

WAS THE 30 SEPTEMBER 2025 M_w 6.9 OFFSHORE NORTHERN CEBU EARTHQUAKE EFFECTIVE FORECAST USING EVENT-BASED PROBABILISTIC SEISMIC RISK ASSESSMENT (EBPSRA)?

Azdine Kay S. Ysulan and Henremagne C. Peñarubia

Department of Science and Technology - Philippine Institute of Volcanology and Seismology



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The 30 September 2025 M_w 6.9 Offshore Northern Cebu Earthquake

Date: **30 September 2025**

Time : **09:59 PM**

Magnitude: **M_w 6.9**

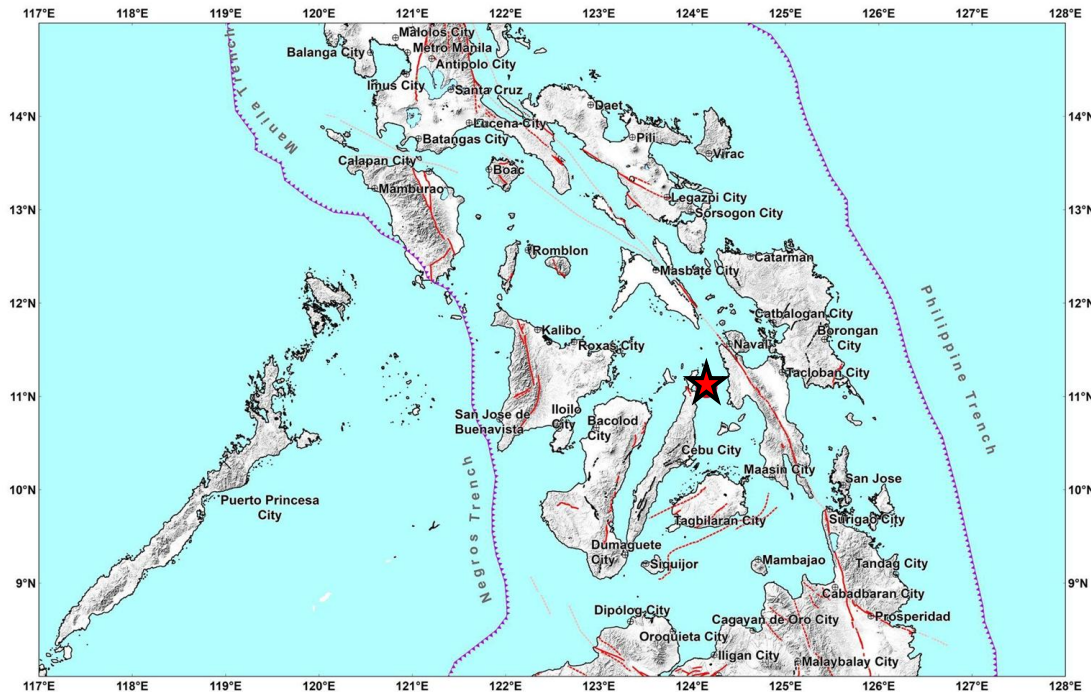
Coordinates: **11.10°N , 124.14°E**

Depth: **5 kilometers**

Location: **019 km N 70° E of
City of Bogo (Cebu)**

Tectonic Type: **Shallow Crustal
Rupturing Event**

Causative Source: **Bogo Bay Fault**



DOST-PHIVOLCS Earthquake Information No. 5

https://earthquake.phivolcs.dost.gov.ph/2025_Earthquake_Information/September/2025_0930_1359_B5F.html

Earthquake Impacts



Casualties & Injuries

79 Dead

559 Injured



Displaced Families

217,901 Affected Families

754,733 Affected Persons



Damaged Structures

160,662 Damaged Houses

955 Damaged Infrastructures



Geologic Hazards

Ground Rupture, Ground Shaking,
Liquefaction, Earthquake-Induced
Landslides, Tsunami, and Sinkholes

Source: National Disaster Risk Reduction and Management Council (NDRRMC), 2025 October 24
https://ndrrmc.gov.ph/wp-content/uploads/2025/12/Situational_Report_No_24_for_the_Effects_of_Magnitude_6_9_Earthquake_in_Bogo_City_Cebu_20251.pdf

Evolution of Probabilistic Seismic Hazard and Risk Assessment (PSHRA) in the Philippines



Peñarubia, H. C., Johnson, K. L., Styron, R. H., Bacolcol, T. C., Sevilla, W. I. G., Perez, J. S., Bonita, J. D., Narag, I. C., Solidum, R. U., Pagani, M. M., & Allen, T. I. (2020).

