WDAC Observations for Model Evaluation Task Team

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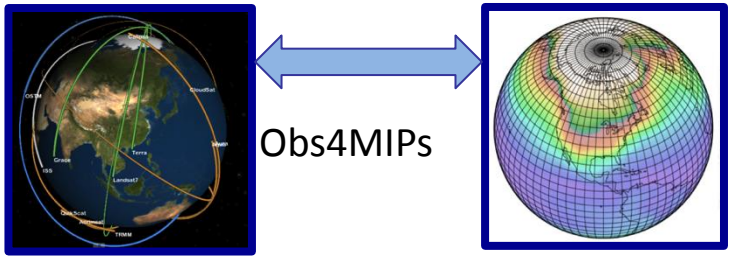
Denis Nadeu (PCMDI) – ezCMOR development
Jim Biard (NCEI) and Matthias Tuma (WCRP)
… and many others

Presentation outline

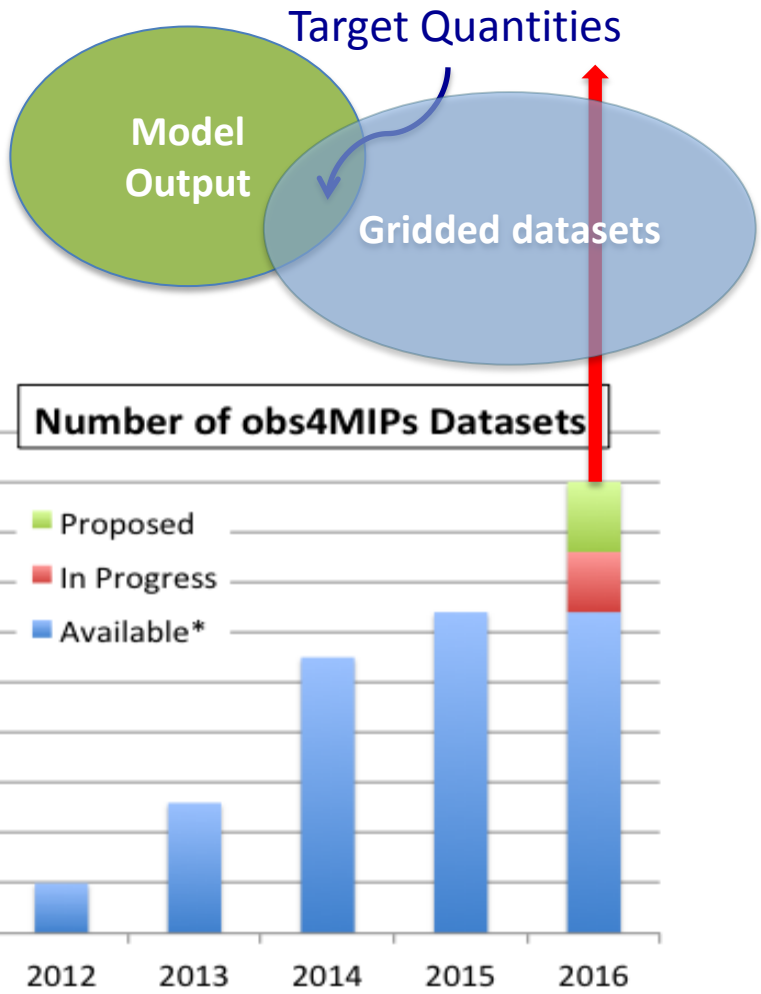
- Quick review, general status report
- Challenges, possible solutions
- Strategic considerations

obs4MIPs

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

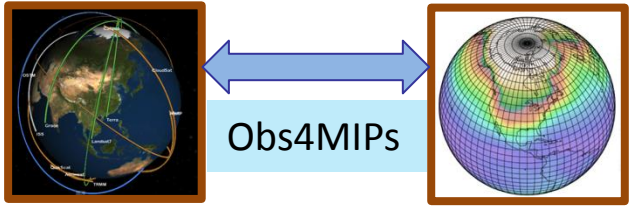


- A Project for identifying, documenting and disseminating observations for climate model evaluation in WCRP model intercomparisons, notably CMIP.
- Data sets accessible on the ESGF alongside CMIP model output, **adhering to the same data conventions**
- Guided by the WCRP Data Advisory Council obs4MIPS Task Team



…. and growing!

obs4MIPs: The 4 Commandments



1. Use the CMIP5* Standard Model Output as guideline for selecting observations

2. Observations to be formatted the same as CMIP Model output (e.g. NetCDF files, CF Convention, where common definitions)

