AIRCURRENTS

RECENT ADVANCES IN AIR'S INDUSTRY EXPOSURE DATABASE FOR EUROPE

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EDITOR'S NOTE: Later this spring, AIR will release a new generation European extratropical cyclone model—one that extends AIR's implementation of numerical weather prediction (NWP) technology. NWP and advanced statistical techniques are used to capture the temporal and spatial clustering of storms, and sophisticated downscaling techniques are used to translate boundary-layer winds to surface winds. Because model output is only as good as the exposure data input, AIR also invests significant resources into the development of high-quality industry exposure databases. In this article, AIR Director of Research Operations, John Rowe, and Cheryl Hayes, Manager of AIR's Exposure Group, discuss the development of a novel approach for disaggregating European exposures using a high-resolution grid—an approach that companies conducting business in Europe can put to good use.

By Cheryl Hayes and John Rowe

INTRODUCTION

The need for high-quality exposure data is well recognized by companies managing business in Europe, not least because average annual losses from European winter storms rank among the highest caused by natural catastrophes worldwide. At the same time, achieving the level of detail required for producing reliable loss estimates presents significant challenges. Recognizing this, when AIR set out to build a new generation European winter storm model, the development of a new industry exposure database was an inseparable part of the process.

One of the most valuable components of all AIR's catastrophe models is the industry exposure database (IED) that accompanies them. Developed by a dedicated team of economists, construction engineers, demographers and statisticians, these databases provide a foundation for all modeled industry loss estimates, whether for simulated events from a stochastic catalog, the re-creation of historical events, or for actual events unfolding in real time.

In the last several years, AIR has refined its exposure data methodology to include a significant investment in granular data and robust analytics that enable a more realistic assessment of the spatial distribution of exposure in Europe. This type of granularity for exposures is particularly important for extratropical cyclones, in which the most intense winds can be highly localized, as demonstrated during the 2009 winter storm Klaus. With the use of a comprehensive and accurate source of high-resolution industry data, companies can not only obtain reliable industry loss estimates, but also benefit from AIR's advanced disaggregation algorithms to achieve an enhanced understanding of the winter storm risk to their own portfolios.

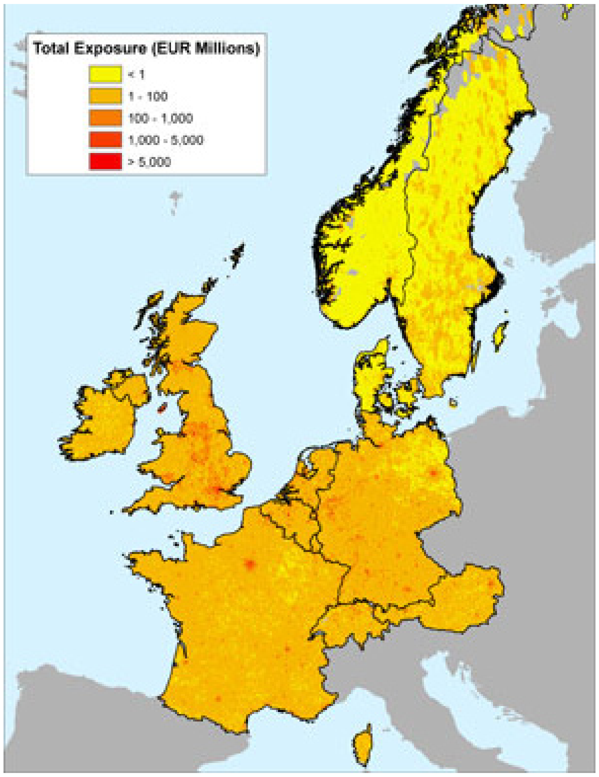

Figure 1. Total Insured Value of Industry Exposure in Europe.

