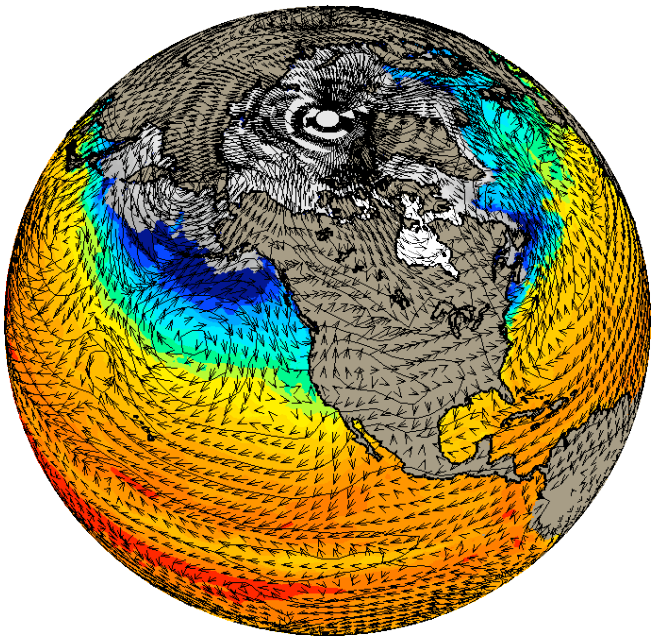


# Issues for Climate Prediction and Climate Services

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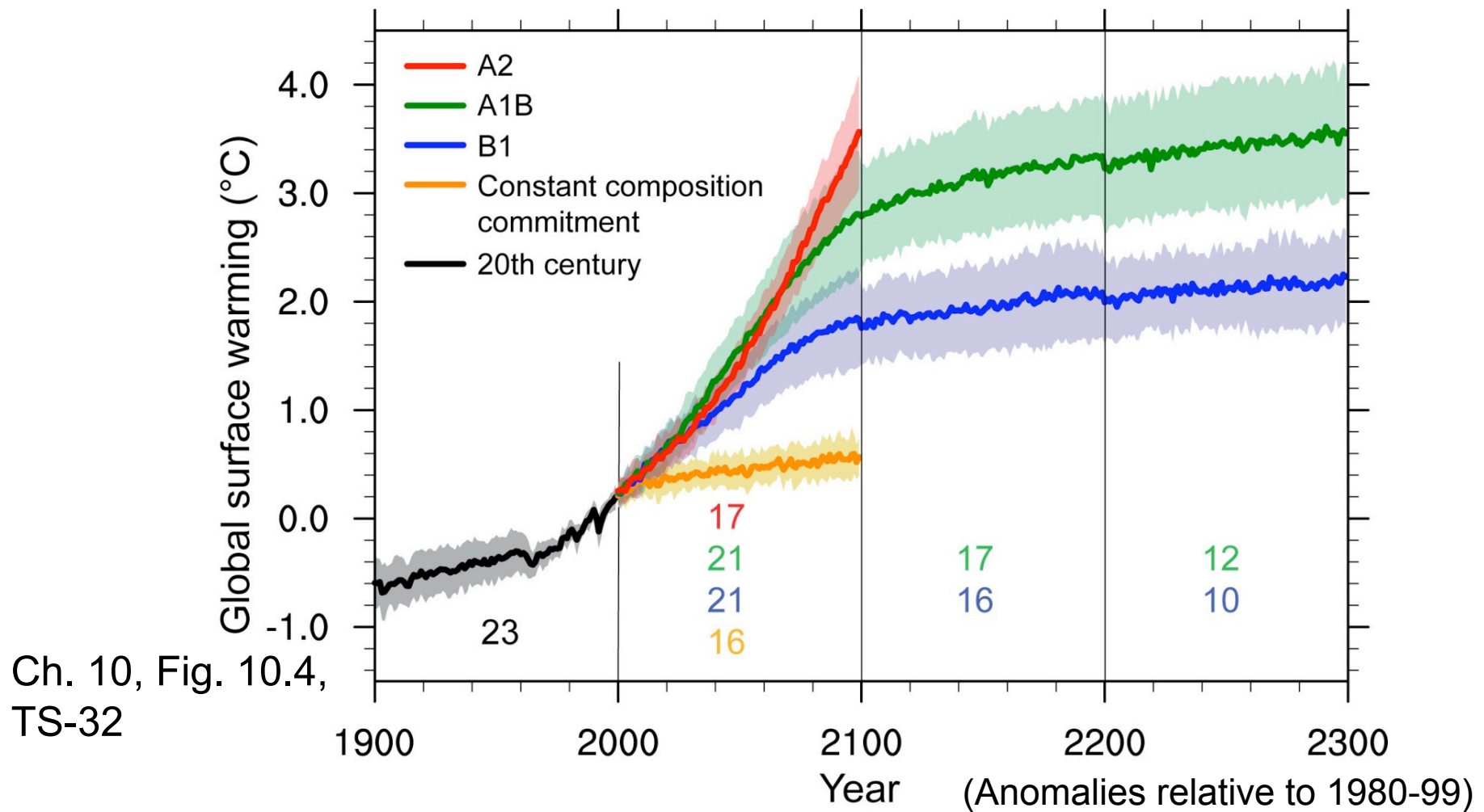


Climate services are dictated by societal needs and will rely on time-evolving regional climate predictions from now until 2100 and beyond