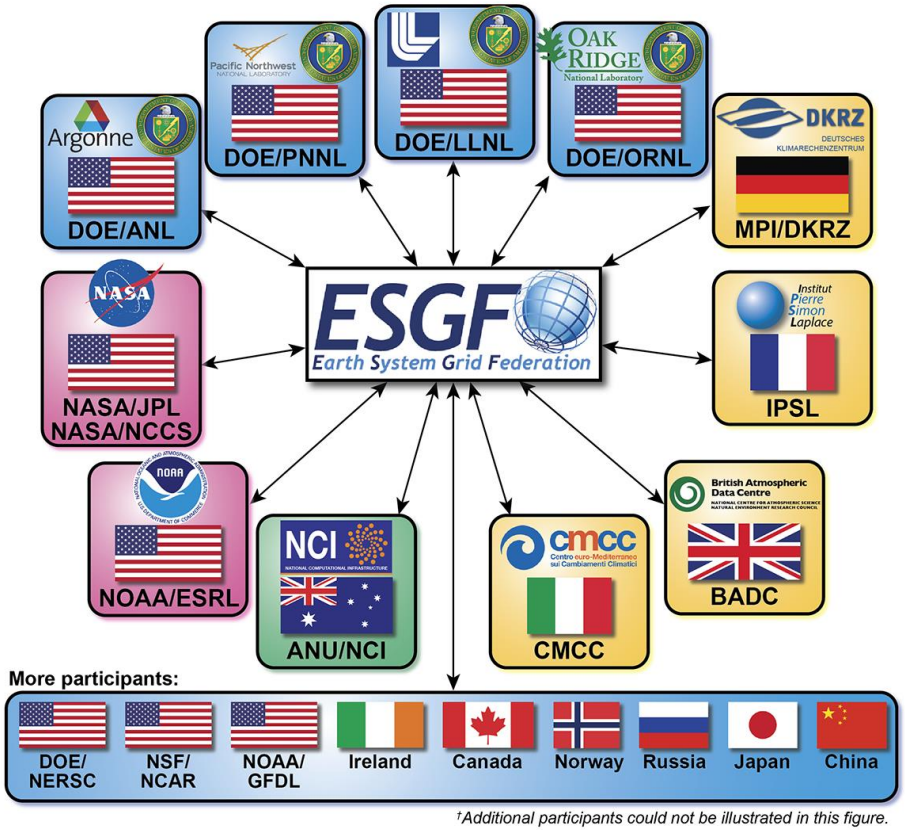
3. Hosted side by side on the ESGF with CMIP model output

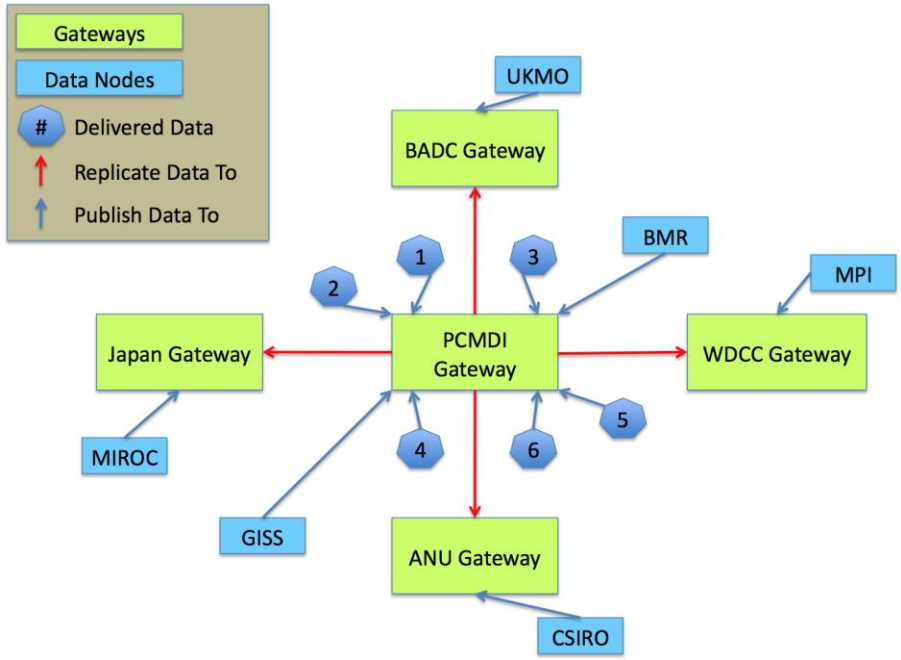
4. Include a Technical Note for each variable describing observation and use for model evaluation (at graduate student level)

* **obs4MIPs conventions are being updated to be consistent with CMIP6**

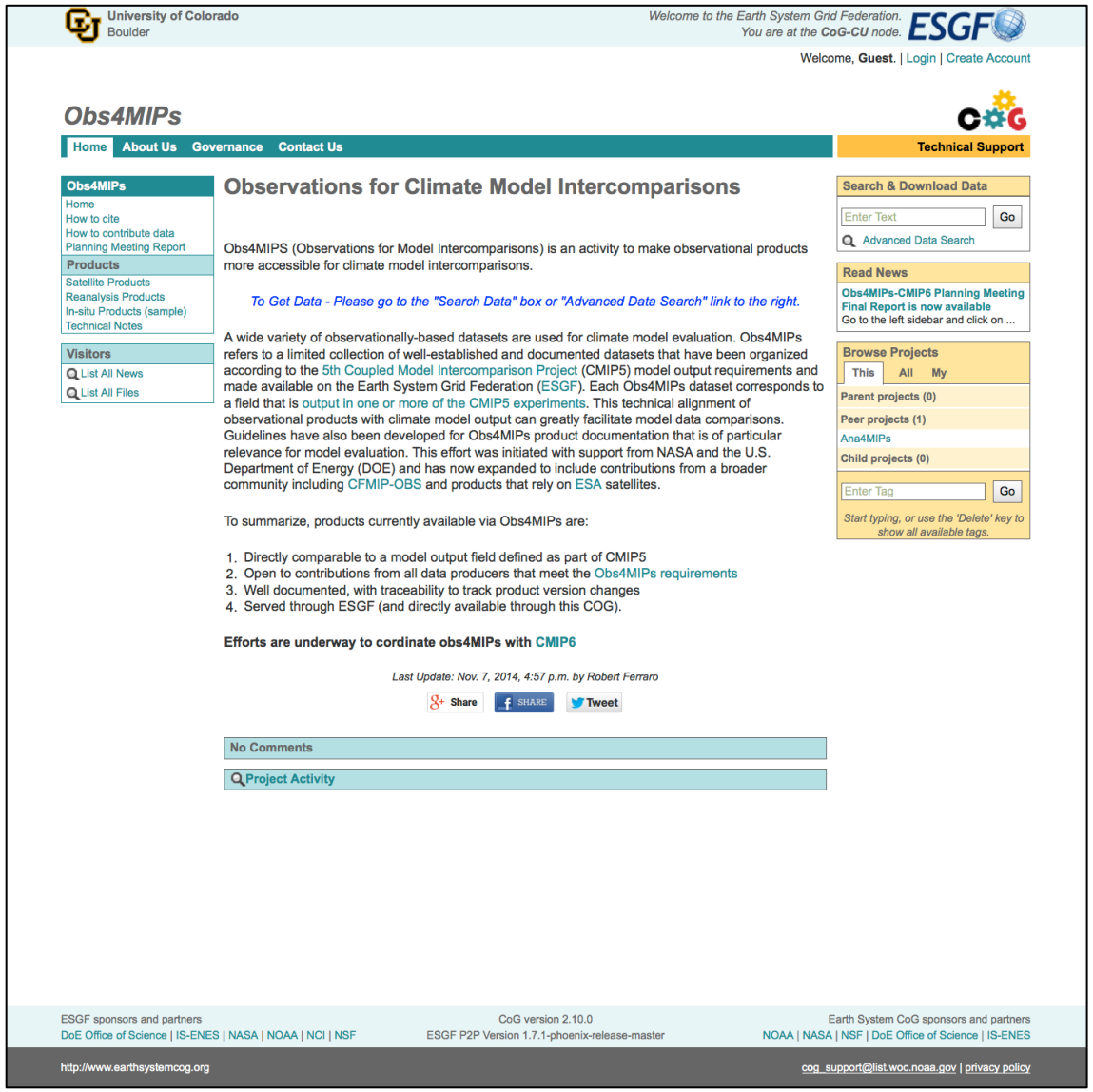
Review: Data accessibility for WCRP projects

