

Obs4MIPs and the WGNE/WGCM Metrics & Diagnostics Panel

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Working Group on Coupled Modeling


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CMIP Infrastructure

“Nuts and bolts”

- Experiment protocol (AMIP, historical, piControl, etc.) and standard output
 - Climate Forecast (CF) convention (as applied in CMIP)
 - Software to ensure data complies to CMIP structure: CMOR; CF-checker
 - Distribution: ESGF - targets the CMIP application of CF
 - Earth System CoG: Interface to ESGF, well suited for coordinating projects
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 - Software to ensure data complies to CMIP structure: CMOR; CF-checker
 - Distribution: ESGF - targets the CMIP application of CF
 - Earth System CoG: Interface to ESGF, well suited for coordinating projects
- Little in the way of coordinating:
 - Routinely used observations
 - Community-based analysis well-suited for repeat use

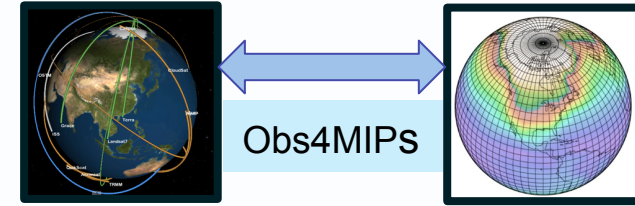
Obs4MIPs

**Objective: To make observational data more accessible
for evaluation of CMIP class simulations**



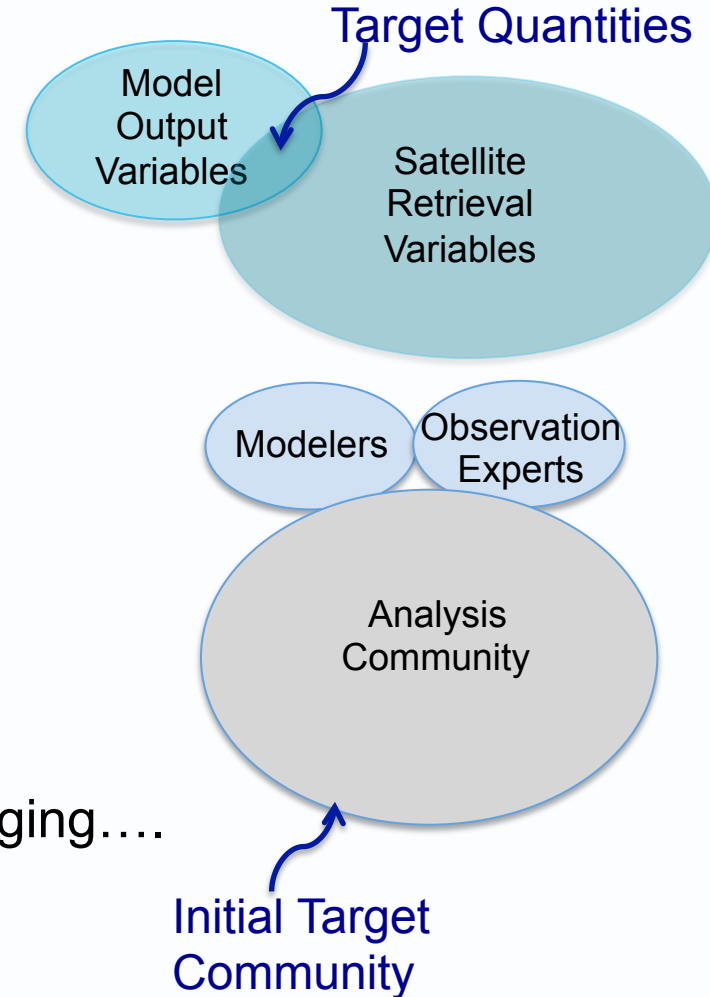
obs4MIPs: the 4 commandments

Is now a WCRP project with WDAC oversight



1. Use the CMIP standard model output as guideline for selecting observations
2. Observations to be structured similar to CMIP model output
3. Hosted on the ESGF with CMIP output
4. Include a technical note for each dataset

Has been limited to satellite data but that is changing....



