Priorities and Plans: A Prospective from the Academic Community

School of METEOROLOGY

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School of METEOROLOGY

- One of the largest meteorology programs in the U.S.
  - Approx 300 undergraduate and 110 graduate students (~50 PhD)
- 24 faculty plus 30 adjunct/affiliate faculty
- Expertise spans observations and numerical modeling of convection, data assimilation, radar, urban and boundary layer, climate and regional climate, dynamical meteorology and tropical meteorology plus linkages to hydrology, ecosystem modeling and societal aspects
- Faculty lead three OU research centers (ARRC, CAPS and CIMMS)
- More American Meteorological Society Industry Graduate Fellowship students than any other program in U.S.
- 17 recent PhD graduates have become professors in U.S. and international universities

Norman Oklahoma's Atmospheric Sciences Community

the university of OKLAHOMA

- School of Meteorology (SoM)
- Department of Geography (GEOG)
- Center for Analysis and Prediction of Storms (CAPS)
- Oklahoma Climatological Survey (OCS)
- Cooperative Institute for Mesoscale Meteorological Studies (CIMMS)
- Environmental Verification and Analysis Center (EVAC)
- Center for Natural Hazards and Disaster Research (NHDR)
- Center for Spatial Analysis (CSA)
- Atmospheric Radar Research

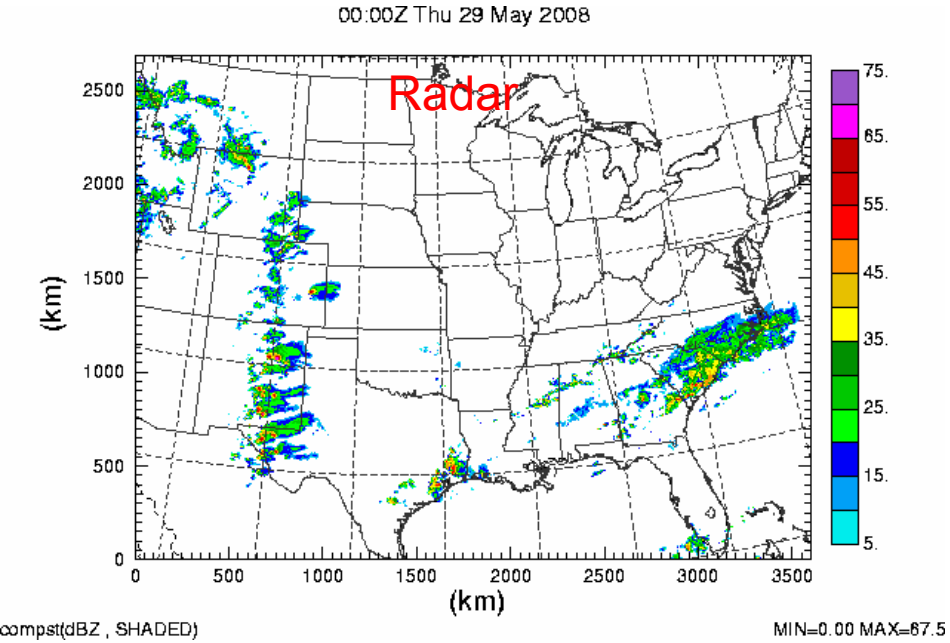
- National Severe Storms Laboratory (NSSL)
- Storm Prediction Center (SPC)
- National Weather Service Forecast Office
- Radar Operations Center (ROC)
- Warning Decision Training Branch (WDTB)

National Weather Center

- Numerous modes of collaborations:
  - Internships for students
  - Government researchers as instructors
  - Government researchers and operational scientists as advisors to graduate students (also low cost extension of gov't research capabilities)
  - Rapid transfer of research knowledge and techniques into operation
  - Operational needs and expertise can influence research directions
- NSSL's Spring Experiment is one visible collaboration with OU providing computer support and contributing model simulations

Example of Spring 2008 Storm-scale Ensemble Predictions at 4 km resolution using ARPS 3DVAR and WRF-ARW.