The next round of climate change experiments, the Coupled Model Intercomparison Project phase 5 (CMIP5), is starting now (about 20 global climate change modeling groups in 12 countries around the world)

CMIP5 is being coordinated by WCRP through its Working Group on Coupled Models (WGCM) in collaboration with many elements of the climate science community

**In addition to climate predictions, science must be part of any organized climate service**



2007 IPCC AR4: CMIP3 multi-model dataset still a valid resource; will be maintained for at least the next several years

“what if” SRES scenarios (no mitigation) and idealized stabilization to quantify climate change commitment

Late in 2006, it became clear that a profound paradigm shift for climate change science was about to happen, with a direct implications for the emerging concept of climate services

The IPCC AR4 in 2007 saw the end of the past 20 years of non-mitigation scenarios run in global climate models

Climate change science is now focusing on mitigation/adaptation

**New mitigation scenarios target certain levels of climate change that require policy actions**

**With different mitigation choices, what is the remaining time-evolving regional climate change to which human societies will have to adapt?**

**The new paradigm for climate change prediction (first formulated at an Aspen Global Change Institute session in summer 2006):**

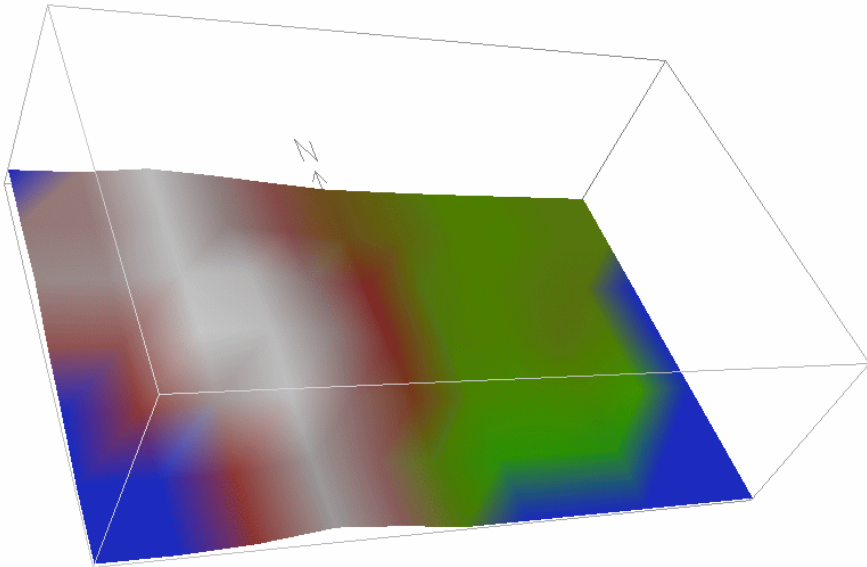
**decadal prediction** with relatively high resolution AOGCMs (~50km) initialized for near-term climate change over the next 30 years

first generation **Earth System Models** (ESMs) with coupled carbon cycle and intermediate resolution (~150km) to study longer term feedbacks past mid-century with new mitigation scenarios

Time slice global atmospheric models (higher resolution ~20km)

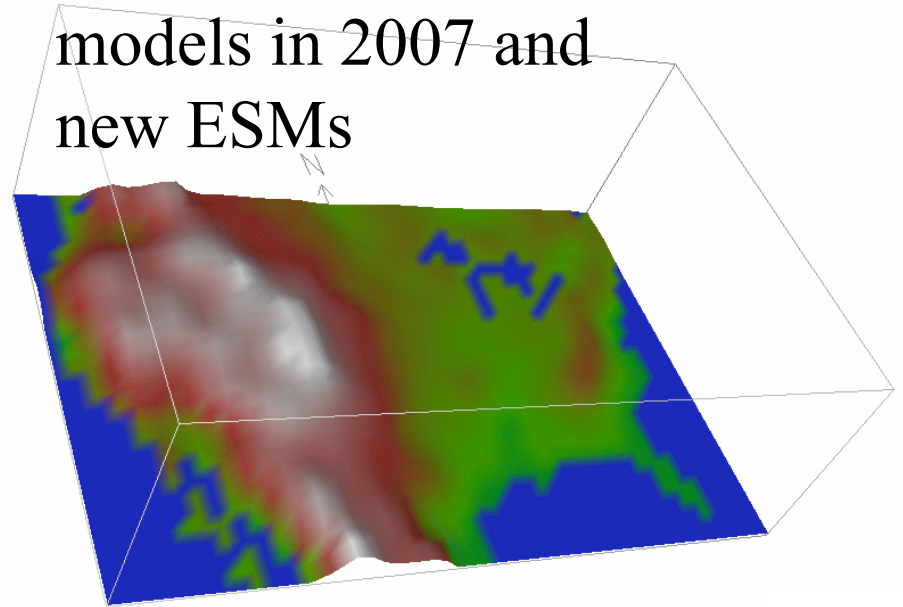
new **tangible linkages throughout the climate science community** WCRP, IGBP, IPCC Working Groups 2 (impacts/adaptation/vulnerability) and 3 (integrated assessment modeling and scenarios), and weather prediction community

