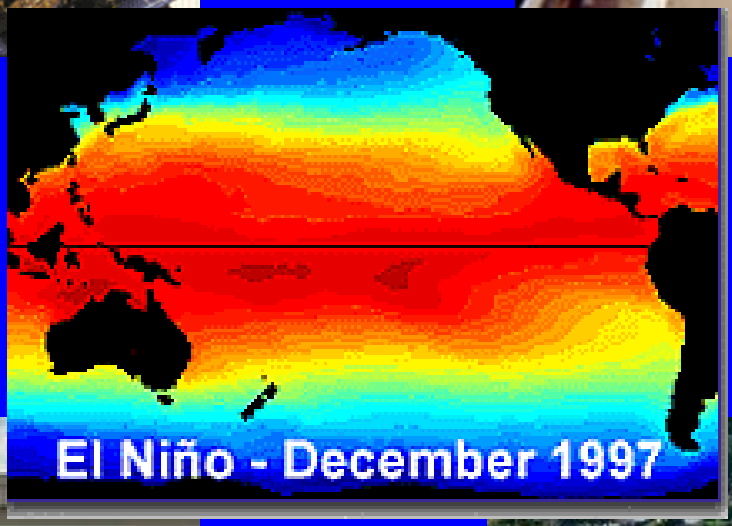
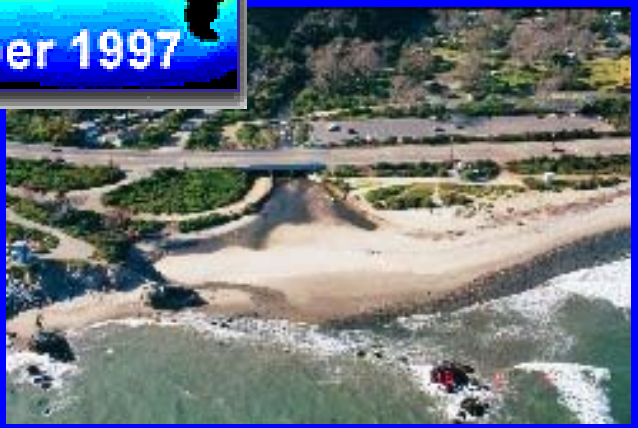
IMPROVING RESPONSES TO CLIMATE PREDICTIONS

Highlights of a Policy Forum

Developed by the American Meteorological Society in collaboration with Columbia University

April 2003





One of the most predictable climate events is El Niño, a naturally occurring weather/climate phenomenon, featuring warming of the surface ocean waters in the central and eastern tropical Pacific. An El Niño typically persists for 12 to 18 months and recurs approximately every two to seven years. Weather phenomena associated with El Niño include increased or decreased temperatures and precipitation, and more or less hurricane activity. These phenomena are somewhat predictable on a seasonal time scale and, therefore, allow decision makers to develop response strategies to the impacts. Significant societal, economic, and environmental impacts may include:

- Drought;
- Flooding/mudslides;
- Forest fires;
- Loss of homes;
- Loss of crops; and
- Loss of lives.

Terminology that may be helpful in understanding this issue[1]

Weather – The state of the atmosphere, mainly with respect to its effects upon life and human activities. Weather consists of the short-term (minutes to days) variations in the atmosphere.

Weather forecast – An assessment of the future state of the atmosphere with respect to precipitation, clouds, winds, and temperature.

Climate – The slowly varying aspects of the atmosphere-hydrosphere-land surface system.

Climate prediction – The prediction of various aspects of the climate of a region during some future period of time. They are generally in the form of probabilities of anomalies of climate variables, i.e., temperature, precipitation, etc, with lead times up to several seasons.

Prior to 1997, the strongest El Niño of record (i.e., largest sea surface temperature anomaly) for this century was recorded in 1982/83. Quite significant weather responses to that El Niño in the United States were observed that resulted in large societal impacts on safety, property, and economic development. The *Financial Times* (July 28, 1997) reported that the 1982/83 El Niño led to estimated U.S. losses of $2.2 billion with 161 human deaths. Several retrospective scientific investigations, including modeling research and development, showed some promise in the prediction of the anomalous climate of 1982/83.

