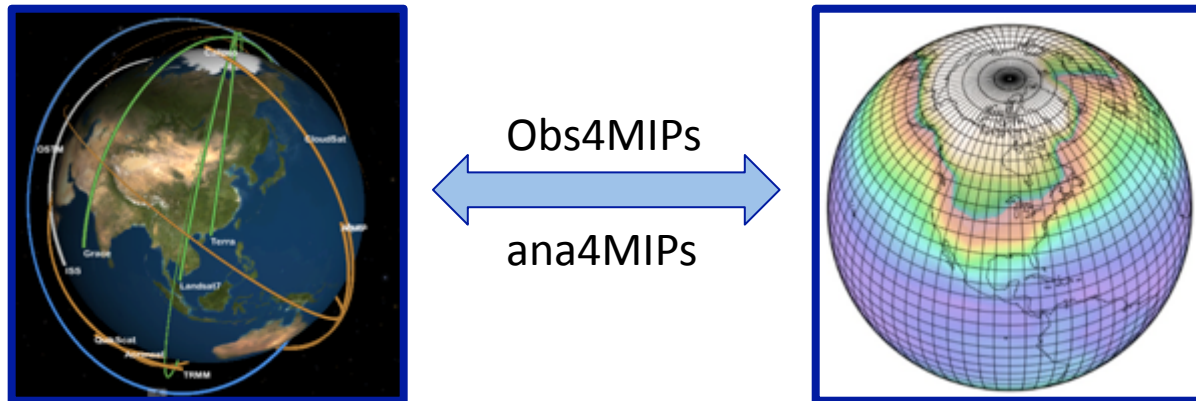# Overview of obs4MIPs & ana4MIPs

Felix Landerer[1] (with **a lot** of input & help from Duane Waliser[1], Peter Gleckler[2], Robert Ferraro[1], Gerry Potter[3])
[1] JPL/NASA; [2] PCMDI/LLNL; [3] GSFC/NASA

Obs4MIPs

ana4MIPs

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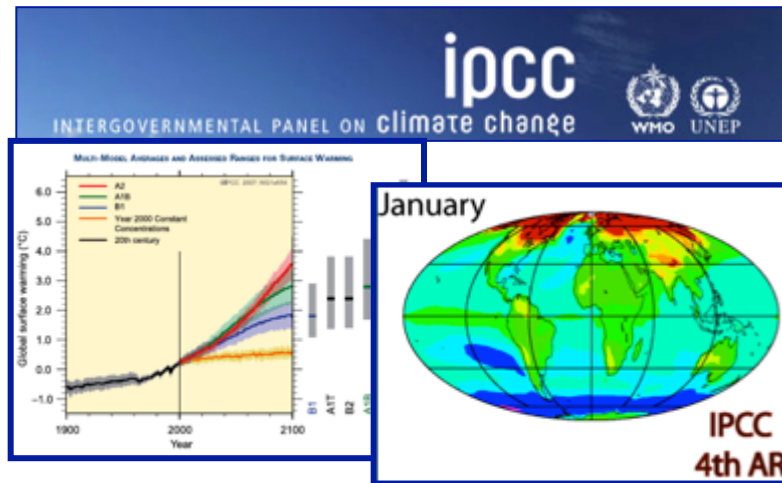July 8-11, 2014
Denver, Colorado

Jet Propulsion Laboratory
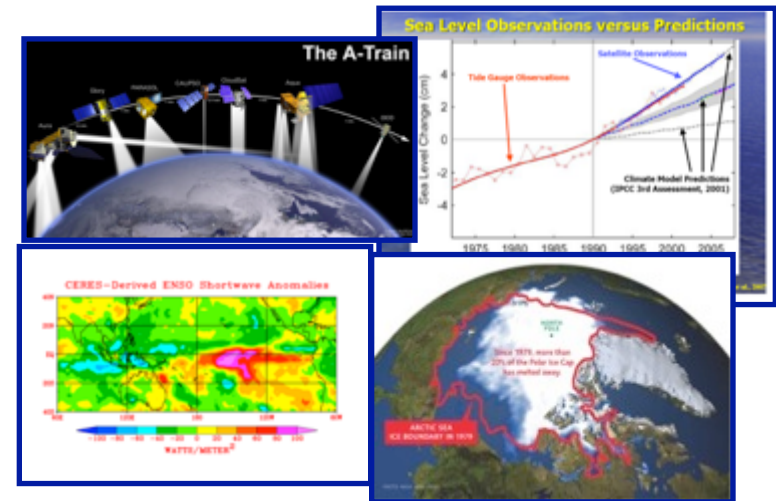California Institute of Technology

PCMDI

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?

