Cat Modelling Update from AIR

Dr Milan Simic

Managing Director

AIR Worldwide Ltd

Agenda

- Update from AIR on 2010
  - US/Atlantic Hurricane
  - EU Windstorm
  - Japan/NW Pacific Typhoon
- Update from AIR on 2011
  - EU Earthquake
  - EU Flood
  - Big push on Solvency II
- Update on recent cat events
  - Chile 2010
  - New Zealand 2010 and 2011
  - Japan 2011

2010 – US/Atlantic Hurricane

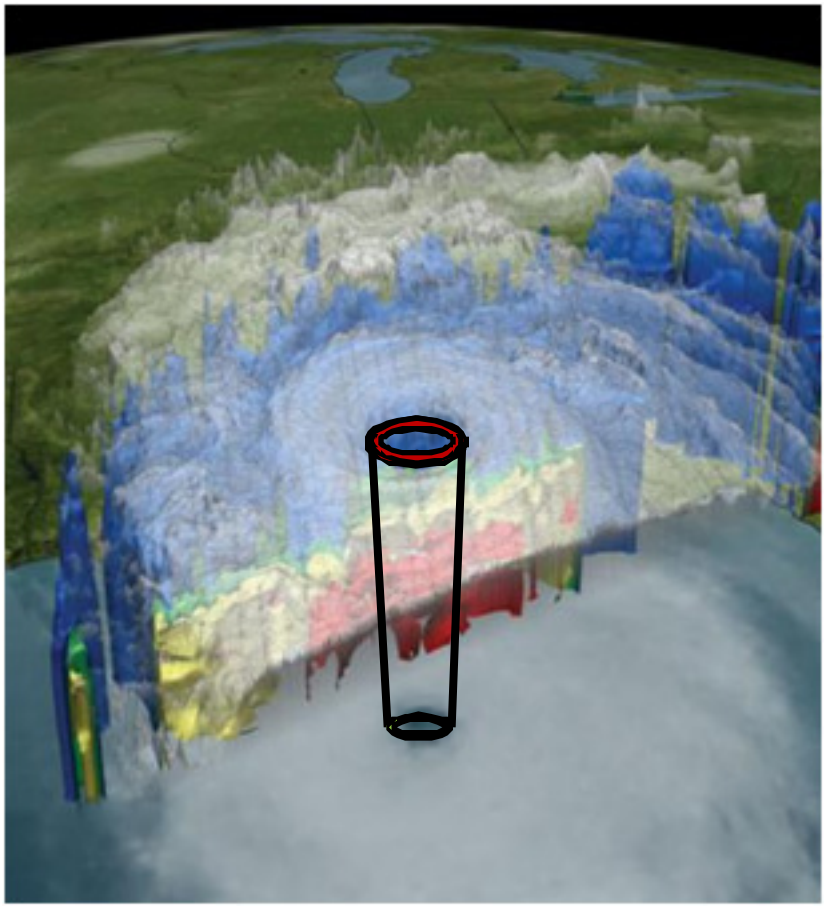
2010 Featured an Updated Basinwide Catalog for All North Atlantic Tropical Cyclone Models

Hurricane Wilma impacted the Caribbean, Mexico and Florida

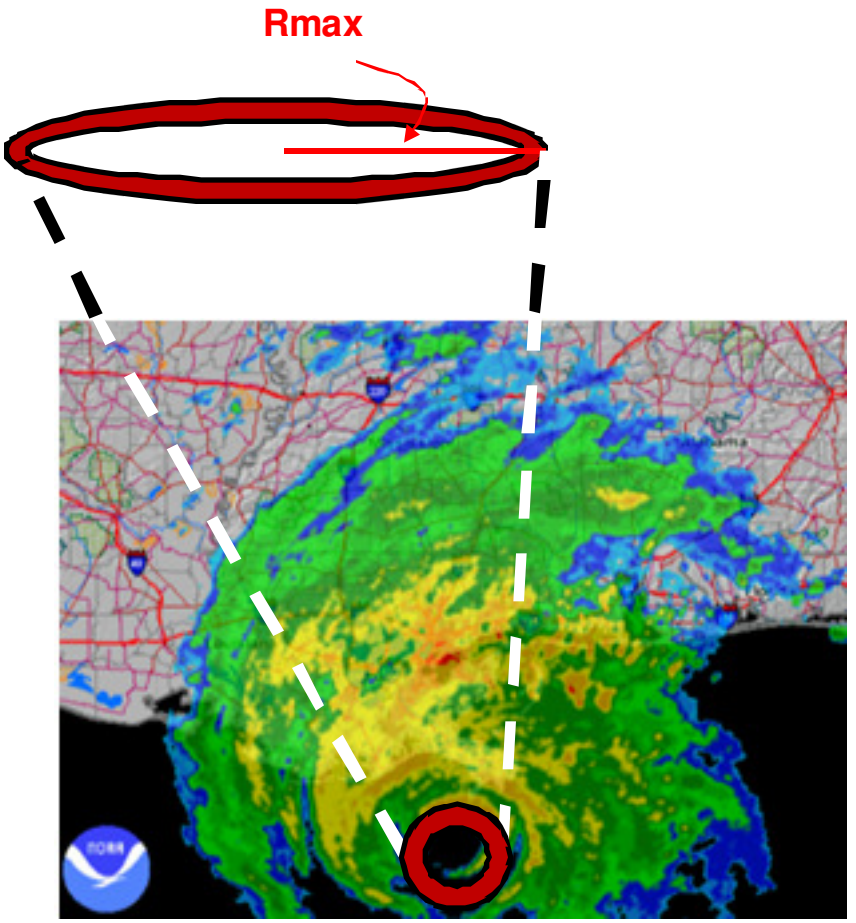
- 30% of storms impact multiple regions
- Consistent Event IDs across Atlantic TC models
  - U.S. Hurricane
  - U.S. Hurricane for Offshore Assets
  - Caribbean TC
  - Mexico TC

Key Takeaway:
Basinwide catalog enables more accurate loss estimates for portfolios spanning multiple countries

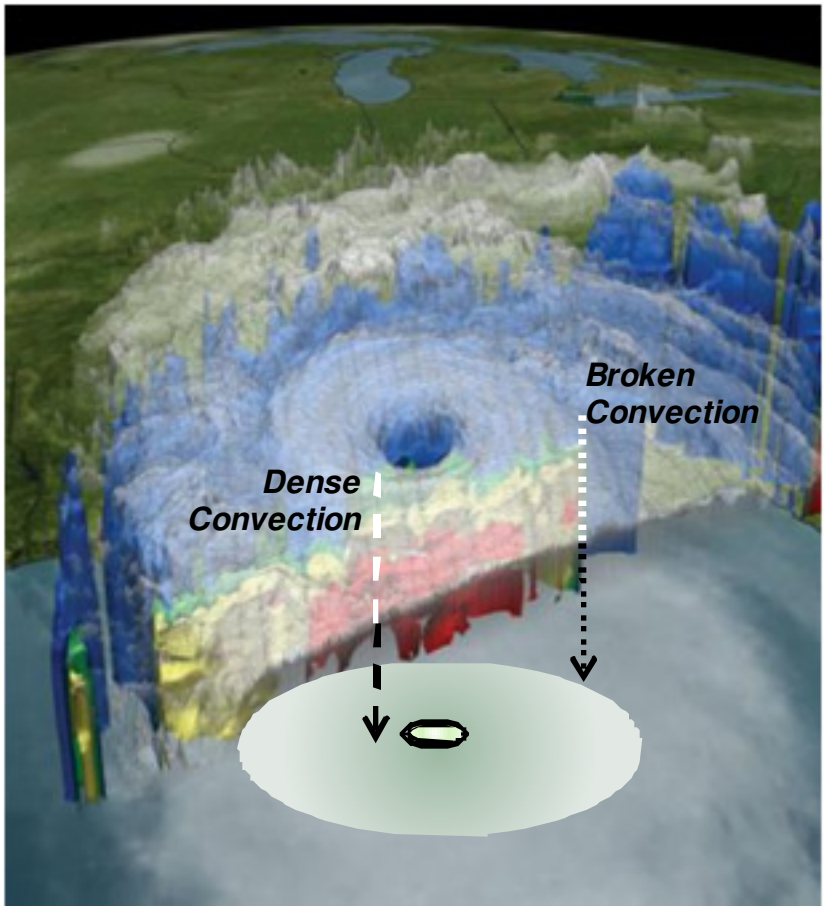
Update to the Rmax Estimation and Addition of Rmax Evolution Based on High Resolution Radar Imagery

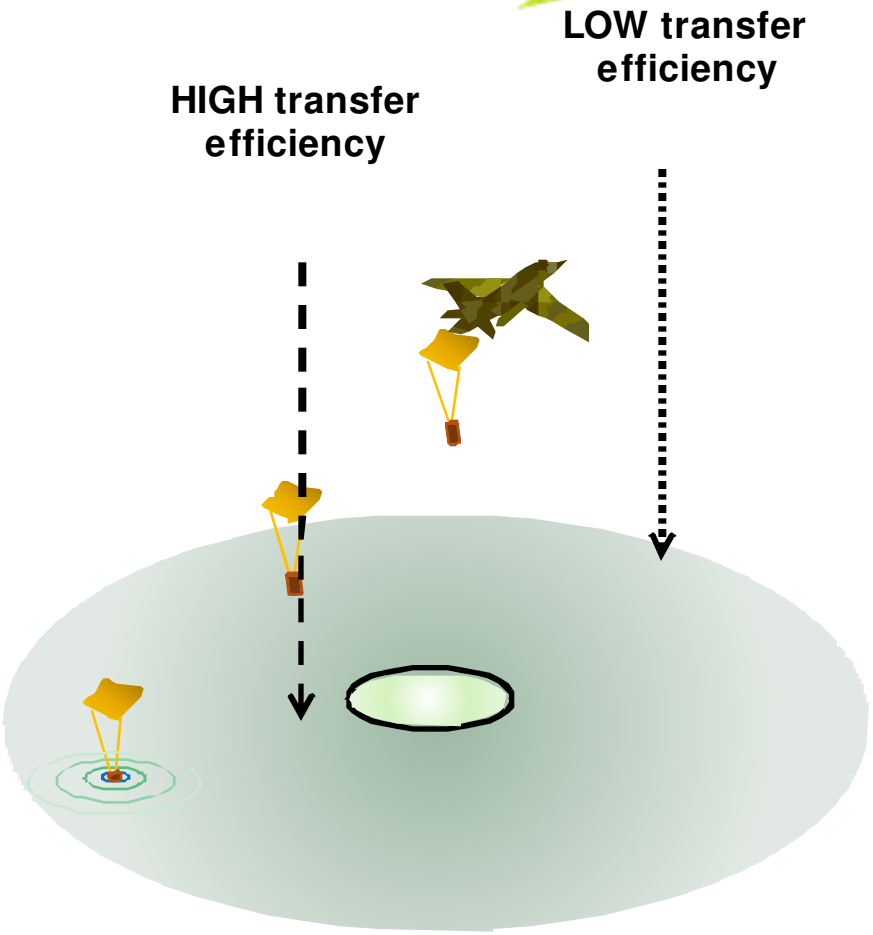


http://www.usgcrp.gov/usgcrp/images/ocp2007/gallery-large/pages/3D-hurricane.htm

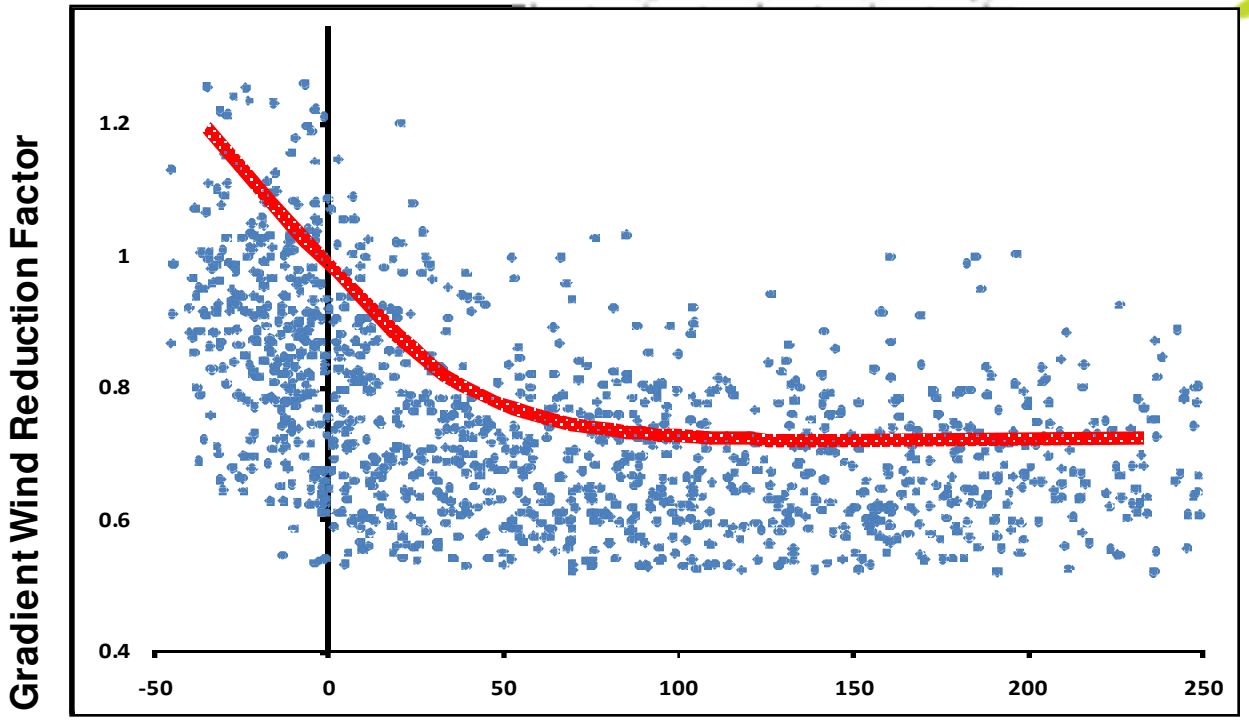


Spatial Variation in the Downward Transfer of Gradient Winds to the Surface Based on Dropsonde Observations



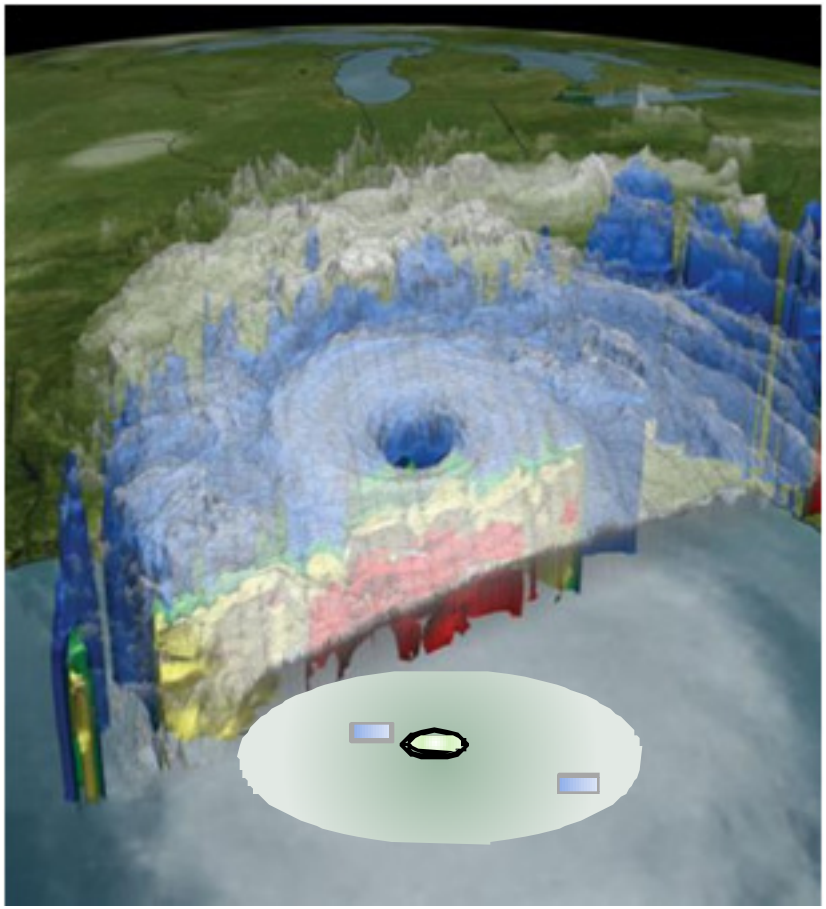


Updated Methodology Using Dropsonde Data Results in Changes in Wind Speed at the Periphery of the Storm

