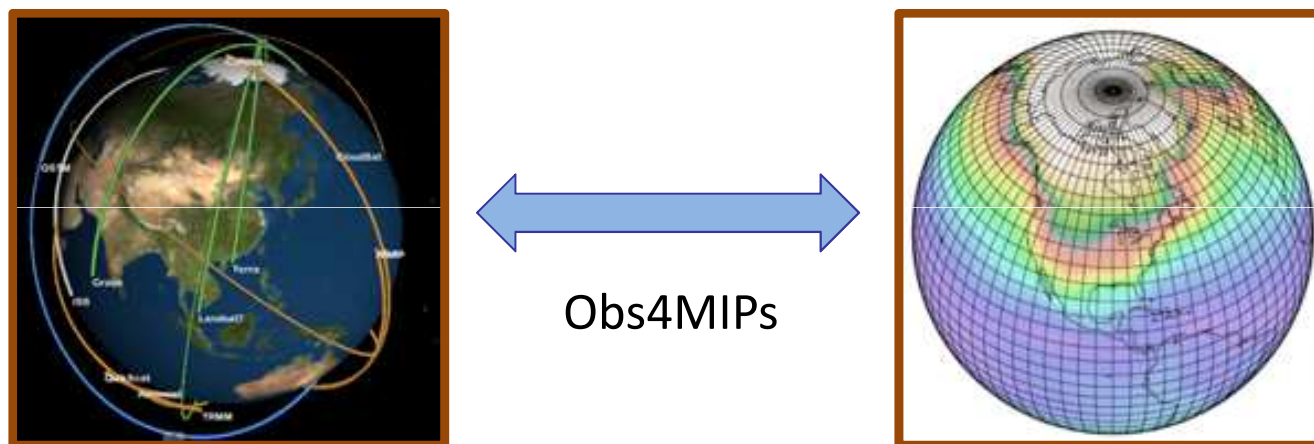


# Observations for Model Intercomparison Projects (obs4MIPs): Facilitating the use of Satellite Data to Evaluate Climate Models



---

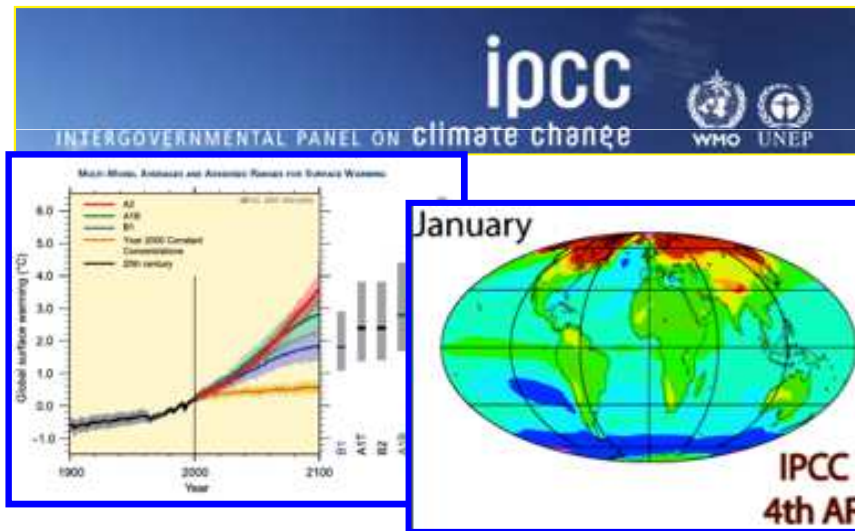
Robert Ferraro (JPL), Duane Waliser (JPL), Peter Gleckler (PCMDI),  
Karl Taylor (PCMDI), Joao Teixeira (JPL)  
NASA obs4MIPs Working Group  
NASA HQ (Tsengdar Lee and Jack Kaye)

Satellite mission teams (e.g. CERES, AIRS, TES, MLS, MODIS, OVWs, REMSS, AVISO, TRMM)

