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# Global Observations for Climate Model Evaluation

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## Outline:

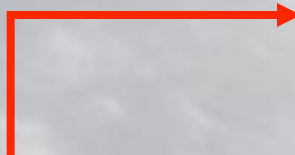
- Observations for CMIP
- Satellite Simulators
- Conditional sampling methods



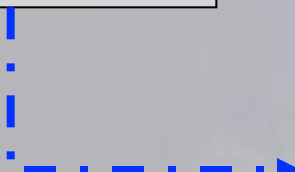
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# New initiative to include observations in CMIP process

Traditional model comparison path



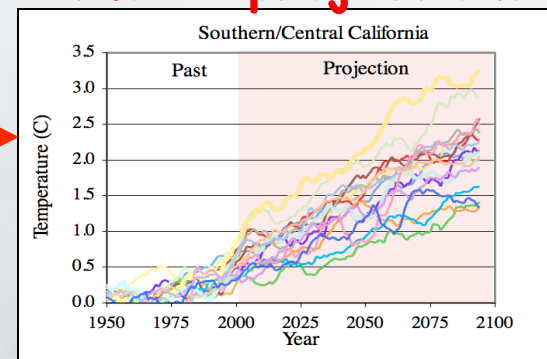
International working groups (e.g. WGCM)



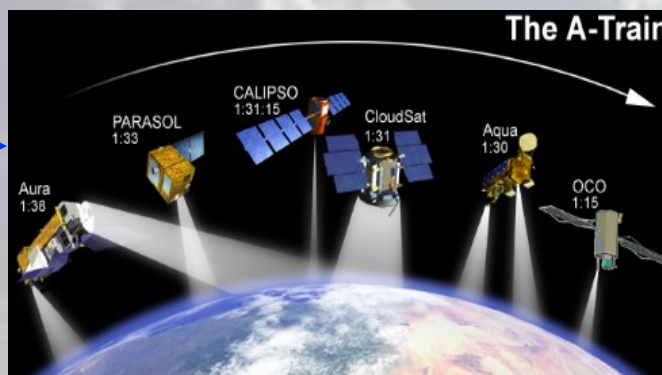
New path to insert observations



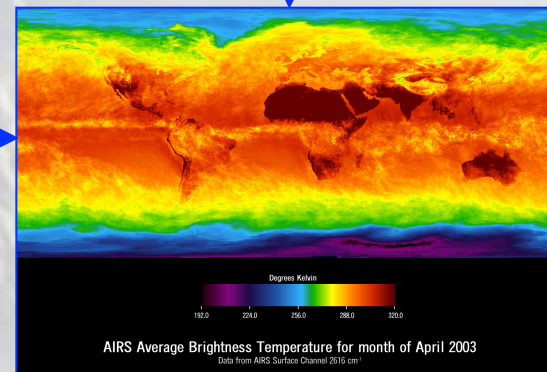
Climate models



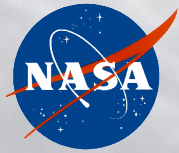
Model projections



Climate satellites



Satellite observations



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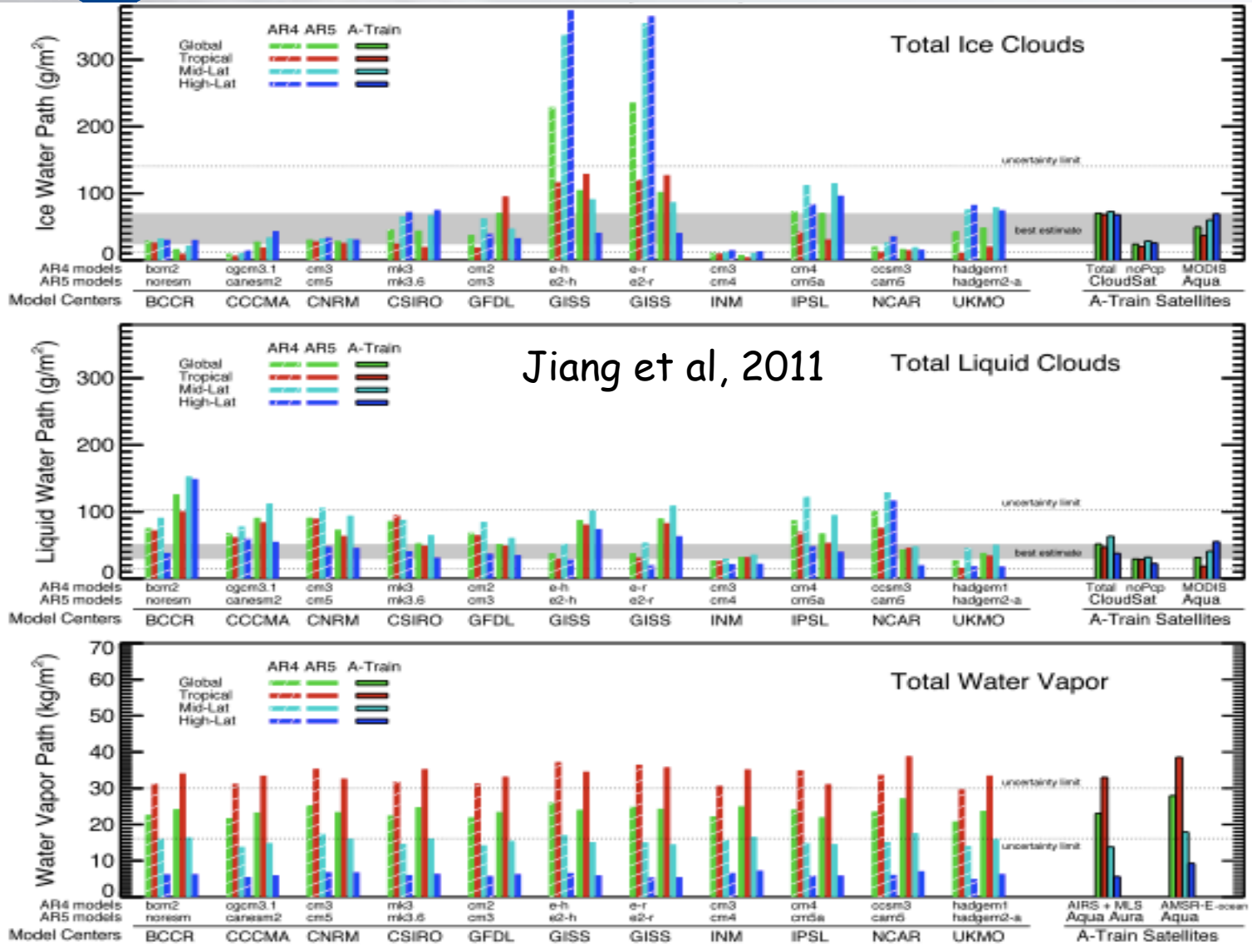
# Observations for CMIP5 Simulations

