resolution +
  - Region +
  - Source Type +
  - Variant Label +

- Source ID +
- Product +
- Realm +
- Variable +
- Variable Long Name +
- CF Standard Name +
- Data Node +

- CMIP5-era
- Institute +
  - Time Frequency +

- CMIP6-era
- Institution ID +
  - Frequency +
  - Grid Label +
  - Nominal Resolution +
  - Region +
  - Source Type +
  - Variant Label +

# obs4MIPs Dataset Suitability & Maturity Indicators

Enables us to expand what data gets included in obs4MIPs

<b>Technical Requirements</b>		<b>Dataset Suitability and Maturity</b>			<b>Comparison Complexity</b>
Meets obs4MIPs data technical requirements	Includes obs4MIPs technical note information	Closeness or robustness of measurement to observed reference quantity	Maturity with respect to climate model evaluation	Provision for robust uncertainty information	Complexity of Model Observation Comparison
Data suitably processed with CMOR and/or consistent with obs4MIPs standards	Complete technical note information provided	Measurement approach provides a very close relationship to observation quantity	Multiple peer-reviewed examples of application to climate model evaluation	Uncertainty information provided per retrieval/grid point	Comparison can be made directly with CMIP model output variable
Largely complete with minor metadata inconsistencies	Technical note information incomplete and/or could be improved	Measurement approach requires complex and/or non-linear retrieval methods and/or subjective inferences/definitions	One peer-reviewed example of application to climate or component model evaluation.	General uncertainty information given relative to the methodology and dataset as a whole - backed by actual field/in-situ validation exercises	Comparison requires some simple post processing of CMIP output variable(s) (e.g. vertical integral or ratio of two variables)
Non-compliant. Should be removed from database!	Technical note not provided	Measurement approach requires significant use/influence from complex or weakly constrained model and/or has significant ambiguity in definition(s)	No peer-reviewed examples of application to model evaluation	No uncertainty information provided	Comparison requires complex processing of CMIP output (e.g. "simulator", budget calculation)

Obs4MIPs

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Last Search | My Data Cart (1)

Institute  
Instrument  
Time Frequency  
Realm  
Variable  
Variable Long Name  
CF Standard Name  
Data Node

esgf-data.jpl.nasa.gov (16)

Enter Text:  Search Reset Display 10 results per page [ More Search Options ]

Show All Replicas  Show All Versions  Search Local Node Only (Including All Replicas)

Search Constraints: ✖ esgf-data.jpl.nasa.gov

Total Number of Results: 16  
 << Previous 1 -2-  
 Add all displayed results to Data Cart Remove all displayed results from Data Cart  
 Expert Users: you may display the search URL and return results as XML or return results as JSON

- obs4mips.RSS.SSMI.sfcWind.mon**  
 Data Node: esgf-data.jpl.nasa.gov  
 Version: 20160523  
 Total Number of Files (for all variables): 2  
 Full Dataset Services: [ Show Metadata ] [ List Files ] [ THREDDS Catalog ] [ WGET Script ] [ LAS Visualization ] [ summary ] [ Globus Download ]  
■ ■ ■ ■ ■ ■ ■ ■  
 Add to Data Cart
- obs4mips.NASA-JPL.GNSS\_RO.ta.monClim**  
 Data Node: esgf-data.jpl.nasa.gov  
 Version: 20160601  
 Total Number of Files (for all variables): 1  
 Full Dataset Services: [ Show Metadata ] [ List Files ] [ THREDDS Catalog ] [ WGET Script ] [ LAS Visualization ] [ summary ] [ Globus Download ]  
■ ■ ■ ■ ■ ■ ■ ■  
 Add to Data Cart
- obs4mips.REMSS.AMSRE.tos.mon**  
 Data Node: esgf-data.jpl.nasa.gov  
 Version: 20111031  
 Total Number of Files (for all variables): 3  
 Full Dataset Services: [ Show Metadata ] [ List Files ] [ THREDDS Catalog ] [ WGET Script ] [ LAS Visualization ] [ summary ] [ Globus Download ]  
■ ■ ■ ■ ■ ■ ■ ■  
 Add to Data Cart
- obs4mips.NASA-JPL.QuikSCAT.sfcWind.mon**  
 Data Node: esgf-data.jpl.nasa.gov  
 Version: 20120411  
 Total Number of Files (for all variables): 3  
 Full Dataset Services: [ Show Metadata ] [ List Files ] [ THREDDS Catalog ] [ WGET Script ] [ LAS Visualization ] [ summary ] [ Globus Download ]  
■ ■ ■ ■ ■ ■ ■ ■  
 Add to Data Cart
- obs4mips.CNES.AVISO.zos.mon**  
 Data Node: esgf-data.jpl.nasa.gov  
 Version: 20110829  
 Total Number of Files (for all variables): 3  
 Full Dataset Services: [ Show Metadata ] [ List Files ] [ THREDDS Catalog ] [ WGET Script ] [ LAS Visualization ] [ summary ] [ Globus Download ]  
■ ■ ■ ■ ■ ■ ■ ■  
 Add to Data Cart
- obs4mips.NASA-JPL.TES.tro3.mon**  
 Data Node: esgf-data.jpl.nasa.gov  
 Version: 20110608  
 Total Number of Files (for all variables): 3  
 Full Dataset Services: [ Show Metadata ] [ List Files ] [ THREDDS Catalog ] [ WGET Script ] [ LAS Visualization ] [ summary ] [ Supplementary Data ] [ Globus Download ]  
■ ■ ■ ■ ■ ■ ■ ■  
 Add to Data Cart