24-h forecast composite reflectivity
00 UTC, May 29, 2008



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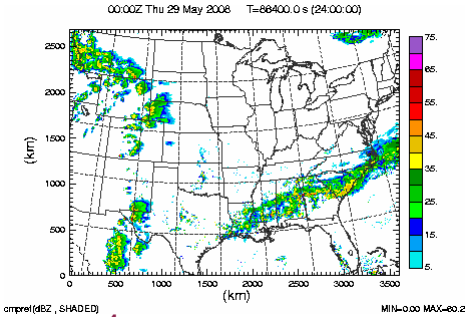

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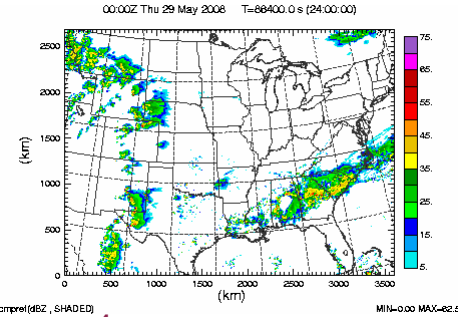

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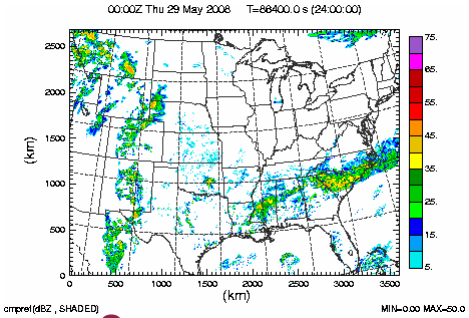

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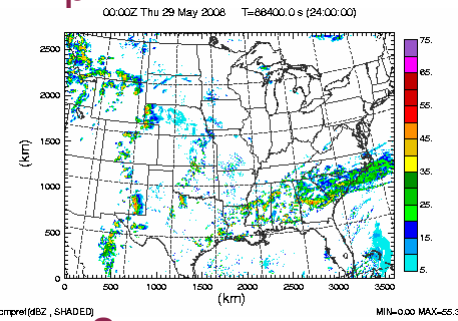

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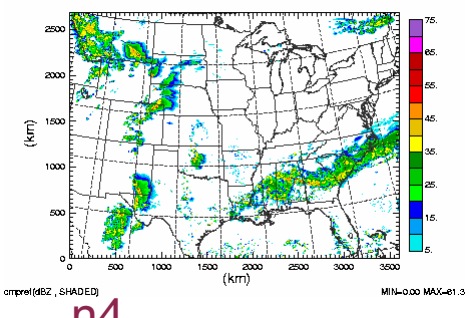

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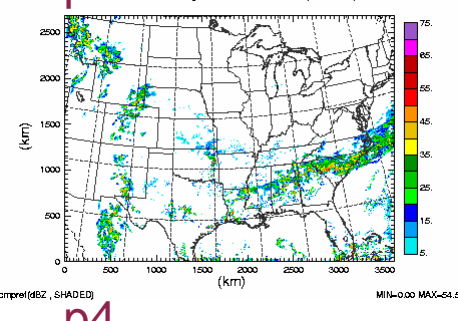

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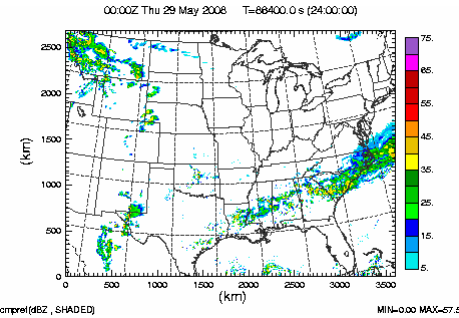

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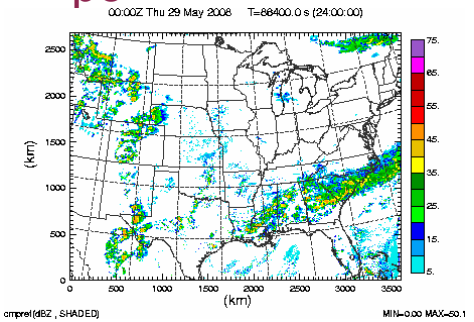