REMOTE SENSING AND GEOSPATIAL TOOLS ENHANCE DATA COLLECTION

In light of significant losses suffered by the forestry industry in recent storms—such as from winter storm Erwin (2005), which is reported to have toppled more than 75,000,000 cubic meters of lumber in Sweden—AIR's industry exposure database for Europe has been enhanced to include forestry exposures for Sweden and Norway. The availability of remote-sensing data—data obtained from aircraft and satellite platforms—has provided AIR with new techniques to collect risk counts and is particularly useful in detecting forest harvest patterns and the effects of forest management techniques on exposures. AIR derived the risk counts for different species of trees in Scandinavia from available remote-sensed data, including the European Space Agency's Corine data set, USGS's land cover data, the European Forest Institute, and the Swedish Forestry Agency.

Statistical methods and expert interpretation is required to determine what human activities are occurring in different parts of the landscape, even when land cover appears to be the same. For example, areas covered by woody vegetation may represent an undisturbed natural shrubland, a forest preserve or state park, or regrowth following tree harvest, which is critical information in developing a robust database of forestry exposures.

A BOTTOM-UP, TOP-DOWN METHODOLOGY

AIR builds its industry exposure databases from the bottom-up, compiling detailed data about risk counts, building attributes (parameters that greatly influence the ability of a structure to withstand high winds, ground motion, or flood depth), as well as replacement values and information on standard policy terms and conditions. Once the risk counts for every insurable property have been identified, a top-down approach using aggregate data from multiple additional sources is taken to validate key attributes of the database. The advantage in coupling these approaches is the development of an aggregated industry-wide database that is both objective and robust.

BUILDING THE RISK COUNTS FOR THE IED IN EUROPE

To begin development of the IED for all 12 modeled countries in Europe, AIR exposures analysts collected the latest available data pertaining to risk counts and building-specific characteristics from a host of sources, including population registers, building and dwelling census data, and employment census data from statistical offices. For some countries, AIR was able to acquire very detailed grid level data at 1 km spatial resolution. Because of the high-level of accuracy in this data, however, it was not uncommon that certain information was withheld in order to address privacy concerns. For example, some commercial risk counts might not be provided for grid cells that contained only a few commercial risks to avoid identification of individual companies.

Such instances are where the expertise and detailed analysis of AIR's exposures team come into focus. In this case, additional datasets, such as information on employee counts, were analyzed to determine which specific grid cells were missing data, while building aggregates were used to determine the actual number of missing risks. Spatial modeling techniques, including smoothing, were used to fill in any gaps in data.

In many regions, commercial census data may also be out-of-date and may not reflect current building details, such as building size or construction type. In such cases, information pertaining to current estimates of population, housing counts, and other demographic variables are used to create index factors to project the data forward. AIR exposures analysts also conduct extensive research to capture changes in engineering practices, such as updates to local building codes and regulations, and create a detailed structural classification of the building stock by construction types, year built and height.

THE DISAGGREGATION ADVANTAGE

Given that no single dataset exists that can provide the depth of information required for the AIR IEDs, it is necessary to collect and fuse multiple datasets at different geographic resolutions. The data obtained from statistics and government offices vary in resolution considerably from low-resolution administrative boundaries in some countries to high-resolution 1 km grid-level in others. With the 2010 release of the AIR Industry Exposure Database for Europe, AIR has employed a sophisticated algorithm to disaggregate all risk counts to a 1 km grid in order to create consistent modeling within and between countries in Europe.

The method utilizes a combination of high-resolution data on elevation and slope, satellite-derived land use/land cover information, and Defense Meteorological Satellite Program's "Night Lights" data from NOAA[1] to determine high- and low-building density in each area of interest. For example, an analysis of topology and land cover characteristics helps AIR determine the likelihood of the presence of buildings, while night light imagery uses patterns of illumination from satellite imagery to discern population density.

Leveraging this topographic, land cover and night lights data, AIR creates a weighted probability map of potential exposure locations, enabling a more precise and realistic disaggregation of exposures in each region. The results of AIR's disaggregation technique have been extensively validated against actual gridded data sets from census agencies and commercial vendors. To perform a reasonability check on the performance of AIR's disaggregation algorithm, the output of a disaggregation analysis was compared with the 1 km census data sets acquired for Switzerland, Austria and Sweden—three countries for which high-quality data exist at high resolution. The figure below demonstrates the good comparison between AIR's disaggregation results and the high-resolution census data sets.

