INSURANCE SECTOR INTERESTS IN BEST-TRACK DATA SETS

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1.   INTRODUCTION

Hurricanes produce tremendous amounts of human suffering and between 1989 and 1999 caused US insurers to lose an average of $3 billion per year.   Such large losses make hurricanes striking the Gulf and East coasts of the United States one of the biggest risks facing property catastrophe insurers and reinsurers (collectively called (re)insurers).   Reinsurance companies provide insurance for insurance companies. (Re)insurers estimate their potential financial losses from tropical cyclones using commercial and in-house proprietary risk models.

The Risk Prediction Initiative (RPI) is a science-business partnership based at the Bermuda Biological Station for Research and is sponsored by a number of (re)insurance companies.   The RPI promotes communication between scientists and businesses and has a particular interest in tropical cyclones.   This presentation explains the role of tropical cyclone best-track data sets in tropical cyclone loss estimates and discusses RPI's and (re)insurer's interests in developing the "next generation" of best-track data sets.

2.   RISK MODELS

Most (re)insurers utilize tropical cyclone best-track data indirectly through the use of risk models.   Risk models are developed by risk modeling companies for the commercial market and by some (re)insurers for in-house use.   There are three different components to the risk models used by (re)insurers: 1) a hazard component, 2) a damage component, and 3) a loss component. The tropical cyclone best-track data sets are among the most important tools used to generate and verify the tropical cyclone events used in the hazard component of tropical cyclone wind risk models.

The hazard component of risk models provides the probabilities for events associated with hazards such as hurricanes, tornadoes, and earthquakes and accounts for a variety of factors that intensify or attenuate the forces associated with a hazard. For example, ground level winds in a tropical cyclone vary as a function of surface

roughness and ground motion from a temblor varies as a function of rock and soil type.

The damage component of a risk model calculates the damage that would be produced by a hazard. For example, the response of a steel-frame warehouse to high winds from tropical cyclones or ground motion from earthquakes will differ from the response of a wood-frame building with no tie-down straps.

The loss component of a risk model totals a variety of costs produced by the catastrophic event and estimates the losses to a (re)insurer's portfolio.   The total losses include the cost of repairing damaged buildings, the payments for loss of business coverage, and the various deductibles and coverage limits associated with the policies issued by an insurer or the "treaties" written by a (re)insurer.

The focus of this paper is on the insurance industry's interest in tropical cyclone best-track data sets; therefore, the following discussion will focus on the hazard component of tropical cyclone wind risk models because the best-track data form the foundation of these risk models.   The risk models can be run in a deterministic or probabilistic mode. In a deterministic mode a user specifies the characteristics such as the tropical cyclone's track, forward motion, intensity, structure, and decay. The deterministic model of a risk model can be used to estimate losses from a historical storm event, a worst-case episode, or any other scenario of interest.

In a probabilistic mode a large number of tropical cyclone events are used to estimate loss exceedance probabilities.   The tropical cyclone events must be realistic for a risk model to produce reliable loss estimates.   Different risk models use the best-track data in different ways. For example, some risk models use a library of possible tropical cyclone tracks based on the best-track data and additional information, such as wind field structure, derived from other data sources. Other risk models use a resampling approach and model a tropical cyclone using parameters sampled from probability distributions.   The probability distributions are developed using the best-track, and other, data sets and represent realistic values for tropical cyclone parameters such as forward motion, intensity, radius of maximum winds, and radius of gale force winds.

Loss estimates from tropical cyclone winds are highly dependent on best-track data. If wind speed exceedance probabilities are incorrect, then

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all the subsequent calculations by the damage and loss components of a risk model will be in error. Risk modelers and (re)insurers are thus very interested in having access to the best possible best-track data.

The RPI is involved in two different efforts aimed at the improvement of best-track data that interest (re)insurers. The first effort is the development of a unified Northwest Pacific (NWPAC) tropical cyclone best-track data set. The second is the development of a "synthetic" data set of hurricane tracks in the North Atlantic.

3. A UNIFIED NWPAC TROPICAL CYCLONE BEST-TRACK DATA SET

Reinsurers have an expanding interest in better understanding the probability of extreme wind and rain events from typhoons because of the growing reinsurance market in the NWPAC. The major "wind market" in the NWPAC is Japan, however, the market importance of other countries lining the NWPAC is growing. In response to the market risk, modeling companies and reinsurers developed typhoon risk models for Japan (and Guam), and are developing models for other countries, e.g., Taiwan and the Philippines. Best-track data sets for NWPAC tropical cyclones provide critical information for developing and validating wind-risk models for the NWPAC.

Using best-track data to develop wind risk models is more challenging in the NWPAC than in the North Atlantic. For example, there are multiple best-track data sets and their records are not as extensive as the best-track data set for the North Atlantic (HURDAT). In addition, there are a variety of meteorological agencies with their own techniques for monitoring, interpreting, and archiving data on tropical cyclones over their countries.

Scientific and business interests would both be served by a unified and improved best-track data set for the NWPAC. As one step toward this goal the RPI and the National Weather Service recently (Nov 2001) hosted a workshop to examine the feasibility and desirability of developing a unified NWPAC tropical cyclone best-track data set. Representatives from eight countries attended the workshop and produced a resolution supporting the development of a unified NWPAC tropical cyclone data set. The resolution suggested that the unified data set include a variety of data beyond the date, location, and intensity of a storm. Among the additional items for inclusion are: radius of maximum winds, speed and direction of the storm, rainfall accumulation at the surface, time and intensity at landfall, and an indication of the uncertainty in the observation.

The resolution was submitted to and accepted by the ESCAP/WMO Typhoon Committee. A working group was formed to examine the feasibility, resources, and implementation of the recommendation to develop a unified best-track data set and will report back to the Typhoon Committee at the Committee's next meeting.

4. A SYNTHETIC DATA SET OF NORTH ATLANTIC HURRICANES

(Re)insurers are interested in landfall probabilities for the strongest hurricanes and how these probabilities vary as a function of climate. Unfortunately the historical record is too short to provide reliable estimates of landfall probabilities for the most intense hurricanes and almost all risk models base their loss probability estimates on climatological averages.

(Re)insurers are interested in developing a next generation "synthetic" data set of hurricane tracks in an effort to better predict intense hurricane landfall probabilities. Ideally, the data set would potentially contain information on North Atlantic tropical cyclones over 10^3 to 10^4 years. Information in the data set would include track and intensity through a storm's lifetime, the wind field structure, and an estimate of total precipitation.

There are numerous challenges in developing such a data set. The interest in a storm's wind field implies that some form of a high-resolution dynamical model will be used to generate the data set. Precipitation parameterizations will need to be improved if rainfall estimates are to be realistic. It will also be a challenge to incorporate realistic synoptic-scale dynamics along with interannual and intraseasonal variations.

5. SUMMARY

(Re)insurers are interested in the development, maintenance, and enhancement of tropical cyclone best-track data sets. The data sets form the foundation of risk models that estimate loss probabilities from tropical cyclones and are used to verify risk model performance. The RPI and (re)insurers are interested in the development of a unified NWPAC tropical cyclone best-track data set and a synthetic data set of hurricane winds in the North Atlantic. These efforts also benefit the scientific community through improvements to tropical cyclone climatologies and databases, and provide more information on how extreme events vary with climate.