Briefing to Western Governors' Association:
The Effect of Global Warming on the Western U.S.

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Despite impressive gains in knowledge of global climate change, our understanding and predictive capacity of the Earth system remains insufficient for many societal needs, including the accurate and reliable predictions of regional climate change required for adaptation and mitigation strategies.

Extreme weather events like heavy rainfall or heat waves are projected to become more frequent as climate changes. Moreover, because more precipitation occurs as rain instead of snow with warming, and snow melts earlier, there is increased runoff and risk of flooding in early spring, and increased risk of drought and wildfire in summer as the warmer air dries the land. Such events have enormous implications for agriculture, hydrology, water resources and urban planning. Current climate models resolve neither the local processes nor the complex topography required to predict such high-impact events over the intermountain West.

Improved models and more powerful computers dedicated to climate modeling and prediction are required for western U.S. states to plan for the impacts of climate change.

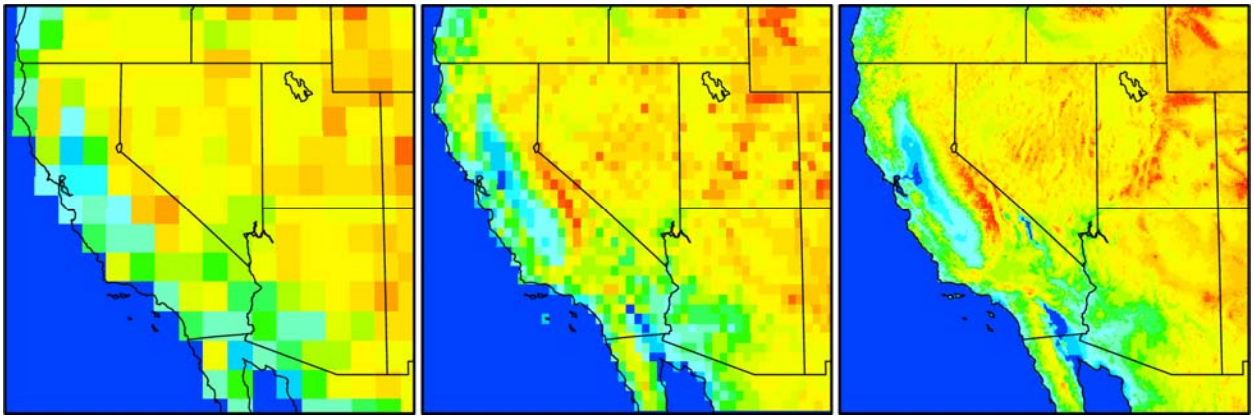
The National Center for Atmospheric Research (NCAR) has the capacity to be foremost in a computer modeling revolution that will produce far more accurate and reliable predictions of regional climate change, including the statistics of extreme events and high impact weather. Central to this effort are next-generation computing facilities. Regional-scale climate prediction will stretch such facilities to their limits and will drive future advances in computing.

NCAR has a record of world leadership and achievement in terms of advancing knowledge of weather and climate variability and change. In keeping with its core mission, NCAR has developed and supported advanced observing facilities, increasingly powerful supercomputing capabilities and related software, valuable research data sets, and widely-used state-of-the-science community weather and climate models.

The NCAR Weather Research and Forecasting (WRF) model is the most widely used weather research and prediction system in the world, with nearly 7,000 research users and 22 operational centers in 95 countries, including the U.S. National Centers for Environmental Prediction (NCEP) and the U.S. Air Force. The Community Climate System Model (CCSM) is a comprehensive, world leading climate model that provides computer simulations of the Earth's past, present, and future climate states. Simulations made with CCSM were instrumental in the most recent Intergovernmental Panel on Climate Change (IPCC) Assessment, which was awarded the Nobel Peace Prize. CCSM IPCC data are used widely by the climate research community.

An ambitious, strategic goal is to combine the WRF and CCSM models into a Nested Regional Climate Model (NRCM) that will allow for fundamental progress on the understanding and prediction of regional climate variability and change. In particular, embedding WRF within CCSM will allow scientists to resolve processes that occur at the regional scale, as well as the influence of those processes on the large-scale climate, thereby improving the fidelity of climate change simulations and their utility for local and regional planning.

NCAR scientists propose a series of simulations with NRCM, perhaps supported through a consortium of western states, to examine likely changes in future climate and regional weather statistics over the intermountain West. These unique data sets will be of immense interest and utility to many stakeholders.



Many climate models, including those supporting the 2013 assessment of the Intergovernmental Panel on Climate Change, track the atmosphere in vertically stacked horizontal rectangles that typically span about 55 x 70 miles at midlatitudes (left). The NRCM approach improves the resolution to about 20 miles (center) across regions as large as ocean basins and continents, with detail as sharp as 2.5 miles or less (right) in areas of particular interest. This strategy provides greatly enhanced prediction and understanding of how rain and snow, snowmelt, drought, hurricanes, and other weather and climate phenomena could evolve in the 21st century.