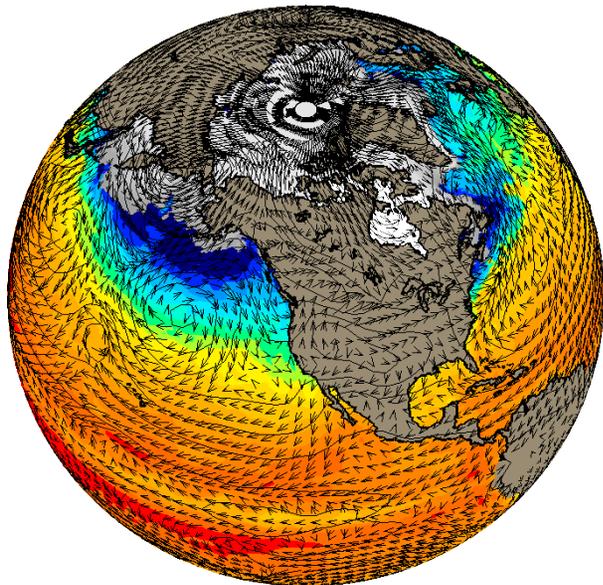


**What's going on with CMIP5
(at least at NCAR)
and will model uncertainty grow in the AR5?**



Gerald A. Meehl
NCAR

Roughly 20 global climate modeling groups from around the world are currently running the “long term” CMIP5 experiments (concentration-driven 20th century, 21st century RCPs, post 2100 extensions to 2300; emission-driven earth system model experiments, paleo, feedback experiments, etc.)

Roughly 10 groups are currently running the “short-term” decadal hindcast/prediction experiments (10 year hindcasts for initial dates every 5 years from 1960; two 30 year hindcasts for initial dates of 1960 and 1980; predictions from initial state of 2005, one to 2015, one to 2030)

These are only anecdotal reports at this point. The WCRP Working Group on Coupled Models (WGCM, the group coordinating these experiments) has sent out a query to the modeling groups requesting more details and we will know more at the upcoming WGCM meeting in October

We expect model data to start becoming available for analysis late this year and early next year.

First WG1 lead author meeting: November 8-11, 2010, Kunming China

The new era of climate modeling that began after the publication of the IPCC AR4 has produced, at a number of modeling groups, a new generation of earth system models with a profusion of model resolutions, configurations, and experiments (a “flotilla of models”)

New model versions at NCAR that will have future climate change simulations

CCSM4 (CAM4): (100 km atmosphere), full suite of CMIP5 simulations (20th century, decadal prediction and long term, paleo, feedbacks, etc.)

CCSM4 (CAM4): (200 km atmosphere), 20th century and single member RCP simulations

CCSM4 (CAM4), 50 km atmosphere, 100 year control, 20th century and RCP4.5; decadal prediction experiments

CESM1 (CAM5); (100 km atmosphere; prognostic aerosols) pre-industrial control, 20th century and several RCP 21st century simulations

CESM1 (WACCM) (200 km atmosphere, “high-top” model, stratospheric dynamics, ozone chemistry): 20th century and at least one RCP4.5 to 2100

CESM1 (BGC): (200 km atmosphere, coupled carbon-nitrogen cycle), CMIP5 carbon cycle feedback experiments, 20th and 21st century RCP4.5

atmosphere-only time slice experiments (20 yrs end of 20th century; 20 yrs end of 21st century) HOMME 25 km, T341 (35 km) CCSM4, 25 km CCSM4:

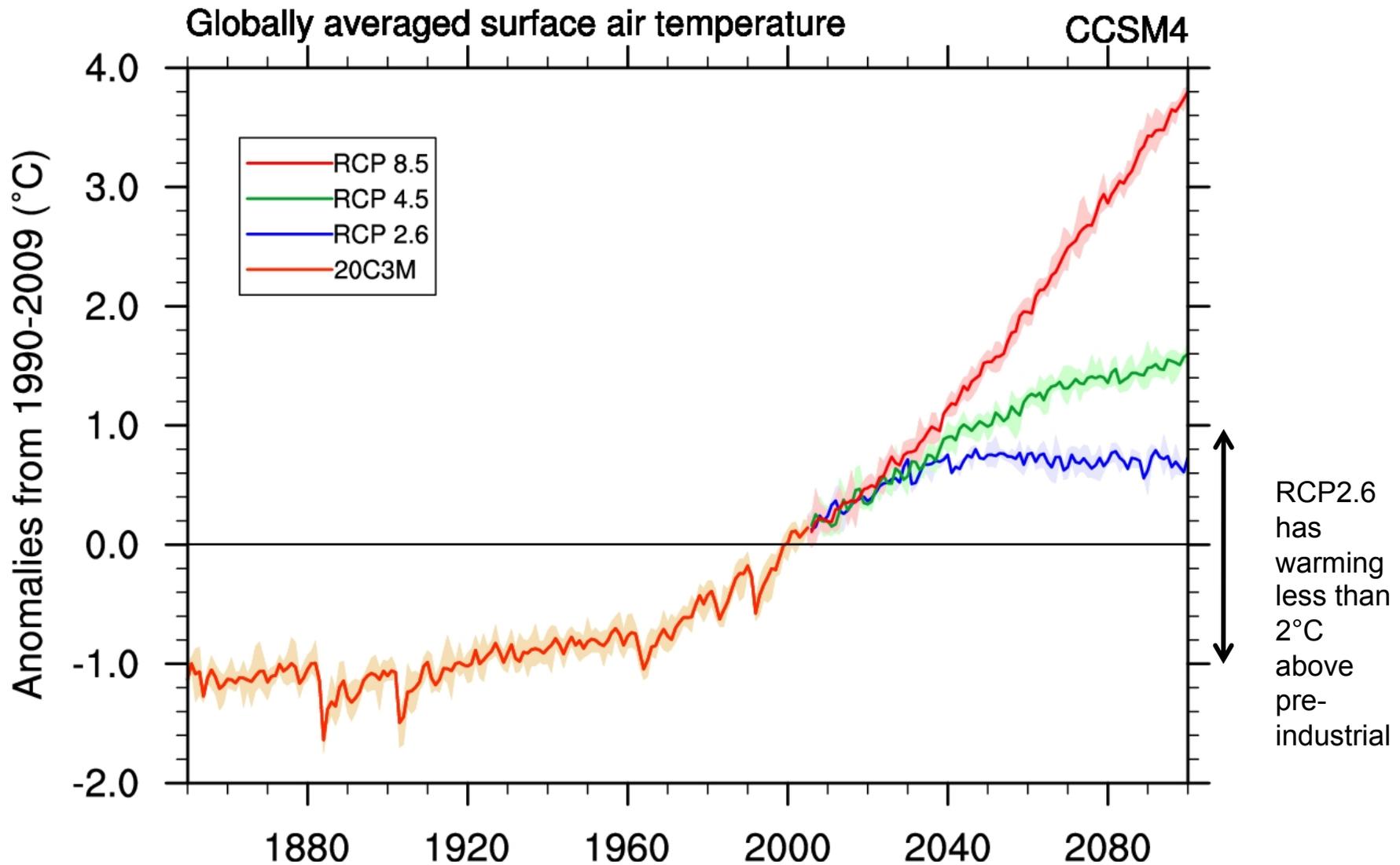
CESM1 (coupled Glimmer-CISM ice sheet model), 20th century, RCP4.5, RCP8.5

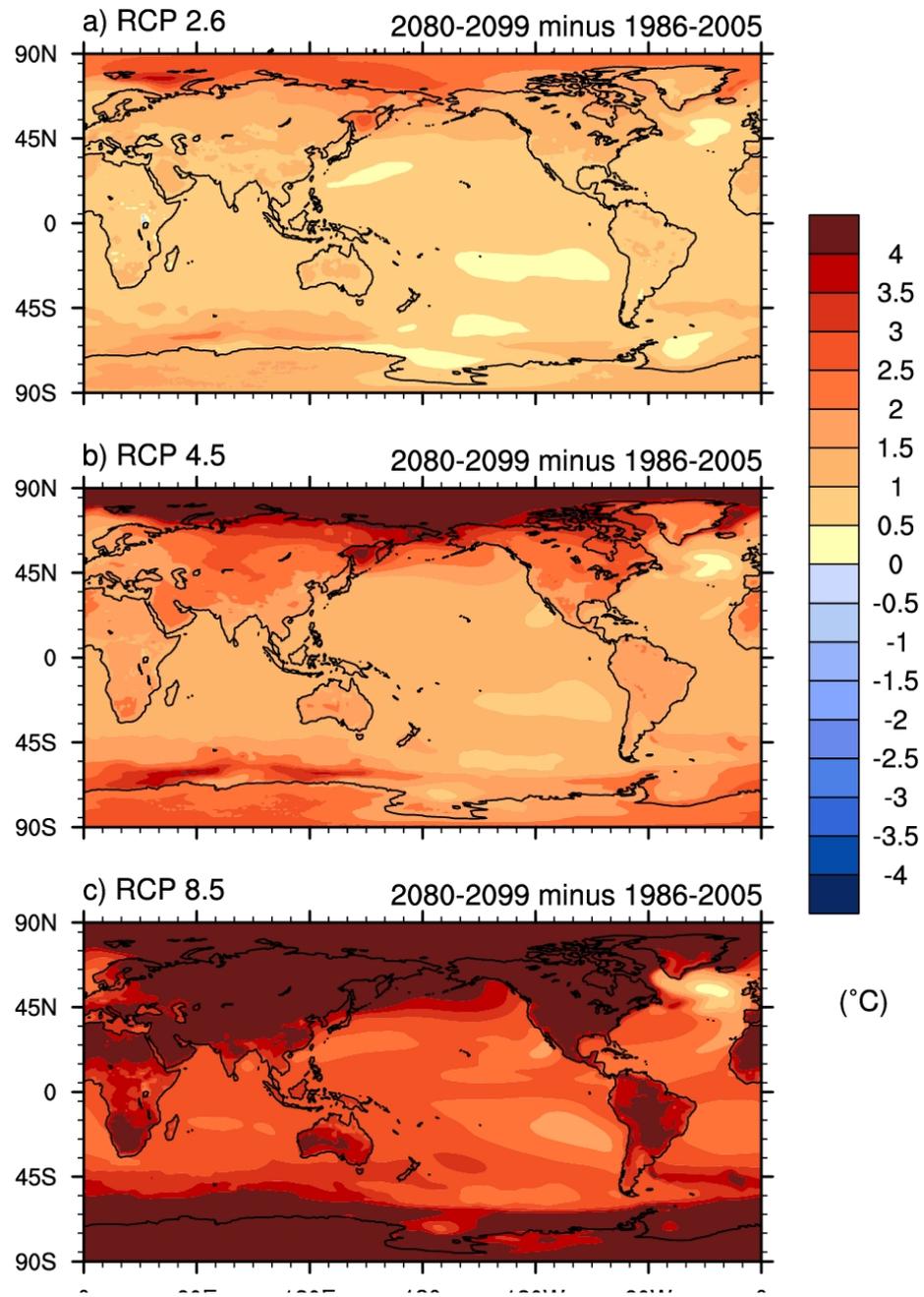
CMIP5 Decadal prediction experiments at NCAR

