10.2 THE OVERLAP IN SCIENTIST'S AND REINSURER'S INTERESTS IN ASSESSING MODELING, AND MONITORING THE IMPACTS OF EXTREME CLIMATE EVENTS

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1. INTRODUCTION

A significant amount of scientific research focuses on climate extremes because they affect society in numerous ways; they are also of inherent interest. The large and wide-ranging community of scientists studying extremes has parallels in the large and wide-ranging array of users of information on climate and weather extremes. The catastrophe reinsurance industry is an example of a user interested in extreme events. Large losses, particularly from landfalling hurricanes over the past few years, have focused the industry's attention on whether the frequency and/or intensity of extreme events are changing. The Risk Prediction Initiative (RPI), a science-business partnership based at the Bermuda Biological Station for Research, and NOAA hosted a workshop in October 2005 that brought together (re)insurers and climate scientists interested in extreme events. Workshop participants sought to answer questions of both scientific and business interest and to identify topics of mutual concern that could be the focus of future research. Here we provide an overview of the reinsurer's perspective on extreme events and summarize some relevant highlights from workshop discussions. While we focus on insured losses we should not forget that these events also cause extreme amounts of human suffering and tragedy.

2. CLIMATE AND WEATHER EXTREMES AND THE REINSURANCE INDUSTRY

Many people are now familiar with the increase in insured losses over the past few decades (Figure 1). This increase, however, must be put into a proper context and not be attributed solely to an increase in the frequency or intensity of catastrophes. For example, when the losses are normalized to account for other factors such as population and wealth (e.g., Collins and Lowe 2001; Pielke et al. 2003; Pielke and Landsea 1998) the increase in inflation-normalized economic and insured loss from hurricane landfalls disappears (Figure 2). Prior to 2005 the 1926 Miami hurricane produced by far the largest normalized insured loss. It will be years before the total insured losses from Katrina will be known with certainty, but the total insured loss from Dennis, Katrina, and Rita, and other storms striking the U.S. during the 2005 hurricane season may well surpass the normalized insured losses of 1926.

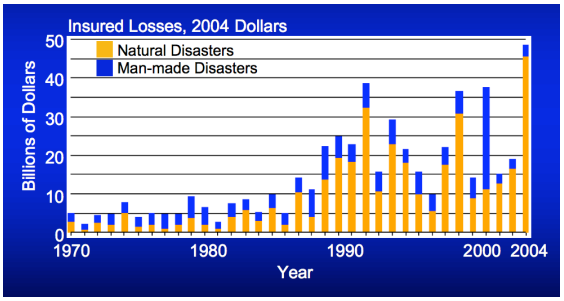

Figure 1. Time series of insured losses produced by natural and man-made disasters. Data from Swiss Re (Zanetti et al. 2004).

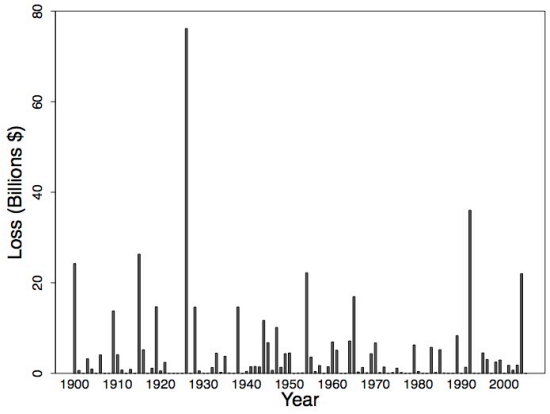

Figure 2. Time series of insured losses for landfalling U.S. hurricanes. Data through 2000 from (Collins and Lowe 2001). The 2001 through 2004 data are based on National Hurricane Center reports. Insured losses have been adjusted to 2004 values by adjusting for changes in coastal population, housing prices, and consumer price index.

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While reinsurers provide coverage for a range of catastrophic events, hurricanes striking the U.S. coastline are the extreme event of greatest interest to the catastrophe reinsurance industry because hurricanes produce the largest amount of insured loss (Figure 3). The catastrophe reinsurance industry's interest in extreme events can not be better explained than by noting that more than two-thirds of the top 30 insured losses were caused by meteorological events.

