AIR - WORLDWIDE

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Earthquake Hazard Group

BETTER TECHNOLOGY
BETTER DATA
BETTER DECISIONS

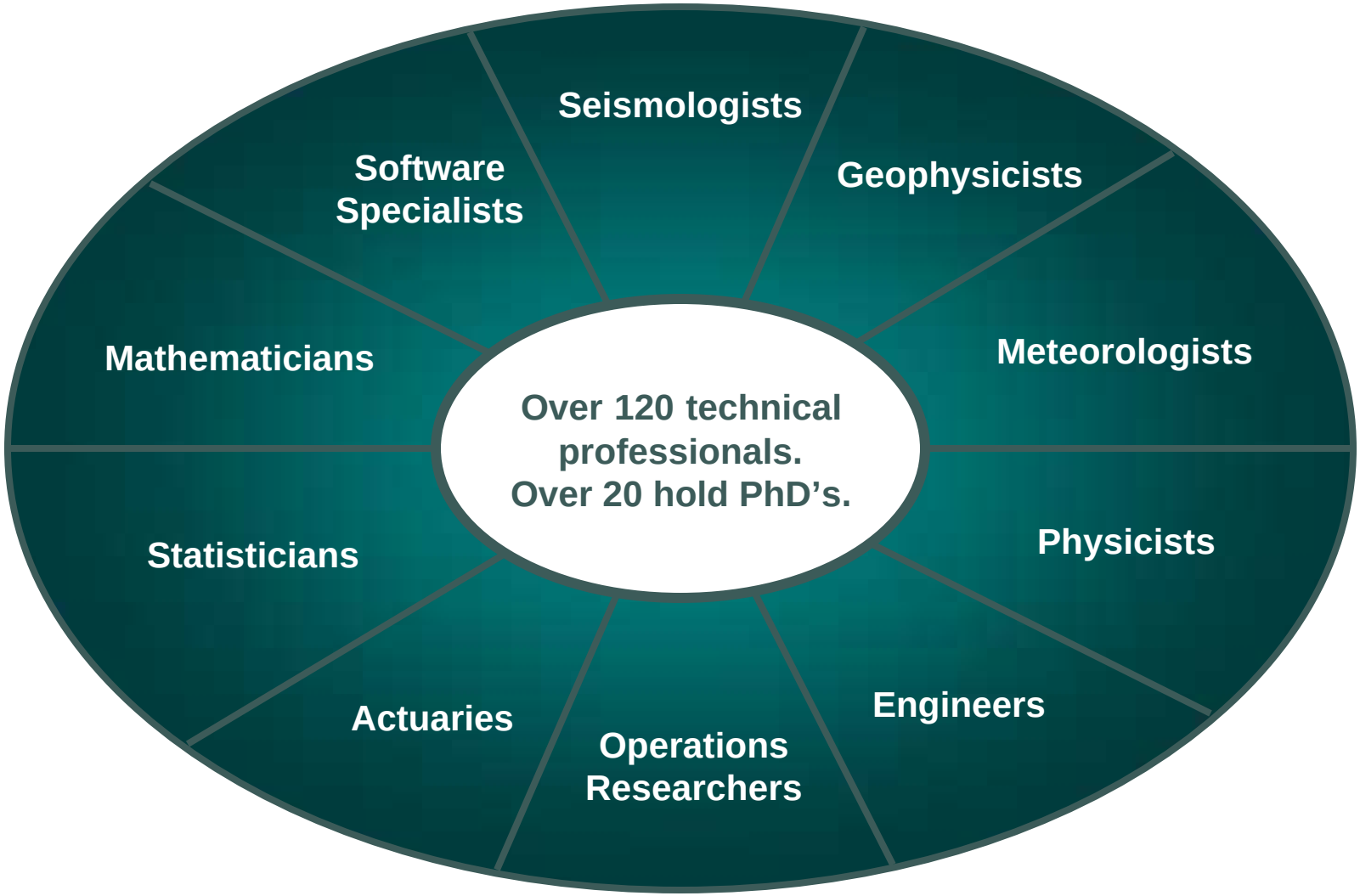
AIR

www.air-worldwide.com

AIR Conducts Probabilistic Loss Analysis for Natural Hazards

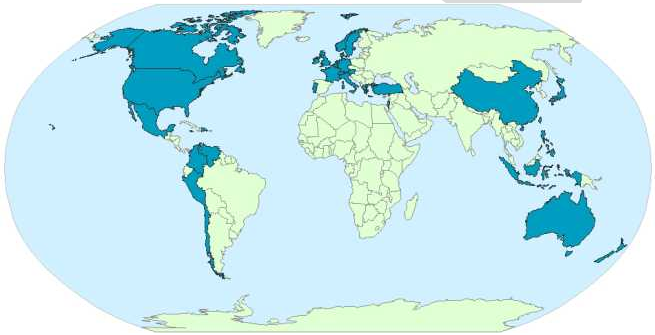
- AIR Worldwide was founded in 1987. Presently, AIR is a subsidiary of ISO
- Offices:
  - Boston
  - San Francisco
  - London
  - China
  - Germany
  - Hyderabad, India

AIR Technical Staff



AIR Catastrophe Models

Tropical Cyclones (Typhoons, Hurricanes)	Tornadoes, Hailstorms & Straight-line Windstorms	Extra-tropical Cyclones (i. e. Winter Storms)	Earthquake (Shake)	Earthquake (Fire Following)	Terrorism (Property, Work Comp, Life)
