CATASTROPHE RISK MANAGEMENT

Australia Earthquake Model

Region specific innovations in both hazard and vulnerability

Earthquake Risk in Australia

With the nearest plate boundary hundreds of kilometers away, earthquake risk in Australia is characterized by infrequent, moderate events, and highly-variable losses. Nevertheless, earthquake risk accounts for the largest portion of insured loss potential in Australia. As evidenced by the 2011 Christchurch event, even moderate earthquakes can be catastrophic.

The rarity of earthquakes in Australia makes the model's unique approach to uncertainty especially relevant. Our robust methodology, which retains the full breadth of uncertainty through each step of the model calculation and reports multiple loss outcomes for any one event, allows re/insurers to gain confidence in decisions that rely on low-probability results.

Key Features

LATEST HAZARD

The Australia Earthquake Model has fully implemented Geosciences Australia's (GA) 2012 hazard update. Data on seismic sources, earthquake catalogues, and earthquake frequency originate from GA with adjustments to suit a modeling context. Of GA's three seismic source models, the Australia Earthquake model incorporates the regional model and a modified background model, reflecting the latest scientific agreement on the seismotectonics of stable continental regions and eliminating conservatism related to use of a hazard model whose primary purpose is to define loading standards in the building code. Maximum magnitudes are consistent with GA hazard.

DISTANT SUBDUCTION SOURCES

The Australia Earthquake Model goes above and beyond GA to include events from distant plate boundaries in Indonesia and Papua New Guinea. Including these sources is yet another example of the model's robust calculation of tail risk, since rare, large-magnitude earthquakes on subduction zones could cause losses on the north and northeast coasts. Since only larger subduction events in Indonesia and Papua New Guinea will affect Australia, magnitudes for events from these sources range from Mw7.0 to over 9.0.

STOCHASTIC EVENT SETS AND SIMULATION

Comprehensive stochastic event sets were constructed by sampling earthquakes and associated frequencies across the full range of possible magnitudes for each source type. A sufficiently long simulation horizon is essential to avoid underestimating tail risk driven by infrequent events, particularly relevant for Australia. Comprehensive probabilistic event sets include 300,000 years of simulated losses.

REGION-SPECIFIC ATTENUATION

The model uses ground motion prediction equations that represent the unique shaking characteristics of stable continental regions. We additionally differentiate the attenuation relations used for cratonic Western Australia from those in the geologically-younger Eastern Australia. For each tectonic setting, the model weights the four Ground Motion Prediction Equations (GMPEs) adopted by GA together with global sets of GMPEs, many of which derive from ongoing Next-Generation Attenuation (NGA) research. Global sets of source-specific GMPEs are used for distant subduction sources.

The Australia Earthquake Model is the one of the first catastrophe risk models to implement the 2012 hazard model update from Geosciences Australia. Specially-developed for Australia's unique mid-plate tectonic setting, the model features region specific innovations in both hazard and vulnerability, and is part of the Catastrophe Risk Management suite of products from CoreLogic® and incorporated into RQE® (Risk Quantification & Engineering).

SOIL-BASED ATTENUATION (SBA)

Going one step beyond NGA, the Australia Earthquake Model uses soil-based attenuation (SBA)—a functional form of NGA equations which assumes that seismic waves propagate through soil. This approach more closely represents the vast majority of insured exposure located on soil sites and reduces modeling uncertainty introduced by applying soil amplification factors to more conventional rock-based equations. By requiring far less adjustment for site conditions, the model's use of SBA retains the improved confidence of the NGAs.

REGION-SPECIFIC VULNERABILITY

Modelled vulnerability curves are specific to Australian construction practices and building code development. Vulnerability insight is well-honed from thousands of seismic studies conducted by CoreLogic during the last 30 years, as well as first-hand observations of 90 earthquakes worldwide, including the 1989 Newcastle event.

MODEL VALIDATION

Validation has been carried out to test the robustness of each model component and is described in detail in our technical documentation.

- Frequency and magnitude of events generated by the stochastic model were compared with those of historical seismicity.
- Probabilistic ground-shaking intensities were compared with the latest available research.
- Historical earthquakes were modelled and the output compared against recorded economic damage.
- Probabilistic losses were calculated based on the analysis of national exposure data. Probabilistic return periods were studied and, where possible, insurance industry burning costs over the last century were compared to modelled losses.
- Modelled results from historical events were compared to specific client portfolio losses.

Model Specifications

GEOGRAPHIC COVERAGE

The model covers all eight states and territories in Australia.

IMPORT RESOLUTION

Exposure data is accepted at resolutions of lat/long, postal code, city, and state. When input data is available only at aggregate levels, the model adds refinement to loss results by disaggregating exposure to a resolution consistent with the hazard generation. The disaggregation scheme is weighted by daytime and nighttime distributions of population.

HAZARD ANALYSIS AND SOIL DATA RESOLUTION

Variable resolutions are based on population density and range between 0.01 and 0.1 degrees. Soil condition mapping, one of the most sensitive components of earthquake modeling, is discretized at a resolution of 0.001 degrees (about 100m) in greater Melbourne, Sydney, and Perth; and at 0.01 degrees (about 1km) elsewhere.

STRUCTURE TYPES AND OCCUPANCIES

With a full suite of representative structure types and occupancy categories, the model differentiates risk across hundreds of combinations, and allows only realistic pairings of occupancy and construction. A common set of structure types and occupancies is available worldwide. Our technical documentation provides detailed guidance on structure type selection.

MODEL OUTPUT

Risk metrics include OEP and AEP loss exceedance curves, AAL, TVAR, and simulations of historical events. 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 modeling. 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.

FINANCIAL MODELING

Major insurance policy structures and reinsurance treaty types are modelled.

LINES OF BUSINESS

Lines of business include residential, commercial, industrial, agricultural, and automobile.

COVERAGE TYPES

The model calculates damage to structures (building damage), contents, and time element (business interruption and additional living expenses). Separate vulnerability functions are used for building and contents damage. Time-element vulnerability functions are a function of both structural and contents damage.

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