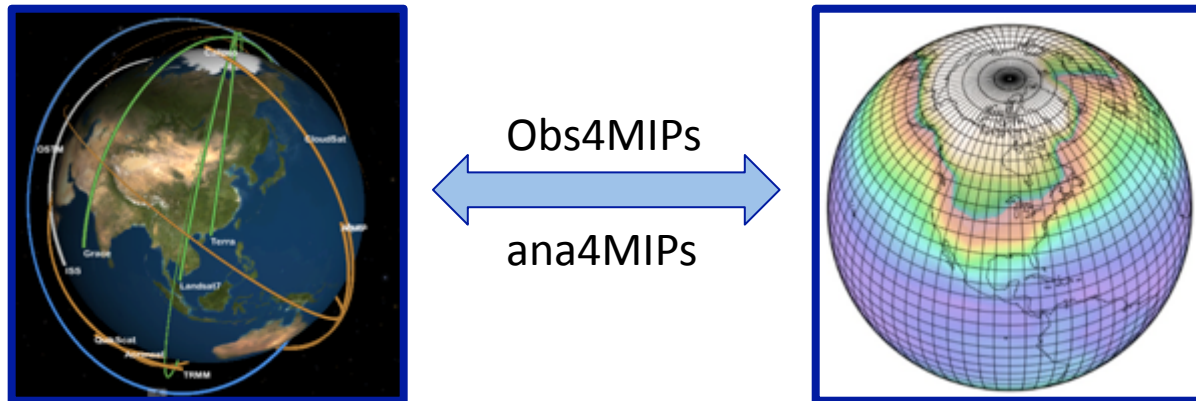


Overview of obs4MIPs & ana4MIPs

Felix Landerer¹ (with a lot of input & help from Duane Waliser¹, Peter Gleckler², Robert Ferraro¹, Gerry Potter³)

¹ JPL/NASA; ² PCMDI/LLNL; ³ GSFC/NASA



US CLIVAR Summit 2014
July 8-11, 2014
Denver, Colorado

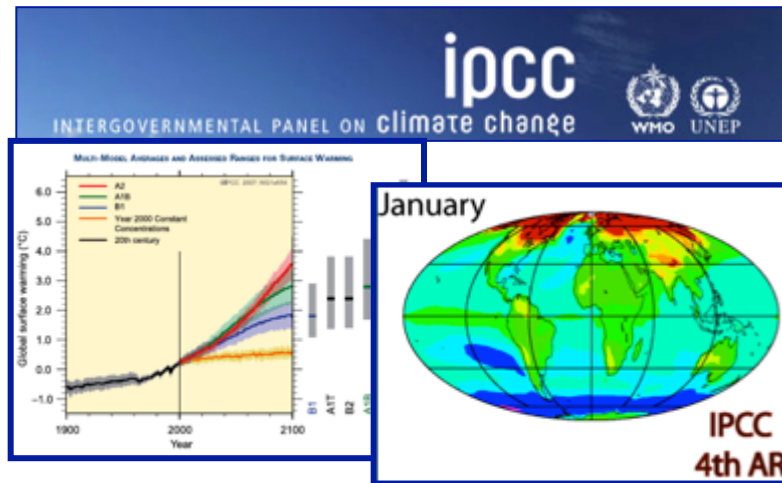


Jet Propulsion Laboratory
California Institute of Technology

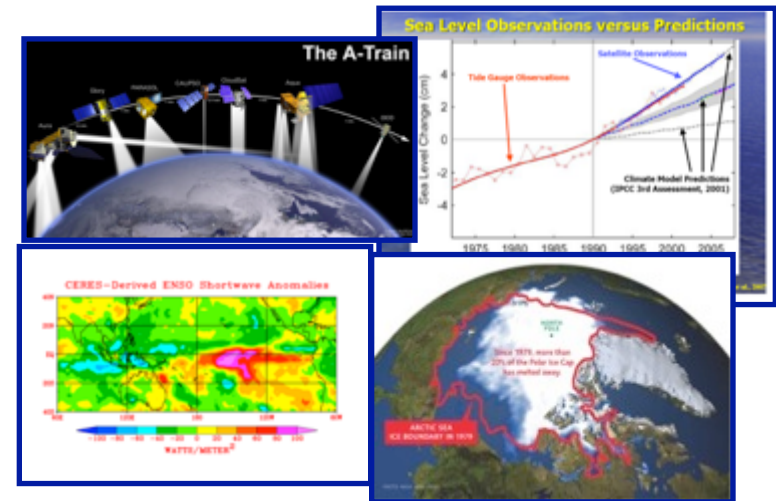


Initial Sentiments Behind obs4MIPs

Under-Exploited Observations for Model Evaluation



How to bring as much observational scrutiny as possible to the CMIP/IPCC process?