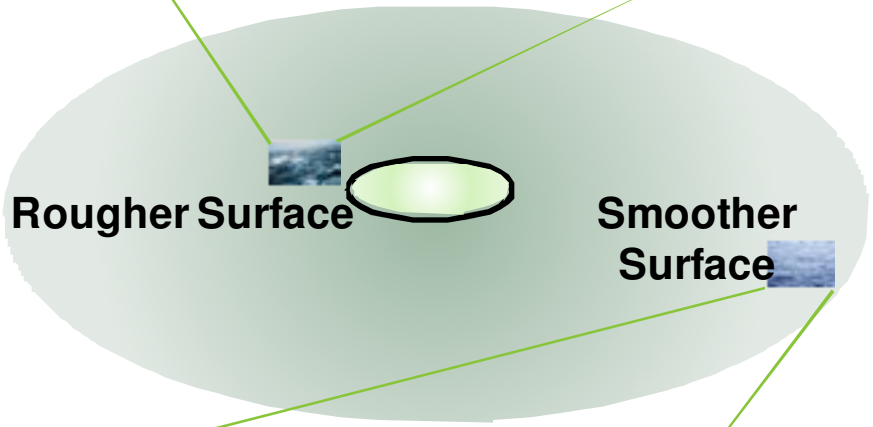


- Recent research by Mark Powell and others documents similar reduction patterns using Stepped Frequency Microwave Radiometers (SFMR)
- The research by Powell provides methodology for quantifying these observations, which are related to the slant of the storm structure

Explicit Modeling of the Influence of Wave Action on Surface Roughness Based on New Data and Research

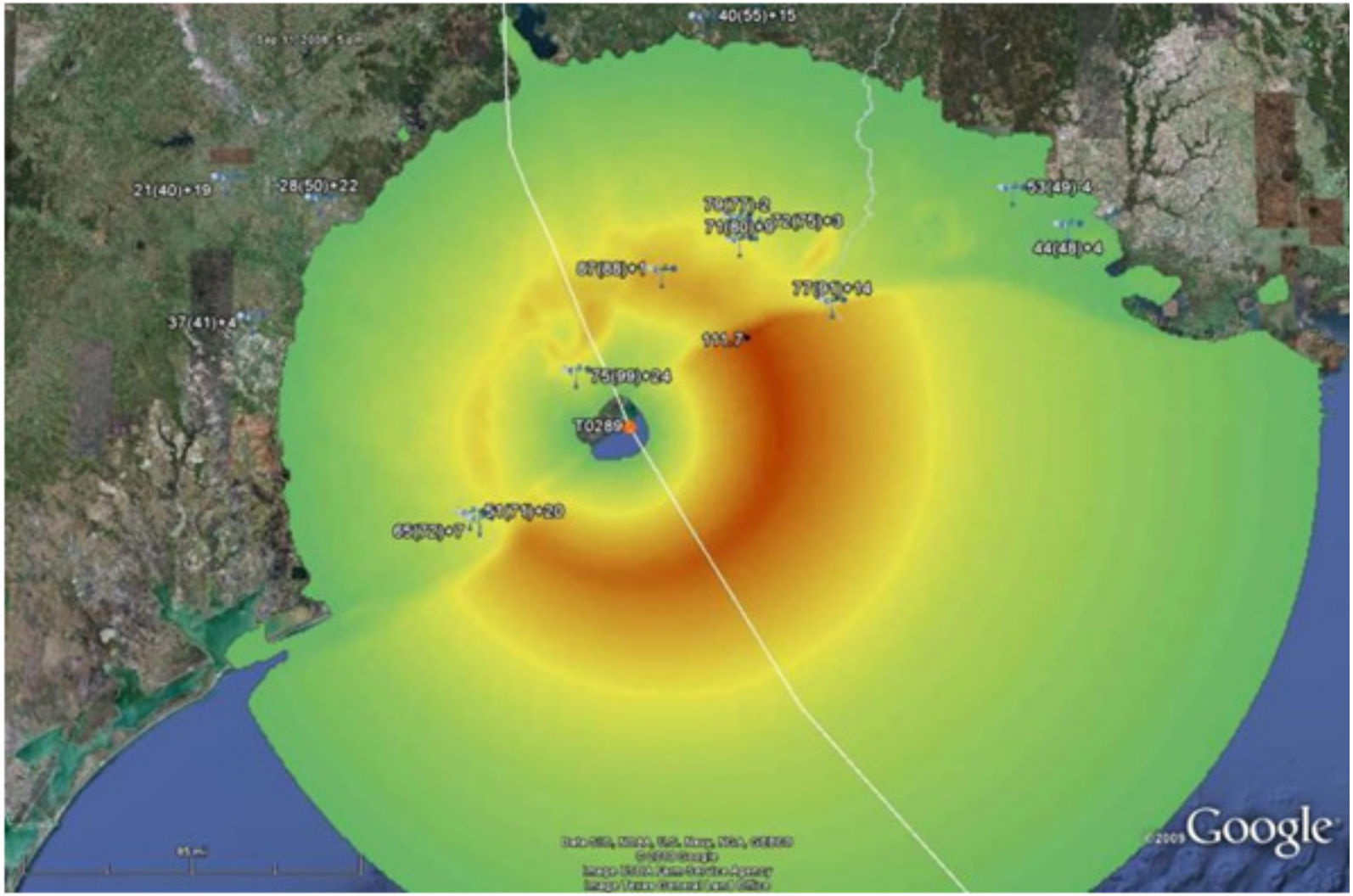


Intense Waves Generated by Higher Wind Stress



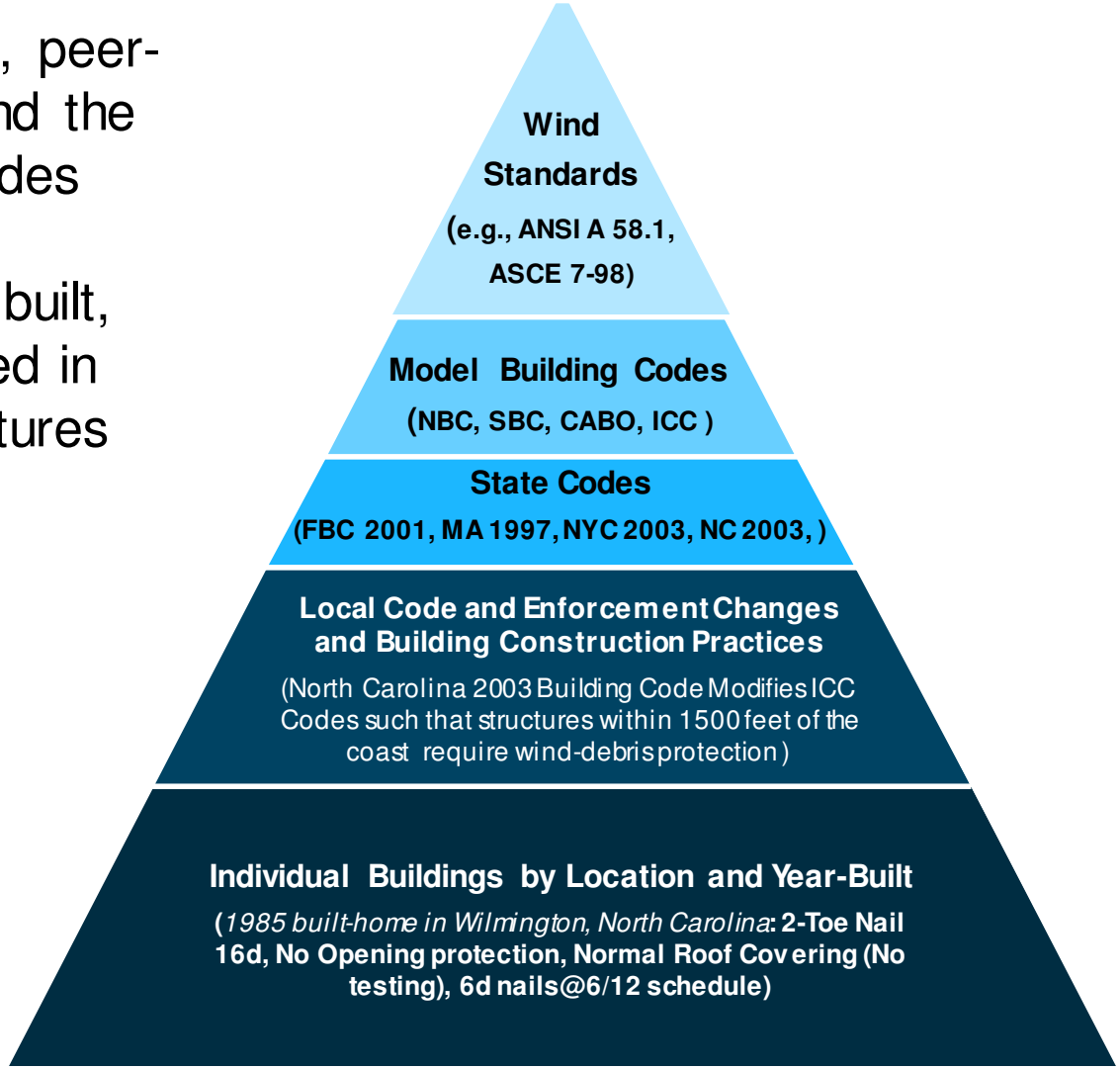
Moderate Waves

An Unprecedented Set of Observation Data Enables More Robust and Detailed Hazard Validation



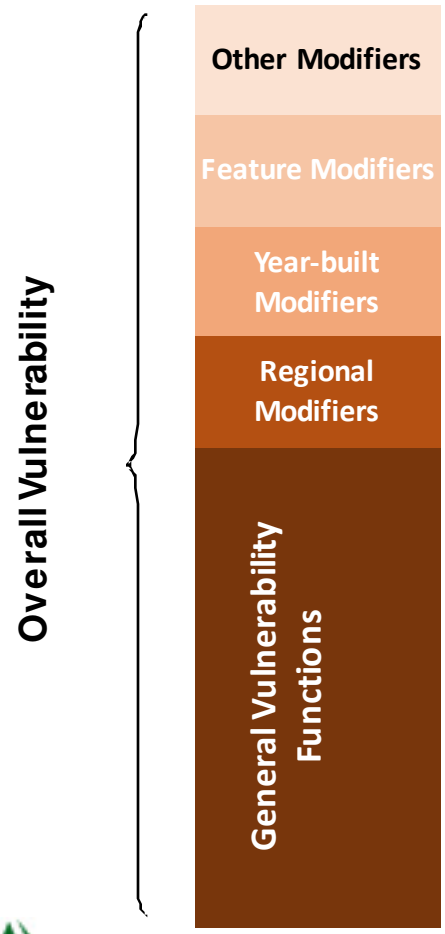
AIR Implemented a Comprehensive Approach to Model Spatial and Temporal Variations in Vulnerability

- AIR undertook an extensive, peer-reviewed study to understand the large number of building codes and standards that exist
- For each location and year-built, *model buildings* were defined in terms of secondary risk features such as roof covering type

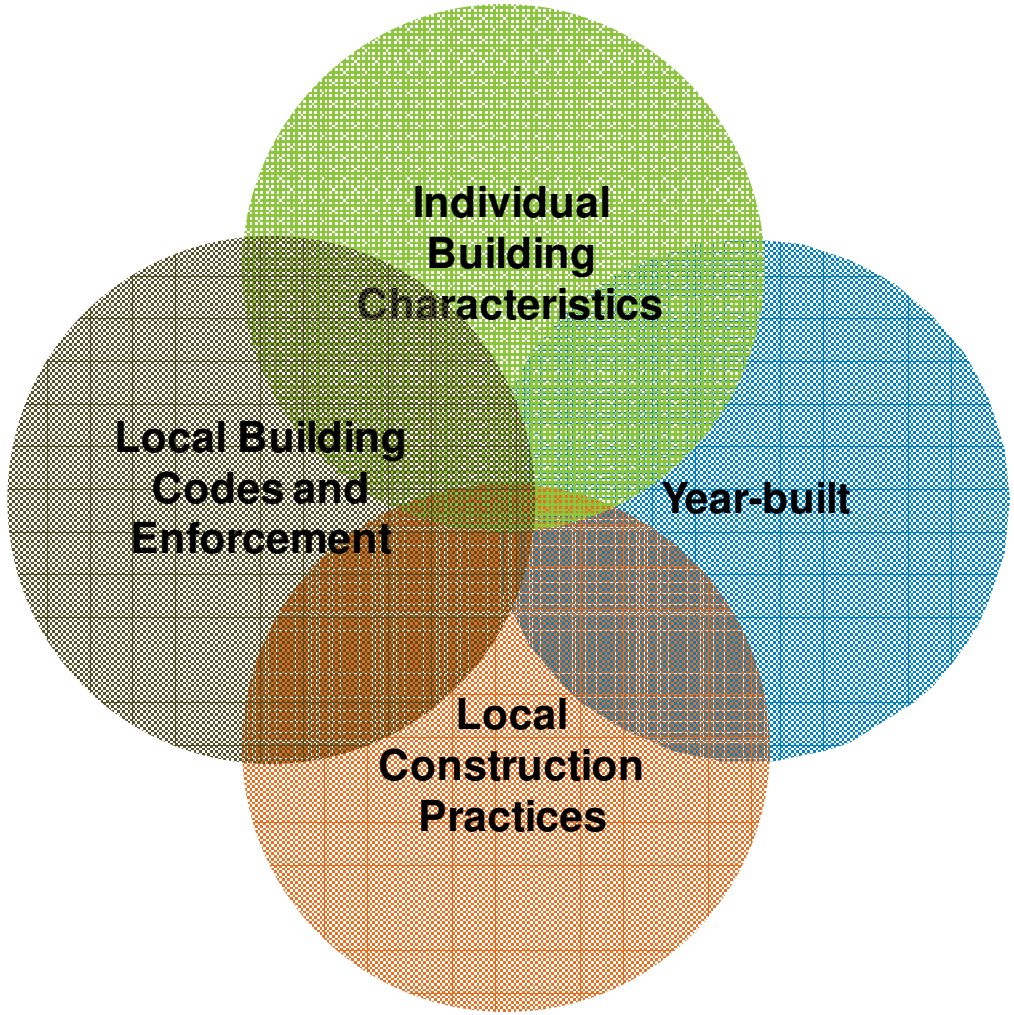


A Coherent Approach to Modeling Vulnerability Better Captures the Impact of Interrelated Building Characteristics

