Modeler: The Increasingly Important Role of Land–Atmosphere Models for High Resolution Ecohydrologic Process Study

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Talk Overview

• Background, context, and science motivation
• Availability of forcing data to support these efforts
• Application of CPMs to synthesize forcing datasets
• Ramifications of CPM resolution on modeling hillslope scale hydrology
• Further outgrowth and use of CPM output
Study Region and Context

- Transition between Great Basin and Northern Rockies
- Irrigated agricultural areas being displaced by urbanization
- Lots of (beautiful) public lands managed by multiple agencies
- Stresses include climate change, invasive species, water/land use intensification
Three observations about slope aspect:
• Affects the steepness and geomorphology
• Affects the spatial distribution of vegetation communities
• Impacts the presence of seasonal snow cover
Regional ecohydrologic/climate systems are coupled natural and human systems
Advance fundamental understanding of coevolution of eco-hydro-geomorphic systems and their management in complex terrain, feedbacks to regional hydroclimate using models and data.
Existing forcings well-suited to applications?

**PRISM:**
- Daily
- 4 km
- Geostatistical interpolation (ANN?)

**NLDAS2:**
- Hourly
- 0.125° (~12 km)
- Data assimilation product

**SNOTEL:**
- Hourly
- Point-only
- Representativeness issues
Can we model as well as we observe?

Rasmussen et al. J. Climate (2011)
Rasmussen et al. BAMS (2012)
- Katelyn Watson (see poster)
- Develop a 30 year regional historical run
- WRF v 3.7.1
- 3 km/3 hr output – Snake River Basin
- 1 km/1 hr output – Boise River Basin
- Model configurations largely follow Rasmussen et al.
- In progress...
Snake River Basin

Boise River Basin

Increasing elevation
Matt Masarik (see poster)

Reservoir managers have an information gap in the 10–30 day horizon

To what extent is there any predictability?

Pilot project to attempt to extract precipitation information in extended range

Dynamically downscale CFSv2 data to 3 km

Progress:
- Reanalysis done
- Reforecasts coming…
- Plume of moisture from the tropics brought heavy rains and flooding to parts of Oregon and Idaho in early June 2010
- Caught WFO and water managers somewhat off guard
- To what extent/when can a CPM add value for
• Miguel Aguayo
• Hillslope hydrological simulation using ParFlow
• Simultaneous evaluation of simulated soil moisture, SWE, discharge in 27 km² watershed
Do we really need <3 km resolution?

For our applications, absolutely!
THE LAB FOR ECOHYDROLOGY AND ALTERNATIVE FUTURING (LEAF)

A 30-Year, Multi-Domain High-Resolution Climate Simulation Dataset for the Interior Pacific Northwest and Southern Idaho

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Publisher
The Lab for Ecohydrology and Alternative Futuring, Boise State University

Publication Year
2016

DOI
http://dx.doi.org/10.18122/B2LEAFD001

http://scholarworks.boisestate.edu/id-30yr-wrf-sim/1/
Proof of Concept Collaboration for Water Supply

From Havens et al., in review

- Automated daily WRF 3 day, 3 km forecast for “fun”
- Runs on unused Cisco UCS cycles (don’t tell legal)
- Output made available via OPeNDAP server
- USDA ARS staff use Thursday forecast
- WRF output bias adjusted (simple CDF matching)
- Input to iSNOBAL model for Boise River Basin at 100 m
- Weekly report to NRCS and Reclamation Snake River Area Office
Finding additional applications

- Microgrids seen as a way to increase penetration of renewables
- Energy sector discussing “demand management”
- Heating/cooling comprise ~50% of building energy use
- Demand is a function of hourly air temperature

Heatmap of building heating/cooling demand in the Wood River Valley (courtesy J. Gardner, E. Ramirez, N. Johnson)
Conclusions

• CPMs provide a useful alternative for creating forcings for downstream applications… even for a simple hydrologist 😊
• Historical simulations largely appear to be within the errors of observations
• Demonstrably better results in hillslope-scale models (so far)
• Sharing data is kludgy, but works (for now)
• Additional applications crop up when we talk to people
Acknowledgements

• Research presented here supported by:
  • NSF EAR–1352631: CAREER: Citizens, Conservation, and Climate: Research and Education for Climate Literacy in Managed Landscapes
  • NSF IIA–1329513: Collaborative Research: Western Consortium for Watershed Analysis, Visualization, and Exploration (WC–WAVE)
  • NASA NNX14AN39A: Monitoring Earth's Hydrosphere: Integrating Remote Sensing, Modeling, and Verification
  • US Bureau of Reclamation R15AC00008: Intermediate–range Climate Forecasting to Support Water Supply and Flood Control with a Mesoscale Model