

- ADVANCED HAZARD MODELING
- STATE-OF-THE-ART ENGINEERING
- INDUSTRY EXPOSURE DATABASE CAPTURES EXCEPTIONAL LEVEL OF DETAIL
- SUPPORTS JAPAN-SPECIFIC POLICY CONDITIONS

# AIR Earthquake Model for Japan

## ADVANCED HAZARD MODELING

The Most Comprehensive View of Seismic Hazard, Post-Tohoku

Despite Japan's long and well-studied earthquake history, the M9.0 Tohoku event caught the scientific community by surprise.

## THE ISSUE.

## THE SOLUTION.

The AIR model reflects the most up-to-date understanding of Japan's seismic hazard and is based on the most recent research by Japan's Headquarters for Earthquake Research Promotion (HERP), complemented by original research by AIR seismologists and published work by the larger scientific community.

Unique Physical Model to Understand Stress Transfer in Seismic Zones Near Tokyo

As with any significant earthquake, the Tohoku event increased the probability of rupture on some nearby faults and lowered it on others.

AIR seismologists used GPS data to develop a kinematic block model to estimate updated rupture probabilities. Their findings indicate that the Boso Segment may have accumulated enough energy to generate an earthquake of magnitude 7.5-8.6, which would devastate the Kanto Plain—and Tokyo.

High-Resolution Geological and Soil Maps Provide a Granular Assessment of Risk, Including for Liquefaction

Soil properties and geological features play critical roles in amplifying or de-amplifying seismic waves, meaning even lower seismicity areas can be at risk. They also play a role in liquefaction risk.

For improved risk differentiation, the AIR model incorporates detailed geological and soil maps with resolutions as high as 50 meters for major urban centers. The liquefaction module explicitly captures liquefaction risk for all of Japan.

Industry's First Fully Probabilistic Tsunami Modeling Capability

Capturing the detailed mechanics of a tsunami from initial formation to dissipation is critical to understanding potential damage and loss.

A numerical model was developed to simulate tens of thousands of stochastic tsunami events, from rupture through the entire inundation period. The model takes into account the effects of friction with the ocean floor on a tsunami's height and forward speed—two major determinants of its damage potential.

Fire Following Module with Realistic Building Distributions

Capturing fire following risk requires a detailed understanding of how fires spread within Japan's unique built environment.

AIR's peer-reviewed fire following module takes into account the spatial distribution of buildings throughout Japan. It implements an innovative multi-level approach to simulate fire ignition, spread, and suppression—all at a high resolution.

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## MODEL AT A GLANCE

**LAST UPDATED** 2013

**MODELED PERILS** Ground shaking, tsunami, fire following, and liquefaction.

**CATALOG** 10,000-year catalog includes more than 104,000 loss-causing simulated events.

### HAZARD MODULE

- Fully consistent with detailed recent geological and soil maps published by the Japan Geological Society
- The industry's first fully probabilistic tsunami modeling capability
- The peer-reviewed fire following module simulates fire following risk on a 1 km grid
- Comprehensive liquefaction module captures the liquefaction risk for all of Japan

### VULNERABILITY MODULE

Provides separate damage functions for ground shaking, tsunami, fire following, and liquefaction perils; damage functions vary by occupancy, construction, height, and age.

**MODEL VALIDATION** Engineering component of the model extensively validated against published research and observed damage from historical earthquakes and detailed post-disaster field surveys. Modeled losses have been compared to reported industry loss data, individual company claims data from historical earthquakes including Tohoku, and detailed post-event damage surveys.

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### STATE-OF-THE-ART ENGINEERING

**Separate Damage Functions for Earthquake, Tsunami, Fire Following, and Liquefaction Capture Vulnerability of Japan's Residential, Commercial, and Specialty Lines**

The damage that earthquake, tsunami, fire following, and liquefaction cause to residential and commercial construction and lines of business varies widely.

### THE SOLUTION.

Separate damage functions for all four perils capture the regional and temporal variations in the vulnerability of Japan's building stock. The model supports 22 construction classes and 117 occupancy classes, as well as specialized risk such as railways, marine cargo, marine hull, transit warehouse, and personal accident.

**Component-Based Approach to Modeling the Vulnerability of Complex Industrial Facilities**

Complex industrial sites comprise a wide variety of components that behave very differently when subjected to earthquake-induced ground shaking. Models that treat complex industrial facilities as a single entity fail to capture the unique damageability of individual components.

The AIR model features damage functions for more than 400 individual industrial components. Their development was based on site-specific risk assessments that encompass structural calculations, materials tests, and post-disaster field surveys.

### EXTENSIVE MODEL VALIDATION

Model results were extensively validated against loss data from historical earthquakes, including nearly 4 million claims from the 2011 Tohoku earthquake.

### NO ISSUE HERE.

### INDUSTRY EXPOSURE DATABASE CAPTURES EXCEPTIONAL LEVEL OF DETAIL

AIR's high-resolution industry exposure database (IED) is based on the latest available information on risk counts, building characteristics, and construction costs. The benefits and uses of the IED are many, from supporting industry loss warranties that pay out based on industry losses to providing the means by which companies can disaggregate their data for more accurate loss estimates.

### SUPPORTS JAPAN-SPECIFIC POLICY CONDITIONS

The AIR Earthquake Model for Japan has been developed to support the country's unique mix of policy types: single-location and multi-location first loss policies, reduced indemnity policies, and step payout policies. Fire Following Earthquake and Earthquake Fire Expenses Insurance—an offering unique to Japan—are also explicitly modeled.

## 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](http://www.air-worldwide.com).



AIR Worldwide is a member of the Verisk Insurance Solutions group at Verisk Analytics.

