

- ADVANCED HAZARD MODELING
- STATE-OF-THE-ART ENGINEERING
- MODEL PERFORMANCE IN REAL TIME

The AIR Earthquake Model for Mainland China

ADVANCED HAZARD MODELING

Multiple Data Sources, Including Physical Modeling, Inform a Comprehensive View of Earthquake Risk

Despite China's long record of damaging quakes, which dates back more than 2,700 years, historical data alone are not sufficient to provide an accurate view of the hazard. This is especially true for large earthquakes, whose recurrence intervals are too long to be captured adequately in the historical record.

THE ISSUE.

THE SOLUTION.

To create a fully probabilistic event catalog, AIR supplements historical data with paleoseismological research and crustal deformation rates that determine the seismic energy accumulation rate in various regions using extensive GPS data and a *kinematic model* of the region developed by AIR seismologists. This approach enabled AIR to establish that the Longmen Shan Fault, long considered inactive, actually was a significant constituent of China's earthquake risk—a finding AIR made before the 2008 Wenchuan earthquake occurred.

Ground Motion Prediction Equations (GMPEs) Reflect China's Varied Regional Characteristics

The intensity of ground shaking at a given site depends in part on regional geological characteristics. Seismic waves travel more efficiently through eastern China than they do through the western part of the country.

To account for regional differences in China's underlying geology, the AIR model employs two sets of ground motion prediction equations. Using a magnitude-dependent weighting scheme that reflects local geology, the model provides a comprehensive assessment of risk.

High-Resolution Geological and Soil Maps Capture Potential for Soil Amplification

Soil properties play a critical role in amplifying or reducing ground motion intensity.

The AIR model features three sets of soil maps at variable resolution, including a map at 500-meter resolution for Beijing.

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MODEL AT A GLANCE

LAST UPDATED 2007

MODELED PERIL Ground shaking.

CATALOG A 10,000-year stochastic catalog consisting of more than 580,000 simulated earthquakes, more than 121,500 of which cause loss to industry exposures.

HAZARD MODULE

- Uses China's historical record, paleoseismic and active fault information, and kinematic modeling using GPS data to determine the seismicity rates and spatial distribution of possible earthquakes
- Captures China's regional seismic complexity and varying soil types

VULNERABILITY MODULE

Includes damage functions for more than 200 separate construction types and occupancy classes, including General Residential, Temporary Lodging, Apartment/Condo, and CAR/EAR; accounts for the impact of regional variation, height, and year of construction on building vulnerability.

MODEL VALIDATION Extensively validated against modeled losses from the Xingtai (1966), Tangshan (1976), Lijang (1996), and Neimeng (1996) earthquakes and detailed post-event damage survey data from the 2008 Wenchuan quake.

Cover image: AIR Worldwide Damage Survey of the 2008 Wenchuan Earthquake
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STATE-OF-THE-ART ENGINEERING

Objective, Engineering-Based Approach to Assessing Building Vulnerability in China

THE ISSUE.

The vulnerability of China's building stock is highly variable depending on region, age, construction type, and other characteristics.

THE SOLUTION.

AIR engineers have developed more than 200 damage functions for a wide variety of construction types, structural systems, and occupancy classes. The damage functions are informed by the results of detailed engineering analysis of region-specific construction practices and building design, published research, and damage observation data from the China Earthquake Administration.

Unique Damage Functions Developed for Buildings under Construction

China has a rapidly growing urban population in seismically active regions. The construction all risks/erection all risks (CAR/EAR) line of business makes up a large proportion of China's insurance business.

Dedicated damage functions for CAR/EAR take into account the variability over time in both the vulnerability and the replacement costs of buildings under construction.

SUPPORTS A LARGE ARRAY OF POLICY CONDITIONS SPECIFIC TO CHINA

NO ISSUE HERE.

Policies that use the "maximum-of-site" or "percent-of-loss" deductible, a policy type common to the China market, are explicitly modeled. In fact, the full range of other policy terms and conditions are supported, including facultative (assumed and ceded) and treaty reinsurances.

MODEL PERFORMANCE IN REAL TIME

On May 13, 2008, hours after the devastating Wenchuan earthquake, AIR seismologists were running simulations of the event using the available information on epicentral location, depth, magnitude, and direction of rupture. Within 24 hours, AIR issued estimates of industry losses and was assisting clients in assessing losses to their portfolios.

MODEL DEVELOPED THROUGH CLOSE COLLABORATION WITH CHINESE EXPERTS

AIR scientists increased their understanding of the recurrence rates of active and potentially hazardous faults in the region through close collaboration with seismologists at the China Earthquake Administration's Institute of Geology. The model's damage functions were informed by AIR's collaboration with the Beijing Institute of Architectural Design.

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.



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