Climate Models circa early 1990s



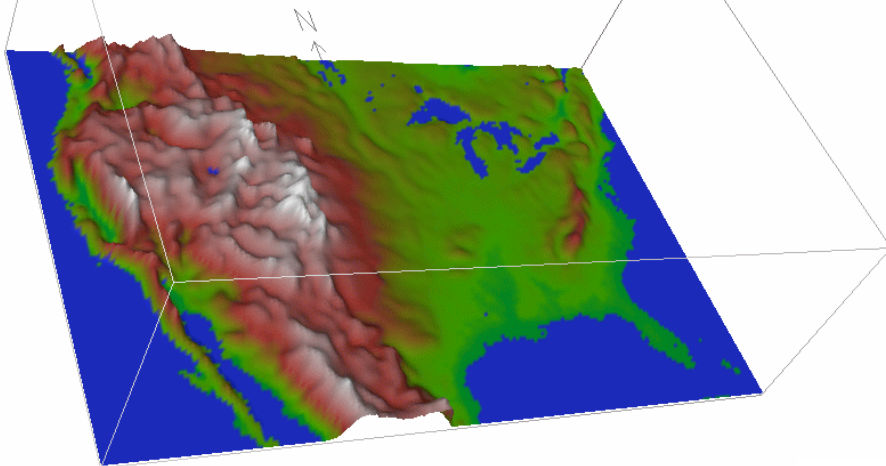
~500 km

Global coupled climate models in 2007 and new ESMs



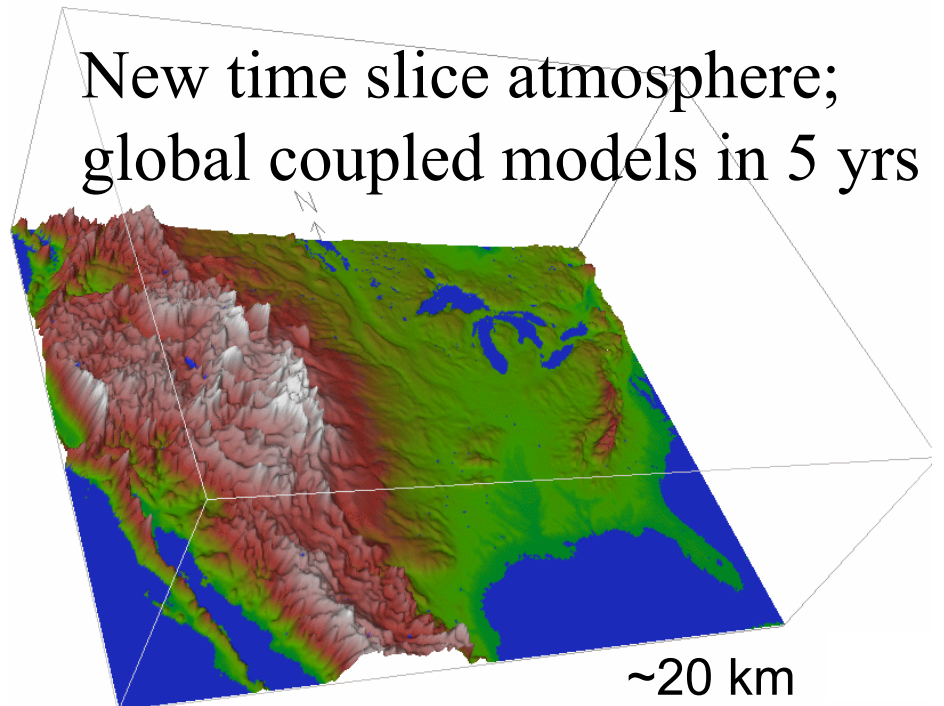
~100 – 200 km

New global coupled decadal prediction models



~50 km

New time slice atmosphere; global coupled models in 5 yrs



~20 km



A new set of climate change experiments: **CMIP5**

**CMIP5 is an experimental design for a five year framework (2008-2013) for climate change modeling**

**CMIP5 is not dictated by IPCC, but formulated by the climate science community**

**experiments completed by the end of 2010 will be assessed in the IPCC AR5**

**Output from these experiments relevant for climate services, but limitations and uncertainties must be communicated**

Crucial science questions will be addressed in CMIP5

For example:

For decadal prediction:

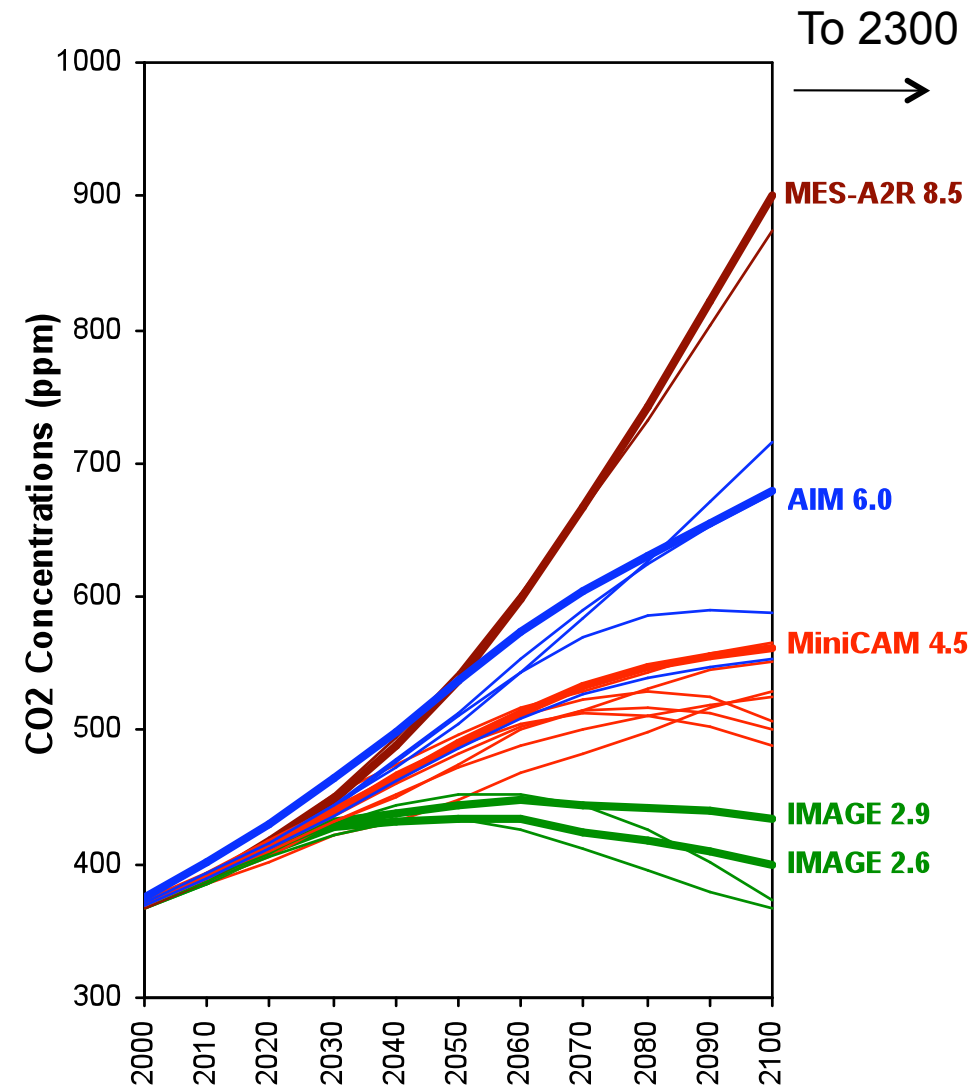
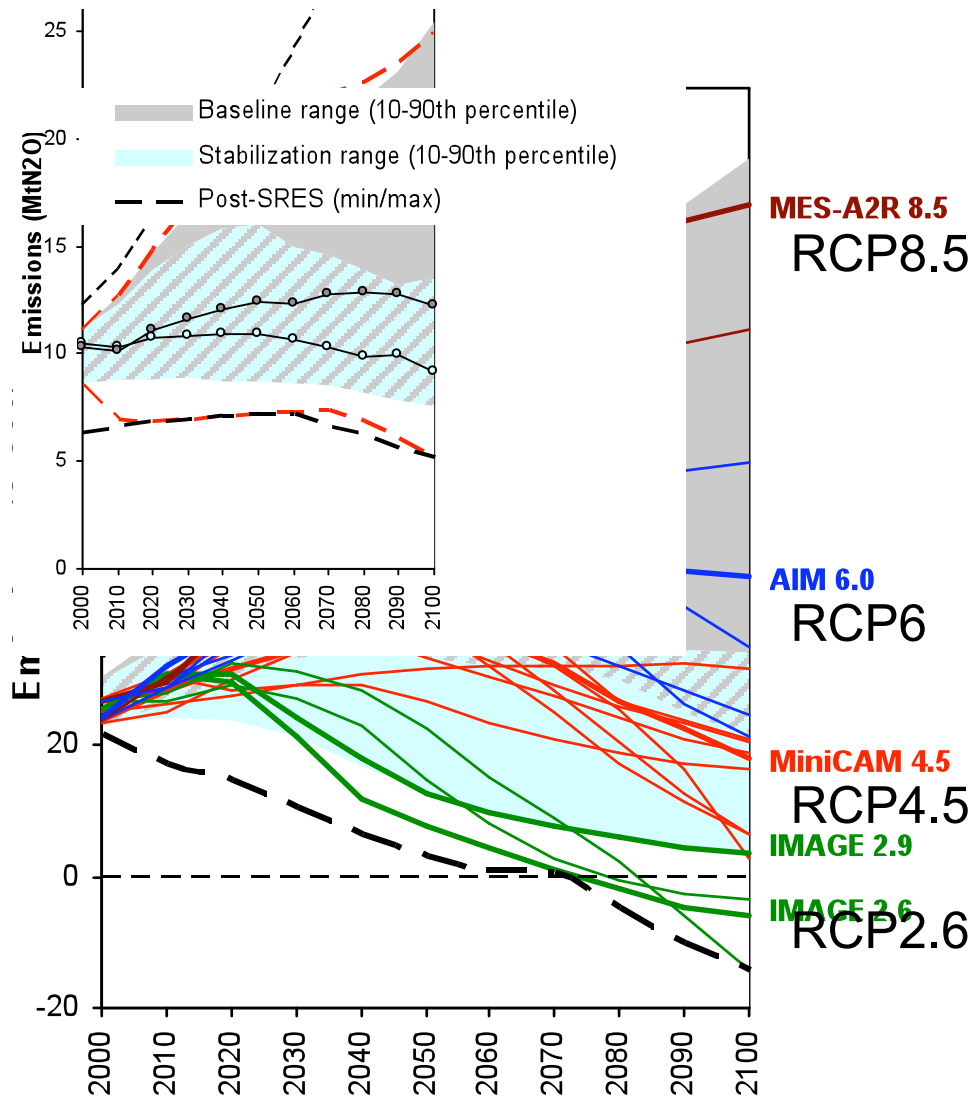
**what are the time-evolving changes in regional climate change and extremes over the next few decades?  
(requires credible simulation of statistics of weather systems)**