How to best utilize the wealth of satellite observations for the CMIP/IPCC process?

Model and Observation Overlap

Where to Start? For what quantities are comparisons viable?



ESGF Portal
pcmdi9.llnl.gov/esgf-web-fe/

ESGF Earth System Grid Federation

Home Search Tools Login Help

Because of a file server crash, PCMDI cannot provide all of the data it normally has. If you have trouble downloading a file from pcmdi*.llnl.gov, please try getting it from another server. In the search page, make sure to click on the button "Show All Replicas".

Welcome to this ESGF P2P

Peer Nodes

- ANL Node
- BADC Node
- BNL Node
- CMCC Node
- DKRZ Node
- DKRZ CMIP5 Node
- NOAA-ESRL Node
- NOAA-GFDL Node
- IPSL Node

CMOR Table Armon: Monthly Mean Atmospheric Fields and Some Surface Fields

(All Saved on the Atmospheric Grid)

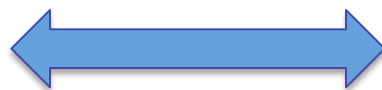
In CMOR Table Armon: 2-D fields on atmospheric grid

Taylor et al. 2008

id	long name	units	comment	questions	output variable name
1	Near-Surface Air Temperature	K	near-surface (usually 2 meters) air temperature	tas	tas
2	Surface Temperature	K	"skin" temperature (i.e., SST for most ocean)	ts	ts
3	Daily Maximum Near-Surface Air Temperature	K	monthly mean of the daily maximum near-surface (usually 2 meters) air temperature	tasmax	tasmax
4	Daily Minimum Near-Surface Air Temperature	K	monthly mean of the daily minimum near-surface (usually 2 meters) air temperature	tasmin	tasmin
5	Sea Level Pressure	hPa	sea, in general, the same as surface pressure	slp	slp
6	Surface Air Pressure	hPa	sea, in general, the same as mean sea level pressure	slp	slp
7	Eastward Near-Surface Wind	m s ⁻¹	near-surface (usually 10 meters) eastward component of wind	uas	uas
8	Northward Near-Surface Wind	m s ⁻¹	near-surface (usually 10 meters) northward component of wind	vas	vas