Multi-ensemble member sets of CMIP5 decadal hindcast and prediction experiments with two initialization schemes in CCSM4 100 km resolution; some planned with CCSM4 50 km resolution:

1. Historical surface forcing
2. DART weakly coupled scheme (ocean data assimilation weakly coupled to atmosphere data assimilation)

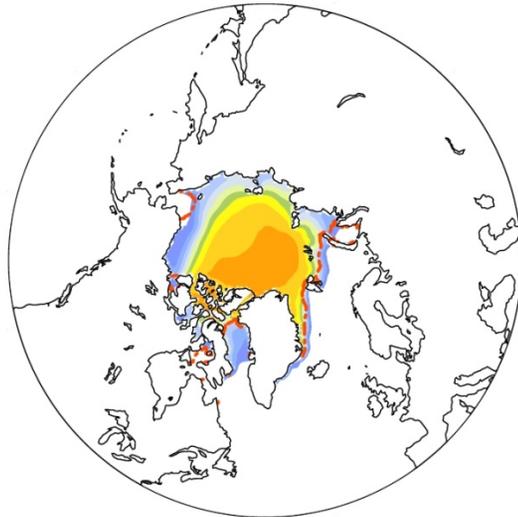
CMIP5 20th and 21st century runs with CCSM4 as of July 27, 2010;
post-2100 extensions and RCP6 starting to run next week
(AOGCM concentration-driven)



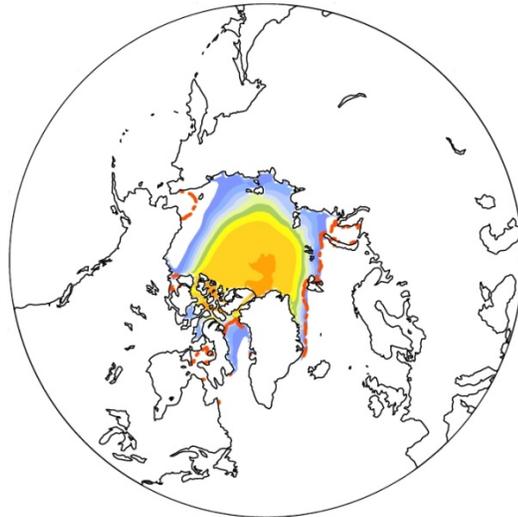


Arctic sea ice: by end of century, RCP2.6 retains most of the Arctic summer sea ice, almost all summer sea ice is gone in RCP8.5