- ❑ **Objective:** to provide climate community observational data analogous to CMIP5 model data - same periods, variables, output frequency, formats
- ❑ **Key:** CMIP5 protocol document (Taylor et al., 2008) is followed strictly
- ❑ Carried out in close coordination with PCMDI/DOE and ESG
- ❑ Directly engages NASA mission and instrument science teams
- ❑ Variety of NASA observations are now available at CMIP5 websites



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# CMIP3 versus CMIP5: Models and Observations



Significant uncertainty in cloud water ...

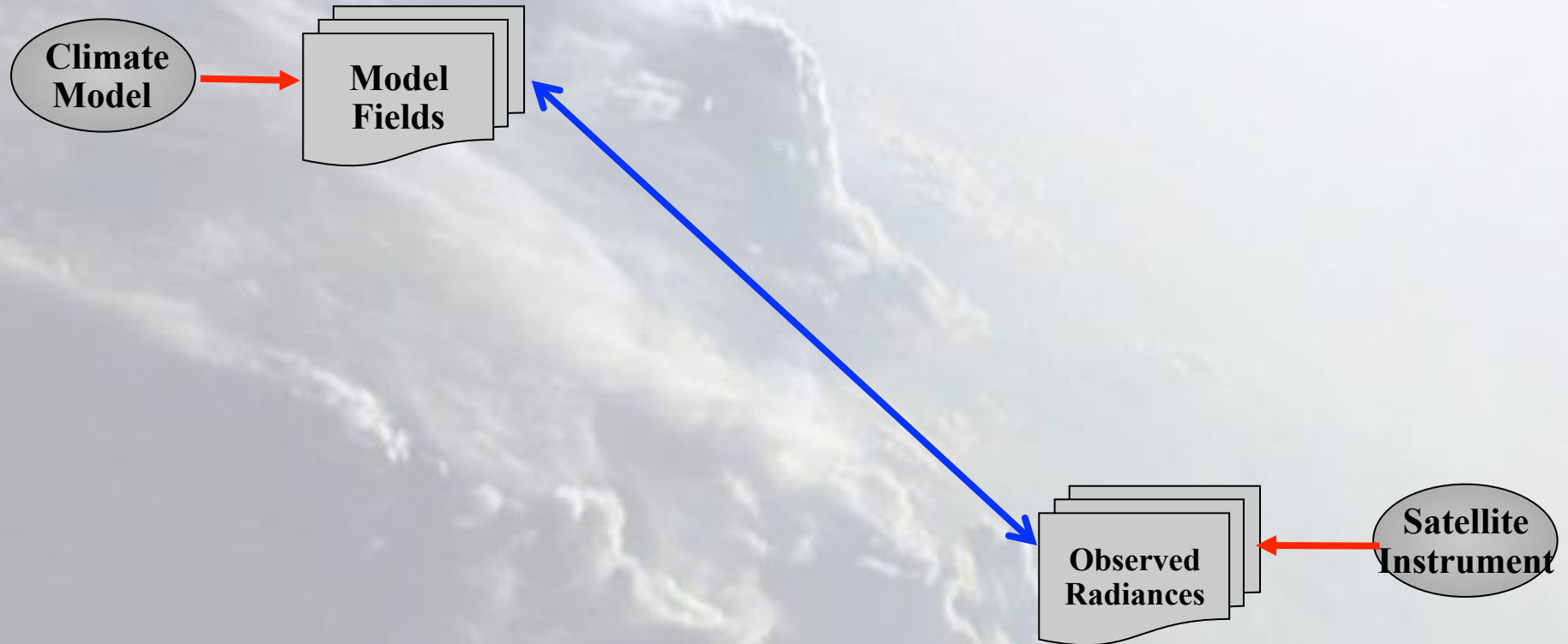
Jiang et al, 2011

But large uncertainty in water vapor



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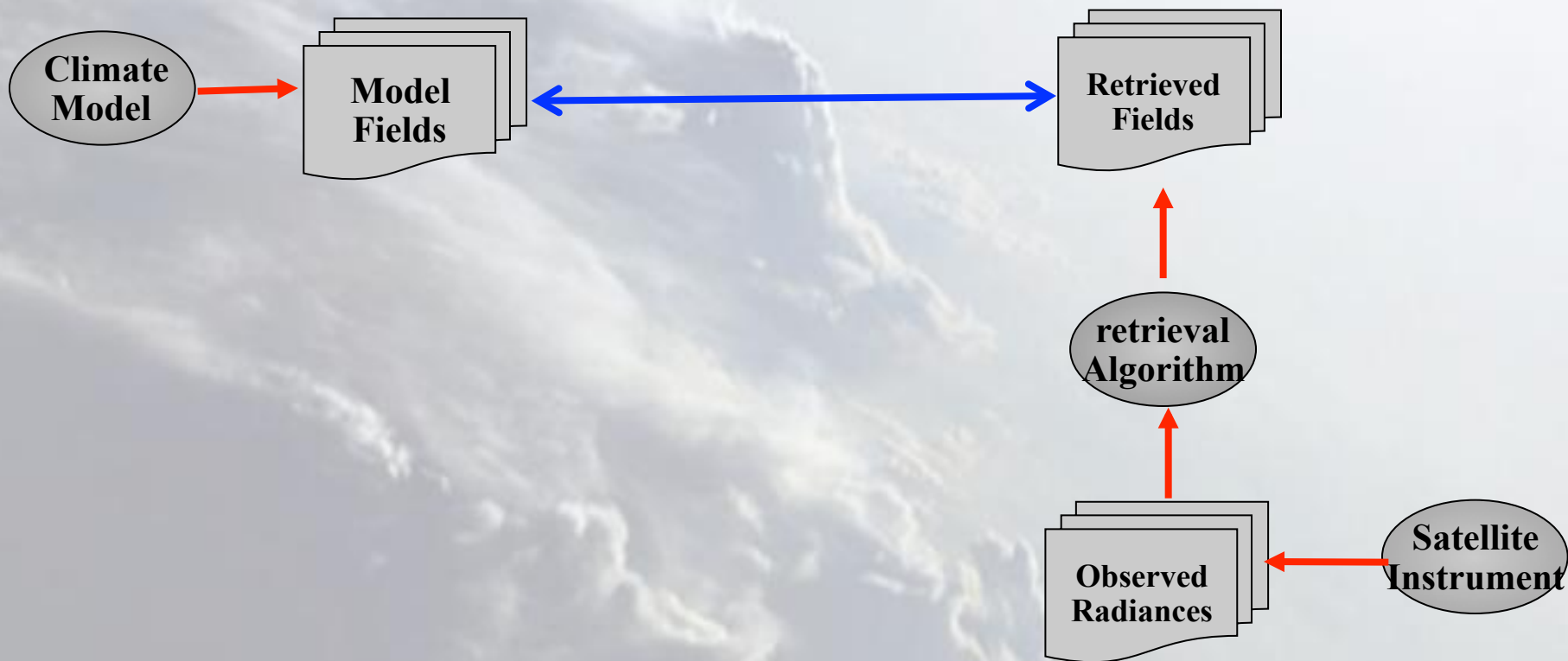
# Climate Models versus Satellite Observations: Stage 1





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# Climate Models versus Satellite Observations: Stage 2