For long term:

**what are the size and nature of carbon cycle and other feedbacks in the climate system, and what will be the resulting magnitude of climate change for different mitigation scenarios? (requires credible interaction and feedbacks among all elements of the climate system)**

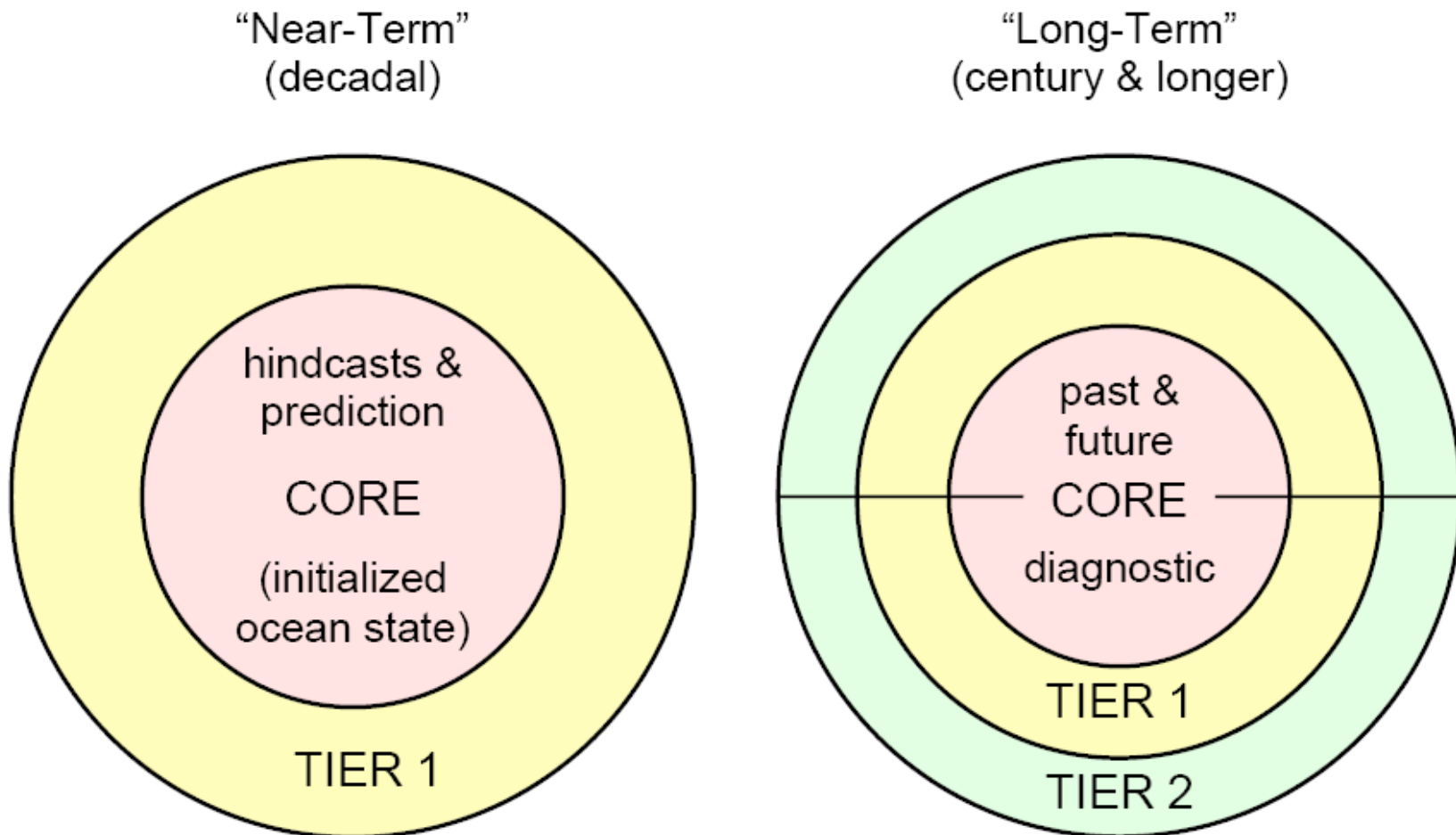