Typical Approach

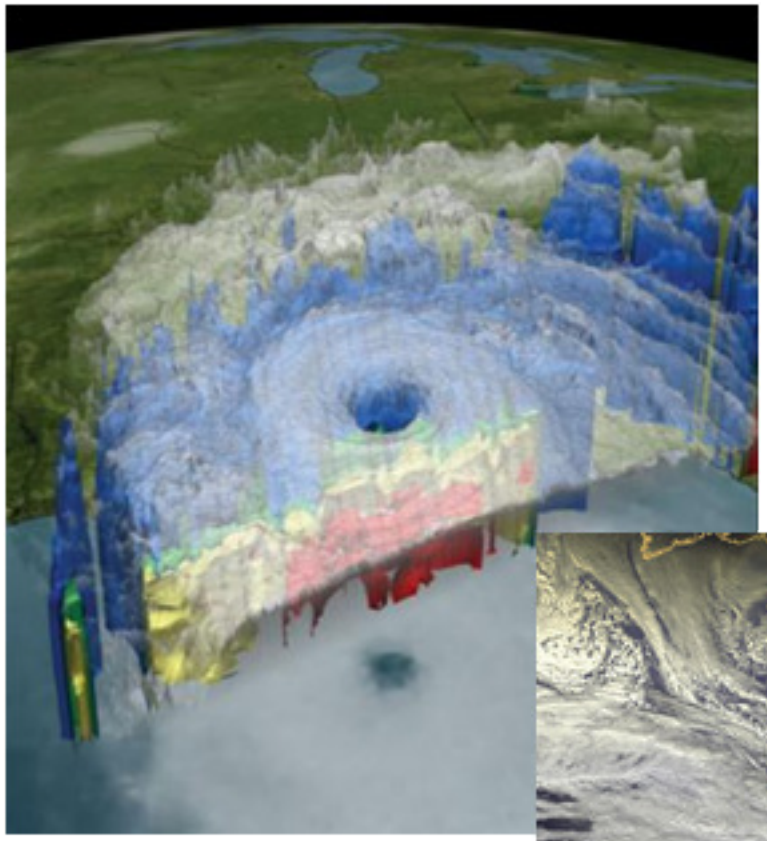


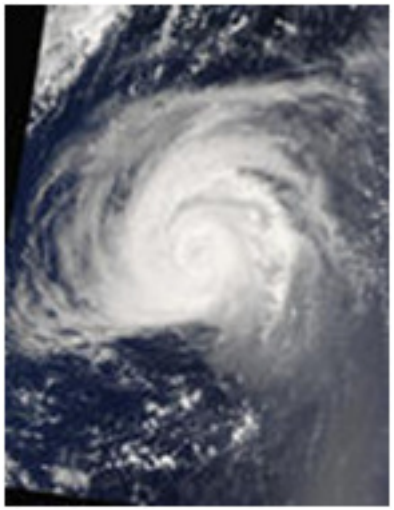
AIR Enhanced Approach

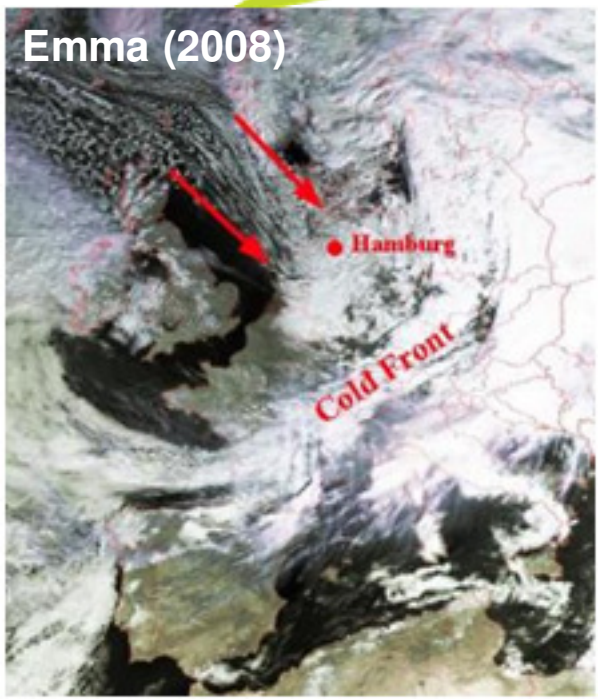


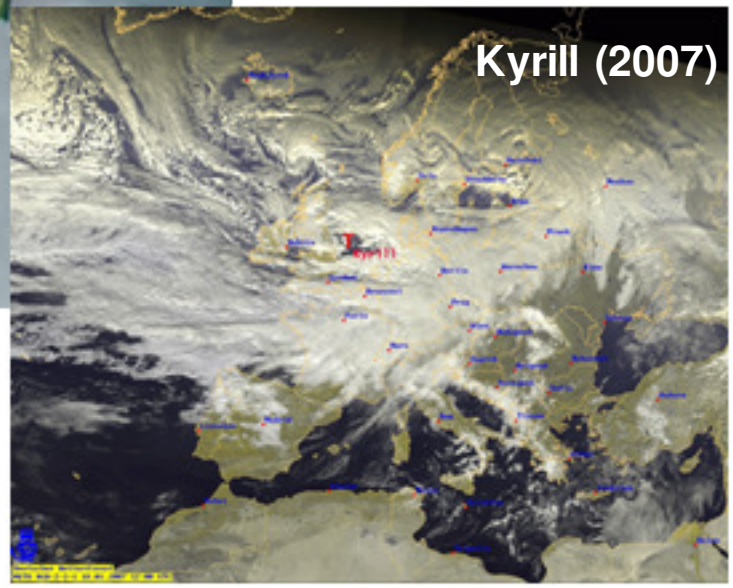
2010 - European Windstorm

Extratropical Cyclones Have Complex Structures









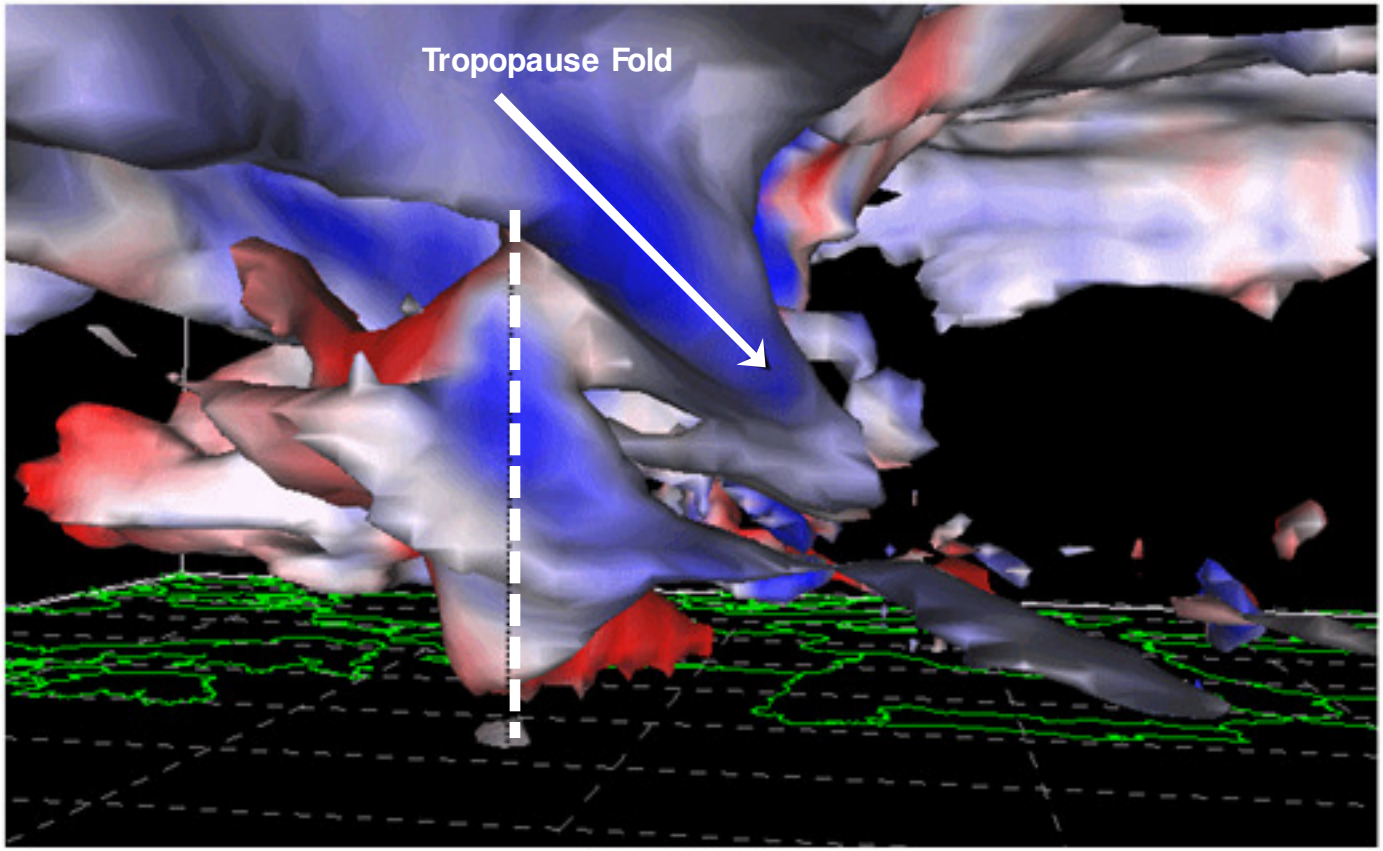
Only Numerical Weather Prediction (NWP) Can Capture Vertical Elements within the Storm That Lead to Enhanced Surface Winds

Vertical Wind Speed

Upward

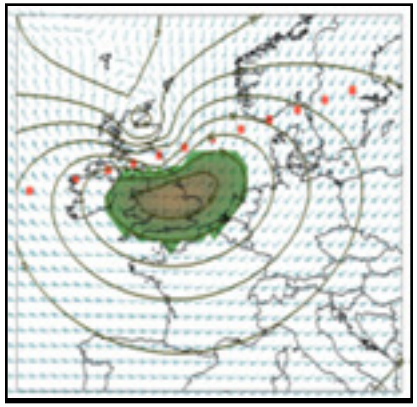
Downward

Klaus – 23 January 2009, 18:00



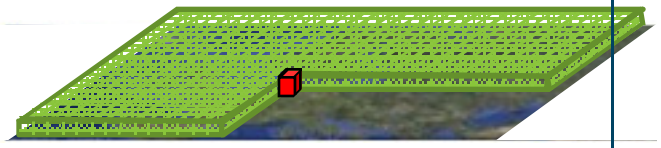
GFS 18Z 23 Jan 2009 (www.ukweatherworld.co.uk)

AIR's ETC Model Uses the Most Advanced Application of NWP Built on 16 Years of Research and Development



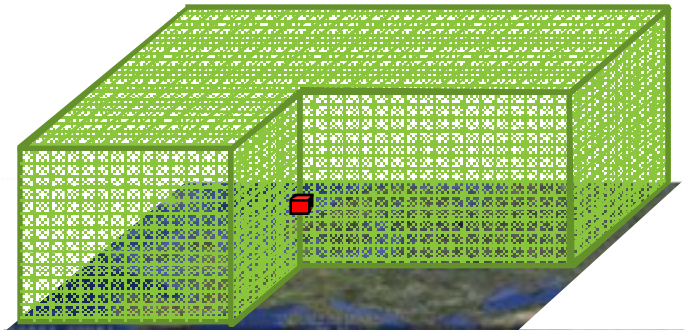
FIRST EUROPEAN WIND MODEL
PARAMETRIC APPROACH

1994



NWP-BASED EUROPEAN WIND MODEL
1st GENERATION
Boundary Layer Model

2000



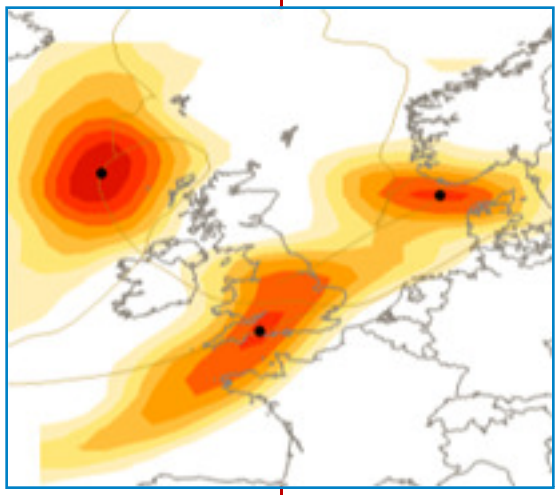
NWP-BASED EUROPEAN WIND MODEL
2nd GENERATION
Full 3D Mesoscale Model

2003

NWP-BASED EUROPEAN WIND MODEL
3rd GENERATION
Increased Resolution

2006

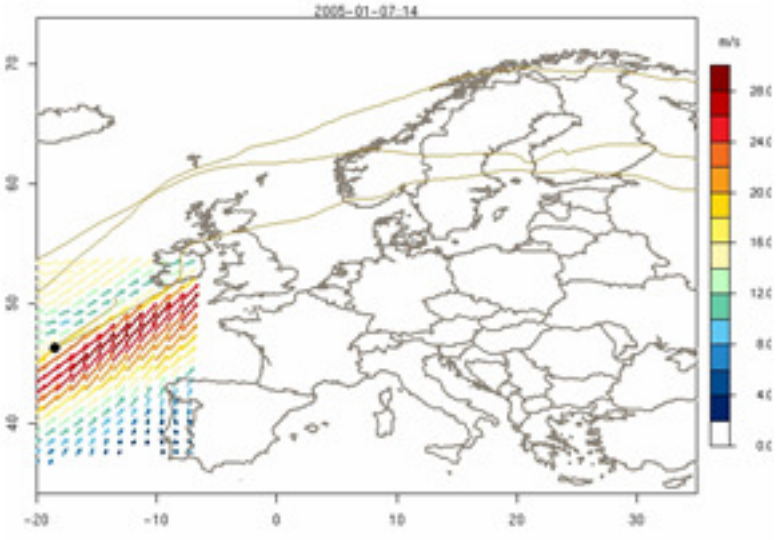
NWP-BASED EUROPEAN WIND MODEL
4th GENERATION
Explicit Temporal and Spatial Clustering
Advanced Downscaling

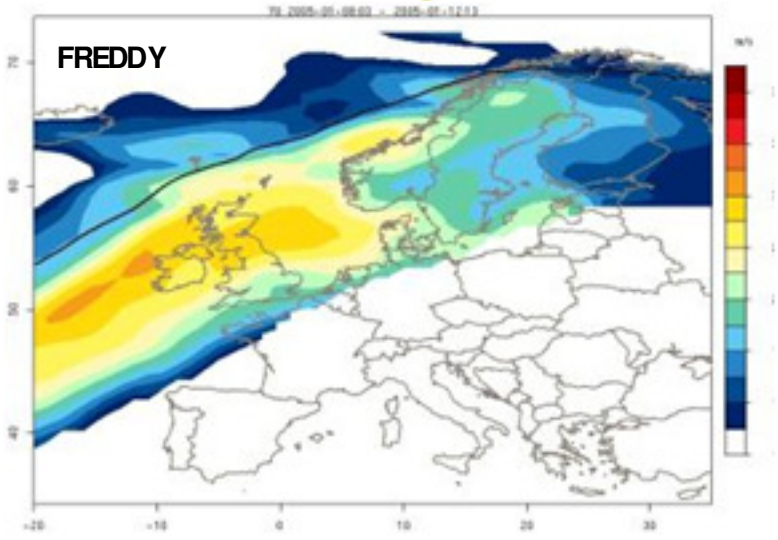


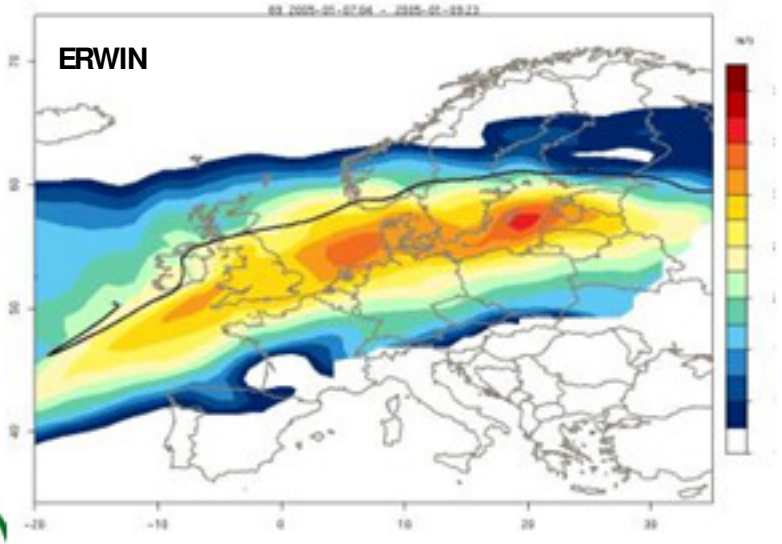
Update

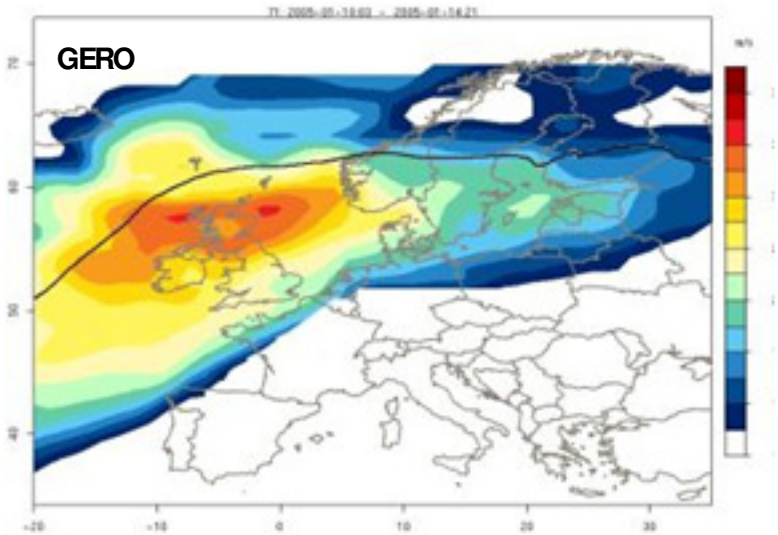
MODEL DEVELOPMENT TIMELINE

Stochastic Storm Generation Begins with Evolution of 1500 Historical Storms in Space and Time

