NA-CORDEX
Draft Science Plan
and Simulation Plan

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Program Goal

Address key science and climate applications questions that transcend the boundaries of numerous climate change communities (computer sci., physical sci., statistics, impacts, stakeholders).
Science Questions

• 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
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

<table>
<thead>
<tr>
<th>AOGCMs</th>
<th>GFDL</th>
<th>CGCM3</th>
<th>HADCM3</th>
<th>CCSM3</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM5</td>
<td></td>
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<td>X**</td>
<td>X1**</td>
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<tr>
<td>RegCM</td>
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<td>CRCM</td>
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<tr>
<td>HadRM</td>
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<td>RSM</td>
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<tr>
<td>WRF</td>
<td>X**</td>
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<td>X1**</td>
</tr>
</tbody>
</table>

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


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:
DJF temperature change

10-km WRFH-wccsm

50-km WRFG-ccsm

CCSM

DJF temperature change
10-km WRFH-wccsm

50-km WRFG-ccsm

CCSM

DJF precipitation change
Current and Future Work

- 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)
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