

CMIP5/PMIP3 Simulations at NCAR

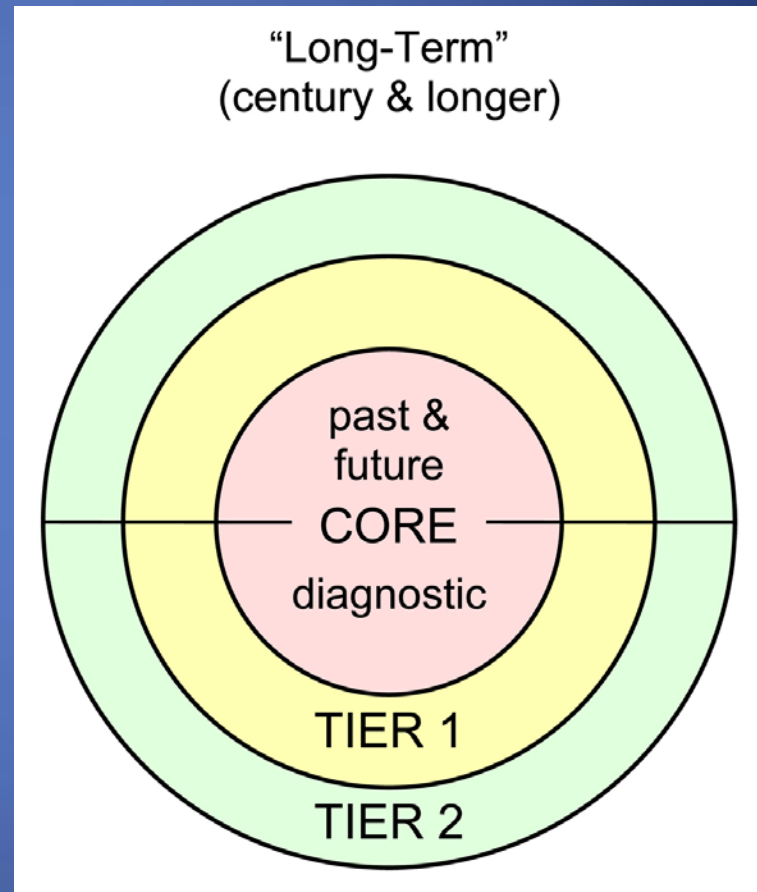
~~and Early Results from CCSM4~~

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NCAR is sponsored by the NSF