Earth System Grid Federation (**ESGF**) will be used for CMIP6 and other WCRP projects





Data access and project connectedness



- Obs4MIPs data (and ana4MIPs) are available through the CoG
- CoG is directly connected to ESGF
- CMIP6 is will be hosted on the CoG, as are many other projects

obs4MIPs planning meeting for CMIP6

April 2014, NASA HQ but still relevant!

Selected consensus recommendations that applied to all of the meeting topic areas:

- Expand the inventory of included datasets
- Include more higher frequency data and model output (a “golden period”?)
- Reliable and defendable error characterization/estimation of observations is a high priority, and obs4MIPs should press harder for this
- Include datasets in support of off-line simulators (prime example: COSP—Cloud Feedback Model Intercomparison Project [CFMIP] Observation Simulator Package)
- Collocated observations, including sparser in-situ datasets, are particularly valuable for diagnosing certain processes and their inclusion in obs4MIPs should therefore be encouraged
- Precise definitions of data products (what’s actually being reported), including biases, and precise definitions of the model output variables are required

Ferraro et al. (2015) BAMS and full meeting report on CoG website

Obs4MIPs: Status of Observation Holdings/Submissions

April 2016

Air Temperature
Specific Humidity
Air Temperature
Specific Humidity
Sea Surface Temperature
TOA Outgoing Longwave Radiation
TOA Outgoing Clear-Sky Longwave Radiation
TOA Outgoing Shortwave Radiation
TOA Outgoing Clear-Sky Shortwave Radiation
TOA Incident Shortwave Radiation
Surface Downwelling Longwave Radiation
Surface Downwelling Clear-Sky Longwave Radiation
Surface Upwelling Longwave Radiation
Surface Downwelling Shortwave Radiation
Surface Downwelling Clear-Sky Shortwave Radiation
Surface Upwelling Shortwave Radiation
Surface Upwelling Clear-Sky Shortwave Radiation
Total Cloud Fraction
Sea Surface Height Above Geoid
Precipitation - monthly
Precipitation – 3 hourly
Precipitation - daily
Precipitation - monthly
Near-Surface Wind Speed
Eastward Near-Surface Wind
Northward Near-Surface Wind
Leaf Area Index
Mole Fraciont of Ozone
Ambient Aerosol Opitical Thickness at 550 nm
Ambient Aerosol Opitical Thickness at 550 nm
Water Vapor Path
ISCCP Cloud albedo
ISCCP Cloud albedo
CALIPSO Scattering Ratio, srbox1
CALIPSO Scattering Ratio, srbox2
CloudSat Radar Reflectivity CFAD
CALIPSO Cloud Fraction
CALIPSO Clear Cloud Fraction
CALIPSO High Level Cloud Fraction
ISCCP Cloud Fraction
CALIPSO Low Level Cloud Fraction
CALIPSO Mid Level Cloud Fraction
CALIPSO 3D Clear Fraction
CALIPSO Total Cloud Fraction
CLOUDSAT Total Cloud Fraction
ISCCP Total Cloud Fraction
ISCCP Cloud Top Temperature
ISCCP Cloud Top Temperature
Missing data fraction
Overpasses
PARASOL Reflectance
Solar Zenith Angle
ISCCP Cloud Top Pressure
ISCCP Cloud Top Pressure
MISR CTH-OD Cloud Fraction
CALIPSO 3D Undefined fraction

Water Vapor Path
Fraction of Absorbed Photosynthetically Active Radiation
Snow area fraction
Ambient Aerosol Extinction Optical Thickness at 550 nm
Sea Ice fraction
Sea Ice fraction
Sea Surface Temp
Sea Surface Temp
Sea Surface Temp
TOA Outgoing Longwave Radiation
TOA Outgoing Longwave Radiation
TOA Outgoing Shortwave Radiation
TOA Outgoing Longwave Radiation
Mole Fraction of Ozone
albedo; Ratio of two variables
Ice Sheet Temperature?
Ambient Aerosol Opitical Thickness at 550 nm
Surface Aqueous Partial Pressure of CO2
dry_atmosphere_mole_fraction_of_carbon_dioxide
Near-Surface Wind Speed