Probabilistic seismic hazard analysis model for the Philippines. *Earthquake Spectra*, 36(1S), 44–68.

<https://doi.org/10.1177/8755293019900521>



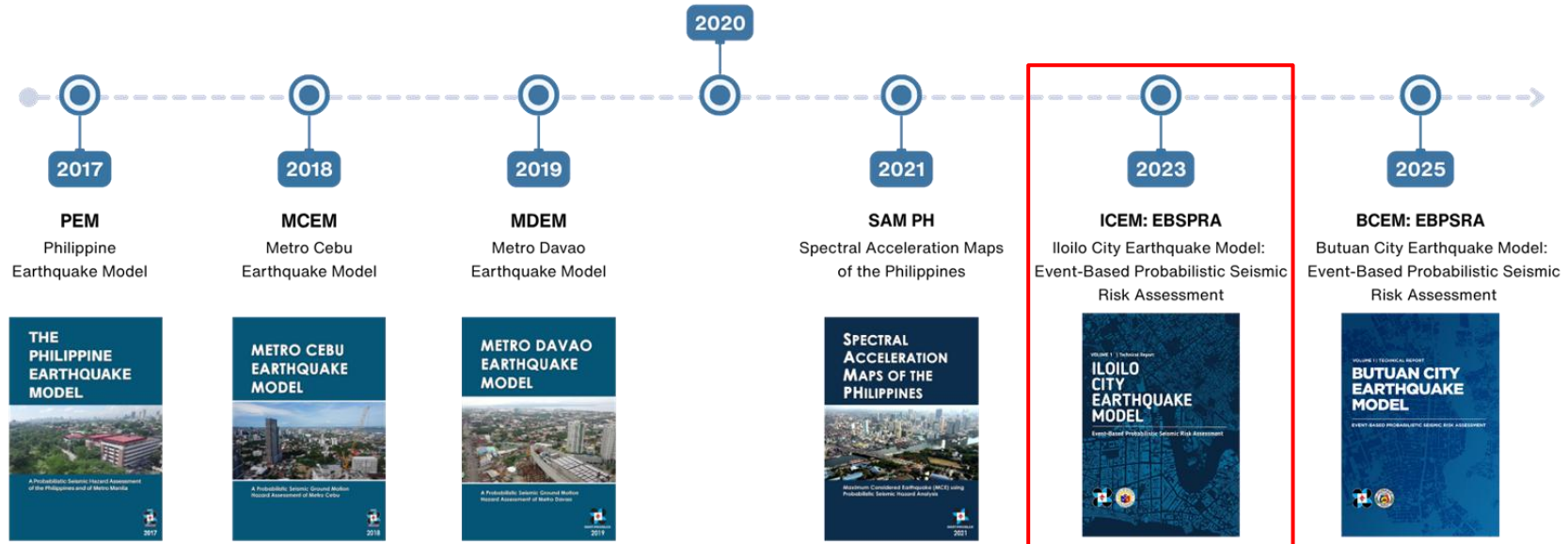
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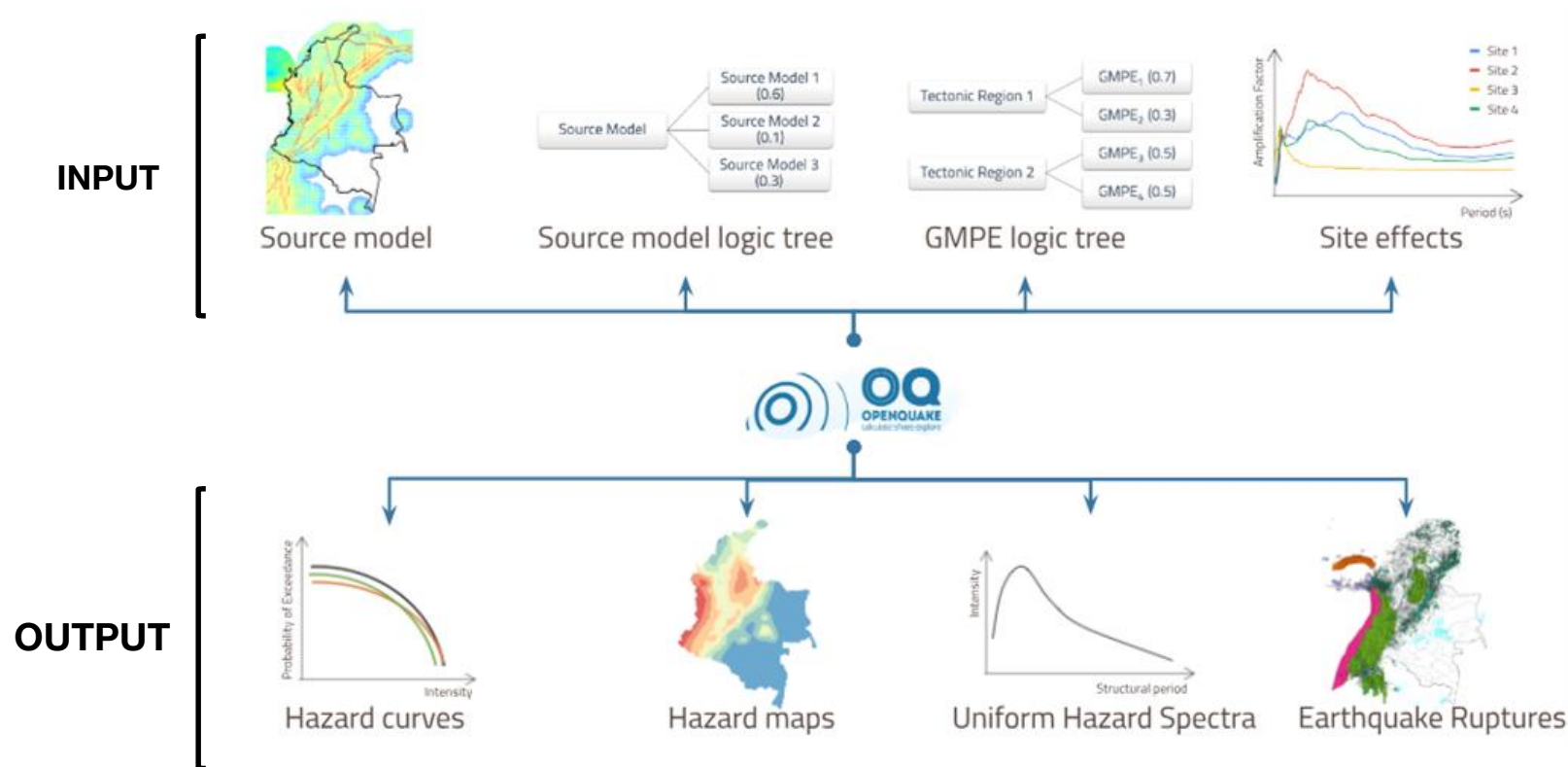