# New mitigation scenarios: representative concentration pathways (RCPs)



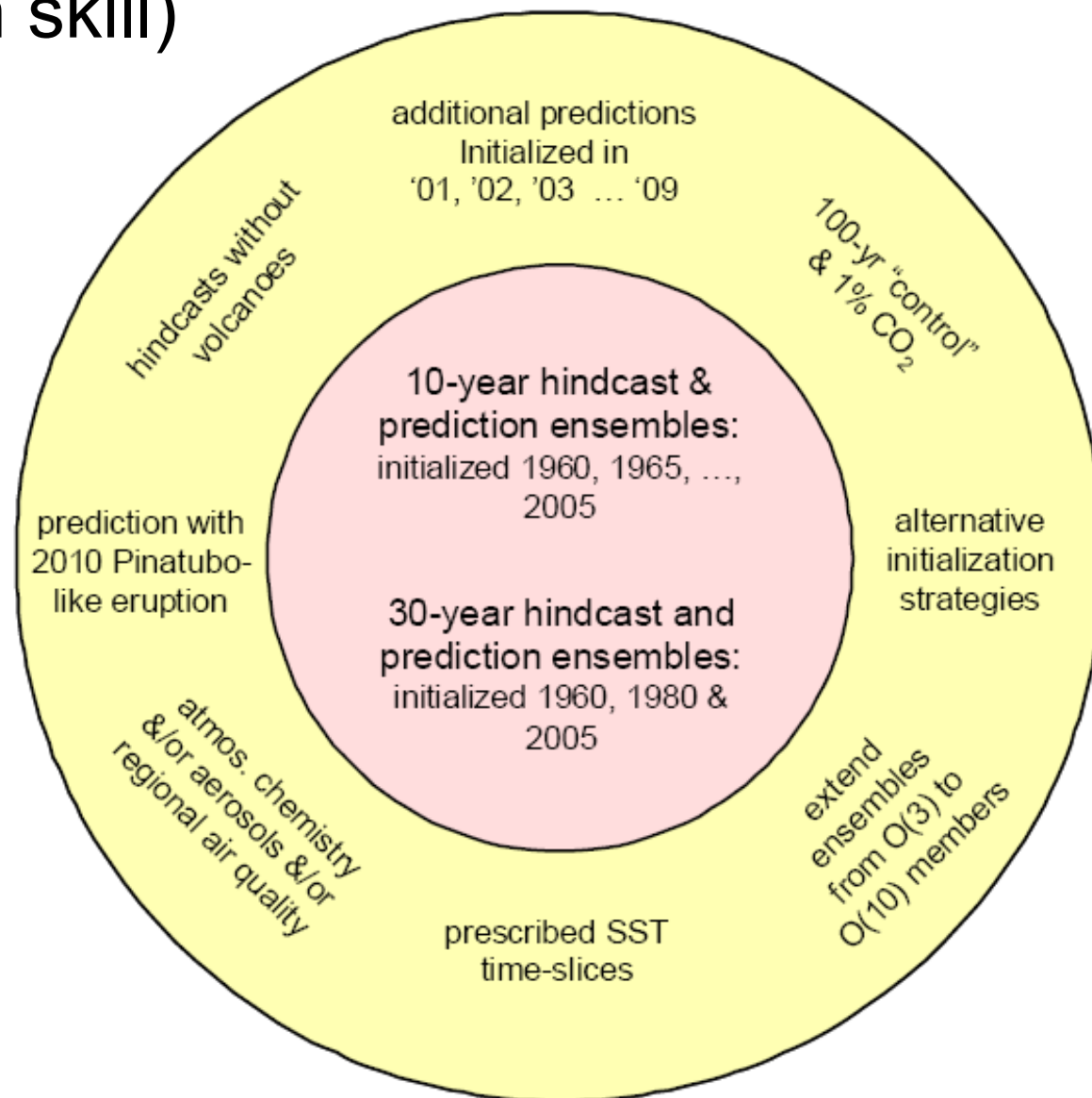
# CMIP5 : the new round of internationally coordinated climate change experiments

Two classes of models for two timescales and two sets of science problems



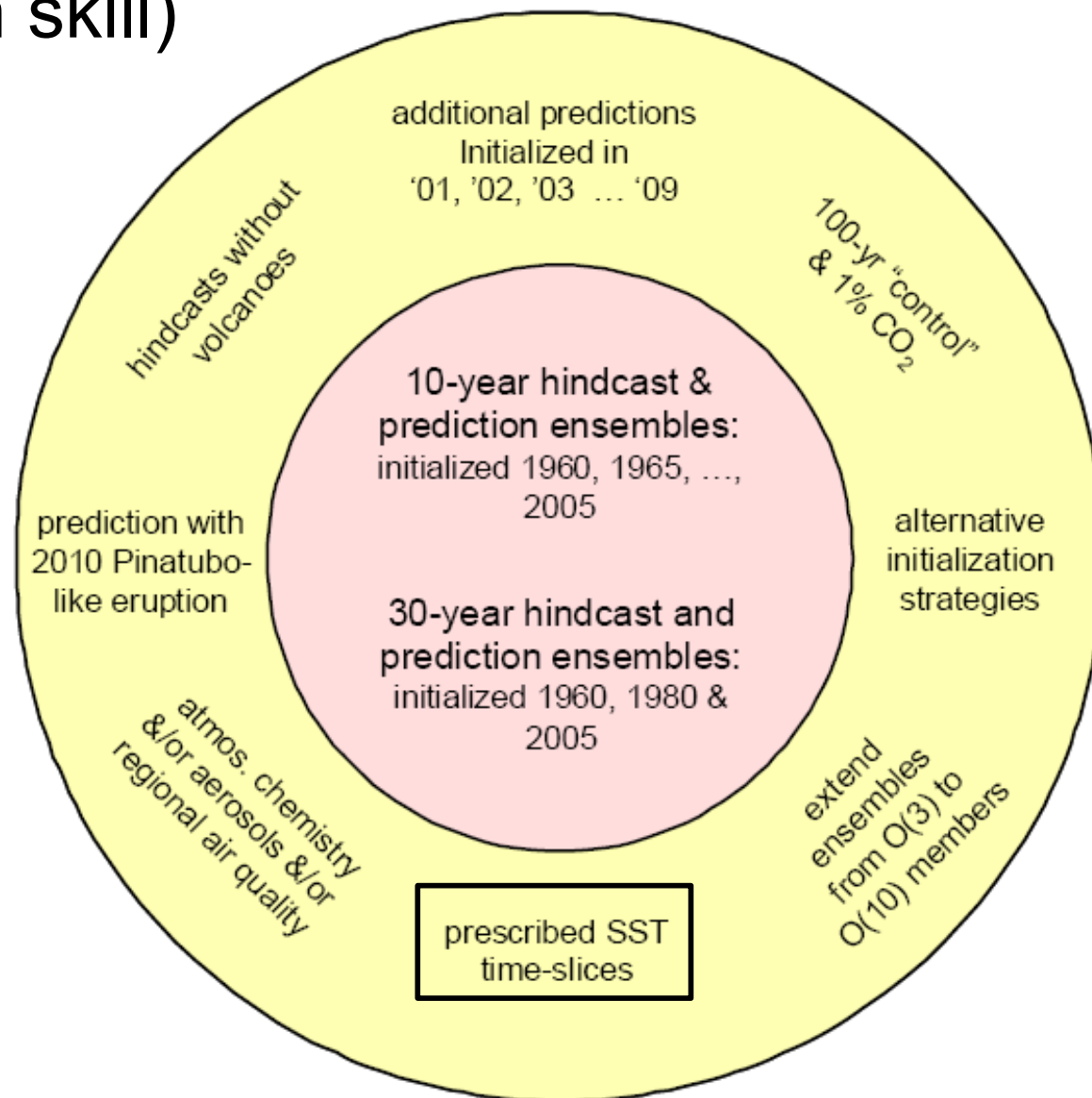
# CMIP5 Decadal Prediction (out to 2035)