Color coded suitability indicators  
To be monitored by the task team

Prototyped with JPL data

**Obs4MIPs**

Home About Us Governance Contact Us You are at the CoG-CU node  
Technical Support  
Last Search | My Data Cart (1)

Institute Instrument Time Frequency Realm Variable Variable Long Name CF Standard Name Data Node

esgf-data.jpl.nasa.gov (16)

Enter Text:  Search Reset Display 10 results per page [More Search Options]

Search Constraints:  Show All Replicas  Show All Versions  Search Local Node Only (Including All Replicas)

Total Number of Results: 16  
 << Previous 1 -2-  
 Add all displayed results to Data Cart Remove all displayed results from Data Cart  
 Expert Users: you may display the search URL and return results as XML or return results as JSON

- obs4mips.RSS.SSMI.sfcWind.mon**  
 Data Node: esgf-data.jpl.nasa.gov  
 Version: 20160523  
 Total Number of Files (for all variables): 2  
 Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [LAS Visualization] [summary] [Globus Download]  
 [Color-coded suitability indicators: 4 green, 1 yellow, 0 red, 0 grey]
- obs4mips.NASA-JPL.GNSS\_RO.ta.monClim**  
 Data Node: esgf-data.jpl.nasa.gov  
 Version: 20160601  
 Total Number of Files (for all variables): 1  
 Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [LAS Visualization] [summary] [Globus Download]  
 [Color-coded suitability indicators: 4 green, 1 yellow, 0 red, 0 grey]
- obs4mips.REMSS.AMSRE.tos.mon**  
 Data Node: esgf-data.jpl.nasa.gov  
 Version: 20111031  
 Total Number of Files (for all variables): 3  
 Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [LAS Visualization] [summary] [Globus Download]  
 [Color-coded suitability indicators: 4 green, 1 yellow, 0 red, 0 grey]
- obs4mips.NASA-JPL.QuikSCAT.sfcWind.mon**  
 Data Node: esgf-data.jpl.nasa.gov  
 Version: 20120411  
 Total Number of Files (for all variables): 3  
 Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [LAS Visualization] [summary] [Globus Download]  
 [Color-coded suitability indicators: 4 green, 1 yellow, 0 red, 0 grey]
- obs4mips.CNES.AVISO.zos.mon**  
 Data Node: esgf-data.jpl.nasa.gov  
 Version: 20110829  
 Total Number of Files (for all variables): 3  
 Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [LAS Visualization] [summary] [Globus Download]  
 [Color-coded suitability indicators: 4 green, 1 yellow, 0 red, 0 grey]
- obs4mips.NASA-JPL.TES.tro3.mon**  
 Data Node: esgf-data.jpl.nasa.gov  
 Version: 20110608  
 Total Number of Files (for all variables): 3  
 Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [LAS Visualization] [summary] [Globus Download] [Supplementary Data]  
 [Color-coded suitability indicators: 4 green, 1 yellow, 0 red, 0 grey]

Color coded suitability indicators  
To be monitored by the task team

Supplemental Information is "free form", accessible from "best estimate" but not searchable independently

Prototyped with JPL data



# Just a few more enhancements needed...

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- Upgrade the daily scan of inventory to include suitability indicators (color codes), supplemental information, and tech notes on a unified page – this should be accomplished within one month
- CMOR “Prepare” utility needs to be generalized to accommodate observations - this will require some investment but we are targeting for this to be done before 2020.

Neither will slow down the inclusion of new datasets

# Summary and Perspective

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- obs4MIPs is positioned to have substantial impact on CMIP6 and other activities
- Task team has been able to address many recommendations (e.g., enable more data and information to be included)
- With infrastructure now in place, the goal for the coming year is to substantially expand the obs4MIPs archive, exploiting the new obs4MIPs data specifications (ODS2.1), supplemental information and data indicators
- Ongoing challenge: further enabling datasets to efficiently be made to meet the obs4MIPs data specifications and published on ESGF
- For each dataset, someone managing an ESGF node has to commit to dataset publication
- Efforts to advance obs4MIPs remain focused on gridded datasets. Expanding the scope to include in-situ data will require new contributors prepared to do substantial work

# Summary and Perspective ii

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- Project is entering a new phase – implementing what the tasked team has envisioned, implemented, and developed with the help of computer scientists
- As two manuscripts are completed, it will be an appropriate time to revisit the make-up of task team with more emphasis on those who can enable datasets to get published to ESGF; but scientific expertise still needed!
- While a great deal of infrastructure is now in place, a broader obs4MIPs would require more people doing hands on work.
- Irrespective of the data delivery system (ESGF), the obs4MIPs data specifications solidify a technical link with the modeling community

## Links to related material

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- [CMIP6 data specifications \(google docs\)](#)
- [obs4MIPs data specifications](#)
- [obs4MIPs tables controlled vocabulary \(github\)](#)
- [Climate Model/obs Output Rewriter, CMOR \(website\)](#)

# EXTRAS



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