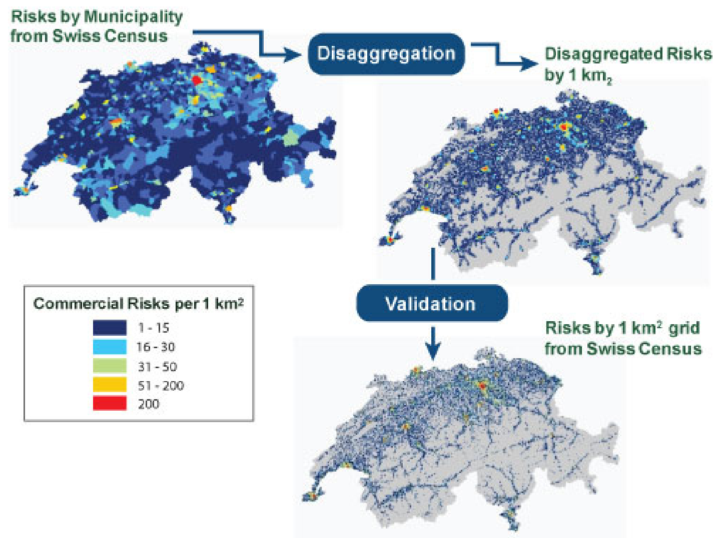

Figure 2. Risk Counts at the Municipality Level in Switzerland Are Disaggregated to a 1 km^2 Grid and Validated against High-Resolution Census Data.

Using CLASIC/2™, AIR's detailed modeling application, companies that have coarse resolution exposure data can leverage AIR's IED to disaggregate the exposure data in their own portfolio to a higher resolution in line with the spatial distribution of AIR's industry data in Europe. In addition, clients with aggregate data are assured that CLASIC/2 will disaggregate their exposure data to a highly-detailed level, enabling more robust catastrophe risk analysis. For example, a reinsurer in Belgium may not have complete sets of detailed address data, but may have aggregate CRESTA-level exposure data. With only seven CRESTA zones in Belgium, this level of data resolution is often not sufficient enough to accurately represent areas of high winter storm exposure. However, after disaggregation, risk counts for Belgium in AIR's IED increase from 43 arrondissements to over 57,000 disaggregated areas. The result provides a high level of confidence when modeling the local wind intensity of winter storms and their subsequent damage.

ESTIMATING REGIONAL VARIATIONS IN REBUILDING COSTS

Once the risk counts are characterized, a rebuild cost estimator is used to calculate the replacement values (how much it would cost to rebuild in the event of a total loss) for the residential, commercial, and agricultural lines, while industry reports and client data are used to develop the replacement values for the auto and forestry lines. The rebuild cost estimator used for Europe accounts for important regional variations in replacement values. Using a host of economic and geographic indicators at a highly localized level, the IED captures realistic variations not only between but also within countries in the cost of materials, labor, and contractor tender price—or mark up.