obs4MIPs: Current set of satellite observations

Sorted by CF Variable *Long Name*

Air Temperature
Ambient Aerosol Optical Thickness at 550 nm
CALIPSO 3D Clear fraction
CALIPSO 3D Undefined fraction
CALIPSO Clear Cloud Fraction
CALIPSO Cloud Fraction
CALIPSO High Level Cloud Fraction
CALIPSO Low Level Cloud Fraction
CALIPSO Mid Level Cloud Fraction
CALIPSO Scattering Ratio
CALIPSO Total Cloud Fraction
Cloud Fraction retrieved by MISR
CloudSat 94GHz radar Total Cloud Fraction
CloudSat Radar Reflectivity CFAD
Fraction of Absorbed Photosynthetically Active Radiation
ISCCP Cloud Area Fraction (Joint histogram of opt thickness and CTP)
ISCCP Mean Cloud Albedo (Cloud-fraction weighted & daytime)
ISCCP Mean Cloud Top Pressure (Cloud-fraction weighted & daytime)
ISCCP Mean Cloud Top Temperature (Cloud-fraction weighted & daytime)
ISCCP Total Cloud Fraction (daytime only)
Leaf Area Index
Mole Fraction of O3

Near-Surface Wind Speed
PARASOL Reflectance
Precipitation*
Sea Surface Height Above Geoid
Sea Surface Temperature
Specific Humidity
Surface Downwelling Clear-Sky LW
Surface Downwelling Clear-Sky SW
Surface Downwelling LW
Surface Downwelling SW
Surface Upwelling Clear-Sky SW
Surface Upwelling LW
Surface Upwelling SW
TOA Incident SW
TOA Outgoing Clear-Sky LW
TOA Outgoing Clear-Sky SW
TOA Outgoing LW
TOA Outgoing SW
Total Cloud Fraction
Water Vapor Path

* 3 hourly data

A number of new datasets in the queue

obs4MIPs planning for CMIP6 – future needs

Workshop at NASA HQ (May 2014)

Consensus recommendations:

- Expand the inventory, and include higher frequency satellite data
- Push for reliable and defensible error characterization/estimation
- Include datasets in support of off-line simulators
- Collocated observations, including in-situ datasets, particularly valuable for diagnosing certain processes

WDAC Observations for Model Evaluation Task Team Membership

Peter Gleckler, co-chair, PCMDI

Duane Waliser, co-chair, JPL

Sandrine Bony, IPSL

Mike Bosilovich, GSFC

Helene Chepfer, IPSL

Veronika Eyring, DLR

Robert Ferraro, JPL

Pierre-Phillipe Mathieu, ESA

Jerry Potter, GSFC

Roger Saunders, UKMO

Jörg Schulz, EUMETSAT

Karl Taylor, PCMDI

Jean-Noël Thépaut, ECMWF

Michel Rixen, WCRP

Otis Brown, NOAA (WDAC co-chair)

A high bar: completeness criteria for documenting obs4MIPs satellite datasets provided by agencies (current status)


Meets data technical requirements
Can be related to CMIP Standard Model Output
Includes obs4MIPs technical note
Documented use for model diagnosis
DOI issued for technical note
DOI issued for data set
Maturity Matrix of data processing/documentation (CORE CLIMAX)
Maturity Matrix of data quality (CEOS)

Required for inclusion in obs4MIPs

Strongly encouraged

Additionally desired criteria


Current status: opportunities and challenges

- Commitments to contribute datasets: ESA CCI, EUMETSAT, NASA, NOAA
 - Available through CoG-ESGF; peer-projects Ana4MIPs, CREATE-IP
 - WCRP/WDAC encouragement for activity to extend beyond satellite data
 - PCMDI preparing CMOR3 for CMIP6 *and* to accommodate observational data, including an “EZ” package
- Work needed to clearly define metadata for different classes of data (e.g., describing uncertainty estimates, in-situ); keeping it aligned to CMIP
- Task team streamlining process of accepting/implementing datasets
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WGNE/WGCM Metrics and Diagnostics Panel



Some topics related to model metrics

- Diverse summary statistics gauging large-scale agreement with observations
 - Use in model tuning
 - Process-oriented measures
 - Exploring model dependence
 - Comparing error characteristics of MME and PPE
 - Emergent constraints
 - Weighting model projections
- 

A growing number of team-based tools being developed for evaluation of CMIP simulations

Some recent examples:

Climate Variability and Diagnostics Package (Phillips et al., 2014)

ESMValTool (Eyring et al, GMD, 2015)

PCMDI Metrics package (Gleckler et al., EOS in press)

