AIR Currents Special Edition

OCTOBER 21 2013

Inland Flood Risk in the United States

Thirty catastrophic floods in as many years in the U.S. have each caused economic losses in excess of USD 1 billion. These floods often impact more than one state, and are typically caused by a combination of many factors. Realistically capturing flood risk on the more than 1.4 million miles of U.S. river network is a formidable challenge.

Adding to this complexity is the changing landscape of flood insurance, with major reforms coming to the National Flood Insurance Program (NFIP). The following Q&A's address some basic considerations in developing the industry's first fully probabilistic, dynamical flood modeling solution for the U.S.

WHAT ARE THE CHALLENGES IN MODELING U.S. FLOODS?

The first challenge is the market itself. Because of the U.S. Government's heavy involvement, the private flood insurance market has not been attractive to insurance innovators and pioneers. The market still has to fully embrace flood as a peril that can be insured in a profitable way—an opportunity that AIR's new flood model can help realize.

A second challenge is the very size of the U.S. AIR has overcome this challenge with a state-of-the-art precipitation model that couples a global circulation model with a regional numerical weather prediction model to produce realistic precipitation patterns.

HOW CAN A U.S. FLOOD MODEL ASSIST IN PRICING AND MITIGATING THE RISK?

The industry has lacked sophisticated tools to manage flood. AIR's introduction of a fully probabilistic flood model for the U.S. in 2014 will bring "best-of-breed" model architecture to address this need, and we believe there is significant growth opportunity for insurers to rethink their approach to this peril.

HOW ARE MODELS ABLE TO ASSIST INSURERS IN UNDERWRITING FLOOD RISK?

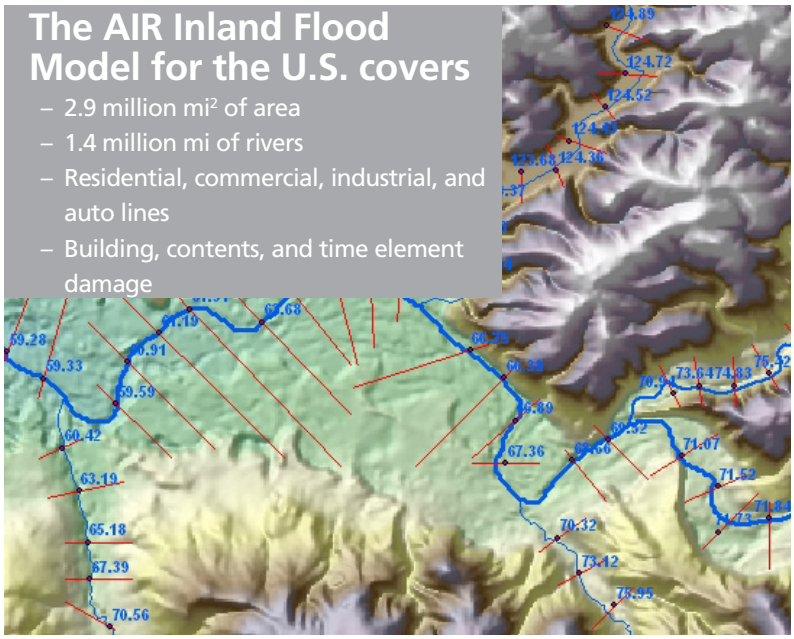
The underwriting benefits for insurers are significant because the model output adds a new dimension to flood risk evaluation beyond the typical "in or out" rules developed from FEMA hazard zones. A probabilistic model like AIR's will give underwriters the ability to perform detailed location-level analysis that may uncover significant flood risk differences, even between locations within the same flood hazard zone.

WHAT PART WILL FLOOD MODELS PLAY IN THE FUTURE OF RISK MANAGEMENT?

Inland flooding in the U.S. causes more than USD 5 billion in economic loss every year. We anticipate that flood models will play the same critical risk management role for insurers that hurricane and earthquake models currently play. With upcoming regulatory changes expected in the private market, the AIR model arrives just in time to help the insurance industry respond to increased demand for comprehensive flood coverage and coverage in excess of NFIP limits.

The AIR Inland Flood Model for the U.S. covers

- 2.9 million mi² of area
- 1.4 million mi of rivers
- Residential, commercial, industrial, and auto lines
- Building, contents, and time element damage



PCI Annual Meeting

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AIR WORLDWIDE®

How Hail Affects Crops—Modeling Issues and Solutions

Every year, crops in the U.S. are damaged by hail. The nature of the peril—and the available data—make it challenging to model and, in turn, challenging for crop insurers and reinsurers to assess their risk. Hail size and energy are difficult to measure—and hailstorms are very localized, with radar data indicating only heavy rain as a proxy for hail. Also, the publicly available official data is biased toward reporting hailstorms in urban areas. The amount of damage to crops caused by hailstorms depends on the time of year and stage of growth. For example, corn and soybeans that experience hail damage during some of the vegetative stages can recover. But during the reproductive stages, such as when corn is tasseling, crops can be severely damaged or destroyed by hail. Adding to the complexity, losses to property and crop from the same storm can vary widely.