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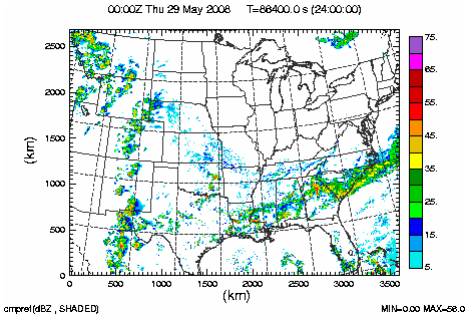

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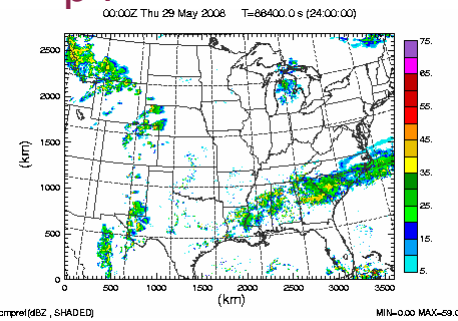
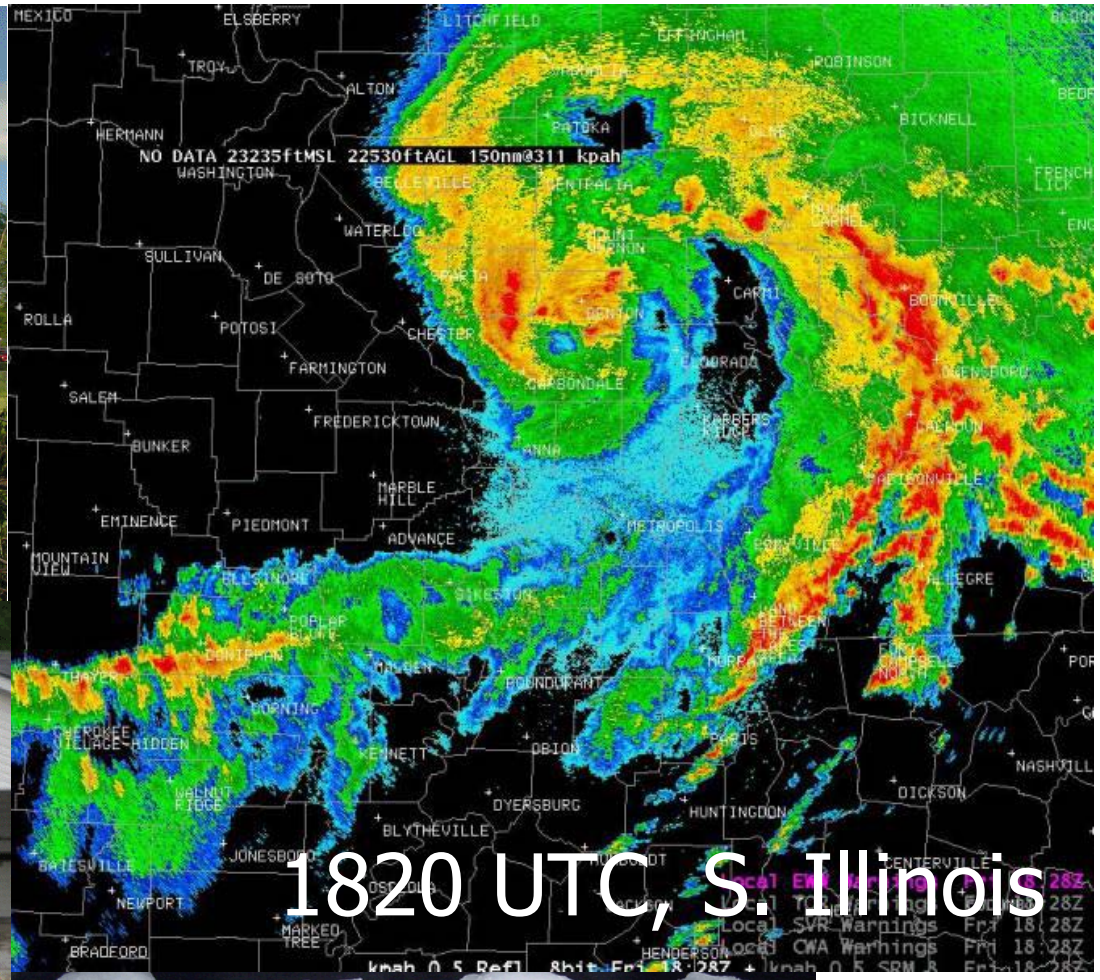