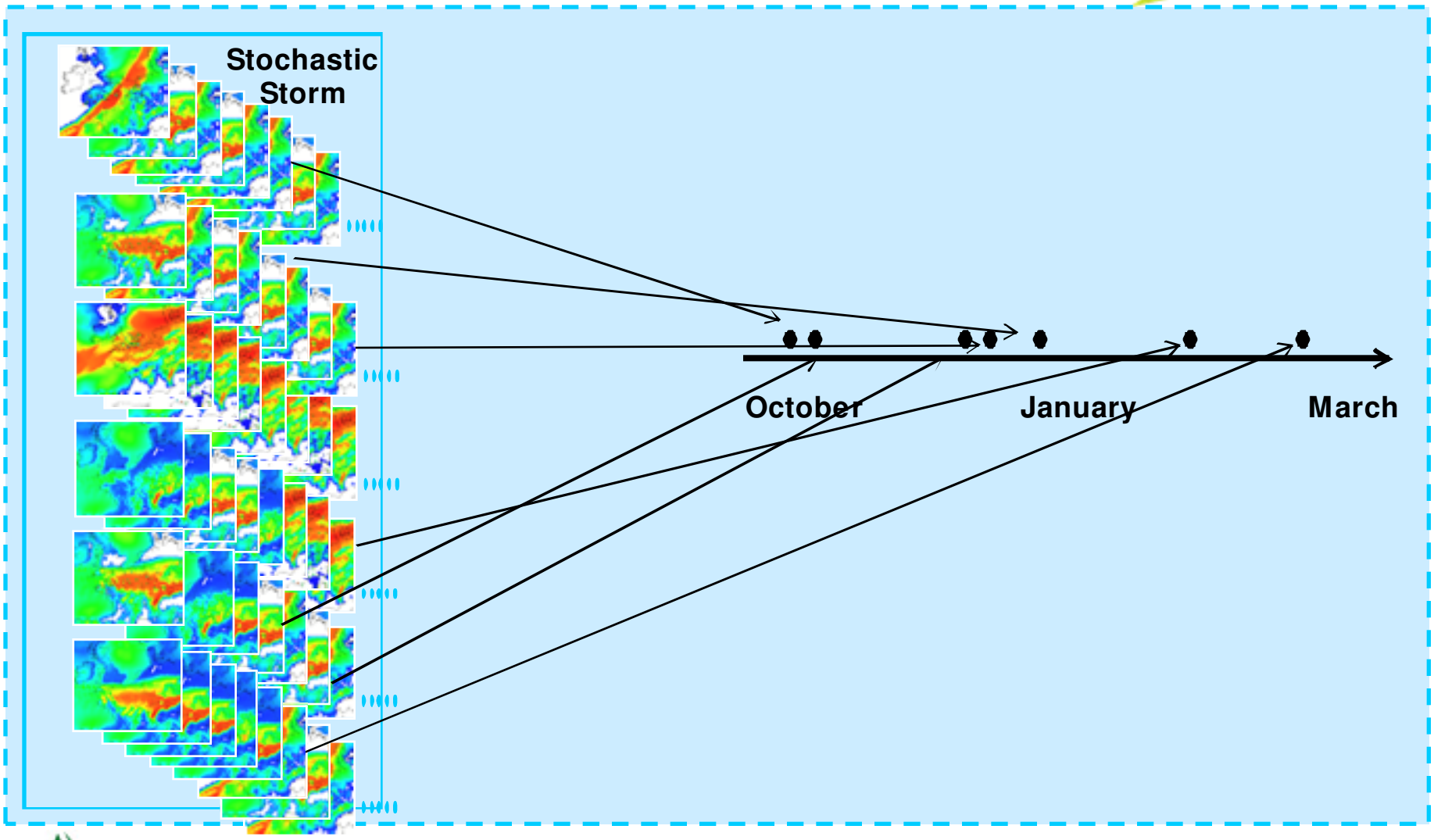




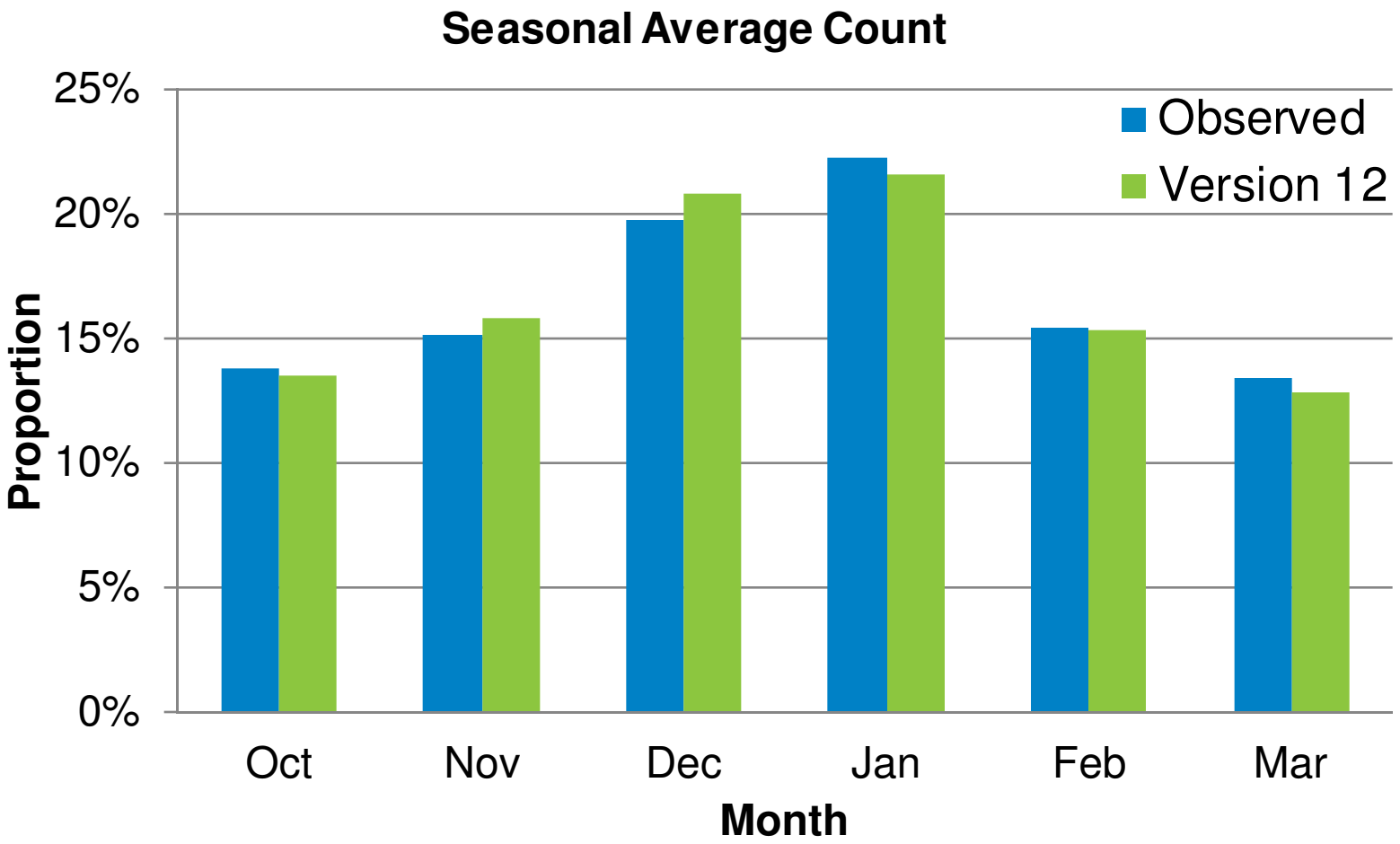




…and Helps Create a Better Catalogue by Assigning Storm Order



…while Also Capturing a Realistic Distribution of Storms Occurring Each Month

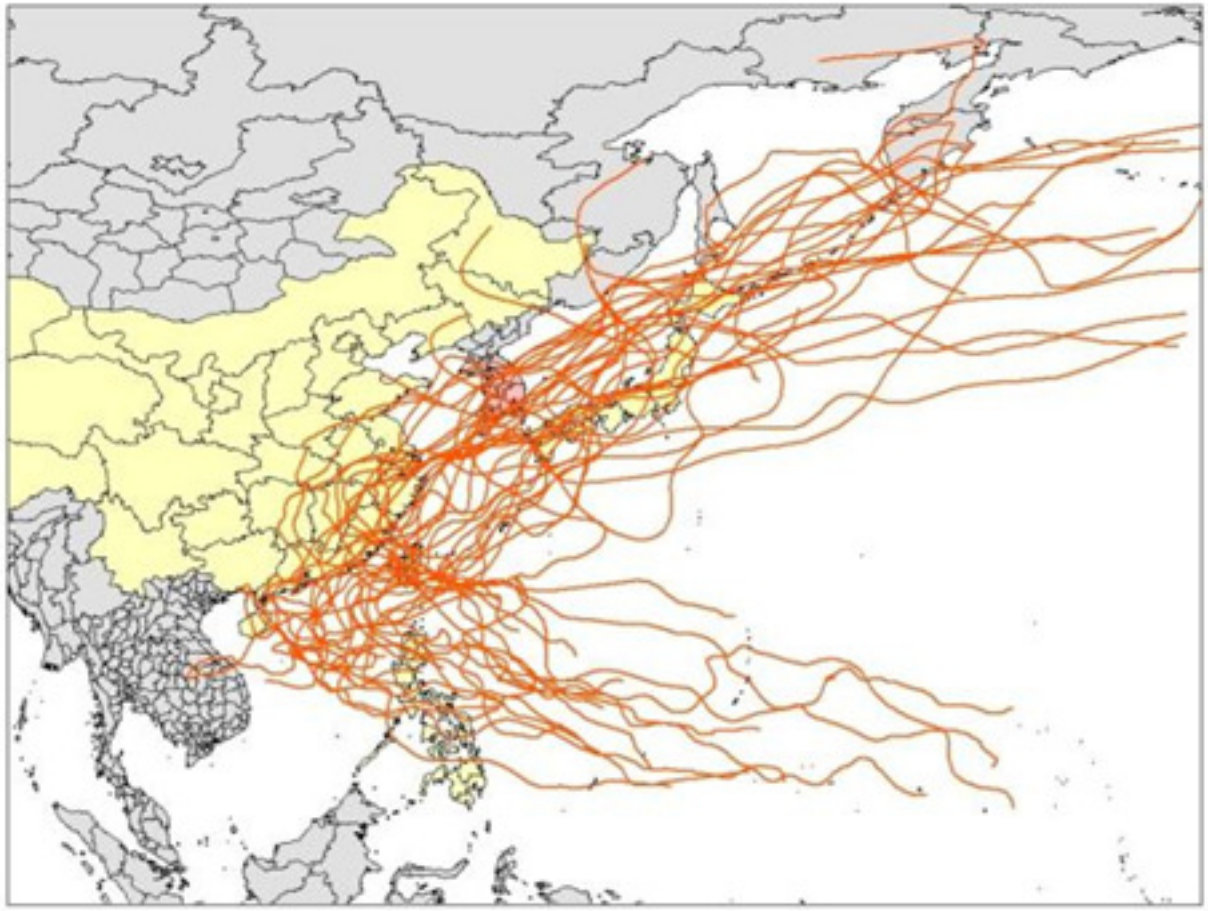


2010 - Japan/NW Pacific Typhoon

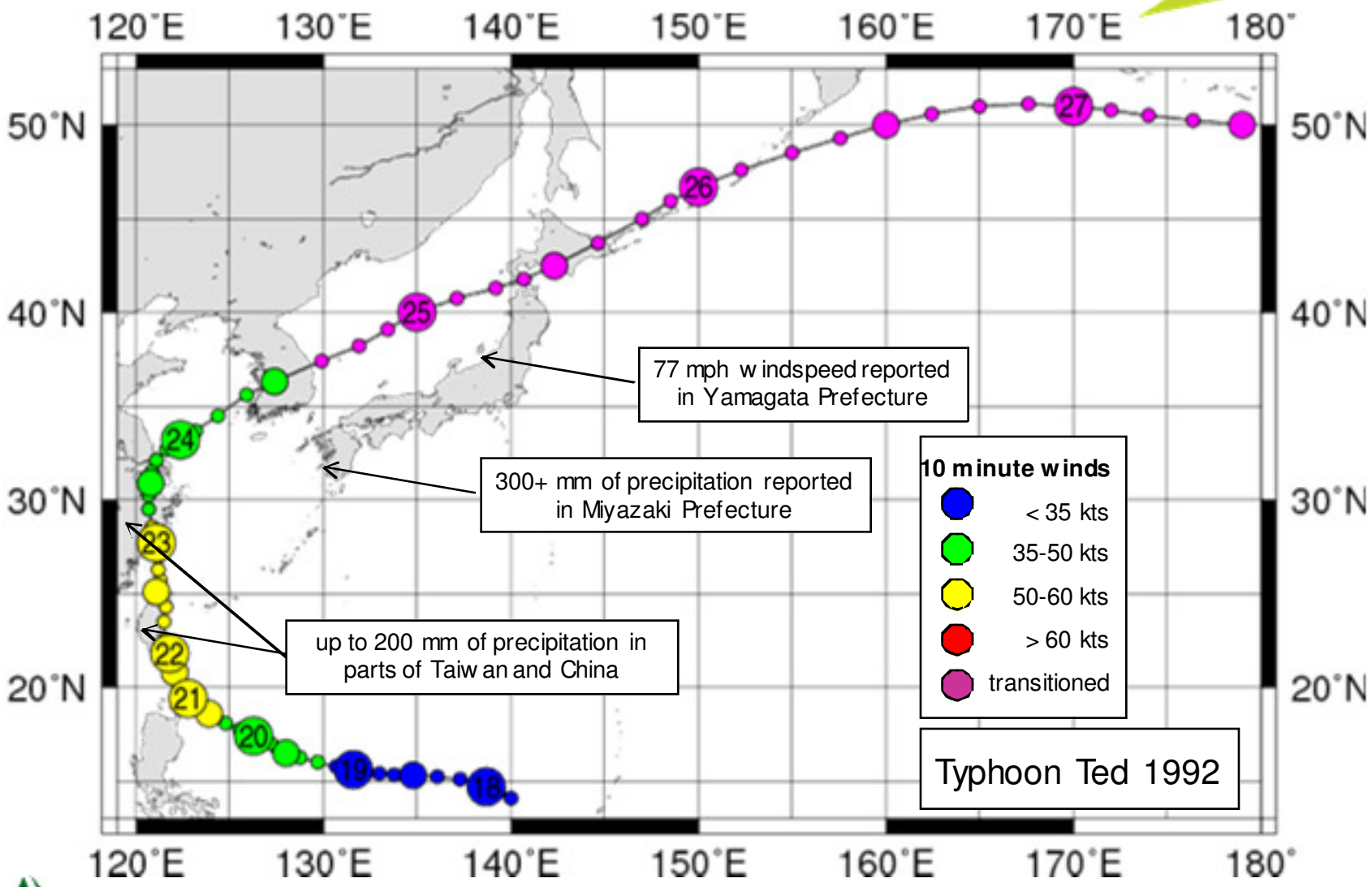
AIR

2010 Saw the Implementation of a Basinwide Northwest Pacific Typhoon Catalogue

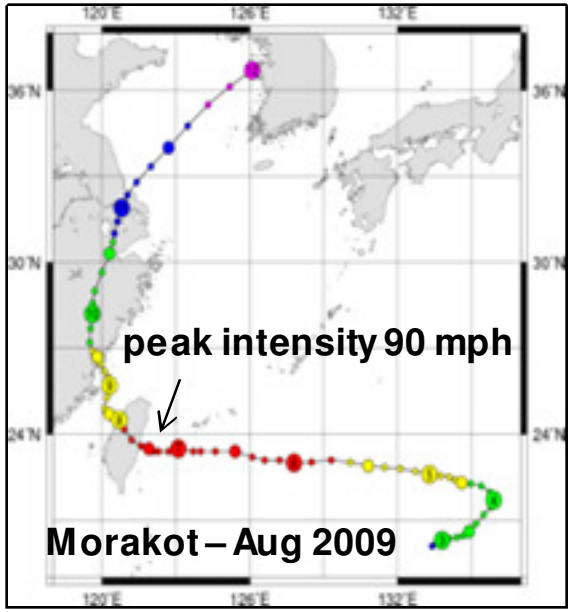
- Basinwide stochastic catalogue for modelling risk in entire region



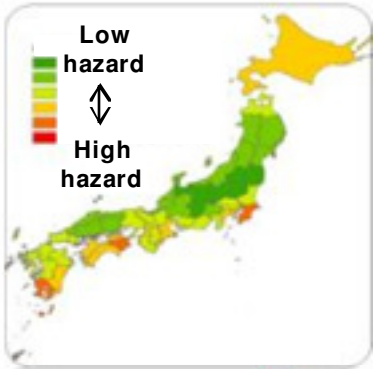
Motivation for the Creation of a Basinwide Catalogue



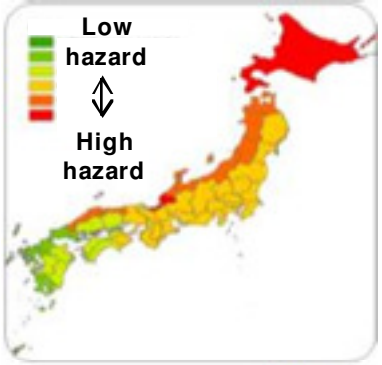
Morakot (2009) Is a Recent Example of a Typhoon Impacting Taiwan and China – Flooding Was Significant in Both Countries



