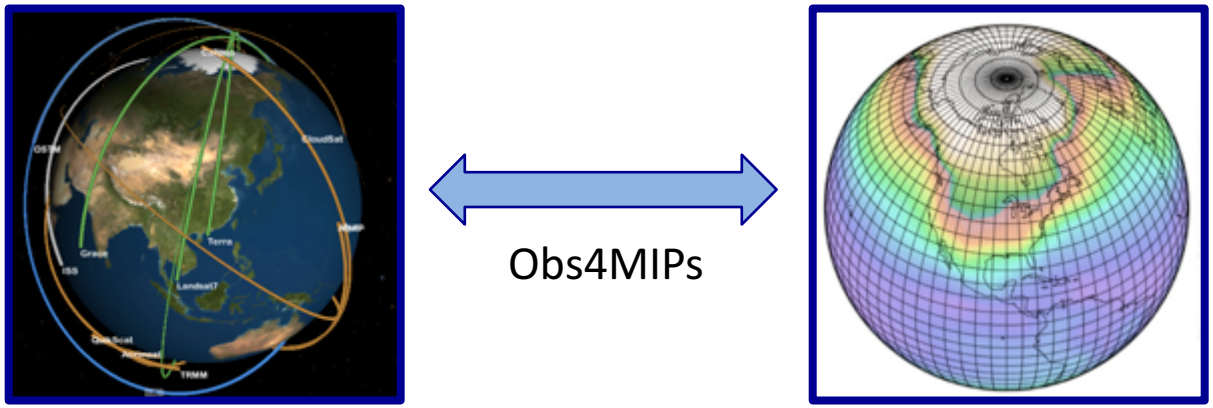
Obs4MIPs - Satellite Observations Rehosted for GCM Model Evaluation

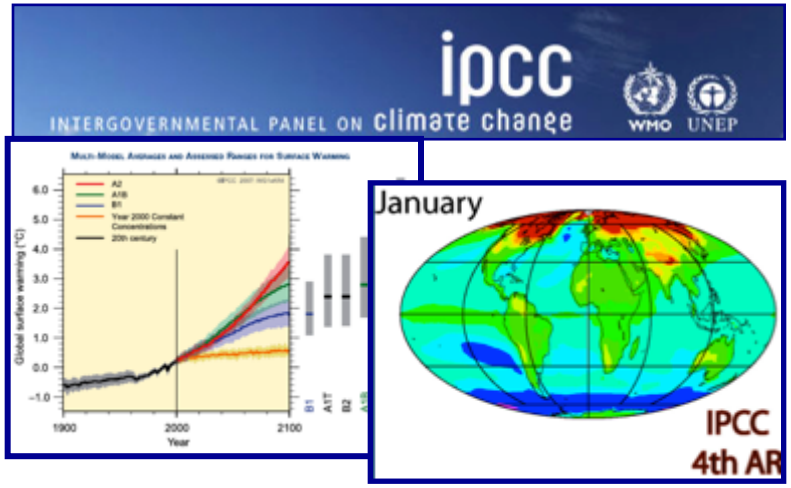


Robert Ferraro
Jet Propulsion Laboratory

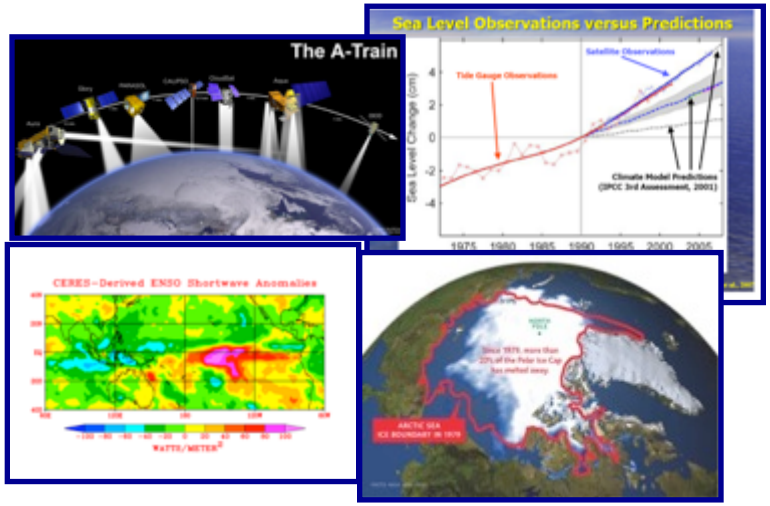
This project is collaboration between NASA and DOE, and is overseen by an International Task Team constituted under the WCRP Data Advisory Council