Australia	Canada	Austria	Australia	Canada	United States
Caribbean	United States	Belgium	Canada	Japan	
Hawaii		Canada	Caribbean	United States	
Hong Kong		Denmark	Chile		
Japan		France	Colombia		
Philippines		Germany	Greece		
Taiwan		Ireland	Hong Kong		
United States		Luxembourg	Indonesia		
		Netherlands	Israel		
		Norway	Italy		
		Switzerland	Japan		
		Sweden	Mexico		
		UK - includes Flood	New Zealand		
		United States	Philippines		
			Portugal		
			Taiwan		
			Turkey		
			United States		
			Venezuela		
			China		
			Peru		

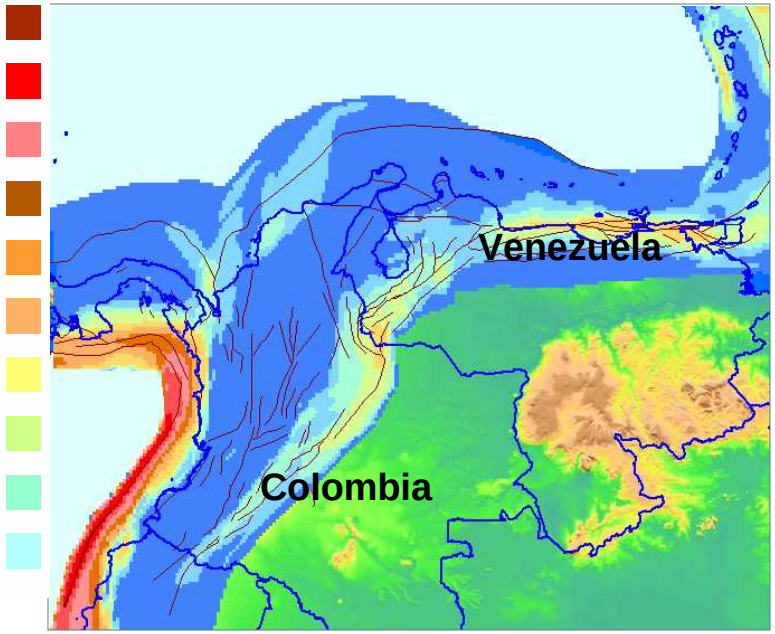


Paleoseismic, GPS, and Earthquake Catalog Data are Used to Construct Regional Seismicity