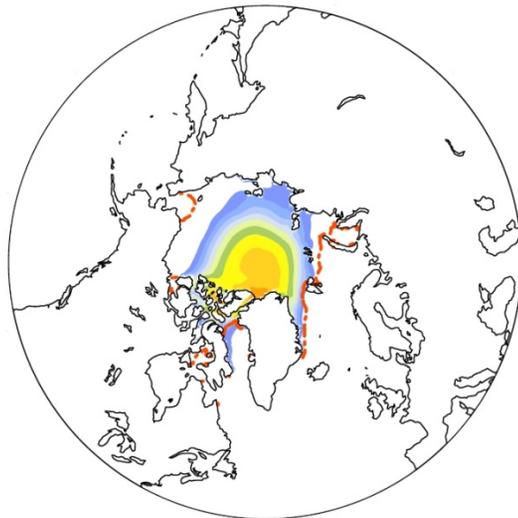
a) 20C3M 1986-2005



b) RCP 2.6 2080-2099



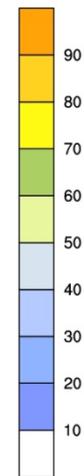
c) RCP 4.5 2080-2099



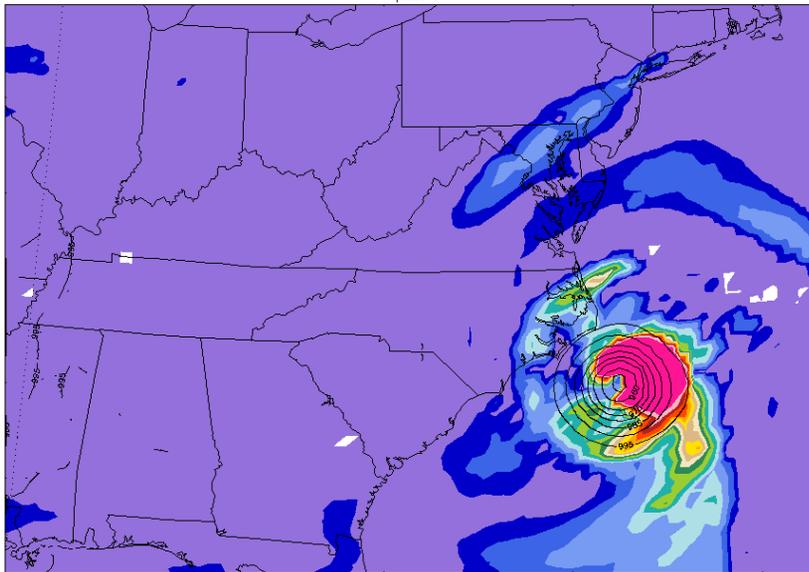
d) RCP 8.5 2080-2099



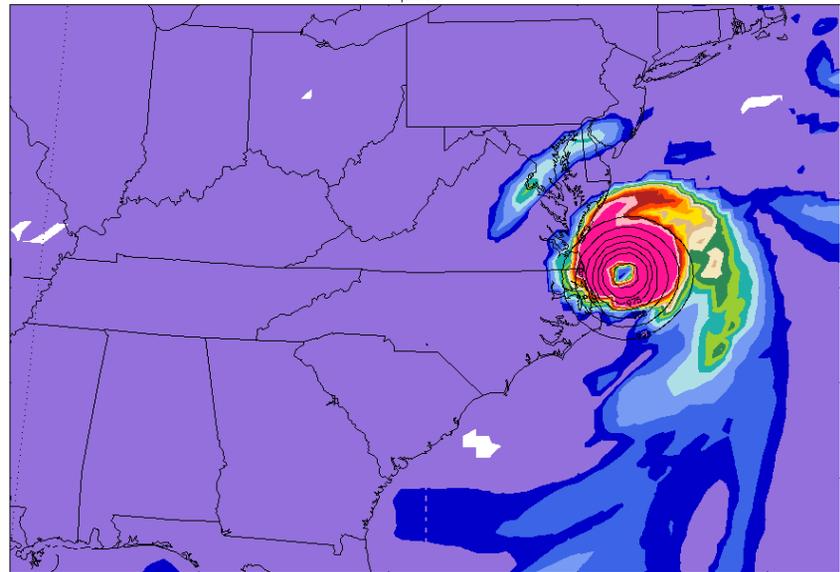
ASO %



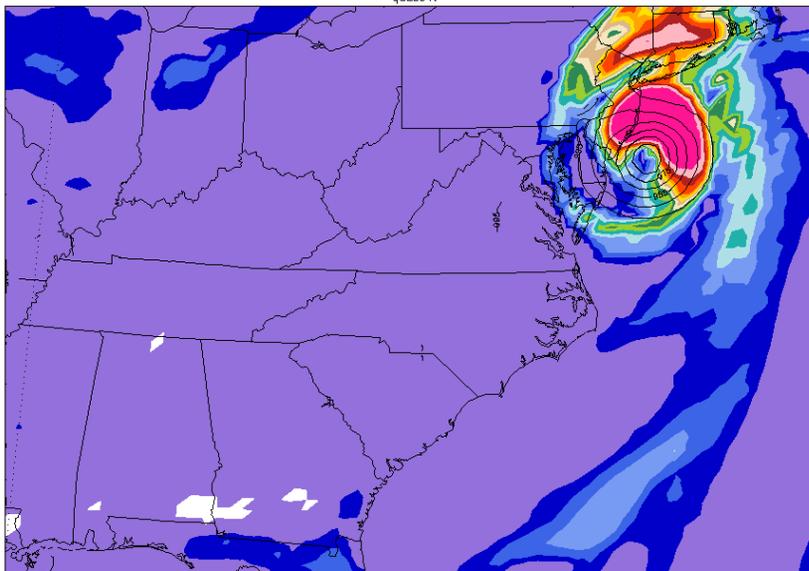
“August 1 2005 0Z”



