AIR's 2013 Global Exceedance Probability Curve

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The AIR Institute's
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Contact Information

If you have any questions regarding this document, contact:

AIR Worldwide
131 Dartmouth Street
Boston, MA 02116-5134
USA
Tel: (617) 267-6645
Fax: (617) 267-8284

Executive Summary

In 2012, AIR published a white paper titled *Taking a Comprehensive View of Catastrophe Risk Worldwide*. Its purpose was to put 2011's high insured losses into context and to promote how AIR's global industry exceedance probability curve can provide companies with a more comprehensive view of potential losses. This paper updates those modeled global loss metrics based on AIR's latest suite of models released in the summer of 2013.

These updates include a comprehensive update to the Japan earthquake model to reflect the understanding of seismic risk post-Tohoku, significant enhancements to AIR's earthquake and tropical cyclone models for Hawaii, updates to the U.S. Multiple Peril Crop Insurance Model, and a brand new global pandemic flu model.[1] The results presented in this paper also reflect AIR's most up-to-date Industry Exposure Databases (IEDs), which contain counts, replacement values, and physical attributes of insurable properties in each modeled country.[2]

Of particular note, the updated earthquake model for Japan now includes the fully probabilistic handling of tsunami risk—a first for the industry—and explicit modeling of liquefaction risk. These additions represent a commitment by AIR to expand the scope of modeled perils to include the "secondary" perils that are often associated with major catastrophes. Along with updated loss metrics, the paper also presents two global loss scenarios at the 1% aggregate exceedance probability (the 100-year return period). AIR plans to publish updated metrics on an annual basis to reflect the latest model additions and updates.

In general, one would expect modeled losses to increase over time. These increases are driven largely by increases in the numbers and values of insured properties in areas of high hazard. But they will also be driven by the expansion of modeling into new regions and perils, which will change the relative contribution to global losses by region and by peril.

By offering high resolution IEDs for every modeled country and a straightforward and intuitive catalog generation process, AIR is the only modeling company capable of providing insight into different levels of loss from catastrophes on a *global* scale.

[1] Because of the unique catalog architecture of the AIR pandemic model, pandemic losses were excluded from the analyses in this paper.

[2] IED growth factors were used to reflect the current building stock in several countries. More information on these index factors, which can be entered into CATRADER for industry loss analyses, is available to clients on the AIR website.

The 2013 Global Exceedance Probability Curve

Table 1 presents some key loss metrics from AIR's global exceedance probability (EP) curve, based on the latest models and IEDs from AIR.

Table 1. Key loss metrics from AIR's global industry EP curve for all regions and all perils

Exceedance Probability	Insured Loss (USD)
Average Annual Loss	67.4 billion
1% Aggregate Loss	219.4 billion
0.4% Aggregate Loss	289.1 billion

Table 2 shows the contribution by region to the AAL and the 1% EP loss.

Table 2. Global AAL and 1% exceedance probability insured loss by region for all perils

Region	Average Annual Aggregate Loss (USD)	1% Aggregate EP Loss (USD)
All Exposed Areas	67.4 billion	219.4 billion
Asia	11.7 billion	60.5 billion
Europe	8.5 billion	49.9 billion
Latin America	6.6 billion	50.7 billion
North America	38.9 billion	180.0 billion
Oceania (Australia and New Zealand)	1.7 billion	21.9 billion

For more information on how the EP curve is constructed, and why exceedance probability metrics are not additive across regions, please read the *AIR Currents* article *Modeling Fundamentals: Combining Loss Metrics*.

Please refer to *AIR Models by Peril and Region* for comprehensive information on AIR's model coverage.

Figure 1 shows the contribution to the global AAL by peril. The relatively small contribution by flood is perhaps surprising given its prominence in the headlines. Currently, AIR offers inland flood models for the United Kingdom and Germany, with planned expansions into Austria, the Czech Republic, and Switzerland. In the summer of 2014, AIR will introduce an inland flood model for the United States, with its more than 2 million kilometers of river network.[3] These additions will change the look of the chart below.

