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NARCCAP

NARCCAP Second Users' Meeting

Welcome!

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Boulder, CO

September 10-11, 2009

Meeting Goals

- Learn about NARCCAP – conceptually and nuts and bolts
- Interact with modelers and other scientists on NARCCAP Team– get questions answered – give users' perspectives
- Network with other users with similar research interests - develop projects
- Discuss with NARCCAP Team further development ideas for data provision and information on web site for users
- Have fun!

Uncertainties about future climate

- The future trajectory of emissions of greenhouse gases (based on uncertainties about how the world will develop economically, socially, politically, technologically)
  - Explored through the development of scenarios of future world development
- How the climate system responds to increasing greenhouse gases.
  - Explored through use of climate models
  - Spatial scale at which climate models are run is an additional source of uncertainty

Concentrations of greenhouse gases in the atmosphere

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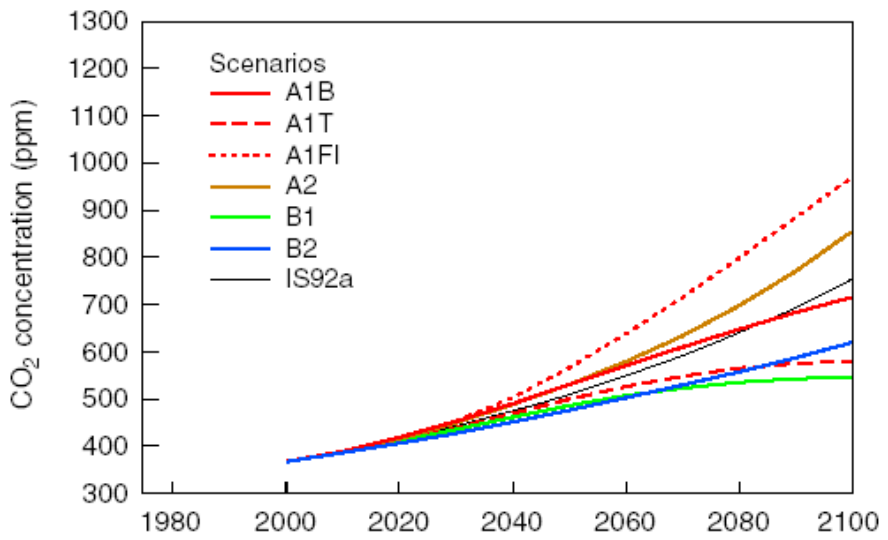

