"Climate Information and Forecasts: New Tools for Risk Management"

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RISK MANAGEMENT STRATEGIES IN AN UNCERTAIN WORLD

Introduction

Nearly 10,000 lives were lost in the US between 1988-2001 in 43 disasters, each one of which had associated damages of or exceeding $1 billion; together the costs for these disasters exceeded $185 billion (NOAA Website 3/29/02). While these are the largest recorded disasters for this time period, other atmospheric or related climate extreme events that occurred such as lightning strikes, tsunamis, hail, winds, extreme temperatures, nor'easters, ice storms, and avalanches, were not included in the damage estimates.

Among the most important climatic events that lead to significant losses and dislocations in the US are droughts, floods, hurricanes, and tornadoes. These events present difficult challenges to hazard planners as their warning times, durations, and frequencies differ significantly (See Table 1). For example, local planners may only have minutes to days to plan for an impending tornado, while these same planners may have up to a year to plan for an impending drought. Similarly, planners may have to contend with a direct threat of a flood for weeks, while a hurricane could impact an area for only a few minutes. The one commonality is that on average, their annual financial losses to Americans exceed a billion dollars.

Disaster losses are increasing. Growth in populations, particularly groups that settle in more hazardous areas, coupled with aging dams, bridges and other engineered structures, create a greater likelihood of high risk events with significant economic and social costs. Given this backdrop, climate information and forecasts are becoming increasingly utilized in climate risk management**.**

Since the 1980's, knowledge of processes contributing to climate variability and associated impacts has grown more sophisticated, with climate information and forecasts increasingly being developed and disseminated in many areas around the world. One of the best known and understood types of climate variability is El Niño, a naturally occurring meteorological phenomenon that develops every five to seven years in the western Pacific. Climate extremes such as those caused by El Niño impact a variety of sectors such as those of agriculture, water supply, health, tourism, and fisheries as well as rural and coastal development. They also impact societal and physical infrastructures.

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In this write-up, we highlight two cases associated with the 1997-98 El Niño for special attention. The 1997-98 El Niño was a strong event, with losses of 21,000 deaths and more than $30 billion in direct structural damages (van Aalst *et al.*, 2000). 1997-98 was the first time a strong El Niño event was detected early and made known for planning purposes through a network of organizations to millions of people in many regions of the world. A significant savings in lives and property was achieved. The case described below show how climate forecasts and information have become effective tools for risk management.

Table 1: A Comparison of Four Types of Common Climatic Events in the US

	Drought	Flood	Hurricane	Tornado
Warning Time	Up to a year, but often, none	From seconds to months, hours, weeks	36 hours to months, minutes, weeks	Minutes to two days
Duration	Months, years, decades	Hours, weeks	Minutes, weeks	Seconds to more than 1 hr.
Frequency	Each year – some part of the US has severe or extreme drought	A stream typically overflows 2 out of 3 years	1.6/yr – all intensities 1/5.75 years – class 4 and 5	The average number of tornadoes between 1990-1999 in the US was over 1200
Annual Average costs and losses	$6-$8 billion	$2.41 billion	$1.2-$4.8 billion	$1.1 billion (Crop damage not included)

Source:
University of Nebraska website, http://enso.unl.edu/ndmc/enigma/compare.htm;
NOAA website, http://www.spc.noaa.gov/faq/tornado/;
CIRES website, http://sciencepolicy.colorado.edu/sourcebook/tornadoes.html.

Forecasts – Economic Value and Utilization

We have a growing understanding of the value of climate information and forecasting from quantitative and qualitative studies. Accurate and timely climate forecasts hold the promise for improving economic and social well-being in both good and bad years (Easterling and Stern, 1999). Even though the range of economic estimates is wide, the numbers suggest that large benefits can be achieved, depending on geographic and economic circumstances[3]. For example, in the US agricultural sector, Solow *et al.*

[3] The variance in estimate of these benefits in the literature reflects differences in analytic methods, study questions, level of aggregation, and how the results are reported (Mjelde *et al.*, 1998).

(1998) calculated $230 million (in 1995 dollars) of annual benefits in net society welfare could be attributed to using ENSO based forecasts.