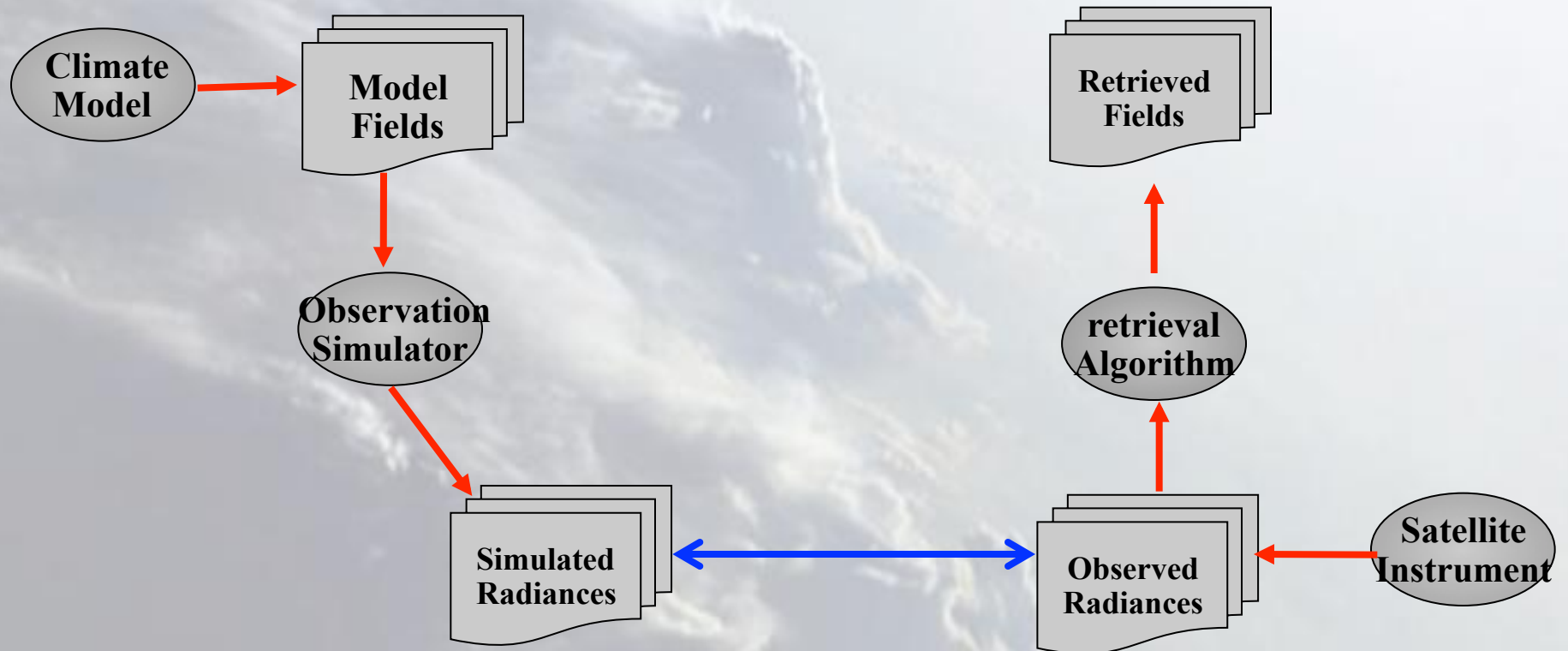




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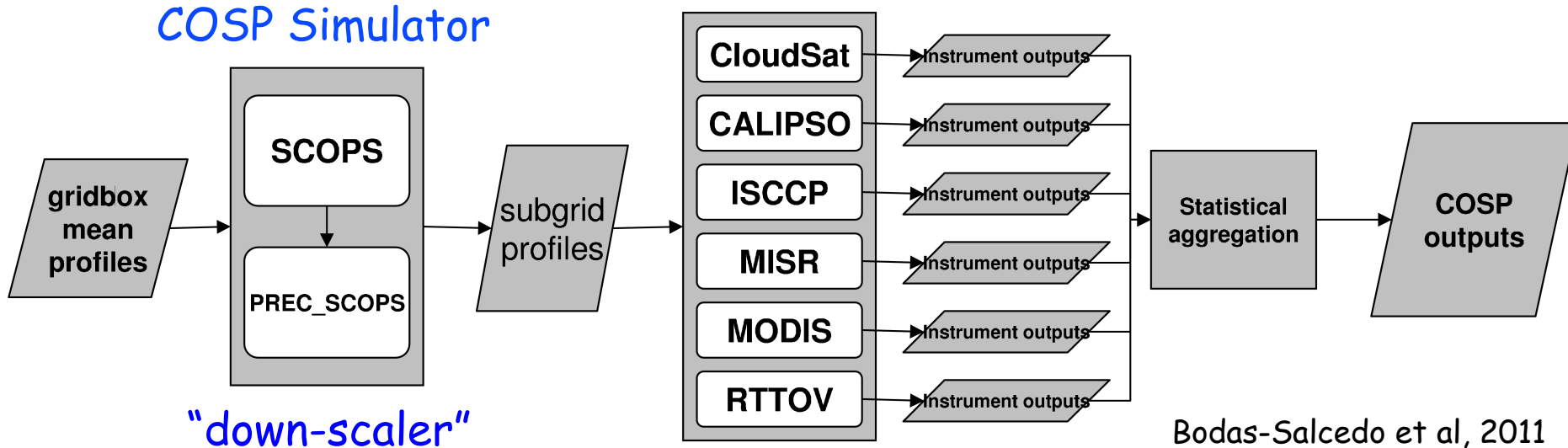
# Climate Models versus Satellite Observations: Stage 3





# Satellite Observation Simulators

## COSP Simulator



## Forward operators

reconciling observation and model scales is still an open issue (i.e. model subgrid scales)

