



NCAR

# **Regional Climate Modeling Assessment and Experimentation at the National Center for Atmospheric Research**

**Peter Backlund  
Director, Research Relations  
NCAR**

**9 December 2008**

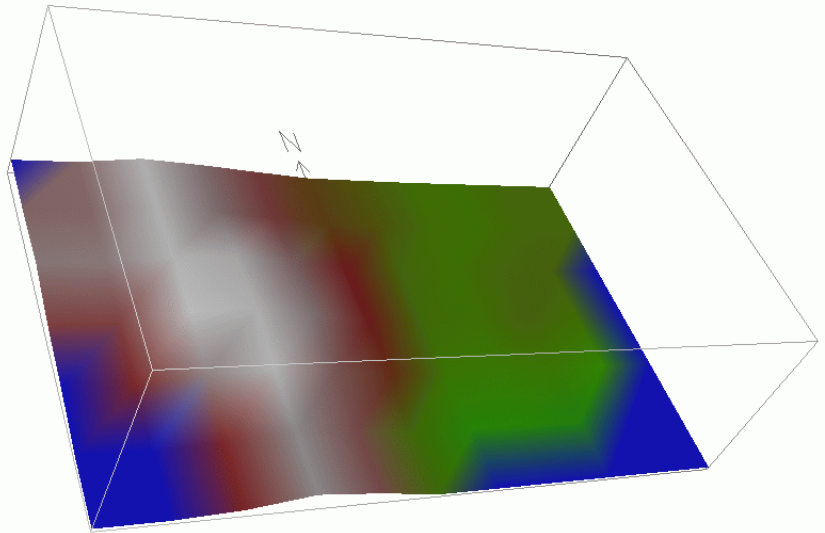
**National Center for Atmospheric Research**

# Outline for this Talk

North American Regional Climate Change  
Assessment Program (NARCCAP)

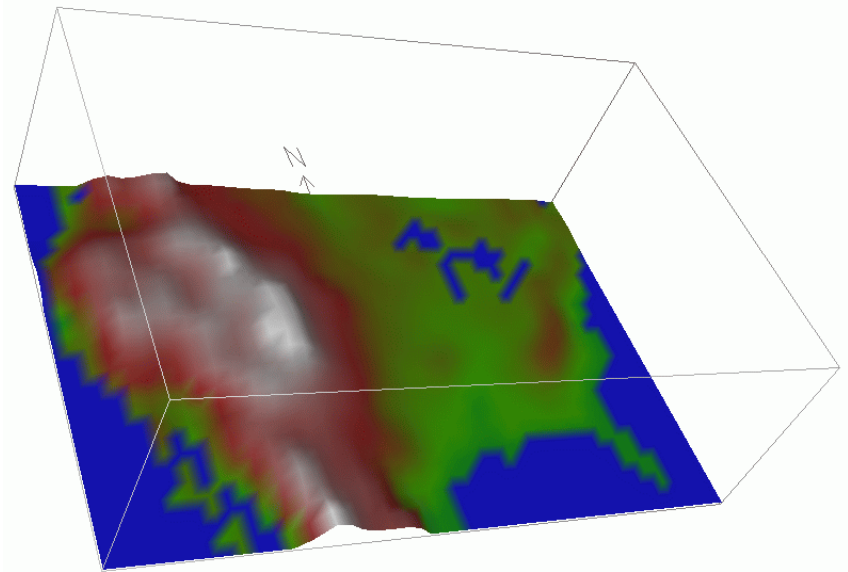
Nested Regional Climate Model (NRCM)