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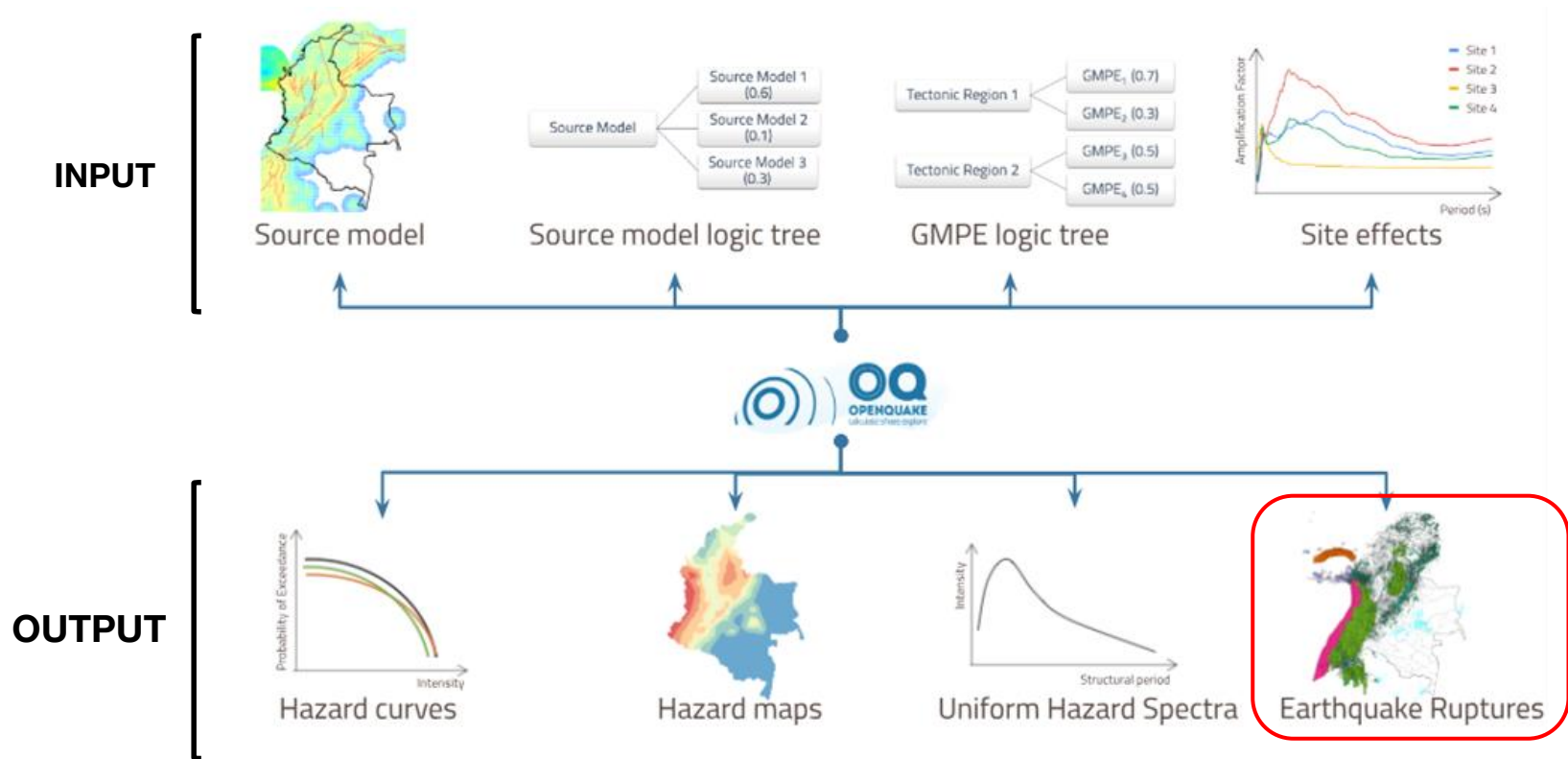
EBPSRA Methodology