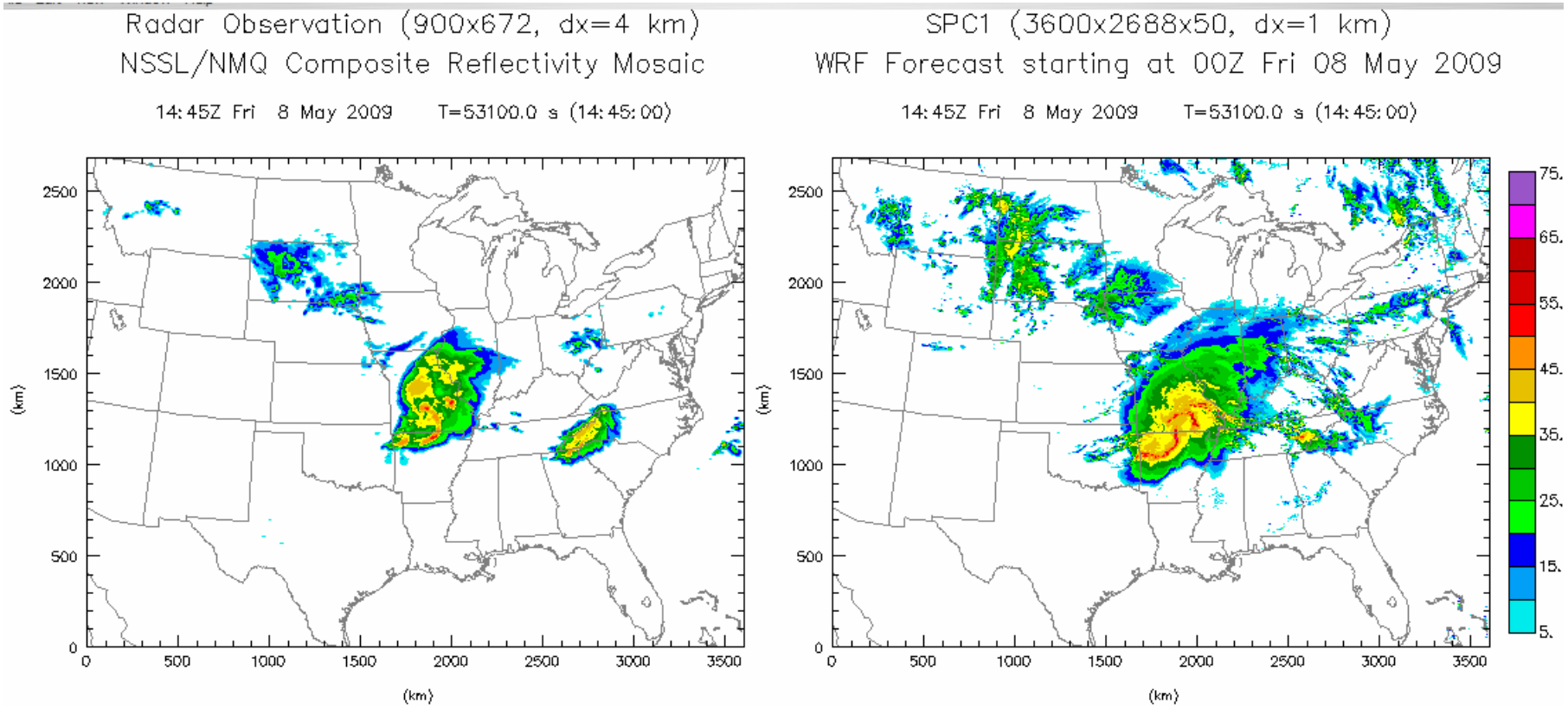
May 8, 2009 Bow echo/Derecho/MCV/Inland hurricane case

NWS WFO St. Louis MO



Movie

CONUS-Scale Realtime Forecast at 1 km grid spacing from spring 2009 (WRF with ARPS Radar DA)