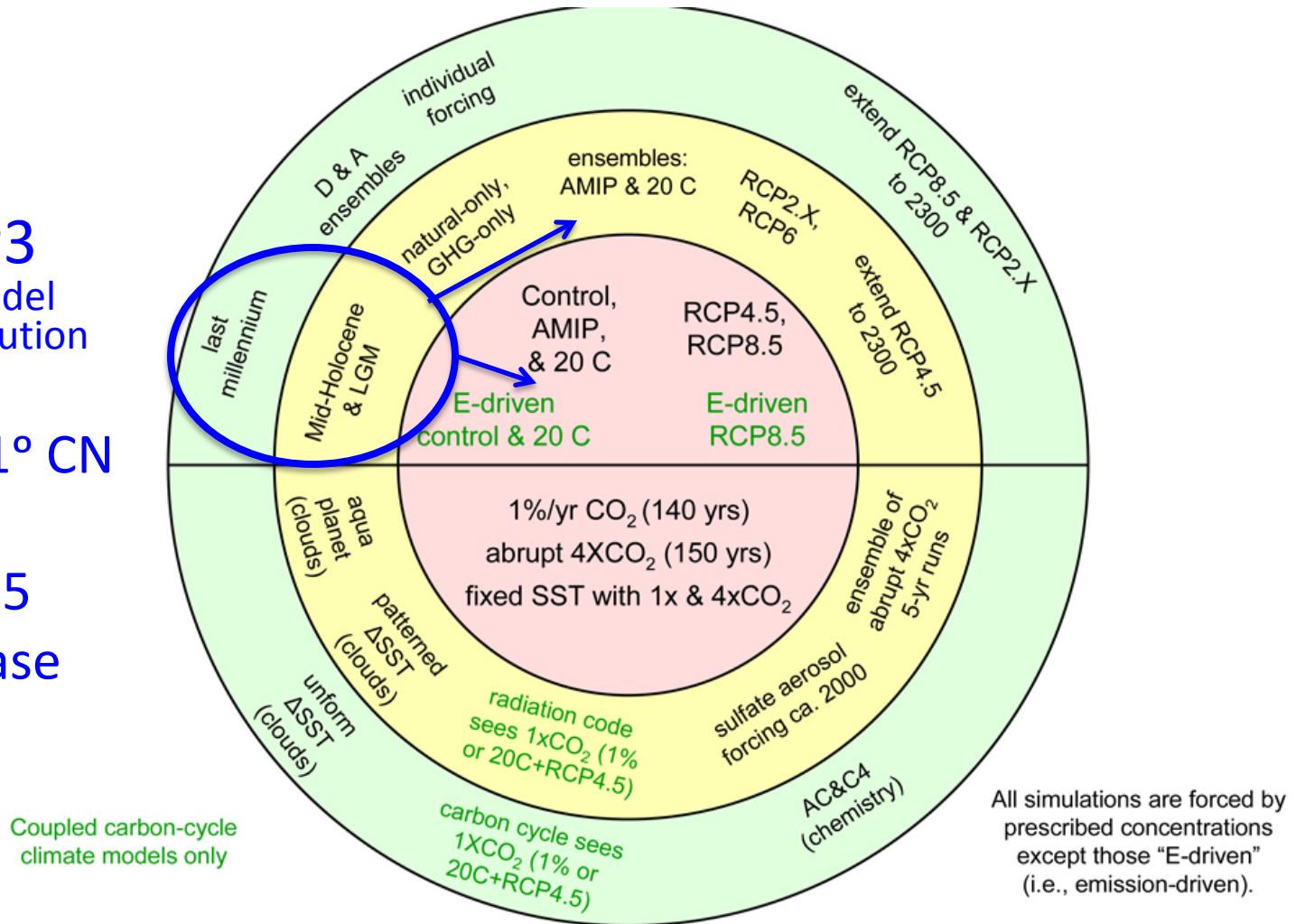


CMIP5 Long-term Experiments

PMIP3
same model
same resolution

CCSM4 1° CN

CMIP5
database



Last Millennium (850-1850AD)