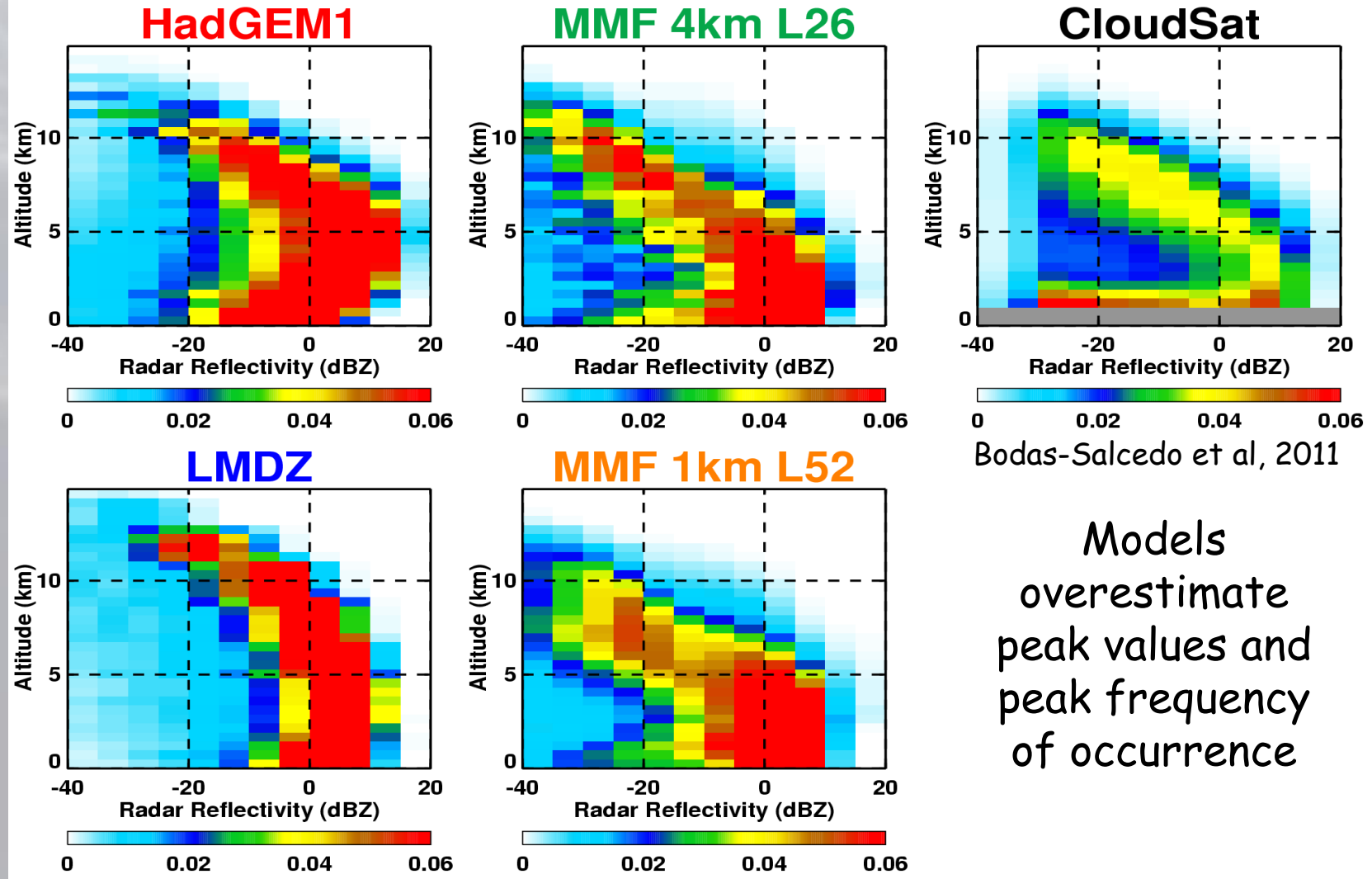
Interpreting results in observation-space is not always straightforward





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# Satellite Simulators: Models versus CloudSat