Complete (~125*)

In Progress* (~15)

Submissions From Data Call (~90)

* A few technotes remain to be completed

Near-Surface Air Temperature
Air Temperature
Geopotential Height
Eastward Near-Surface Wind
Northward Near-Surface Wind
Near-Surface Wind Speed
Near-Surface Specific Humidity
Surface Downward Latent Heat Flux
Surface Downward Sensible Heat Flux
Near-Surface Air Temperature
Precipitation
Sea level pressure
Sea Surface Temp
Total Chlorophyll Mass Concentration
Infrared brightness temperatures (11 µm, 0.6 µm, 6.7 µm)
Leaf Area Index
normalized difference vegetation index
Fraction of Photosynthetically Active Radiation
Sea Surface Temperature
precipitation
air temperature
Burnt Area Fraction
Surface Snow Amount
Mid Tropospheric Humidity
Upper Tropospheric Humidity
Air Temperature
geopotential height
bending angle
refractivity
CLARA cloud_area_fraction; CFMIP 45
surface albedo
cloud_area_fraction
cloud top phase; area_fraction_of_liquid_cloud_water_particles_at_cloud_top
cloud top pressure; air_pressure_at_cloud_top
cloud optical thickness; atmosphere_optical_thickness_due_to_cloud
cloud ice water path; atmosphere_cloud_ice_content
surface_downwelling_shortwave_flux_in_air
surface downwelling clear sky shortwave flux
surface_downwelling_shortwave_flux_in_air
cloud ice water path; atmosphere_cloud_ice_content
cloud liquid water path
cci cloud area fraction (7x7 table); CFMIP 45 (tbd)
cloud area fraction
cloud top phase; area_fraction_of_liquid_cloud_water_particles_at_cloud_top
cloud top pressure; air_pressure_at_cloud_top
cloud optical thickness; atmosphere_optical_thickness_due_to_cloud
Sea Ice Area Fraction
Surface Temperature
Sea Ice Area Fraction
surface (2m) air temperature anomaly
Near-Surface Specific Humidity
Near-Surface Relative Humidity,
Near-Surface Air Temperature

Eumetsat Proposed/Contributed Datasets

ta	Air Temperature	GNSS-RO (i.e. GPS soundings)	Hans Gleisner, EUMETSAT ROM SAF / DMI hgl@dmi.dk
zg	geopotential height	GNSS-RO (i.e. GPS soundings)	Hans Gleisner, EUMETSAT ROM SAF / DMI hgl@dmi.dk
?	bending angle	GNSS-RO (i.e. GPS soundings)	Hans Gleisner, EUMETSAT ROM SAF / DMI hgl@dmi.dk
?	refractivity	GNSS-RO (i.e. GPS soundings)	Hans Gleisner, EUMETSAT ROM SAF / DMI hgl@dmi.dk
needs new variable clclara	CLARA cloud_area_fraction; CFMIP 45 (ISCCP histogram)	AVHRR; EUMETSAT CM SAF Project team; CLARA products	EUMETSAT CM SAF Project team. Scientific Coordinator: Rainer Hollmann, DWD rainer.hollmann@dwd.de
needs new variable bluesky albedo	surface albedo	AVHRR; EUMETSAT CM SAF Project team; CLARA products	EUMETSAT CM SAF Project team. Scientific Coordinator: Rainer Hollmann, DWD rainer.hollmann@dwd.de
needs new variable cltclara	cloud_area_fraction	AVHRR; EUMETSAT CM SAF Project team; CLARA products	EUMETSAT CM SAF Project team. Scientific Coordinator: Rainer Hollmann, DWD rainer.hollmann@dwd.de
needs new variable phaclara	cloud top phase; area_fraction_of_liquid_cloud_water_particles_at_cloud_top	AVHRR; EUMETSAT CM SAF Project team; CLARA products	EUMETSAT CM SAF Project team. Scientific Coordinator: Rainer Hollmann, DWD rainer.hollmann@dwd.de
needs new variable pctclara	cloud top pressure; air_pressure_at_cloud_top	AVHRR; EUMETSAT CM SAF Project team; CLARA products	EUMETSAT CM SAF Project team. Scientific Coordinator: Rainer Hollmann, DWD rainer.hollmann@dwd.de
clivi	cloud ice water path; atmosphere_cloud_ice_content	AVHRR; EUMETSAT CM SAF Project team; CLARA products	EUMETSAT CM SAF Project team. Scientific Coordinator: Rainer Hollmann, DWD rainer.hollmann@dwd.de
clwvi	cloud liquid water path+cloud ice water path	AVHRR; EUMETSAT CM SAF - CLARA products	EUMETSAT CM SAF Project team. Scientific Coordinator: Rainer Hollmann, DWD rainer.hollmann@dwd.de
rsdssi	surface_downwelling_shortwave_flux_in_air	AVHRR; EUMETSAT CM SAF - CLARA products	EUMETSAT CM SAF Project team. Scientific Coordinator: Rainer Hollmann, DWD rainer.hollmann@dwd.de
rsdscs	surface downwelling clear sky shortwave flux	AVHRR; EUMETSAT CM SAF - CLARA products	EUMETSAT CM SAF Project team. Scientific Coordinator: Rainer Hollmann, DWD rainer.hollmann@dwd.de
rsdssi	surface_downwelling_shortwave_flux_in_air	Meteosat; EUMETSAT CM SAF - SARAH products	EUMETSAT CM SAF Project team - SARAH. Scientific Coordinator: Rainer Hollmann, DWD rainer.hollmann@dwd.de