Global Earthquake Model (GEM) Foundation. OpenQuake Training Platform

<https://www.training.openquake.org/event-based>

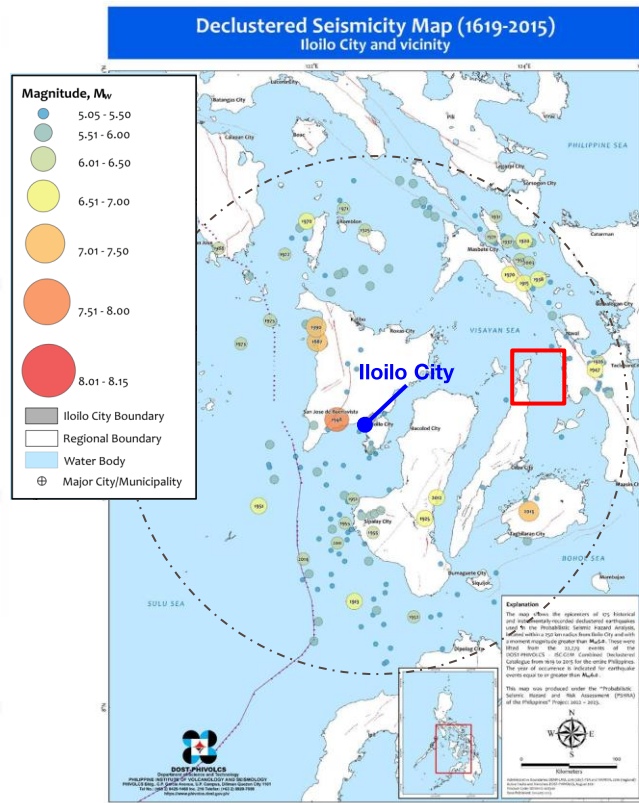
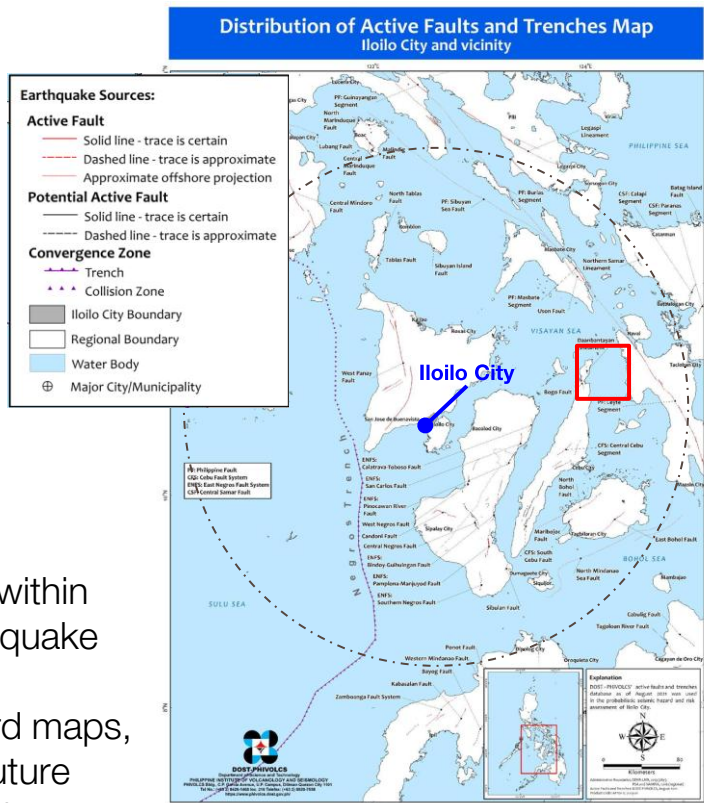
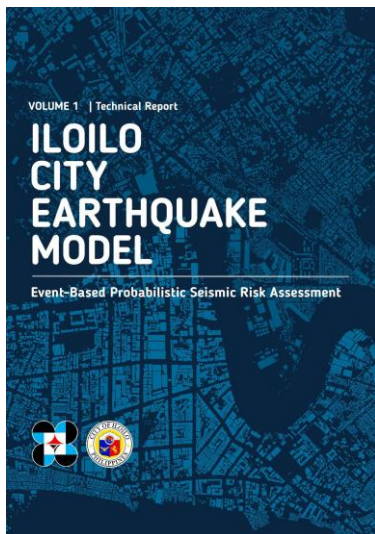