Taylor et al. 2008

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

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

<u>Over 300 Variables in (monthly) CMIP Database</u>   ⟷   <u>Over 1000 satellite-derived quantities</u>
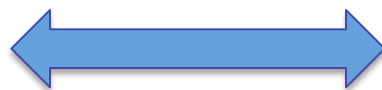
obs4MIPs: Initial 4 Commandments

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.

Target Quantities

Model Output Variables

Satellite Retrieval Variables

Modelers

Observation Experts

Analysis Community

Initial Target Community
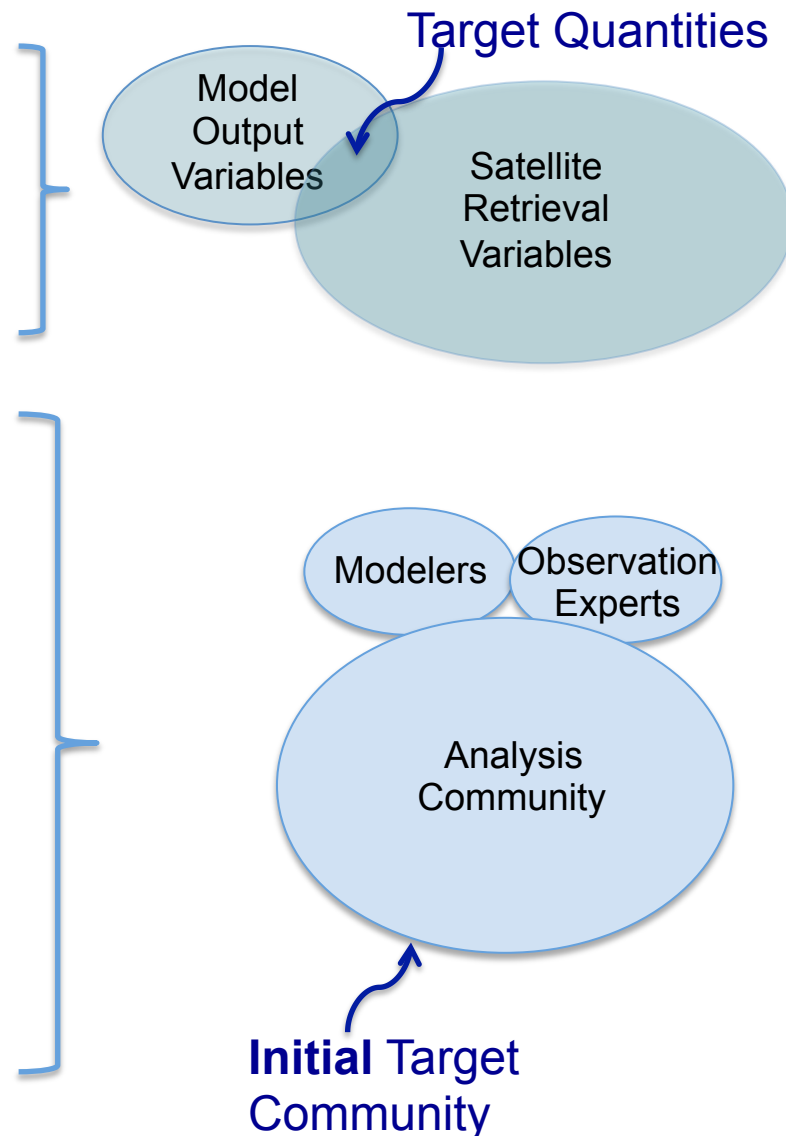
obs4MIPs "Technical Note"