Initial Sentiments Behind obs4MIPS

Under-Exploited Observations for Model Evaluation

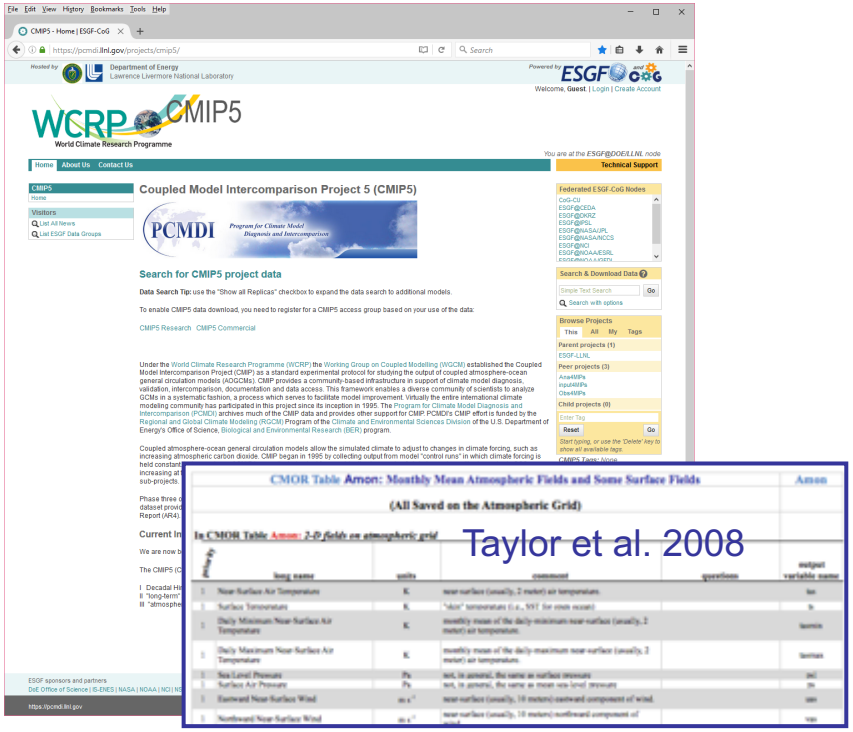


How to bring as much observational scrutiny as possible to the CMIP/IPCC process?



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

Model and Observation Overlap



~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

What's the Problem?

Formats

- Modelers typically use NetCDF, globally gridded output
- Satellite data comes in lots of formats: HDF, NetCDF, binary, etc; Different processing levels (L2 – Swath, L3 – gridded, L4 – analysis), with voids, fills, and flags

Metadata

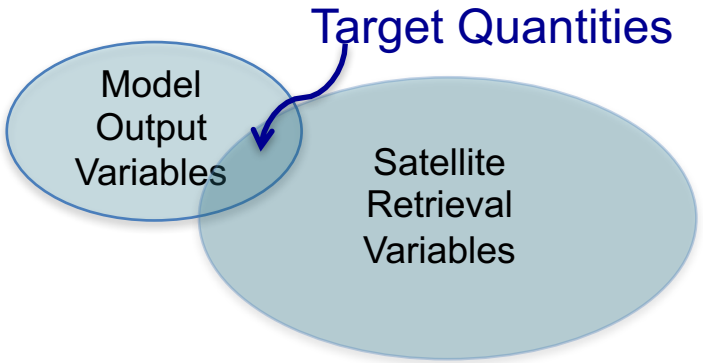
- Modelers typically use the CF convention
- Satellite data may be NASA EOS compliant, CF compliant, or follow no specific convention – metadata may not actually be imbedded in the data files …

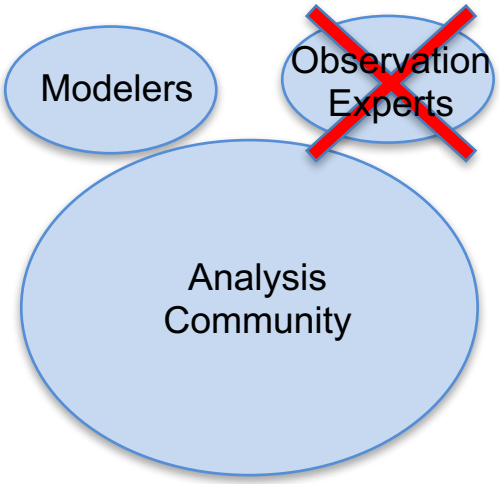
Experience

- Modelers (not all) know very little about satellite data, don't understand retrievals, biases – Finding data is still hard and they see multiple products for the "same" variable and don't know how to choose
- Satellite data providers produce documentation for themselves, which is often impenetrable for non-observational scientists
- Mapping between model output and observations is not always obvious

obs4MIPs: The 4 Commandments

1. Use the CMIP5/6 simulation protocol as guideline for selecting observations.
2. Observations to be formatted the same as CMIP Model output (e.g. NetCDF files, CF Convention)
3. Include a Technical Note for each variable describing observation and use for model evaluation (at graduate student level).
4. Hosted on the ESGF with CMIP model output, using the same search and download facilities, (and in the future, online analysis capabilities)