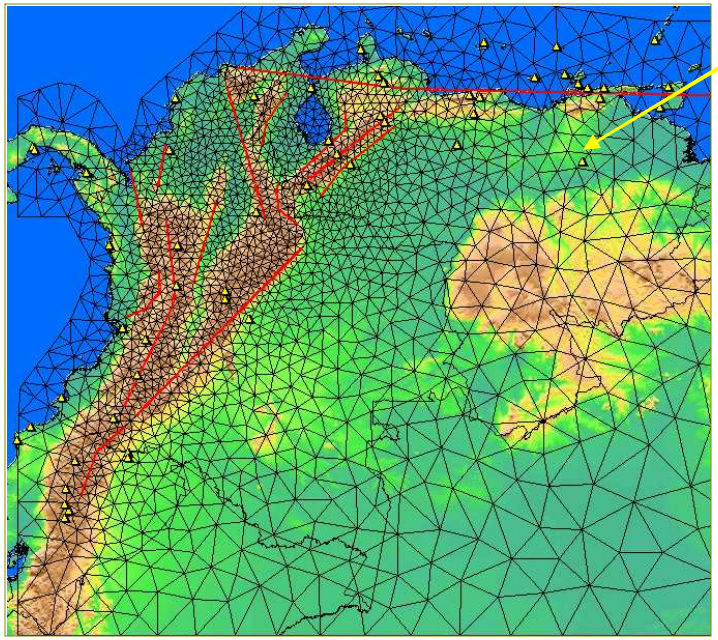
An Example from Colombia and Venezuela

Kinematic Model and GPS Data are Used to Calculate Regional Strain Rate Distribution