Having experienced the 1982/83 El Niño, meteorologists and climatologists were able to coordinate their research efforts in predicting an even stronger El Niño occurrence in 1997/98. These predictions allowed communities to take measures to abate certain hazardous impacts, and enabled decision makers to capitalize on economic opportunities. The 1997/98 El Niño was the largest and warmest to develop in the Pacific Ocean in the past 100 years, and a milestone for seasonal forecasts. Analysis of 1997/98 El Niño impacts on the U.S. economy suggest that predictions are a significant decision variable for management in several climate sensitive industries, as well as disaster preparedness. For example, there is strong evidence that California saved over $1 billion in property damages due to better preparation by state and local officials in response to the 1997/98 El Niño forecast.[2]

As can be seen from California, decisions made in response to climate prediction information proved to be very successful. Examples of decision-making that can benefit from climate predictions include the following:

- Reservoir and water storage management decisions;
- Agriculture decisions related to crop selection, irrigation, planting and harvesting schedules, and use of chemicals;
- Emergency preparedness decisions regarding early logistic deployment of disaster assistance facilities (e.g., mobile homes, portable communication systems) and recovery supplies and personnel; and
- Capital investment decisions regarding seasonal recreation (e.g., additional ski equipment).

Although climate predictions have proven to be very beneficial, decision makers still have many concerns about integrating climate predictions into their management systems. Some of these concerns include:

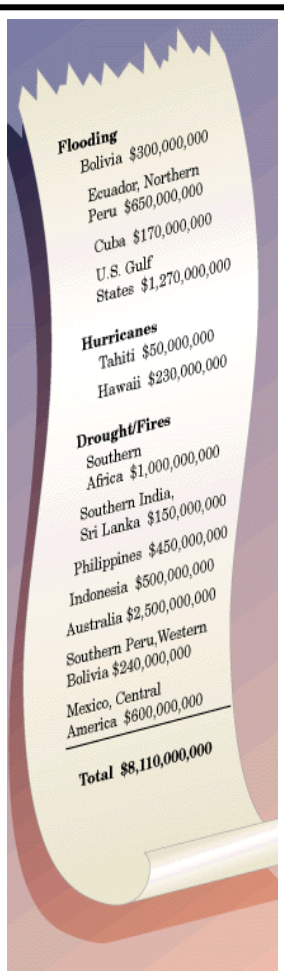
- Accuracy and reliability of climate predictions;
- More documentation of benefits for responding to climate predictions;
- Quantification of forecast uncertainties; and
- Management/legal constraints on use of the forecasts.

Flooded area in Lakeport, California as a result of the 1998 El Niño event. (Federal Emergency Management Agency)
http://www7.nationalacademies.org/opus/elNiño.html

To cope effectively with climate impacts, nations require accurate, timely seasonal and longer-term predictions. However, this is only a starting point. To respond effectively to climate predictions that involve significant seasonal variations, nations also require appropriate policies governing public and private decisions – at the local, national, and international levels. However, in most instances, the needed policies are not in place.

AMS POLICY FORUM: IMPROVING RESPONSES TO CLIMATE PREDICTIONS

In response to this need, the Atmospheric Policy Program of the American Meteorological Society (AMS), in collaboration with Columbia University, developed and convened a forum designed to identify improvements in the development of strategies that benefit from effective application of climate information and seasonal climate predictions. This Forum brought together weather and climate scientists, specialists in developing decision strategies, and policy makers. The discussions developed findings, policy options, and recommendations necessary to achieve the improvements. The Forum focused on climate predictions such as El Niño and associated meteorological phenomenon. Because these types of climate anomalies can have huge societal impacts on local, state, regional, and international communities, it is important to understand and improve climate predictions and the infrastructure needed for such research. This knowledge can then be used more effectively to allow communities to respond and prepare for climate variations. The federal government currently funds climate research initiatives through a number of Departments including Commerce (NOAA), Energy, and Agriculture, as well as the National Science Foundation and NASA. University research programs also devote significant resources toward climate research and other related atmospheric/oceanic projects.



Economic impacts attributed to the 1982-83 El Niño. (Reports to the Nation On Our Changing Planet, www.pmel.noaa.gov/tao/elNiño/report/)

Examples of Climate Prediction Users During the 1997/98 El Niño[3]

Water Resource Managers cleared debris from water drainage systems, lowered water levels in lakes and canals, and had high inventory in sand bags in case of flooding.

Agribusiness Managers developed new irrigation schedules, changed their primary crops according to precipitation levels, and changed feeding schedules according to the amount of grain available

Power Utility Managers made decisions relating to the trading and or purchasing of power.

GENERAL RECOMMENDATIONS

The AMS Policy Forum developed several general recommendations that can be best implemented through cooperative efforts among the public, private, and academic sectors.

1) The nation should increase investments in climate science research, climate impact assessments, and strengthening the supporting infrastructure to improve climate predictions resulting in significant societal benefits.

2) Providers of climate predictions should include clearly defined uncertainty measures (probabilistic information) that are presented with mutually understood terminology.

