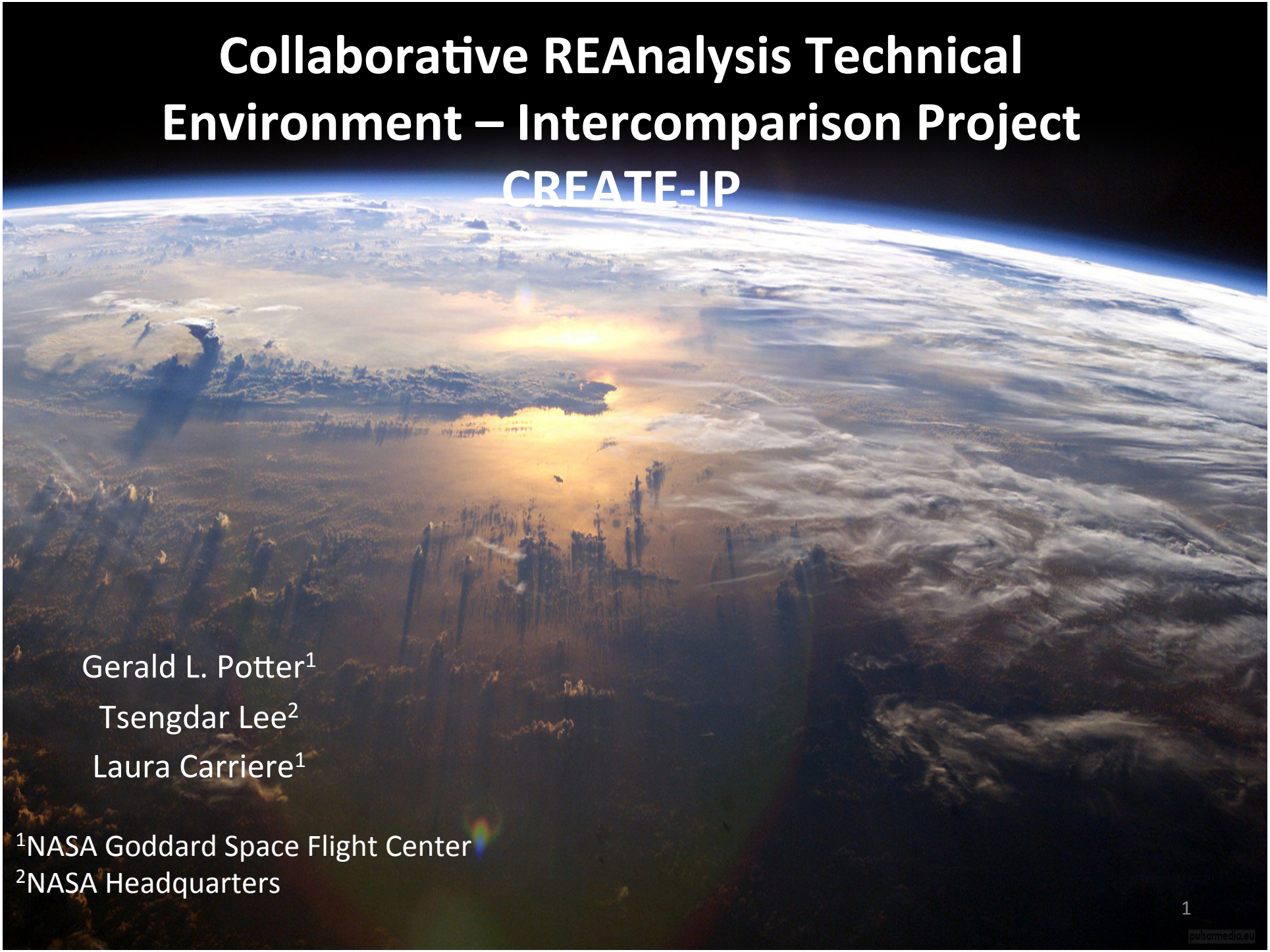
Collaborative REAnalysis Technical Environment – Intercomparison Project CREATE-IP