~120 ocean
~60 land
~90 atmos
~50 cryosphere

Over 300 Variables in
(monthly) CMIP Database



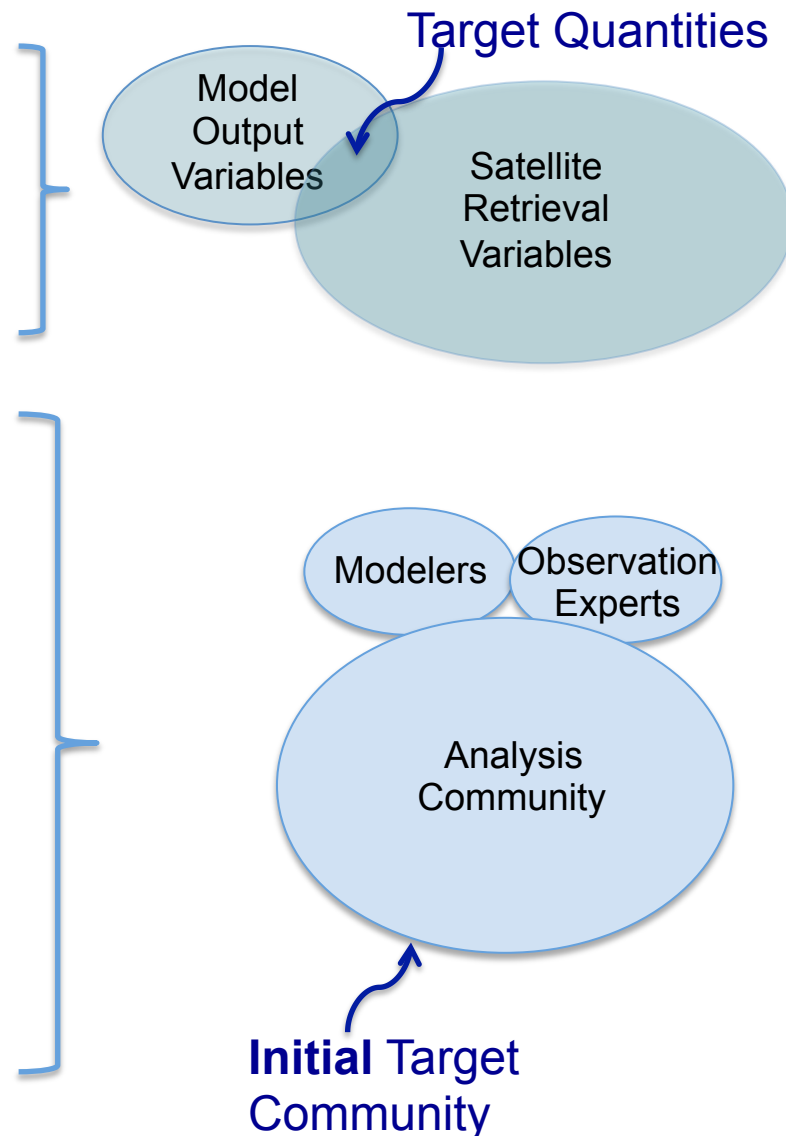
Over 1000 satellite-
derived quantities



Example: NASA – Current Missions ~14
Total Missions Flown ~ 60
Many with multiple instruments
Most with multiple products (e.g. 10-100s)
Many cases with same / similar products

obs4MIPs: Initial 4 Commandments

1. Use the [CMIP5 simulation protocol](#) (Taylor et al. 2009) as guideline for [selecting observations](#). Matching variable required (**THIS WILL ADAPT TO CMIP6**)
2. Observations to be [technically aligned with CMIP Model output](#) (e.g. NetCDF files with CF Convention)
3. Include a [Technical Note for each variable](#) describing observation and use for model evaluation (at graduate student level).
4. Hosted side by side [on the ESGF](#) with CMIP model output.



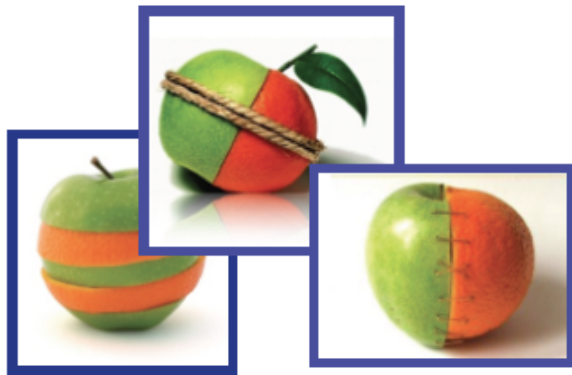
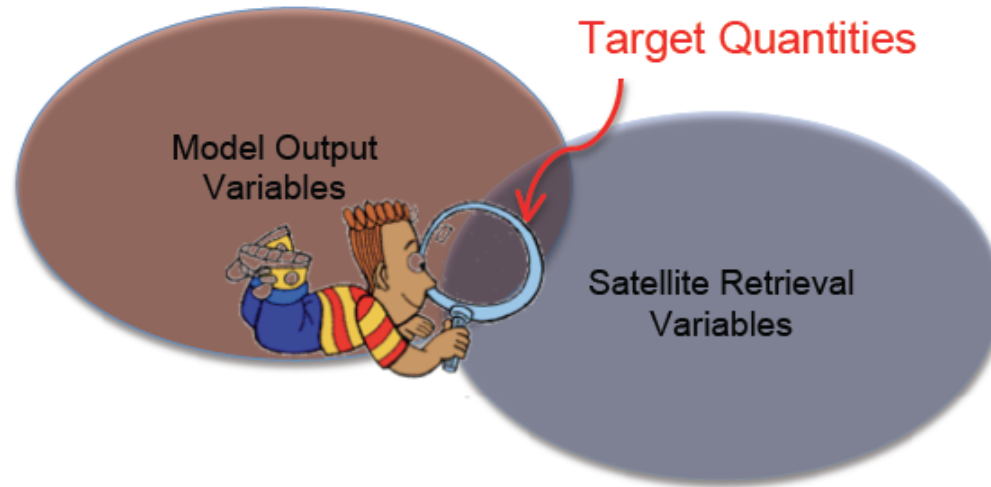
obs4MIPs “Technical Note”

Content

- Intent of the Document
- Data Field Description
- Data Origin
- Validation and Uncertainty Estimate
- Considerations for use in Model Evaluation
- Instrument Overview
- References
- Revision History
- POC

Model and Observation Overlap

For what quantities are these comparisons viable?