Content

- Intent of the Document

- Data Field Description

- Data Origin

- <u>Validation and Uncertainty Estimate</u>

- <u>Considerations for use in Model Evaluation</u>

- Instrument Overview

- References

- Revision History
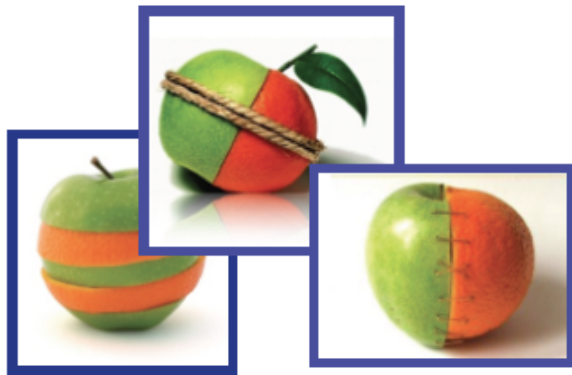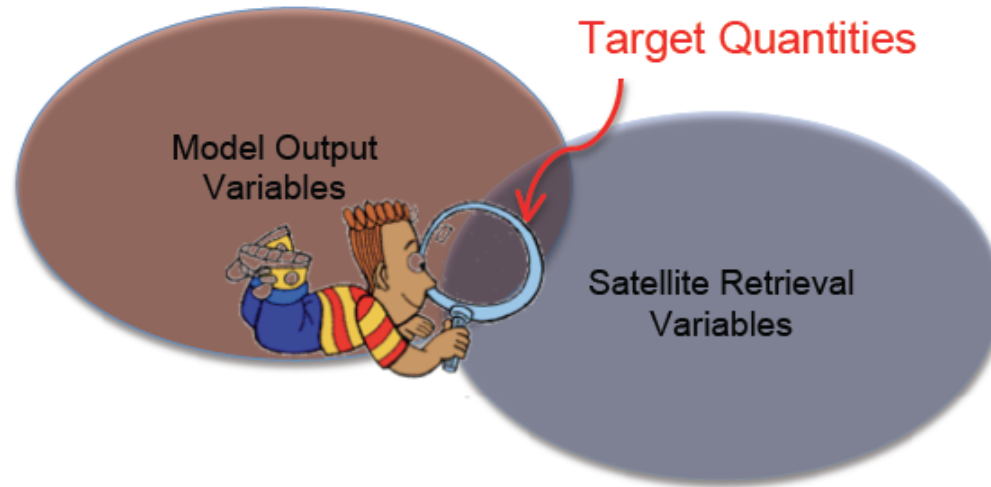
- POC

Model and Observation Overlap
For what quantities are these comparisons viable?

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
Discussions on protocols and additions to the in-situ holdings underway	

obs4MIPs
www.earthsystemcog.org/projects/obs4mips

Obs4MIPs

Home **About Us** **Governance** **Contact Us**

What is CoG? **Site Support**

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 ; pctisccp - 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
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.

ESGF: Side by Side with CMIP

obs4MIPS Project

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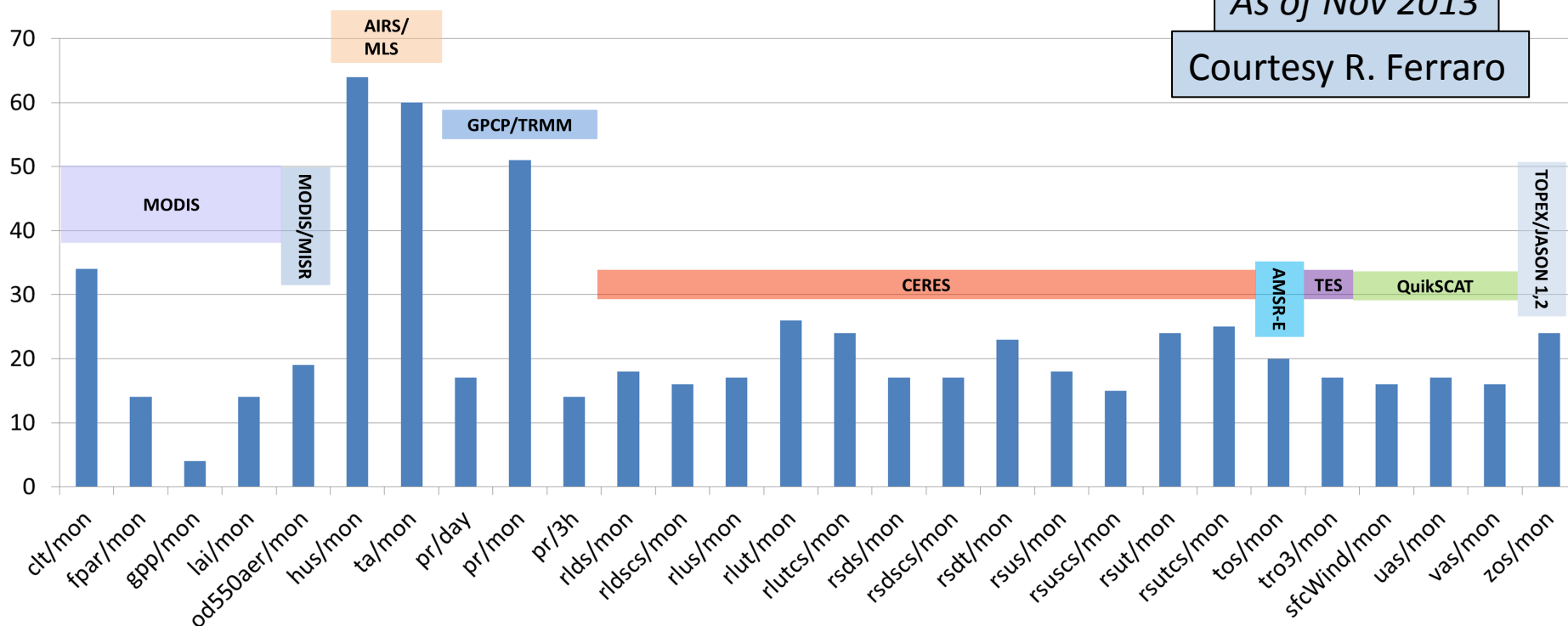
* "Unique" counts unique user ID downloads of a complete dataset, not individual files.
Repeat downloads of the same dataset by the same user were counted only once.

