From Global Projections to Regional Predictions

The Nested Regional Climate Model
www.nrcm.ucar.edu

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Projection of Future Warming

Lower CO₂ Increases

Higher CO₂ Increases
Projection of Precipitation Change

multi-model  A1B  DJF

multi-model  A1B  JJA
"Models still show significant errors ... The ultimate source of most is that many important small-scale processes are not represented explicitly in models ..."

Randall et al. 2007
Improving Predictions of Regional Changes in Weather and Climate

- Goal of NRCM is to seamlessly integrate weather (WRF), high resolution ocean (ROMS) and climate models (CCSM) to:
  - better capture and investigate important space/time scale interactions
  - develop approaches for reducing biases
  - inform the development of next-generation Earth System Models
  - apply to model to challenging science and important societal questions
  - assist decision-makers to plan for regional changes

IPCC (2007)  ...  IPCC (2013)  ...  NRCM

Tropical Channel, 36 km, N/S boundaries
1-way nested into NCEP Reanalysis

6 Hour Total Rainfall (mm) - 19970101 00Z

Results to be published in Special Issue of *Climate Dynamics*
- J. Hurrell, Coordinating Editor
- ~12 papers documenting the experimental framework, NRCM strengths and weaknesses, including relevant comparisons to CAM

10th WRF Users’ Workshop  23-26 June 2009  Jim Hurrell, CGD
12 km Simulation of August 2005

OLR (W/m²) - 20050801 00Z

12km Domain

36/12km Simulation
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 WRF domains nested into CCSM
- 1996-2005, then time slices out to 2055
- Multi-member ensembles for each period
- Dedicated time on NCAR IBM Power 6 (July-Nov 2008):
  - 24 nodes (~20% of total number of processors)
  - 36 (12) km simulations use 128 (256) processors per job
  - Used 3.9M processor hours and generated > 300 Tb of data
April Snow Depth

Observations
National Hydrologic Remote Sensing Center

Climatology

CCSM3 T85
2045-2050

NRCM 12 km

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The Nested Regional Climate Model  
(www.nrcm.ucar.edu)

- Practical approach to high-resolution climate modeling:
  - 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/climate
  - Inform development of next-generation models
    - Unified atmospheric modeling system capable of predictions from hours to decades
      - non-hydrostatic dynamics with conservation properties for climate
      - coupled data assimilation system
      - capacity to run efficiently on massively-parallel computing system
  - Support as priority “Frontier” in NCAR strategic plan
    - Western Governor’s Assoc. and California Water Agencies (western water)
    - DOE, Offshore Oil Industry and Reinsurance Industry (hurricanes)
    - DOE, NRL, CREW, Colorado, local industry (wind energy production)
Thank You