After much scrutiny and two workshops, only ~20 satellite variables were identified as being “safely” comparable in the pilot effort.

obs4MIPs: Current Set of Observations

AIRS (≥ 300 hPa)	Temperature profile
	Specific humidity profile
MLS (< 300 hPa)	Temperature profile
	Specific humidity profile
QuikSCAT	Ocean surface winds
TES	Ozone profile
AMSR-E	SST
ATSR (ARC/CMUG)	SST
TOPEX/JASON	SSH
CERES	TOA & Surface radiation fluxes
TRMM	Precipitation
GPCP	Precipitation
MISR	Aerosol Optical Depth
MODIS	Cloud fraction
	Aerosol Optical Depth
NSIDC	Sea Ice (in progress)

CFMIP-OBS Provided

Cloudsat	Clouds
Calipso	Clouds & Aerosols
ISCCP	Clouds
Parasol	Clouds & Aerosols

Initial in-situ Example

ARMBE/DOE	Clouds, Radiation, Meteorology, Land Surface, etc
<i>Discussions on protocols and additions to the in-situ holdings underway</i>	

Obs4MIPs

[Home](#)
[How to cite](#)
[How to contribute data](#)

Products

[Satellite Products](#)
[Reanalysis Products](#)
[In-situ Products \(sample\)](#)
[Technical Notes](#)

Visitors

[List All News](#)
[List All Files](#)

Satellite Products

Tech notes are [available](#) as indicated below for specific datasets.

CMIP Protocol Variables	Data Source	Time Period	Comments	QC?	TechNote?
clisccp ; albisccp ; cltisccp ; cttisccp ; pcticccp - ISCCP Cloud Area Fraction (Joint histogram of optical thickness and cloud top pressure) ...	ISCCP	1983-2008	CFMIP2 variable contributed by CFMIP-OBS		
ta, hus - Atm Temp, Specific Humidity	AIRS (≥ 300 hPa)	9/02 – 5/11	AIRS +MLS needed to cover all required pressure levels	Y	Y
ta, hus - Atm Temp, Specific Humidity	MLS (< 300 hPa)	8/04 - 12/10	AIRS +MLS needed to cover all required pressure levels	Y	Y

Search & Download Data

[Advanced Data Search](#)

Browse Projects

Parent projects (0)

Peer projects (1)

[Ana4MIPs](#)

Child projects (0)

Start typing, or use the 'Delete' key to show all available tags.

ESGF: Side by Side with CMIP

The image shows two browser windows side-by-side. The left window is the ESGF Portal, and the right window is the Technical Notes page for the Obs4MIPs project.

ESGF Portal (Left Window):

- URL: pcmdi9.llnl.gov/esgf-web-fe/live?sessionId=36C3
- Logo: ESGF Earth System Grid Federation
- Navigation: Home, Search, Tools, Login, Help
- Current Selections:
 - [remove all](#)
 - [\(x\) product:observations](#)
 - [\(x\) project:obs4MIPs](#)
 - [\(x\) query:obs4MIPs](#)
- Search Categories (left sidebar):
 - Project: **obs4MIPs (24)** (highlighted with a red arrow)
 - Institute
 - Model
 - SubModel
 - Instrument
 - Experiment Family
 - Experiment
 - SubExperiment
 - Time Frequency
 - Product
 - Realm
 - Variable
- Search Results (center):
 - Search term: **obs4MIPs**
 - Examples: temperature, "surface temperature", To download data: add datasets to your Data Cart
 - Search filters: ☒ Search All Sites, ☐ Show All Replicas
 - Display: 10 datasets per page
 - Buttons: [Add All Displayed to Datacart](#), [Remove](#)
 - Results list:
 - obs4MIPs.NASA-GSFC.TRMM.atmos.mon**
Data Node: [esgdata1.nccs.nasa.gov](#)
Version: 20130204
No description available.
Further options: [Add To Cart](#), [Visualize and Analyze](#)
 - obs4MIPs.IPSL.CALIOP.night**
Data Node: [vesg.ipsl.polytechnique.fr](#)
Version: 1
No description available.

Technical Notes (Right Window):