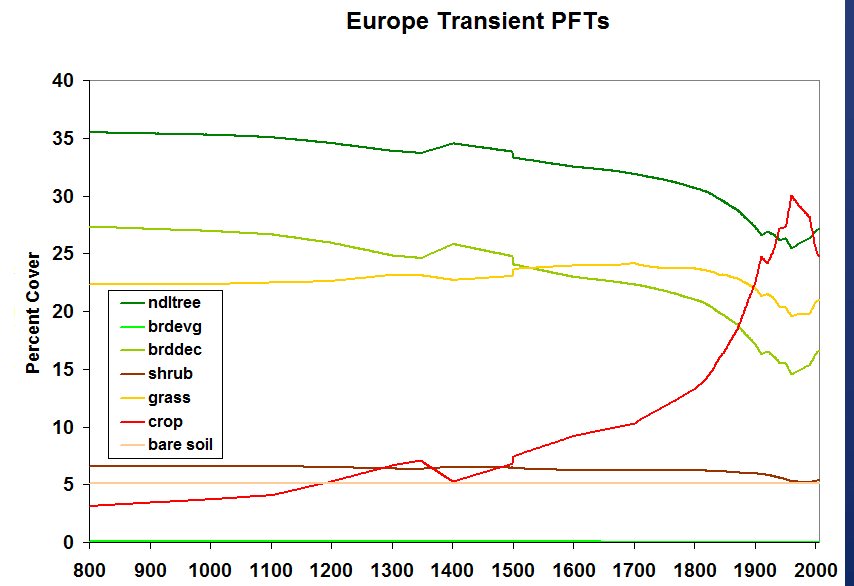
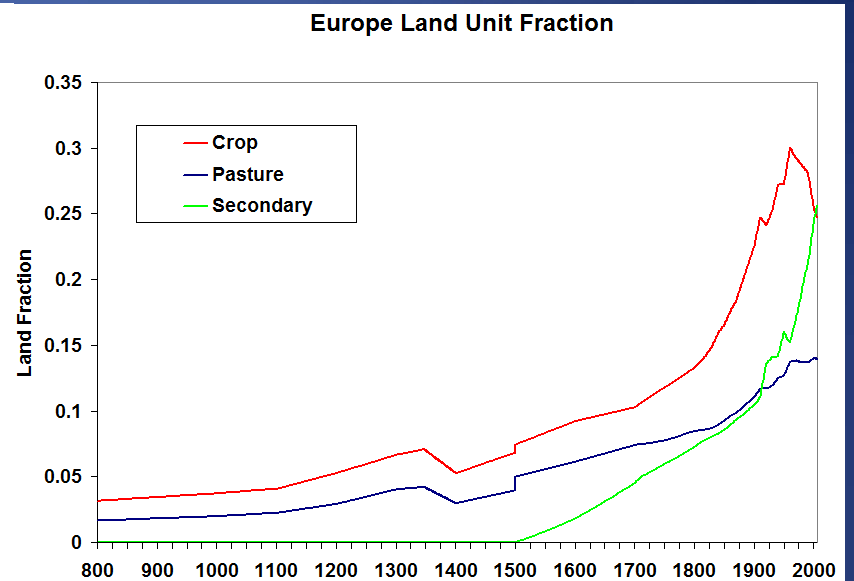
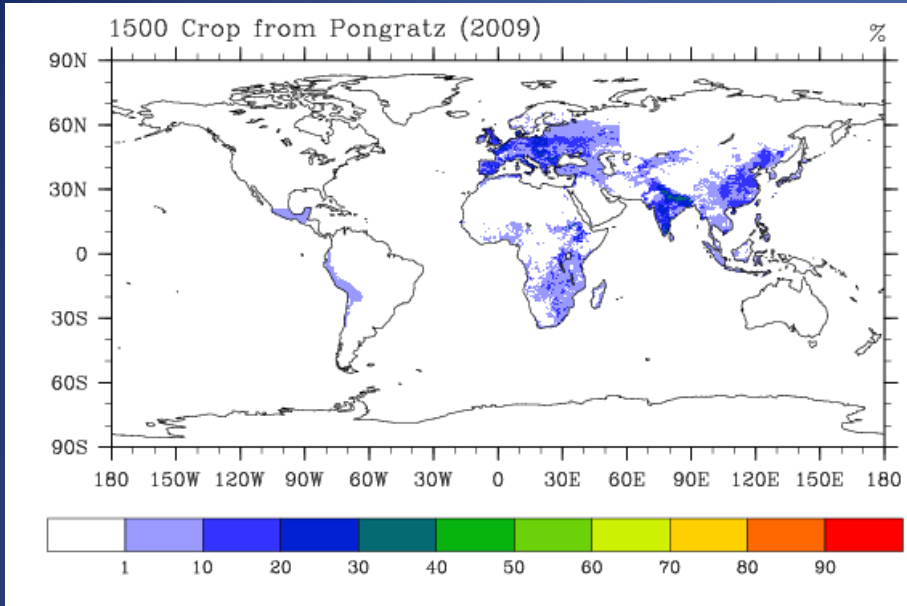
- 9 Modeling groups
- Experimental design:

Purpose:

- Evaluate the ability of models to capture observed variability on multi-decadal and longer time-scales
- Determine what fraction of the variability is attributable to “external” forcing and what fraction reflects purely internal variability
- Provides a longer-term perspective for detection and attribution studies

	PMIP3	Alternative solution
Orbital parameters	Annually varying Table provided (0-2100 CE/AD), if not internally calculated	
Date of vernal equinox	March 21 at Noon	
Trace gases	Annually varying (850-1850) (Table provided)	
Volcanic Aerosols	Multiple reconstructions (of AOD, Effective Radius, Mass)	
Solar irradiance	choose at least one between Multiple reconstructions provided below	
Ozone	solar related variations (parameterised as function of change in solar irradiance - Drew Shindell)	same as in CMIP5 PI
Aerosols	biomass burning changes????	same as in CMIP5 PI
Vegetation	Land use conversion (forests to C3/C4 crops) (Pongratz, 2009, Foley and Ramunkutty) Provided below	same as in CMIP5 PI
Ice sheets	No changes from Pre-Ind control	
Topography and coastlines	same as in CMIP5 PI	

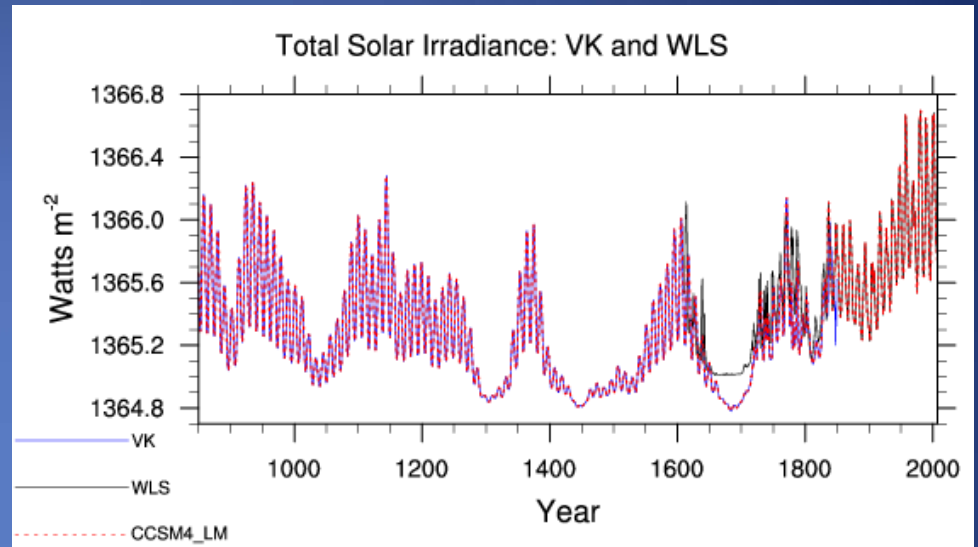
Land Use and Land Cover



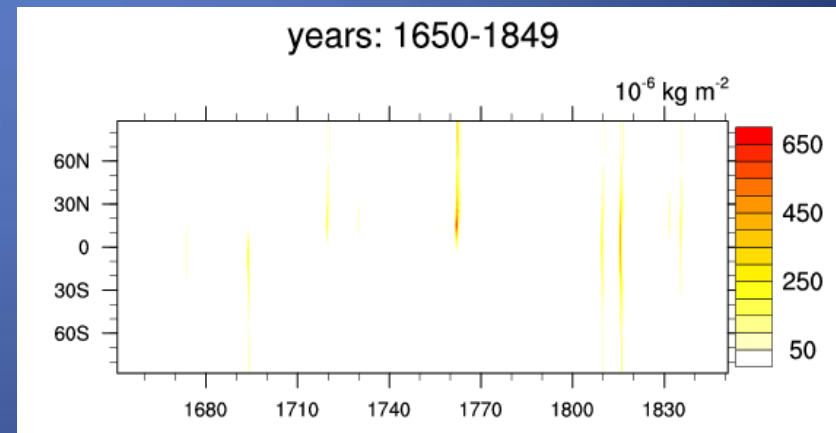
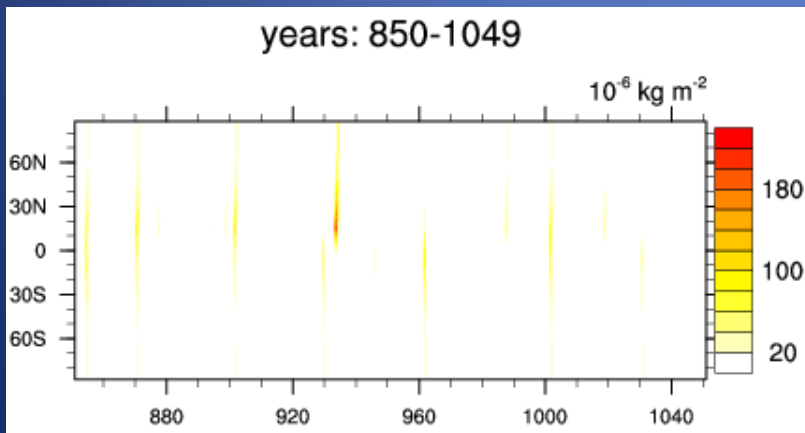
Blend land use from Hurtt et al. (2006) and Pongratz (2009) and CCSM4 natural vegetation