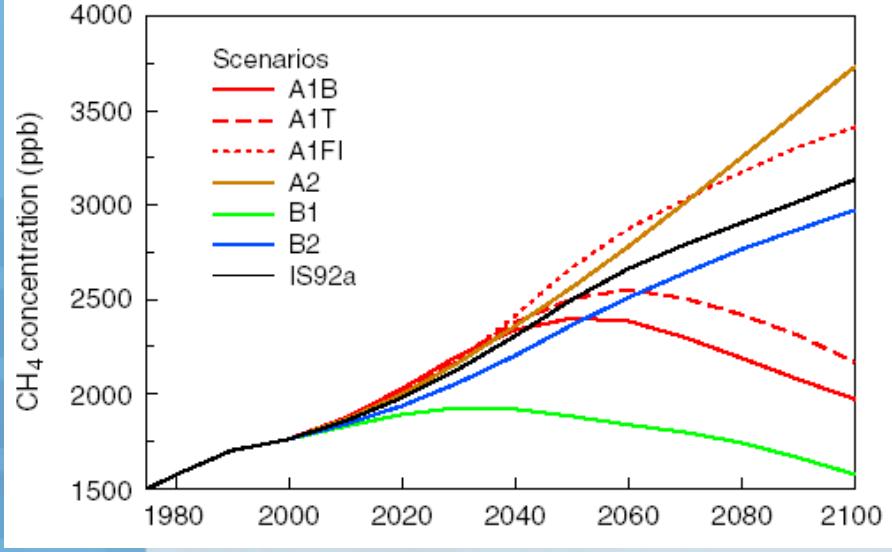

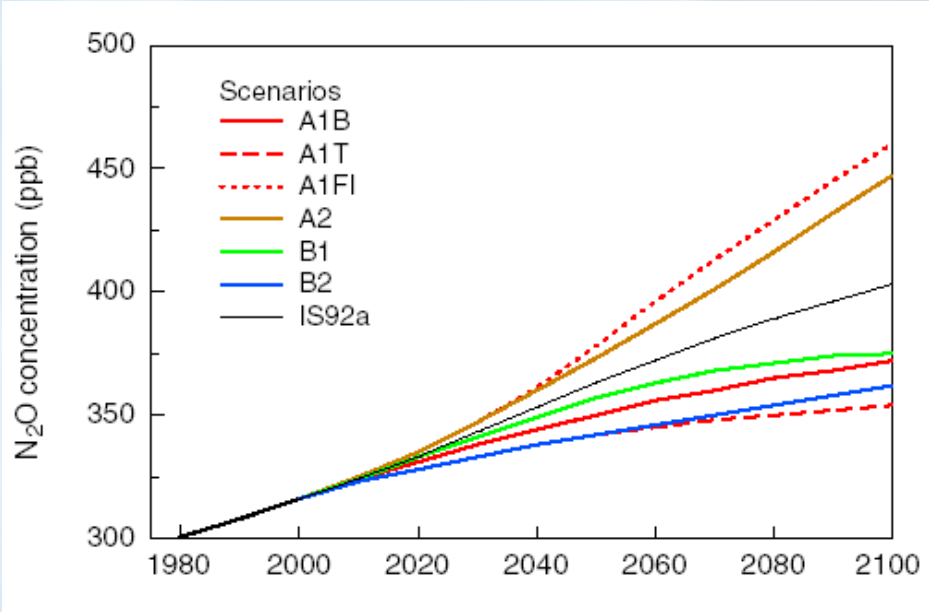

The Future

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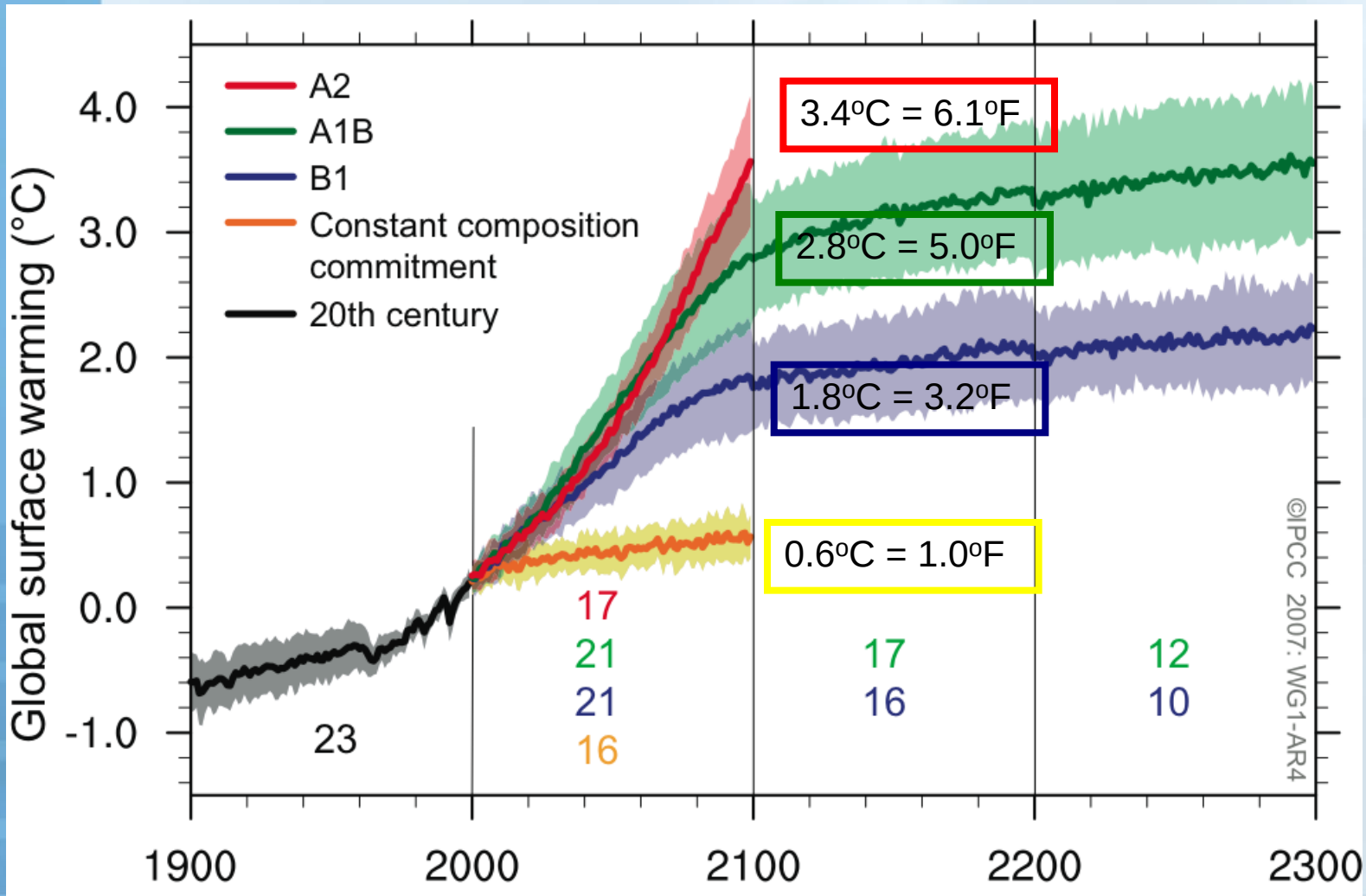
Warming will increase if GHG increase. If GHG were kept fixed at current levels, a committed 0.6°C of further warming would be expected by 2100. More warming would accompany more emission.