Models  
overestimate  
peak values and  
peak frequency  
of occurrence

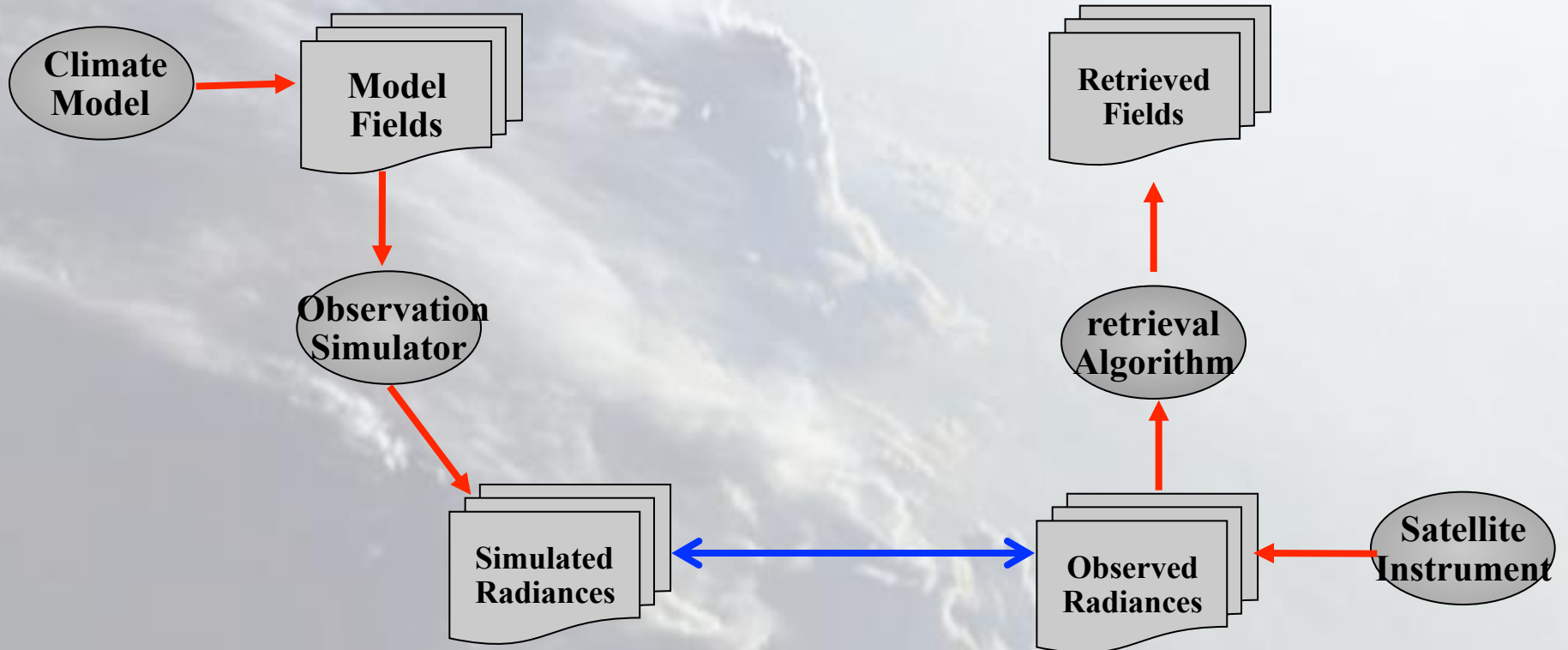
Additional key information but ... interpretation is not necessarily easy