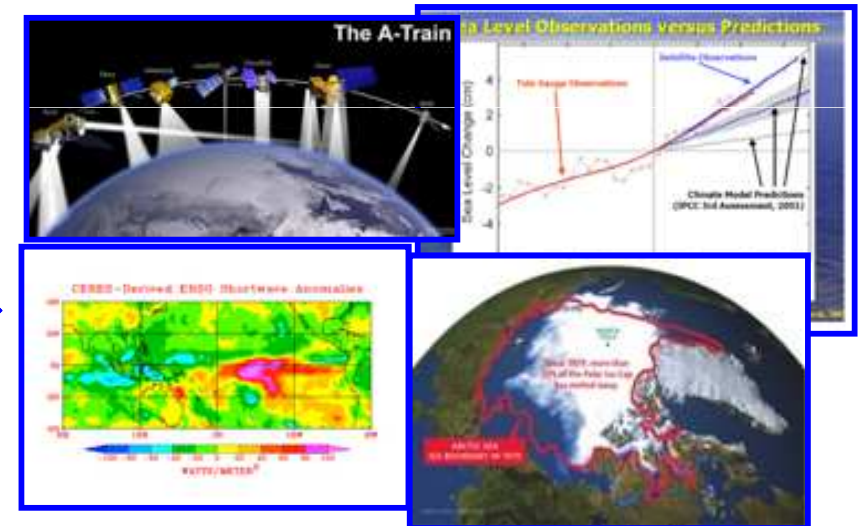
---

*robert.ferraro@jpl.nasa.gov*  
*CMUG Integration Meeting, Hamburg, June 2013*

# Satellite Data & CMIP/IPCC: Better Linkage



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



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

# Model and Observation Overlap

For what quantities are these comparisons viable?



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

(All Saved on the Atmospheric Grid)

Taylor et al. 2008

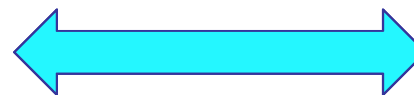
Category	Long Name	Units	Comment	Quantity	Variable	Variable Code
1	New Surface Air Temperature	K	new surface (level: 2.5 km) air temperature	...	...	...
2	Surface Temperature	K	new (level: 1.5 km, 2.5 km) air temperature	...	...	...
3	Daily Maximum New Surface Air Temperature	K	monthly mean of the daily maximum new surface (level: 2.5 km) air temperature	...	...	...
4	Daily Minimum New Surface Air Temperature	K	monthly mean of the daily minimum new surface (level: 2.5 km) air temperature	...	...	...
5	New Cloud Fraction	%	new (level: 2.5 km) cloud fraction	...	...	...
6	Surface Air Pressure	hPa	new (level: 2.5 km) surface air pressure	...	...	...
7	Sea Level Pressure	hPa	new (level: 2.5 km) surface air pressure	...	...	...
8	Sea Level Pressure	hPa	new (level: 2.5 km) surface air pressure	...	...	...
9	Sea Level Pressure	hPa	new (level: 2.5 km) surface air pressure	...	...	...
10	Sea Level Pressure	hPa	new (level: 2.5 km) surface air pressure	...	...	...

~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 the same products

Over 300 Variables in (monthly) CMIP Database



Over 1000 satellite-derived quantities

# Some Basic Tenets of this Activity

1. Use the **CMIP5 simulation protocol** (Taylor et al. 2009) as guideline for deciding which observations to stage in parallel to model simulations.  
**Target: monthly avg (e.g. OMON, AMON, LMON) products on 1°x1° grid**
2. Convert Satellite Observations to be **formatted exactly** the same as CMIP Model output  
**CMOR output, NetCDF files, CF Convention Metadata**
3. Includes a 6-8 page **Technical Note** describing strengths/weaknesses, uncertainties, dos/don'ts regarding interpretations comparisons with models. **(at graduate student level)**
4. Hosted **side by side** on the ESG with CMIP5
5. Advertise availability of observations for use in CMIP5 analysis.