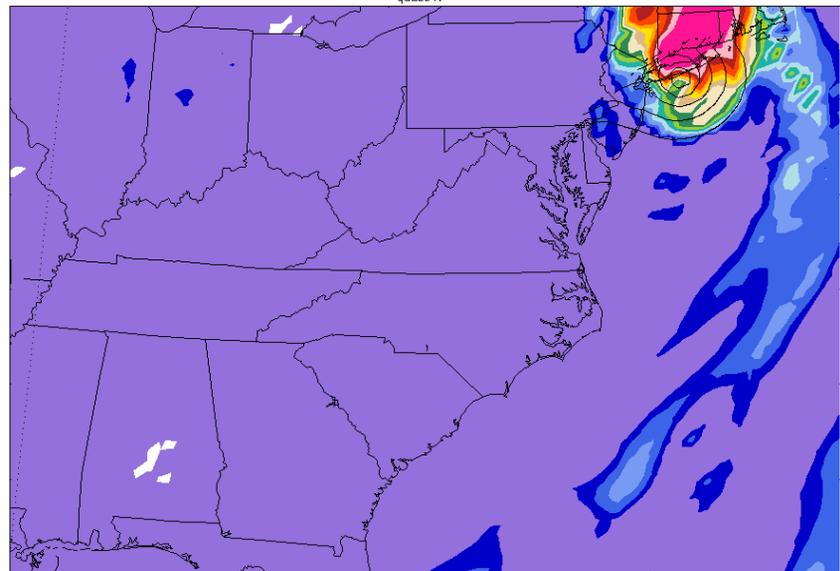
“August 1 2005 12Z”



“August 2 2005 0Z”

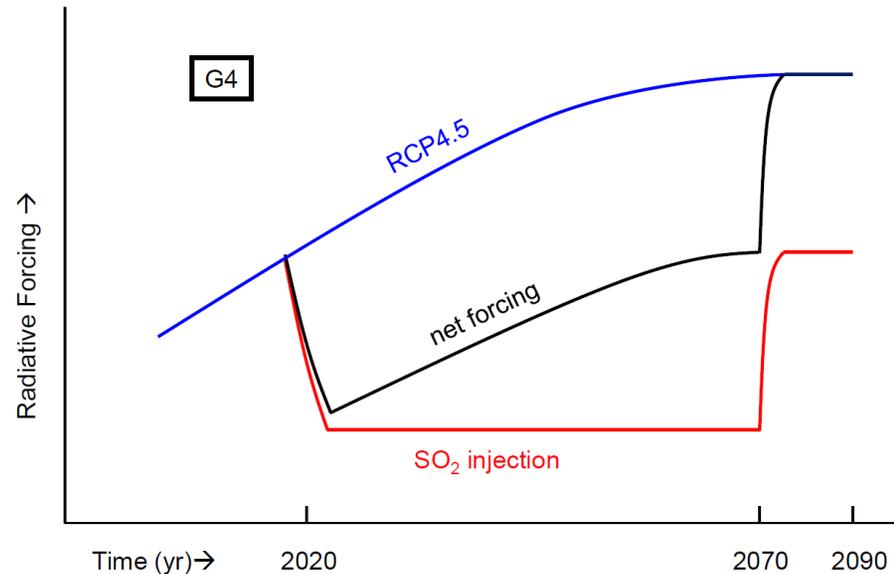
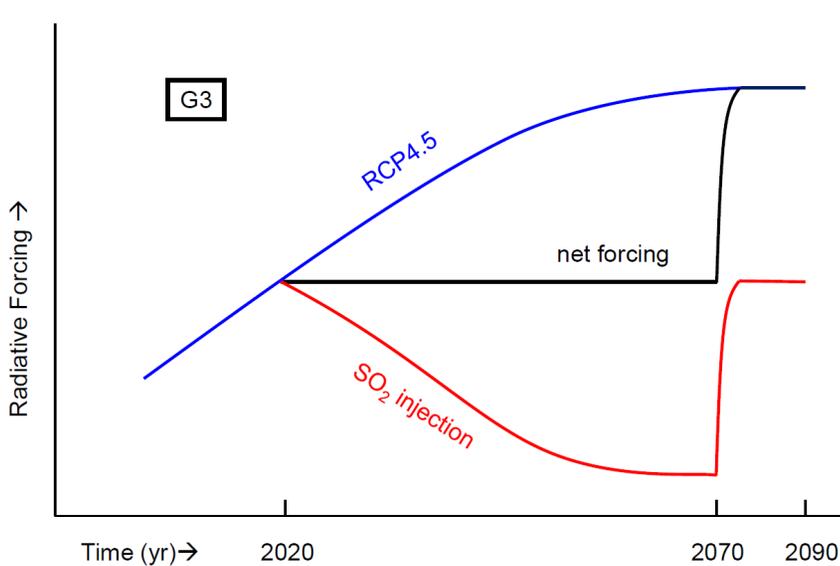
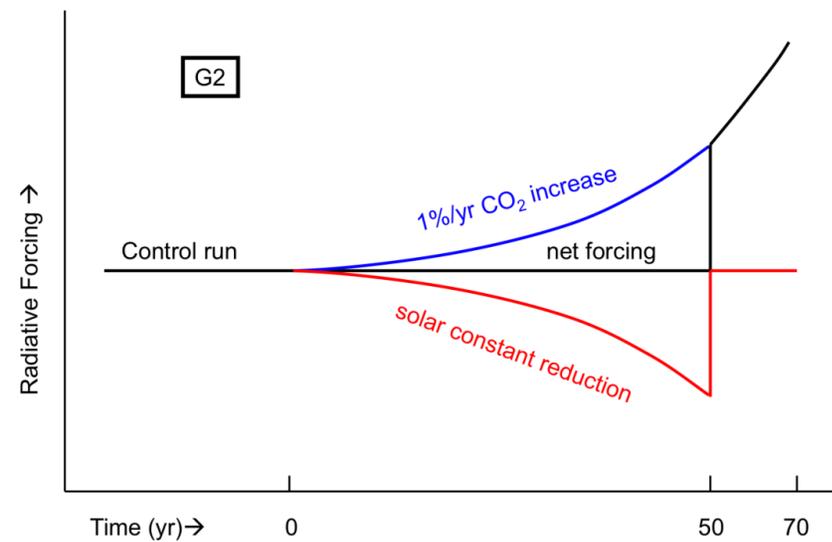
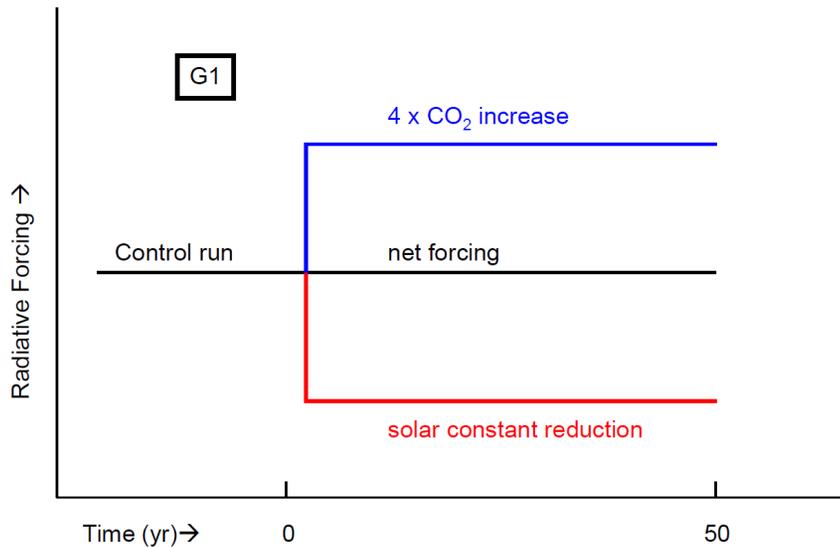