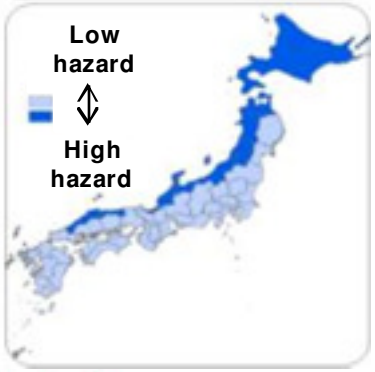
Regional Variability in Wind Vulnerability for Non-Engineered Buildings Incorporates Multi-Hazard Characteristics



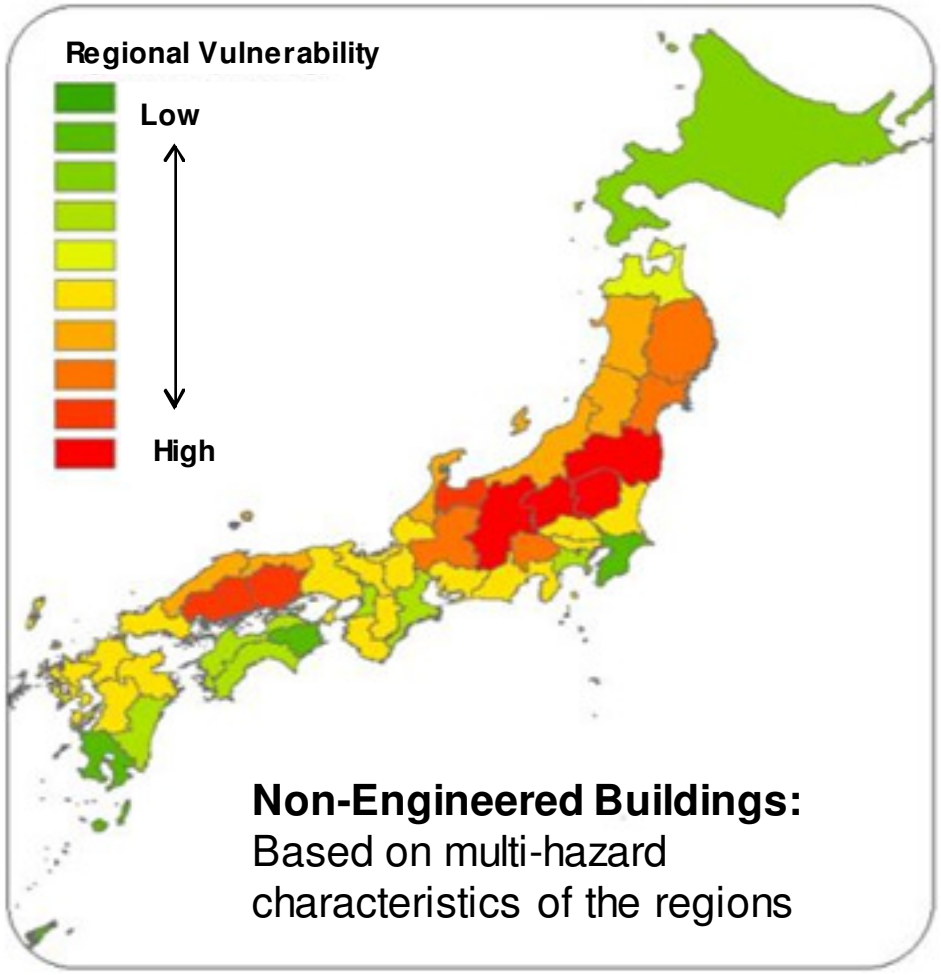
Regions defined based on basic design code wind speeds



Regions defined based on design codes for spectral acceleration



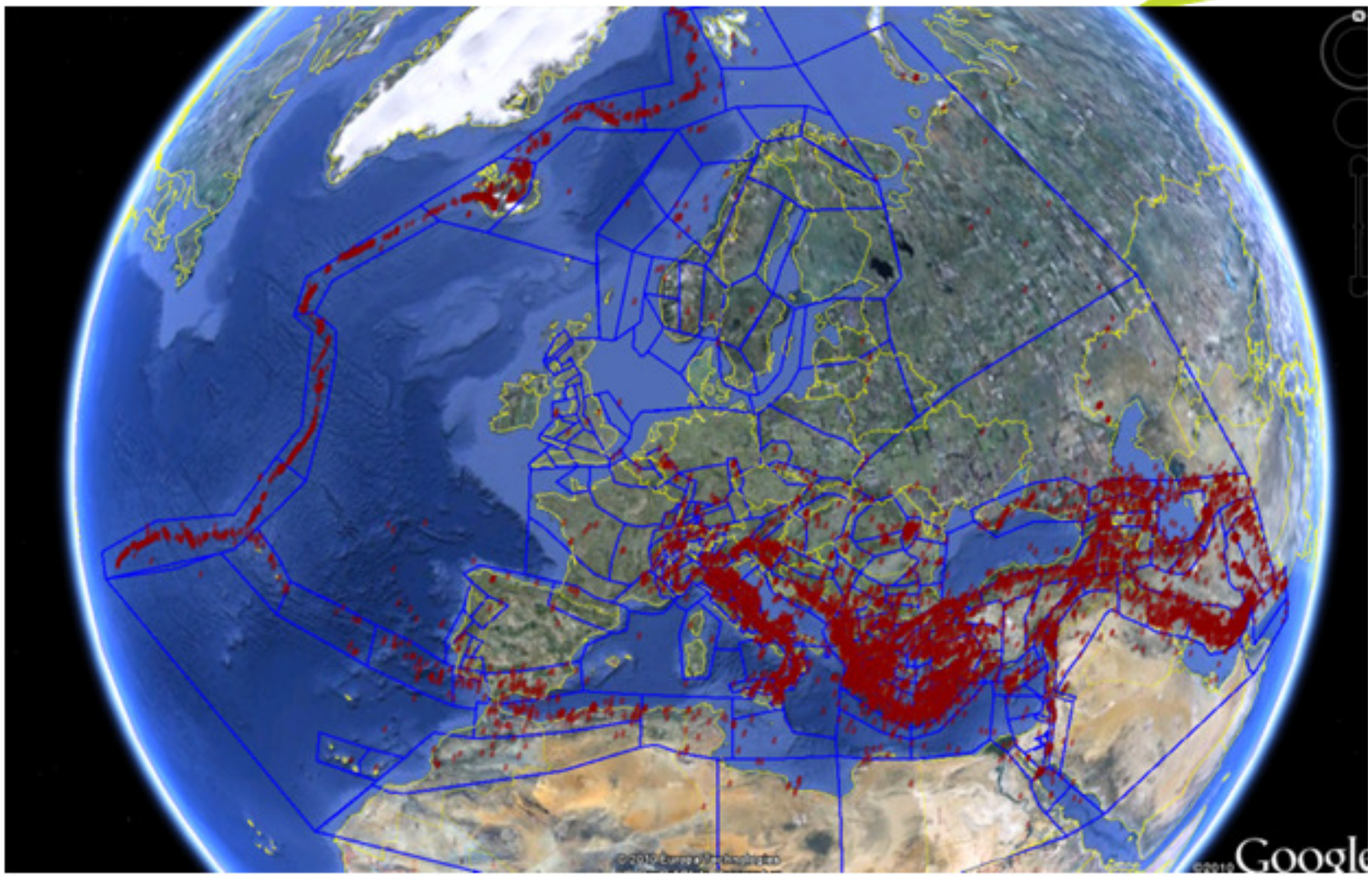
Regions defined based on snow depth



2011 – European Earthquake

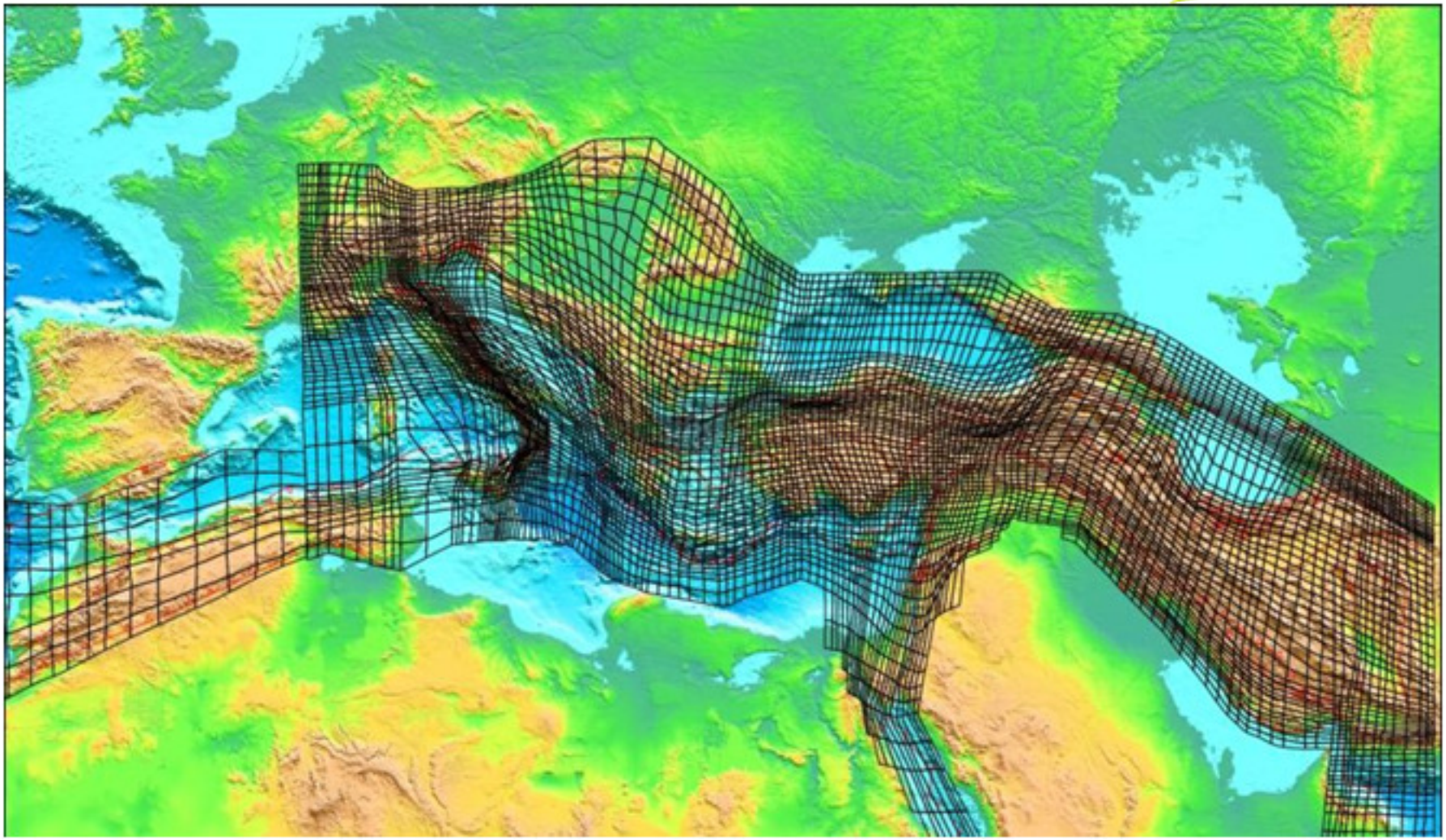
AIR

AIR Is Significantly Expanding the Domain of the Earthquake Model for Europe

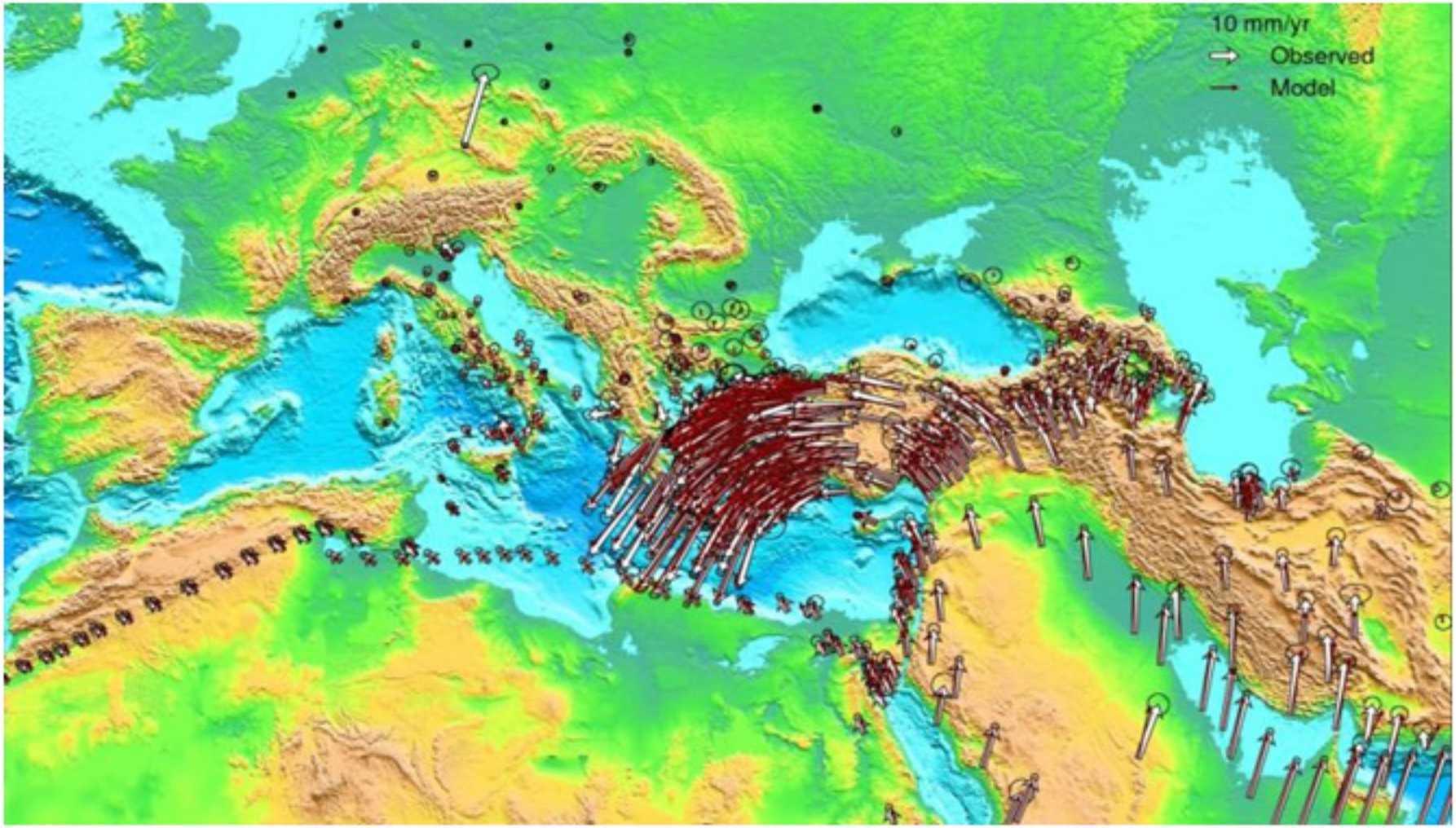


Seismicity of Europe is Shaped by Complex Interaction between Various Seismotectonic Features

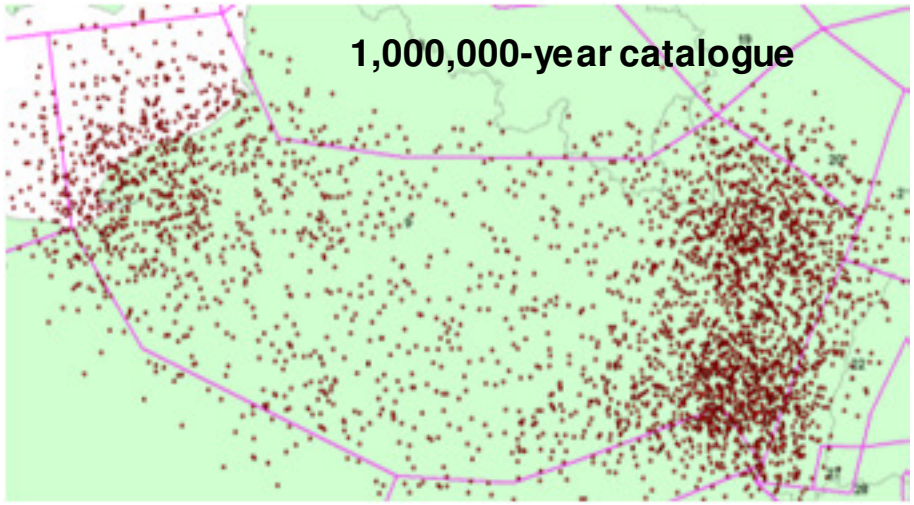
A Regional Kinematic Model Using GPS, Plate Motion Velocity, and Fault Slip Rate Calculates Strain and Seismic Moment Rates