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

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?
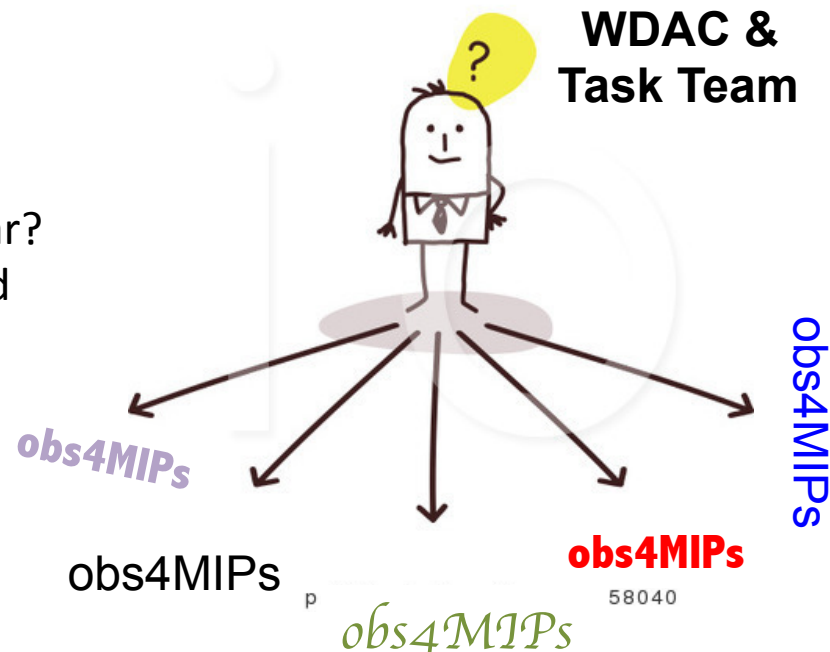
Invite only; ~60 attendees
Mix of observational experts, modelers, managers

Meeting Report Under Preparation With Summary to BAMS

WDAC & Task Team

obs4MIPs

obs4MIPs

obs4MIPs

obs4MIPs

obs4MIPs

58040

Many Questions and Potential Priorities for WDAC Task Team

Evolution and Plans of obs4MIPs

✓ Pilot Phase - CMIP5
- *Initial protocols – variables, sources & documentation*
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- *Additional data types, sources, variables (e.g., CFMIP, CMUG, CEOS, reanalysis)*
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☐ 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*
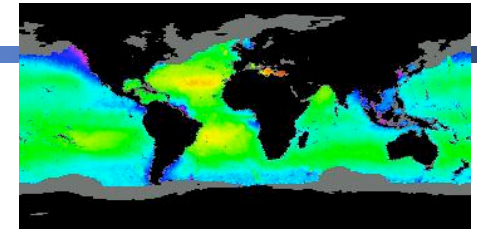
Example 1:
Sea Surface Salinity [*so(1ˢᵗ level)*]

SMOS

Aquarius

SSS 10-Day Composite from Jan 21 through Jan 30-2012-0.5°x0.5°
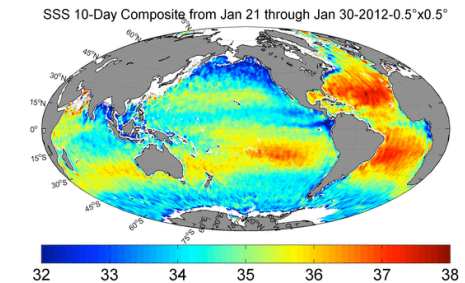
Measurement Technique(s)