CO2 Eq

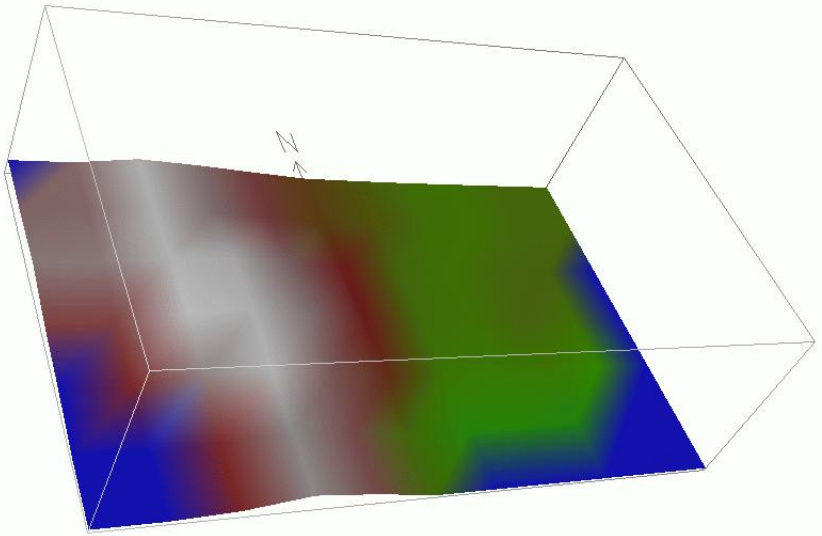
850

600

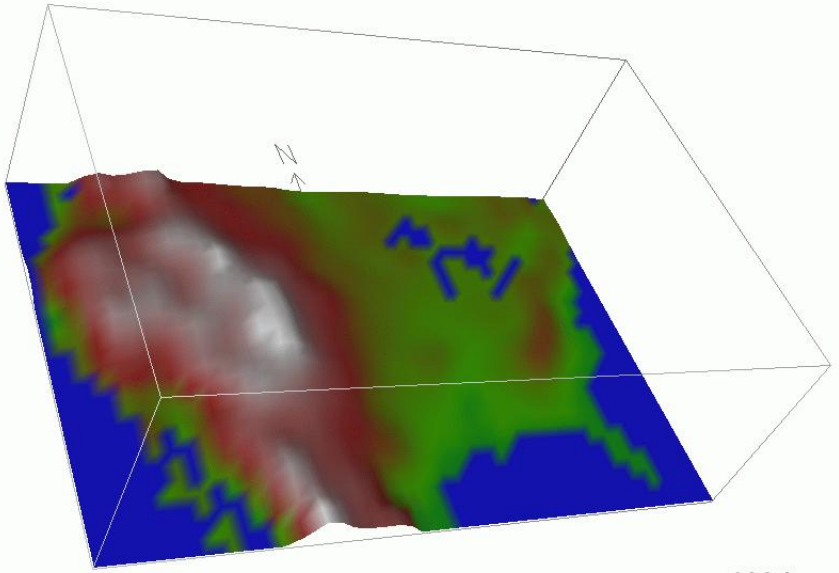
400

- What about higher resolution information about climate change?
- Global models run at about 200 km spatial resolution - what resolution do we need for adaptation planning in various sectors (water resources, agriculture etc.)
- How to balance the desire for higher resolution with the other major uncertainties (future emissions, general response of climate system).