AIR's U.S. Crop Hail model, scheduled for release in June, addresses key issues facing crop insurers and reinsurers. Three are discussed below.

THE AIR CROP HAIL MODEL FOR THE UNITED STATES	THE ISSUE.	THE SOLUTION.
OVERCOMES REPORTING BIAS IN THE HISTORICAL DATA	Daily reports of hailstorms, only available from the Storm Prediction Center (SPC), show a bias skewed to urban areas. This means that hailstorms in rural areas—where crops are planted—are underreported.	The model employs statistical data smoothing and augmentation techniques to correct for urban bias by adding actual event-specific claims data provided by private crop insurers to SPC data.
CROP-SPECIFIC DAMAGE FUNCTIONS PROVIDE THE MOST ACCURATE LOSS ESTIMATES	Hail affects different crops differently, and the extent of damage depends on what stage of growth the crop is in.	The AIR U.S. Crop Hail model incorporates damage functions that vary by crop and by every growth stage of each crop—a critical factor in the estimation of crop losses.
CATALOG FOR CROP HAIL CORRELATES WITH AIR'S U.S. SEVERE THUNDERSTORM MODEL FOR CONVENIENT DAMAGE ESTIMATION TO BOTH CROPS AND PROPERTY	Because hailstorms are such localized events, they can inflict damage on crops while leaving nearby property unaffected—and vice versa. In addition, some hailstorms have no effect on crops because they occur outside of the crop growing season.	Users of AIR's CATRADER® software can seamlessly combine their crop and property portfolios to simultaneously estimate damage caused by hailstorms to both.

Modeling Fundamentals: FAQs about Average Annual Loss

Q: HOW IS AVERAGE ANNUAL LOSS (AAL) CALCULATED?

A: AIR catastrophe model catalogs contain many years of simulated activity that reflect our best scientific understanding of potential future events. A key model output is the exceedance probability (EP) curve, a fully probabilistic loss distribution calculated by running the catalog against the portfolio of interest. The mean of this distribution is the average annual loss (AAL), or the expected loss per year, averaged over many years. It can be calculated on an occurrence (event) or aggregate (annual) basis at any level of geographic granularity—from a global, all-perils industry perspective, to a more detailed view like wind risk to a particular portfolio, all the way down to that of a single location and peril.

Q: HOW IS AAL DIFFERENT FROM THE ONE-YEAR RETURN PERIOD LOSS?

A: The AAL is the expected loss per year, averaged over many years. The one-year return period loss is expected to be equaled or exceeded every year. Its exceedance probability is 100%. It is the lowest loss point on the EP curve, and it is always less than the average annual loss (and can be zero, depending on the region/peril and the makeup of the portfolio).

A good, common-sense reasonability check of the distribution is to examine the two-year return period loss, which represents the 50% exceedance probability loss. While AAL is the mean loss of the distribution, the two-year return period loss is the median, meaning you should expect to see lower losses in half of the years and higher losses in the other half. Unlike for the one-year return period loss, it is possible for the two-year return period loss to be higher than the AAL.

Q: WHAT IS THE RELATIONSHIP BETWEEN AAL AND LOSS COST?

A: AAL, which is a rough measure of the absolute "riskiness" of a set of exposures, is highly dependent on the underlying value of the portfolio. A high AAL, for example, could indicate that a portfolio contains high exposure value or that the exposure is at high risk of loss to the perils under examination, or both. The loss cost, on the other hand, is a measure of the relative risk of a set of exposures. It is calculated by normalizing the AAL per USD 100 of exposure.

Q: HOW IS AAL VALIDATED?

A: A common mistake is to use the annual average loss from the available loss history to validate the modeled AAL. However, the modeled AAL is based on 10,000 or more years of simulated activity, and thus cannot be directly compared with the observed AAL based on historical data, which typically extends no more than a few decades. Indeed, the purpose of a model is to enable risk managers to look beyond the limited historical data for a better understanding of what is possible.

To make a meaningful comparison, it is first necessary to isolate losses from an analogous range of exceedance probabilities from the stochastic catalog. One way to do this is to benchmark the highest historical loss in the data set against the modeled EP curve to determine the corresponding return period. Then, using modeled losses only up to this return period, the modeled AAL can be calculated and then compared to the historical AAL.