May 8, 2009 MCV/Derecho Case

School of METEOROLOGY

- *The School and the OU Institutes led by our faculty are best known for weather research, but also are home for a variety of climate and applied climate research topics. In addition to the OK Climatological Survey, include:*
  - *Extensive involvement in the Department of Energy's Atmospheric Science Research Program including the Site Scientist for the extensive CART observational facility in Oklahoma (Peter Lamb, David Turner (NSSL) and Randy Peppler*
  - *Regional climate modeling, but generally outside of Oklahoma (Lance Leslie)*
  - *Climate process studies aimed at reducing the uncertainty in climate modeling (David Parsons)*
  - *Evaluation of the historical records with a focus on water vapor (David Parsons)*
  - *Climate and carbon issues (Berrien Moore III)*
  - *Seasonal prediction including representation on a National Academy Panel (Michael Richman)*
  - *Energy and climate change including alternative energy sources (Mark Morrissey)*

- *The School of Meteorology and the OU Institutes led by our faculty have extensive capabilities in the prediction and observations of rainfall from the time-scale of minutes to decades (obs) and growing collaborative capabilities linking these results to hydrological and ecosystem modeling and to users.*

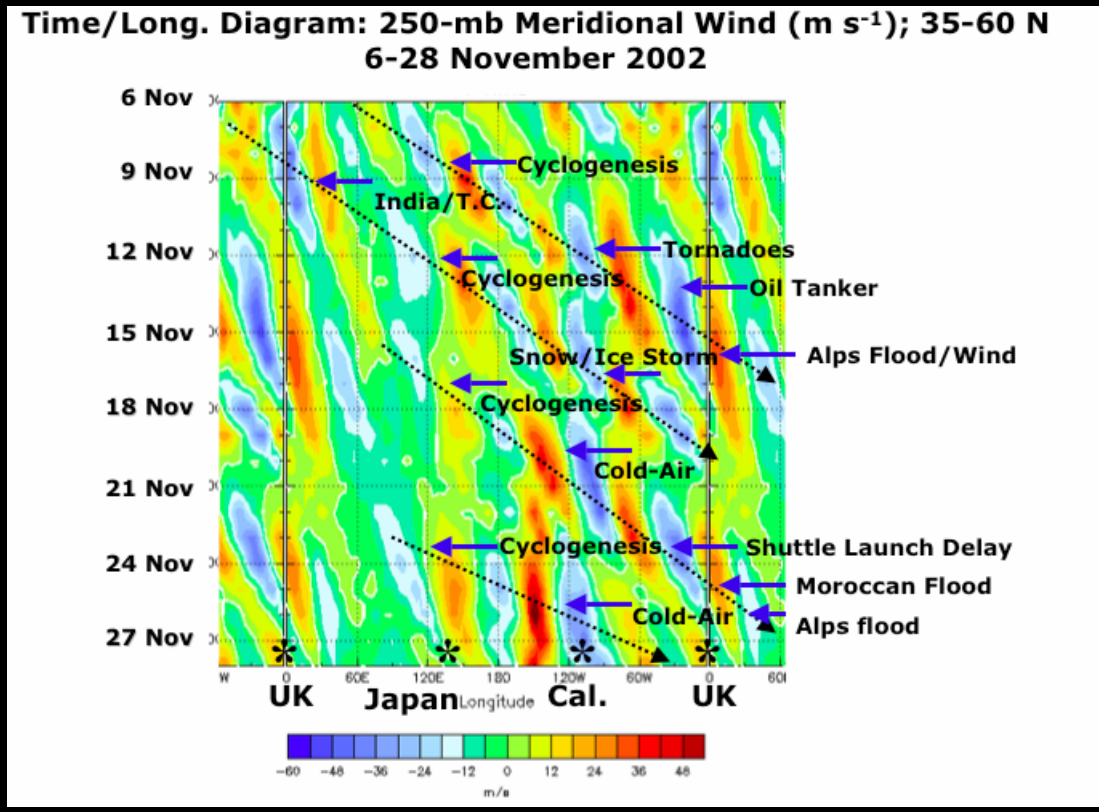
Scientific Priorities and Plans

1. **Proposal for the establishment of a Department of Interior Regional Climate Science Center for the Southern Great Plains:**
   - ***User-driven (e.g., need for prediction of changes in the water and ecosystems of the region)***
   - ***Requires down-scaling of the atmospheric global climate change projections through statistical approaches and model (WFR-based) based techniques (e.g., ecosystem and hydrological data assimilation)***
   - ***Requires coupling of the down-scaled atmospheric predictions with hydrological and ecosystem modeling (also requires population and water use projections)***
   - ***Understanding and prediction of impacts on indigenous populations***
   - ***Can only be accomplished through extensive partnerships academic and operational***