Eumetsat Proposed/Contributed Datasets

needs new variable phacci	cloud top phase; area_fraction_of_liquid_cloud_water_particles_at_cloud_top	ESA Cloud_cci (AVHRR, MODIS, ATSR-2, AATSR) (single instrument or combined)	EUMETSAT CM SAF Project team. Scientific Coordinator: Rainer Hollmann, DWD rainer.hollmann@dwd.de
needs new variable pctcci	cloud top pressure; air_pressure_at_cloud_top	ESA Cloud_cci (AVHRR, MODIS, ATSR-2, AATSR) (single instrument or combined)	EUMETSAT CM SAF Project team. Scientific Coordinator: Rainer Hollmann, DWD rainer.hollmann@dwd.de
sic	Sea Ice Area Fraction	?	Thomas Lavergne, Norwegian Meteorological Institute, e-mail: t.lavergne@met.no
pme	Freshwater Flux	EUMETSAT CM SAF - computed E-P	EUMETSAT CM SAF Project team. Principal Investigator: Rainer Hollmann, DWD rainer.hollmann@dwd.de; DWD: Marc. Schröder marc.schroeder@dwd.de; Kathrin Graw, Kathrin.graw@dwd.de
sfcWind	Near-Surface Wind Speed	EUMETSAT CM SAF - satellite = SSM/I, SSMIS	EUMETSAT CM SAF Project team. Principal Investigator: Rainer Hollmann, DWD rainer.hollmann@dwd.de; DWD: Marc. Schröder marc.schroeder@dwd.de; Kathrin Graw, Kathrin.graw@dwd.de
pr	Precipitation	EUMETSAT CM SAF -satellite = SSM/I, SSMIS	EUMETSAT CM SAF Project team. Principal Investigator: Rainer Hollmann, DWD rainer.hollmann@dwd.de; DWD: Marc. Schröder marc.schroeder@dwd.de; Kathrin Graw, Kathrin.graw@dwd.de
huss	Near-Surface Specific_Humidity	EUMETSAT CM SAF - satellite = SSM/I, SSMIS	EUMETSAT CM SAF Project team. Principal Investigator: Rainer Hollmann, DWD rainer.hollmann@dwd.de; DWD: Marc. Schröder marc.schroeder@dwd.de; Kathrin Graw, Kathrin.graw@dwd.de
hfls	surface upward latent heat flux	EUMETSAT CM SAF - computed using bulk approach using SST(AVHRR), wind and humidty from SSM/I, SSMIS	EUMETSAT CM SAF Project team. Principal Investigator: Rainer Hollmann, DWD rainer.hollmann@dwd.de; DWD: Marc. Schröder marc.schroeder@dwd.de; Kathrin Graw, Kathrin.graw@dwd.de
evspsbl	Evaporation	EUMETSAT CM SAF - computed from latent heat flux	EUMETSAT CM SAF Project team. Principal Investigator: Rainer Hollmann, DWD rainer.hollmann@dwd.de; DWD: Marc. Schröder marc.schroeder@dwd.de; Kathrin Graw, Kathrin.graw@dwd.de
hfss	surface upward sensible heat flux	EUMETSAT CM SAF - computed using bulk approach using SST(AVHRR), wind from SSM/I, near surface temperature=computed from SST	EUMETSAT CM SAF Project team. Principal Investigator: Rainer Hollmann, DWD rainer.hollmann@dwd.de; DWD: Marc. Schröder marc.schroeder@dwd.de; Kathrin Graw, Kathrin.graw@dwd.de
prw	Water Vapor Path	EUMETSAT CM SAF - satellite = SSM/I, SSMIS	EUMETSAT CM SAF Project team. Principal Investigator: Rainer Hollmann, DWD rainer.hollmann@dwd.de; DWD: Marc. Schröder marc.schroeder@dwd.de; Kathrin Graw, Kathrin.graw@dwd.de