“August 2 2005 6Z”



25 km resolution CAM5 time slice experiment: east coast cat 3 hurricane

The Geoengineering Model Intercomparison Project, GeoMIP, a CMIP Coordinated Experiment (Ben Kravitz, Alan Robock, Olivier Boucher, Hauke Schmidt, Karl Taylor, Georgiy Stenchikov, Michael Schulz)



In the IPCC AR4 there was one class of model (AOGCMs) running one type of experiment (concentration-driven 20th and 21st century SRES scenarios) of roughly the same resolution (around 150 km in the atmosphere)

In the IPCC AR5 there will be multiple classes of models with varying degrees of complexity at a variety of resolutions running concentration and emission-driven 20th and 21st century RCPs in addition to high-res time slice, initialized decadal prediction experiments, and more

The challenge for the climate modeling community: run and analyze a profusion of new models, new model configurations, model resolutions, model experiments

The challenge for IPCC: synthesize and assess a likely wider range of model results than in the AR4; **greater uncertainty across models?**

WGCM will coordinate different communities to synthesize multi-model results in a series of papers that can then be assessed by the WG1 AR5

e.g. proposed decadal hindcast/prediction workshop at the Aspen Global Change Institute June 2011

Some results so far

The context:

Equilibrium climate sensitivity

PCM:	2.1°C
CCSM3:	2.7°C
CCSM4:	3.1°C
CESM1 CAM5:	4.5°C

Transient climate response (TCR)