ILAMB (Luo et al., 2012)

Many others of interest for CMIP: TECA, CFMIP, GEXEX, MJO,

WGNE/WGCM metrics and diagnostic panel

Following WMAC recommendation

Members have relevant/diverse experience, and liaison with key WCRP activities:

Beth Ebert (BMRC) – JWGV/WWRP, **WMO forecast metrics**

Veronika Eyring (DLR Germany) – WGCM/SPARC/CMIP6, **stratosphere, ESMs**

Pierre Friedlingstein (U. Exeter) – IGBP, **carbon cycle**

Peter Gleckler (PCMDI), chair – WGNE/obs4MIPs, **atmosphere and ocean**

Simon Marsland (CSIRO) – CLIVAR OMDP, WGCM, **ocean**

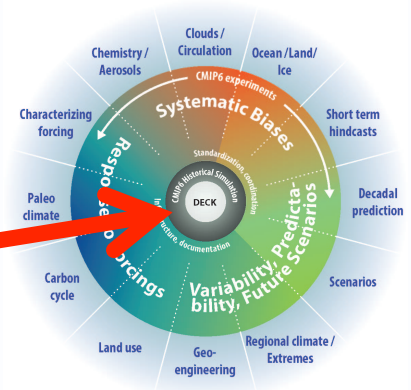
Robert Pincus (NOAA) – GEWEX/GCSS, **clouds/radiation**

Karl Taylor (PCMDI) – WGCM/CMIP, **atmosphere, CMIP**

Keith Williams (UK Met office) – WGNE, **Transpose AMIP, clouds** (new member)

Plans of the panel for CMIP6

Climate Metrics and Diagnostics Panel



- Establish and maintain a catalogue of capabilities being developed:
 - A resource for modeling groups and CMIP analysts
 - Encourage “best practices”: target CMIP data, open source, etc.
 - Identify and encourage synergies where possible
- As DECK+historical simulations are published on ESGF, ensure results are quickly made available to modeling groups and CMIP analysts
- Make certain CMIP6 results are documented (GMD special edition?)

Panel beginning a CoG catalog of developing capabilities of potential interest for the DECK (a few examples)

Name	Scientific Analysis	Software tools required	Targets CMIP data	Intended users	Availability, Point of Contact	References	Comments
CFMIP Diagnostics Repository	A variety of analysis codes targeting cloud properties	MatLab®	mixed	Open	http://cfmip.metoffice.com/CFMIP_diag.html POC: Yoko Tsushima yoko.tsushima@metoffice.gov.uk	<i>Bodas-Salcedo et al., 2011</i>	To be made by the metrics panel
Climate Variability Diagnostics Package (CVDP)	Interannual variability	NCL driven by python	Yes	Open	http://www2.cesm.ucar.edu/work-ing-groups/cvswg/cvdp/data-repository POC Adam Phillips (asphilli@ucar.edu)	Phillips et al., EOS, 2014	
Earth System Model Validation Tool (ESMValTool)	Mean state, variability, trends, and processes for various aspects of ESM evaluation	NCL driven by python	Yes	Open, Dedicated Team	www.pa.op.dlr.de/ESMValTool/ POC: Veronika Eyring (Veronika.Eyring@dlr.de)	Eyring et al., 2015	
International Land Model Benchmarking Project (ILAMB)	Land evaluation in CMIP ESMs	?	Yes	Dedicated Team	http://ilamb.org POC: Forrest Hoffman (forrest@climatemodeling.org)	Luo et al. [2012]	
PCMDI's Metrics Package (PMP)	Climatological analysis of atm, ocean, ice and land with	A "light" installation of UV-CDAT (python)	Yes	Open, but primarily for modelers	Doutriaux et al. (2015). PCMDI Metrics Initial Release. DOI:10.5281/zenodo.13952 POC: Peter Gleckler (gleckler1@llnl.gov)	Gleckler et al, EOS, 2015	

Sample attributes to be documented in Metrics and Diagnostics catalog

What analysis does this capability offer?

Is it intended for use as a team capability or made available to others?

How does one download and install the software?

How is version control maintained? Support?

What are the software dependencies?

Is it designed to work easily with the CMIP data structure?