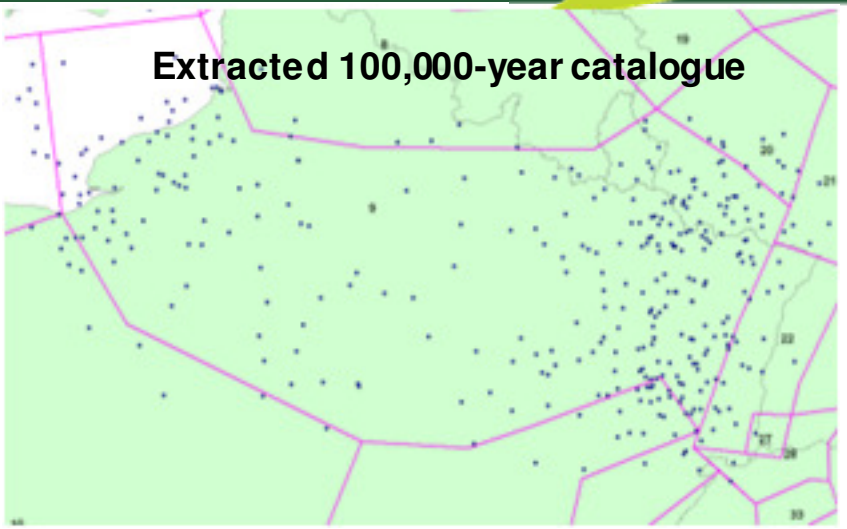


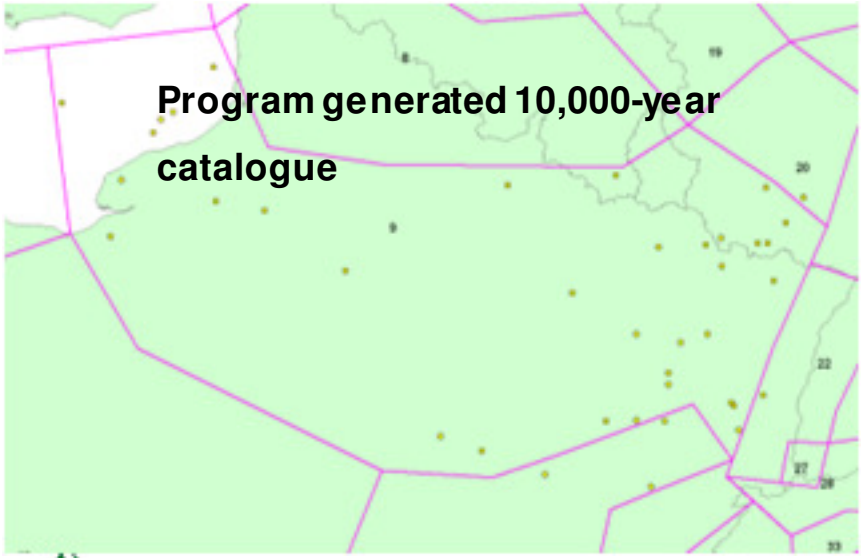
AIR's Pan European Earthquake Model Realistically Captures Observed GPS Velocities



AIR's Pan European Earthquake Catalogue is Optimised for Low Seismicity Regions



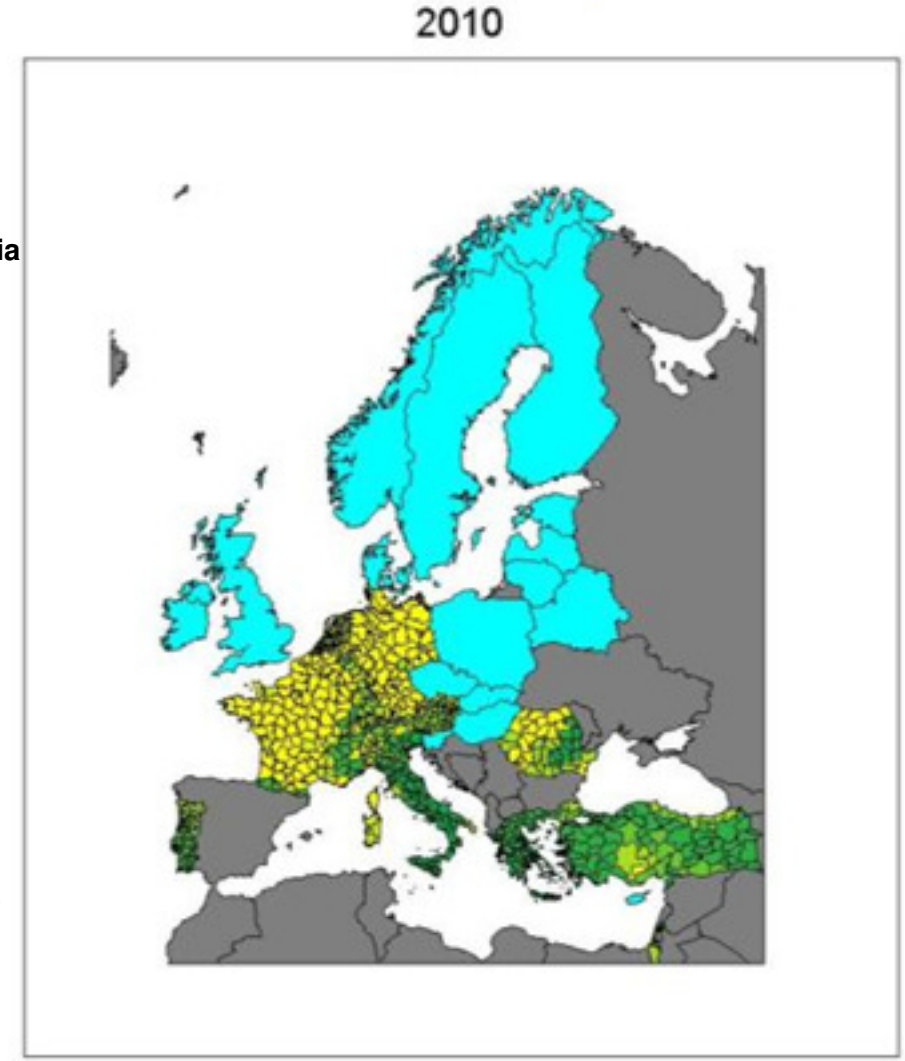




Catalogue optimization procedure can obtain a better spatial distribution of events and preserve magnitude-frequency and hazard distribution.

Temporal and Spatial Variation of Vulnerability across the Pan-European Region in the AIR Earthquake Model

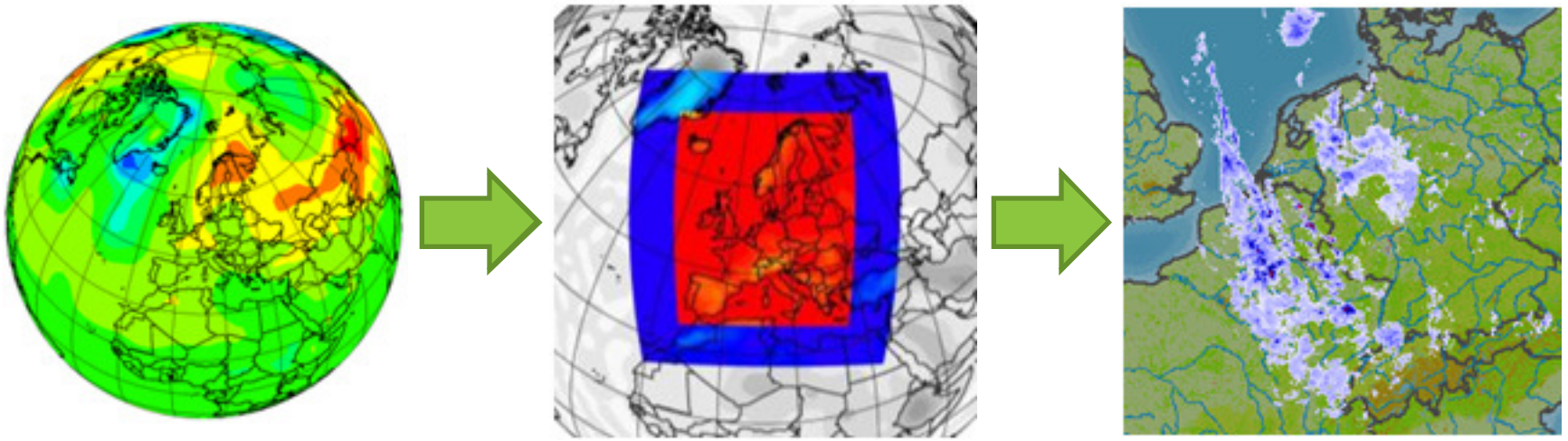
- 1950: Most countries did not abide by any code. Codes existed in Turkey, Italy, and Romania only
- 1955: Efforts to develop first version of codes in Austria, Bulgaria, France, Israel, and Portugal started
- 1960: First version of code released for Germany, Greece, and Portugal
- 1965: Seismic codes for Austria, Israel, France, and Slovenia released. Codes for Turkey, Bulgaria, and Romania revised
- 1970: Code revised for Romania. Preliminary seismic regulation released for Switzerland
- 1975: Code updated for Italy, Israel, and Turkey. Code released for Slovakia and Czech Republic. Cyprus adopts Turkish code.
- 1980: First code for Hungary released. Code for Austria revised. Romanian code revised after 1977 Vrancea Earthquake
- 1985: Code update for Greece, Portugal, France, Germany, and Slovenia
- 1990: Code updated for Italy and Bulgaria. First versions of code released for Switzerland and Cyprus
- 1995: Major code update for France, Greece, and Romania
- 2000: Update to Austria, Czech Rep., Slovakia, and Israel. Turkey adopt provisions similar to Eurocode 8
- 2005: Italy, Germany, and Greece adopt provision similar to Eurocode 8. Code update for Hungary and Switzerland
- 2010: Romania and Slovenia adopt provisions similar to Eurocode 8



2011 – European Flood

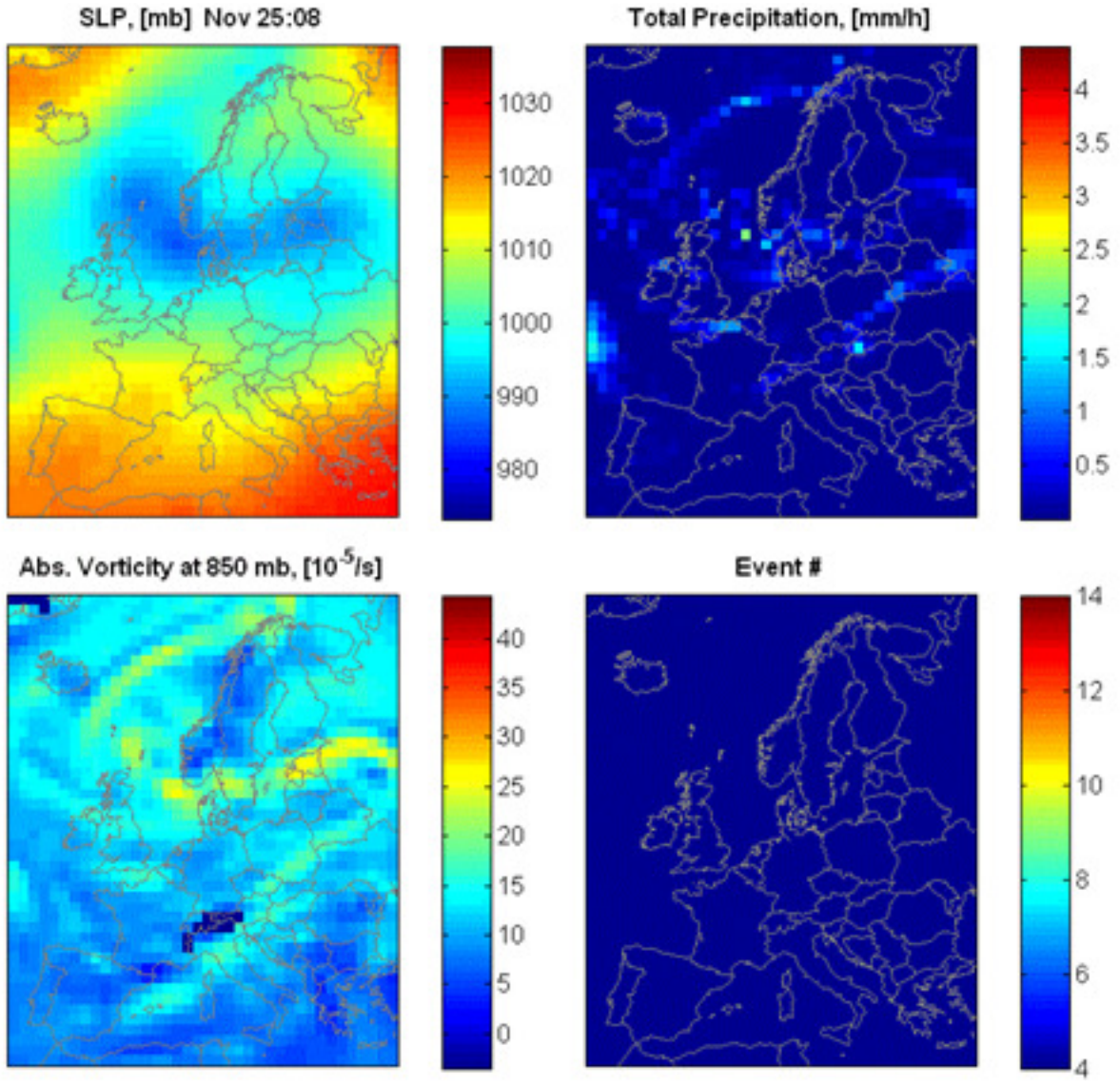
AIR's Innovative Solution Overcomes the Inherent Challenges of Using a Global Climate Model (GCM)

- Couple GCM at global scale with a NWP model at regional scale to provide coherent large-scale patterns
- Employ sophisticated downscaling techniques to realistically simulate small scale features
- Utilise "quantile mapping" to preserve local rainfall statistics



AIR Developed a Novel Approach to Separate Storms within Continuous NWP-based Simulations

- Based on space-time analysis of sea level pressure and vorticity
- Provides a unique storm system ID for each spatial and temporal location



2011 – Big Push on Solvency II

AIR Interacts with Regulatory Bodies in Europe

- Creation of AIR website Solvency II host page
- Formation of client steering group
- AIR contributed to the QIS5 effort
- Interaction with FSA, BaFin and other European Regulatory Bodies
- AIR Solvency II Reference Guide is designed to allow clients to quickly navigate to pertinent data

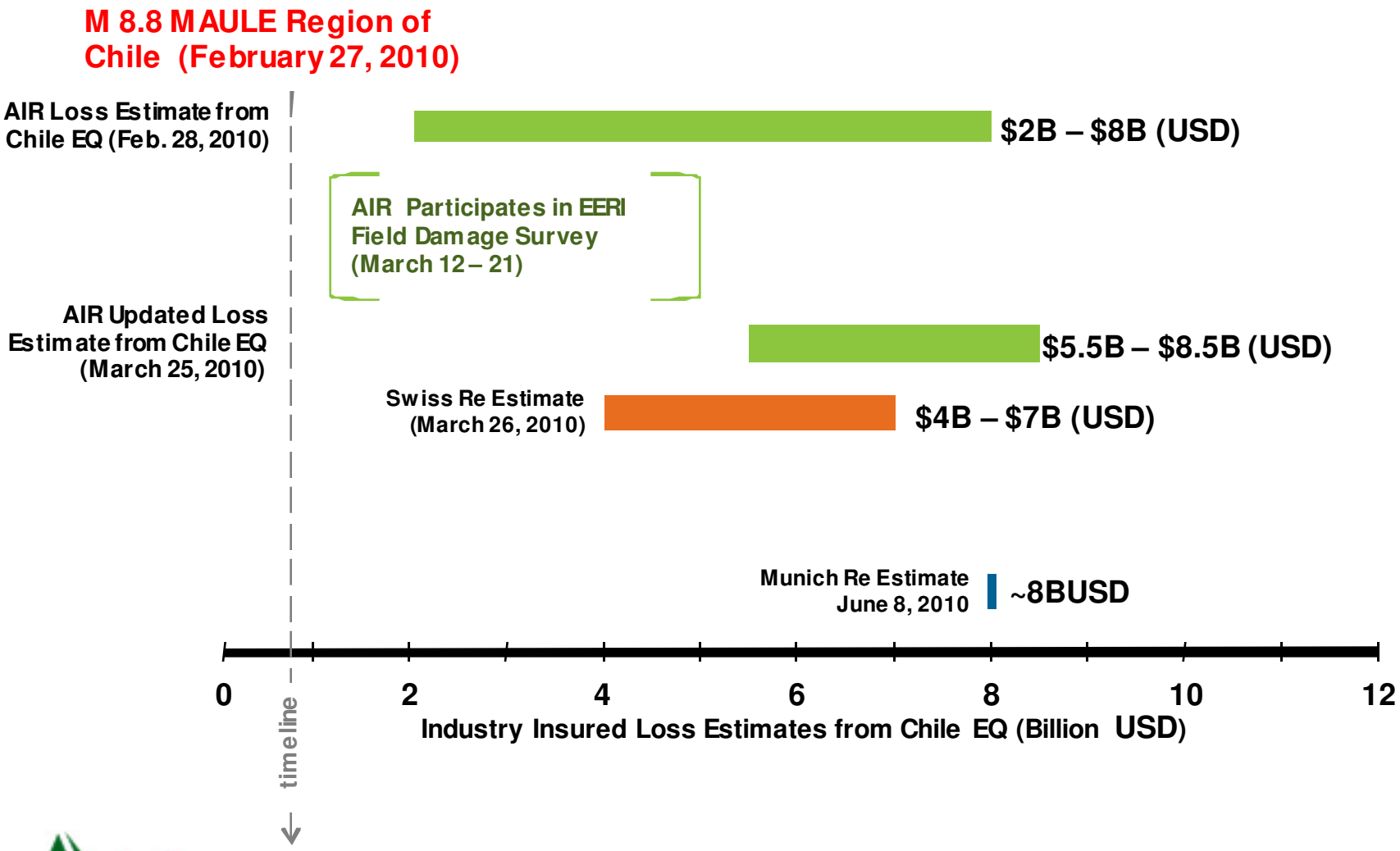
Update on Recent Cat Events

ALERT™ (AIR Loss Estimates in Real Time)