PCM:	1.30°C
CCSM3:	1.46°C
CCSM4:	1.56°C
CESM1 CAM5:	unknown at this time

Sulfate aerosol radiative forcing

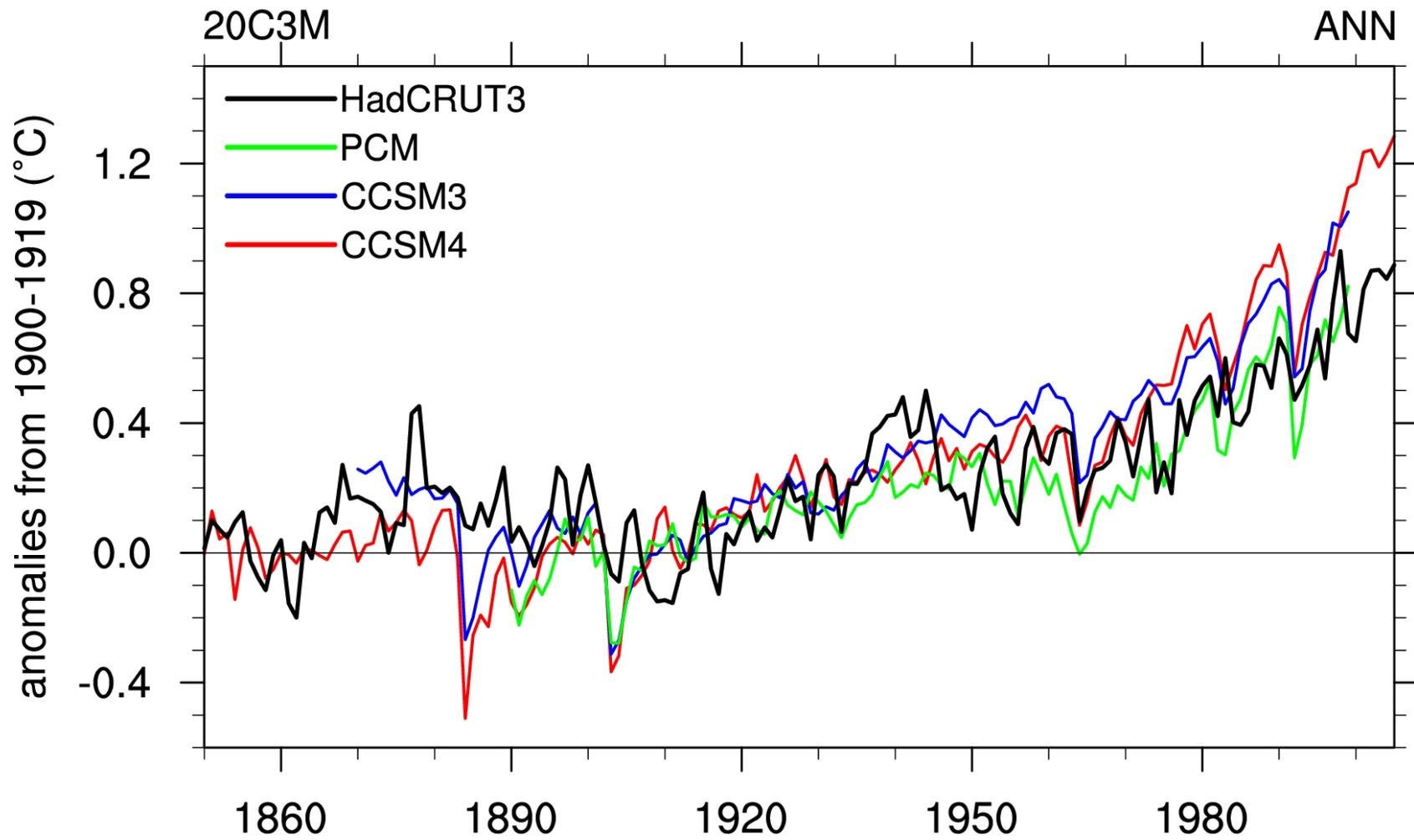
PCM: sulfate direct $\sim -0.8 \text{ Wm}^{-2}$