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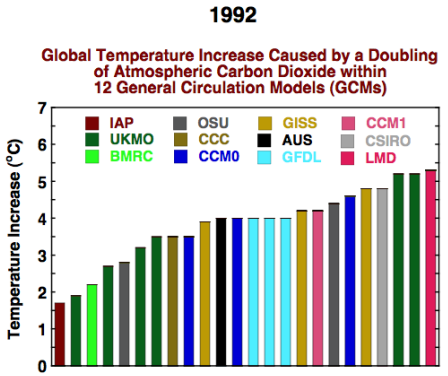
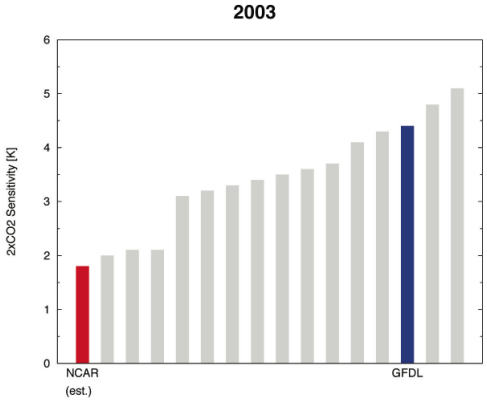
Why do climate model intercomparison?

- History – first to understand differences – process studies
  - Feedback and sensitivity
    - Early studies to understand why models had different sensitivity to increasing CO_2
    - Isolated effect of clouds – models still disagree (25 years later)
  - Why models behave the way they do (devise numerical experiments)

