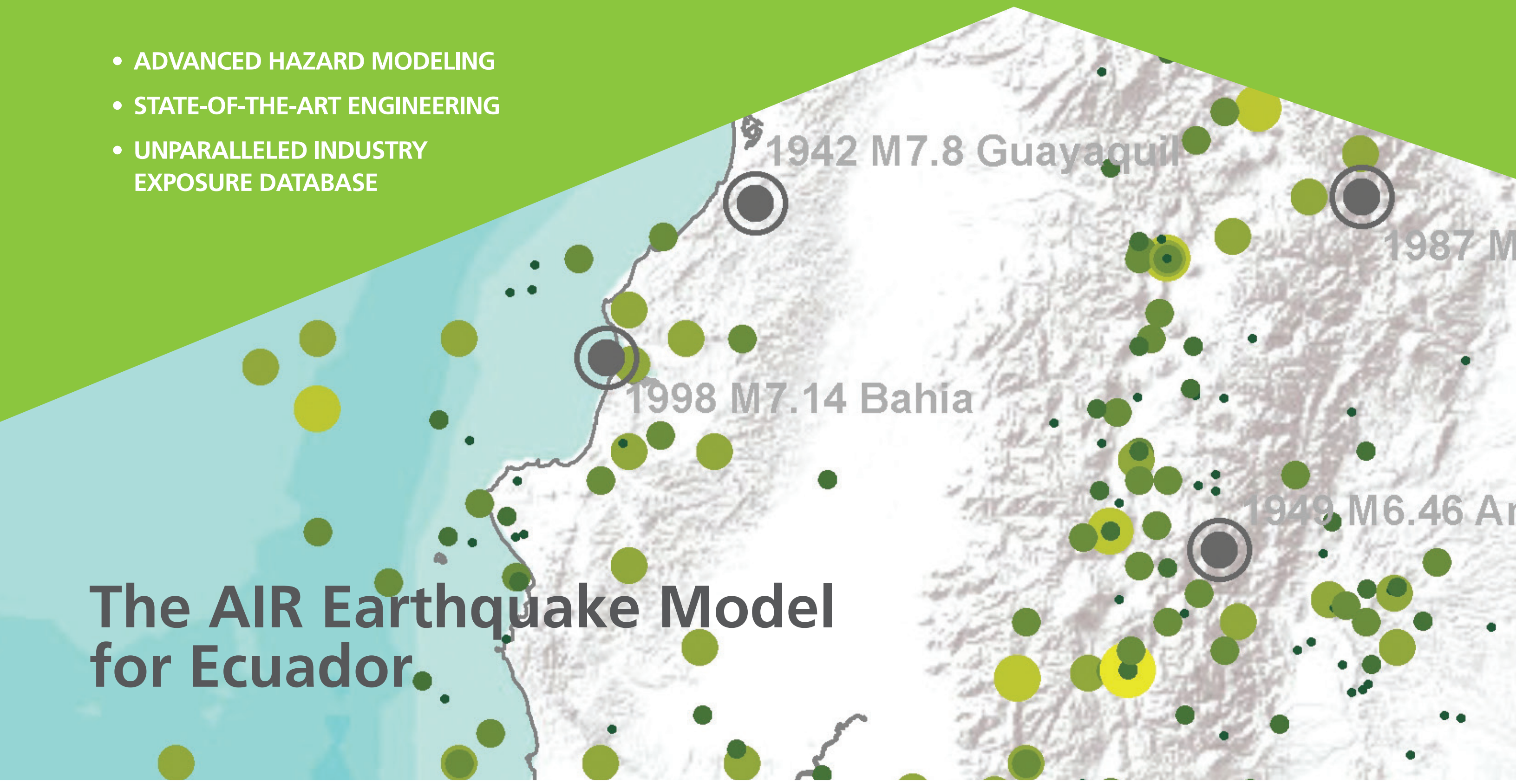
- ADVANCED HAZARD MODELING
- STATE-OF-THE-ART ENGINEERING
- UNPARALLELED INDUSTRY EXPOSURE DATABASE



The AIR Earthquake Model for Ecuador

ADVANCED HAZARD MODELING	THE ISSUE.	THE SOLUTION.
Comprehensive Data Set to Improve Assessment of Long-Term Seismic Activity	While Ecuador has experienced earthquakes for many millions of years, the recorded history is relatively short. Therefore, additional information, including local and regional GPS data indicative of the region's long-term strain rate, is needed to improve the assessment of seismic risk.	AIR compiled detailed active fault data, which was used in conjunction with GPS data and paleoseismic data, to determine the crustal deformation rate in all of Ecuador's seismic source zones. This information was used to create a stochastic catalog reflecting the region's long term seismic activity.
High Resolution Geological Maps Capture Potential for Soil Amplification and Liquefaction	Soil properties play a critical role in amplifying or de-amplifying seismic waves. They also play a role in liquefaction risk.	The AIR model features multiple layers of soil maps of variable resolution, including surficial geological maps of 100-meter resolution and microzonation maps of 50-meter resolution, for the cities of Quito and Guayaquil. The liquefaction module explicitly captures liquefaction risk in these cities.
Stochastic Catalog Reflects Time-Dependent and Time-Independent Earthquake Rupture Probabilities to Provide the Most Robust View of Risk	According to time-dependent views of earthquake risk, the annual probability of an earthquake occurring on a given fault is dependent on when the last earthquake occurred on that fault and how much that fault is accumulating elastic strain (or slip deficit).	The AIR model incorporates both time-dependent and time-independent earthquake rupture probabilities—the former for seismic source zones in Ecuador with well-known rupture histories, and the latter for source zones where rupture histories are not well known.
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 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.
Appropriately Accounts for Loss Volatility	Infrequent, large loss events—also known as "tail" events—drive the earthquake risk in Ecuador. Thus, information from historical earthquakes alone is not sufficient to gauge future losses.	The AIR model appropriately captures the frequency and magnitude of "tail" events, and outputs a reliable estimate of average annual loss—one that accounts for the volatility to be expected from periods of calm interrupted by the occurrence of extreme (tail) events.