New Forcings

Total Solar Irradiance

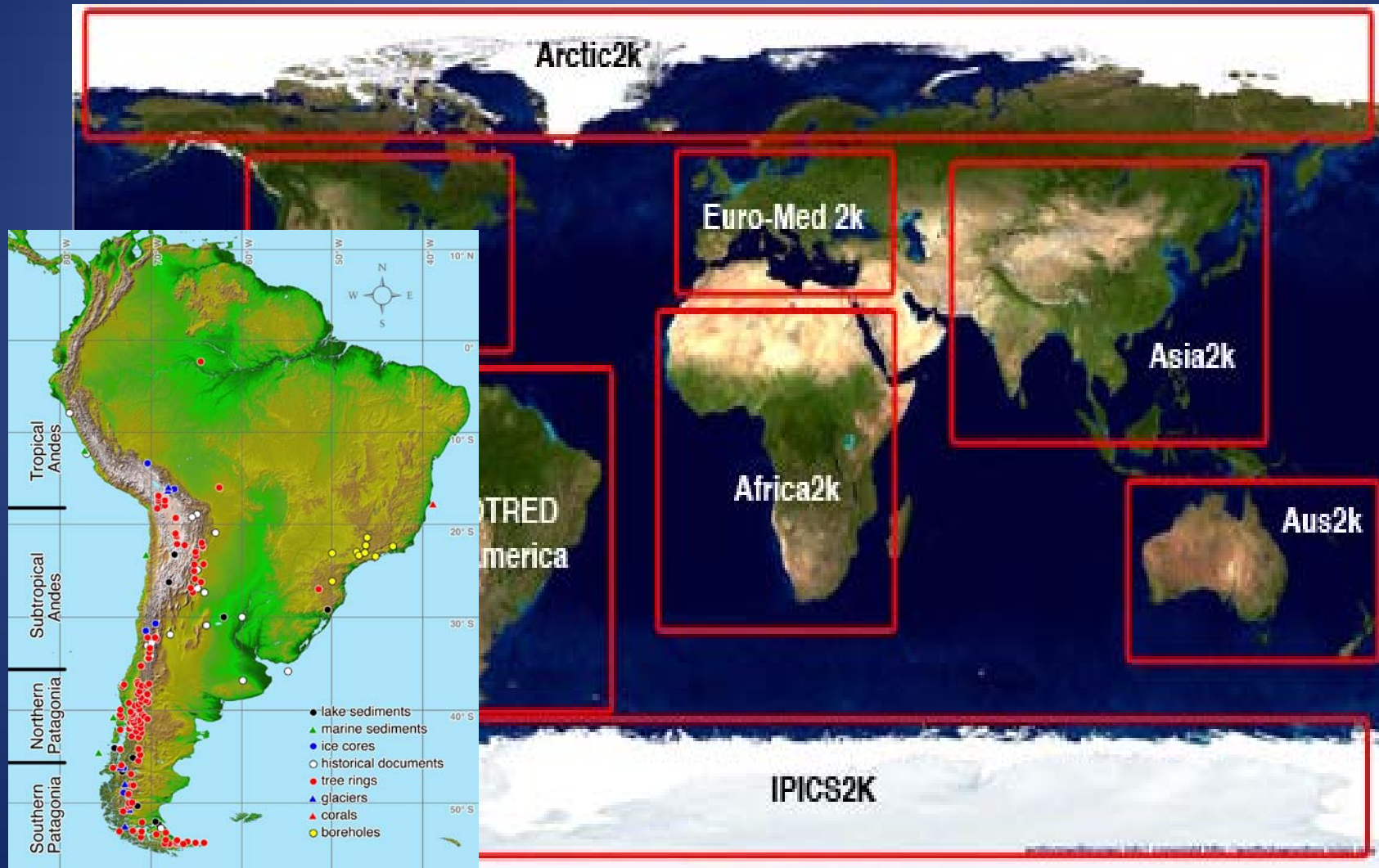


IVI2 Column Mass Volcanic Aerosols



New data synthesis

IGBP PAGES 2K Network

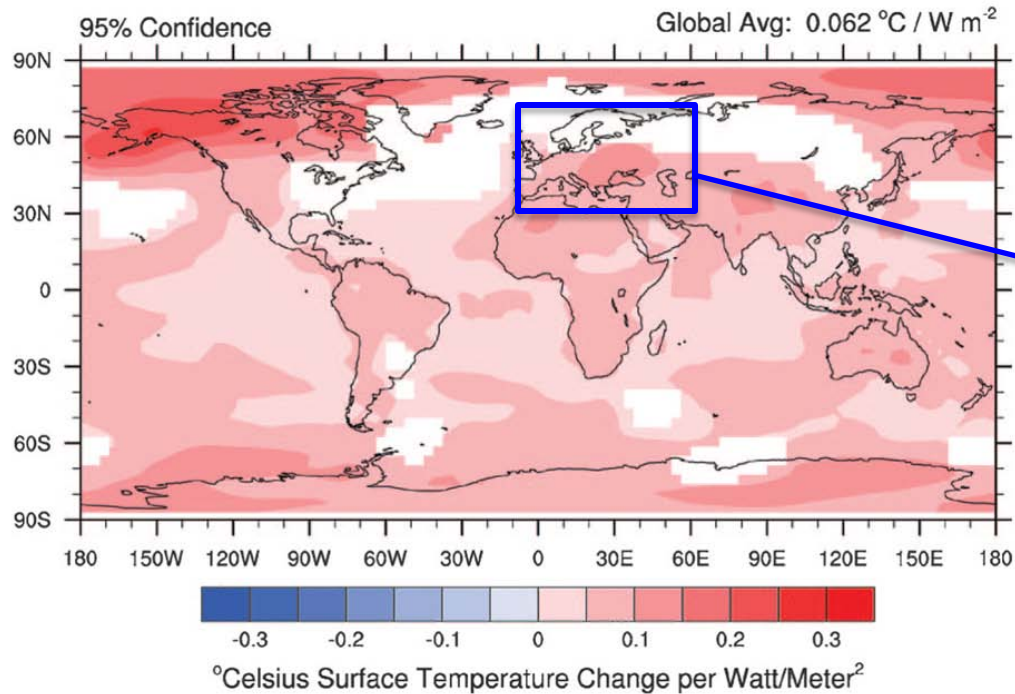


Patterns of Forcing Responses

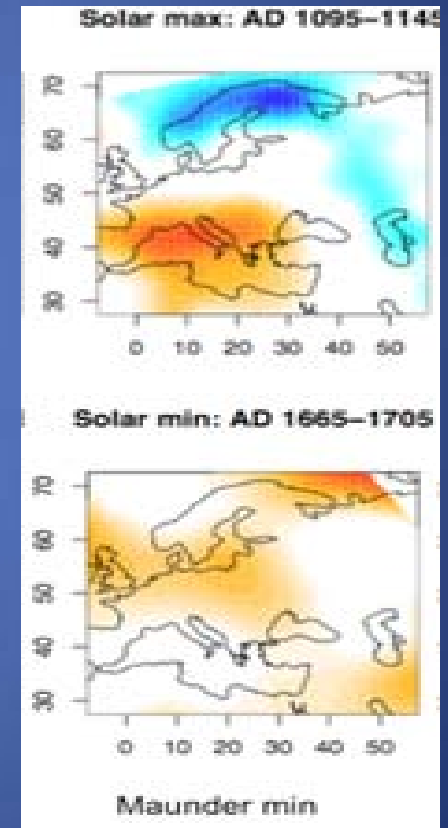
Regression with solar forcing

CSM1.4

Observations



Ammann et al. 2007



