Climate Modeling to Support Urban Water Management in the Wasatch Range

Court Strong

*University of Utah, Department of Atmospheric Sciences*

Steve Burian and Christine Pomeroy

*University of Utah, Department of Civil and Environmental Engineering*
Presentation Overview

Objective
Describe cyberinfrastructure research activities linking climate and urban water management

Outline
• Background
  – The CI-WATER project
  – Wasatch Range precipitation and urban water management
• Regional modeling using WRF
  – Model configuration
  – Historical validation for water year 2008
• Future research plans
• Summary
CI-WATER Project

Goal is to provide and use these tools to enhance the capacity for water resource planning and management in the Utah-Wyoming region.
CI-WATER – UU Goals

1. Climate variability including extremes

2. Climate-urban-water cyberinfrastructure

3. Design, operation, and risk of urban water infrastructure

Environmental Response: Changes to Water Cycle Processes, Ecosystems, and Water Quality Processes
Climate-urban-water CI

• Probabilistic framework
  – Manage massive urban watershed input data sets
  – Execute hundreds of thousands of simulations
  – Store and post-process terabytes of data

• Climate uncertainty
  – Account for different greenhouse gas scenarios
  – Account for different model biases
  – Develop terabytes of boundary conditions and initial conditions that will be used to constrain our hydroclimate projections.
Importance of initial conditions

- The Large Ensemble Project
  - One model: CCSM3 (T42)
  - One forcing: A1B 2000-2061
  - 40 simulations

Trends in precipitation [% per 55 years] expressed as a percentage of the model’s ensemble-mean climatology for 2005-2060.
Wasatch Range Precipitation

Mountain versus valley floor annual cycles

[Map and graphs showing precipitation data for Alta and KSLC over months]

[Graph showing orographic ratio over months]
Wasatch Range Precipitation

Lake effect snow

Alcott et al. (Submitted, *Mon. Wea. Rev.*)

Yeager et al. (Submitted, *J. Appl. Meteor. Clim.*)
Regional modeling: model configuration

• The Weather Research and Forecasting (WRF) regional weather and climate model Version 3.3.1 (Skamarock et al. 2005)

• Configured following Headwaters Project (Rasmussen et al. 2011):
  – Noah land surface model
  – Mellor–Yamada–Janjic planetary boundary layer scheme
  – Community Atmosphere Model’s (CAM) longwave and shortwave schemes
  – Thompson et al. (2008) cloud microphysics scheme

• Plus some customizations to account for Great Salt Lake
Regional modeling: model configuration

- Lambert conformal projection, three domains

Boundary conditions:
6-hourly NCEP Climate Forecast System Reanalysis (38-km resolution).
Water year 2007-2008
Regional modeling: model configuration

- Resolution of topography
Regional modeling: historical validation

\[ \frac{\sum \text{WRF}}{\sum \text{Snotel}} = 1.003 \]

Precipitation (mm)
Regional modeling: historical validation

$\sum \frac{\text{WRF}}{\sum \text{snotel}} = 1.302$
250-mb geopotential height 2008

NCEP / NCAR Reanalysis
28 Jan 2008 12Z

mesowest.utah.edu
Summary and future research plans

- Additional historical runs
- Boundary force WRF with climate model projections
- Develop software to quickly generate future meteorological (precip., temp., etc.) scenarios
- Link climate simulation results to urban water systems models
- Analyze urban water system response to climate variability and the associated adaptation costs

http://www.hiddenwaters.org/

Court Strong, University of Utah
court.strong@utah.edu