# Climate Models



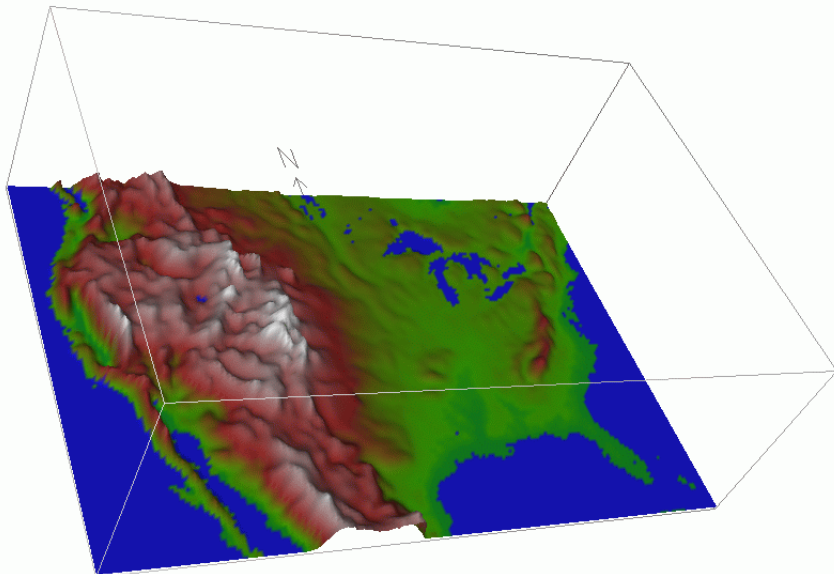
400 km

# Global forecast models



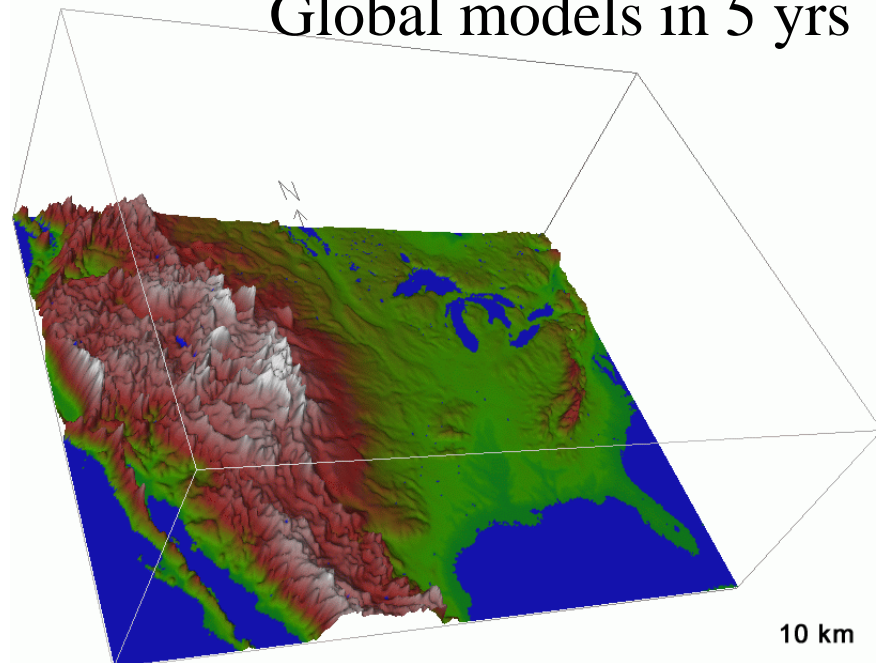
100 km

# Regional models



25 km

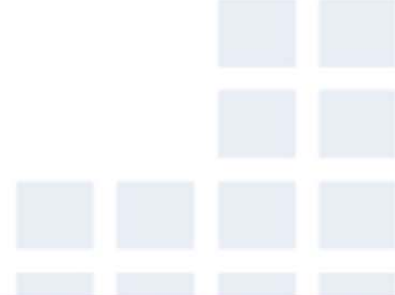
# Global models in 5 yrs



10 km



NCAR



# NARCCAP

PI: Linda O. Mearns, NCAR



National Center for Atmospheric Research



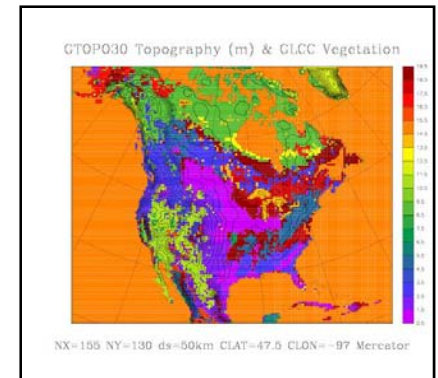
# The North American Regional Climate Change Assessment Program (NARCCAP)

Initiated in 2006, it is an international program that is producing high resolution climate simulations over North America

- Exploration and quantification of multiple uncertainties in regional model and global climate model regional projections.

4 AOGCMS (CCSM3, GFDL, HadCM3, CGCM3)  
6 RCMs (CRCM, HadRM3, MM5, RegCM3, RSM, WRF)

- Development of multiple high resolution regional climate scenarios for use in impacts assessments.
- Further evaluation of regional model performance over North America.
- Exploration of some remaining uncertainties in regional climate modeling (e.g., importance of compatibility of physics in nesting and nested models).
- Program has been funded by NOAA, NSF, DOE, EPA – 4-year program  
~ \$4 million

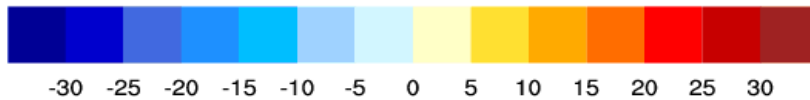
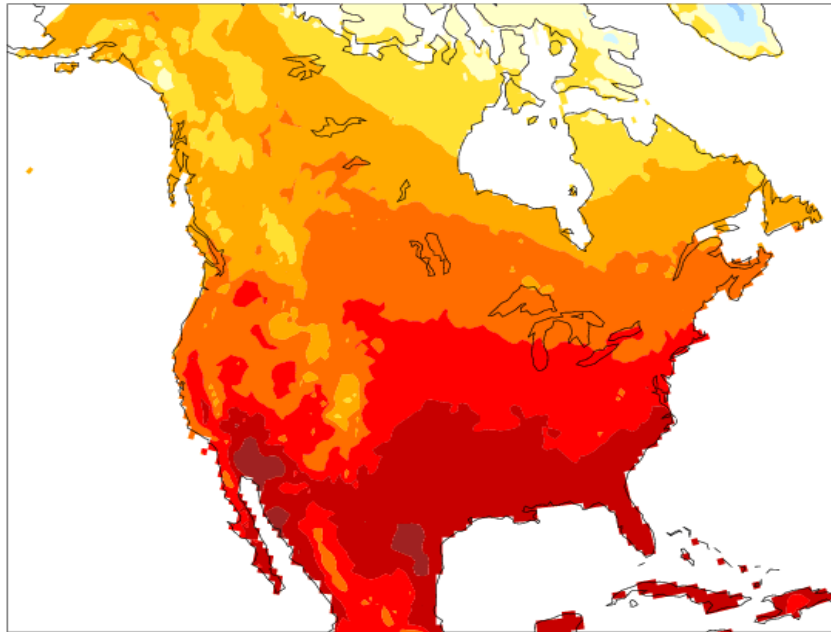


# Summer Temperature

## CRU obs., JJA seasonal avg, 1979-2002

near-surface temperature

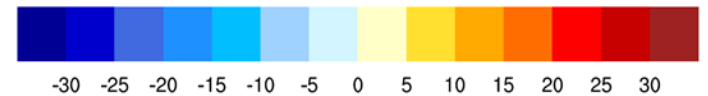
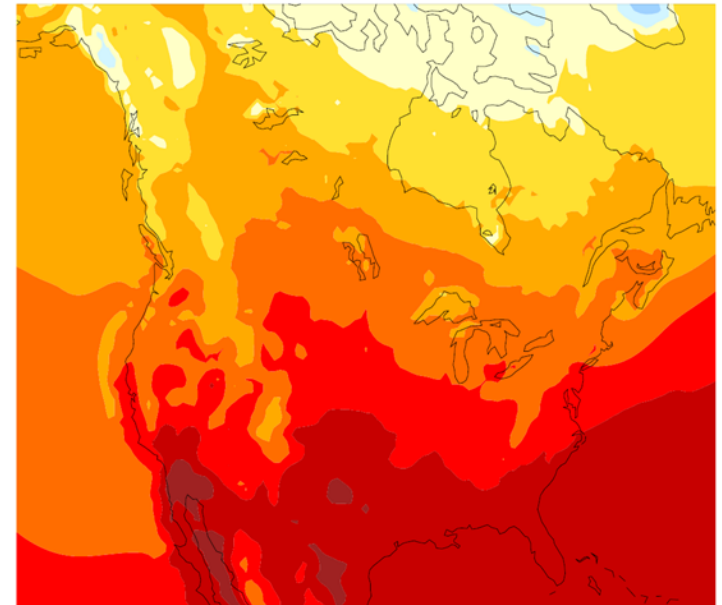
degrees Celsius