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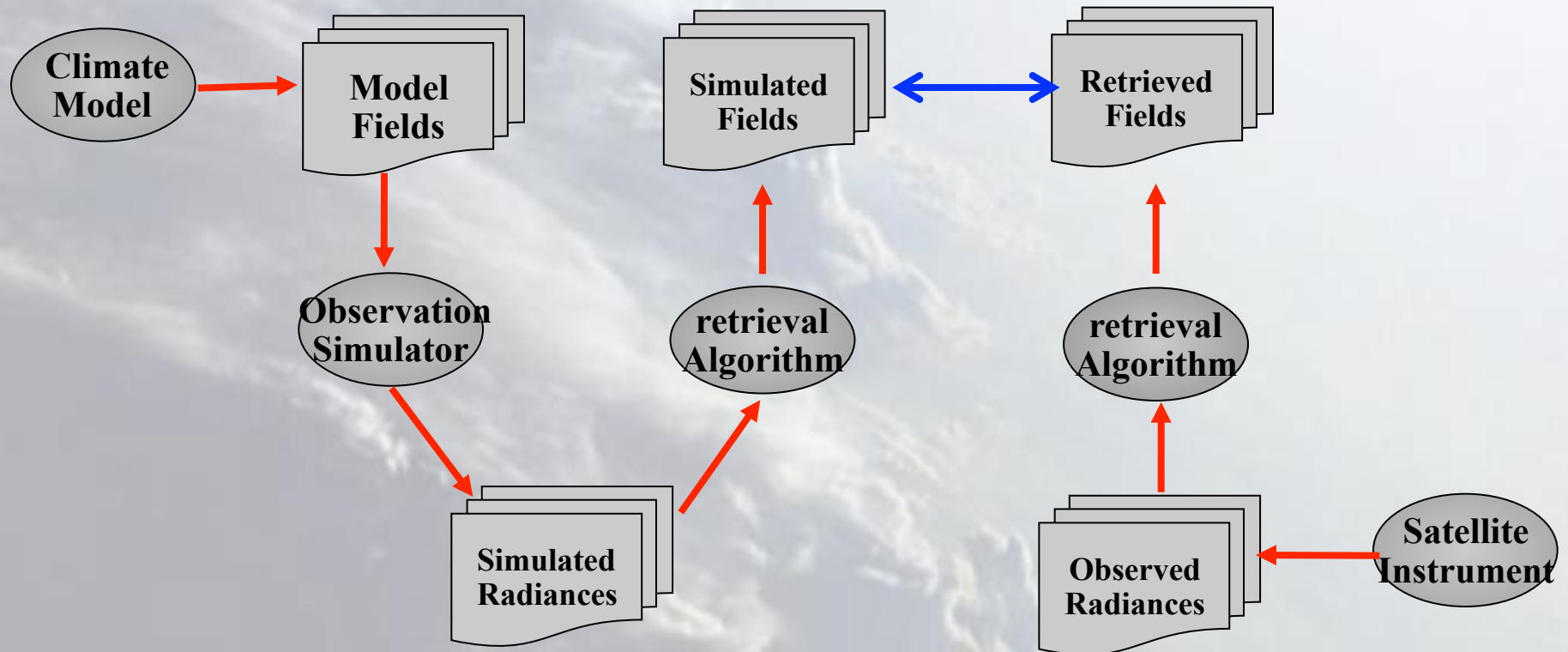
# Climate Models versus Satellite Observations: Stage 3





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# Climate Models versus Satellite Observations: Stage 4



