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NA-CORDEX
Draft Science Plan
and Simulation Plan

Linda O. Mearns, NCAR
William F. Gutowski, Iowa State

NA-CORDEX Meeting

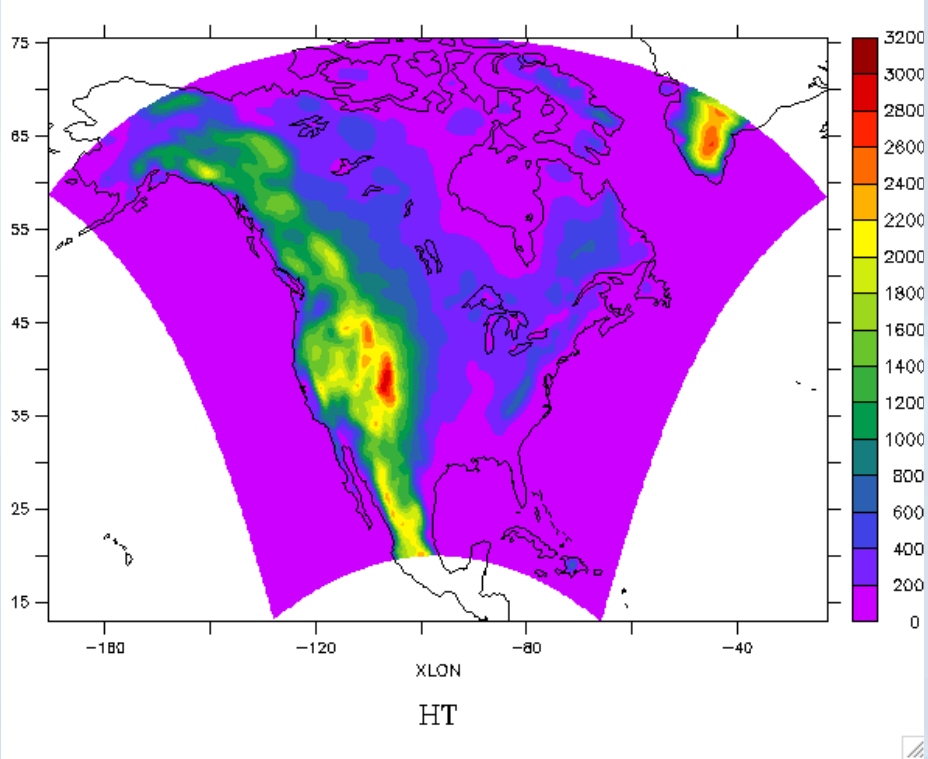
National Center for Atmospheric Research

February 20, 2013

Program Goal

Address key science and climate applications questions that transcend the boundaries of numerous climate change communities

(computer sci., physical sci., statistics, impacts, stake-holders).



Science Questions

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- What is the added value of the CORDEX higher resolution simulations? How do we establish this? What are appropriate metrics?
- How will NA – CORDEX build on prior experience, e.g., NARCCAP? What more will we learn?
- What key physical processes are resolved as resolution increases? (e.g., mesoscale convective systems, sea/lake breezes, lake effects).

Added Value of Spatial Scale?

Bukovsky, Liu, Mearns, Rasmussen

DJF 1982-1991

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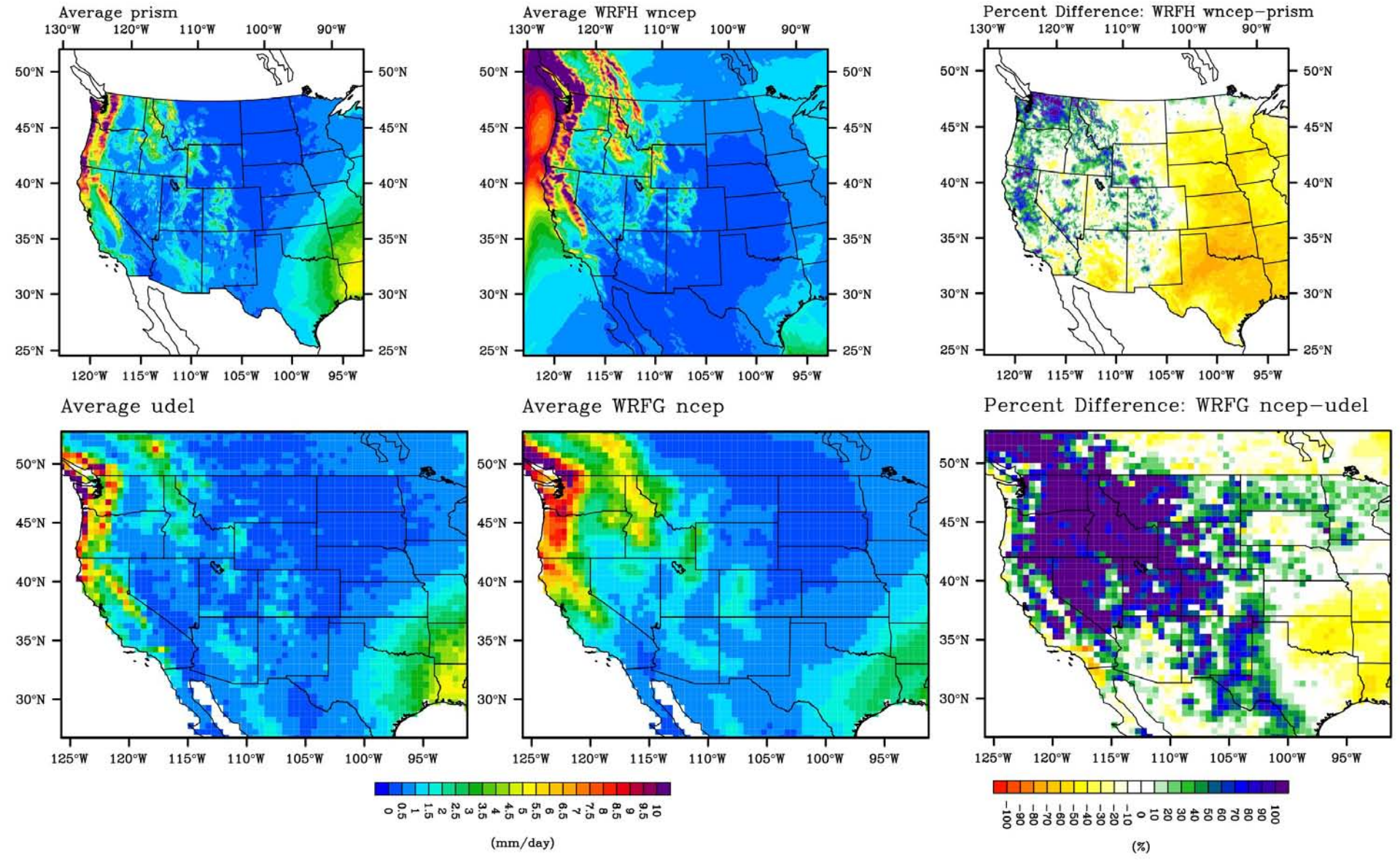