Scientific Priorities and Plans

2. Climate change and extremes:

CIMMS (Cooperative Institute for Mesoscale Meteorological Studies- the OU-NOAA joint institute) has a new mandate to make contributions in the area of the impact of climate change in the frequency, location, intensity and duration of weather extremes



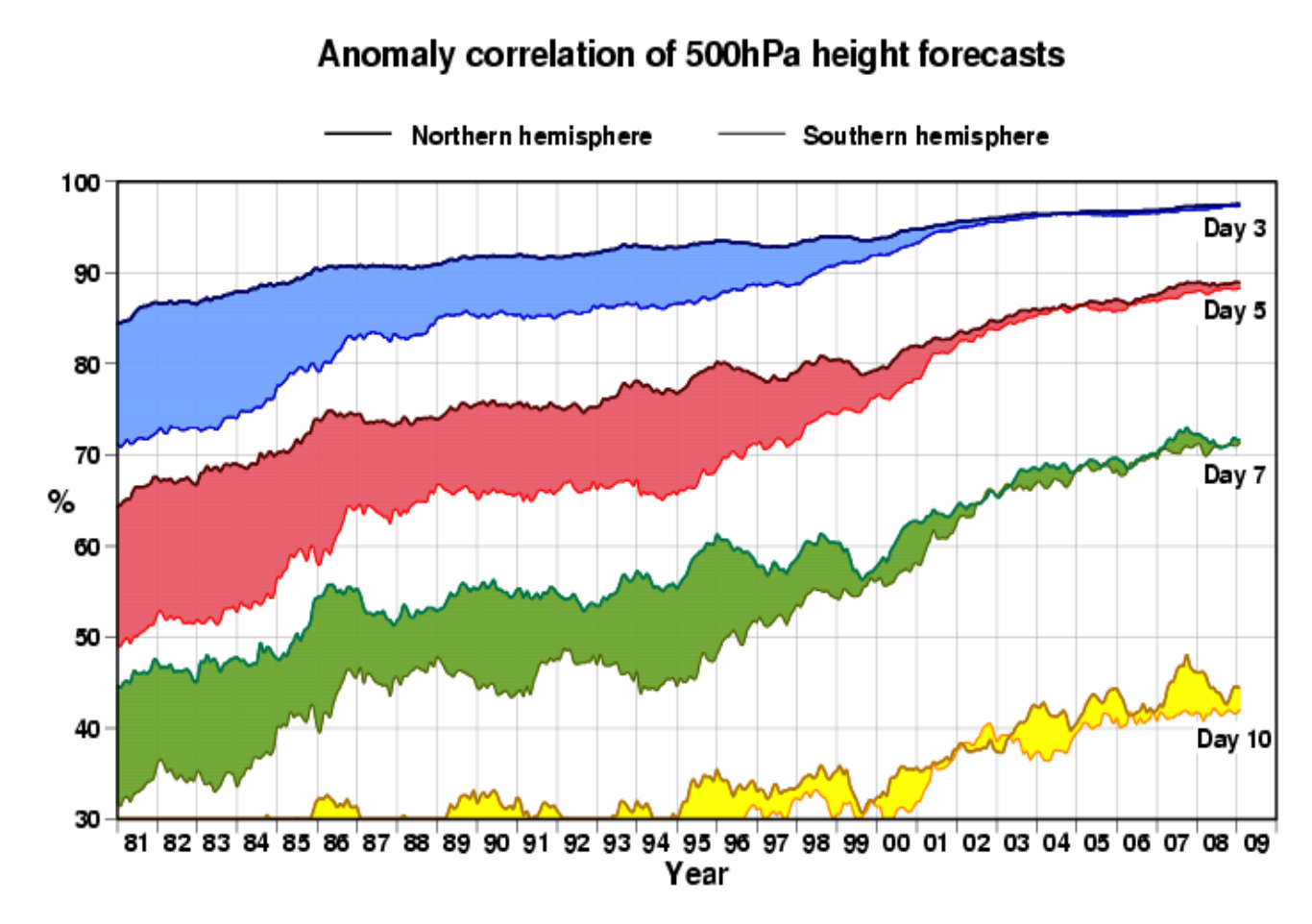
Scientific Priorities and Plans

3. Downscaling of convective precipitation in regional climate models:

--- Prediction of precipitation (esp. for convection) in numerical weather prediction systems is a *relatively* unsolved problem that can casts fundamental uncertainty on planning for water, agriculture, and ecosystem projects.