- 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

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!)
- <u>Monthly</u> 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 (*mlotst*)

Area-averaged MLD (in m) in the Southern Ocean (austral summer) from the 45 CMIP5 models and the observation. (Huang et al 2014)

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)
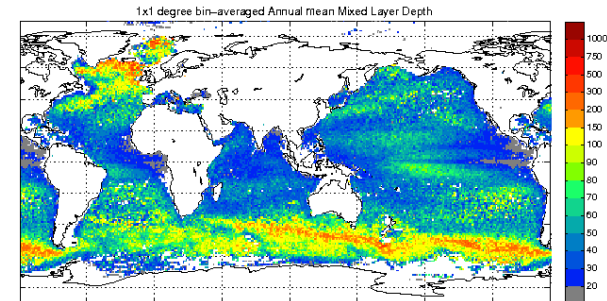- No near-term remote sensing product in sight

Mean MLD depth

1x1 degree bin-averaged Annual mean Mixed Layer Depth

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
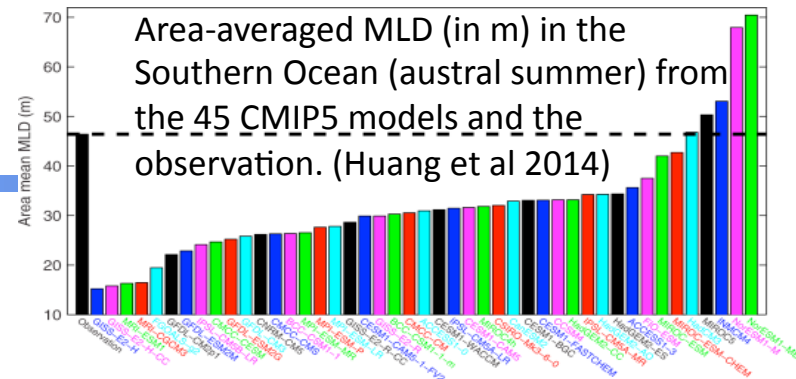
obs4MIPs Status / Development needs for CMIP6

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
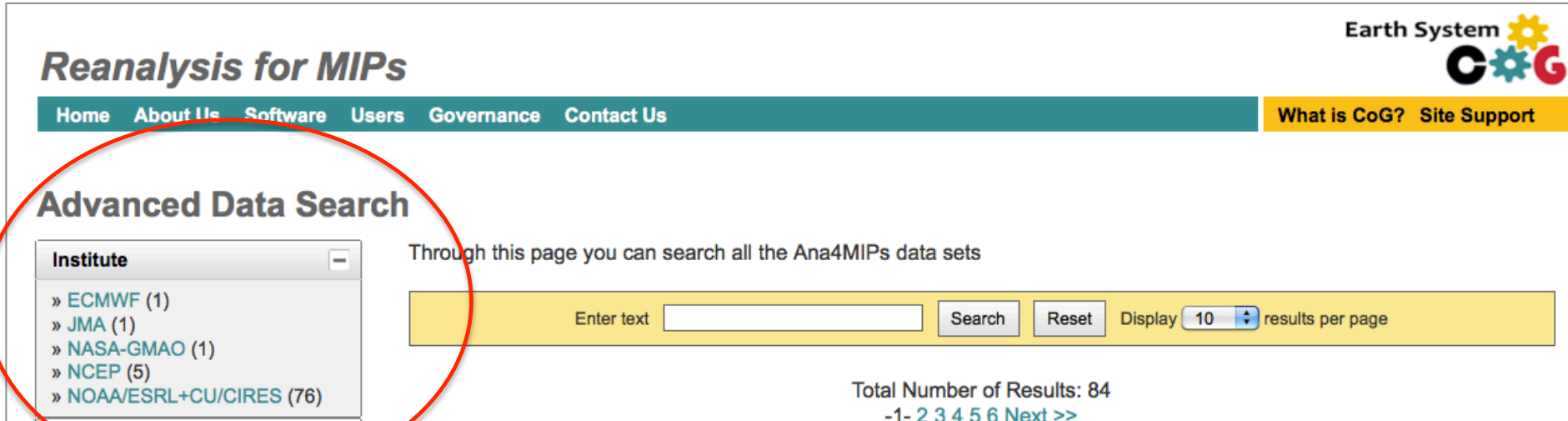- Currently no *mlostst* data set

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 reanalyzes.

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)

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