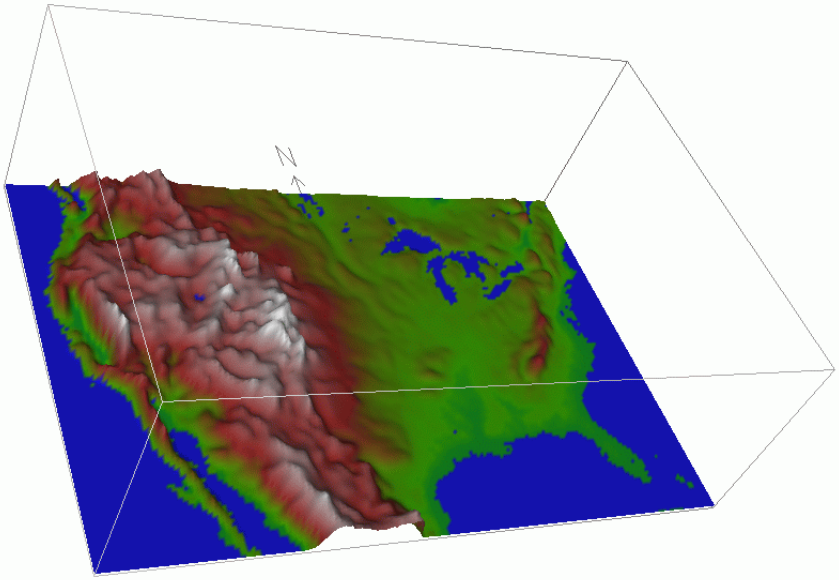
Climate Models



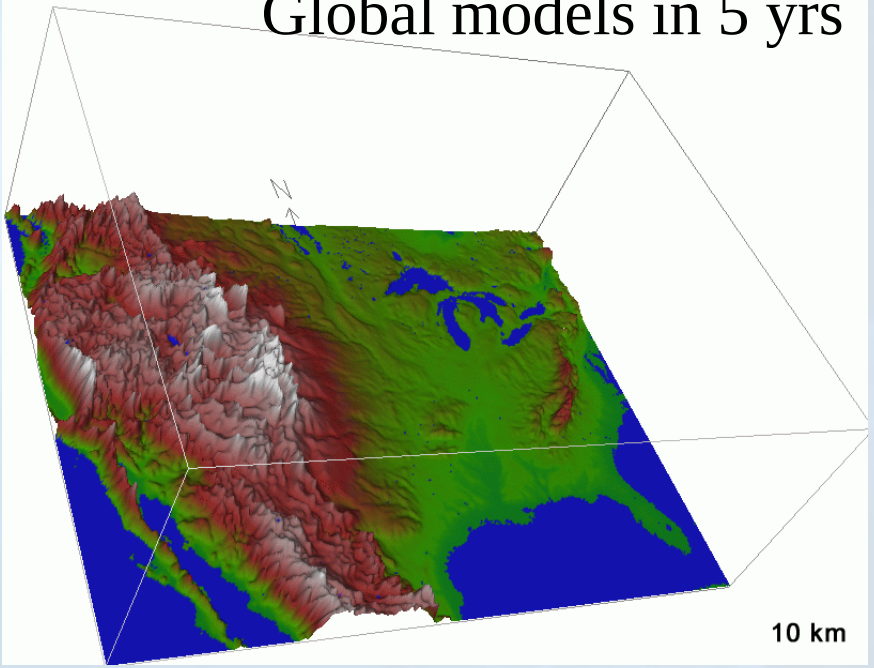
Global forecast models



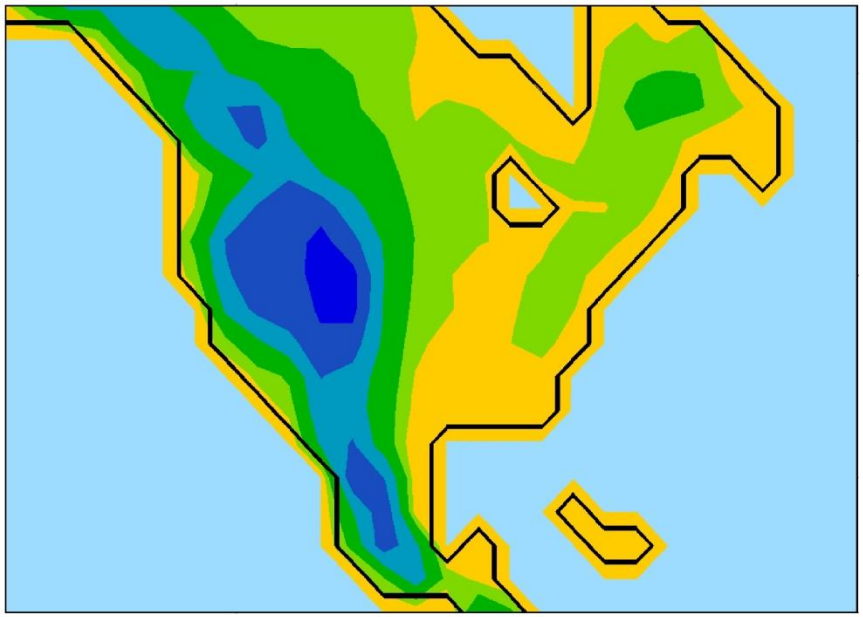
Regional models



Global models in 5 yrs

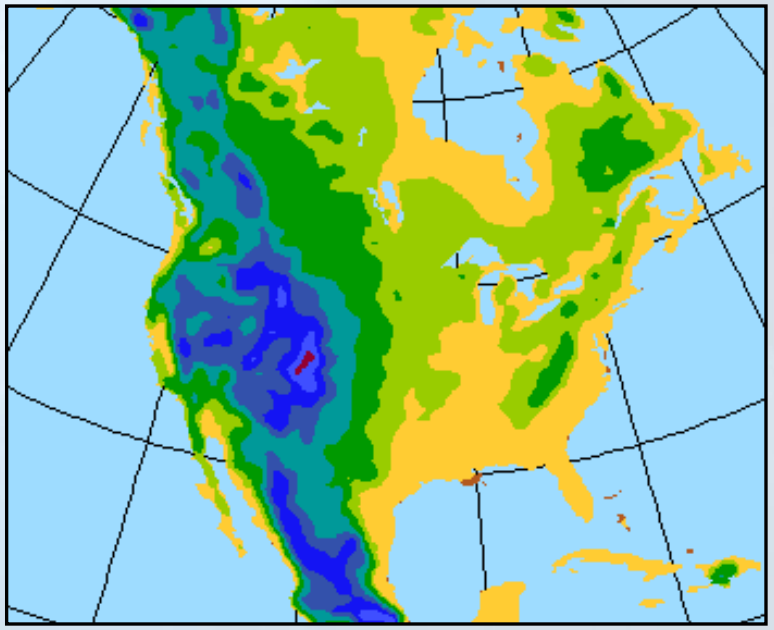


Advantages of higher resolution



North America at typical global climate model resolution

Hadley Centre AOGCM (HadCM3), 2.5˚ (lat) x 3.75˚ (lon), ~ 280 km



North America at 50 km grid spacing

Regional climate models allow use of finer resolution

- HadCM3 grid spacing is about 280 km.
- To reduce the spacing to 50 km, we would need $(280/50)^3 = 175$ times the computing power.
- Proposal: Use a finer-scale model over only a limited region of interest.

Regional Modeling Strategy

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Nested regional modeling technique

- Global model provides:
  - initial conditions – soil moisture, sea surface temperatures, sea ice
  - lateral meteorological conditions (temperature, pressure, humidity) every 6-8 hours.
  - Large scale response to forcing (100s kms)
- Regional model provides finer scale (10s km) response

Examples Where Regional Modeling Is Useful

- Regions with small irregular land masses (e.g., the Caribbean)
- Complex topography (mountains)
- Complex coastlines (e.g., Italy)
- Heterogeneous landscapes

The North American Regional Climate Change Assessment Program (NARCCAP)

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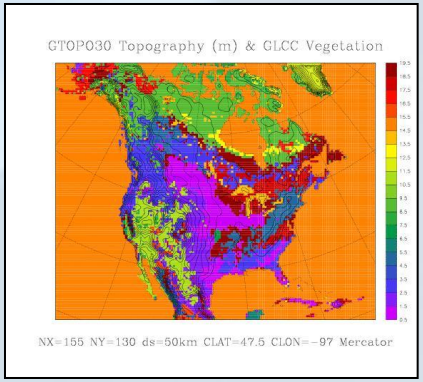
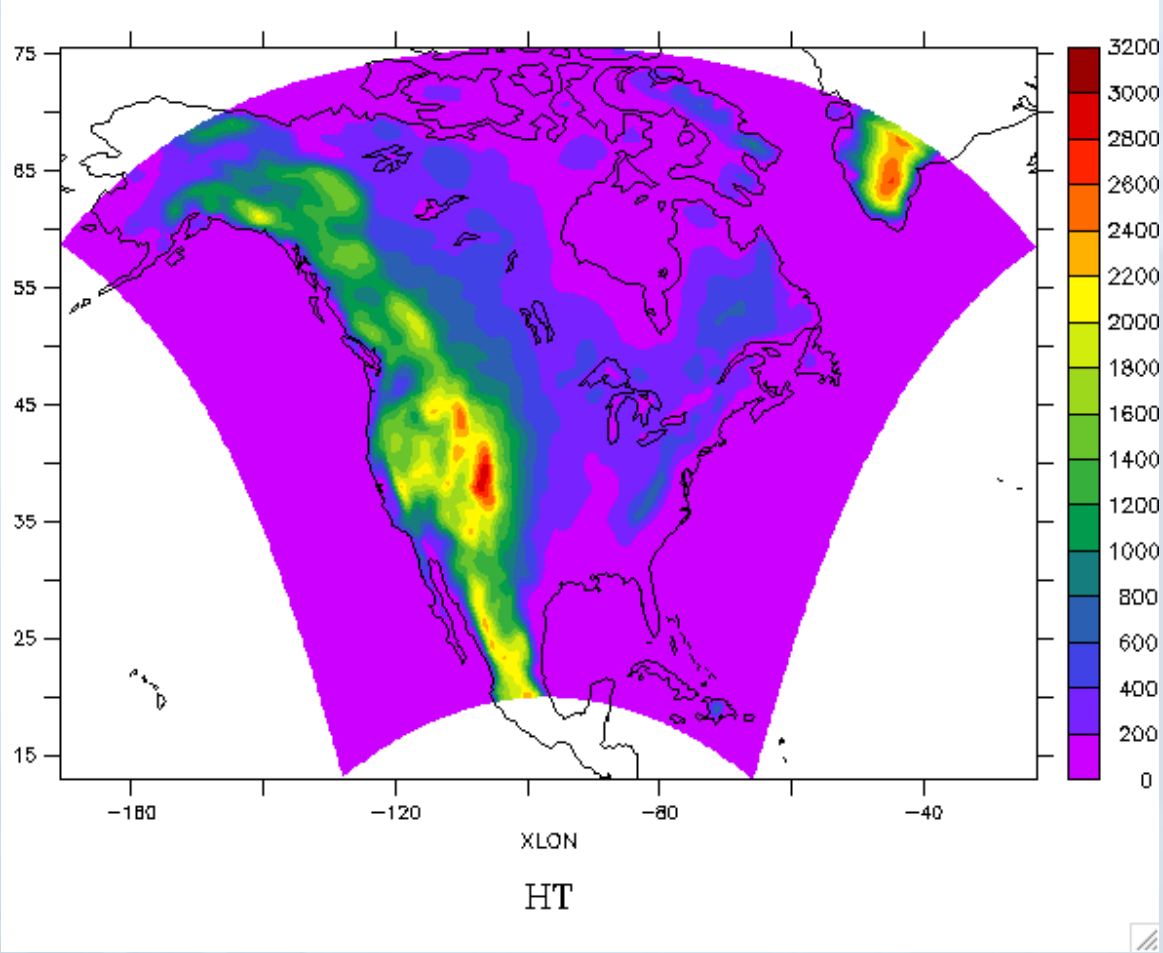
Providing climate scenarios for
the United States, Canada, and northern Mexico