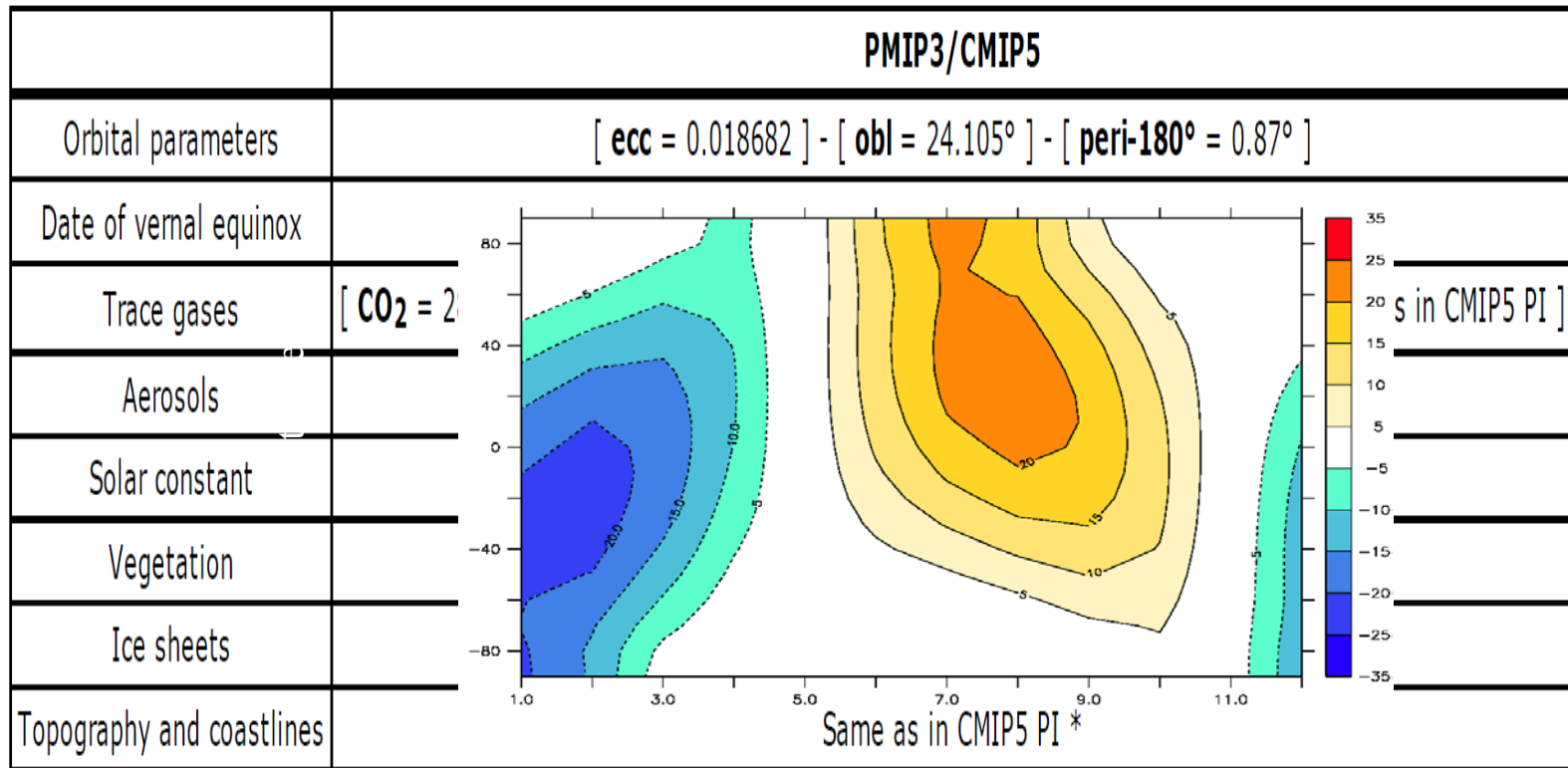
Guiot et al. 2009

Mid-Holocene (6000 years ago)

- 12 modeling groups
- Experimental design:

Purpose:

- Compare with paleodata the model response to known orbital forcing changes and changes in greenhouse gas concentrations



New data synthesis

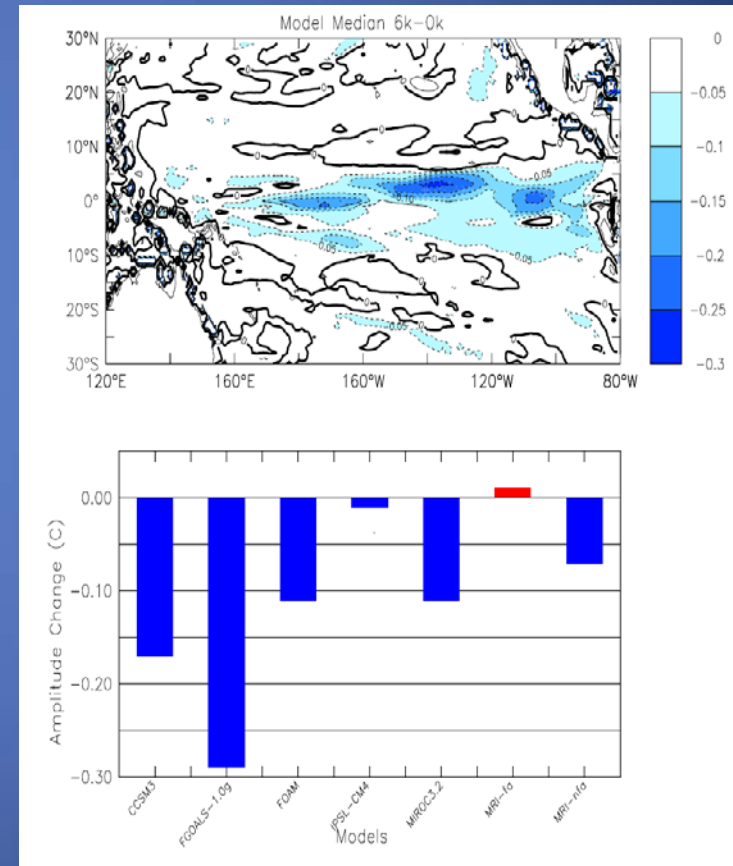
Continued emphasis on hydrologic and ecosystem responses