- Provides real-time loss estimates
- Industry losses estimated for the most likely scenarios
- Posted on ALERT website as detailed hazard and loss maps
- Files containing all scenarios can be downloaded and input directly into AIR software for further analysis of company-specific losses

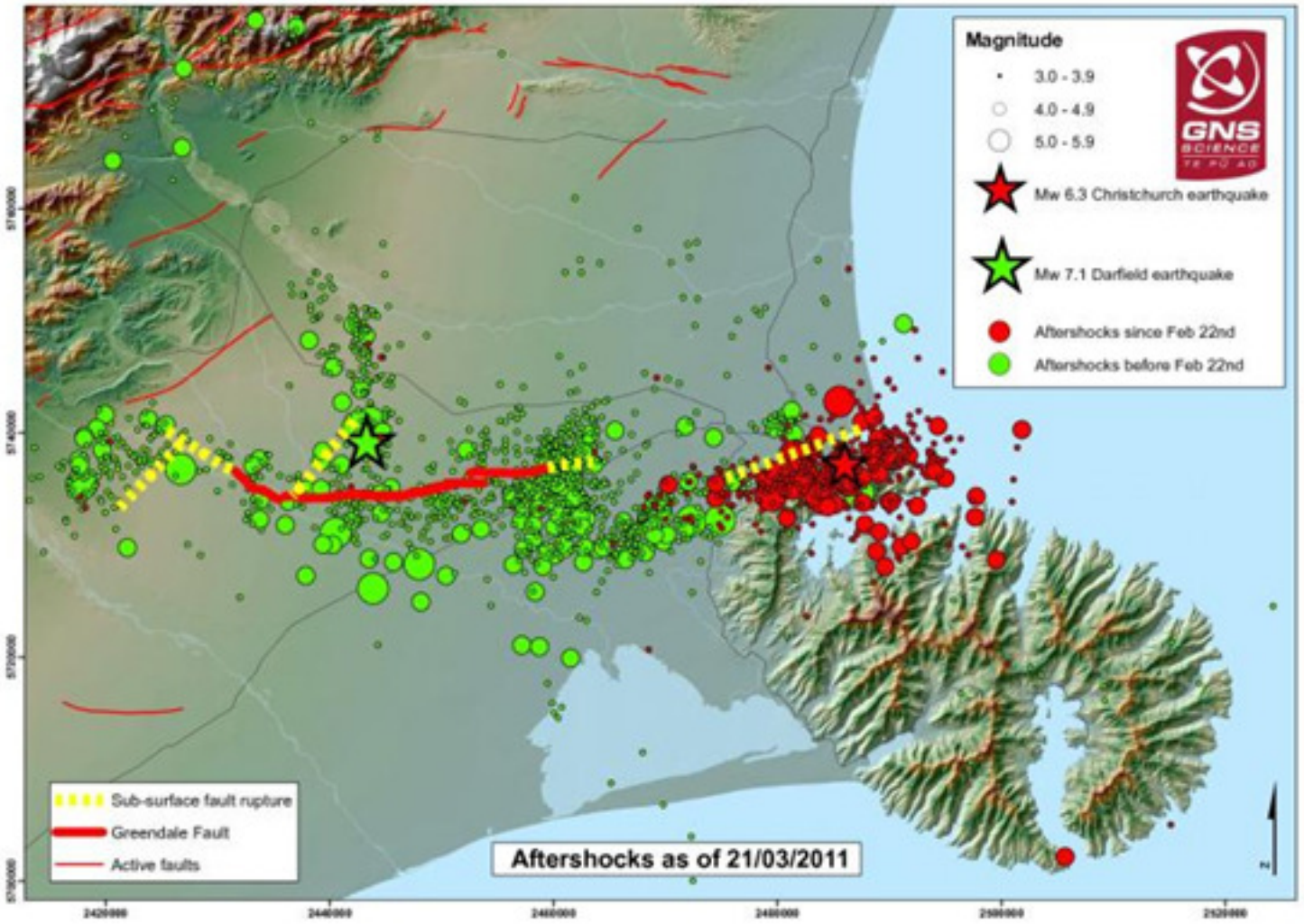
Mw 8.8 Maule Earthquake Affected a Very Large Area

Summary of ALERT Loss Estimates for the Maule Earthquake



*AIR industry insured loss estimate for property lines excluding infrastructure

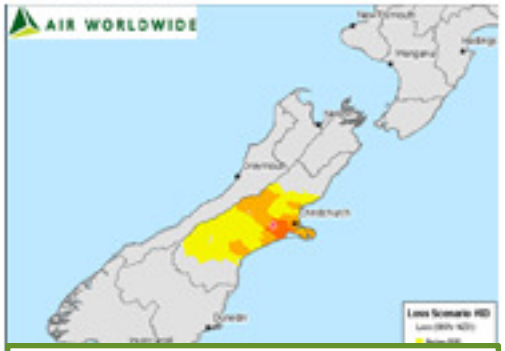
Summary of the Mw 7.1 (4 September 2010) and Mw 6.3 (22 February 2011) Christchurch Earthquakes



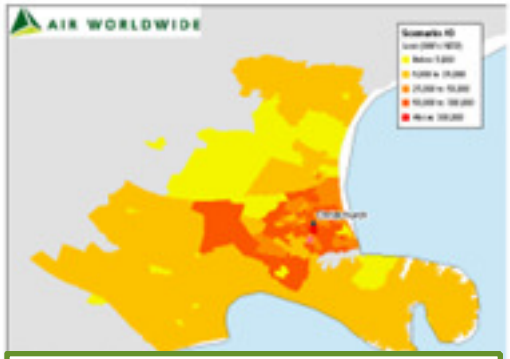
How Easy It Is to Estimate New Zealand AAL from Historical Events?

Historical AALs:

- 1900 – August 2010: 409m NZD
- 1900 – October 2010: 454m NZD
- 1900 – March 2011: 545m NZD

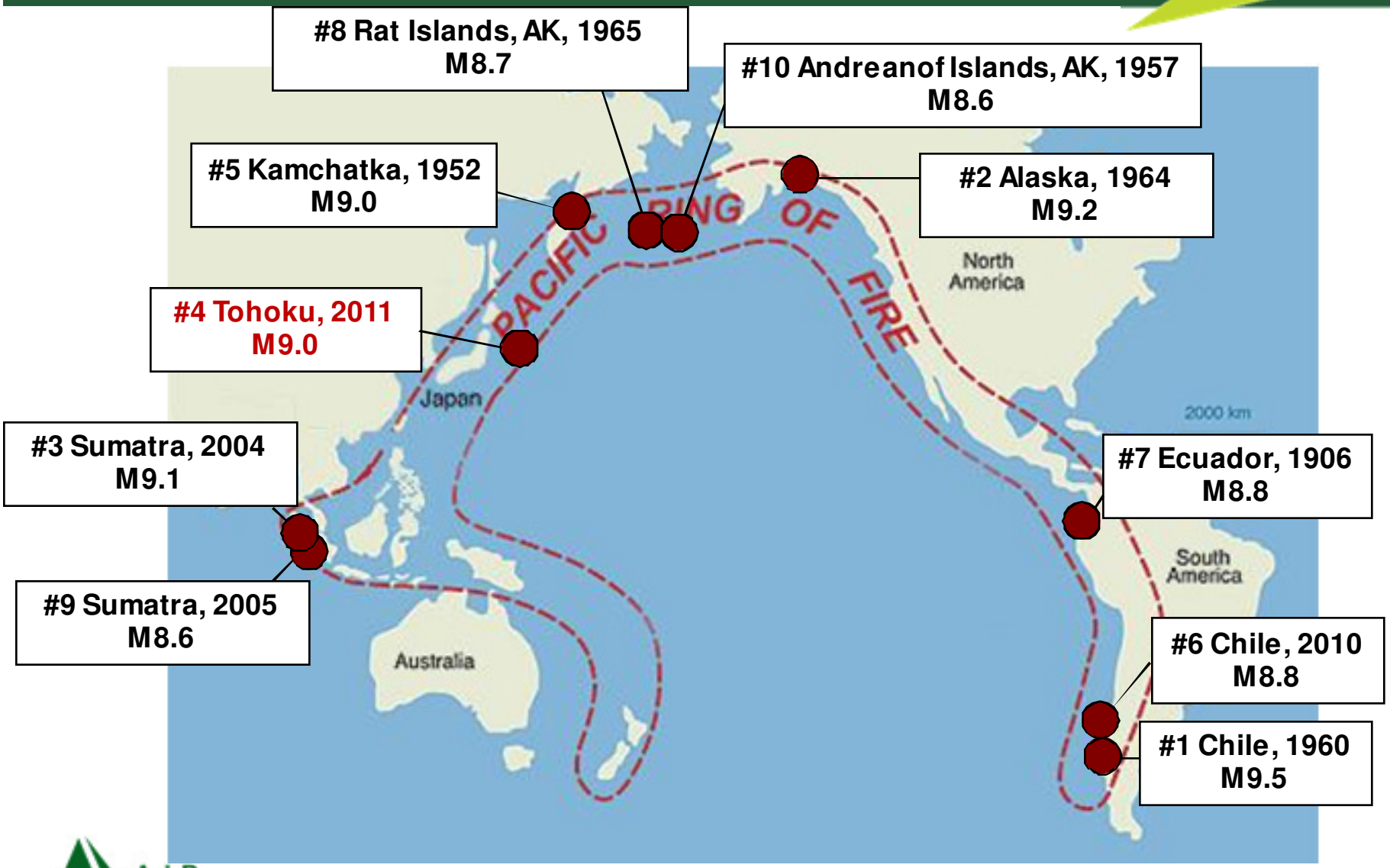


September 2010 earthquake
$2.7B - $6.0B (NZD)

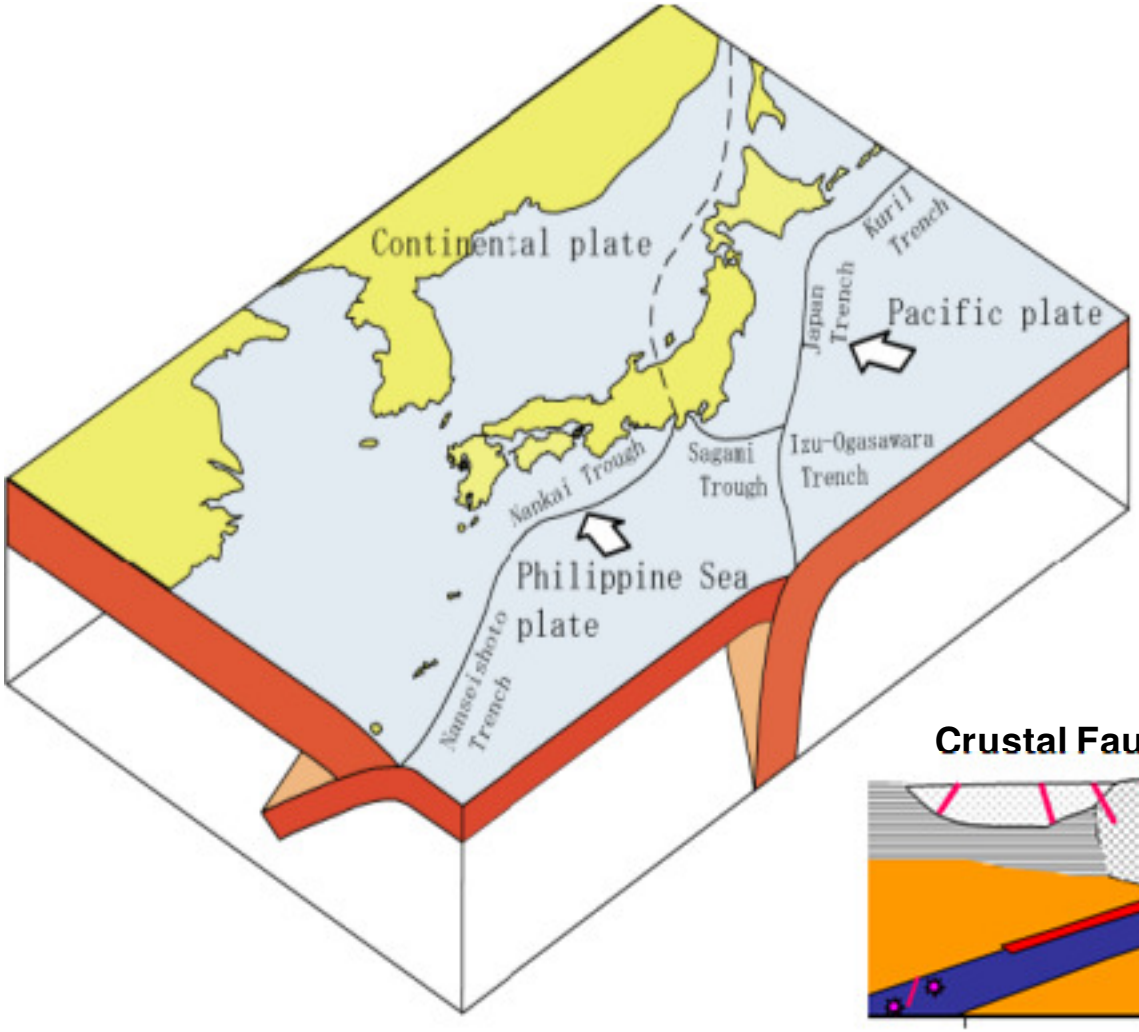


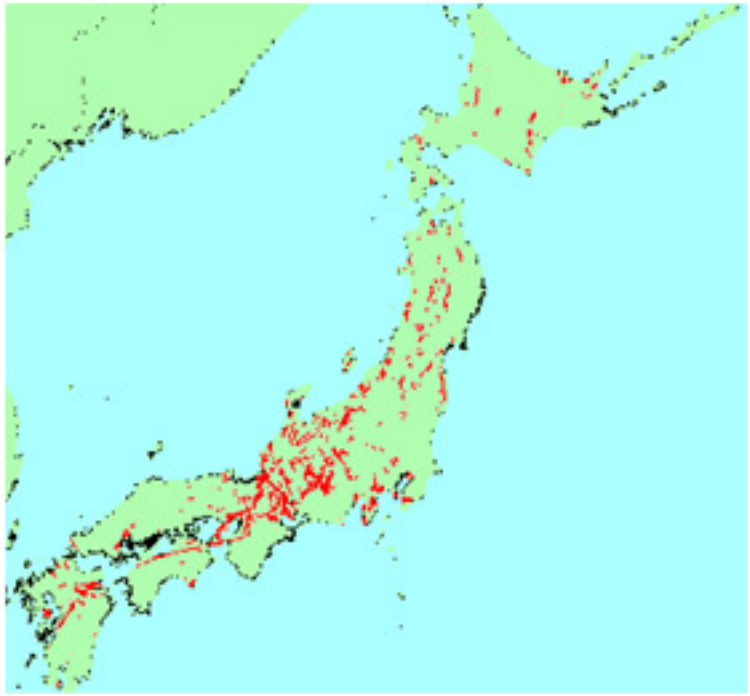
February 2011 earthquake
$5.0B - $11.5B (NZD)