- URL: www.earthsystemcog.org/projects/obs4mips/tech-notes
- Page Title: Technical Notes
- Welcome, Guest. | [Log in](#) | [Create Account](#)
- Earth System Cog logo
- Navigation: Home, About Us, Governance, Contact Us
- Buttons: [What is CoG?](#), [Site Support](#)
- Search Data: Enter Text, [Go](#), [Advanced Data Search](#)
- Browse Projects: ☒ This, ☐ All, ☐ My
 - Parent projects (0)
 - Peer projects (1): [Ana4MIPs](#)
 - Child projects (0)
- Enter Tag: [Go](#)
- Start typing, or use the 'Delete' key to show all available tags.
- Obs4MIPs sidebar:
 - Home
 - How to cite
 - How to contribute data
 - Products
 - Satellite Products
 - Reanalysis Products
 - In-situ Products (sample)
 - Technical Notes
 - Visitors
 - [List All News](#)
 - [List All Files](#)
- Technical Notes content:
 - Obs4MIPs satellite products
 - AIRS Air Temperature
 - AIRS Specific Humidity
 - AMSR-E Sea Surface Temperature
 - AVISO Sea Surface Height
 - ARC Sea Surface Temperature
 - CERES TOA Outgoing Clear Sky Longwave Radiation (rlutcs)
 - CERES TOA Outgoing Longwave Radiation (rlut)
 - CERES TOA Incident Shortwave Radiation (rsdt)
 - CERES TOA Outgoing Clear Sky Shortwave Radiation (rsutcs)
 - CERES TOA Outgoing Shortwave Radiation (rsut)
 - ERA-Interim Zonal and Meridional Wind
 - GPCP Monthly Precipitation
 - GPCP 1-Degree Daily Precipitation

obs4MIPs: Access Statistics

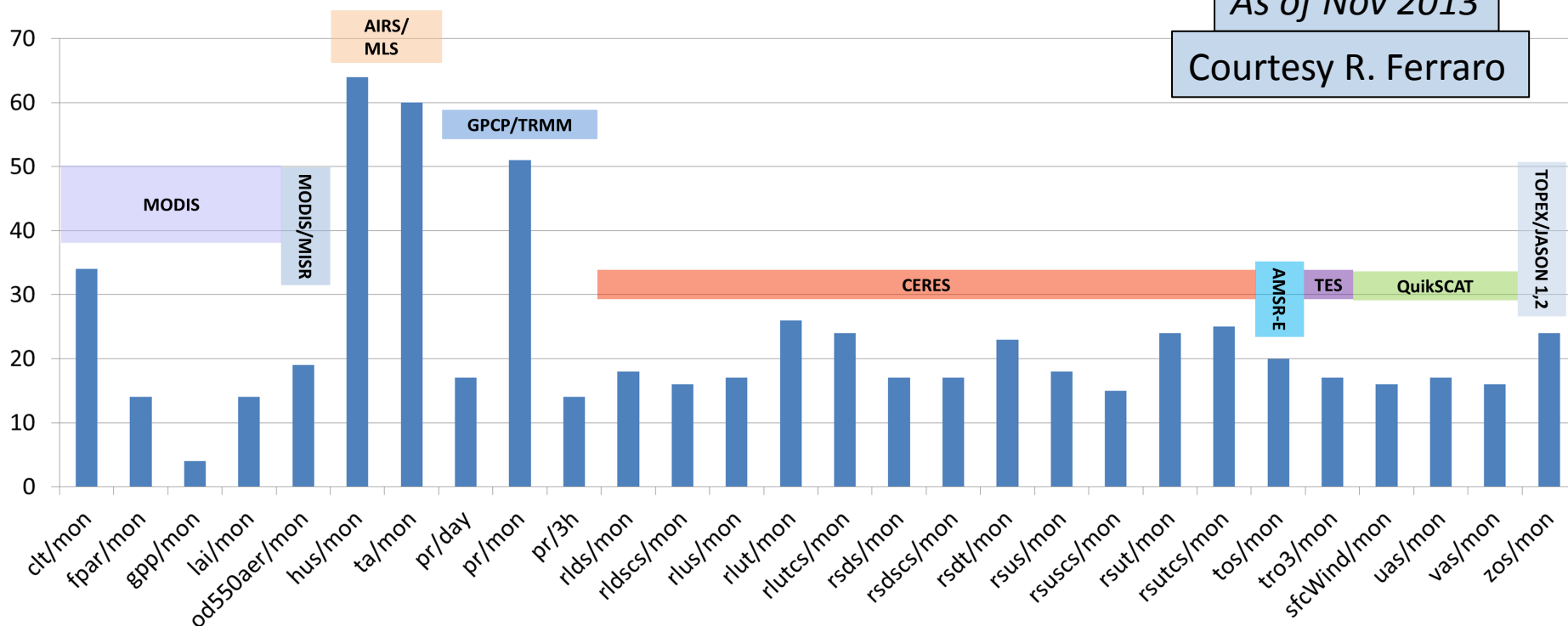
(NASA Datasets Only)

119 unique* users from 16 countries
641 dataset downloads in 2012-13

NASA ESGF Data Nodes Unique Dataset Downloads

As of Nov 2013

Courtesy R. Ferraro



* "Unique" counts unique user ID downloads of a complete dataset, not individual files.
Repeat downloads of the same dataset by the same user were counted only once.