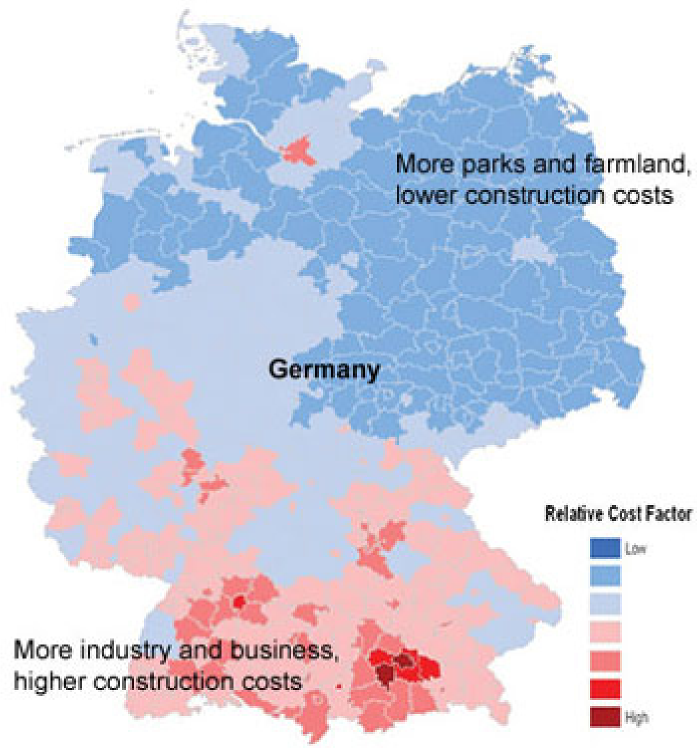

Figure 3. AIR's Rebuild Cost Estimator Results in a Realistic Geographic Variation of Property Values.

VALIDATING THE INDUSTRY EXPOSURE DATABASE

AIR's industry exposure database for Europe is extensively validated by comparing it against values obtained from various insurance industry and governmental sources. Further, while AIR does not *calibrate* replacement values in the IED to client company data (which can contain a variety of inconsistent and incomplete information), AIR does use detailed company data to validate the IED. Indeed, AIR has access to detailed company data representing about 50% of the total industry exposure, both for commercial and residential properties.

VALUE OF AIR'S INDUSTRY EXPOSURE DATABASE IN MODELING EXTRATROPICAL CYCLONES

AIR continues to place a high priority on developing and refining its industry exposure databases in an effort to help companies assess and manage their catastrophe risk.

In its most fundamental form, the IED is used to calculate industry loss estimates for all event types—including potential future events in the stochastic catalog, scenarios matching the characteristics of actual extratropical cyclones, and simulated historical extratropical events. Since most companies are focused on assessing how the model performs on their book of business, companies can also use the IED to validate their own losses. Using AIR's CATRADER® system, for example, a company can validate their own loss distributions for a particular winter storm by comparing detailed loss results from all models against industry losses created using AIR's IED. This is particularly helpful for validating the reasonability of detailed losses so that companies can communicate confidence in the modeling results or identify systemic exposure data issues. Using the capabilities of the IED and the stochastic catalog in the AIR Extratropical Model for Europe, clients can also generate benchmarks for industry loss comparisons, which is important for providing a clear picture of the goodness of fit between the modeled and historical data and evaluating the overall credibility of the model.

AIR's IED is also playing an increasingly important role in the capital markets in Europe where more companies are using insurance-linked securities to provide cover for their significant property exposures. To enable investors to better evaluate the risks associated with these financial instruments and perform sensitivity testing, the IED can be used to produce reliable risk profiles. These profiles can be used by the capital markets to structure and monitor catastrophe bonds, industry loss warranties, and derivative contracts.

CONCLUSION

Anticipating catastrophic events, such as winter storms, and assessing their potential financial impacts are critical to insurer operations. In the decade since winter storms Anatol, Lothar, and Martin caused over €10 billion of insured losses across Europe, insurers have recognized the importance of applying granular, high-quality data to their modeling tools in order to gain a comprehensive picture of their risk and set more realistic pricing.

For its part, AIR has invested considerable resources in developing an industry exposure database that provides an independent, high-resolution view of insurable and insured property exposures in Europe. Because the AIR industry exposure database leverages the best available public and private data sources, and does not rely simply on aggregating insurance company data, clients can feel confident in the robustness of the model results. Moreover, clients that lack reliable and consistent exposure data in Europe can leverage the IED to distribute their data to a higher resolution, improving their overall catastrophe risk management.

1 THE U.S.'S NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

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 50 countries. More than 400 insurance, reinsurance, financial, corporate and government clients rely on AIR software and services for catastrophe risk management, insurance-linked securities, site-specific seismic engineering analysis, and property replacement cost valuation. AIR is a member of the ISO family of companies and is headquartered in Boston with additional offices in North America, Europe and Asia. For more information, please visit www. air-worldwide.com.