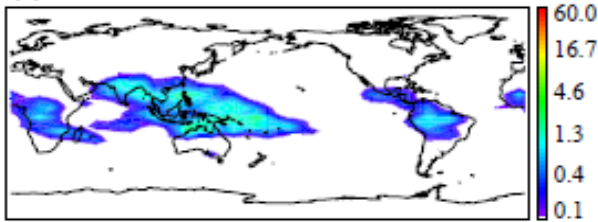
In stage 4: retrieval issues are taken into account and models/  
observations are compared in geophysical variables



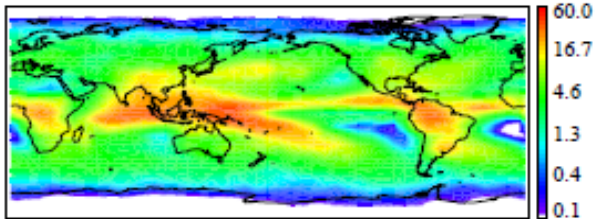
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# Conditional sampling of cloud observations by vertical velocity $w_{500}$

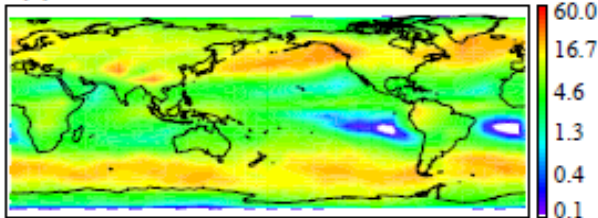
(a) CloudSat Mean CWC 16 km



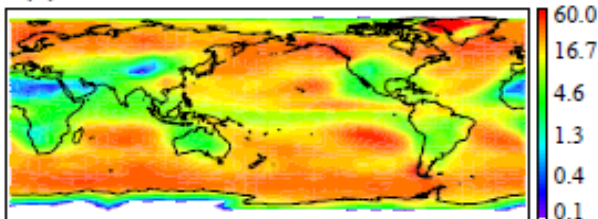
(b) CloudSat Mean CWC 9 km



(c) CloudSat Mean CWC 5 km



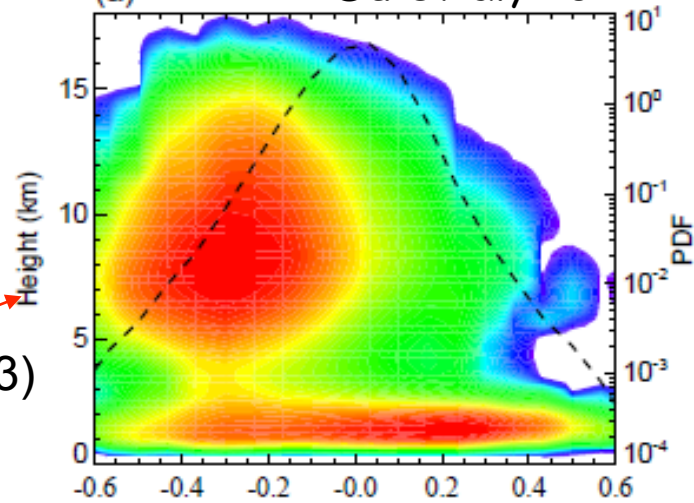
(d) CloudSat Mean CWC 2 km



CLOUD WATER CONTENT (mg/m<sup>3</sup>)

(2)

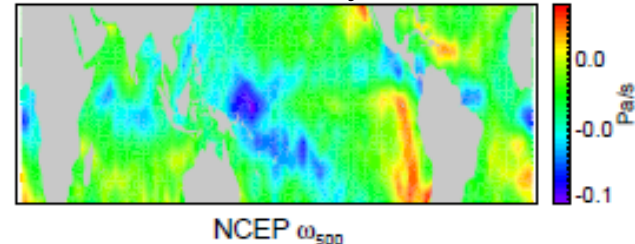
(a) Su et al, 2011



(3)

UP  
vertical velocity  
DOWN

(1)



- Step 1: select a vertical velocity value/class
- Step 2: sort clouds based on vert. velocity class
- Step 3: create cloud composite picture

Conditional sampling methods allow to compare: climate models, satellite observations, in-situ observations, LES/CRM models

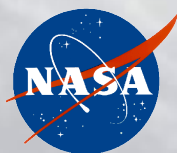


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# Summary

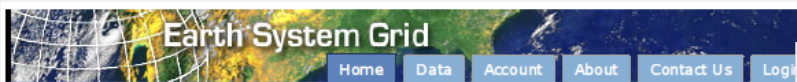
- How to provide observations to CMIP?  
Effort is underway to provide access to observations for CMIP5
- How to compare models and satellite observations?  
Satellite simulators and beyond ...
- How to compare climate models, satellite, in-situ observations and high-resolution models? Conditional sampling methodologies
- New observations and satellite missions - Model evaluation/development can play key role in designing future missions



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# Satellite Observations for CMIP5 Simulations

## ESG-JPL Gateway : Side by Side Archive




ESG Gateway hosted by the Program for Climate Model Diagnosis and Intercomparison

Search:  for:

To conduct a search, select a category from the pull down menu and/or enter free text into the text box.