- **Explores multiple uncertainties in regional and global climate model projections.**
  - **4 global climate models x 6 regional climate models**
- **Develops multiple high resolution regional climate scenarios for use in impacts assessments.**
- **Evaluates regional model performance to establish credibility of individual simulations for the future**
- **Participants: Iowa State, PNNL, LNNL, UC Santa Cruz, Ouranos (Canada), UK Hadley Centre, NCAR**
- **Initiated in 2006, funded by NOAA-OGP, NSF, DOE, USEPA-ORD – 4-year program**

NARCCAP Domain



NARCCAP - Team

Linda O. Mearns, NCAR

Ray Arritt, Iowa State, Dave Bader, LLNL, Wilfran Moufouma-Okia, Hadley Centre, Sébastien Biner, Daniel Caya, OURANOS, Phil Duffy, LLNL and Climate Central, Dave Flory, Iowa State, Filippo Giorgi, Abdus Salam ICTP, William Gutowski, Iowa State, Isaac Held, GFDL, Richard Jones, Hadley Centre, Bill Kuo, NCAR; René Laprise, UQAM, Ruby Leung, PNNL, Larry McDaniel, Seth McGinnis, Don Middleton, NCAR, Ana Nuñes, Scripps, Doug Nychka, NCAR, John Roads*, Scripps, Steve Sain, NCAR, Lisa Sloan, Mark Snyder, UC Santa Cruz, Ron Stouffer, GFDL, Gene Takle, Iowa State

* Deceased June 2008

Organization of Program

- **Phase I: 25-year simulations using NCEP-Reanalysis boundary conditions (1980—2004)**
- **Phase II: Climate Change Simulations**
  - **Phase IIa: RCM runs (50 km res.) nested in AOGCMs current and future**
  - **Phase IIb: Time-slice experiments at 50 km res. (GFDL and NCAR CAM3). For comparison with RCM runs.**
- **Quantification of uncertainty at regional scales – probabilistic approaches**
- **Scenario formation and provision to impacts community led by NCAR.**
- **Opportunity for double nesting (over specific regions) to include participation of other RCM groups (e.g., for NOAA OGP RISAs, CEC, New York Climate and Health Project, U. Nebraska).**

Phase I

- All 6 RCMs have completed the reanalysis-driven runs (RegCM3, WRF, CRCM, ECPC RSM, MM5, HadRM3)
- Configuration:
  - common North America domain (some differences due to horizontal coordinates)
  - horizontal grid spacing 50 km
  - boundary data from NCEP/DOE Reanalysis 2
  - boundaries, SST and sea ice updated every 6 hours