## MM5I+NCEP, JJA seasonal avg, 1979-2002

Surface Air Temperature

degrees C

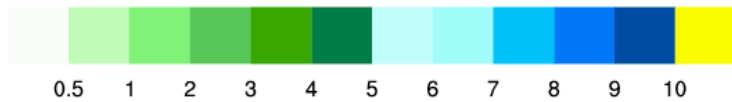
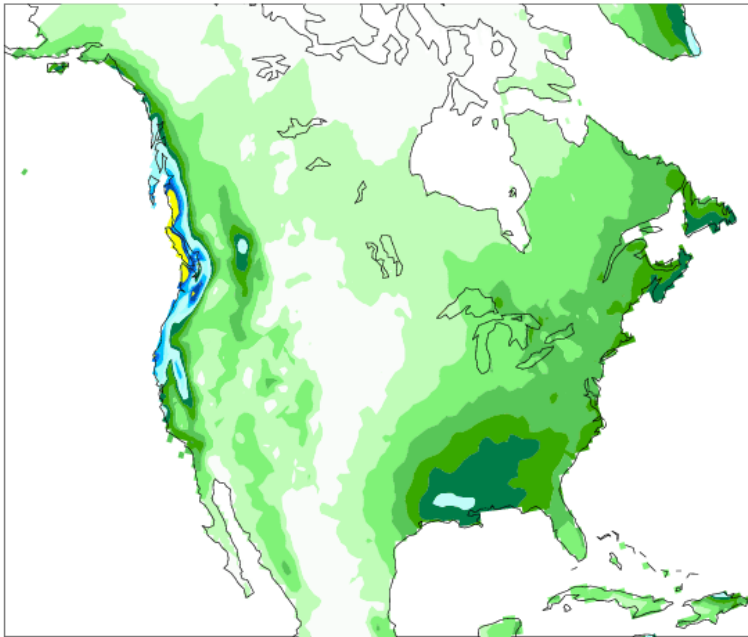




# Winter Precipitation

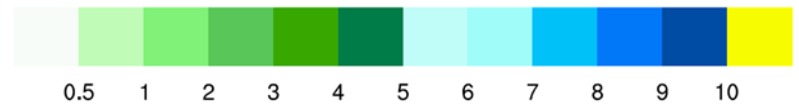
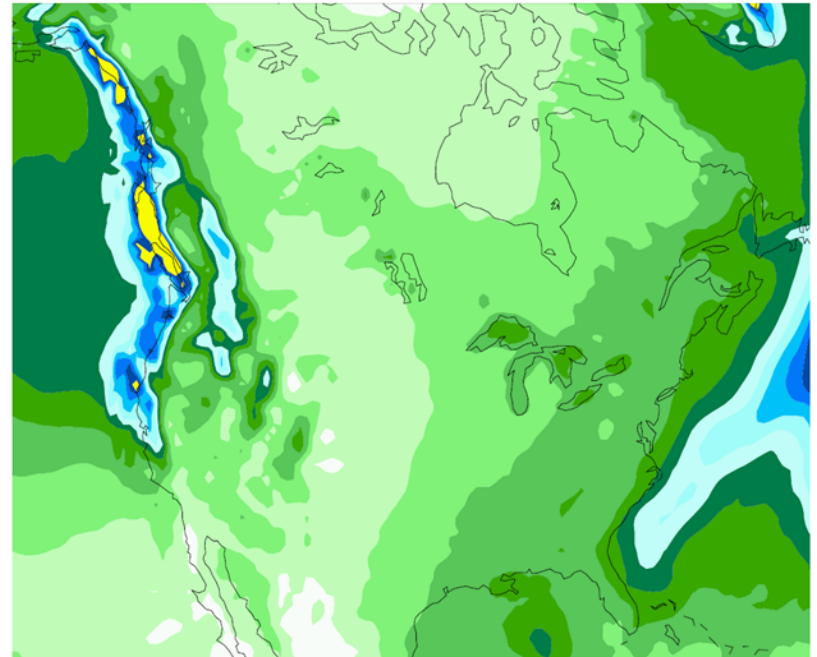
**CRU obs., DJF seasonal avg, 1979-2002**

precipitation mm/day



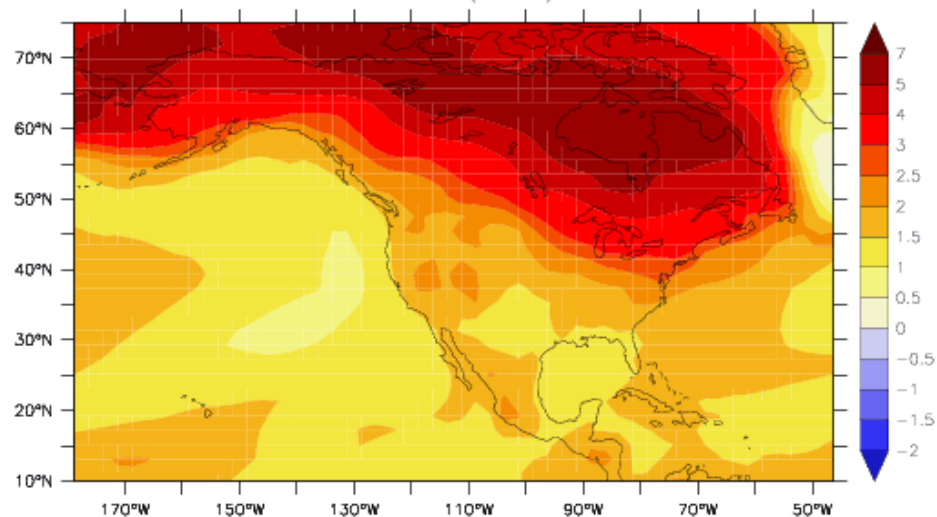
**MM5I+NCEP, DJF seasonal avg, 1979-2002**