Improved understanding of variability

41 different published studies with reconstructions of one or more variables
4835 total observations;
reconstructions of individual variables range from 1408 (GDD5) to 4232 (MTWA)
715 out of 3687 non-ice covered land (2x2-deg) grid cells

Bartlein et al. 2010

ENSO in PMIP2



Zheng et al. 2009

Last Glacial Maximum (21,000 years ago)

- 12 modeling groups
- Experimental design:

Purpose:

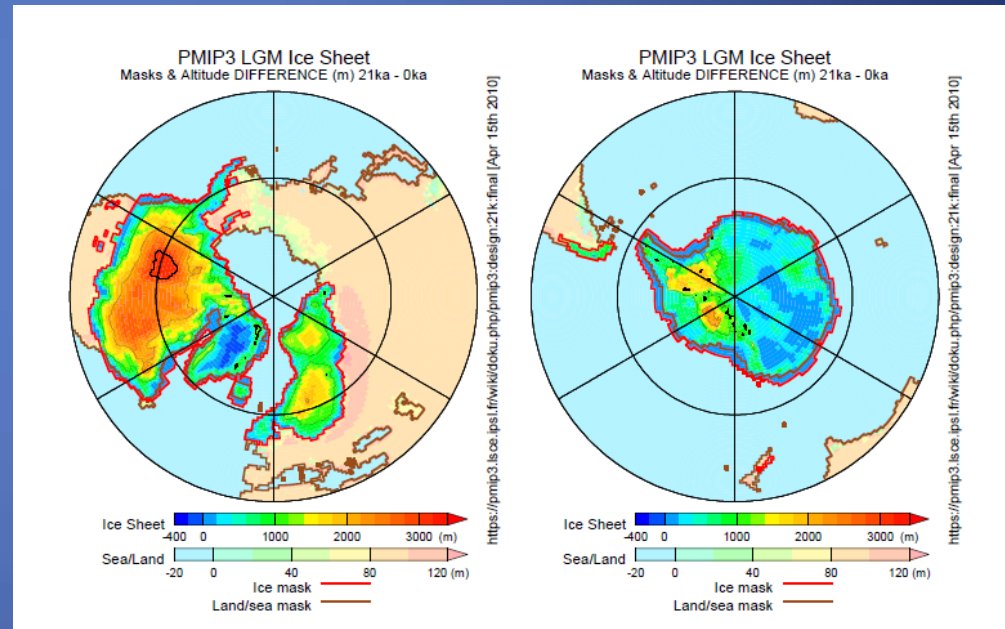
- Compare with paleodata the model response to ice-age boundary conditions
- Attempt to provide empirical constraints on global climate sensitivity

	PMIP3	Minimum solution
Orbital parameters	[$ecc = 0.018994$] - [$obl = 22.949^\circ$] - [$peri-180^\circ = 114.42^\circ$]	
Date of vernal equinox	March 21 at Noon	
Trace gases	[$CO_2 = 185$ ppm] - [$CH_4 = 350$ ppb] - [$N_2O = 200$ ppb] [$CFC = 0$] - [$O_3 =$ same as in PI]	
Aerosols	Same as in CMIP5 PI (see <i>Dust forcing</i> note below)	
Solar constant	Same as in CMIP5 PI	
Vegetation	Same as in CMIP5 PI	
Ice sheets	Ice sheet extent and related changes in topography provided	
Land surface elevation and coastlines	<u>Land-sea mask</u> and <u>elevation changes</u> provided	Minimum changes (<u>see below</u>)
Ocean bathymetry	Up to groups, depending on the flexibility of their ocean model (see note below)	
River outflow	Modified according to a river pathway map (provided, <u>see below</u>)	Same as in CMIP5 PI
Ice sheet mass balance	Add excess LGM freshwater to ocean (<u>see below</u>)	Same as in CMIP5 PI
Mean ocean salinity	+1 PSU everywhere (to be added <i>once</i> at the beginning of the simulation)	
Mean atmospheric surface pressure	Global average equal to PI value (<u>see below</u>)	