Science Questions (2)

- How do we balance the runs performed to efficiently sample the full uncertainty space (RCPs, GCMs, RCMs, internal variability)?
  - What uncertainties are most important to various user communities – among those listed above plus resolution?
- Handling of bias correction - and comparison with statistical downscaling methods such as BCSD, BCCA, SDSM.

NARCCAP Experimental Design
A2 Emissions Scenario

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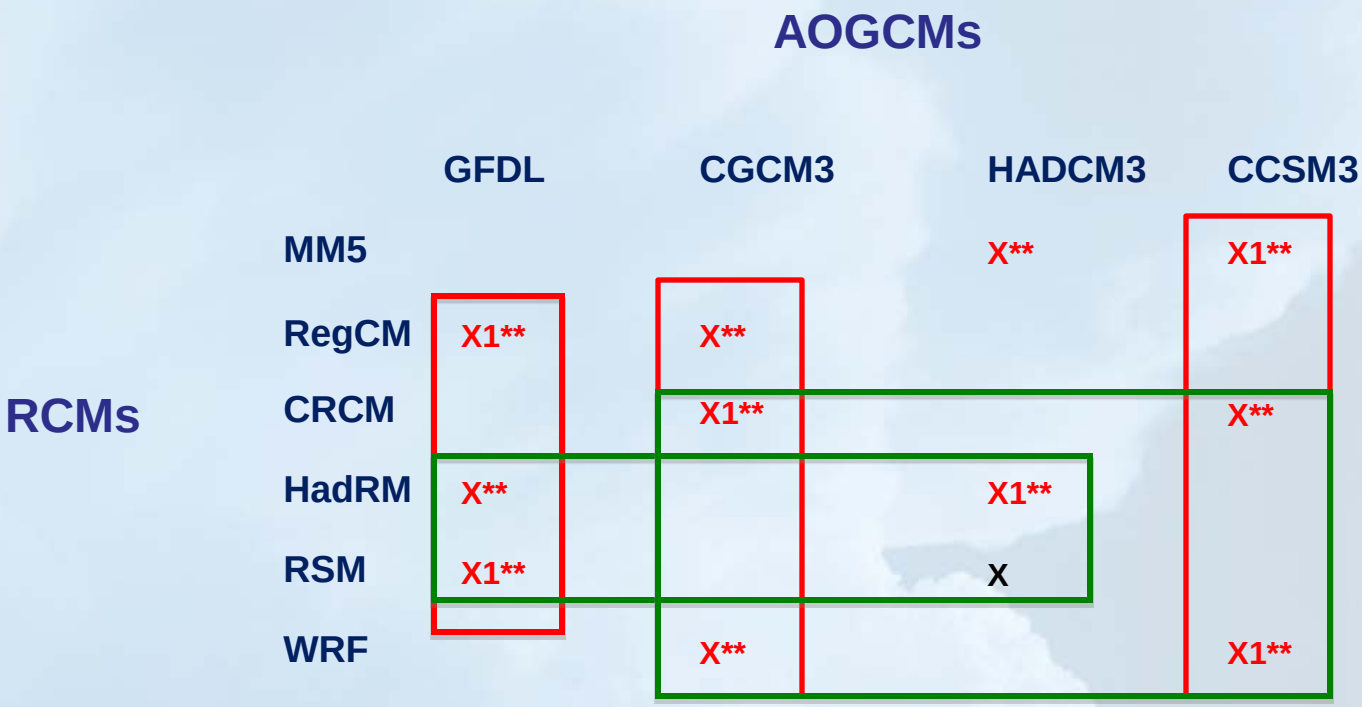