Target Community

obs4MIPs "Technical Note"

Every dataset must include a Technical Note, which is hosted with the dataset on the ESGF

The Tech Note is limited to about 6 – 8 pages, with figures

Content should summarize important information in a way that a graduate student can understand

References to more complete documentation, and journal articles, are included at the end

Technical note content is mandatory, and is review by the task team before it is published

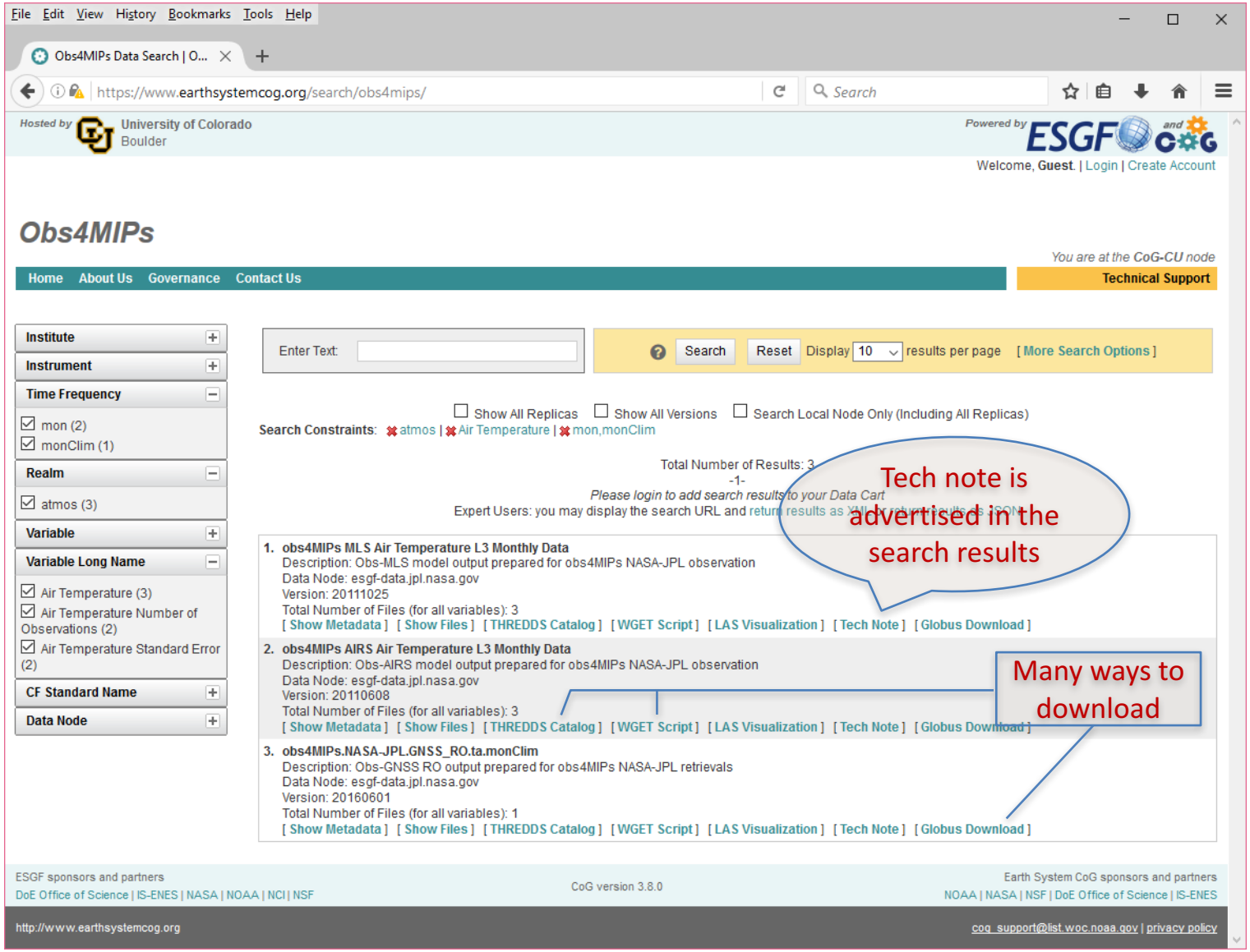
- Intent of the Document
  - Data Field Description (CF name, units)
  - Point Of Contact (name, email address)
- Data Origin
- Validation and Uncertainty Estimate
- Considerations for use in Model Evaluation
- Instrument Overview
- References
- Revision History

An uncertainty estimate is required, and more detailed error information (zonal, point by point) is encouraged

For example:
Sun Synchronicity
Diurnal Sampling
Sampling Bias
Effect of cloud contamination