Focus on ice sheet reconstruction

Multi-reconstruction approach

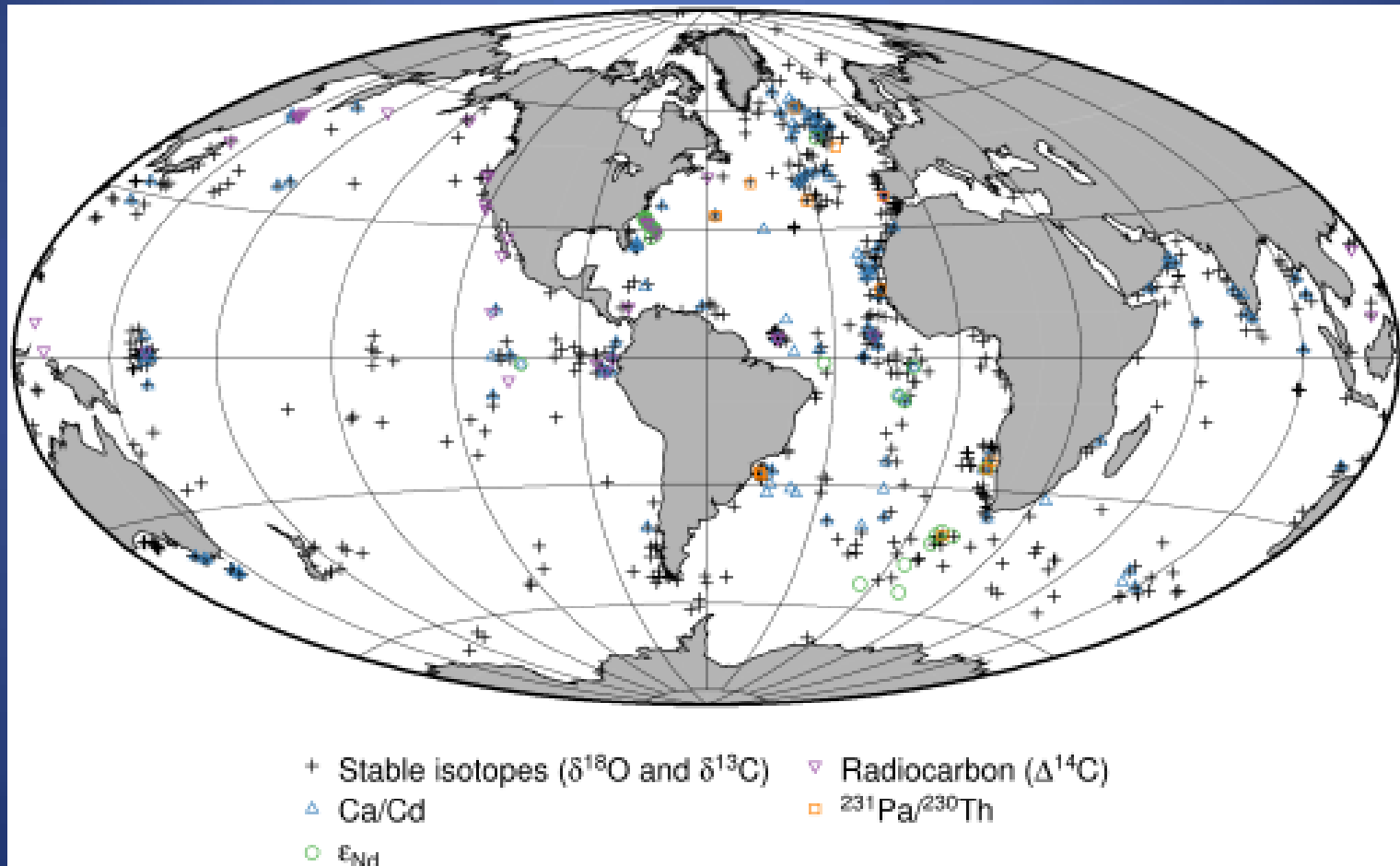
- Three candidate reconstructions
 - Peltier ICE-6G reconstruction for NH and SH
 - Lambeck ANU reconstruction for NH and SH
 - Tarasov MOCA ice sheet model for NH
- Expert judgments and uncertainties from glaciologists, geologists, ice core scientists
- Blended product averaging 3 ice sheet reconstructions
- River routing provided so that the river pathways is consistent with the presence of the ice-sheet



pmip3.lisce.ipsl.fr/wiki/doku.php/pmip3:design:21k:final

New data synthesis

New emphasis on ocean response



Conclusion

- Three CMIP/PMIP3 simulations
 - Last Millennium (850 to 1850 to 2005AD transient)
 - Middle Holocene (6000 years ago time-slice)
 - Last Glacial Maximum (21,000 years ago time-slice)
- Using CCSM4 1° CN – same model/resolution as 20th century and 21st century RCP simulations
- Completed late this year – early next year
- Available in CMIP5 database
- IPCC AR5 has Paleo chapter + several other chapters where Paleo is relevant