1 = chosen first GCM

Red = run completed
** = data loaded

Suggested NA-CORDEX Design (Core)

- ERA-Interim driven: 30 years
- GCM driven time period: 1950-2100
- 2 RCMs, 2 GCMs, 2 RCPs (but what of sampling internal variability (from GCMs?))
- Resolutions: basic is 50 km, and then 25? 10?
- Potential expansion to more RCMs, GCMs

Choosing Models

- Criteria? For RCMs, commonly used and well tested (e.g., WRF, RegCM4, RSM + CRCM and Hadley RCM)
- GCMs? CMIP5 - Range of climate sensitivity, quality of boundary conditions, national favorites?
- Consideration of simulations in progress or completed by other groups (e.g., UQAM CRCM5 driven by CanESM2 and MPI GCMs, RCP 4.5, 0.44 deg. res.)
- WRF (nudged) runs at Arizona – HadGEM and MPI

Euro-CORDEX

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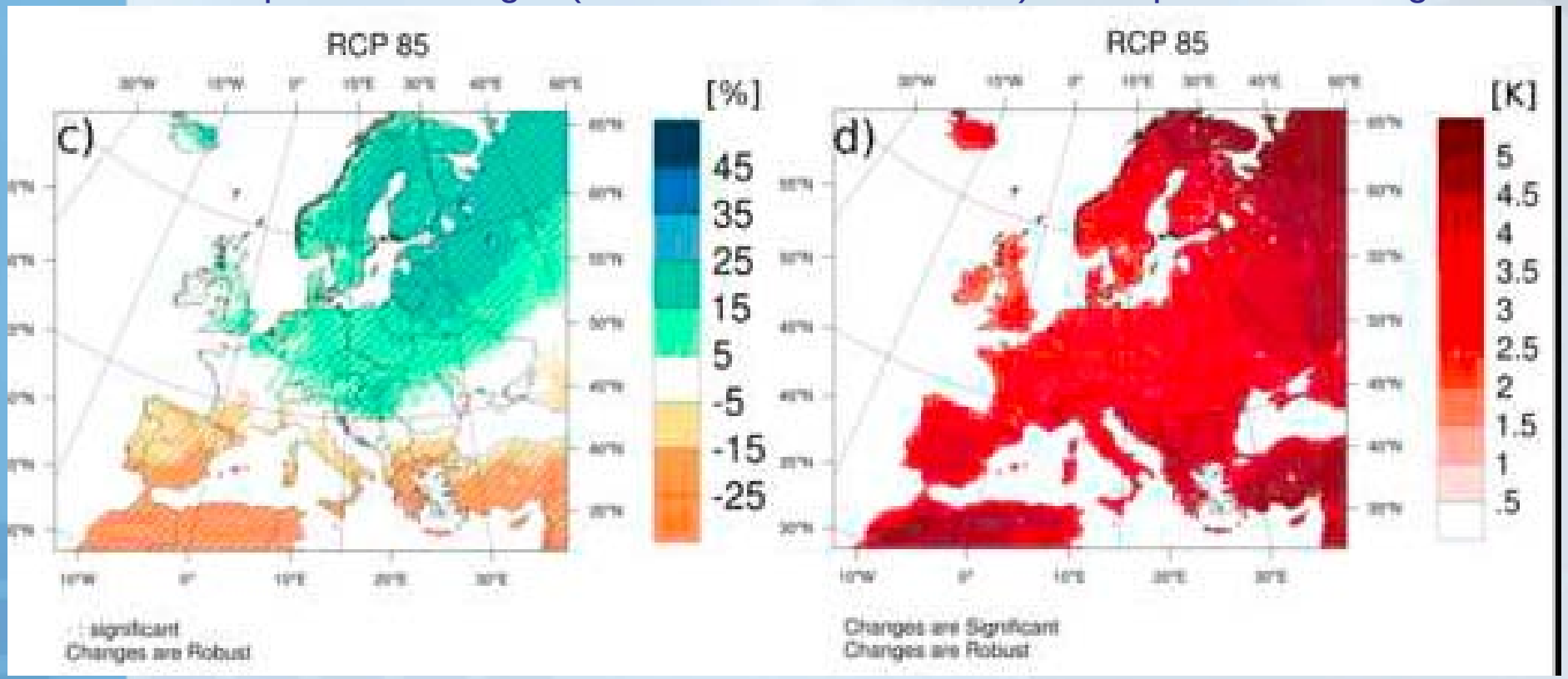
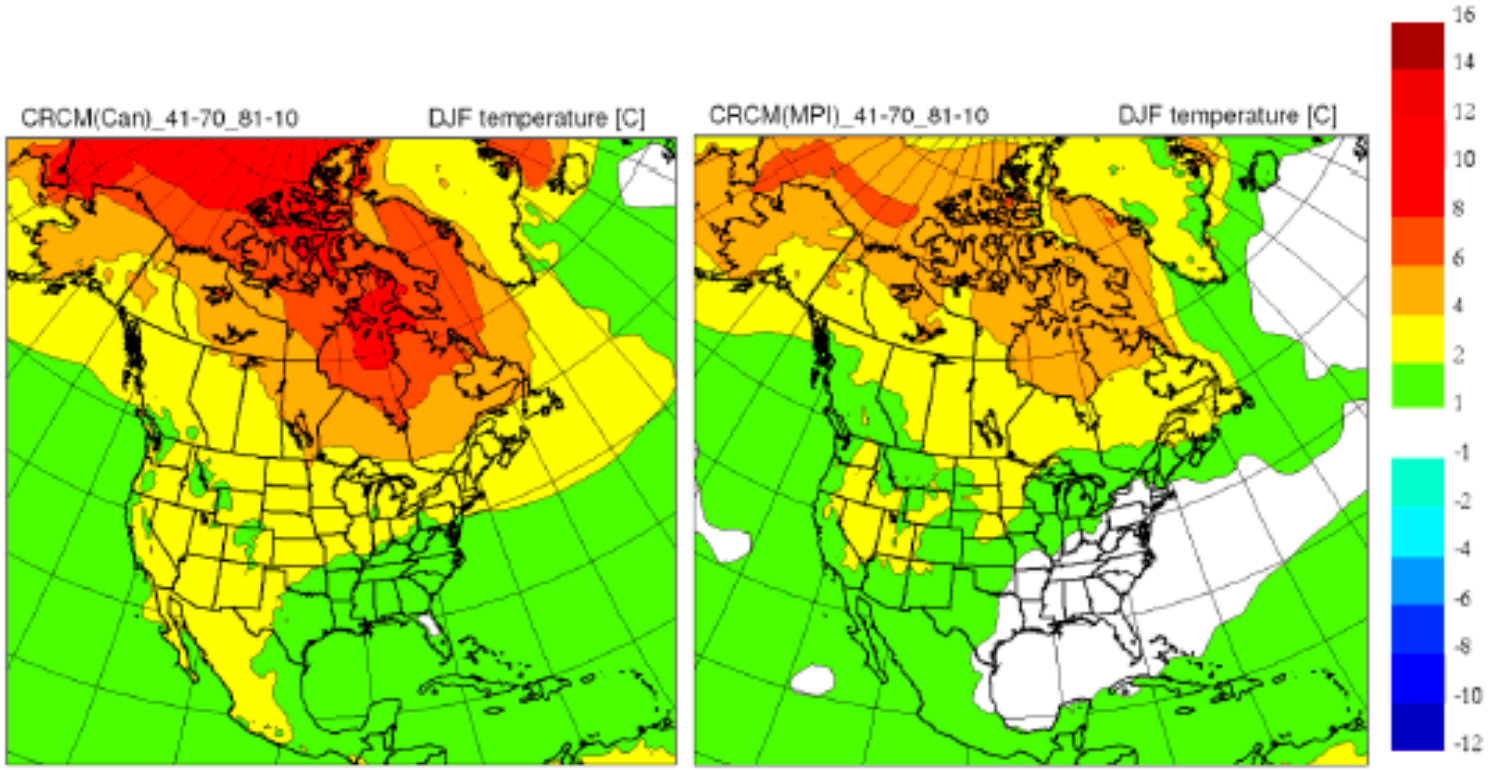
Annual Precipitation Change (2071-2100 – 1970- 2000) Temperature Change