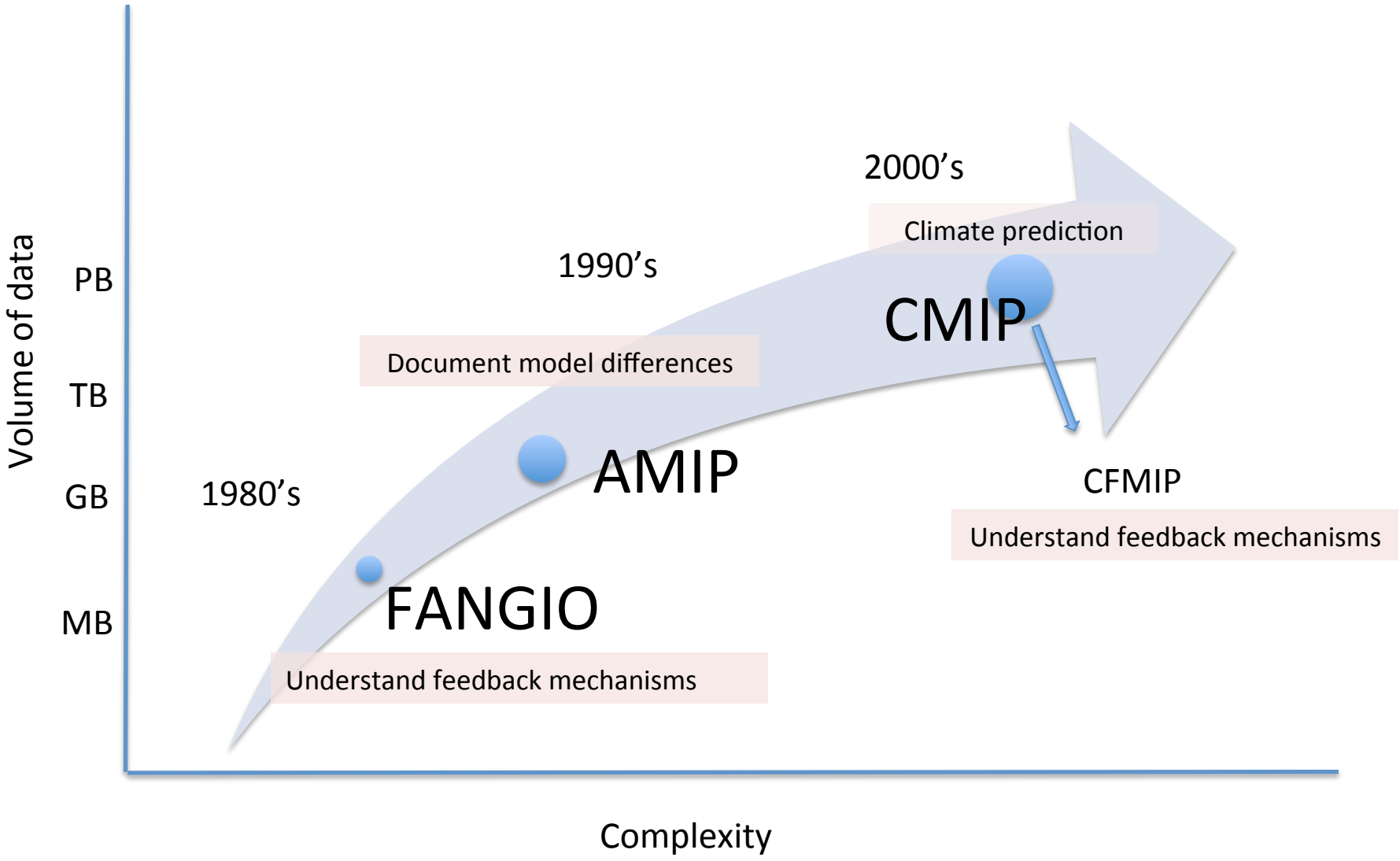


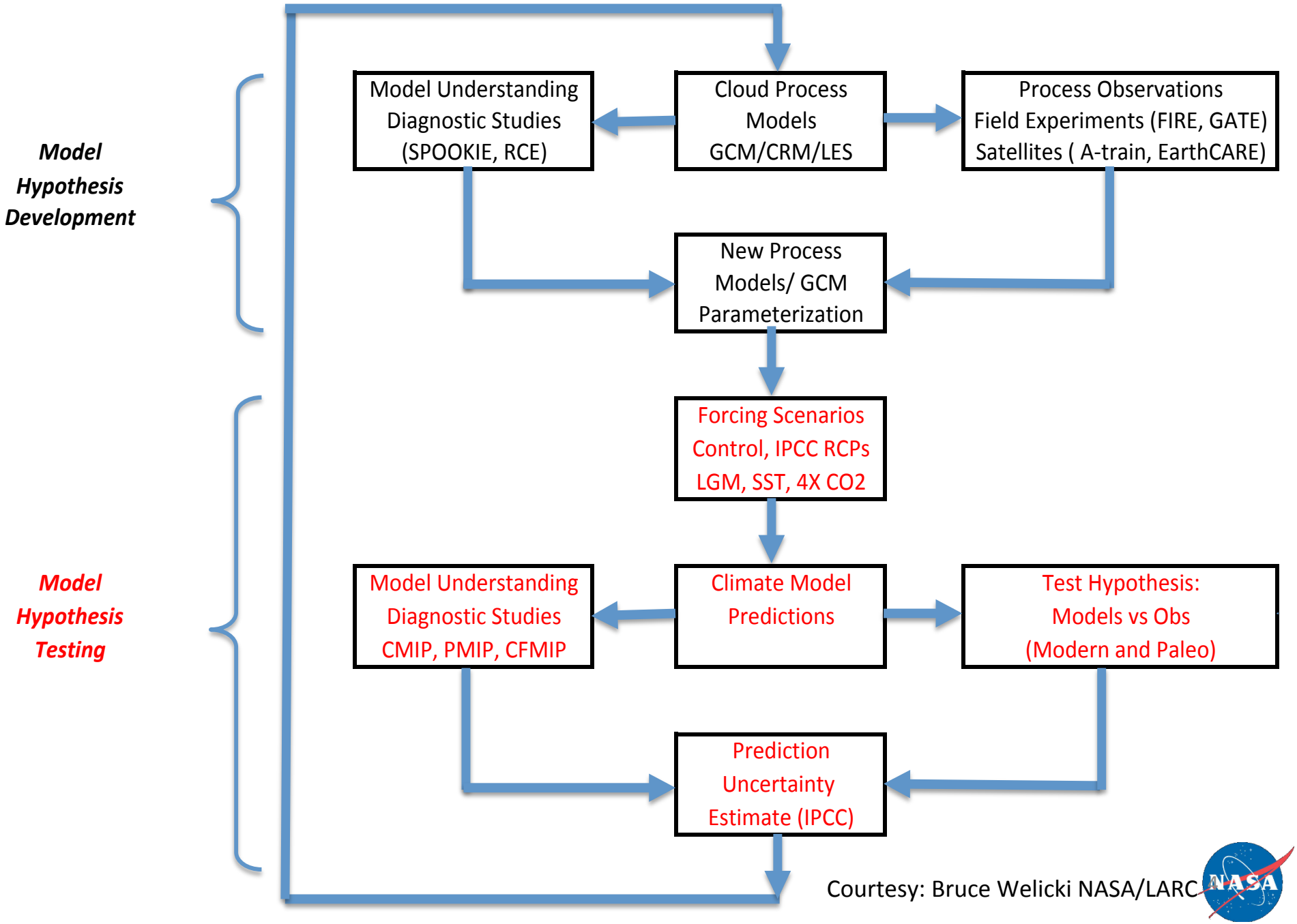
11 years – still large range



Courtesy Bob Cess

Climate Model Intercomparison





Courtesy: Bruce Welicki NASA/LARC

Recent obs4MIPs workshop

- Considerable discussion for expansion
  - Higher frequency
  - Expanded list
  - "Golden Year" focus