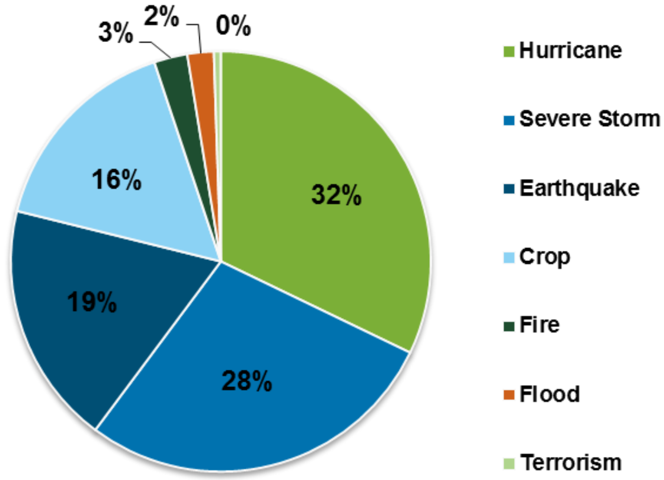

Figure 1. Contribution to global insured AAL for all regions by peril

[3] Also in 2014, AIR will begin rolling out flood hazard maps for regions where the high-resolution elevation data needed for detailed modeling is currently unavailable. Specifically, flood hazard maps for Thailand and China will be released in AIR's Touchstone® platform in summer 2014.

Global Industry Insured Loss Scenarios Around the 1% Exceedance Probability

As noted in Table 1, the 1% aggregate exceedance probability loss on AIR's global EP curve is approximately USD 219 billion. Because understanding large aggregate loss years helps companies evaluate alternative reinsurance options, it is important not only to quantify the loss at this level, but also to consider the variety of events that can produce it in any given year.

The following two examples describe years at or near the 1% exceedance probability on AIR's global industry EP curve, each of which is made up of different possible combinations of natural catastrophes worldwide. It is important to note, however, that many combinations of events—different perils in different regions—could produce this level of loss.

Aggregate Loss Scenario 1

In this scenario, the primary loss driver is earthquake, which causes more than USD 200 billion of insured loss worldwide (out of a total of USD 228 billion in that simulated year). Most of the total loss (>USD 150 billion) results from a single large earthquake in the U.S. Pacific Northwest. The second most significant source of loss is an M8.8 earthquake that occurs offshore of central Chile, affecting the highly populated cities of Santiago, Valparaiso, and Vina del Mar. The insured loss from this event, at USD 36 billion, far exceeds that reported during the 2010 Chile earthquake.

Other earthquakes around the world cause a combined loss exceeding USD 13 billion, and crop damage in the U.S. and China produce losses in excess of USD 10 billion. The remaining USD 16 billion (or about 7%) of insured loss comes from a combination of U.S. severe thunderstorms, tropical cyclones, and other events, including wildfires, extratropical cyclones, and floods.

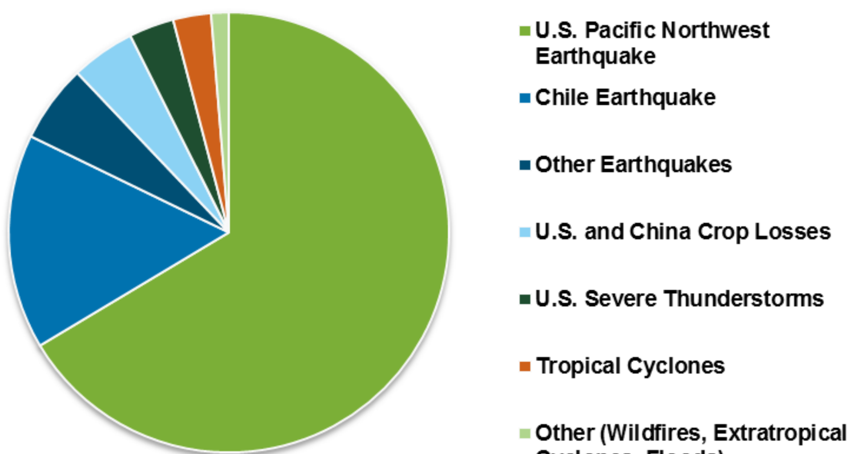

Figure 2. Breakdown of losses for Aggregate Loss Scenario 1 (Source: AIR)

Table 3. Top 5 loss-causing events in Aggregate Loss Scenario 1 (Source: AIR)

Event	Insured Loss (USD)
M9.0 U.S. Pacific Northwest Earthquake	151 billion
M8.8 Chile Earthquake	36 billion
U.S. Crop Loss	7 billion
M7.2 Turkey Earthquake	6 billion
China Crop Loss (Flood Event)	3 billion

Aggregate Loss Scenario 1 corresponds to Year 8461 in AIR's 10,000-year catalogs, implemented in Version 15 of CATRADER and CLASIC/2, and Version 1.5 of Touchstone.

