CoreLogic®

CATASTROPHE
RISK
MANAGEMENT

U.S. Severe Convective Storm Model

Region specific innovations in both hazard and vulnerability

Integrating updated building codes and construction practices with the latest science and engineering, the U.S. Severe Convective Storm Model offers unique modeling innovations including specialized hail vulnerability functions for structures and automobiles, a finite hazard footprint model that produces a robust representation of the focused and severe damages arising from tornadoes, embedded weather system modeling to simulate event occurrences of tens to hundreds of tornadoes, hail storms, and straight-line wind events spanning multiple states. The unique CoreLogic approach to uncertainty is especially relevant to regions experiencing infrequent tornado touchdowns. Our robust methodology allows re/insurers to gain confidence in decisions related to low probability events that have significant financial consequences.

The U.S. Severe Convective Storm Model is part of the suite of products by Catastrophe Risk Management from CoreLogic® incorporated into the global multi-peril platform, RQE® (Risk Quantification and Engineering). The platform enables robust risk measurement and differentiation calculations.

Key Features

EVENT FREQUENCY MODEL BASED UPON ADJUSTED HISTORICAL DATA

The frequency of U.S. Severe Convective Storm events is based upon NOAA's Storm Prediction Center public record of tornadoes and hail reports from 1950 onwards. The records contain details about each tornado event, including the tornado identifier, the tornado's Fujita classification, date, time of occurrence, maximal width, the tornado's length, number of injuries and fatalities, and geographic starting and ending position (latitude and longitude). In addition, the hail records provide date, time of occurrence, geographic position, and hail size, from a minimum of 0.75 inches up to 5 inches and above.

Improvements in tornado and hail tracking technology and reporting have led to an apparent increased frequency in tornado activity. The use of Doppler radar beginning in the mid-1980's and an improved understanding of tornado and hail formation processes enabled improvements to the reporting process especially with low F-Scale tornadoes. Therefore, historical data must be adjusted before a valid model may be developed. The CoreLogic solution to the problem of reporting bias is to focus on data reported since the early 1990s, an approach validated using NOAA research. The resulting de-trended historical data set is used to model the probabilistic stochastic event set for tornadoes, hail storms, and straight-line winds. This robust probabilistic set includes approximately 840,000 events. The model also accounts for temporal and spatial clustering of events. The probabilistic set is evaluated against the historical data set for completeness and validation.

Statistical Model Testing and the Elimination of Model Bias The nature of severe convective storm events includes events that can (A) endure for as long as seven days, (B) produce hundreds of tornadoes, hail storms and straight-line wind events, each with a damaging footprint of perhaps several acres, and (C) produce damage in tens of states across the central U.S.

The U.S. Severe Convective Storm Model's stochastic event simulation has undergone stringent statistical convergence testing to ensure that the model produces a robust and credible representation of the insured risk from severe convective storms. Convergence testing was done individually for separate components of severe convective storms (tornadoes, hail storms and straight-line winds) and upon the combined model to demonstrate a consistent measure of risk.

MODEL VALIDATION FROM A BROAD ARRAY OF SOURCES

The annual probability of a tornado touchdown upon a specific parcel of land is very small, and the effectiveness of a loss model for severe convective storms requires identifying all potential sources of validation. Property Claim Services (PCS) data covering the time since 1970 provides one perspective of event frequency and severity, although increasing urbanization and insurance values limit the effectiveness of this data. Historical records of crop-hail insurance loss payments provide a complementary and useful source of validation for the hail model. There are many scientific studies of hail undertaken for suppression studies, designs of structures, crop and property insurance risk assessments, and aircraft operations. A fourth form of data is limited to hail-produced losses in events that cause more than $5 million (in year of occurrence) in property damage, labeled by the insurance industry as catastrophes. In some years the crop-hail data was collected for individual storms, allowing examination of storms on a weekly and monthly basis. This data has been compiled on various geographical scales and offers considerable spatial information on patterns of crop-damaging hail. Finally, modeled versus observed burning cost evaluations of stable insurance portfolios were undertaken in many regions of the country to develop greater confidence in the model.

The hazard model has also been reviewed and validated by Dr. Harold Brooks. Dr. Brooks is a Research Meteorologist and heads the Mesoscale Applications Group at NOAA/ National Severe Storms Laboratory.

STOCHASTIC EVENT SET

Stringent acceptance criteria has been used in the development of the stochastic event set. The resolution grid of tornadoes, hail storms, and straight-line wind events is constant across the landscape, which provides consistent results. Since all geographies are modeled with equal confidence, even the most specialized portfolio will be modeled to the same high standards as a market portfolio. The model includes spatial and temporal clustering, which is an essential aspect of severe convective storm risk.

VULNERABILITY

The U.S. Severe Convective Storm Model incorporates vulnerability curves that are developed from reviews of historical loss data and wind risk studies conducted over the last 20 years.

PERILS COVERED

The U.S. Severe Convective Storm Model specifically models wind (tornado and straight-line winds) and hail (damage due to the kinetic energy associated with impact).

Model Specifications

IMPORT RESOLUTION

Import and risk evaluation is geocoded at latitude and longitude coordinates, ZIP Codes, and county levels. When exposure data is provided at aggregate levels (ZIP Code and county), the model adds refinement to loss results by disaggregating data to finer resolution points based on weighted distribution of values for the purpose of analysis and risk estimation.

HAZARD ANALYSIS AND SOIL DATA RESOLUTION

The hazard is gridded into cells of approximately 10 km2, smaller than the typical ZIP Code. The tornado touchdown grids are elongated rectangles aligned in a north-easterly direction approximating the most likely tornado path. Hail storm grids are square.

GEOGRAPHIC COVERAGE

The model covers the 48 contiguous United States, including the District of Columbia.

LINES OF BUSINESS

Lines of business include Residential, Commercial, Industrial, and Automobile.

STRUCTURE TYPES AND OCCUPANCIES

With many different structure types and dozens of occupancy categories for each line of business, the U.S. Severe Convective Storm Model differentiates risk across hundreds of combinations.

COVERAGE TYPES

The model calculates damage to structures (building damage), contents, and damage related to time (loss of operations or loss of use). Separate, independent vulnerability functions are used for calculating losses related to each coverage type. Time-element vulnerability functions are a function of structural and contents damage.

MODEL OUTPUT

Risk metrics include loss exceedance curves, including OEP/AEP, AAL, TVAR, event-by-event losses with associated uncertainty, as well as simulations of historical events. Reporting of results supports multiple levels of refinement:

- Total aggregate portfolio;
- ZIP Code or county;
- Detailed output by policy and site.

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

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

FOR MORE INFORMATION, PLEASE CALL 866-774-3282
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