6 RCMs (including WRF) at 0.11 deg. and 5 GCMs are involved, but currently only 4 RCMs and 3 GCMs completed CRP 8.5 to 2100 (a total of 4 runs)

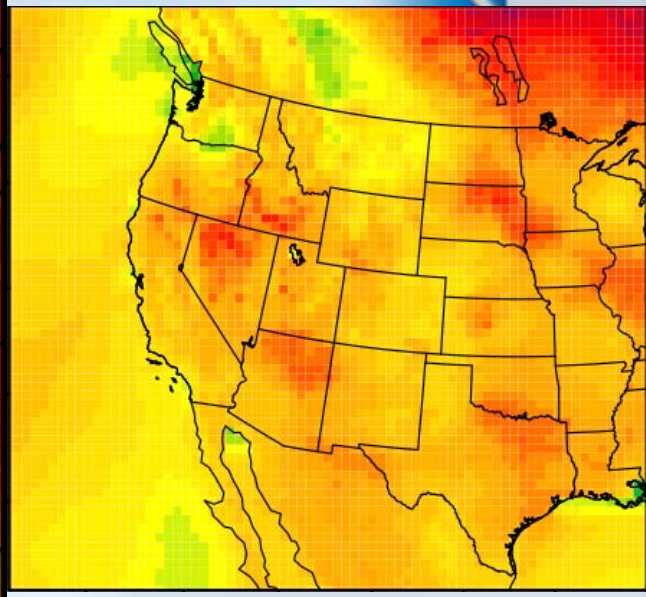
Sample UQAM Results

- CRCM(CanESM2 / MPI-ESM-LR) 2041-2070 to 1981-2010 mean DJF 2m temperature:

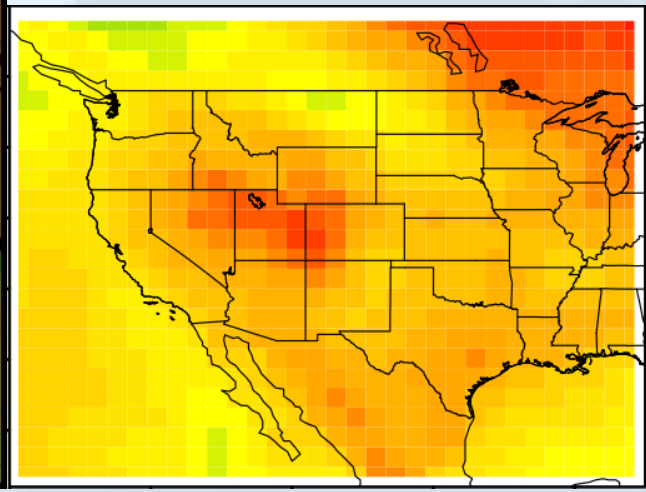


10-km WRFH-wccsm

50-km WRFG-ccsm



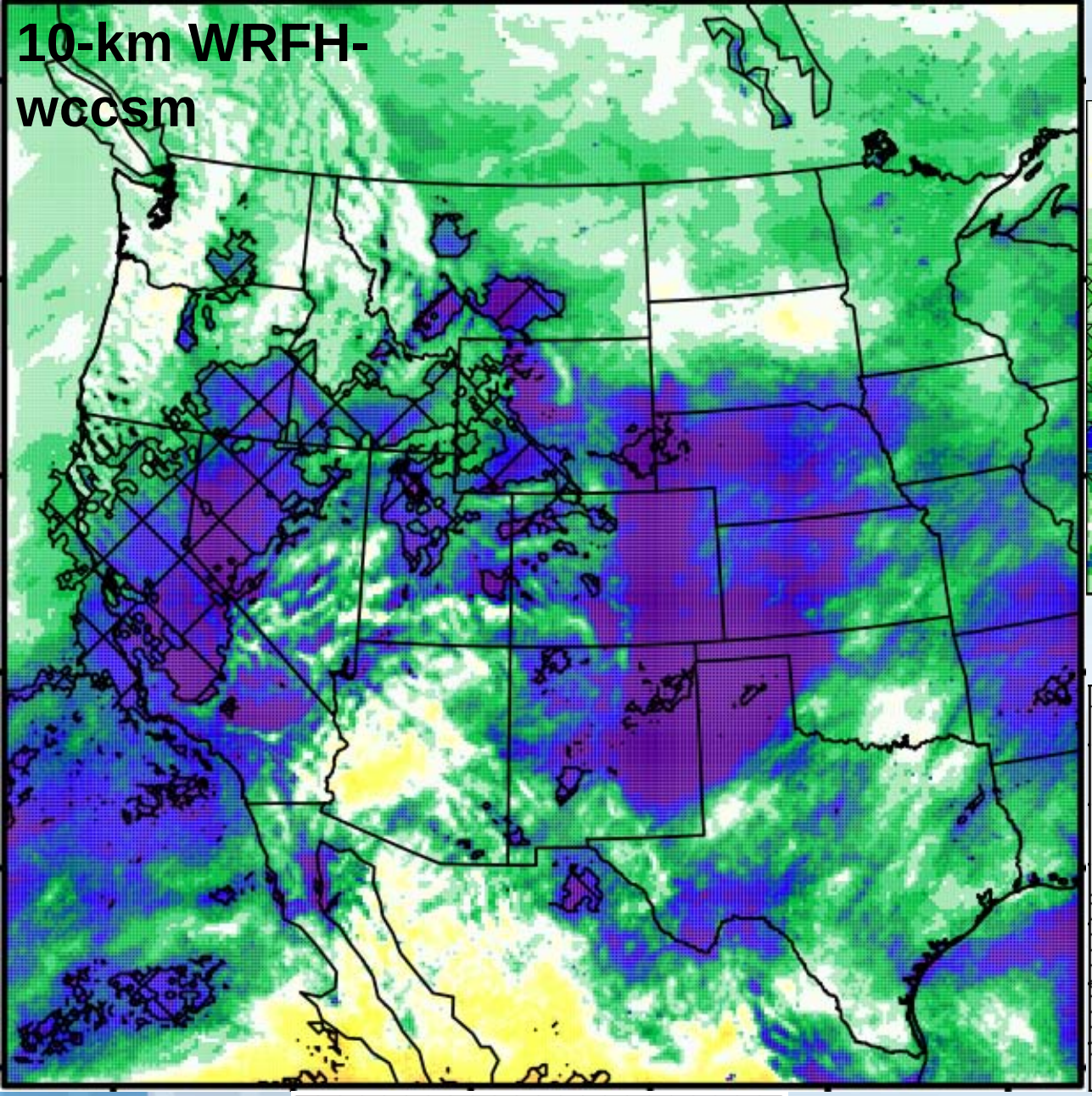
CCSM

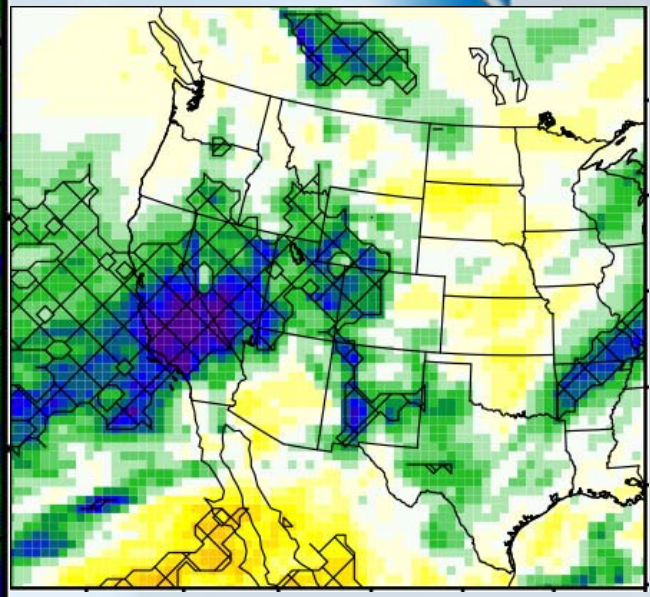


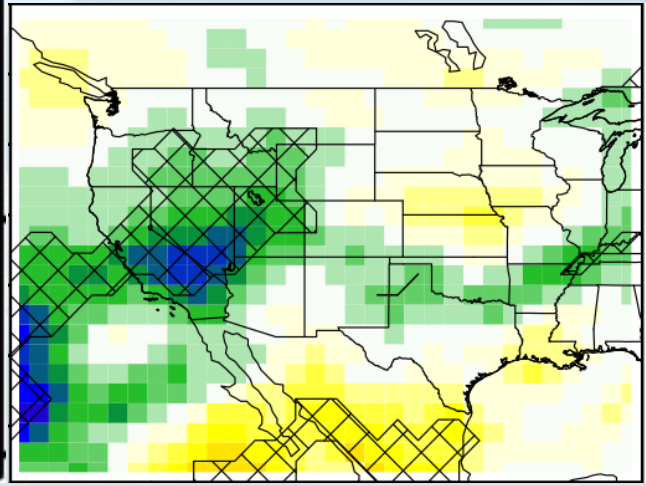
0 0.2 0.4 0.6 0.8 1 1.2 1.4 1.6 1.8 2 2.2 2.4 2.6 2.8 3 3.2 3.4 3.6 3.8 4 4.2 4.4 4.6 4.8 5

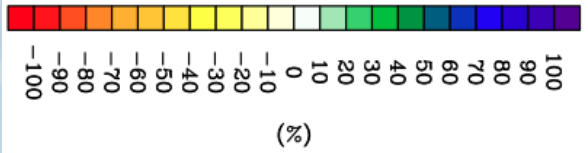
(C)

DJF temperature change









DJF precipitation change

Current and Future Work

- Current climate simulation: 2000~2010; 1980~1989; 1990~1999.