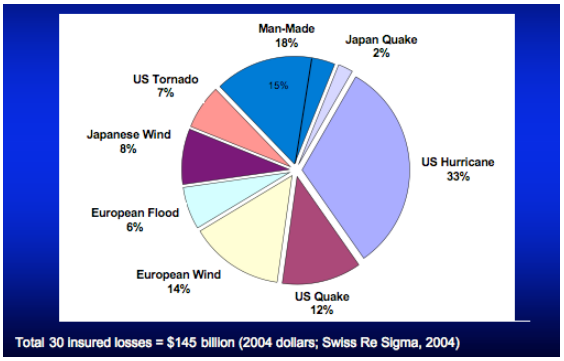

Figure 3. The distribution of the top 30 insured catastrophe losses (property and business interruption) between 1970 and 2003. The data are based on a Swiss Re publications (Zanetti et al. 2004). The total loss from the top 30 events between 1970 and 2003 was $145 billion in 2004 dollars.

It is interesting that although the maximum probable loss from a U.S. earthquake is thought to be higher than that from a hurricane, earthquakes caused only 14% of the losses in Figure 3. Man-made catastrophes accounted for 18% of the losses, with 15% of the total losses due to events on a single day, 11 September 2001. Note that the losses for 9/11 depicted in Figure 3 include only property damage and business interruption insurance. The total amount of insured loss was much higher because of other coverage such as liability and life insurance. The potential for terrorist attacks to produce such large insured losses is one reason why in 2002 the U.S. federal government passed the Terrorism Risk Insurance Act, a program which caps the losses to the private insurance sector.

Another perspective on which extremes interest the catastrophe industry can be see if one considers the insured losses in a single year (Figure 4). Storms were responsible for 78% of insured catastrophe losses and a large fraction of these losses were due to landfalling U.S. hurricanes. It should be noted that the catastrophic tsunami in the Indian Ocean killed nearly 300,000 people but caused only about $5 billion in insured loss. This helps highlight the fact that the location of an extreme event is a major factor in determining whether an event is of interest to the catastrophe reinsurance market. The U.S. is the largest insurance market in the world (Figure 5). All other things being equal, an extreme event in the U.S. is likely to produce a larger insured loss than an extreme event in another country.

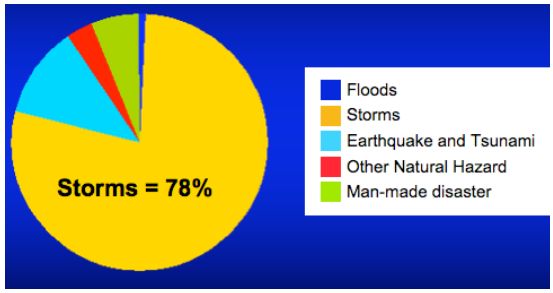

Figure 4. Distribution of total insured catastrophe losses (property and business interruption) in 2004. The data are based on a Swiss Re publication (Zanetti et al. 2005).

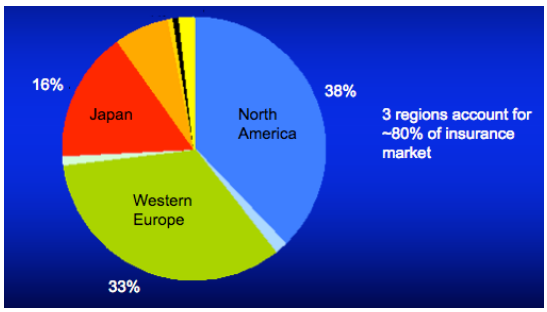

Figure 5. Distribution of reinsurance premiums for the reinsurance industry. (Birkmaier and Codoni 2004).