Scientific Priorities and Plans

3. Prediction of precipitation:



Scientific Priorities and Plans

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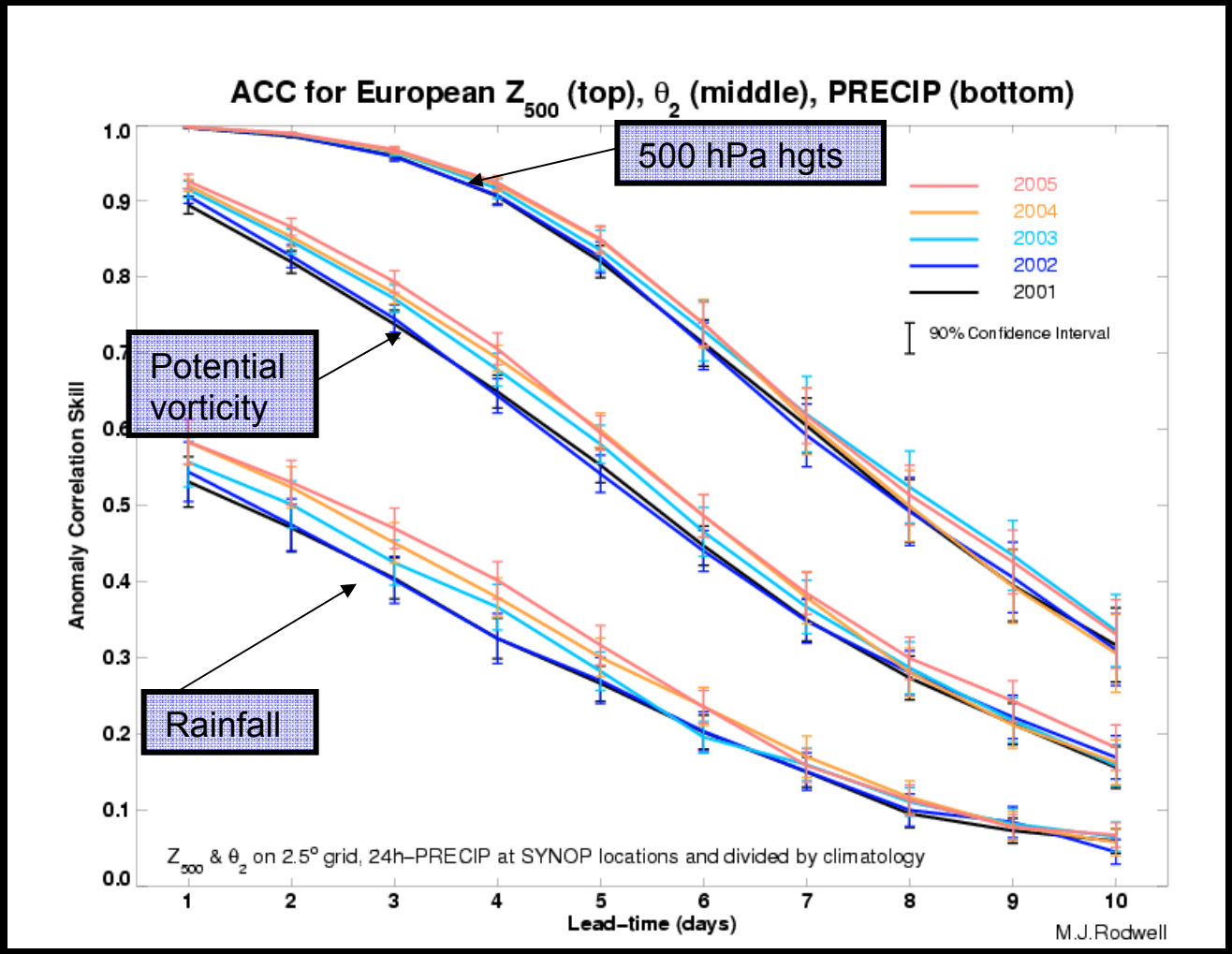


3. Downscaling of convective precipitation in regional climate models (cont):

- Use of convection permitting models
  - The use of such models for regional climate modeling is a challenge as Hohenegger et al. (2009) showed the sign of the precipitation enhancement for Europe changed when convective storms were explicitly resolved! A similar study at NCAR showed a similar level of uncertainty.