  - NCEP R2, CFSR SST, re-initialize each year, spectral nudging (Exper. 7)
  - Outputs: 600*519, 3-h, 12km, 38 levels->3D.

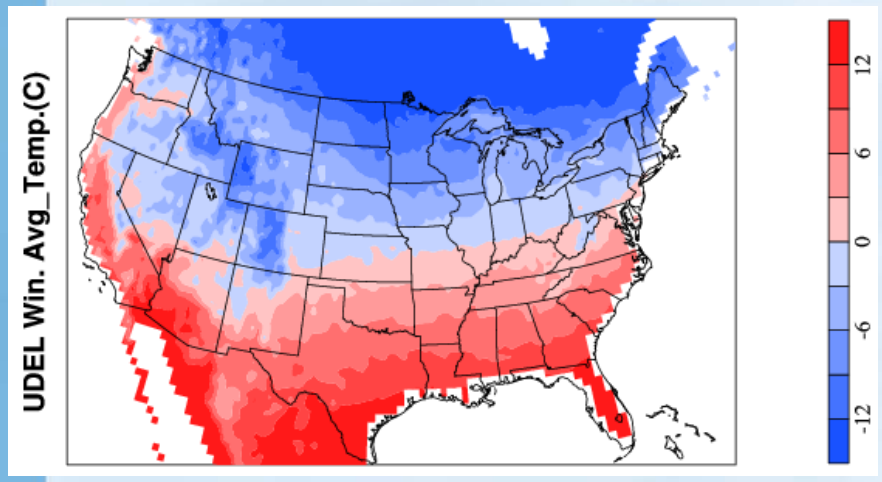
- Future climate simulation: 2045~2055; 2085~2095.
  - Correct model biases according to current simulations.

- Evaluation:
  - Climate Research Unit (CRU) monthly temp. and precip. (0.1*0.1).
  - University of Delaware (UDEL) monthly temp. and precip. (0.1*0.1).
  - TRMM/PR 3B42 daily precipitation (0.25*0.25).
  - NARR (32km) monthly mean data.