The objective is to place all of the relevant information needed to make use of the dataset in one document next to the data holding itself

Data and Documentation Together



obs4MIPs: Current Set of Observations

https://www.earthsystemcog.org/projects/obs4mips/satellite_products

(CF) Variable Long Name (# Datasets)

- Air Temperature (3)
- Ambient Aerosol Optical Thickness at 550 nm (2)
- CALIPSO 3D Clear fraction (3)
- CALIPSO 3D Undefined fraction (3)
- CALIPSO Clear Cloud Fraction (3)
- CALIPSO Cloud Fraction (3)
- CALIPSO High Level Cloud Fraction (3)
- CALIPSO Low-Level Cloud Fraction (3)
- CALIPSO Mid Level Cloud Fraction (3)
- CALIPSO Scattering Ratio (6)
- CALIPSO Total Cloud Fraction (3)
- Cloud Fraction retrieved by MISR (1)
- Eastward Near-Surface Wind (1)
- Eastward Wind (1)
- Fraction of Absorbed Photosynthetically Active Radiation (1)
- Geopotential Height (1)
- ISCCP Cloud Area Fraction (Joint histogram of optical thickness and cloud top pressure) (1)
- ISCCP Mean Cloud Albedo (Cloud-fraction weighted & daytime only) (1)
- ISCCP Mean Cloud Albedo (Unweighted & daytime only) (1)
- ISCCP Mean Cloud Top Pressure (Cloud-fraction weighted & daytime only) (1)
- ISCCP Mean Cloud Top Pressure (Unweighted, daytime only) (1)
- ISCCP Mean Cloud Top Temperature (Cloud-fraction weighted & daytime only) (1)
- ISCCP Mean Cloud Top Temperature (Unweighted & daytime only) (1)
- ISCCP Total Cloud Fraction (daytime only) (1)
- Leaf Area Index (1)
- Mass Fraction of Cloud Ice (1)
- Mole Fraction of O3 (1)
- Monthly Average Near-Surface Wind Speed (1)
- Near-Surface Wind Speed (1)
- Northward Near-Surface Wind (1)
- Northward Wind (1)
- Precipitation (4)
- Sea Ice Area Fraction (4)
- Sea Surface Height Above Geoid (1)
- Sea Surface Temperature (3)
- Specific Humidity (2)
- Surface Downwelling Clear-Sky Longwave Radiation (1)
- Surface Downwelling Clear-Sky Shortwave Radiation (1)
- Surface Downwelling Longwave Radiation (1)
- Surface Downwelling Shortwave Radiation (1)
- Surface Upwelling Clear-Sky Shortwave Radiation (1)
- Surface Upwelling Longwave Radiation (1)
- Surface Upwelling Shortwave Radiation (1)
- TOA Incident Shortwave Radiation (1)
- TOA Outgoing Clear-Sky Longwave Radiation (1)
- TOA Outgoing Clear-Sky Shortwave Radiation (1)
- TOA Outgoing Longwave Radiation (3)
- TOA Outgoing Shortwave Radiation (1)
- Total Cloud Fraction (1)
- Water Vapor Path (1)
- aerosol optical thickness at 550 nm (1)
- column-average dry-air mole fraction of atmospheric carbon dioxide (1)
- column-average dry-air mole fraction of atmospheric methane (1)
- monthly average atmosphere water vapor content over ice-free oceans (1)
- sea surface temperature (1)

Concluding Remarks

In theory, automated translation among file formats and metadata conventions is possible

In practice, it's not so easy – regridding is a touchy subject …

And documentation for the non-expert is largely non-existant

We think that providing data and documentation tailored to the customer is the best way to increase its utility

Obs4MIPs is evolving under the guidance of the WDAC Task Team

Many issues to sort out going forward … Like how to handle in situ data …

Find obs4MIPs at

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

Or Google "obs4MIPs"

Acknowledgements

Obs4MIPs Task Team Members

- Peter Gleckler, co-chair, PCMDI/DOE
- Duane Waliser, co-chair, JPL/NASA
- Sandrine Bony, IPSL
- Mike Bosilovich, GSFC/NASA.
- Helene Chepfer, IPSL
- Veronika Erying, DLR
- Robert Ferraro, JPL/NASA
- Pierre-Phillipe Mathieu (ESA)
- Roger Saunders, UKMO
- Jörg Schulz, EUMETSAT
- Karl Taylor, PCMDI/DOE
- Jean-Noël Thépaut, ECMWF
- Jerry Potter, PCMDI/DOE, GSFC/NASA

Ex-Officio

- Tsengdar Lee, NASA
- Renu Joseph, DOE
- Pierre-Philippe Mathieu, ESA
- Michel Rixen, WMO
- Otis Brown, WDAC

Part of this work was performed at the Jet Propulsion Laboratory, California Institute of Technology under a contract from NASA