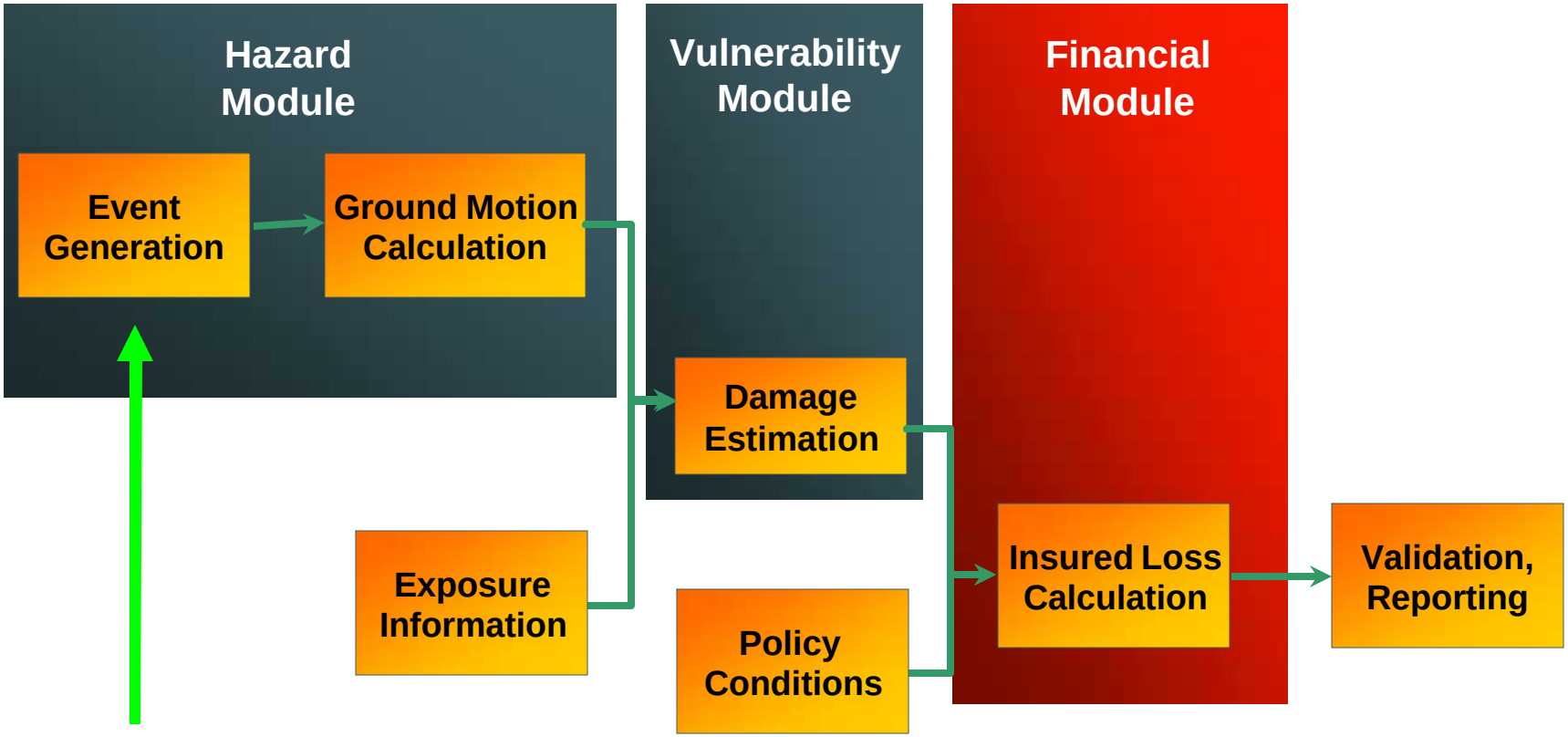
High



3D Elastic Finite Element Models are Used to Get Insight into Faults Slip Rates and Regional Strain Rates



