

For more information, contact:

Martin Hoerling

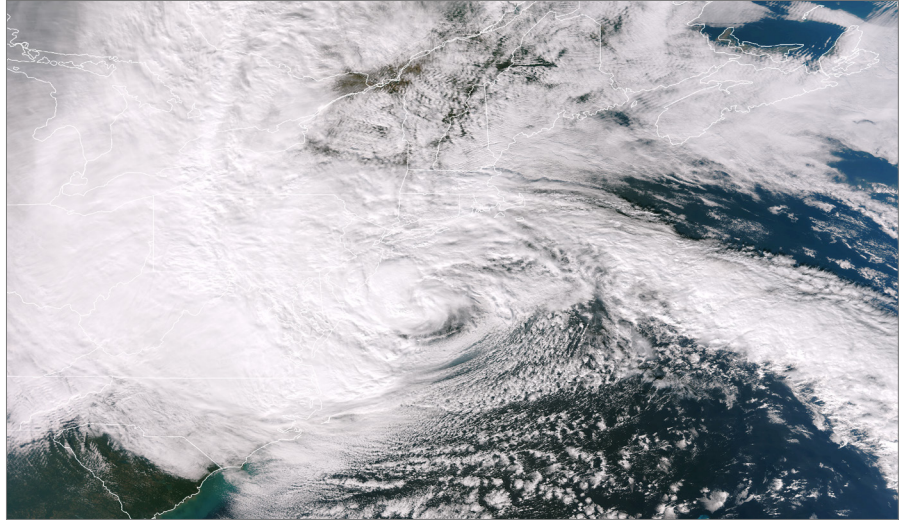
NOAA Earth System Research Laboratory

Physical Sciences Division

Boulder, Colorado

Phone: 303-497-6165

Email: Martin.Hoerling@noaa.gov



Satellite image on 29 October 2012 showing the storm system of post-tropical storm Sandy just before making landfall along the New Jersey coast.

Interpreting Weather and Climate Conditions

Weather and climate attribution and predictability assessments are a scientific process for identifying the major causes of observed climate and weather patterns. This research includes explaining extreme events for which great public interest exists because they produce profound societal impacts, and trends of decade-to-century duration. Key research questions are: What are the causes of extreme events? Is there a change in frequency? To what extent are human influences or natural processes at play? Are these events predictable?

Why attribution?

Policy-makers, decision-makers, and the public are increasingly interested in explanations of current climate conditions and how they compare with the past. They also want to know why climate is evolving as observed; that is, to provide attribution of the causes for observed climate variations and change.

Of equal importance is ensuring that natural variability, when occurring, is not misunderstood to indicate that climate change is either not happening or that it is

happening more intensely than the true human influence. For example, learning whether recent drought in the western U.S. is due mainly to natural variability and a return toward previous conditions might be anticipated, or instead there is a longer-term trend toward increasing dryness in the region due to human-caused climate change. Armed with this information, preparations can be made to respond to and minimize the impacts of similar events in the future.

How is attribution performed?

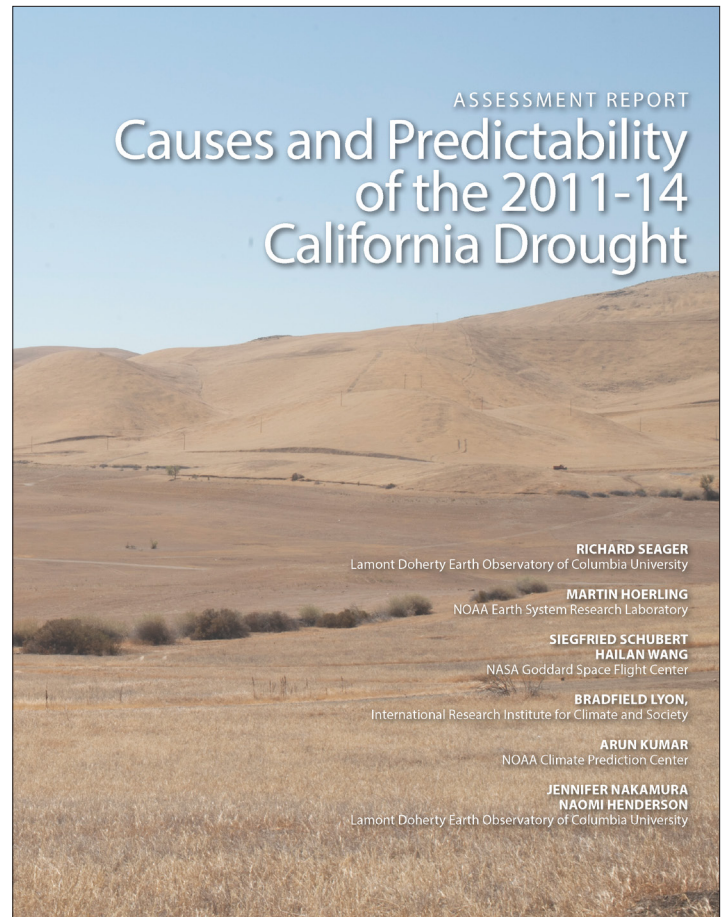
The ESRL Physical Sciences Division lead a Weather and Climate Attribution Activity to provide explanations and assessment of predictability of the observed state of the climate system. Examples include: U. S. annual surface temperature and precipitation; U.S. extreme events and major climate anomalies, including drought, cold outbreaks, heat waves, and floods; intensity of the hurricane season; and apparent abrupt regional changes. The PSD-led group has assessed, and will continue to, assess the performance of weather and climate predictions including: explaining the success and failure of U.S. seasonal temperature and precipitation predictions, ocean predictions and drought outlooks.

The scientific methods used can involve both analyzing observations and their past climate relationships, and experiments with weather and climate models to evaluate physical processes that could result in the observed changes.

What are the benefits?

Timely and authoritative explanations of current and evolving weather and climate conditions are required to meet surging public interest and needs for climate information, to provide early warning, and to inform preparedness

Without clear and present knowledge of the state of the climate system, policy and decision makers cannot make informed decisions concerning how society should invest in critical infrastructure in risk-prone areas. Since 1980 the U.S. has sustained 188 weather and climate disasters with damages/costs of \$1 billion or more. In 2015, there were 10 events with losses exceeding \$1 billion each across the United States, resulting in the deaths of 155 people. These deaths and the significant economic effects are striking examples of the need to inform policy and decision makers of the causes of such events and related implications for the future. The Physical Sciences Division has led the assessment of several recent droughts impacting the Nation's commerce and economy: the Texas 2011 event, the U.S. 'Cornbelt' 2012 event, and the 2012-2014 California drought. These studies are performed in coordination with interagency groups and with the National Integrated Drought Information System (NIDIS) in order to provide timely and expert scientific information to stakeholders and decision makers seeking to mitigate drought impacts. Floods, such as in the Missouri River Basin in 2011 for which attribution and predictability



According to this NOAA-sponsored study, natural oceanic & atmospheric patterns are the primary drivers behind California's ongoing drought. The full report is available online at: <http://cpo.noaa.gov/MAPP/californiadroughtreport>

assessments were done in partnership with the U.S. Army Corp of Engineers, or over northeast Colorado in 2013, address additional societal risks from weather and climate extremes. The causes of these and other events are examined in a predictive context to learn what factors could have led to improved early warning and preparedness.

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Physical Sciences Division
325 Broadway
Boulder, CO 80305

Visit us online at:
www.esrl.noaa.gov/psd/csi/