“Climate Crisis” in the West Predicted with Increasing Certainty

Computer model analyses trace hydrological trends to human causes with unprecedented robustness

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A new analysis led by researchers at Scripps Institution of Oceanography at UC San Diego shows that climate change from human activity is already disrupting water supplies in the western United States.

Trends in snowpack, river runoff and air temperatures - three fundamental indicators of the status of the West's hydrological cycle - point to a decline in the region's most valuable natural resource, water, as population and demand grows in the West.

Details of the analysis appear in "Human-induced changes in the hydrology of the western United States" in today's issue of *Science Express*, the online edition of the journal Science.

The study focused on the western United States because of its large and growing population in a generally dry region where battles over water are becoming increasingly common. The researchers report that the declines in snowpack, warming air temperatures and earlier spring river runoff that are already seen in the region are well explained by climate impacts expected from greenhouse gas and aerosol emissions from human activities.

The team also notes that the demonstrated accuracy of the computer models used in this analysis of the current situation bolsters the credibility of their predictions of future climate trends. These results show climate change is already affecting water supplies, a limited natural resource in the western U.S., and the region is facing a looming climate crisis.

The team, which included researchers from Scripps Oceanography, Lawrence Livermore National Laboratory, University of Washington, the National Institute for Environmental Studies in Japan and the San Diego Supercomputer Center (SDSC), relied on multiple computer models and intensive data analysis. The scientists found that observed hydroclimatic changes differ in length and strength from trends that would be expected from natural variability, changes in solar activity or large-scale precipitation changes.

The observed changes, however, do correspond to those expected from the impacts of human activity on the climate system.

Lead researcher Tim Barnett, a research marine physicist at Scripps, said the analysis is unprecedented in its sophistication and novelty of approach.

"We couldn't shake the results," he said. "We got the same answer no matter what analysis techniques or datasets we used."

Team members said that the specific focus of the analysis on the real-life issues affecting one region is also new. The climate models were chosen based on their realistic portrayals of observed global climate and of region-specific climate phenomena such as the Pacific Decadal Oscillation, an oceanic pattern that has a strong bearing

on the climate of the western United States. Several of the member institutions took part in the analysis while SDSC team members helped manage the more than 20 terabytes of data incorporated by the climate models.

The accuracy of the representation of past climate trends and their cause suggests that the same models are a reliable predictor of future conditions in the West. These models have forecast a serious water supply problem for those dependent on the Colorado River drainage and substantial alterations to the hydrology of the Sacramento River delta, home to many sensitive ecosystems and economically important wildlife.

The models "portend a crisis," said Barnett. "After the performance on the last 50 years of observations, we can put high confidence in their general predictions for the next 20 years, at least in the western United States.

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