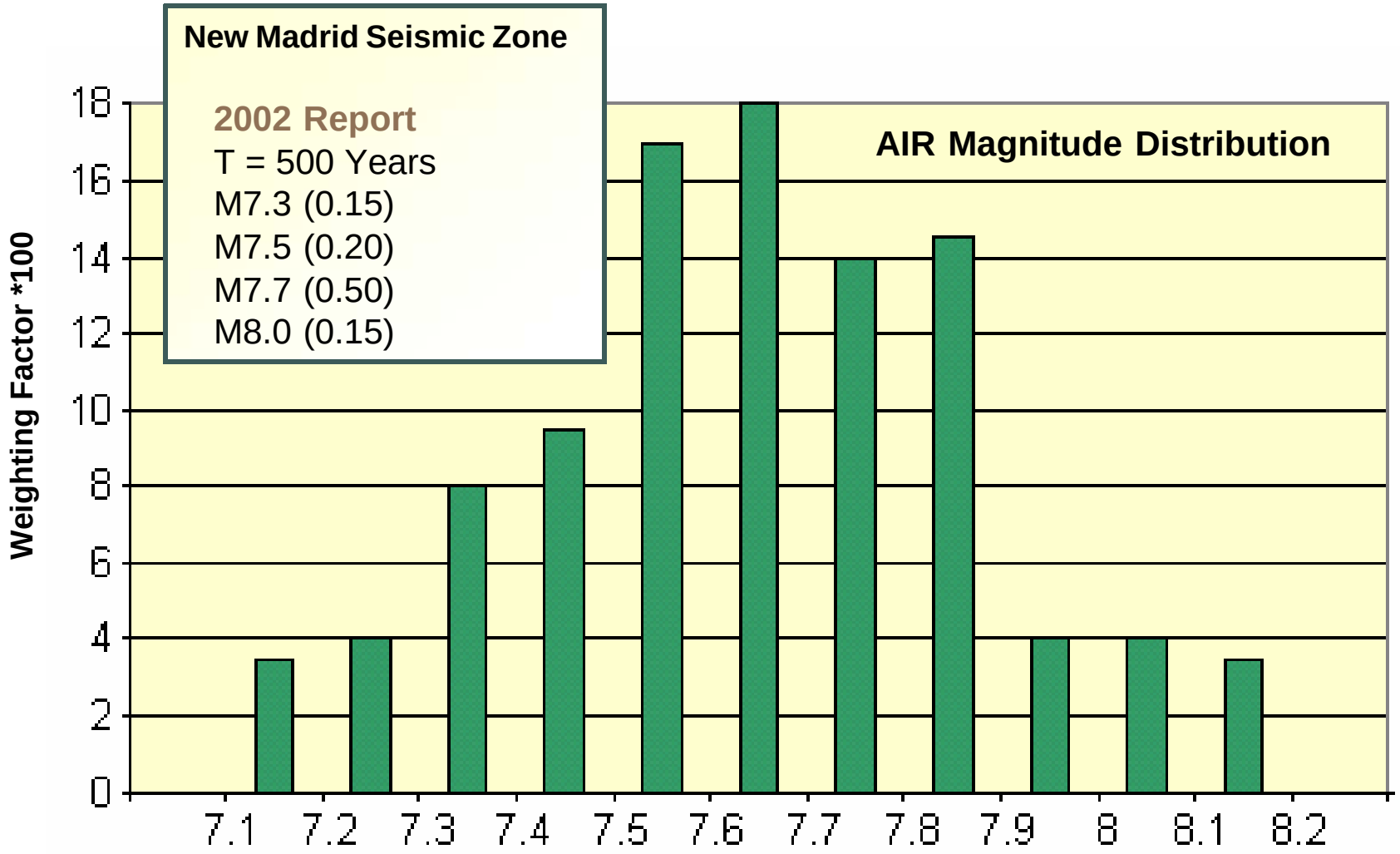
Primary Model Components



Faults, Special Seismic Zones, and Background Seismicity

Magnitude Rate Distribution

USGS 2002 and AIR Magnitude Rate Distribution of Large Earthquakes for New Madrid Seismic Zone (NMSZ)



USGS and AIR Magnitude Rate Distribution of Large Earthquakes for Charleston Seismic Zone