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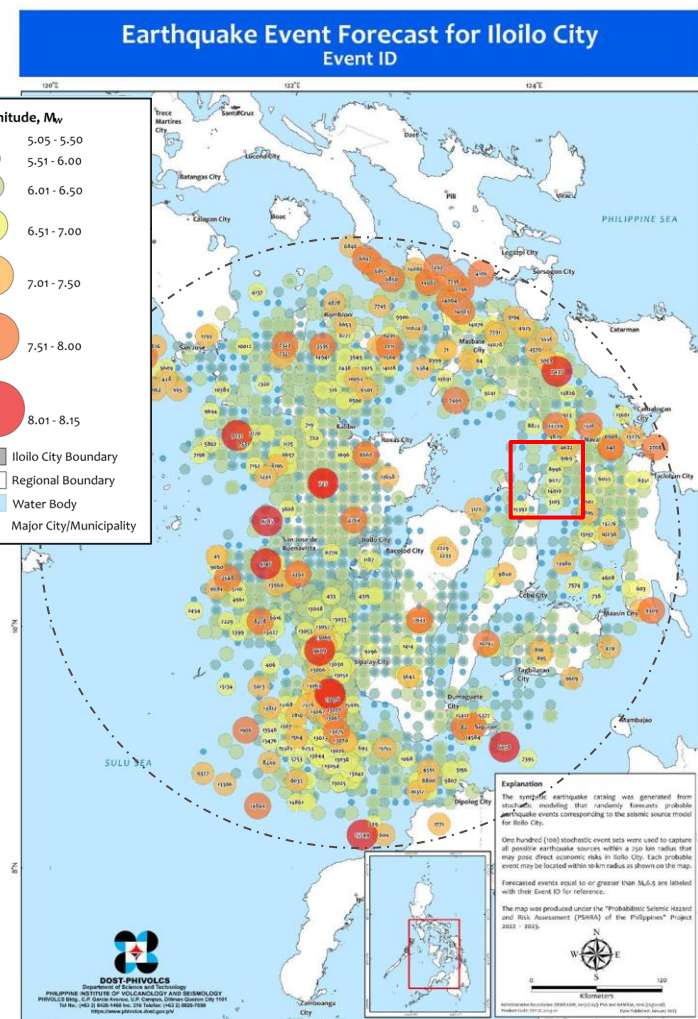
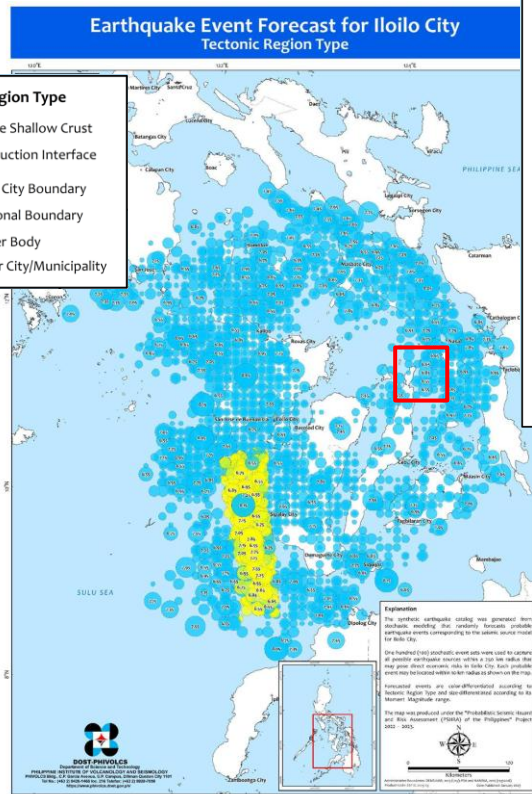
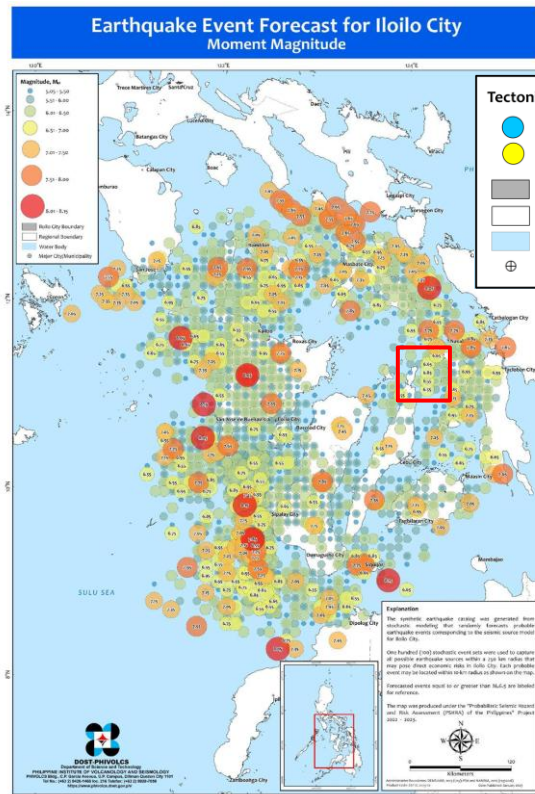
ICEM: EBPSRA 2023 Hazard Radius