  - Proxy data sets – off line simulators
  - *Possible more reanalysis variables*
  - Co-located data sets
  - Relaxed "model equivalent" data rules
  - Address process diagnostics
  - In-situ data
  - Include more proxies in the CMIP output experiments

Condensed from a list courtesy Robert Ferraro and others

Reanalysis* for climate model evaluation and comparison – ana4MIPs

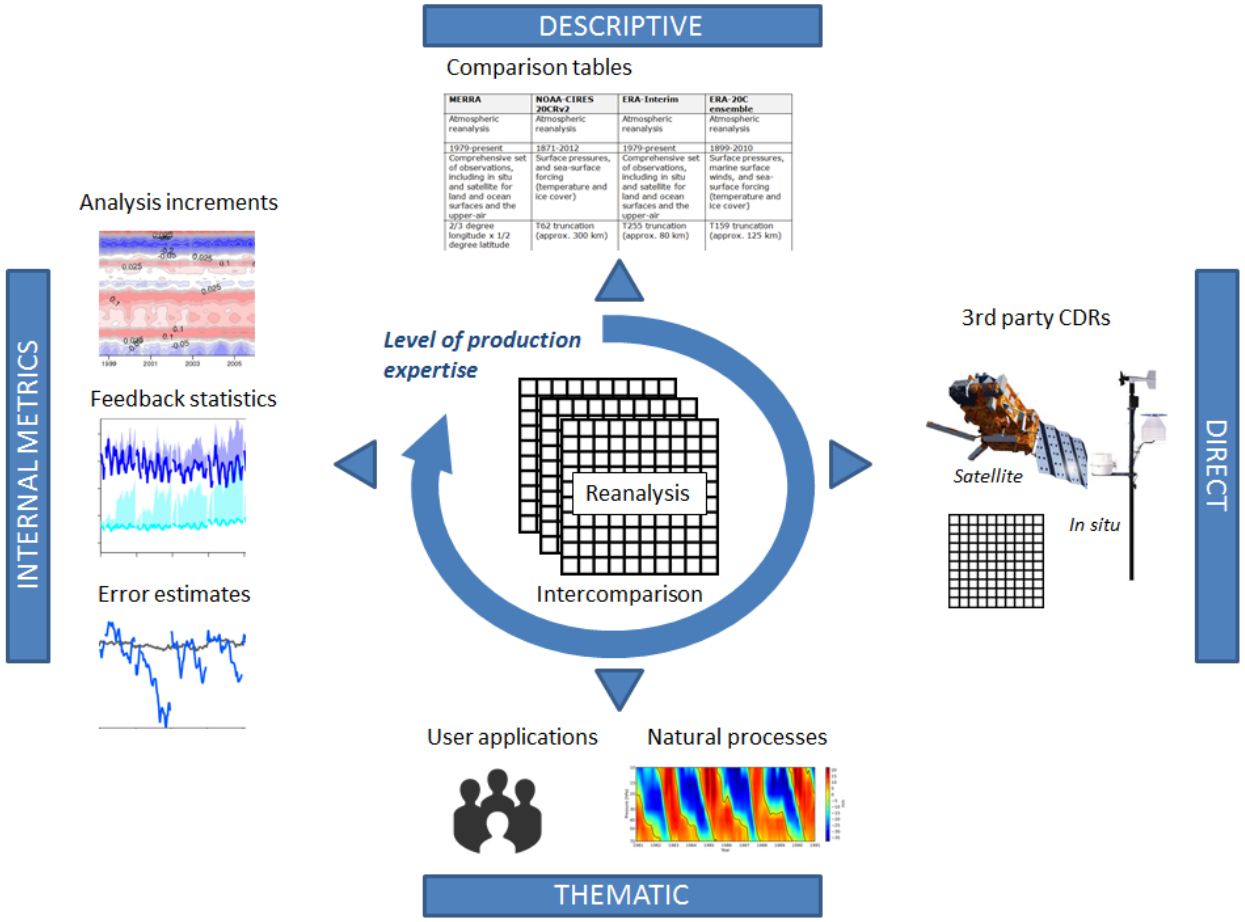
- Initiated to fill the gaps where direct observations are not possible.
  - Select variables from reanalyses to correspond with CMIP5 – similar to obs4MIPs
  - Limited to those variables that have model evaluation potential (U,V,T,Q,PS)