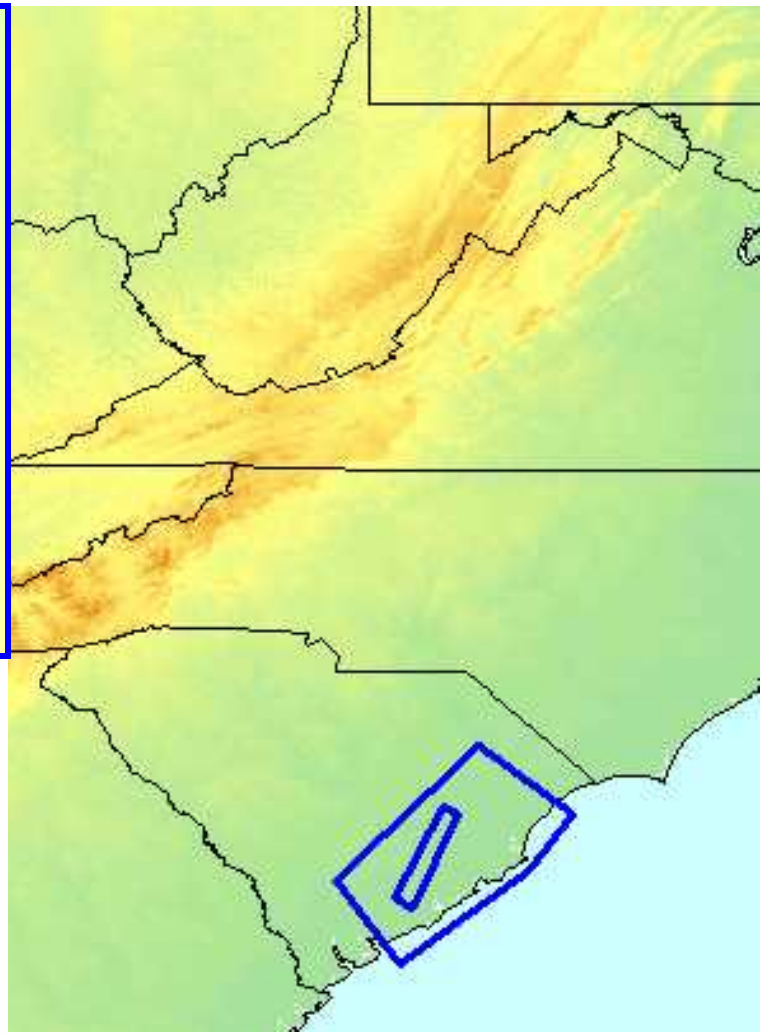
Charleston, South Carolina Seismic Zone

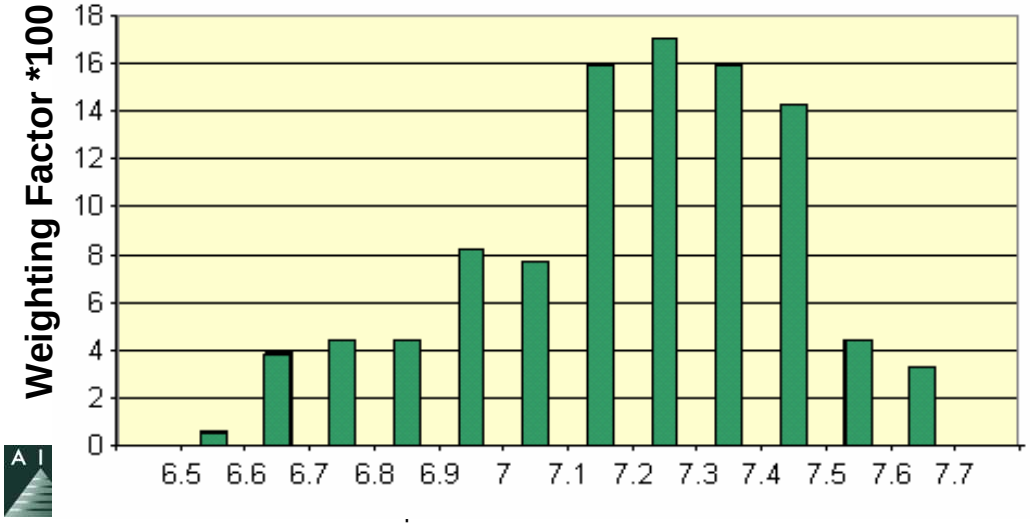
2002 Report

T = 550 Years
M6.8 (0.20)
M7.1 (0.20)
M7.3 (0.45)
M7.5 (0.15)