NARCCAP PLAN – Phase II

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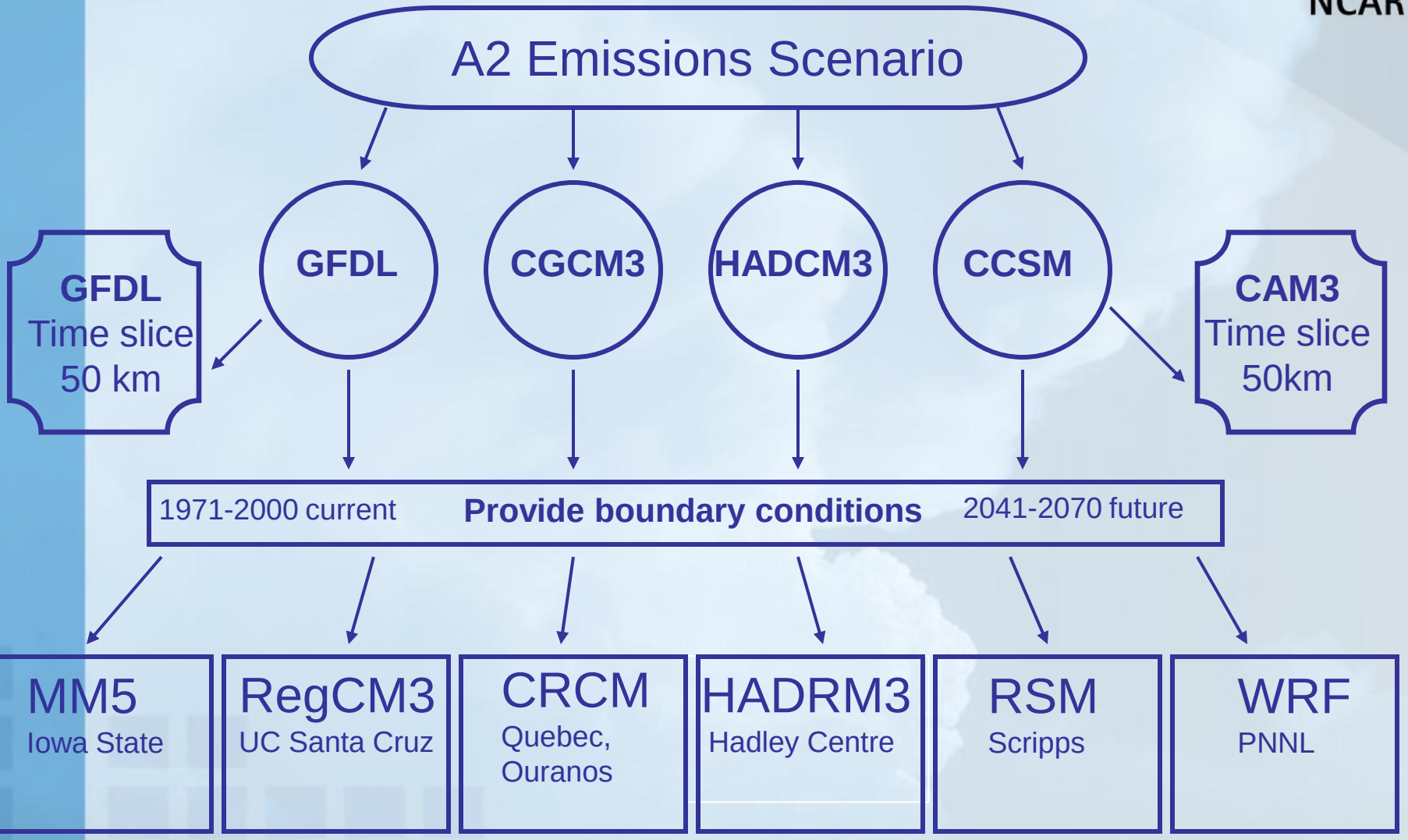

Sample Phase I Results

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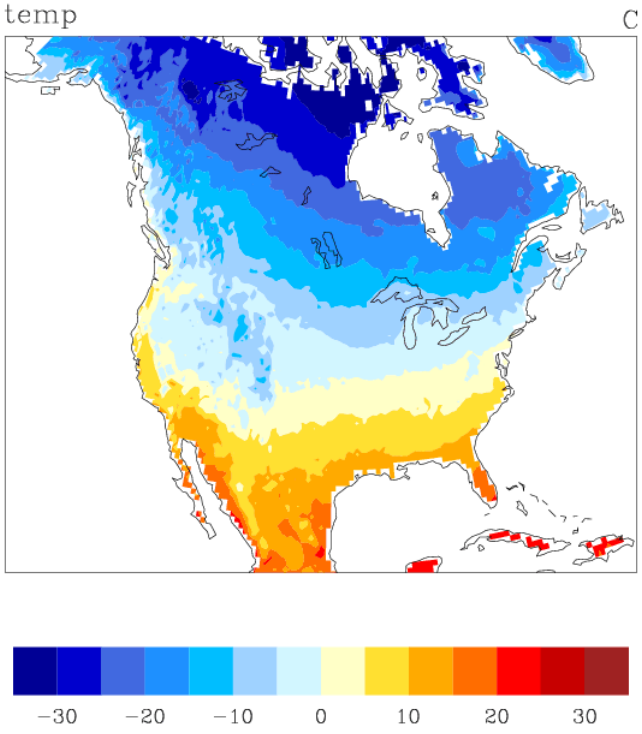
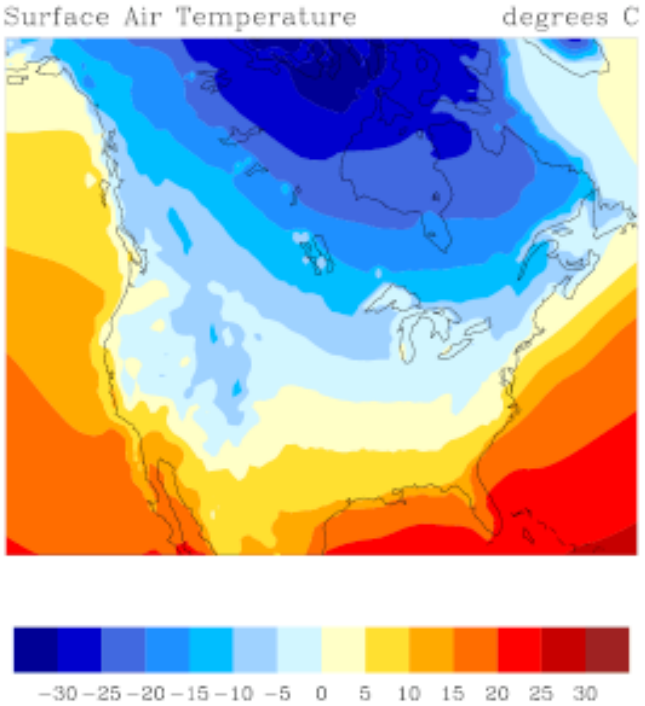
UDEL obs., DJF seasonal avg, 1980-2004



