

## **Regional Climate Change Modeling Briefing-Draft**

### **Goal**

- Accurate regional projections of climate change impacts in the west are needed to inform decisions regarding climate adaptation strategies.
- Policy makers at the state and local levels require information that is based off of models that have finer spatial resolution than now provided with advanced climate models so decisions can be made with more confidence.

### **Background**

- Climate change is occurring
  - Warming is embedded in the climate system due to past greenhouse gas emissions
  - Western States have already seen the impacts of climate change<sup>1</sup>
    - Most of the western US is warming faster than the global average
    - Longer frost-free growing season
    - Earlier and warmer spring
    - Earlier flower blooms and leaf out for several plant species
    - Earlier spring snowmelt and runoff
    - Greater fraction of spring precipitation falling as rain instead of snow
  - We will continue to see climate change which will have impacts on urban planning, agriculture, hydrology, wildlife and water resources<sup>2</sup>
    - Extreme weather events such as heat waves and heavy rainfall are predicted to become more frequent with climate change<sup>2</sup>
    - Abrupt warming in the early spring can lead to increases in snow melt runoff and risk for flooding<sup>2</sup>
    - Forests and wildlands are adapted to recent climatic conditions and variability, but the rate of temperature change expected during the next century will greatly exceed that produced naturally over the past several thousand years. Forests, wildlands, and wildfires will also be affected by management practices, and other factors such as land-use change. In isolation, future climate change is likely to contribute to:<sup>1</sup>
      - Drier conditions and increased wildfire intensity.
      - More insect outbreaks and reduced forest health.
      - Movement of tree and plant species ranges to higher elevations.
- Current status of climate models
  - Basic research is needed to discover elements of the climate system that have not been identified
    - A limited understanding and capability to simulate the complex motions of the atmosphere, ocean, and cryosphere is an obstacle in improving weather and climate prediction<sup>2</sup>
    - Basic research will help determine how to better represent small-scale processes in climate models such as<sup>2</sup>:
      - The manner in which thunderstorms and groups of thunderstorms drive larger circulations
      - The simulation and prediction of hurricanes and the depiction of their effects on climate

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- Regional Climate Modeling needs<sup>2</sup>
  - Sustained, long-term, global observations are needed to properly run climate models
    - The best estimates are needed of the current observed state of the atmosphere, oceans, cryosphere, and land surface<sup>2</sup>
    - Challenges include:
      - Representing cloud cover accurately
      - Reconstructing ocean salinity when modeling the ocean circulation
    - These advances among others, will require more powerful computers dedicated to reliably predict climate with a level of detail and complexity that is not possible now<sup>2</sup>.
  - Large uncertainties exist for regional models over North America<sup>3</sup>
  - The topography of the west is important in generating accurate regional climate information in the west.
    - Decision makers need local information because they make policy that is relevant to them on a local and regional scale
      - For example, what does reduced rainfall in the southwest and lower snow pack in the Rocky Mountains mean to water managers
- Future of climate models
  - Future climate models need to provide information at much finer scales.
    - Most climate models are run with resolutions no finer than 62 miles. It is possible to make simulations better by making the resolution finer at about 3 miles or less over the intermountain west (Figure 1)<sup>2</sup>
      - For example, the National Center of Atmospheric Research (NCAR) has combined their weather research and forecasting model with a community climate model into a Nested Regional Climate Model (NRCM) that has a resolution that is approximately 3 miles<sup>2</sup>
    - Large-scale climate predictions can be considerably altered locally so it is important to make projections for local climates
      - For example, a city may be forecasted to cool although the more general large-scale behavior for the state could be warming. A local area could get more precipitation where the large-scale behavior could be drying<sup>3</sup>
  - The capability for improved regional projections of climate change exists
    - Improving regional prediction of weather and climate requires improved numerical models<sup>2</sup>
    - Improved predictions of climate change at regional and local scales should help a future climate change research program close the gap between science and decision making
  - More powerful computers dedicated to climate change modeling and prediction are required for the western U.S. states to gain useful climate information<sup>2</sup>
  - Many experts are needed to work on modeling weather and climate

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- The climate modeling community needs to work with society to provide useful information. See SAC briefing on the development of the National Climate Service