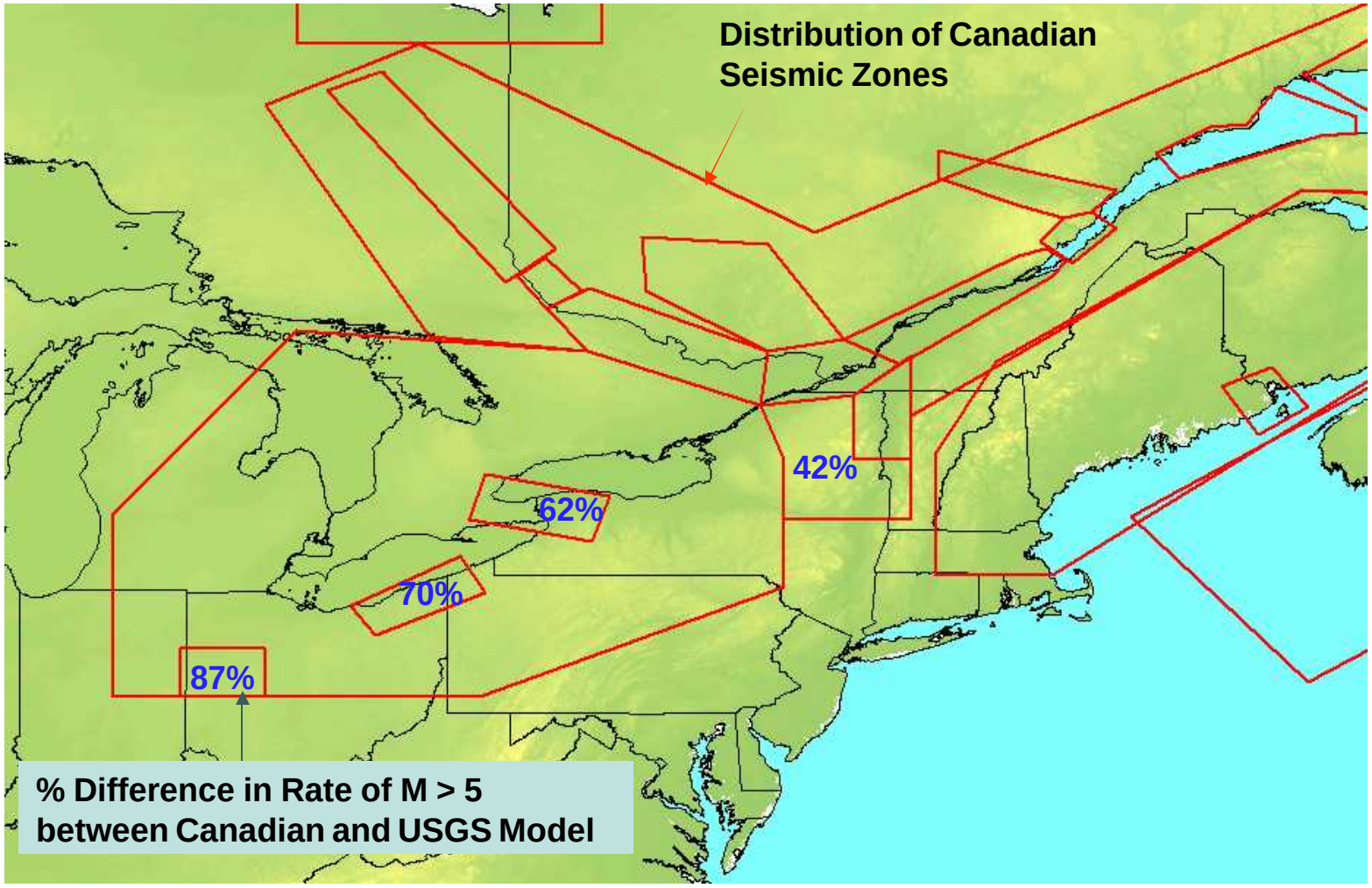
Spatial Distribution

Broad Zone	Woodstock Zone
0.5	0.5





AIR Relies on USGS and Canadian Geological Survey Hazard Reports to Construct Regional Seismicity Models



Ground Motions at Rock Reference Sites are Calculated and are Translated into Soil Site Ground Motions

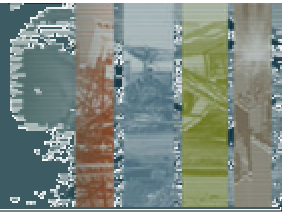
Amplification:

$$\sqrt{(\rho_1 * c_1)/(\rho_2 * c_2)} \quad ?$$

NEHRP Procedure ?

- Providing regional frequency and amplitude dependent site amplification maps compatible with regional attenuation equations can improve ground motion calculations

Ground Motion Correlation is Used to Quantify Loss Uncertainty



Ground Motion Correlation is Formulated Based on the Values of Inter and Intra Variability

$$\ln(Y) = \overline{\ln(Y)} + \varepsilon_{inter} + \varepsilon_{intra}$$

$$\rho_{GM} = \frac{\sigma^2_{inter}}{\sigma^2_{inter} + \sigma^2_{intra}}$$

Assessing Catastrophe Risk: Questions we are Often Asked

- **The users of catastrophic models often are quite interested in understanding the physical causes of regional and local hazard/risk and reasons for model changes**
- **A very detailed technical report will be very useful for understanding the USGS logic and thought process in constructing national hazard maps**