Precipitation mm/day

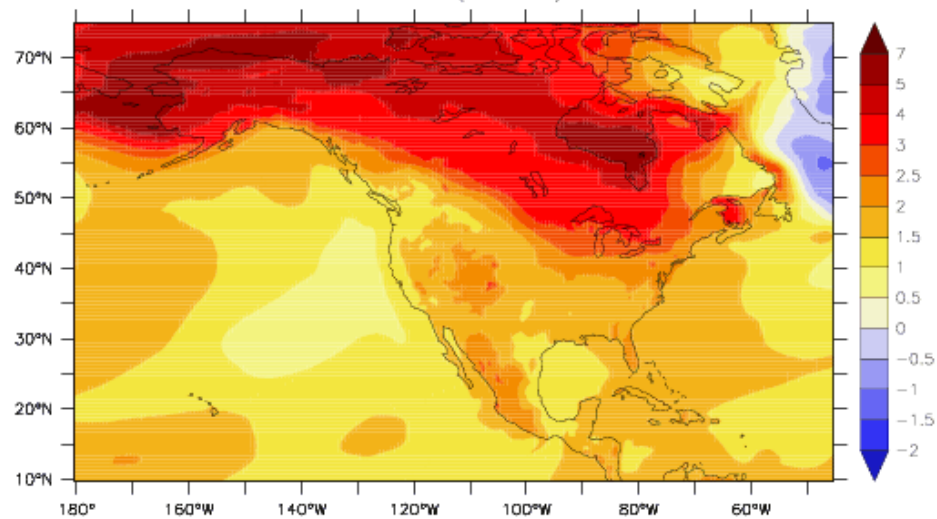


# Near Surface Air Temperature, deg C, DJF

CM2.1 (M45)



AM2.1 (M180)