Task Team Efforts/Organization

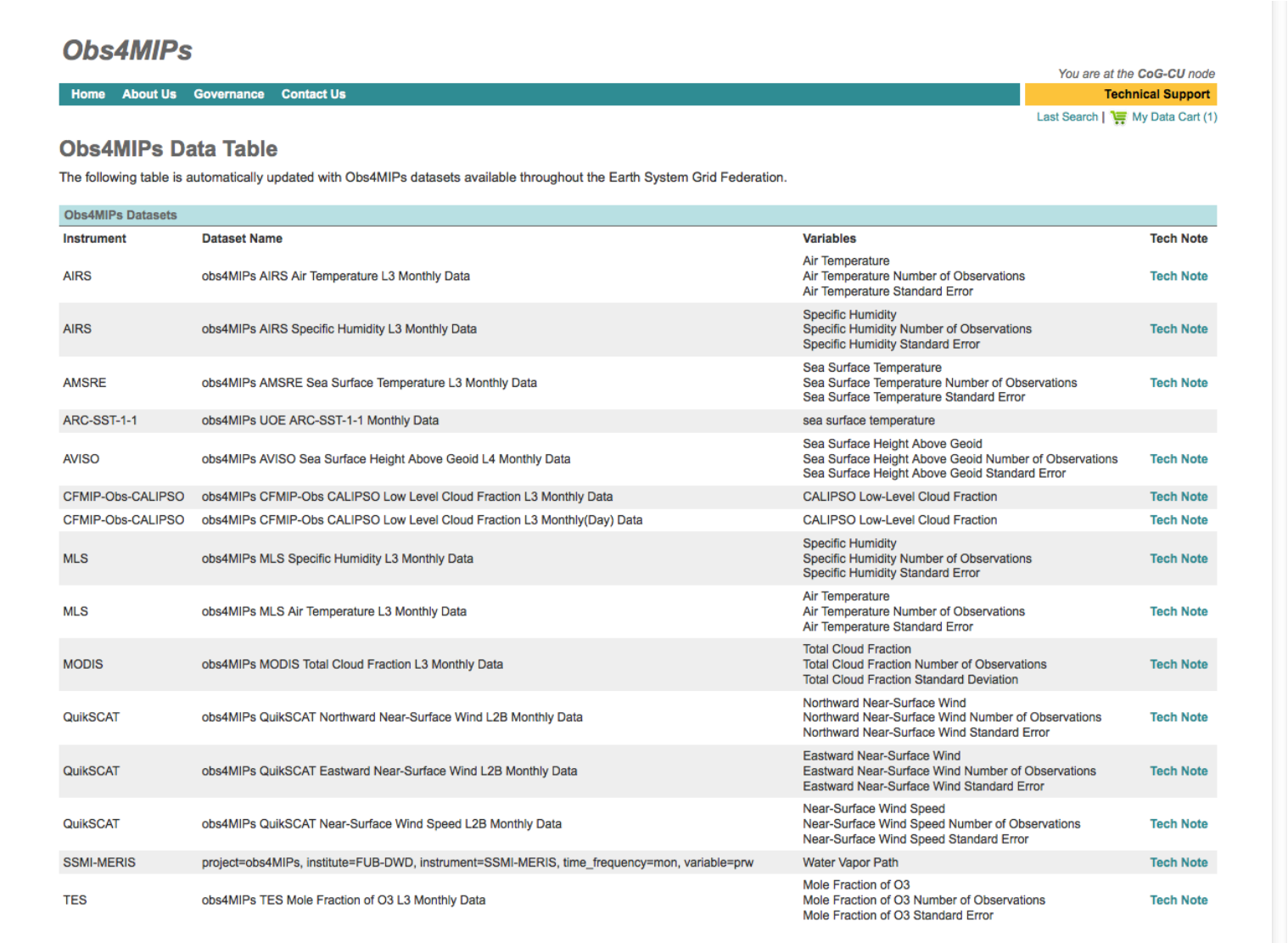
- Regular TT telecons (~monthly)
- All project management data accessible to TT via Google Docs
- Much of the TT effort has been helping to better define strategic path, but increasingly…
- Moving toward helping to shepherd datasets from proposal to publication on ESGF

Status report on data conventions:

- CMIP6 data structures and metadata conventions expected in early December
- Climate Model Output Rewriter (CMOR) is used by modeling groups to ensure their data is aligned with the CMIP
- CMOR3 is ready via a python interface, and now can accommodate gridded observations

- This development will greatly facilitate moving forward with the ~90 recently proposed/selected datasets.

Monitoring datasets across the distributed federation:
A new capability scans all ESGF nodes and generates a catalog of available datasets



Obs4MIPs

You are at the CoG-CU node

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Obs4MIPs Data Table

The following table is automatically updated with Obs4MIPs datasets available throughout the Earth System Grid Federation.

Obs4MIPs Datasets

Instrument	Dataset Name	Variables	Tech Note
AIRS	obs4MIPs AIRS Air Temperature L3 Monthly Data	Air Temperature Air Temperature Number of Observations Air Temperature Standard Error	Tech Note
AIRS	obs4MIPs AIRS Specific Humidity L3 Monthly Data	Specific Humidity Specific Humidity Number of Observations Specific Humidity Standard Error	Tech Note
AMSRE	obs4MIPs AMSRE Sea Surface Temperature L3 Monthly Data	Sea Surface Temperature Sea Surface Temperature Number of Observations Sea Surface Temperature Standard Error	Tech Note
ARC-SST-1-1	obs4MIPs UOE ARC-SST-1-1 Monthly Data	sea surface temperature	
AVISO	obs4MIPs AVISO Sea Surface Height Above Geoid L4 Monthly Data	Sea Surface Height Above Geoid Sea Surface Height Above Geoid Number of Observations Sea Surface Height Above Geoid Standard Error	Tech Note
CFMIP-Obs-CALIPSO	obs4MIPs CFMIP-Obs CALIPSO Low Level Cloud Fraction L3 Monthly Data	CALIPSO Low-Level Cloud Fraction	Tech Note
CFMIP-Obs-CALIPSO	obs4MIPs CFMIP-Obs CALIPSO Low Level Cloud Fraction L3 Monthly(Day) Data	CALIPSO Low-Level Cloud Fraction	Tech Note
MLS	obs4MIPs MLS Specific Humidity L3 Monthly Data	Specific Humidity Specific Humidity Number of Observations Specific Humidity Standard Error	Tech Note
MLS	obs4MIPs MLS Air Temperature L3 Monthly Data	Air Temperature Air Temperature Number of Observations Air Temperature Standard Error	Tech Note
MODIS	obs4MIPs MODIS Total Cloud Fraction L3 Monthly Data	Total Cloud Fraction Total Cloud Fraction Number of Observations Total Cloud Fraction Standard Deviation	Tech Note
QuikSCAT	obs4MIPs QuikSCAT Northward Near-Surface Wind L2B Monthly Data	Northward Near-Surface Wind Northward Near-Surface Wind Number of Observations Northward Near-Surface Wind Standard Error	Tech Note
QuikSCAT	obs4MIPs QuikSCAT Eastward Near-Surface Wind L2B Monthly Data	Eastward Near-Surface Wind Eastward Near-Surface Wind Number of Observations Eastward Near-Surface Wind Standard Error	Tech Note
QuikSCAT	obs4MIPs QuikSCAT Near-Surface Wind Speed L2B Monthly Data	Near-Surface Wind Speed Near-Surface Wind Speed Number of Observations Near-Surface Wind Speed Standard Error	Tech Note
SSMI-MERIS	project=obs4MIPs, institute=FUB-DWD, instrument=SSMI-MERIS, time_frequency=mon, variable=prw	Water Vapor Path	Tech Note
TES	obs4MIPs TES Mole Fraction of O3 L3 Monthly Data	Mole Fraction of O3 Mole Fraction of O3 Number of Observations Mole Fraction of O3 Standard Error	Tech Note

~125 DataSets

Priorities for the next year

- Broadening the scope available data, possibly moving beyond gridded data to include in-situ

- Making the process much more efficient, including
  - Data preparation
  - “publication” of data to ESGF
  - Online proposal form – replacing previous PDF fill in form.