Aggregate Loss Scenario 2

In this scenario, the highest source of loss is an M8.5 earthquake that strikes the densely populated Kanto and Chubu regions of Japan, including the Tokyo metropolitan area. This earthquake, which occurs on a crustal fault at a depth of only 15 km, causes insured losses of nearly USD 120 billion. Other main drivers of loss include Atlantic hurricanes, which cause more than USD 40 billion in insured losses, and severe thunderstorms in the U.S., which cause more than USD 25 billion in losses.

Tropical cyclones in the Asia-Pacific region result in insured loss of more than USD 13 billion and earthquakes in Europe cause nearly USD 10 billion. The remaining sources of loss include crop damage in the U.S. and China, other earthquakes and tropical cyclones around the world, floods, wildfires, terrorism events in the U.S, and extratropical cyclones.

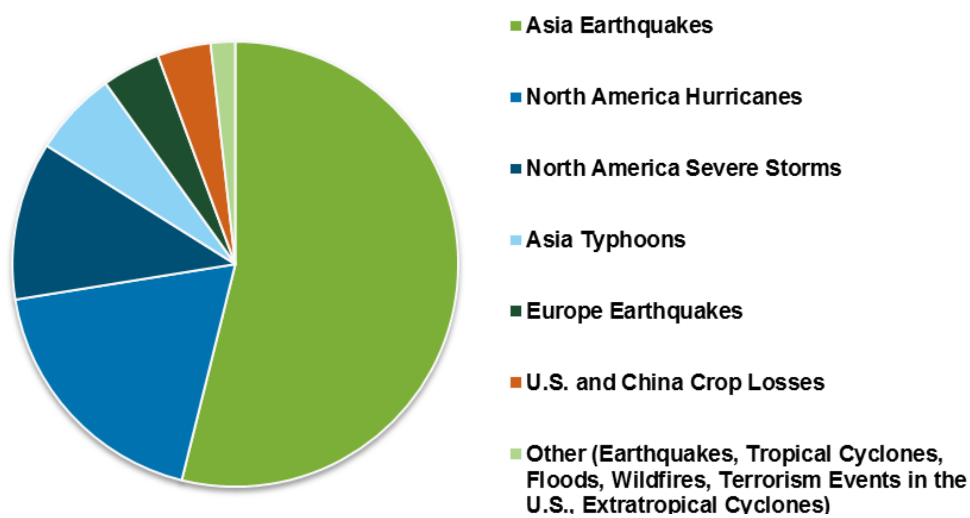

Figure 3. Breakdown of losses for Aggregate Loss Scenario 2 (Source: AIR)

Table 4. Top 5 loss-causing events in Aggregate Loss Scenario 2 (Source: AIR)

Event	Insured Loss (USD)
M8.5 Japan Earthquake	118 billion
Category 3 Atlantic Hurricane (Florida, Louisiana, Mississippi, Offshore Assets in the Gulf of Mexico, Bahamas)	41 billion
Northwest Pacific Tropical Storm (Japan)	10 billion
M6.4 Europe Earthquake (Switzerland, Germany, Austria)	8 billion
U.S. Crop Loss	6 billion

Aggregate Loss Scenario 2 corresponds to Year 4409 in AIR's 10,000-year catalogs, implemented in Version 15 of CATRADER and CLASIC/2, and Version 1.5 of Touchstone.

Nonmodeled Sources of Loss

There is considerable discussion in the industry about how to handle the risk from nonmodeled perils and regions, which are not included in AIR's global estimate. As such, the true exceedance probabilities for the various levels of insured loss are expected to be higher than those published in this report. For example, the loss of USD 219 billion is expected to be exceeded at a probability of more than 1% when considering the risk from *all* sources of insured loss.

Nevertheless, AIR's existing suite of models—which today encompasses more than 90 countries—covers events representing over 98% of worldwide insured losses in 2012. Over the 13-year period from 2000 through 2012, AIR's models cover events representing about 88% of insured losses from global natural catastrophes (Figure 4). Primary sources of nonmodeled loss include severe thunderstorm and flood events around the world that are not currently covered by AIR models.