# *From Global Projections to Regional Predictions: The Nested Regional Climate Model Approach*

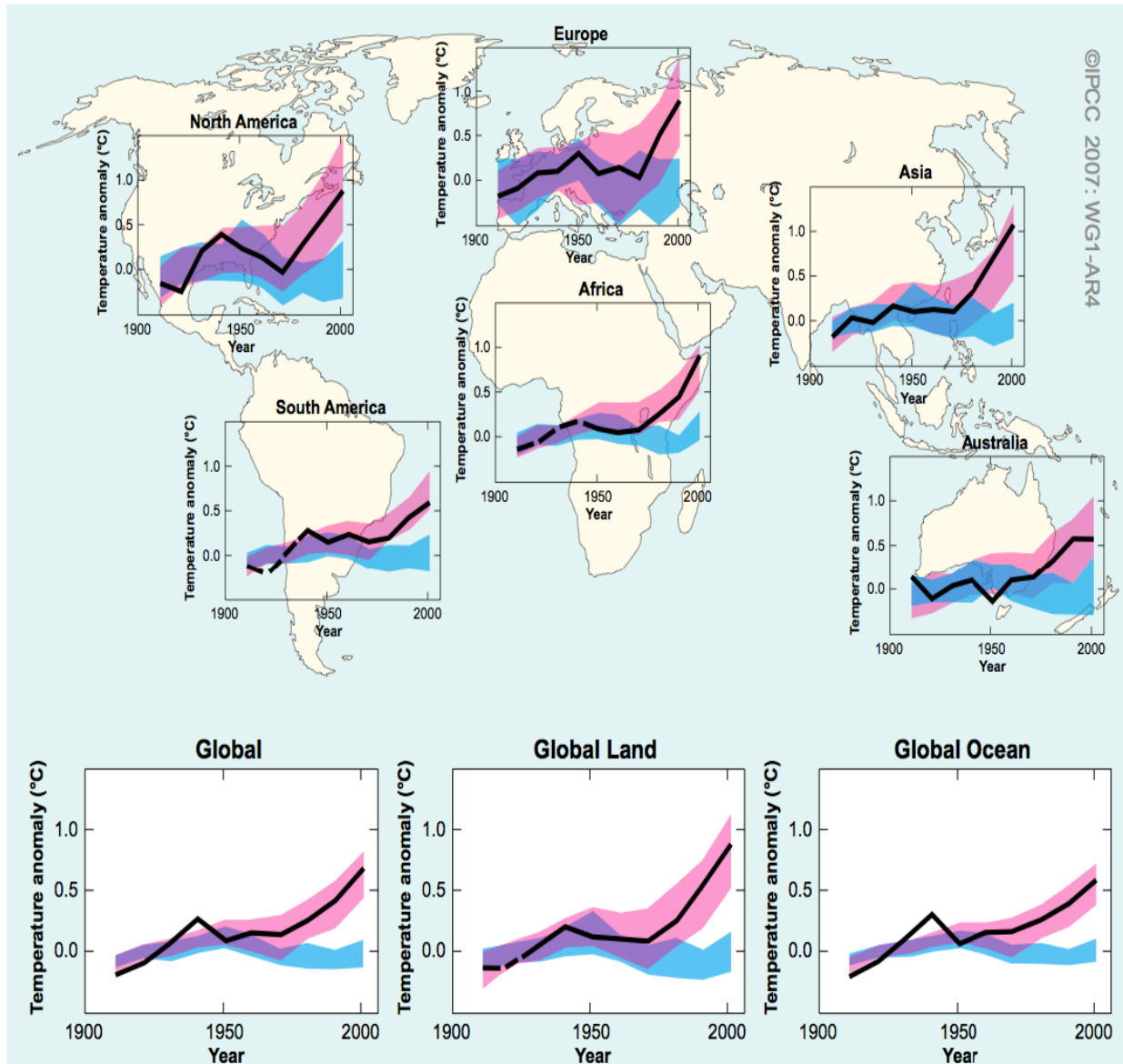
**PIs: Jim Hurrell and Greg Holland**

*CGD and MMM, NCAR*



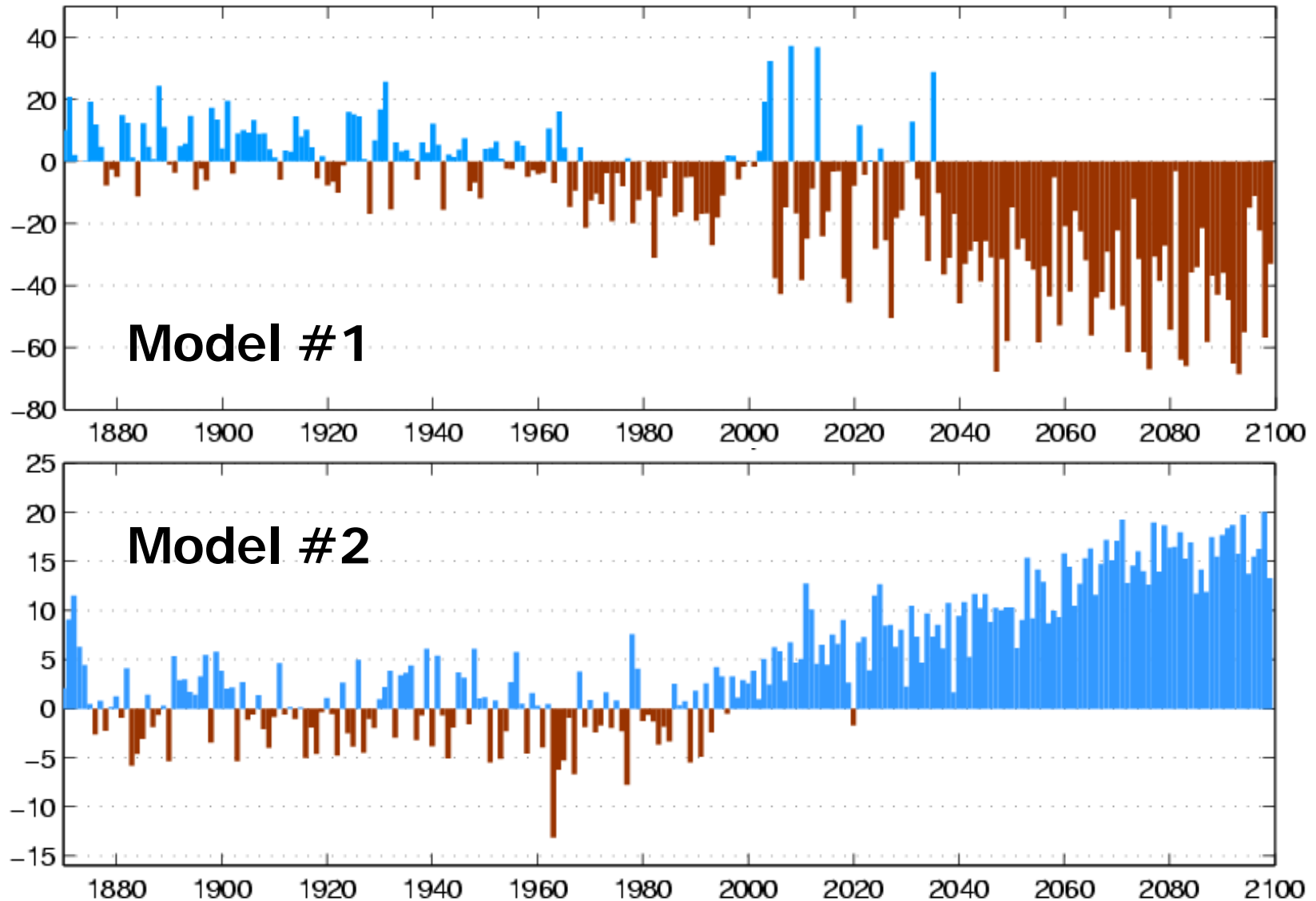
# *Simulation of 20<sup>th</sup> Century Warming*

## Global and Continental Temperature Change



# *Uncertainties in Regional Change*

## Sub-Saharan Rainfall





# Towards a Next Generation Climate-Weather-ESM

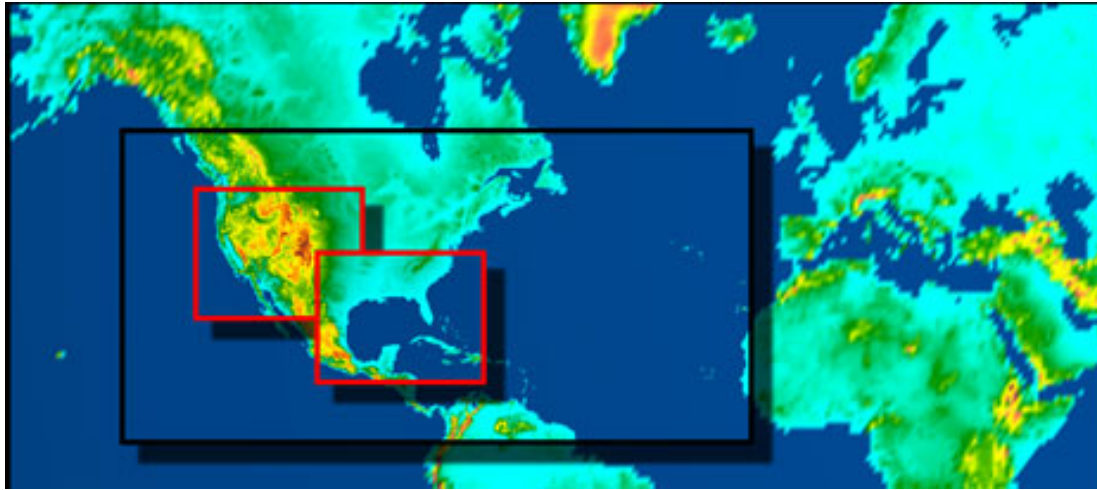


- Existing and future applications require (at least locally) meso-scale and cloud-scale resolution in a global model
- Current *climate* models are poor *weather* models, and current *weather* models are poor *climate* models.
- Opportunity to leverage the diverse interests and experience of the climate and weather communities to create and share a next-generation atmospheric simulation system.
- New dynamic grids and solution methods capable of efficient operation on petascale computers

## Nested Regional Climate Model



# North Atlantic and North American Regional Climate Changes



The goal is to simulate the effects of climate change on precipitation across the intermountain West States and tropical cyclones, with a focus on the Gulf of Mexico.