MM5I+NCEP, DJF seasonal avg, 1980-2004



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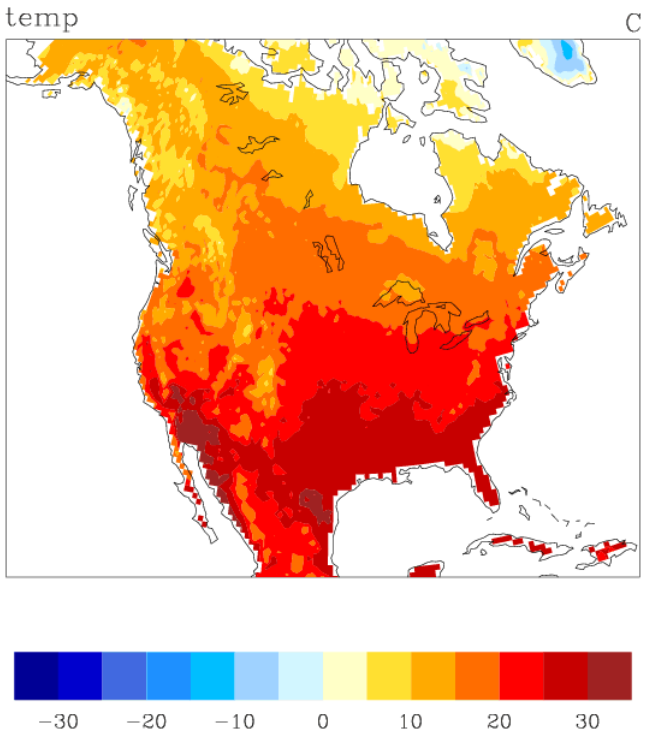
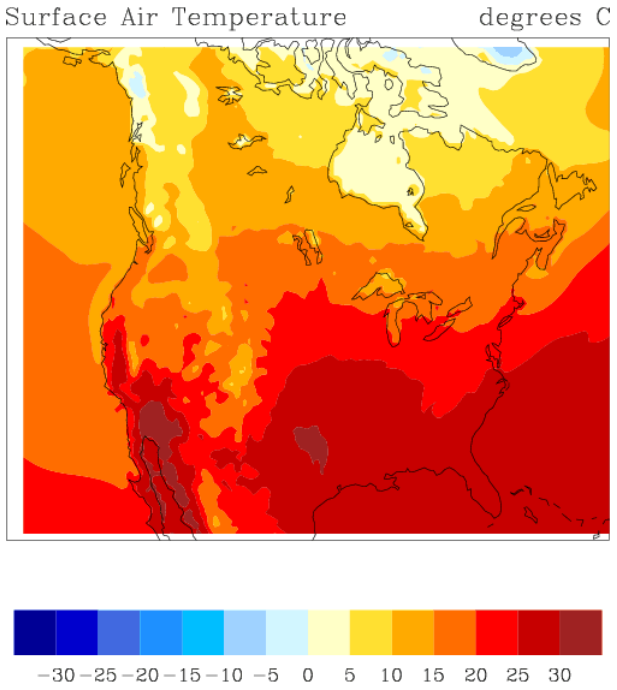
UDEL obs., JJA seasonal avg, 1980-2004



CRCM+NCEP, JJA seasonal avg, 1980-2004



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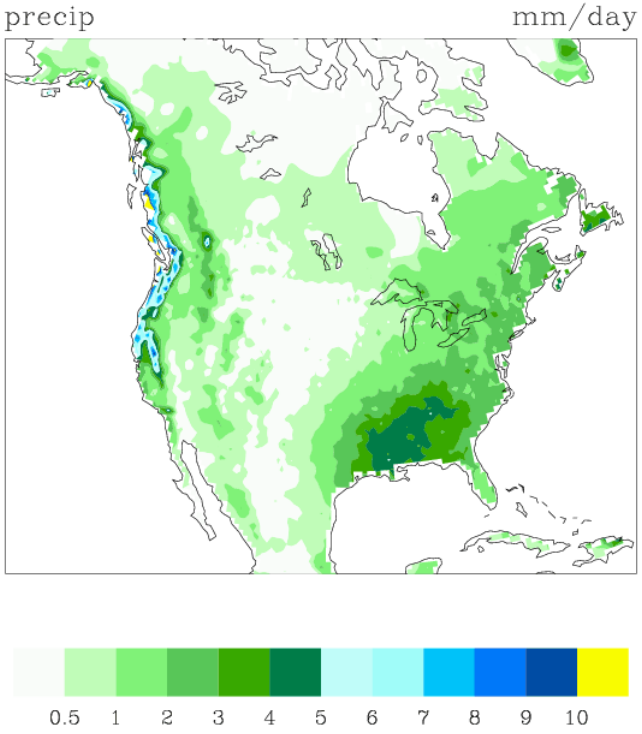
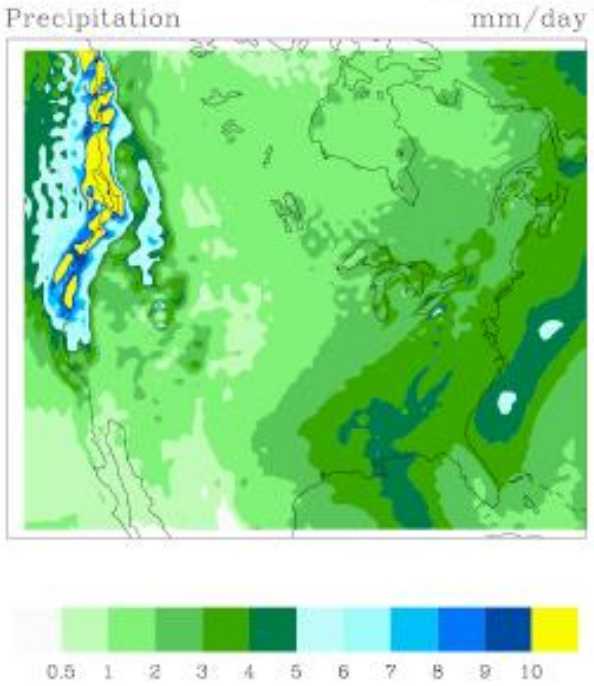
UDEL obs., DJF seasonal avg, 1980-2004