(Many experiments are hindcasts to quantify prediction skill)



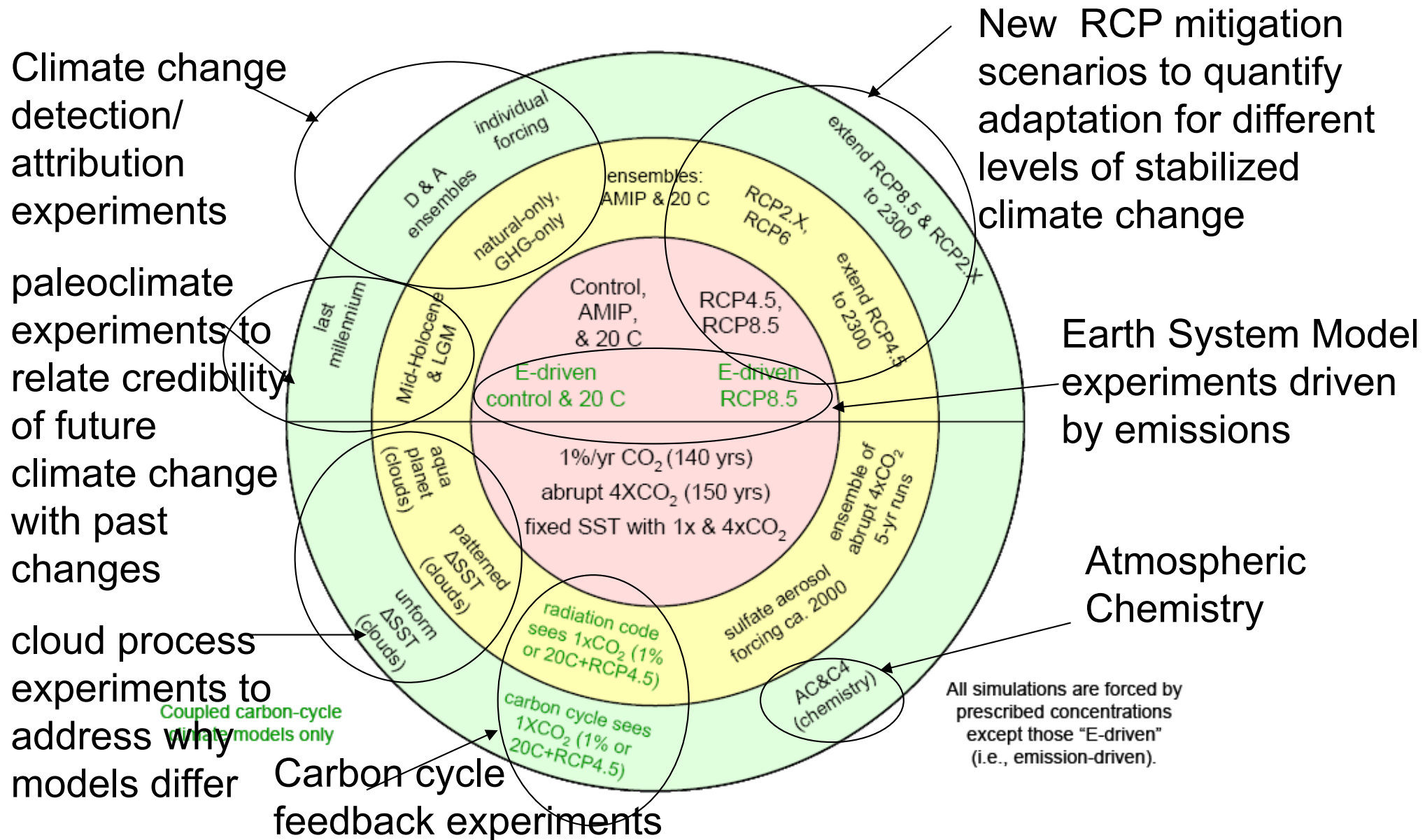
# CMIP5 Decadal Prediction (out to 2035)

(Many experiments are hindcasts to quantify prediction skill)



# Longer term CMIP5 experiments: First Generation Earth System Models (AOGCMs also)

focus on climate change beyond mid-century to 2300:



## Summary:

Climate services depend on climate change modeling simulations; the next round is CMIP5 coordinated by WCRP

Climate change science is now focused on mitigation/adaptation: new RCP mitigation scenarios imply policy decisions and options for targeted climate change stabilization at different levels

What is the regional, time-evolving climate change to which society will have to adapt?