***Reanalysis** is a scientific method for developing a comprehensive record of how weather and climate are changing over time. In it, observations and a numerical model that simulates one or more aspects of the Earth system are combined objectively to generate a synthesized estimate of the state of the system.

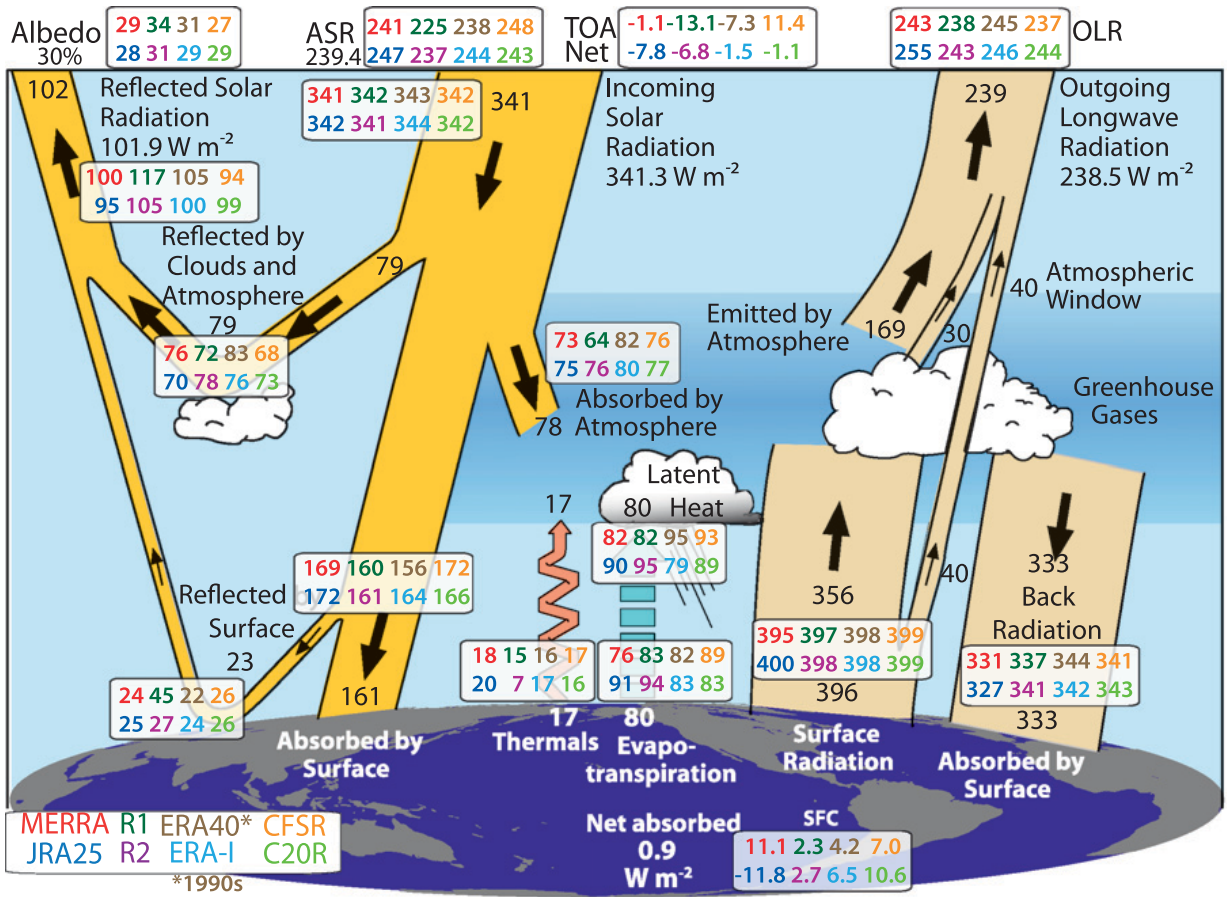
CREATE-IP

- Collaborative REanalysis Technical Environment – Intercomparison Project
  - Expanded set of variables, tendencies, observations
  - High frequency data
  - O-A, O-F to address model and observation biases
    - Gridded observations used in assimilation
  - Enablement of a computational environment
  - Designed to serve as a launch point for reanalysis intercomparison

Reanalysis intercomparison



Courtesy: Coordinating Earth observation data validation for RE-analysis for CLIMATe ServiceS – (Core Climax) – Procedure for comparing reanalyses and comparing reanalyses to assimilated observations and CDRs. 17 July 2014



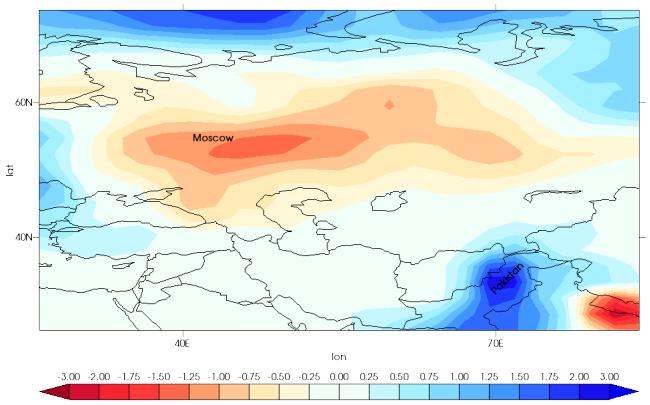
The background values of radiation or energy flows (Trenberth et al. 2009) are based on observations for 2000–05. Superposed, with the key (lower left), are values from the various reanalyses for the 2002–08 period except for ERA-40, which is for the 1990s (color coded; W m2). Above the graphic, values are given for albedo (%), ASR, net TOA radiation, and OLR; the box labeled SFC near the bottom gives the net flux absorbed at the surface. For the 1990s the latter value is 0.6 W m^2.

From Trenberth et al. 2011 *J. Climate* DOI:10.1175/2011JCLI4171.1

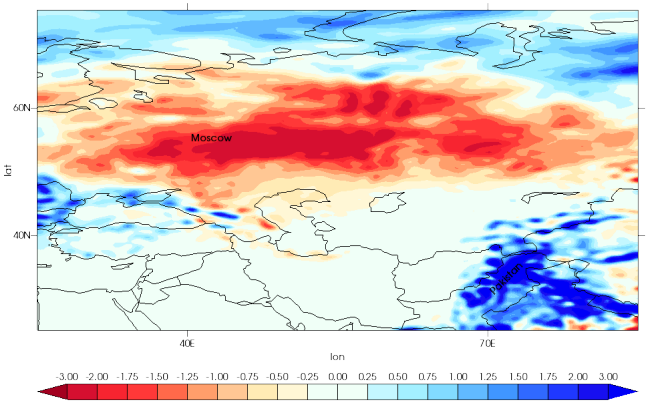
June-July-August Precipitation Anomaly for 2010 (based on 1979-2013)