# obs4MIPs

## Current Data Sets



Jet Propulsion Laboratory  
California Institute of Technology

CMIP Protocol Variables	Data Source	Time Period	Comments	QC?
<b>ta, hus</b> - Atm Temp, Specific Humidity	AIRS ( $\geq 300$ hPa)	9/02 – 5/11	AIRS +MLS needed to cover all required pressure levels	Y
<b>ta, hus</b> - Atm Temp, Specific Humidity	MLS ( $< 300$ hPa)	8/04 - 12/10	AIRS +MLS needed to cover all required pressure levels	Y
<b>tos</b> - Sea Surface Temperature	AMSR-E	6/02 - 12/10		Y
<b>rlut, rlutcs, rsdt, rsut, rsutcs</b> - TOA outgoing LW & SW Radiation, Incident SW Radiation	CERES	3/00 - 6/11		y
<b>rlds, rldscs, rlus, rsds, rsdscs, rsus, rsuscs</b> - Surface down- and upwelling LW & SW Radiation	CERES	3/00 - 2/10		
<b>clt</b> – Total Cloud Fraction	MODIS	2/00 - 9/11		Y
<b>zos</b> - Sea Surface Height Above Geoid	TOPEX/JASON series	10/92 - 12/10	AVISO Product	Y
<b>pr</b> - Precip flux	TRMM	1/98 - 6/11	Monthly Ave + 3 hourly products	
<b>pr</b> - Precip flux	GPCP	1Jan96 - 30Jun11	Daily ave	
<b>pr</b> - Precip flux	GPCP	1/79 - 6/11	Monthly Ave	
<b>sfcWind, uas, vas</b> - near surface winds	QuikSCAT	8/99 –10/09	Oceans only, excluding sea ice regions. No land products.	Y
<b>fpar</b> - Fract Abs Photo Active Radiation	MODIS	2/00 - 12/09		
<b>lai</b> - Leaf Area Index	MODIS	2/00 - 12/09		y
<b>tro3</b> – Mole Fract of Ozone	TES	7/05 - 12/09		
<b>tos</b> - Sea Surface Tem	ARC SST (ATSR, AATSR)	1/97 - 12/11		y
<b>od550aer</b> - AOD 550 nm	MISR	3/00 - 12/12	Land only	
<b>od550aer</b> - AOD 550 nm	MODIS	2/00 - 12/09	Ocean only	
<b>clisccp ; albisccp ; cltisccp ; cttisccp ; ptisccp</b>	ISCCP/IPSL	1983 - 2008		
<b>cfad2Lidarsr532 ; cfad2Lidarsr532 ; cfadLidarsr532 ; clrcalipso ; uncalipso ; clcalipso ; clccalipso ; clhcalipso ; clcalipso ; clmcalipso ; cltcalipso</b>	CALIPSO/IPSL	2006 - 2010	Monthly Ave & Day/Night	
<b>parasolRefl ; parasolRefl ; sza</b>	PARASOL/IPSL	2005 - 2008	Monthly & Daily	
<b>overpasses ; missingdatafraction ; cfadDbze94 ; cltcloudsat</b>	CloudSat/IPSL	2006 - 2010		



# ESG Gateway : Side by Side Archive with CMIP



The image displays two browser windows side-by-side, both showing the ESGF (Earth System Grid Federation) portal. The left window is at [pcmdi9.llnl.gov/esgf-web-fe/live;jsessionid=36C3](http://pcmdi9.llnl.gov/esgf-web-fe/live;jsessionid=36C3) and shows search results for 'obs4MIPs'. The right window is at [esgf-datanode.jpl.nasa.gov/esgf-web-fe/](http://esgf-datanode.jpl.nasa.gov/esgf-web-fe/) and shows the NASA obs4MIPs page.

