CATASTROPHE RISK MANAGEMENT

Euroflood Risk Model

Region specific innovations in both hazard and vulnerability

Flood Risk in Germany and Austria

Inland flooding in Europe is typically a result of prolonged or intense precipitation and is responsible for both frequent and high severity losses. In recent history, the Elbe flood event in 2002 stands out as a significant European natural catastrophe. In Germany alone, it resulted in economic damage of around €9 billion and insured losses of approximately €1.8 billion. In Austria, economic damage from flooding of several rivers, including the Danube basin, came to approximately €3 billion, with insured losses at €400 million. Flooding in 2005 produced additional losses for both countries. In Austria, economic damage and insured losses were estimated at more than €500 million and €150 million respectively.*

Key Features

PERIL DEFINITION/GEOGRAPHIC COVERAGE

Riverine Flood: In Germany, river-based flooding is modelled for the Rhine, Elbe, Oder, Weser, Ems, and Danube, and their major tributaries. In Austria, river-based flood is modelled for the Danube basin, including exposed areas of its major tributaries: the Salzach, Inn, Ager, Krems, and Enns rivers.

Off-plain Flood: Flood risk outside river-based flood plains is modelled for the rest of Germany. This hazard represents flooding caused by the accumulation of precipitation. (Flash flooding where the hazard is flowing water, coastal storm surge, mudslides, and drainage system backup are not modelled.)

HAZARD DEFINITION/DERIVATION - RIVERINE

Water depth is the hazard that drives damage. Riverine and off-plain flooding are both primarily derived from a pan-European precipitation module. Euroflood tackles the complexity of flood events with a modular approach comprising the following elements:

- **Precipitation events:** Probabilistic precipitation events are based on a sampling of eight different parameters of heavy precipitation systems, such as intensity and area, and detailed historical loss data over a 43-year period. Source data includes re-analysis from the European Centre for Mid-Range Weather Forecasts (ERA - 40) and daily precipitation data from national meteorological stations. Over 13 million probabilistic heavy precipitation events stratified to 32,000 hydrological events provide a complete stochastic set that captures correlation between river basins.
- **Precipitation to discharge:** For each stochastic event, the total and effective run-off per catchment area is calculated using a unit hydrograph approach. Topographic and antecedent precipitation, azimuth, and the potential effect of snow melt are taken into account.
- **Discharge to water height:** This module calculates water discharge rates at points in the river system according to a water routing calculation that considers the effects of both convolution and dispersion.

Euroflood is a fully probabilistic risk model that quantifies risk from flooding in Germany and Austria. The model is part of the Catastrophe Risk Management global catastrophe modelling platform, RQE® (Risk Quantification & Engineering) from CoreLogic®.

* Figures from the Austrian Insurance Association and AXCO.

- **Water height to flood defences:** Embedded flood defence information is used to model defence breaching probabilistically. Data sources include local authority and digital terrain model data.
- **Defence failure to flood propagation:** Water is propagated laterally to hazard cells. The module calculates flood volumes and water heights using a detailed digital terrain model (DTM).

HAZARD DEFINITION/DERIVATION – OFF-PLAIN

For Germany, off-plain flood hazard is derived from the same precipitation event set. It diverges in approach from the use of a GIS-raster flood definition module to produce water heights outside river floodplains. Euroflood combines a hydrodynamic approach with digital terrain model source data.

STOCHASTIC EVENT SET

The stochastic event set is based on 32,000 synthetic heavy-precipitation systems and corresponding flood events to create a pan-European stochastic set that allows for accurate correlation between river basins.

EXPOSURE DEFINITION

In the absence of detailed exposure data, Euroflood uses an embedded built environment module to select the most likely structure type and elevation for building stock that exists in the specified area. This enables aggregate exposure data to be disaggregated to appropriate hazard cells for analysis.

VULNERABILITY DERIVATION

Vulnerability functions were derived from first principles using ABS Consulting engineering data and third-party studies, and were refined with claims data. An engineering-based approach with validation against claims data provides greater model stability than relying on claims data alone.

MODEL VALIDATION

Each model component was reviewed against scientific data and published studies. The model was also favorably reviewed by independent academic experts. Tests included:

- Precipitation event set and water heights sets were validated against published historical meteorological and hydrological data. For both riverine and non-riverine flooding, water extent and water depth outputs from the model were validated against published flood maps.
- The built environment module was validated in two ways: first, through visual inspection of sample postcodes to verify that the module corresponds well with the real distribution of building types, structure type, building height, etc.; second, it was compared to postcode-level insured portfolios and census data to verify accurate distribution of the insured value per structure type and other attributes.
- Vulnerability functions were validated first against detailed post-flood studies that assessed typical damage to properties (percentage building/contents damaged against hazard intensity), and second against actual claims paid, taking into account deductibles, insurance and market conditions, and demand surge.
- Loss results were validated against insurance company portfolio losses for various events.

Model Specifications

LINES OF BUSINESS

Lines of business include Residential, Commercial, Industrial, Municipal, and Agricultural.

STRUCTURE TYPES AND OCCUPANCIES

All appropriate structure and occupancy types per line of business are modelled. Risk classifications are aligned with European nomenclature and other CoreLogic European hazard models.

INSURANCE COVERAGES

Building, contents, and business interruption are modelled.

EXPOSURE IMPORT AND DISAGGREGATION

Data can be imported at lat/long level, postcode, place name, CRESTA Zone, and country level. Number of stories, the existence of a cellar, and occupancy can be defined for detailed data. Aggregated data at postcode level is disaggregated and geocoded using the embedded built environment module.

HAZARD ANALYSIS RESOLUTION

Based on 50m x 50m hazard cells per underlying digital terrain model data.

MODEL OUTPUT

Risk metrics include OEP and AEP loss exceedance curves, AAL, TVAR, and simulations of historical events. Reporting of results supports multiple levels of refinement such as: total aggregate portfolio, postal code, county, state, and detailed output by policy and site. Different peril components (wind only, wind and flood) can be modelled to obtain model results accordingly. In addition, RQE's Year Loss Table (YLT) uniquely features three-dimensional output: simulation year, events, and sample outcomes. Instead of reporting mean losses with standard deviations, each loss in the YLT represents one possible outcome for the associated event. This allows users to retain the full distribution of uncertainty when using model output in dynamic financial analysis and capital modelling. Conventional event loss results and other risk metrics can be derived from the YLT with arithmetic or simple database queries. YLT and event loss results are supported at the portfolio level. Other risk metrics are supported at multiple levels of refinement: from total aggregate portfolio results, to detailed output by policy and site. The model is usable for risk differentiation and pricing, risk aggregation, and portfolio risk management, with suitable output and reports.

FINANCIAL MODELLING

All major insurance policy structures and reinsurance treaty types are modelled.

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