- 36, 12 and 4 km domains nested into CCSM
- 1996-2005, then time slices out to 2050
- Multi-member ensembles for each period
- Dedicated time on NCAR IBM Power 6 (Bluefire) since July:
  - 24 nodes (~20% of total number of processors)
  - 36 (12) km simulations use 128 (256) processors per job
  - Will use 3.9M processor hours through 11/08
  - ~300 Tb of data (to date); 450 Tb total (including earlier runs)



# *Improving Predictions of Regional Changes in Weather and Climate*

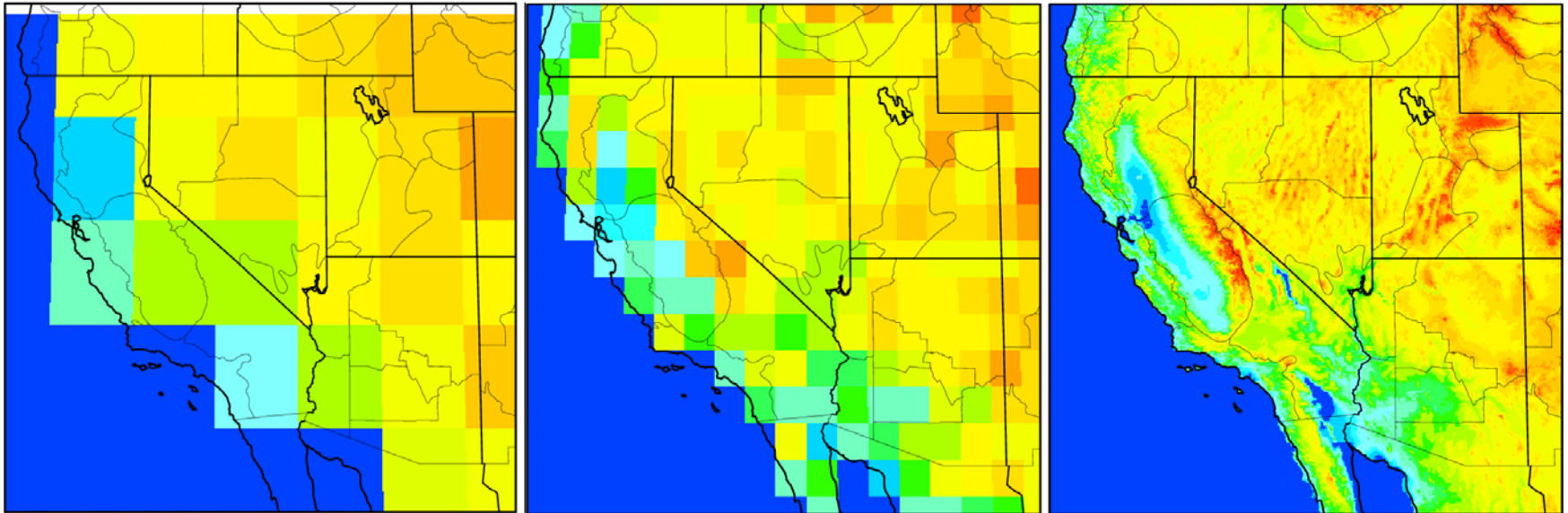
## **The Nested Regional Climate Model**

High Resolution Climate Modeling

IPCC (2007)

IPCC (2013)