CCSM3: sulfate direct $\sim -0.8 \text{ Wm}^{-2}$

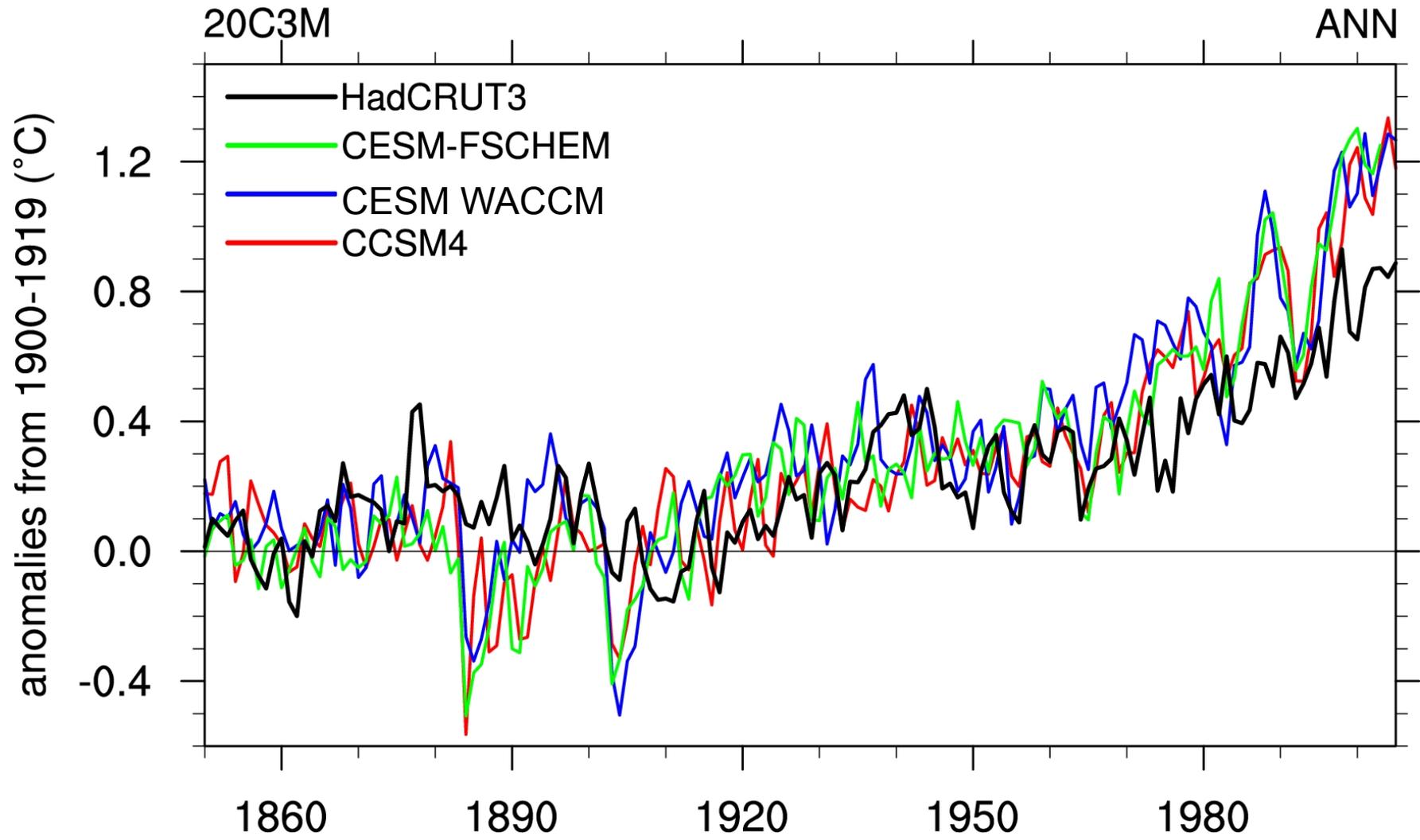
CCSM4: sulfate direct -0.8 Wm^{-2}

CESM CAM5: sulfate direct -0.5 Wm^{-2} ; indirect -1.6 Wm^{-2}

Globally averaged surface air temperature



Globally averaged surface air temperature



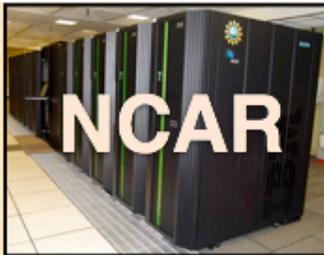
CCWG Model Runs

2010

CMIP5 runs

2011-2013

CESM1 & high resolution



CMIP5 experiments; climate variability/change analyses; CCSM4 aerosol sensitivity experiments
CCSM4 20th-century & RCP scenarios



CMIP5 Long-term stabilization scenarios; CCSM4 single forcing experiments
CESM CMIP5 20th century and RCPs



CCSM4 decadal prediction runs
 $\frac{1}{2}^\circ$ CCSM4 simulations
High-resolution time slices (0.25° HOMME, T341, CCSM4)



CAM-HOMME runs, CCSM4

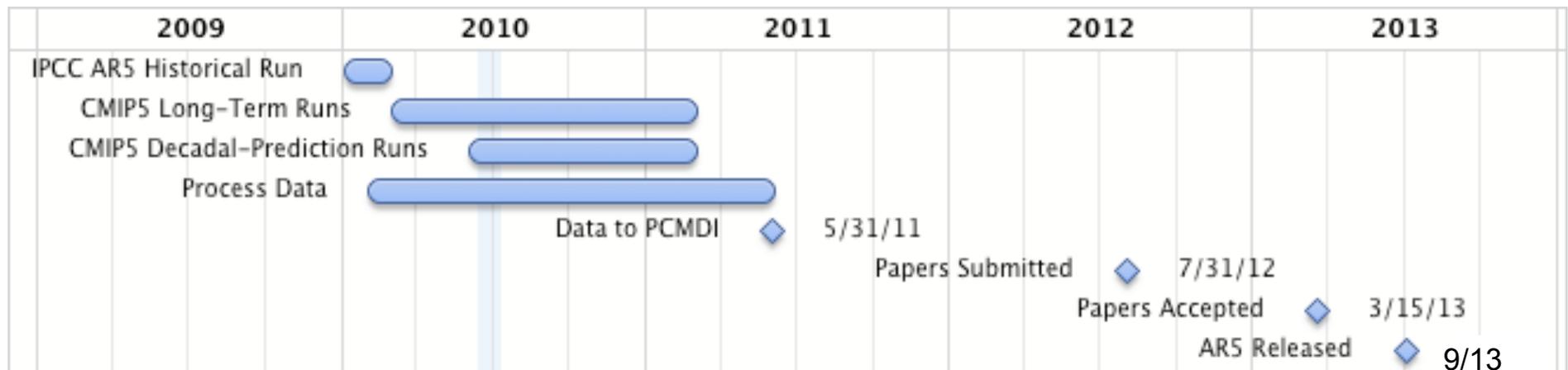
Analysis of climate variability and climate change; geoengineering runs; continue CMIP5 experiments; cloud-resolving CESM

High-resolution decadal prediction experiments; CCSM4/CESM perturbed physics ensembles
CESM single forcing experiments

CESM decadal prediction experiments; High-resolution coupled experiments; Special DOE scenarios for future US energy strategies

CCSM4/CESM, CAM-HOMME

CCWG CMIP5 experiments for assessment in IPCC AR5 Estimated Timeline



CMIP5 experiments performed

Representative Concentration Pathways (RCPs)