Science must be a central element of any organized climate service

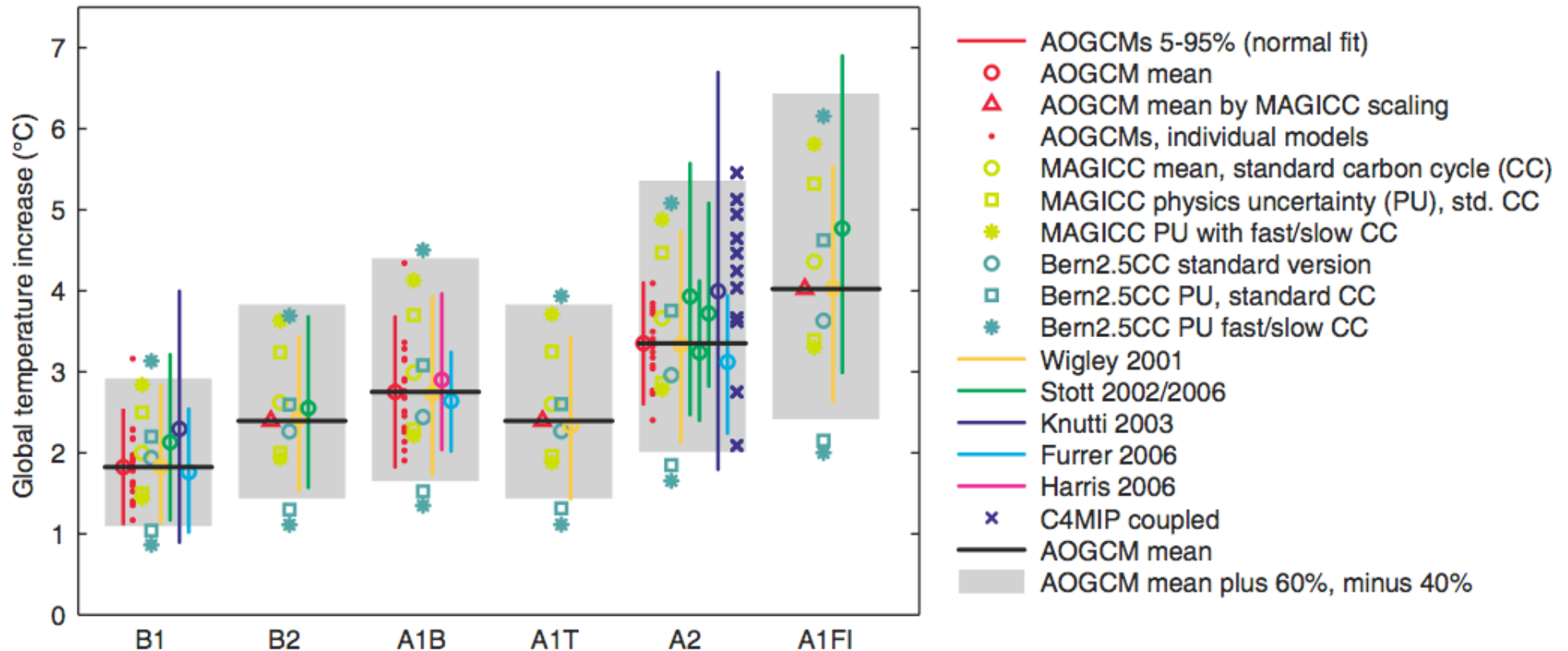
Limitations and uncertainties involved with climate change model predictions/projections must be communicated to users of climate services





# Why is there a spread among model projections?

## Part of the answer involves differences in the simulation of feedbacks



IPCC AR4 Fig. 10.29

**Greater uncertainty towards higher values due in part to uncertainty in the size and nature of the carbon cycle feedback**

Current status:

RCP scenarios to be released later this month

Modeling groups are finalizing new versions; likely that about 5 groups will have 50 km class AOGCMs for decadal prediction, and at least 10 groups will have ESMs

Model simulations to be assessed in the AR5 completed in 2010

PCMDI will begin to compile model data mid-2010 (some using distributed grid technology; some sent in by disk as in CMIP3)

Analyses of model data begins late 2010 and continues through 2011

Modeling groups continue CMIP5 model simulations and analyses through 2013

IPCC AR5 WG1 report published early 2013

**Compared to a non-intervention reference scenario, emission reductions of about 70% by 2100 are required to prevent roughly half the change in temperature and precipitation that would otherwise occur. By 2100, the resulting stabilized global climate would ensure preservation of considerable Arctic sea ice and permafrost areas. Future heat waves would be 55% less intense, and sea level rise from thermal expansion would be about 57% lower than if a non-mitigation scenario was followed.**

## **Beyond 2013:**

Higher resolution ESMs (25 km atmosphere, 0.1 degree ocean; coupled carbon cycle, chemistry, aerosols, dynamic vegetation);

IAMs routinely merged with ESMs

initialized decadal predictions with 10 km AOGCMs

Time slice experiments with 5 km resolution atmospheric models and even higher resolution possible

Fully coupled Greenland and Antarctic ice sheet models in ESMs