The Pacific Ring of Fire Represents The Most Seismically Active Area in the World

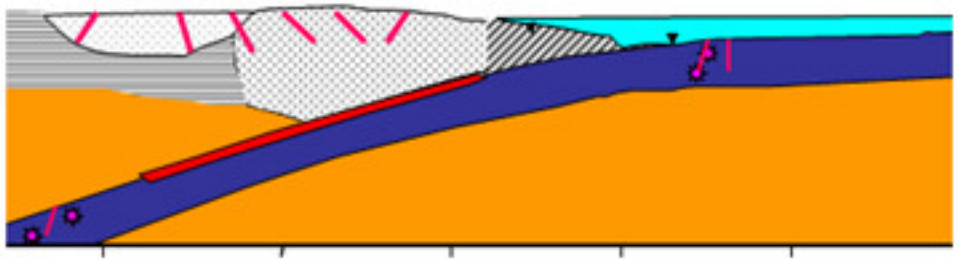


Japan Seismicity Is Dominated by the Subduction of the Pacific and Philippine Sea Plates



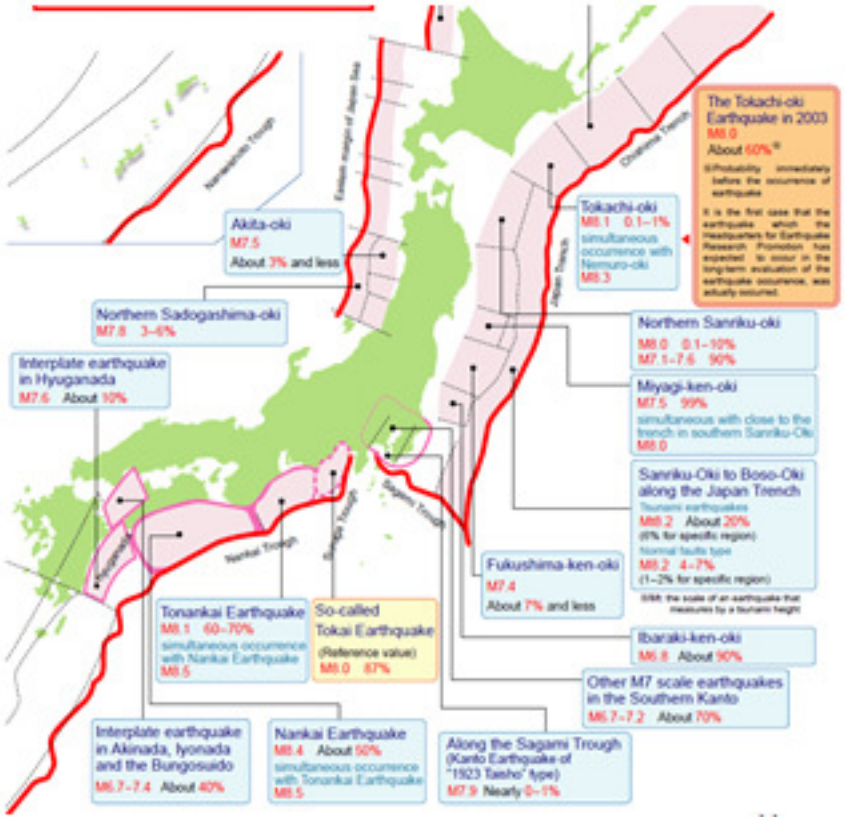


Crustal Faults

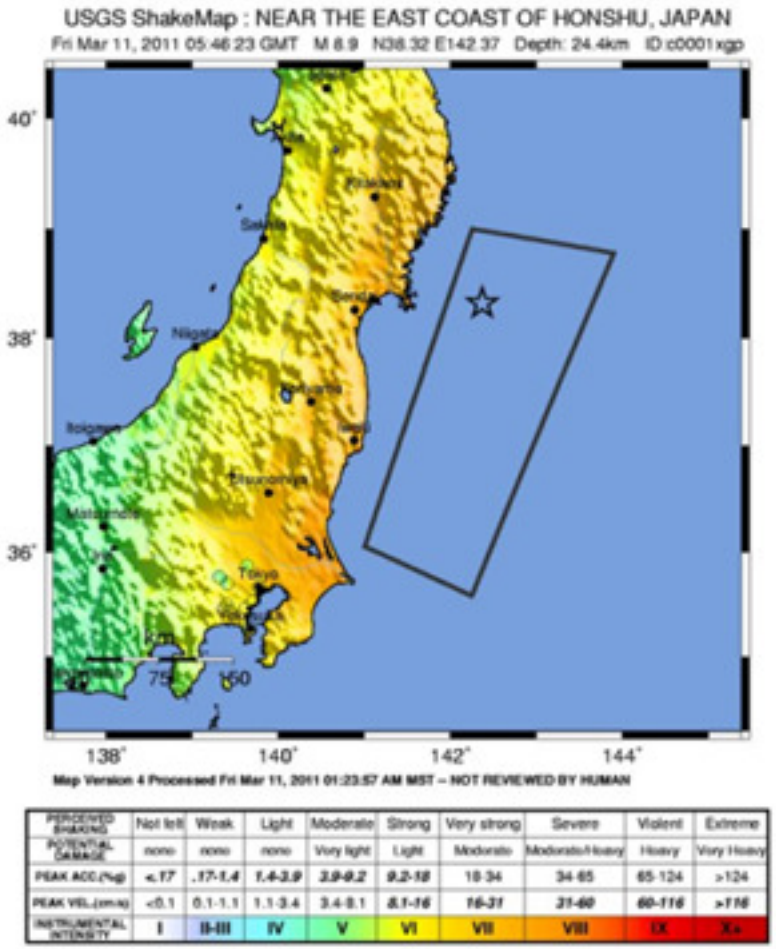


HERP Hazard Work Did Not Include This Level of Seismicity in the Region

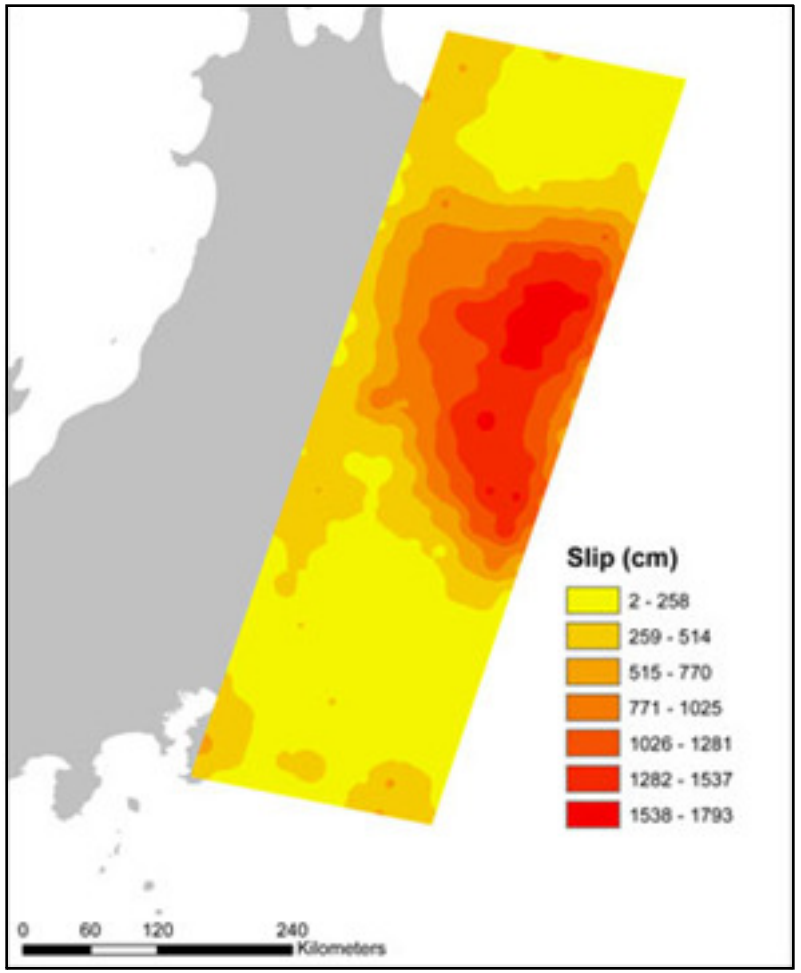
- HERP (Headquarters for Research Promotion) was established after the 1995 Kobe earthquake
- The 2005 regional seismicity model has gone though incremental updates in 2006 and 2007
- HERP report includes information on
  - 98 well studied faults
  - 178 other faults
  - about 26 subduction zone segments



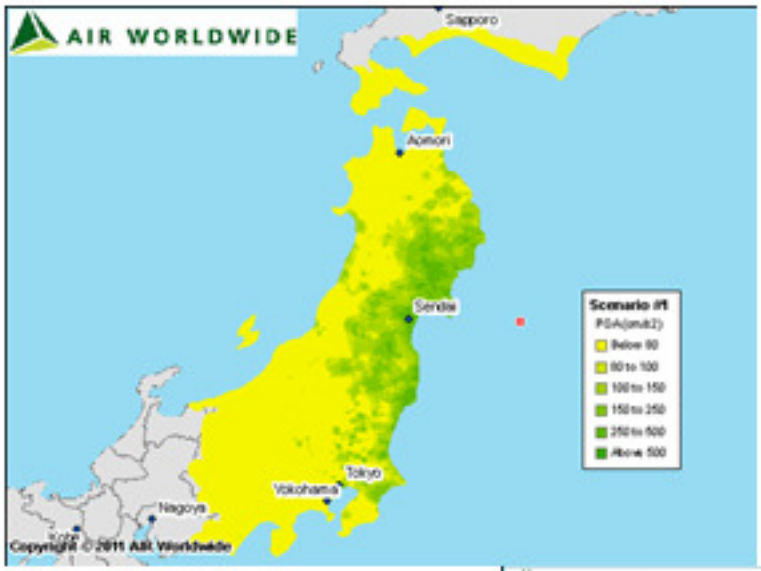
USGS-Estimated Fault Plane for 11 March 2011 Tohoku Earthquake

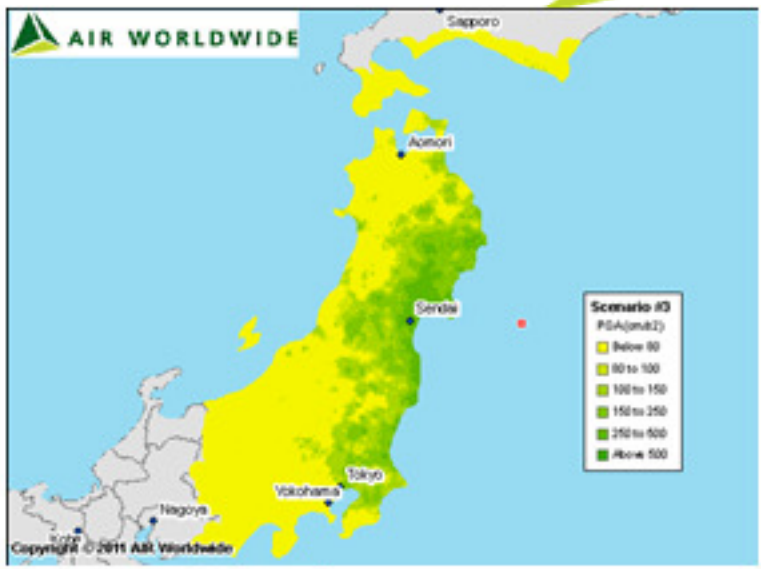


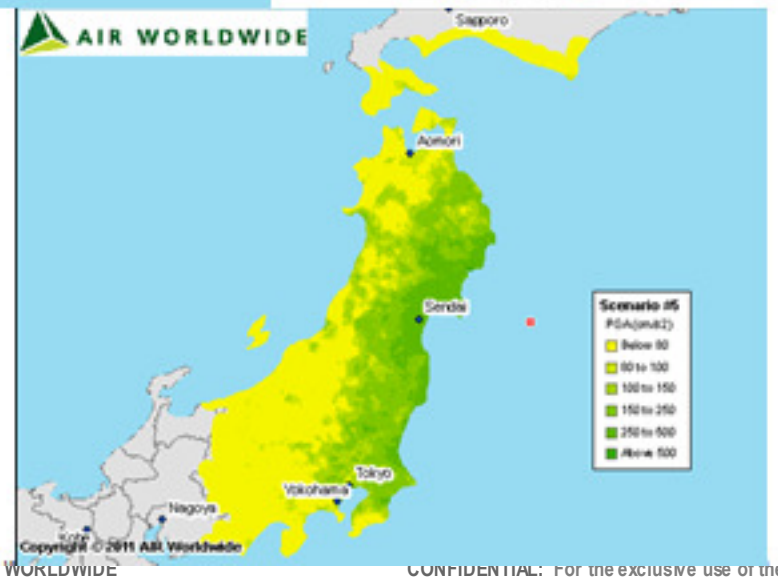
PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+



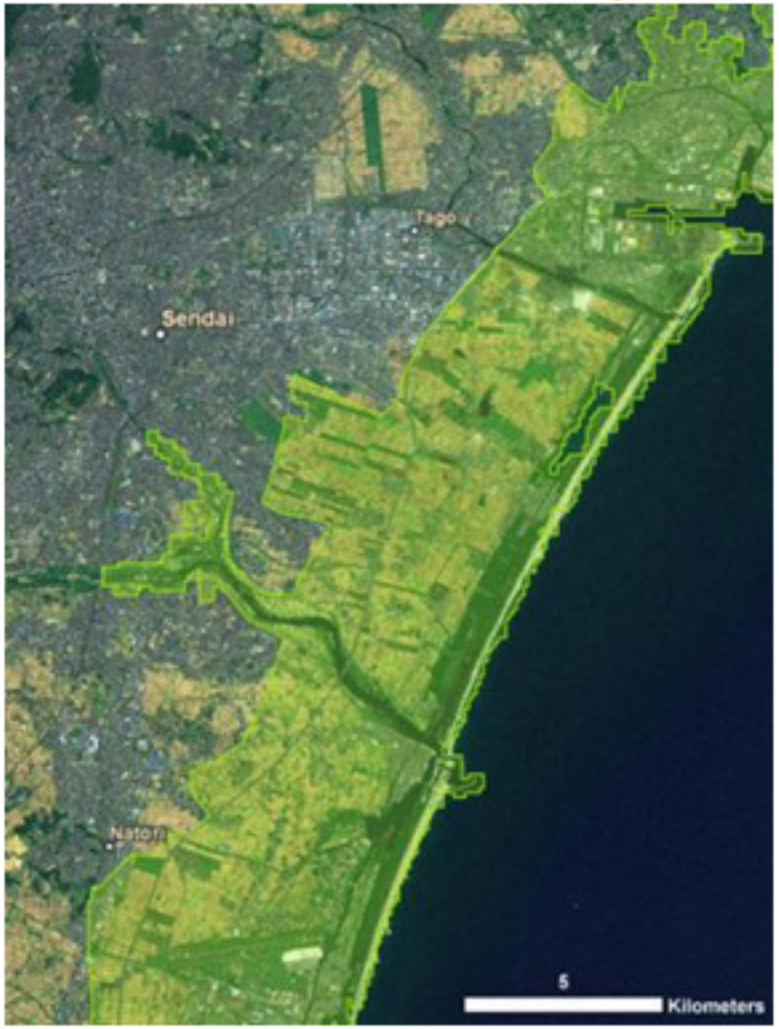
Considerable Uncertainty Remains Surrounding the Intensity of this Earthquake







AIR's Modelled Inland Tsunami Penetration in Natori and Sendai



Knowing the Distribution of Exposure is Critical for Estimating Tsunami Loss Estimates

Prefecture	0-1 km	1-2 km	2-3 km
Fukushima (7)	0.9	1.4	1.6
Ibaraki (8)	2.0	3.4	3.3
Iwate (3)	0.9	1.3	1.4
Miyagi (4)	1.3	3.4	4.0
TOTAL	**5.1**	**9.4**	**10.3**

Values in US$ Billion

ALERT Coverage and Loss Estimates for Tohoku Earthquake

MAIN SHOCK – M9.0 Tohoku Region (Mar. 11, 2011)

EARLY OBSERVATIONS (March 11th and 12th)

**15B to 35B USD INSURED LOSS*
(March 12)**

K-NET Ground Motion Data Becomes Available (Mar 12-24)

* The loss estimates do not reflect:
- Losses to uninsured properties
- Losses to infrastructure
- Indirect business interruption losses
- Loss adjustment expenses
- Losses from non-modeled perils, including tsunami and fire-following

USING UPDATED GROUND MOTION DATA AND ACCOUNTING FOR TSUNAMI LOSSES

**20B to 30B USD INSURED LOSS*
(March 24)**

Questions