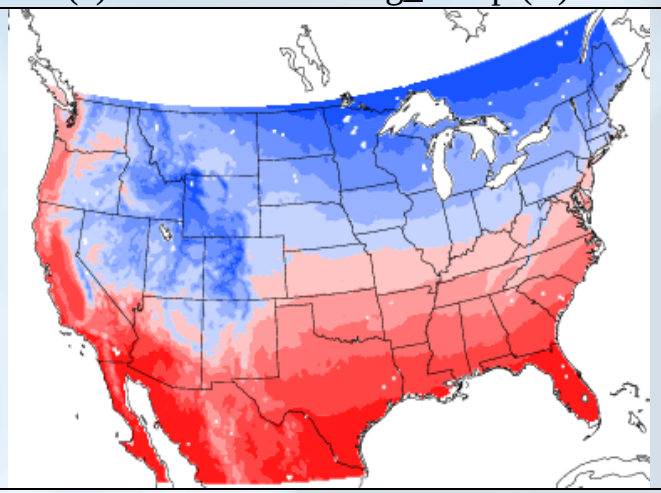
Jiali Wang, Rao Kotamarthi
Argonne Nat. Lab

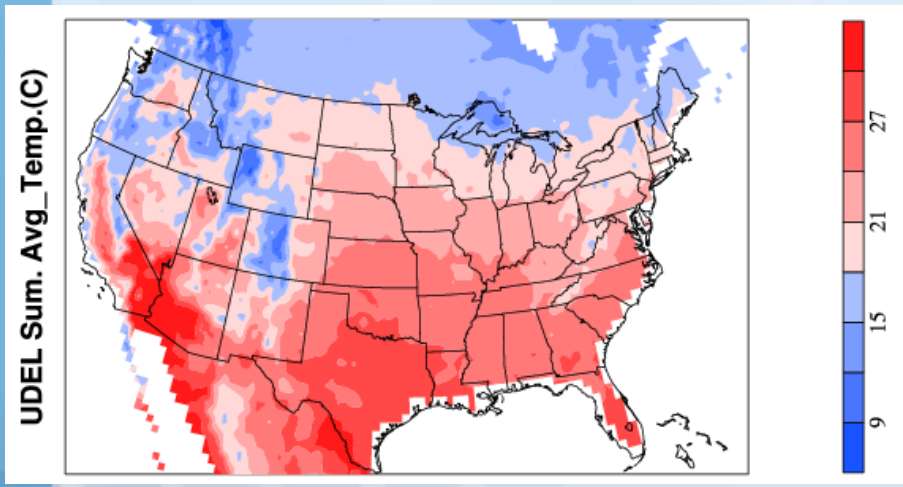
Evaluations of 10-year (2000~2009) simulation

--Surface Air Temperature (degC).

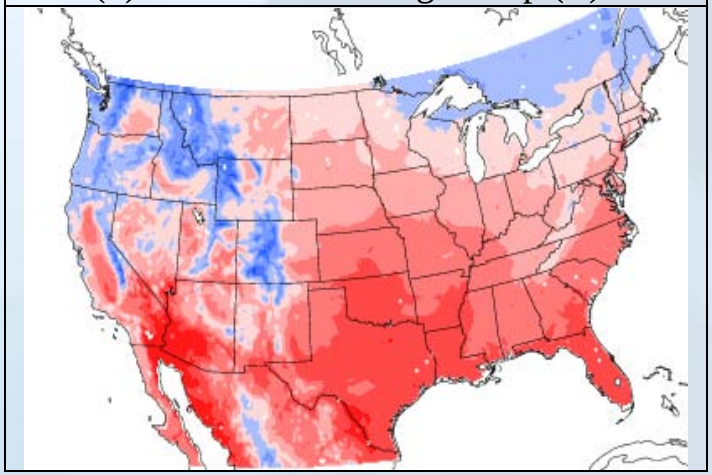


(a) NRCM Win. Avg_Temp (C)

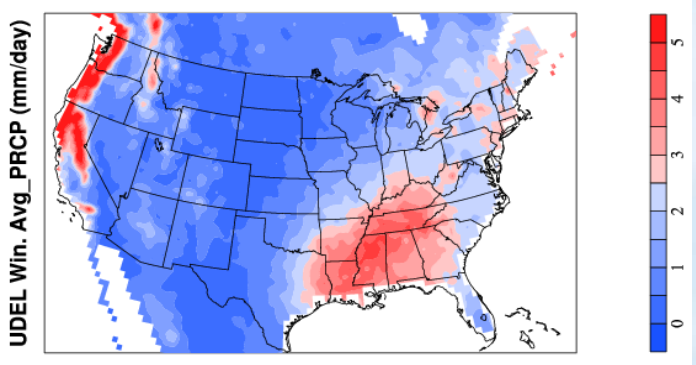


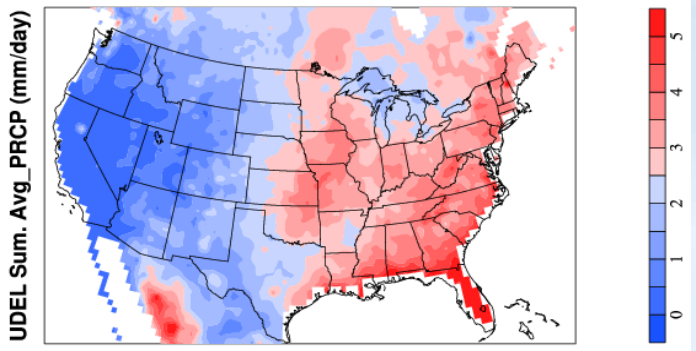


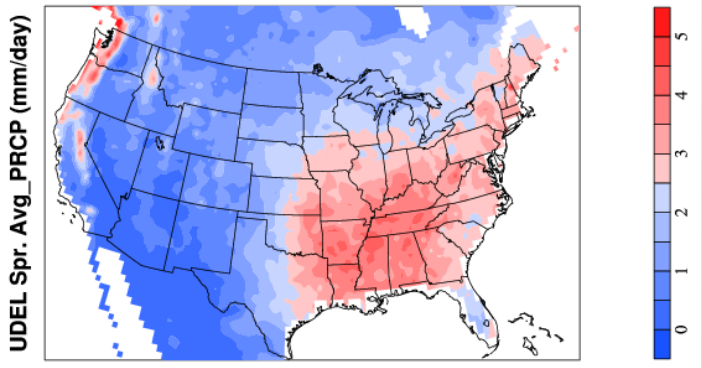
(b) NRCM Sum. Avg_Temp (C)