  - Convective permitting models have shown benefits for operational weather prediction in regional models through adding information about the type of precipitation systems. However, regional climate modeling and global NWP provide additional challenges (e.g., examination and elimination of any biases).

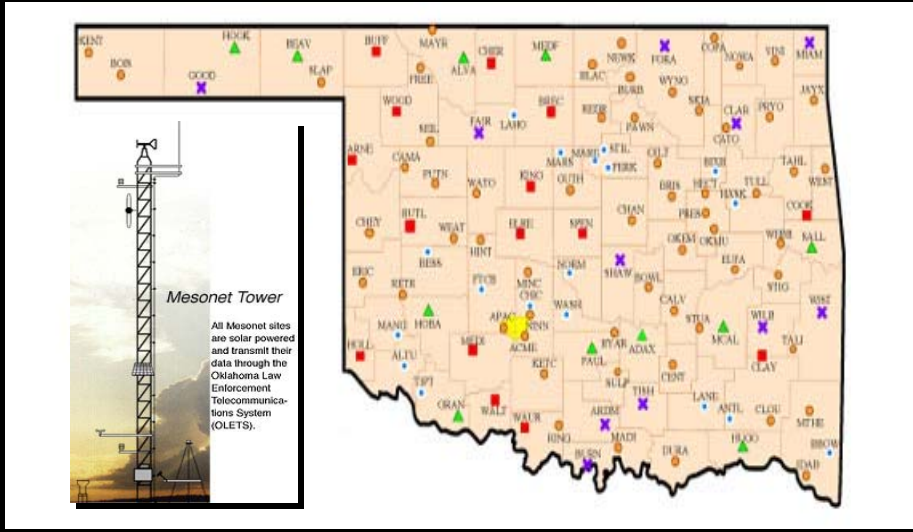
3. Downscaling of convective precipitation in regional climate models (cont):

4. Using observations for advancing understanding and evaluating/verifying predictions from regional climate models:

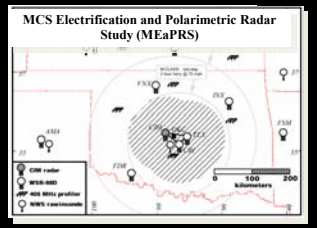
Oklahoma: The Most Heavily Instrumented Piece of Real Estate on the Planet!

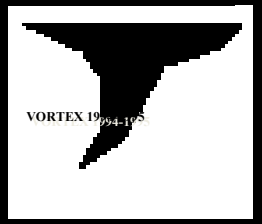
Installed nation's first high-density State-wide surface mesonetwork

--- Funded by energy dollars



Field experiment (process studies) frequently select Oklahoma for study due to Mesonet, DOE-CART facility, and enhanced radar-profiler networks





5. Other proposed projects relevant to regional climate:

- Integrated Graduate Research, Education, and Training (IGERT) proposal that attempts link research between meteorology, hydrology, radar engineering and social science (low probability of being funded)

- Internal OU proposal for advancing the understanding of the predictability of the earth system

6. RECOMMENDATIONS

Since the areas predicted are the same, global models are routinely compared creating a healthy competition that improves modeling systems. Consider modeling intercomparison experiments with other centres and research groups both over SE Europe and elsewhere (following the example of regional NWP) to understand model shortcomings.

NWP allows daily testing of predictions against observations, consider making use of a unified approach to testing and improving model physics as well as testing the regional climate model in NWP mode.

Aerosol, downscaling convective rainfall, coupling to ecosystem and hydrological modeling are difficult problems so consider strong links to the regional and international research and operational communities and to users.

Don’t underestimate your need for computational and human resources.