Want to learn the fundamentals and more? The AIR Institute's Certified Catastrophe Modeler (CCM) Program is designed to prepare the next generation of modelers for the complex challenges of catastrophe risk assessment and management. Learn about the full week program at bit.ly/AIR_CCM

Is the Insurance Industry Prepared for Large Losses on a Global Scale?

In **2011**, insured losses from **global natural catastrophes** were the second highest ever recorded, at more than **USD 118 billion.**

Many companies with global exposure were surprised by the large losses, especially since there was no major U.S. hurricane that year…they started asking questions.

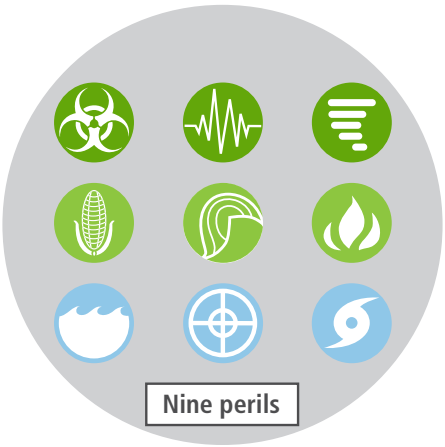
How do we put such large loss years in perspective?

Will we be prepared in the event of **even greater** global loss?

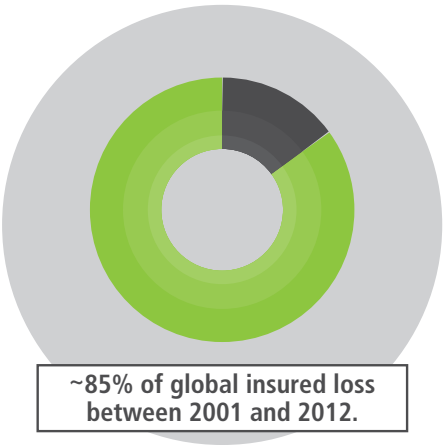
AIR WORLDWIDE IS IN A UNIQUE POSITION TO HELP

OUR MODELS CURRENTLY COVER:

More than 90 countries, each featuring a high resolution industry exposure database

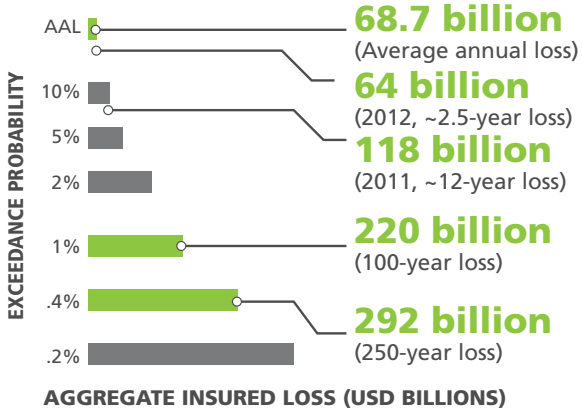


Nine perils



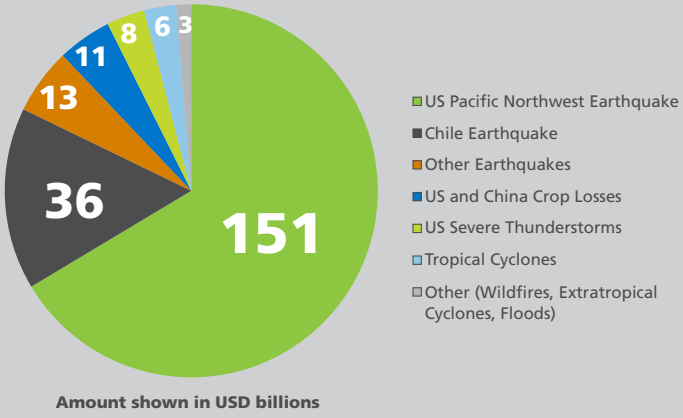
~85% of global insured loss between 2001 and 2012.

AIR models and industry exposure databases provide clarity around the likelihood of experiencing any given loss, on a global scale:



WHAT CAN A ~100-YEAR LOSS LOOK LIKE?

Here's just one of *many* possible realizations:



Amount shown in USD billions

AIR offers the only software solution that companies can use to benchmark and manage catastrophe risk in more than 90 countries around the globe. Globally exposed companies can fully anticipate possible outcomes, including future years that will produce losses exceeding any historical amounts.

AIR WORLDWIDE

Verisk Analytics

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