The distribution of past losses and the source of premiums provide a basis for understanding what types of extremes are of interest to the property catastrophe reinsurance industry. The extreme event should occur in a location with a significant insurance market (e.g., the U.S., Europe, or Japan) for the hazard. And, the extreme event should be capable of producing a significant loss. An interesting example of this is floods. Floods are not of great interest to U.S. insurers because the National Flood Insurance Program provides most homeowners with flood insurance whereas flooding in Europe is of more interest (but it varies by country) because insurers provide flood insurance.

Although catastrophe reinsurers are interested in a limited range of extreme climate and weather events the workshop presentations covered a number of additional topics (Table 1). Although many of the extremes listed in Table 1 were not among those causing the largest insured losses (c.f., Figures 3 and 4) the expanded range was needed to provide context for a number of topics that interested the insurers. In particular the presentations were aimed at addressing: 1) changes in event frequency in response to global warming, 2) the possibility of setting upper and lower bounds for alterations in extreme events, and 3) information and observations needed to improve models and statistics of extreme events. In addition, discussions were aimed at determining the statistics and return periods most useful to scientists and (re)insurers for monitoring and assessing extreme events, and identifying which extreme events currently are of greatest relevance to the insurance industry and how these interests might change in the future.

Climate or Weather Extreme	Focus of Insurer Interest
Temperature	Deaths from heat and/or cold wave
Precipitation	Flooding
Drought	Power generation, crops
Wildfire	Wildfire in wildland-urban interface
Waves	Damage to coastal infrastructure, drilling platforms
Tropical cyclones	Wind, flood, and wave damage and death
Tornadoes, hail, lightning	Damage and death
European wind storms	Damage and Death
Coral Reefs	Wave damage

Table 1. Topics covered by presentations at workshop and reason for interest by reinsurers.

3. ISSUES OF COMMON CONCERN

Much of the discussion at the workshop was driven by the large losses and high activity of the past few hurricane seasons and recent publications that suggest an increase in the intensity, duration, and frequency of the most intense tropical cyclones (Emanuel 2005; Webster et al. 2005). While this focus might differ from a typical range of topics covered at a meeting that was attended by scientists only, many of the issues raised in relation to landfalling hurricane activity would be relevant for any extreme meteorological event.

Two broad issues were the focus of workshop discussions on assessing, modeling, and monitoring extreme events. The first concerns defining the issues of interest. For example, what is the exact type of extreme event of interest? It is important to properly define this. Often extreme events are thought to be rare or have a small probability of occurrence. However, Hurricane Katrina, which certainly had an extreme impact on the Gulf Coast, would not necessarily be considered a rare event. A hurricane with Katrina's strength is not that uncommon in the Gulf of Mexico. In fact, Hurricane Rita had comparable winds. In addition, workshop participants stressed that we shouldn't focus solely on the effects of anthropogenic climate change. Natural variability is still important. It is difficult to separate the contribution of natural and anthropogenic climate change to the recent upswing in hurricane activity in the Atlantic basin.

The second issue concerned the impact of limited data and the resultant need for model studies. Observations of tropical cyclone winds provide a good example. Quality wind speed measurements, over land or water, while becoming more common, are surprisingly rare given the size and impact tropical cyclones. Direct observations of hurricanes using aircraft only occurs routinely in the Atlantic and East Pacific basins when a storm approaches land. At all other times wind speeds are based on satellite observations and algorithms that have been tuned using limited observational data. In fact the private sector is now supporting directed field programs to gather wind speed observations. A closely related concern is the need for better statistical tools for analyzing extreme events and estimating uncertainties.

Model studies offer the most promising solution to overcoming limited data and the associated large uncertainties. Modeling natural and anthropogenic climate variability can also provide a synthetic catalog of extreme events and help overcome issues related to limited data.

4. SUMMARY

Changes in the intensity and frequency of extreme events are of great concern to the catastrophe reinsurance industry and the rest of society. The recent workshop on assessing, modeling, and monitoring extreme climate events provided a rare, but not extreme, opportunity for

the scientific and business worlds to explore topics of mutual interest. Catastrophe reinsurers are most interested in understanding whether the frequency and/or intensity of specific extreme events are changing. However, limitations of our understanding and data availability require the study of the full range of extreme events.

5. ACKNOWLEDGEMENTS

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