3) Representatives of government agencies, private sector organizations, and academia should establish a collaborative approach to develop and provide a national capability for climate prediction and information services that would foster mutual trust and useful applications of climate information.

4) Academic institutions should establish educational programs to produce *science integrators* who understand how to communicate user needs to providers and facilitate the application of climate information for users.

5) Climate service providers and decision makers should work together to develop measures of improved performance resulting from using climate information as part of the decision process.

SPECIFIC POLICY RECOMMENDATIONS

1) Government decision makers should integrate the use of climate information into national and international planning. Tools, based on climate data and analysis, should be developed that help integrate climate information and understanding into planning at all government levels.

2) In partnership, the government, academia, and private sector should identify one or more "grand challenges" to improve climate prediction services and applications. These challenges will provide a strategic focus for organizing shared efforts to advance the mainstreaming of climate information in policy formulation in the near- and long-term. An example of such a grand challenge is an overall study to document and report on the impacts of climate variability on society.

3) Governmental and academic institutions should consider increasing educational opportunities for climate scientists to better understand society and climate. Understanding how society reacts to climate and related forecasts is an important undertaking that can help define needed meteorological research as well as improve the benefits from climate prediction services.

4) Government agencies, resource management institutions, and private sector enterprises should aggressively recruit and retain scientists with science integration skills as part of their programs in climate-sensitive sectors. Providers and potential users of climate information should recognize the important role of *scientific integration*, a relatively new profession. Scientific integrators possess not only knowledge and/or experience in climate science and forecasting, but also an understanding of the processes involved in user decision-making.

5) The government should make balanced investments in research to advance the chances of reaching the theoretical potential in climate predictions to meet national economic and social needs. The investments should be devoted to: enhanced understanding of climate variability; more accurate climate prediction modeling techniques and data assimilation methods; expanded quality and quantity of observations; supporting infrastructure of computers and information systems; and a collaborative modeling focus, both nationally and internationally, among institutions and governments.

6) The U. S. government, in partnership with academia and the private sector, should encourage the World Meteorological Organization (WMO) to provide mechanisms for sharing information on climate services and applications internationally. Ongoing discussions about the emergence of Regional Climate Centres in the WMO provides a special, near-term opportunity. To achieve sustainable development on a global scale, the nations of the world will need to effectively use climate information.

7) The AMS should provide opportunities for continued science-policy dialogues, since climate science policy is a relatively new area. There should be more opportunities for open dialogue that is focused on climate-sensitive sectors. The goals of these dialogues include: identification of critical climate information needs; enhanced understanding of vulnerability; improved assessment methodologies; exploration of response strategies; and increased awareness of current and emerging forecasting capabilities and decision-support tools.

CONCLUSIONS

Many aspects of these recommendations must be met by the private sector—including corporate decision makers and the value-added meteorological services industry that provides climate information. Other aspects require public sector investments and actions. There are also recommendations that require university actions and research activities. The recommendations developed in this Forum, although directed, for the most part, at specific portions of these interested communities, can be best implemented through cooperative efforts among those communities. Implementation of the Forum recommendations by partnerships in the United States and abroad would result in the development of effective responses to climate variations.

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[1] Glickman, Todd S., et al., eds. *Glossary of Meteorology*. Boston: American Meteorological Society, 2000.
[2] "Improving El Niño Forecasting: The Potential Benefits," ed. Rodney F. Weiher, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, August 1999.
[3] Changnon, Stanley A. ed. *El Niño 1997 – 1998 The Climate Event of the Century*. Oxford: Oxford UP, 2000.

Support for this Forum was provided by the AMS Policy Study Series Underwriters, ITT Industries and Raytheon, and by the Forum Study Donor, Space Systems Loral. For further details on the Forum, see background information, the full report, and position papers at: www.ametsoc.org/atmospolicy

The American Meteorological Society (AMS) is a scientific and professional society of more than 11,000, members from the United States and over 100 foreign countries. For more information regarding the AMS Atmospheric Policy Program Forum Study Series, please go to www.ametsoc.org/atmospolicy

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Cover Images:
Center Picture - El Nino – December 1997 – Credit: NOAA
Bottom left - "Flash floods can be a side-effect of strong El Niños." - Credit: NOAA.
Bottom right – "Coastal Erosion from El-Niño Winter Storms: October, 1997 through April, 1998 in Southern California." – Credit: USGS
Top left – "Houses in Oakland, Calif., destroyed by landslide during the 1997-98 El Niño." – Credit: USGS
Top right – "Effects of El Niño" – Credit: The GLOBE Program

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