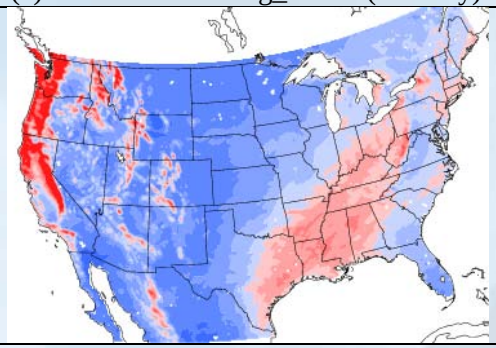
Evaluations of 10-year (2000~2009) simulation --Precip. Rate (mm/day)



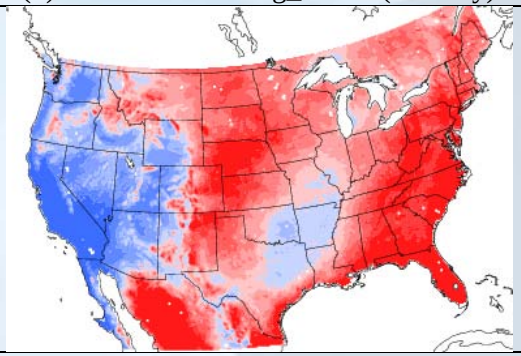




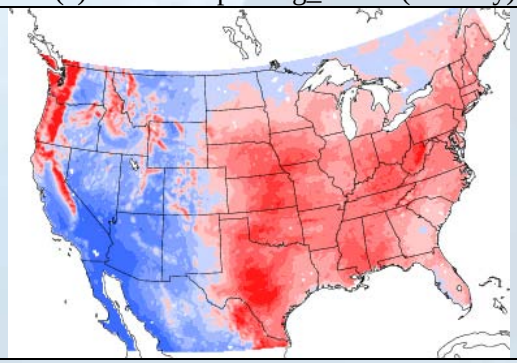
(a) NRCM Win. Avg_PRCP (mm/day)



(b) NRCM Sum. Avg_PRCP (mm/day)



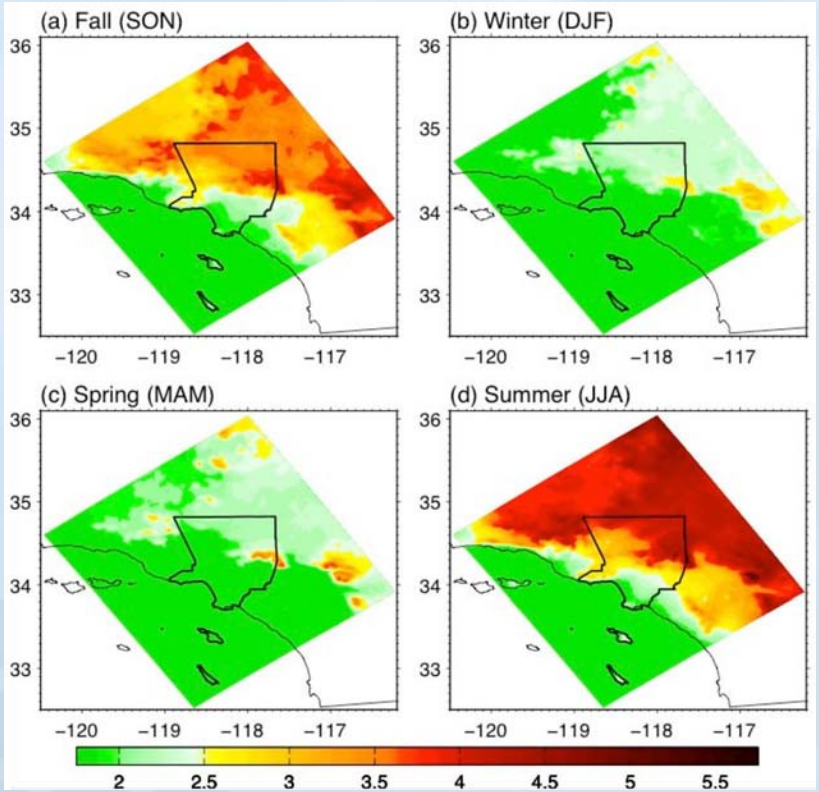
(c) NRCM Spr. Avg_PRCP (mm/day)



Another Science Issue

- Higher resolution cases for selected decades:
  - Further nesting to ‘cloud permitting’ res. – 4 km
  - Further nesting to ‘cloud resolving’ res. – 1 km

WRF downscaled to 2 km using the CCSM4 (triple nested) over LA County – temperature change, future – current, RCP 4.5



Hall et al. 2012