AIR WORLDWIDE®

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MODEL AT A GLANCE

MODELED PERILS Ground shaking, tsunami, and liquefaction

CATALOG The model incorporates a 10,000-year catalog of 324,316 simulated earthquakes, 30,487 of which cause loss to the industry exposure (2014) of Ecuador. Stochastic events included in the model are of magnitude 5.0 and greater.

HAZARD MODULE Integrates all global, regional, and local catalogs as follows: ISC-GEM Global Instrumental Earthquake Catalog, GEM Global Historical Earthquake Catalog, ISC EHB Bulletin, USGS ANSS Comprehensive Catalog, Catálogo de sismicidad from the Red Sismológica Nacional de Colombia (RSNC), South America CERESIS catalog, Utsu Catalog of Damaging Earthquakes in the World, Global Centroid Moment Tensor Catalog.

VULNERABILITY MODULE Supports 115 occupancy classes and 106 construction classes; accounts for the impact of the evolution of Ecuador's building codes and other local factors affecting the seismic performance of buildings in Ecuador. In addition, Touchstone® supports occupancy classes for industrial facilities, including chemical processing, oil refineries, and mining. Occupancy classes for infrastructure such as bridges, pipelines, and tunnels are also supported. Touchstone also supports builder's risk.

HISTORICAL EVENT SET The AIR software systems include a historical event set consisting of 99 historical earthquakes, 21 of which cause loss to the current distribution of the industry exposure in Ecuador. The five earthquakes of the historical event set that cause the highest insurable losses in Ecuador are, in descending order: 1797 Riobamba, Ecuador, M7.6; 1906 Esmeraldas, Ecuador, M8.35; 1987 Napo, Ecuador, M7.14; 1942 Guayaquil, Ecuador, M7.8; and 1949 Ambato, Ecuador, M6.46.

Cover image: AIR Worldwide

STATE-OF-THE-ART ENGINEERING	THE ISSUE.	THE SOLUTION.
Damage Estimation Based on Rigorous Engineering Analysis	How buildings respond to earthquakes depends on both the ground motion and the building type. Traditional approaches to damage estimation don't capture these complex interactions.	Complementing local expertise, damage estimation in the AIR model uses state-of-the-art engineering analysis, including results from detailed nonlinear dynamic analysis (NDA) computer models of buildings subjected to actual ground motion records.
Considers Impact of Local Construction Practices on Building Vulnerability	The seismic performance of buildings in Ecuador is greatly influenced by local construction practices, with damageability often affected by variations in workmanship, materials, and building code enforcement across the country and over time.	AIR engineers collaborated with local experts to better understand the regional vulnerability of various building types, enabling AIR to develop a model that takes into account these local factors and the evolution of Ecuador's building codes.
Comprehensive Set of Damage Functions	Ecuador's building stock is diverse, and vulnerability varies by construction and occupancy.	The AIR model offers a robust set of damage functions for 106 construction types and 115 occupancy classes. Supported lines of business include residential building, residential contents, residential combined, commercial, industrial, commercial/industrial combined, and automobile. In addition, AIR's detailed modeling solution supports occupancy classes for industrial facilities, including chemical processing, oil refineries, and mining. Occupancy classes for infrastructure such as bridges, pipelines, and tunnels are also supported. Furthermore, AIR's detailed modeling solution supports builder's risk.

NO ISSUE HERE.

COMPATIBLE WITH NEW CAPITAL REQUIREMENTS

Ecuador's insurance market is experiencing strong growth. If Ecuador's Superintendencia de Bancos y Seguros moves toward a risk-based capital requirement like those recently established in Peru and Colombia, the AIR Earthquake Model for Ecuador would allow local insurance companies to tailor their capital reserve in accordance with their portfolio's unique risk profile.

UNPARALLELED INDUSTRY EXPOSURE DATABASE

The industry exposure database (IED) for Ecuador is constructed at a high resolution (1 km grid), and contains the most recent risk counts and their respective replacement values, along with information about the occupancy and physical characteristics of structures such as construction type and height classification. In addition to the residential, industrial/commercial, and automobile lines of business, the IED features industrial facilities.