Evolution and Status of obs4MIPs

✓ Pilot Phase - CMIP5

- *Initial protocols – variables, sources & documentation*
- *Compatibility with CMIP file formats and ESGF*
- *PCMDI Science & GSFC IT Workshops*
- *Identified and provided ~ 15 variables*

✓ Expanding the Pilot

- *Additional data types, sources, variables (e.g., CFMIP, CMUG, CEOS, reanalysis)*
- *Reconsidering the initial guidelines/boundaries*
- *Some partial oversight & governance: NASA+ Working Group*

□ Planning Ahead – CMIP6

- *Identify additional data sources / remaining variable gap across Earth System*
- *Judicious/expanded model output considerations, including satellite simulators*
- *Increasing community input on objectives and on implementation contributions*
- *Broadening awareness & governance: WDAC obs4MIPs Task Team*

obs4MIPs-CMIP6 Meeting & WDAC Task Team Meeting
(NASA HQ, April 30-May1, 2014)

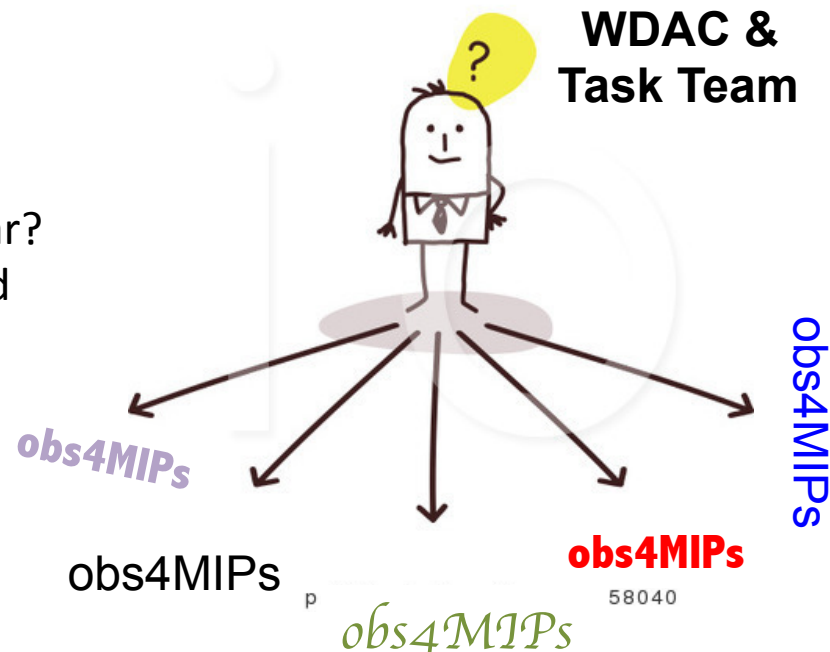
Meeting objective: Ensure relevant satellite data sets currently (or potentially) available can be fully utilized for CMIP6 research

***Meeting Report Under Preparation
With Summary to BAMS***

Great discussions!

Examples:

- More data sets – which ones, priority?
- Higher frequency (strong interest in this)
- Process & Model Development focus – how to?
- Relaxing the “model-equivalent” criteria – how far?
- Better characterization of obs uncertainty needed
- Satellite Simulator/Observation Proxy priorities?
- Geostationary priorities/guidance
- In-Situ – where to start, how far to go?



Invite only; ~60 attendees

Mix of observational experts, modelers, managers

Many Questions and Potential Priorities for WDAC Task Team

Evolution and Plans of obs4MIPs



Pilot Phase - CMIP5

- *Initial protocols – variables, sources & documentation*
- *Compatibility with CMIP file formats and ESGF*
- *PCMDI Science & GSFC IT Workshops*
- *Identified and provided ~ 15 variables*



Expanding the Pilot

- *Additional data types, sources, variables (e.g., CFMIP, CMUG, CEOS, reanalysis)*
- *Reconsidering the initial guidelines/boundaries*
- *Some partial oversight & governance: NASA+ Working Group*



Present: Planning Ahead – CMIP6

- *Identify additional data sources / remaining variable gap across Earth System*
- *Judicious/expanded model output considerations, including satellite simulators*
- *Increasing community input on objectives and on implementation contributions*
- *Broadening awareness & governance: WDAC obs4MIPs Task Team*



Future

- *More synergistic feedbacks between model development/improvements and new mission/observation definitions and prioritization*

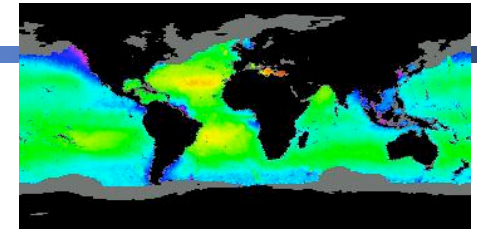
Example 1:

Sea Surface Salinity [*so(1st level)*]

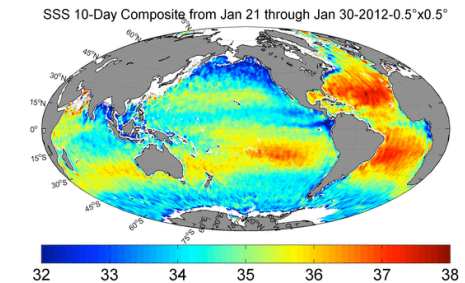
Measurement Technique(s)

- Brightness Temperature (mostly in L-band) is sensitive to salinity
- Use microwave radiometer to measure BT
- Need also:
 - Wind
 - SST
- Observed SSS corresponds to top skin layer (<5 cm) vs. 5-10 m average SSS in GCMs
-> OSSE need to be assessed

SMOS



Aquarius



Data products & coverage

SAC-D / Aquarius Level-3

Spatial coverage: 1 x 1 degrees (Lat x Lon)
global (no ice)

Temporal resolution: [1] 7 Day; [2] monthly

Time span: 2011-Aug-25 to Present

SMOS Level-3

Spatial coverage: 0.5° x 0.5°
global (no ice)

Temporal resolution: 10-day composite

Time span: 05-2010 – 06-2012

obs4MIPs Status / Development needs for CMIP6

Current CMIP5 model output (ESG)

- Native ocean model grid (but as 3-D field!)
- Monthly only

Changes to CMIP6 model output

- OSSE? -> needs to be assessed
- Frequency: might not be sufficient for process studies

Changes to *obs4MIPs* data sets

- Currently no SSS data set
- Accuracy of SSS?

Example 2:

Mixed Layer Depth (*mlostst*)

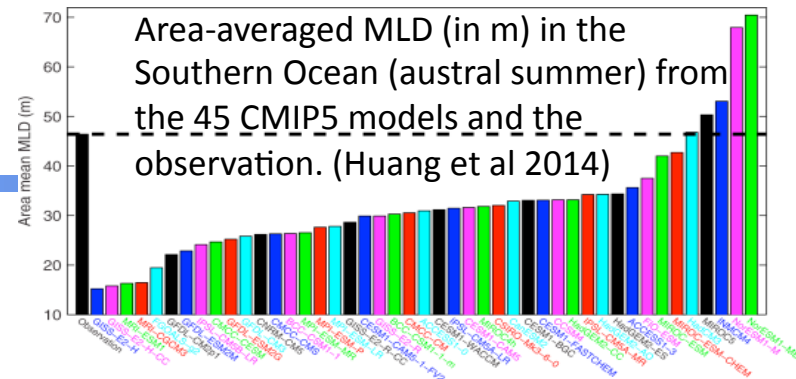
Measurement Technique(s)

- Depth from surface where ocean properties are well-mixed
 - Very important for atm-oce interactions
 - Biogeochemical processes
- Inferred from *in-situ* hydrography (i.e., ARGO)
 - Needs a 'criteria' (either temperature or density)
 - Typical depth 20-200m (but up to ~1000m in deep-convection high-lat regions)
- No near-term remote sensing product in sight

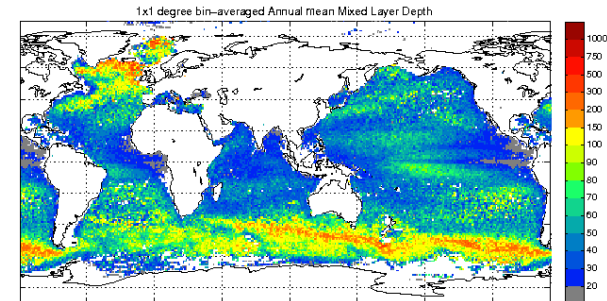
Data products & coverage

IPRC (Intl. Pacific Research Center) & UCSD

Spatial coverage: 1° x 1° (OI), or binned
Temporal coverage: since ~2004 (climatology)
Data type: ARGO profiles



Mean MLD depth



obs4MIPs Status / Development needs for CMIP6

Current CMIP5 model output (ESG)

- Native ocean model grid
- Monthly only
- based on 'sigma_t' criterion

Changes to CMIP6 model output

- OSSE? -> probably not
- Frequency: sufficient (?)