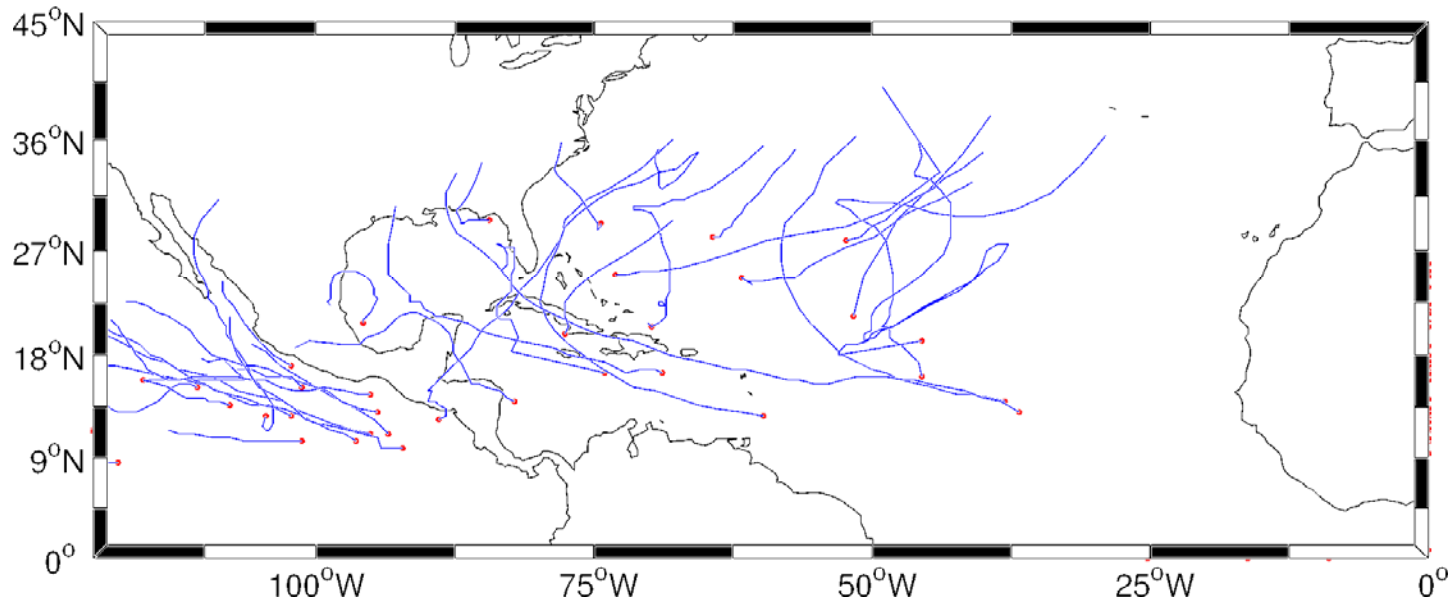
NRCM





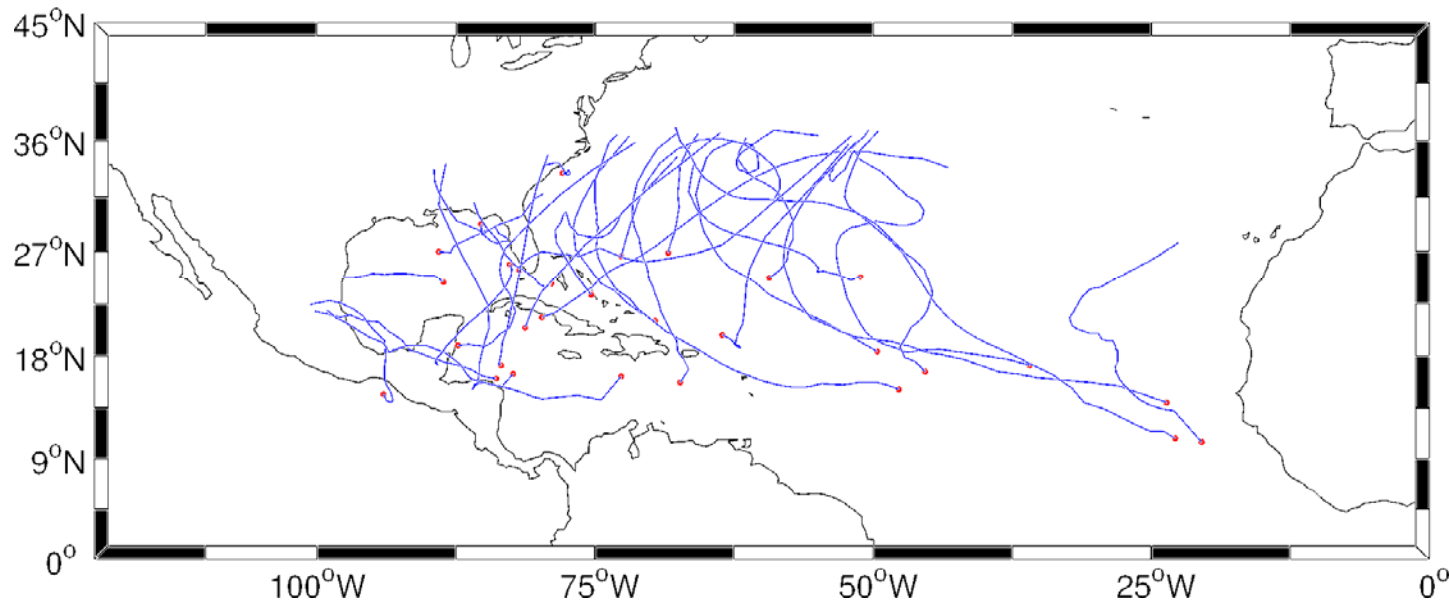
# ***Importance of Resolution***

NRCM 36km 2005



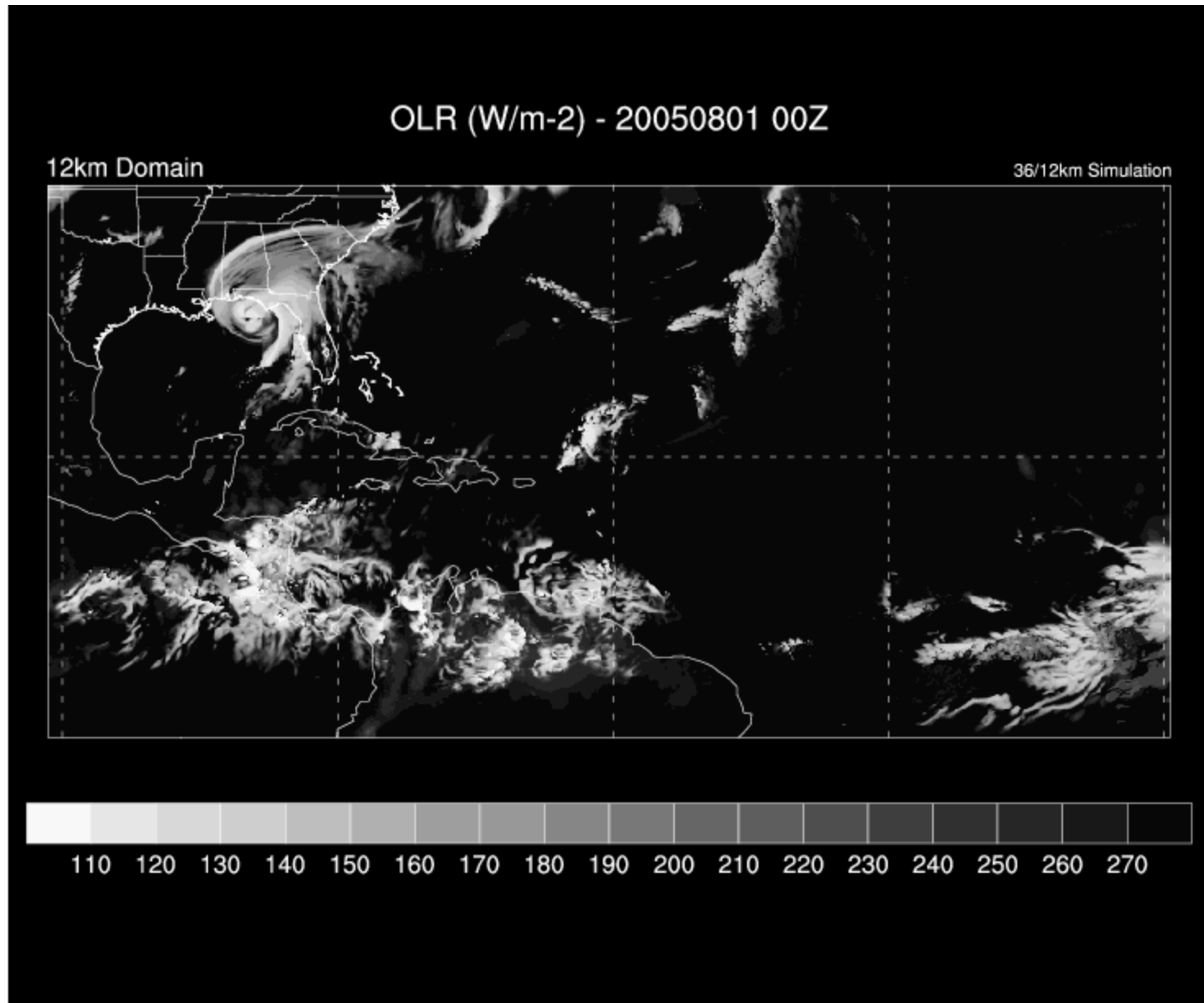
**18 storms**

NRCM Nested 12km 2005



**25 storms**

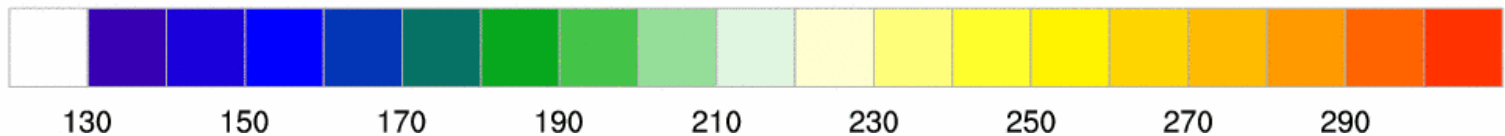
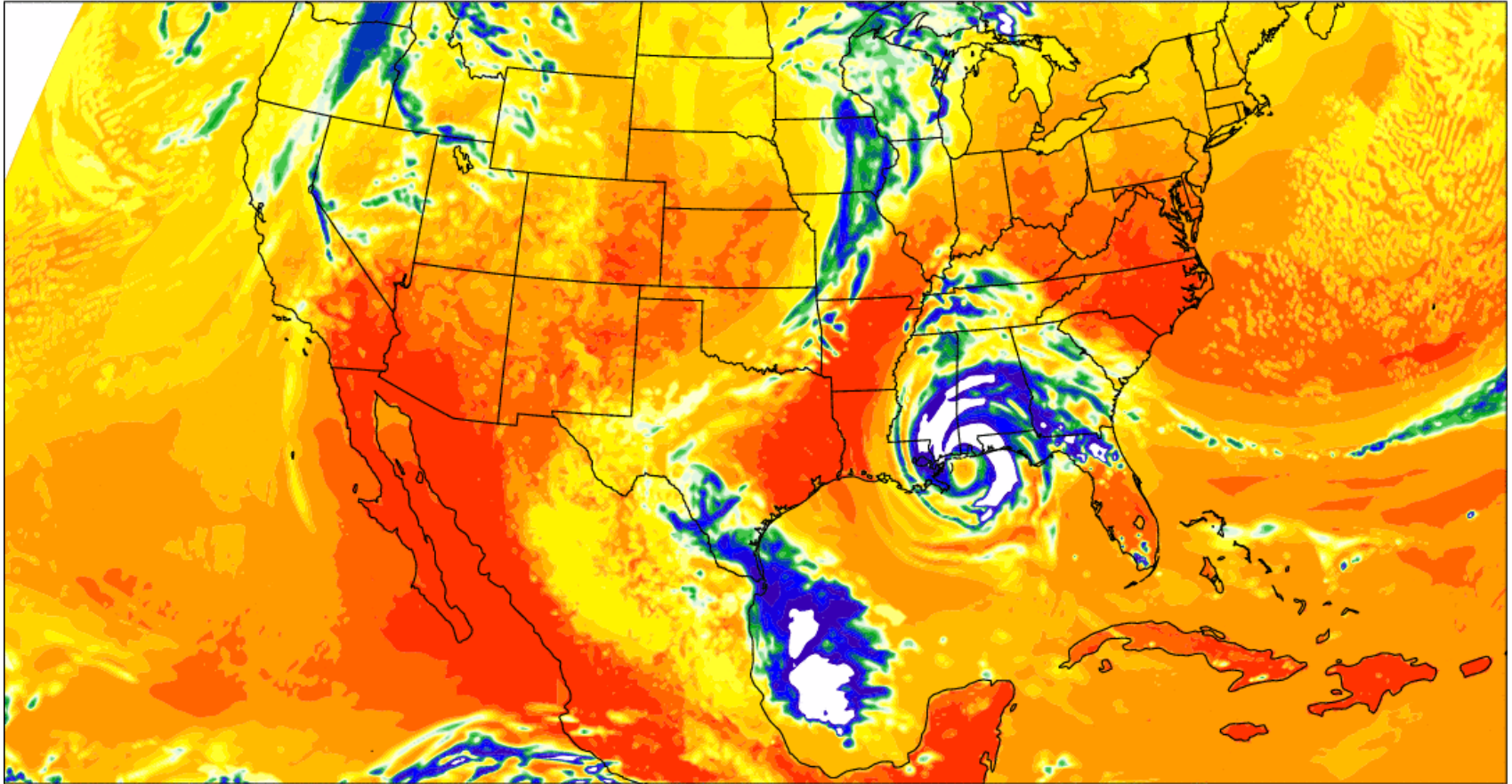
# *12 km Simulation of August 2005*



# *Simulation of October 2046*

TOA OUTGOING LONG WAVE

W m<sup>-2</sup>



# *Summary*

## **The Nested Regional Climate Model**

- Test bed for high-resolution climate modeling:
  - *Trial coupling weather and climate models to:*
    - *utilize the best of both;*
    - *improve fidelity of global climate simulations*
    - *provide forecasts of changes in high impact weather and extremes*
  - *Develop a new community of regional climate prediction experts and assist local decision makers*
- New community model
- Inform development of next-generation models
- A tool for cutting-edge science

End

Thank You