Known earthquake generators (within 300 km radius) and actual earthquake events were modelled to:

- produce Iloilo City's hazard maps,
- and conversely forecast future earthquake events set that may generate the same hazard

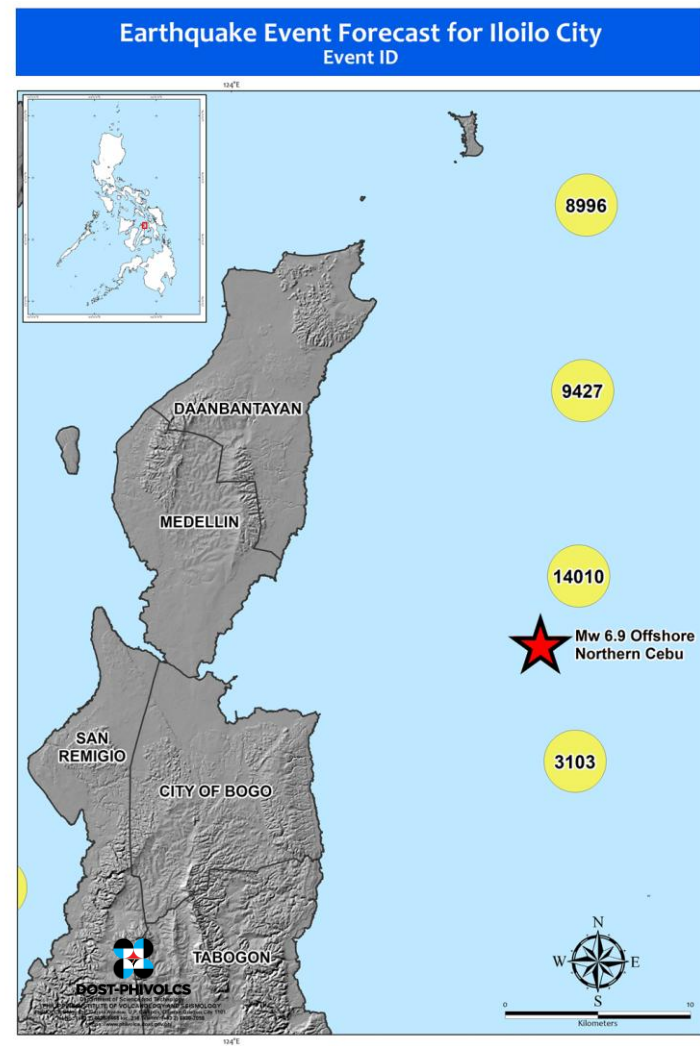
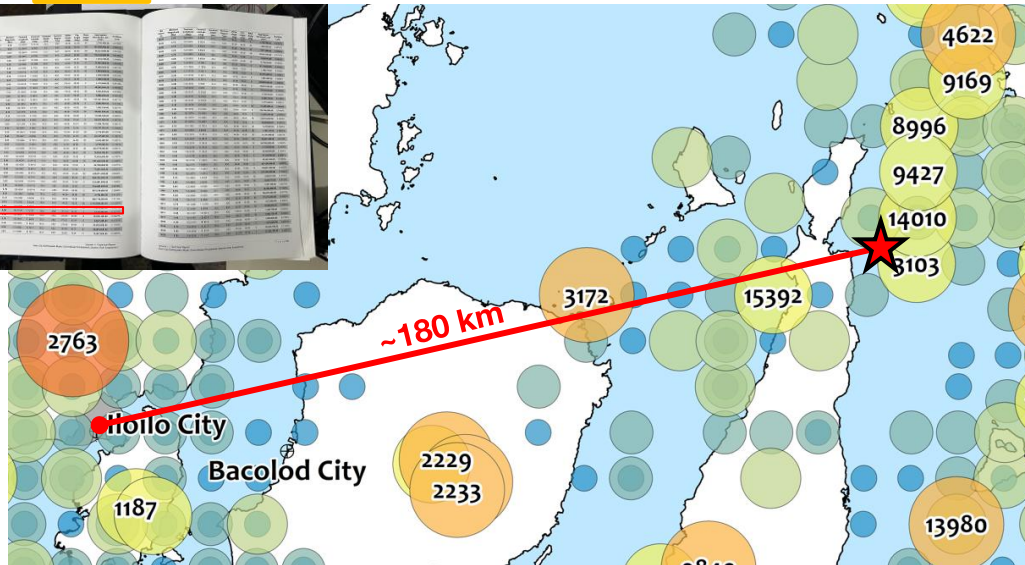
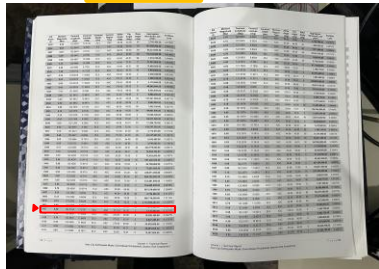
ICEM: EBPSRA 2023