- Two examples (next slides) of enhancing capabilities - to be discussed at the ESGF workshop next month

Technical Requirements			
Meets obs4MIPs data technical requirements	Data suitably processed with CMOR and/or consistent with obs4MIPs standards	Largely complete with minor metadata inconsistencies	Non-compliant. Should be removed from database!
Includes obs4MIPs technical note information	Complete technical note information provided	Technical note information incomplete and/or could be improved	Technical note not provided
Dataset Suitability and Maturity			
Closeness or robustness of measurement to observed reference quantity	Firmly established and/or validated methodology	Indirect means of calculation or observations only providing partial constraint (e.g. ocean surface latent heat flux)	Largely model-derived quantity (e.g. LAI, root zone soil moisture, NPP)
Maturity with respect to climate model evaluation	Multiple peer-reviewed examples of application to CMIP climate model evaluation	One peer-reviewed example of application to CMIP climate and/or examples of other sorts of model evaluation.	As of DATE-TBS, no significant application to climate model evlauation
Provision for robust uncertainty information	Uncertainty information provided per retrieval/grid point	General uncertainty information given relative to the methodology and dataset as a whole - backed by actual field/in-situ validation exercises	No uncertainty information provided
Comparison Complexity			
Complexity of Model Observation Comparison	Comparison can be made directly with CMIP model output variable	Comparison requires some simple post processing of CMIP output variable(s) (e.g. vertical integral or ratio of two variables)	Comparison requires complex processing of CMIP output (e.g. “simulator”, budget calculation)

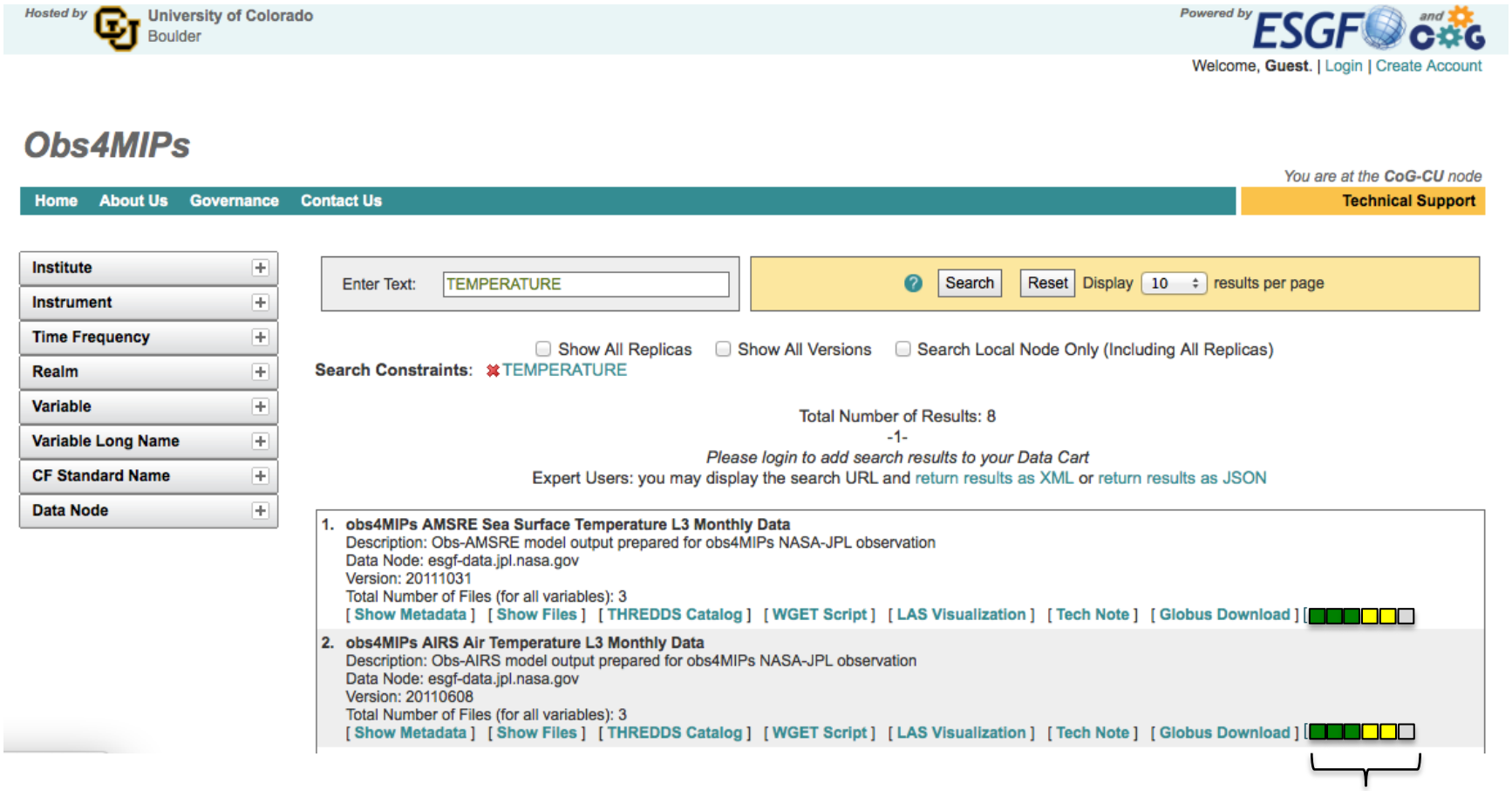
obs4MIPs

Dataset Suitability
&
Maturity Indicators
(DRAFT)