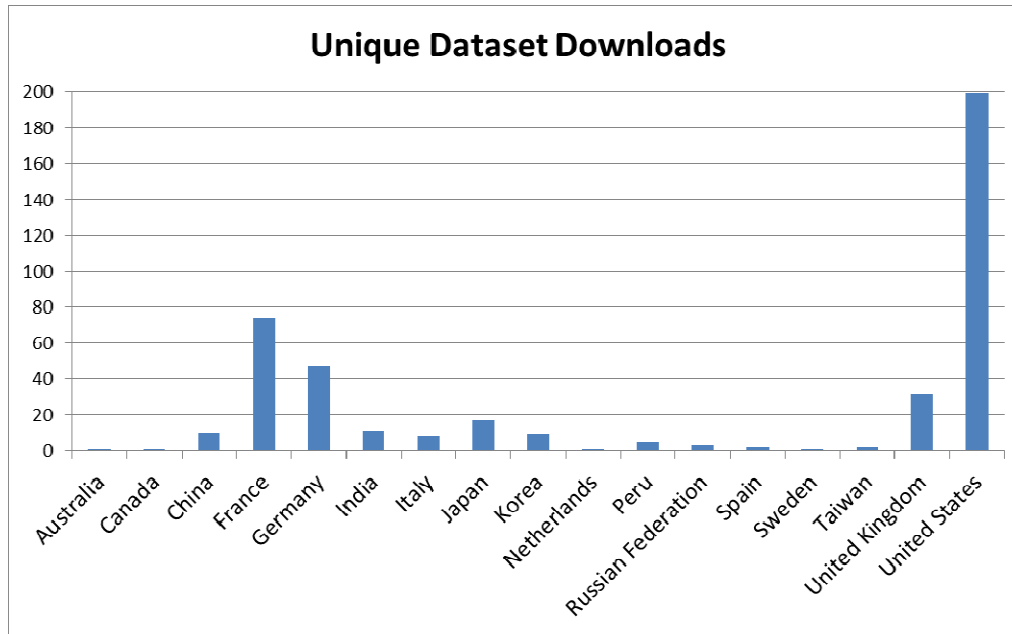
**Left Window (Search Results):**

- 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
- Search Categories: Project, Institute, Model, SubModel, Instrument, Experiment Family, Experiment, SubExperiment, Time Frequency, Product, Realm, Variable
- Result 1: **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
- Result 2: **obs4MIPs.IPSL.CALIOP.night**  
Data Node: vesg.ipsl.polytechnique.fr  
Version: 1  
No description available.  
Further options: Add To Cart, Visualize and Analyze