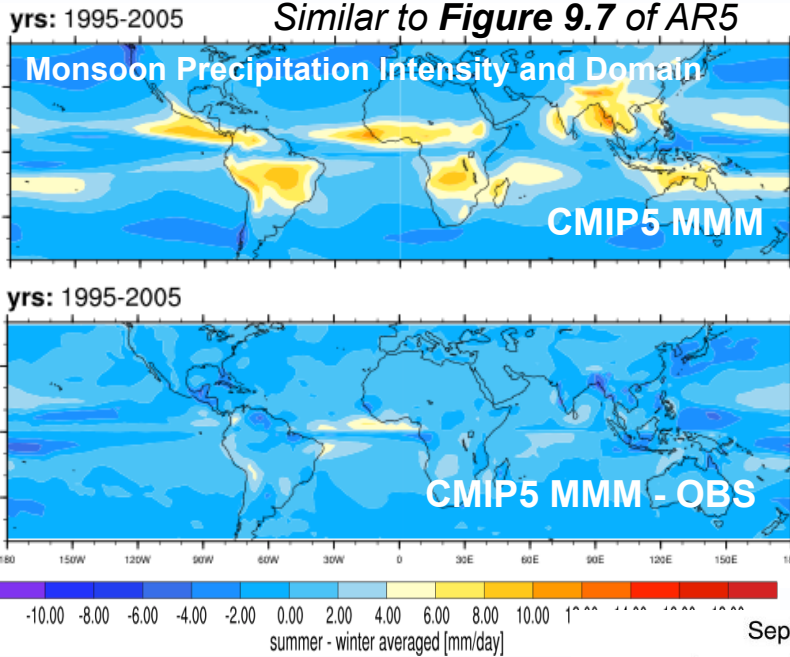
Is it suitably documented?

Does it include functional test cases?

Are there opportunities for users to contribute to the capability?

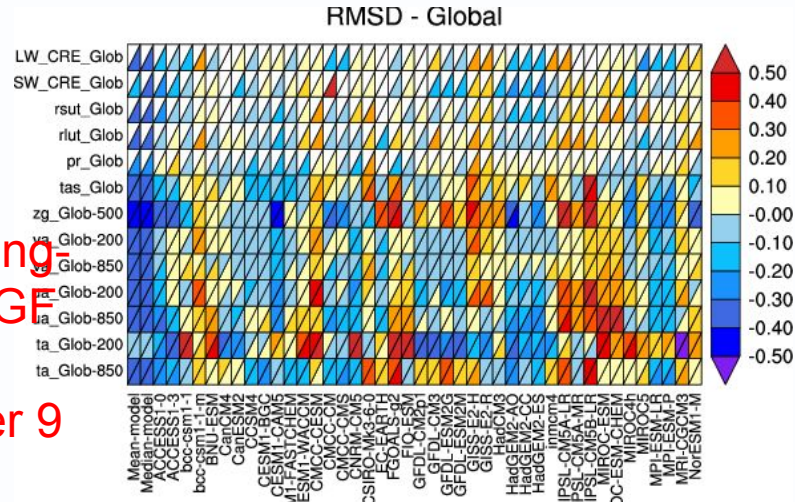
Routine Evaluation Central Part of CMIP6 promoted by the Panel

CMIP evaluation tools to produce well-established analyses as soon as model output becomes available
 e.g., Community-developed ESM Evaluation Tool and PCMDI metrics package