Earthquake Event Forecast - M_w , Tectonic Region Type & Event ID

Probable Earthquakes Catalog with Aggregated Structural Loss Estimates

EQ Event ID	Moment Magnitude (Mw)	Centroid Longitude (deg)	Centroid Latitude (deg)	Centroid Depth (km)	Tectonic Region Type	Strike Angle (deg)	Dip Angle (deg)	Rake Angle (deg)	Aggregated Structural Loss (PHP)	Portfolio Loss
8996	6.65	124.1722	11.3027	15.0	ASC	270.02	90.00	0	127,941,000.00	0.4854%
9427	6.85	124.1704	11.2127	35.0	ASC	270.03	90.00	0	7,120,960.00	0.0270%
14010	6.55	124.1685	11.1228	25.0	ASC	270.02	90.00	0	21,226,500.00	0.0805%
3103	6.55	124.1667	11.0329	25.0	ASC	270.02	90.00	0	9,114,260.00	0.0346%



Forecasting Evaluation Comparison

Parameter Evaluated	Actual Event (30 Sept 2025)	Forecasted (ICEM: EBSPRA 2023)	Validation Status
Event Magnitude	M _w 6.90	M _w 6.85	✓ High Accuracy
Epicentral Location	11.10°N, 124.14°E Offshore Northern Cebu	Captured within 300 km Radius	✓ Spatial Hit
Fault Geometry/Source	Bogo Bay Fault	Bogo Bay Fault was not included in the hazard model Background Seismicity Zone	⚠ Simulated Proxy
Depth Domain	Shallow Crustal (5 km)	Active Shallow Crust (ASC) Tectonic Region Type	✓ Model Alignment

- The **100 stochastic event sets** generated and **used** for the 2023 risk calculations forecasted a max simulated event of M_w 6.85 in this area—remarkably close to the M_w 6.90 observed.
- The high degree of correlation suggests the stochastic model's rupture parameters may have effectively simulated the tectonic potential of Northern Cebu.

Conclusion & Way Forward

- The 2025 $M_w6.9$ event was captured in terms of location, size, and tectonic region despite fault data gaps.
- Reaffirms the utility of the OpenQuake Engine for regional and city-level hazard modeling for the Philippines.
- Newly discovered faults (Bogo Bay Fault) must be integrated into future iterations.

Thank You



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THANK YOU!

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