2010 Russian Heat wave

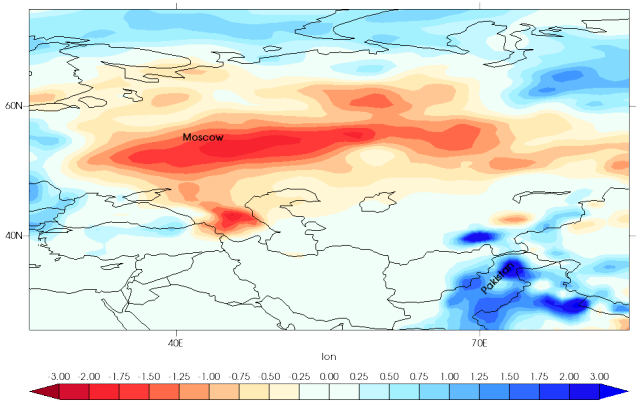
GPCP – observations



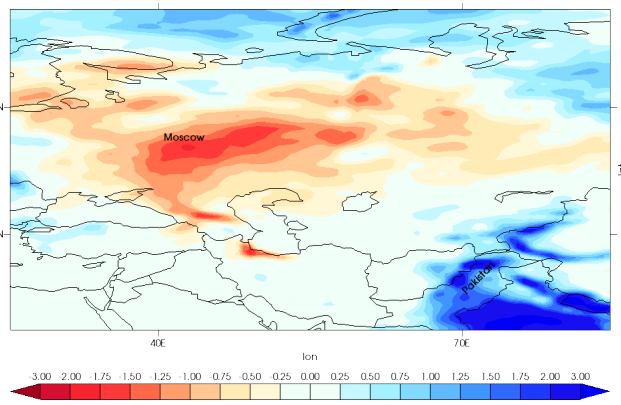
CFSR



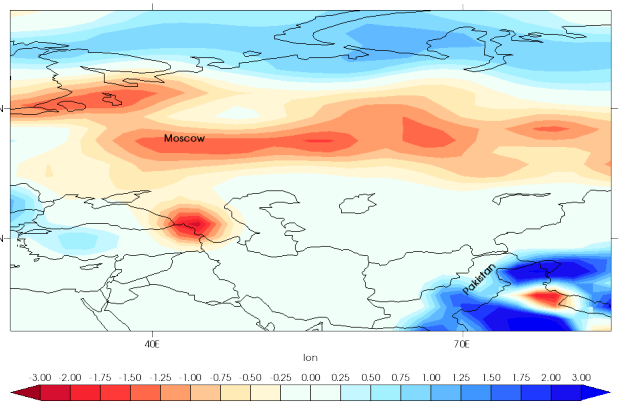
ECMWF



MERRA



20CR*

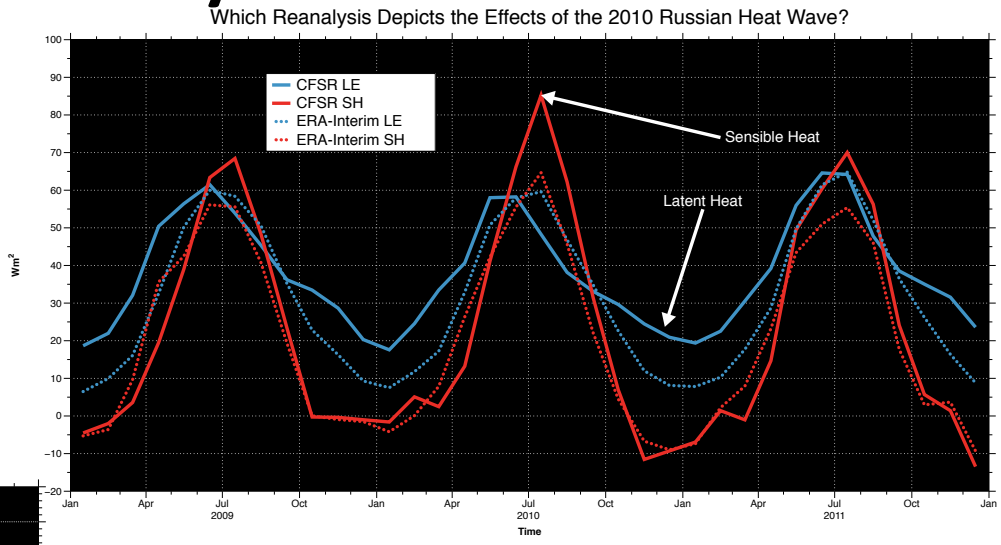


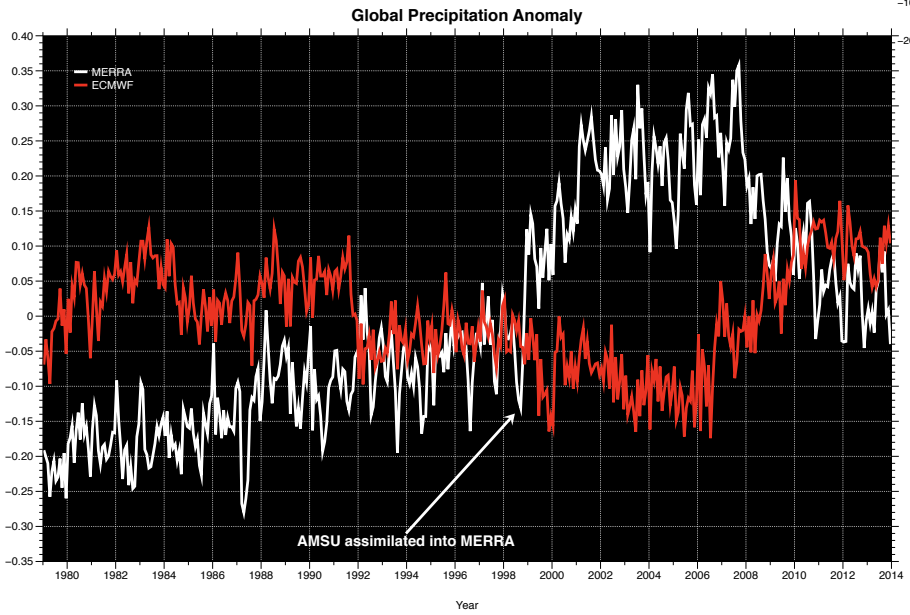
*anomaly from the 1871-2012 reanalysis

Examples of reanalysis differences

2010 Russian Heat wave – how well do the reanalyses capture the intense surface drying over Western Russia?

Surface drying/heating in 2 reanalyses





Global precipitation anomaly in 2 reanalyses

AMSU had a significant impact on MERRA but the ECMWF choose not to assimilate that data – because of the impact on precipitation

Current Data Holdings

Name	Source	Time Range	Assimilation	Resolution available from CREATE-IP	Dataset Output Times and Time Averaging
NASA Modern-era Retrospective Analysis for Research and Applications (MERRA)	NASA GMAO	1979-present	3D-VAR, with incremental update	2/3 lon x1/2 degrees; 42 pressure levels	Monthly average
ECMWF Interim (ERA-Interim)	ECMWF	1979-present	4D-VAR	0.75x0.75 degrees; 37 pressure levels	Monthly average
NCEP Climate Forecast System Reanalysis (CFSR)	NCEP	1979-present	3D-VAR	0.5x0.5 degrees; 22 pressure levels	Monthly average
Japanese 25-year Reanalysis (JRA-25)	Japan Meteorological Agency (JMA) and Central Research Institute for Electric Power Industry (CRIEPI)	1979-present	3D-VAR	1.25x1.25; 12 pressure levels	Monthly average
NOAA-CIRES 20th Century Reanalysis (20CR)	NOAA/ESRL PSD	1871-2010	Ensemble Kalman Filter	2.0x2.0 degrees; 19 pressure levels	Monthly average

Conclusions

- Reanalysis in ESGF in **similar format**
  - Used by modeling and diagnostic community – ana4MIPs
    - Variables not directly observable – winds etc.
  - New more comprehensive reanalysis intercomparison- CREATE-IP
    - Help evaluate observations, perform process studies, help with model biases, identify causes of climate change in the past, help understand uncertainty

Problem of evaluating and using reanalysis requires new thinking

- Data analysis in the traditional way won't work
  - "Library" paradigm must change for large amount of data expected in CREATE-IP project.

Dan Duffy's talk Wednesday