Even though we are in an era of improved forecast skill, forecasts may not be successfully utilized. Some of the problems relate to the perception and communication of risk. For example**, s**ome people simply do not understand how to interpret forecasts and other climate information. Others do not use them because of a strong aversion to risk, i.e. possible problems associated with these new tools are too great. Others do not use them because the forecasts are not available at a scale that would be helpful (e.g., the Navajo reservation spans a number of jurisdictions such as states, counties, and watersheds, and meaningful forecasts do not exist for the specific location of interest). In many other cases, people have not incorporated them in their decision making because the timing of institutional decisions may not match the timing of forecasts or the incentives for professional advancement does not include taking chances on utilization of new scientific information[4].

Case 1: A *Conceptual Model and Experience in Four Regions/States in the US*

Beller-Simms (2001) developed a conceptual model of natural hazard mitigation and preparation in which she examined the stages of decision-making undertaken by state and local institutions for the 1997-98 El Niño; this study highlighted the importance of forecasts in disaster management and strategy development. People in the case study areas of California, Arizona, New Mexico, and Texas, had all witnessed significant anomalies in precipitation patterns in the two previous El Niño events. They approached the threat of the 1997-98 El Niño in radically different ways ranging from doing nothing to pursuing a suite of activities including identifying forecasts and risks to constituents via the Internet to preparing the region for the threat via a highly-publicized state meeting. Decision makers in these areas relied on forecasts to plan their mitigation and preparation activities.

These case studies show the importance of climate forecasts and information as tools for risk management. The early identification of the 1997-98 El Niño allowed state and local decision-makers to plan a course of action to lessen the impacts of an upcoming event that was expected to cause a large economic toll in loss of property and life similar to that experienced in previous years. While no dollar amount was available, planners believe that mitigation and preparation activities led to significant numbers of lives saved and property protected. Knowledge learned from responding to this event also helped decision makers respond to subsequent events including the Year 2000 threat.

Case 2: Investments in Climate Information and Forecasts in the Context of Multi-National Lending Organizations

[4] See NOAA website for the abstracts of grants funded by the Human Dimensions Program.

A recent study of World Bank emergency assistance loans targeted at the 1997-98 El Niño shows the still unexploited potential for using climate information and forecasting systems in developing countries (van Aalst *et al.*, 2000). The study's findings suggest that climate information systems could directly help developing countries build or maintain a future path of economic and social development. The report recommended pathways for the World Bank to use to facilitate investments in the science, technology, and institutions that comprise climate information systems. According to the report's recommendations, the World Bank and its clients would need to rely more heavily on knowledge of climate events and its application to short- and long-term decision-making.

An important recommendation of the study was for the World Bank to build practical experience and understanding in the field of climate forecasting and its application to decision-making. Tracking the loans, designing and testing performance measures for investments, and conducting hindsight studies would help generate first-hand knowledge about actual and potential benefits and societal returns from investments in climate information systems. A second key finding was the importance of investing in pilot projects to gain hands-on experience for the World Bank and its clients. Pilot projects in areas most vulnerable to El Niño related events could be established in Africa, Mesoamerica, Pacific Islands, and Asia.

Summary and Further Thoughts

1. Forecasting and knowledge about climate variability are essential tools for effective disaster mitigation and preparation, and, more broadly, for risk management.
2. We are learning and gaining experience though provision of forecasts and other climate information to decision-makers, but important challenges remain (Glantz, 2001).
3. Even with wider dissemination and attention to communication techniques, forecasts and other climate information are not always utilized, for a variety of cultural, societal, economic, and philosophic reasons.
4. The impacts of climate events and catastrophes can be lessened with careful investments in science, people and institutions. Information systems complete with human, physical, and financial capital, seem to work best when incorporated directly into programs that underpin and protect the fabric of society (Basher, *et al.*, 2001).
5. An important consideration often neglected in risk management and evaluation of public interventions is the extent to which people influence the risk they face through their own actions. Enhanced knowledge gained from climate forecasts and information helps people and institutions respond to risks and make decisions appropriate for their well-being. If interactions across the human-climate-physical system are not included into the system being considered, public intervention can have unnecessarily high costs given the amount of risk reduction achieved (Kane and Shogren, 2000).

6. Comprehensively evaluating the risks posed by environmental, geologic, climate and anthropogenic hazards in a unifying framework makes use of the richness of the climate and other relevant scientific information, and helps set priorities for future investments.

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