Changes to *obs4MIPs* data sets

- Currently no *mlostst* data set

Ana4MIPs: Current Set of Reanalysis

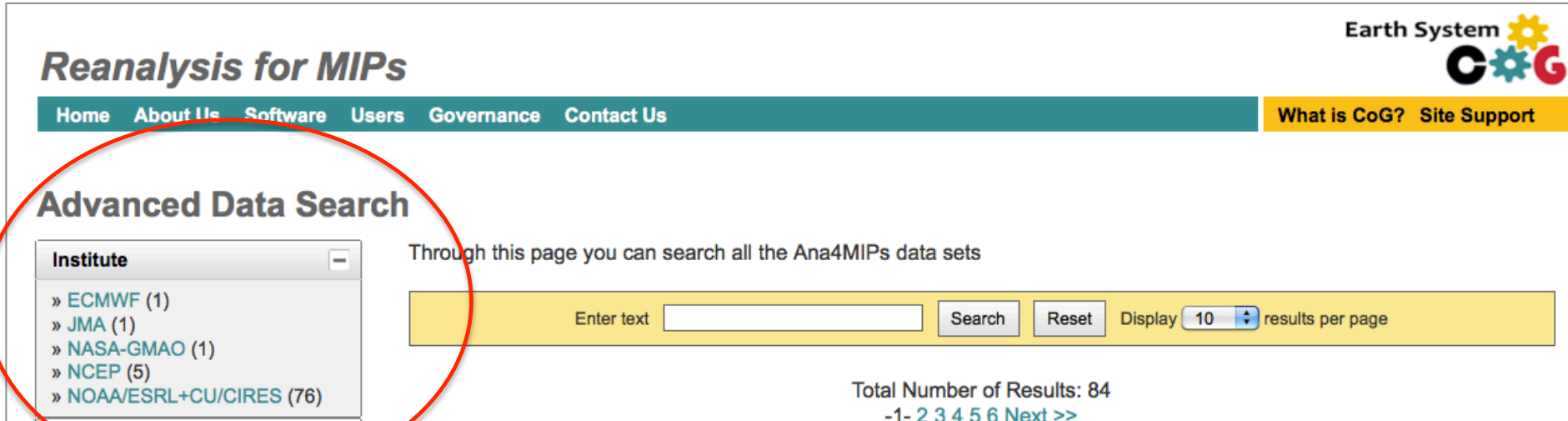
The objectives of the ana4MIPs project are:

- 1) To provide access to collocated reanalysis data sets in a common format to improve data access and use.
- 2) To facilitate the intercomparison of analysis products to aid in evaluating and improving reanalyses.
- 3) To provide observation-based quantities for climate model evaluation that are not available in any other form.

Data examples: upper atmosphere wind, moisture, temperature fields and fluxes not routinely globally observed.

Ana4MIPs: Current Set of Reanalysis

Lead: Gerry Potter (GSFC / NASA)



The screenshot shows the 'Reanalysis for MIPs' website. The header includes the 'Earth System CoG' logo and navigation links: Home, About Us, Software, Users, Governance, and Contact Us. A yellow banner on the right says 'What is CoG? Site Support'. The main section is titled 'Advanced Data Search'. On the left, a dropdown menu labeled 'Institute' is highlighted with a red circle. It lists the following options: » ECMWF (1), » JMA (1), » NASA-GMAO (1), » NCEP (5), and » NOAA/ESRL+CU/CIRES (76). To the right of the dropdown, text states 'Through this page you can search all the Ana4MIPs data sets'. Below this is a search bar with the placeholder 'Enter text', a 'Search' button, a 'Reset' button, and a 'Display 10 results per page' dropdown. At the bottom right, it shows 'Total Number of Results: 84' and a pagination link '-1- 2 3 4 5 6 Next >>'.

www.earthsystemcog.org/projects/ana4mips

- can search & download for variables across multiple datasets
- Currently one ocean reanalysis (NOAA-NCEP CSFR) available
- More planned

Summary / Outlook

1. Obs4MIPs products are:
 - Directly comparable to a model output field defined as part of CMIP5
 - Open to contributions from all data producers that meet Obs4MIPs requirements
 - Well documented, with traceability to track product version changes
 - Served through ESGF / CoG
2. obs4MIPs & ana4MIPs leverages existing CMIP infrastructure, but additional work is still needed to better accommodate data sets:
 - streamlined “recipe” for preparation/hosting obs4MIPs datasets
 - Guidelines/requirements for the submission and “acceptance” process
 - Measures of “data quality” or a “data maturity matrix”?
 - Is there a means to provide feedback and a “blog” of sorts for each data set where users can ask questions and seek answers?
 - Do we need to ensure stewardship of each data set?
3. Ana4MIPs is growing, with the goal to include more ocean reanalysis data sets