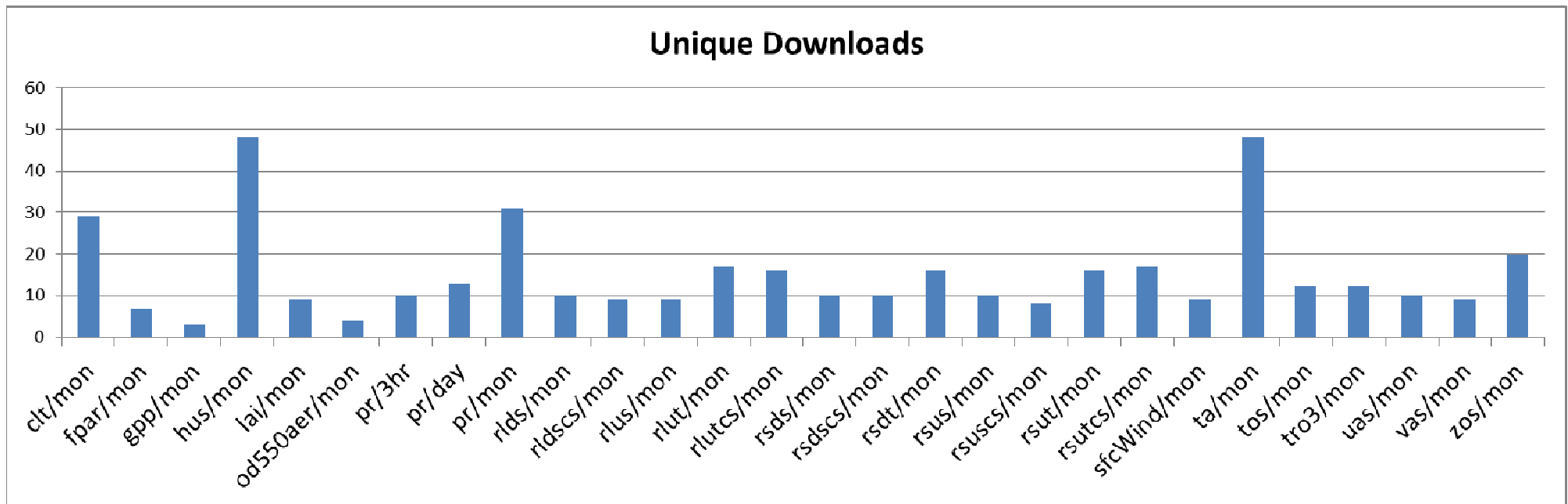
**Right Window (NASA obs4MIPs):**

- Header: Jet Propulsion Laboratory, California Institute of Technology
- Navigation: Home, Search, Tools, Login, Help
- Image: World map
- Text: Welcome to this ESGF P2P Node
- ESGF Earth System Grid Federation logo
- Dataset List:
  - ANL Node
  - BADC Node
  - BNL Node
  - CMCC Node
  - CRZ Node
  - CRZ CMIP5 Node
  - NOAA-GFDL Node
  - IPSL Node
  - NASA-GSFC Node
  - NASA-JPL Node
  - NCI Node
  - NERSC Node
  - ORNL Node
  - PCMDI Node
- Text: These NASA datasets are provided as part of an experimental activity to increase the usability of NASA satellite observational data for the model and model analysis communities. These are not standard NASA satellite instrument products. They may have been reprocessed, reformatted, or created solely for comparisons with the CMIP5 model. Community feedback to improve and validate the datasets for modeling usage is appreciated.
- Quick Links:
  - Create Account
  - MyProfile/Logout
  - Expert Search (XML)
  - Wget Script Generator
  - ESGF aggregated RSS feed
  - Contact ESGF
- Instructions:
  - ESGF Full User Guide
  - Search Help
  - Search Controlled Vocabulary
  - Wget Scripts FAQ
  - Wget Scripting
  - Tutorial: Download Strategies
  - Using Globus Online
  - Subscribing to RSS Notificati
- Dataset List:
  - AIRS Air Temperature
  - AIRS Specific Humidity
  - AMSRE Sea Surface Temperature
  - AVISO Sea Surface Height
  - CERES TOA Outgoing Clear-Sky Longwave Radiation
  - CERES TOA Outgoing Longwave Radiation
  - CERES TOA Incident Shortwave Radiation
  - CERES TOA Outgoing Clear-Sky Shortwave Radiation
  - CERES TOA Outgoing Shortwave Radiation
  - MLS Specific Humidity
  - MLS Air Temperature
  - MODIS Cloud Fraction
  - TES Ozone
  - TRMM Precipitation 3-Hourly
  - TRMM Precipitation Monthly
  - QuickSCAT Wind Speed
  - QuickSCAT Eastward Near-Surface Wind
  - QuickSCAT Northward Near-Surface Wind

# Some Access Statistics (NASA Datasets only)



“Unique” counts unique user ID downloads of a complete dataset, not individual files. Repeat downloads of the same dataset were removed.



- NASA-PCMDI pilot Project has established a (satellite) observation capability for the climate modeling community to support model-to-data intercomparison. This involves IT, satellite retrieval, data set, modeling and science expertise.
- 24 satellite-based datasets covering ~ 50 CMIP5 variables are currently available on the ESGF
- We are interested in collaboration with other agencies, activities and international partners (e.g. IPSL/CFMIP – already contributed, ESA CMUG, ana4MIPs) to expand this for AR6 and related MIPs, and solicit feedback from model analysis community.
- NASA formed a obs4MIPs Working Group, including rep from PCMDI and NOAA to help guide the expansion and direction of this activity. We are hoping to have a component of WCRP (i.e. WDAC) shepherd it at the broadest level.
- This would not have been possible without help from AIRS, MLS, TES, QuikSCAT, MODIS, TRMM, REMSS, PODAAC, GSFC, and AVISO, plus ESGF, IPSL/CFMIP, etc – many people contributed to this effort



- Identify additional observations to include in this activity (broader participation). Hoping to do this in concert and with guidance with WCRP (e.g. WDAC, WMAC).
- Continue to work with the ESG community and PCMDI to facilitate the means to utilize the satellite data, as well as CMUG, Climate Metrics Panel, other MIPs, etc.
- Encourage missions to develop products analogous to model output, including satellite simulators for more direct comparisons with observed quantities (e.g. COSP, but for other processes/ES components).
- Encourage modeling community to develop the means to output quantities analogous to satellite retrieved quantities.
- Need: Future workshop (2013/2014) to begin planning for CMIP6 – CMIP architects, modeling, satellite and reanalysis leads, ESG developers, etc.