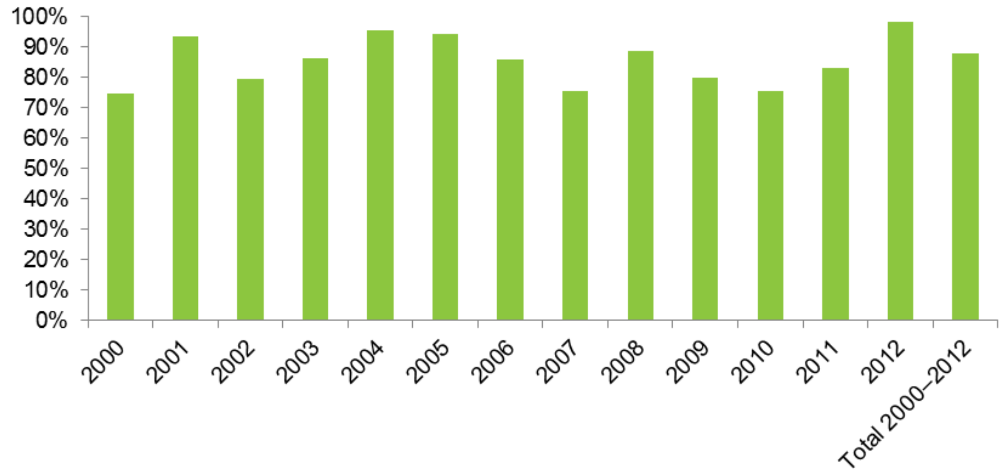

Figure 4. Percentage of reported insured losses by year covered by AIR's current suite of models (Source: AIR, Swiss Re, AXCO, Munich Re)[4]

To better serve the needs of the industry, AIR's research roadmap will continue to expand into previously unmodeled regions and perils. In addition to an ambitious research roadmap, AIR is providing other tools to help companies understand the risk from nonmodeled sources of loss. Touchstone's Geospatial Analytics module allows companies to analyze accumulations of risk anywhere in the world. Users can import hazard footprints and assign custom damage ratios to calculate not only concentrations of risk counts and replacement values, but also exposed limits after accounting for policy terms (including deductibles, layers, limits, and reinsurance treaties). This can help organizations achieve an integrated view of enterprise-wide exposure to catastrophe risk and evaluate where to grow or retract business.

[4] For certain years, the percentage of losses covered by AIR models may have decreased from previously published numbers because of changes in reported losses.

The Importance of Taking a Global View

In 2012, natural catastrophes—including Hurricane Sandy, drought and severe storms in the U.S., and an earthquake in Italy—produced insured losses of USD 64 billion. While this loss is significantly less than the global insured losses in 2011, 2012 was notable for the number and similarity of events that occurred in the U.S. Of the top 10 most costly insured catastrophe losses in 2012, nine events occurred in the U.S., most of which were severe thunderstorm–related.

Global insured losses from 2012 are also lower than AIR's global AAL and fall around the 40% exceedance probability on AIR's global industry exceedance probability curve—*well within* the range of industry loss for which global insurers and reinsurers should be prepared.

Companies who evaluate loss on a global scale, rather than a national or even regional one, should follow some best practices with respect to interpreting catastrophe model results. For example, they should not look at only one peril (or one region) to assess the risk at a given exceedance probability. Indeed, if a company only considered their worst single peril and evaluated loss from this peril at the 1% exceedance probability, they would severely underestimate risk; this is because, in a given year, they could experience losses from two other perils equal to *or greater than* the 1% EP loss from their worst single peril. The aggregate exceedance probability curve, which sums losses from *all* events occurring in a simulated year, is a far better measure of portfolio risk.

Catastrophe risk can threaten a company's financial well-being. Companies operating on a worldwide stage need to understand their risk across global exposures and ensure they have sufficient capital to survive even years of very high loss. They must understand the likelihood of facing such years—as well as the diversity of events that could produce such losses. Finally, companies with global exposures and an expanding global reach need to be prepared for the possibility that future catastrophes will produce losses exceeding any historical amounts. To do this effectively, companies can use the global exceedance probability metrics generated with AIR software to benchmark and manage natural catastrophe risk in more than 90 countries around the globe.

With the insight provided by AIR's global suite of models, companies can pursue profitable growth in a market that is ever more connected—and amid regulatory environments that are ever more rigorous—with greater confidence that the risk they have assumed is risk they can afford to take.

About AIR Worldwide

AIR Worldwide (AIR) is the scientific leader and most respected provider of risk modeling software and consulting services. AIR founded the catastrophe modeling industry in 1987 and today models the risk from natural catastrophes and terrorism in more than 90 countries. More than 400 insurance, reinsurance, financial, corporate, and government clients rely on AIR software and services for catastrophe risk management, insurance-linked securities, detailed site-specific wind and seismic engineering analyses, and agricultural risk management. AIR is a member of the Verisk Insurance Solutions group at Verisk Analytics (Nasdaq:VRSK) and is headquartered in Boston with additional offices in North America, Europe, and Asia. For more information, please visit www.air-worldwide.com.

Acknowledgments

Author: Bill Churney, Chief Operating Officer

Editors: Eric Bland, Science & Technical Writer/Editor, and Serge Gagarin, Manager, Segment Marketing