Running along-
 side the ESGF

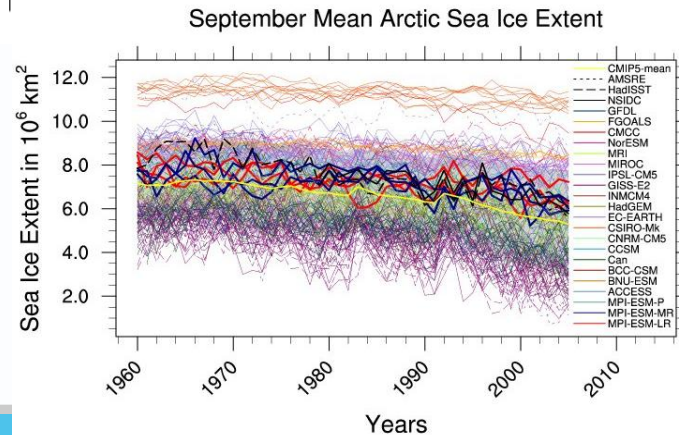
AR5 Chapter 9



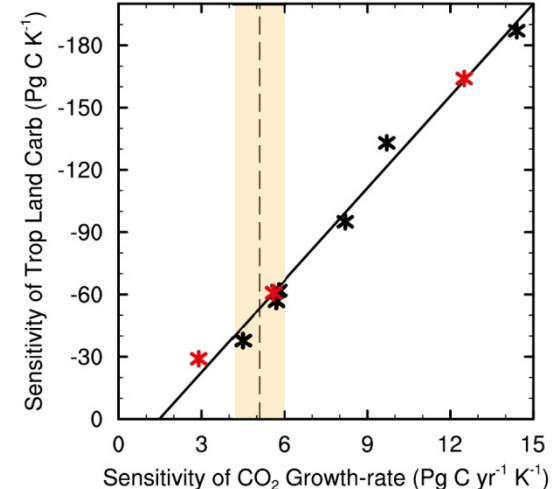
Similar to **Figure 9.7 of AR5**

Link to projections

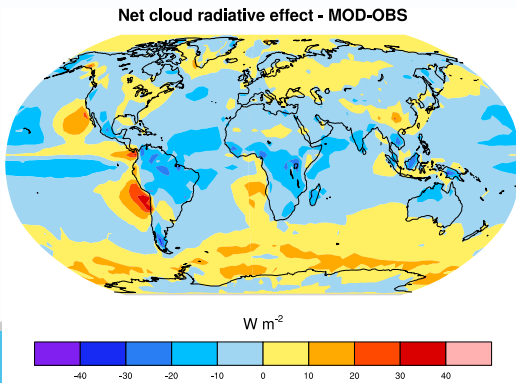
(b) Tropical Land carbon feedback



Similar to **Figure 9.24 of AR5**



Similar to **Figure 9.24 of AR5**



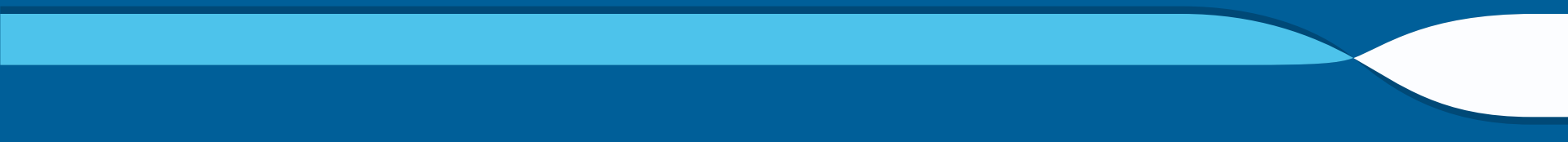
Similar to **Figure 9.5 of AR5**

Topics for the panel to consider with the WGCM

Are online results from these community-based capabilities to be made public, or available only to modeling groups and CMIP analysts? Either way, *traceability is key*, but if public this is even more complex.


A longer-term technical issue: a community-developed interface to data may warrant exploration (e.g., access to data via python, enabling continued use of multiple open source analysis and graphics tools)

EXTRA



WDAC Observations for Model Evaluation Task Team

Terms of Reference

1. Establish data/metadata standards for observational_and reanalysis data sets that are consistent with standards used in major climate model intercomparison efforts (e.g., CMIP)
 2. Encourage the application of these standards to well-established observational datasets that have demonstrated utility for model evaluation.
 3. Provide guidance and oversight to obs4MIPs, including the organization of data hosted on ESGF. Establish criteria and a process by which contributed datasets are accepted for inclusion.
 5. Seek community input and feedback on the value of products conforming to the standards, and refine and extend the standards, as necessary, to meet any additional or evolving needs.
 6. Coordinate above activities with major climate model intercomparison efforts (e.g., CMIP) and liaise with other related WCRP bodies
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WGCM/WGNE Diagnostics and Metrics Panel

Terms of Reference

- Foster the advancement community-based tools for “repeat use” model evaluation
 - Coordinate with other WCRP/CLIVAR activities that are actively developing diagnostics and performance metrics
 - Identify analysis routines and packages that may be of potential use to modeling groups and researchers, and encourage functionality with the CMIP data conventions
 - Ensure that well-established capabilities are applied to the CMIP DECK and Historical experiments, with results made readily accessible
 - Encourage and facilitate performance metrics research by identifying key areas needing work and possibly organizing workshops
 - Progress and terms to be reviewed annually by both the WGNE and the WGCM.
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