ECPC+NCEP, DJF seasonal avg, 1980-2004



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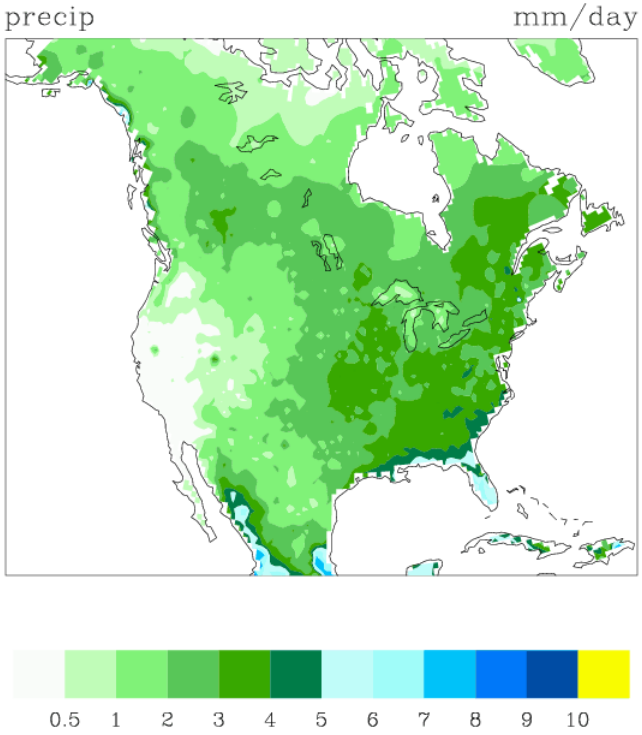
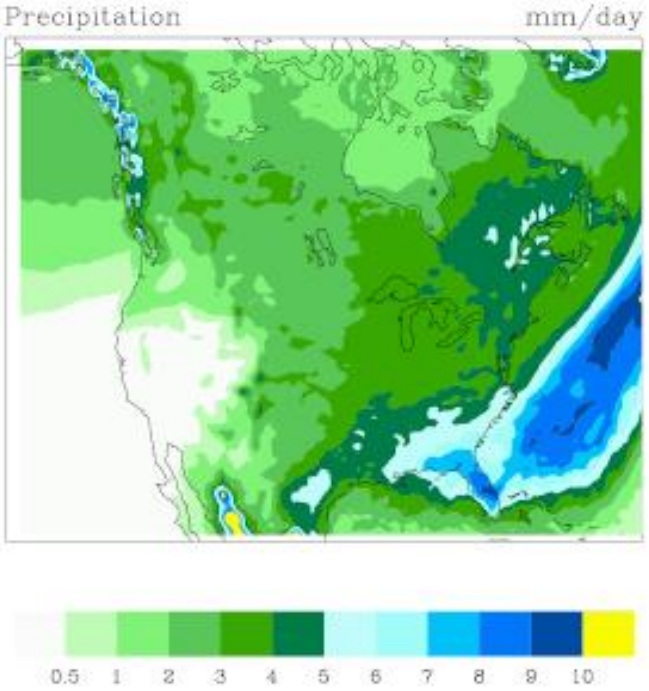
UDEL obs., JJA seasonal avg, 1980-2004



RCM3+NCEP, JJA seasonal avg, 1980-2004



Quantification of Uncertainty

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- The four GCM simulations already ‘situated’ probabilistically based on earlier work (Tebaldi et al., 2004)
- RCM results nested in particular GCM would be represented by a probabilisitc model (derived assuming probabilistic context of GCM simulation)
- Use of performance metrics to differentially weight the various model results

Why quantification of uncertainty is important

- Because the uncertainties are not going away any time soon
- Because we need to make decisions under conditions of uncertainty
- Because many resource managers need this information (but doesn't have to be probabilistic information – can be a range of scenarios)

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The NARCCAP User Community

Three user groups:

- Further dynamical or statistical downscaling
- Regional analysis of NARCCAP results
- Use results as scenarios for impacts studies

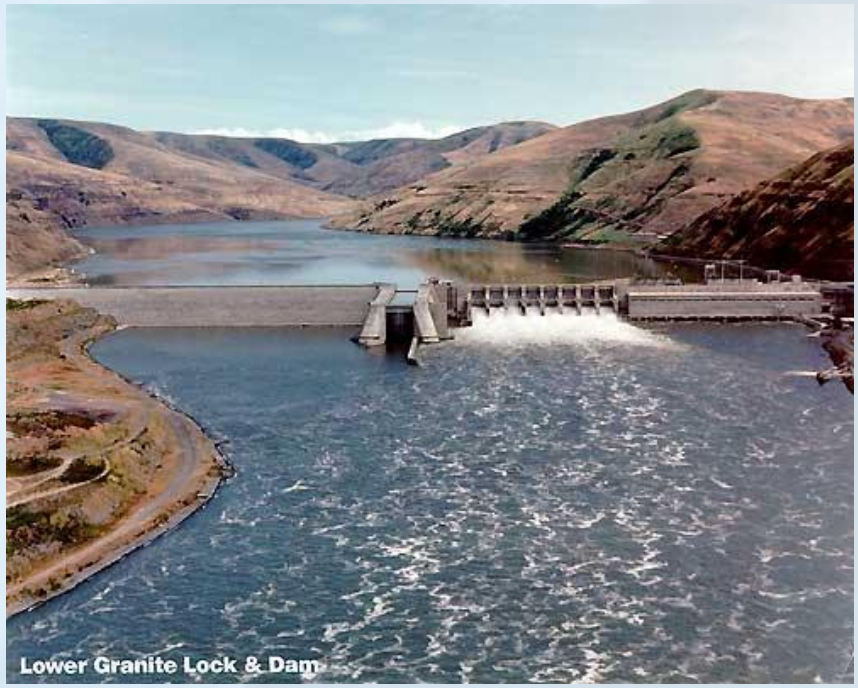
www.narccap.ucar.edu

To sign up as user, go to web site – contact Seth McGinnis,

mcginnis@ucar.edu

Adaptation Planning for Water Resources

- Develop adaptation plans for Colorado River water resources with stakeholders
- Use NARCCAP scenarios
- Determine value of higher resolution scenarios for adaptation plans
- Joint between NCAR, USGS, B. Reclamation M, and Western Wat



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End