- Search Categories**
- Project
    - > CMIP5
    - > TAMIP2
    - > gfdl\_test
    - > obs4MIPS
  - + Institute
  - + Model
  - + Experiment
  - + Frequency
  - + Product
  - + Realm
  - + Variable
  - + Ensemble

**Welcome to PCMDI**



The Program for Climate Model Diagnosis and Intercomparison (PCMDI) was established in 1989 at the Lawrence Livermore National Laboratory located in the San Francisco Bay Area. Our staff includes research scientists, computer scientists, and administrative personnel.

The PCMDI mission is to develop improved methods and tools for the diagnosis and intercomparison of general circulation models (GCMs) to simulate the global climate. The need for innovative analysis and diagnostic tools for climate simulations is apparent, as increasingly more complex models are developed, while the disagreements among these simulations are increasing. To improve our understanding of climate system processes, we must account for the uncertainties in the GCMs for simulation.

obs4MIPS Project

**Status of the CMIP5 Archive**

6/3/2011: CNRM-CERFACS decadal hindcast/forecast datasets available for all realms but sea-ice (10 members already available for all realms ocean, only 3 so far for realms land/atmos/landIce).

6/25/2011: PCMDI CMIP5 data server is back online. The INM datasets are available.

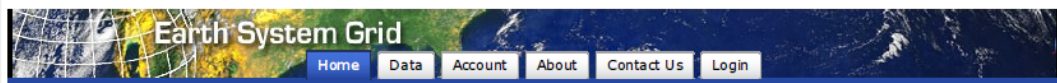
7/7/2011: NCC datasets are now available to all users.

7/19/2011: PCMDI data server will be down for maintenance on 7/19/2011. It is expected back online 7/20 17:00 PST.

7/20/2011: PCMDI data server is back online.

7/20/2011: Because of a processing fault affecting the MOHC reanalysis data from 2080 onwards, this data has been withdrawn. We expect to provide us with corrected data in a format at which time a new version of these datasets will be published.

9/7/2011 - 9/9/2011: The BADC ESGF system will be unavailable on September 7th and 8th. As a precaution you should consider "At Risk" on Friday September 9th.



ESG Gateway hosted at the NASA Jet Propulsion Laboratory

Search:  for:

To conduct a search, select a category from the pull down menu and/or enter free text into the text box.

Please note that the NASA datasets accessible through this gateway 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 models. Community feedback to improve and validate the dataset for modeling usage is appreciated.


- Search Categories**
- Project
    - > CMIP5
    - > obs4MIPS
  - Institute
  - + Model
  - + Experiment
  - + Frequency
  - + Product
  - + Realm
  - + Variable

**AIRS (Atmospheric Infrared Sounder)**



**AIRS Data Catalog at ESG**  
 Documentation: Air Temperature  
 Documentation: Specific Humidity  
 AIRS Home at NASA/JPL

**AMSR-E (Advanced Microwave Scanning Radiometer - EOS)**



**AMSR-E Data Catalog at ESG**  
 Documentation  
 AMSR-E Home at NSIDC

**AVISO**



**AVISO Data Catalog at ESG**  
 Documentation: Sea Surface Height (SSH)  
 AVISO Home

**MLS (Microwave Limb Sounder)**



**MLS Data Catalog at ESG**  
 Documentation: Specific Humidity  
 Documentation: Air Temperature  
 MLS Home at NASA/JPL

**MODIS (Moderate Resolution Imaging Spectroradiometer)**



**MODIS Data Catalog at ESG**  
 Documentation  
 MODIS Home

**TES (Tropospheric Emission Spectrometer)**



**TES Data Catalog at ESG**  
 Documentation: Ozone  
 TES Home at NASA/JPL

- Quick Links**
- Getting Started Guide
  - Create Account
  - Browse Catalogs
  - Search for Data

- ESG Federation**
- PCMDI Gateway
  - BADC Gateway
  - DKRZ Gateway
  - NASA JPL Gateway
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  - ORNL Gateway
  - NERSC Gateway



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# Observations for CMIP5: Initial Datasets

Match up of available  
NASA-related  
datasets to PCMDI  
priority list

THIS LIST IS NOT  
FINAL

Model	Dataset	Time Period
Atm Temperature (200,850hPa)	AIRS ( $\geq 300$ hPa) MLS ( $< 300$ hPa)	9/02 - 8/04 -
Zonal and meridional wind (200,850 hPa)	No obvious match	
Specific humidity (200, 850 hPa)	AIRS ( $\geq 300$ hPa) MLS ( $< 300$ hPa)	9/02 - 8/04 -
Sea level pressure	No obvious match	
Surface (10m) zonal and meridional wind	QuikSCAT CCMP	1999 - 2009 7/87 - 12/09
Ocean surface zonal and meridional wind stress	QuikSCAT CCMP	1999 - 2009 7/87 - 12/09
Sea surface temperature	AMSR-E	6/02 -
TOA reflected shortwave radiation and OLR	CERES	3/00 -
TOA longwave and shortwave TOA clear-sky fluxes	CERES	3/00 -
Total precipitation	TRMM GPCP	1997 - 2/79 - 4/08
Cloud cover	MODIS	2/00 -
Precipitable water	SSM/I	7/87 -
Sea surface height	TOPEX/JASON series	10/92 -
Sea ice	NSIDC	