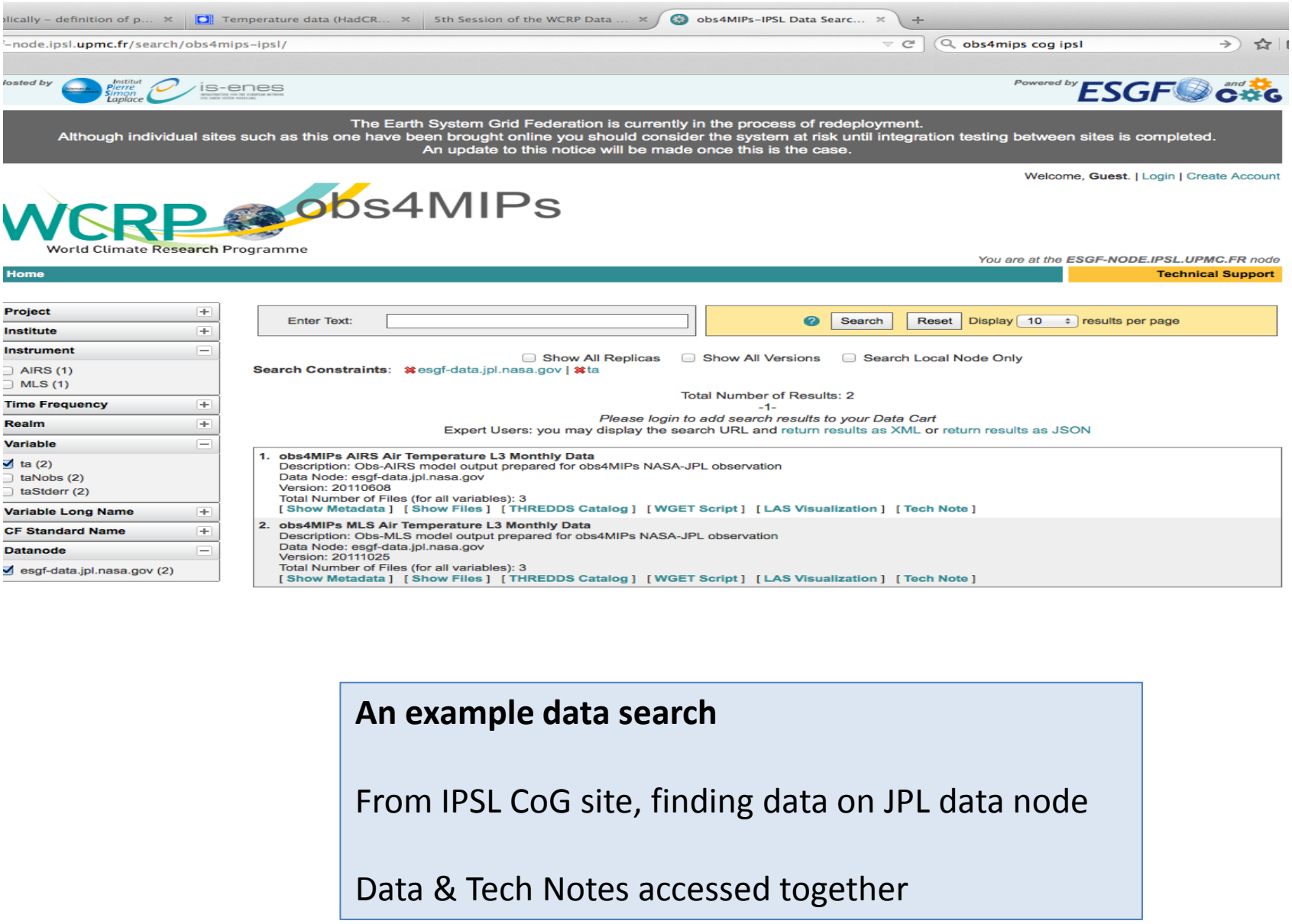
Currently under discussion by TT

Illustration Of Dataset Suitability And Maturity Indicators

Based on typical obs4MIPs dataset search



Entire symbol set linked as a single entity to explanatory page mentioned on previous page.



An example data search

From IPSL CoG site, finding data on JPL data node

Data & Tech Notes accessed together

Beyond access to the “best estimate”

Currently under discussion by WDAC task team

A possible path forward to deal with several unresolved issues within obs4MIPs, e.g.:

- Uncertainty data
- Data flags
- Land-sea masks
- Supporting validation data
- Pointers to data project site

Organization of ancillary data likely more heterogeneous than “best estimate” and therefore not as searchable from a higher level

Summary

- Increasingly, obs4MIPs is serving as a direct connection between data providers and a very large and diverse model evaluation community
- The project has been in a holding pattern for the last year as the CMIP data conventions are updated - this is almost complete
- With a dramatic increase in the number of model simulations to analyze, there is a need for the research community to become more systematic about model evaluation – we hope that obs4MIPs can facilitate this.
- WCRP supportive and interested in the path obs4MIPs is developing that could be utilized for observations more broadly (i.e. apart from those most well suited for model evaluation).