### **Current Status**

- WGA has current funding grant from the National Oceanic and Atmospheric Administration
  - Funds WGA's participation in NIDIS
  - Funding helps states participating in developing climate adaptation strategies including the development of a national climate service
- WGA current policy: See attached documents (WGA Climate Change Positions, Testimony to the national climate service, Policy on Fire Weather, Drought, Creation of NIDIS, Wildlife corridors report, Western Climate Initiative, Sustainable Water Report)

### **Key Considerations**

- Rigorous evaluations of different methods
  - Assessments exist that evaluate the performance of regional climate models that are currently being used for different portions of the United States (e.g., The North American Regional Climate Change Assessment Program).
  - The request for proposal process would be a fair way to coordinate climate modeling efforts and make the process of funding competitive
- Necessary components for successful climate modeling/stakeholder partnership
  - Stakeholders, the climate modeling community, and interdisciplinary researchers/experts need to effectively work together.
  - The needs of the data users must be expressed initially and throughout the process. The climate models must be designed to produce answers for the needs of the users such as state governments, wildlife managers, water quality and water resources agencies, state foresters, agriculture department, flood control, air quality, local governments, individuals, energy and power companies

### **WGA recommendations and next steps**

- Staff council should direct the Western States Water Council and the Western Governors Wildlife Council to provide recommendations for revising WGA policy Resolution 06-3, including taking into consideration improving regional climate modeling.
- Staff Council should establish a climate adaptation working group that includes representatives from lead governors', WSWC, and WGWC, that will help guide WGA positions on federal climate legislation, National Climate Service legislation, and WGA's participation in the NAS climate study.
- The WGA climate adaptation working group will also be responsible for planning and organizing a plenary session during the next WGA annual meeting.

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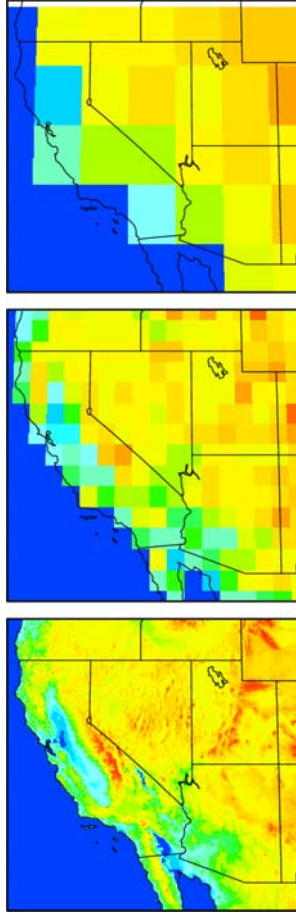


Figure 1. Resolution of orography for models with resolutions of 168 miles (top figure), 68 miles (middle figure) and 2.5 miles resolution (bottom figure). This roughly translates into the typical resolution of climate models (top), what will be done to support the next assessment of Intergovernmental Panel on Climate Change (IPCC) (middle), and an approach such as NCAR's nested regional climate model (NRCM) (bottom).

Briefing Prepared by: Elisabeth Cohen,  
Energy and Climate Policy Coordinator, Governor Huntsman's Energy Advisor's Office,  
office: 801-538-8820, cell:801-865-1791, [lcohen@utah.gov](mailto:lcohen@utah.gov)

<sup>1</sup> Governor Huntsman's Blue Ribbon Advisory Council Scientific Climate Change Report  
[http://www.deq.utah.gov/BRAC\\_Climate/docs/Final\\_Report/Sec-A-1\\_SCIENCE\\_REPORT.pdf](http://www.deq.utah.gov/BRAC_Climate/docs/Final_Report/Sec-A-1_SCIENCE_REPORT.pdf)

<sup>2</sup> Hurrell et al., Bulletin of the American Meteorological Society, 2009; in press.

<sup>3</sup> Christensen, J.H., B. Hewitson, A. Busuioc, A. Chen, X. Gao, I. Held, R. Jones, R.K. Kolli, W.-T. Kwon, R. Laprise, V. Magaña Rueda, L. Mearns, C.G. Menéndez, J. Räisänen, A. Rinke, A. Sarr and P. Whetton, 2007: Regional Climate Projections. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA (p. 887).