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# Probabilistic Seismic Hazard Assessment for Lesvos Island Using Multiple Seismic Source Models Combined in a Logic Tree to Account for Epistemic Uncertainty

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We carry out a new probabilistic seismic hazard analysis (PSHA) for Lesvos Island, in the northern Aegean Sea. Being the most densely populated island and hosting the capital of the prefecture, its seismic potential has significant social-economic meaning. The new version of R-CRISIS module is used for the hazard estimation (Ordaz *et al.*, 2017) which has high efficiency and flexibility in model selection. We incorporate into the calculations several different source models, as well as Ground Motion Prediction Equations (GMPEs) using a Logic Tree approach. This approach allows capturing the epistemic uncertainties in different input models by employing-considering alternative models in the hazard estimation (Bommer *et al*., 2005).

The earthquake source models (Fig. 1) include both line sources, representing seismogenic faults of the broader region, as well as area sources representing seismic zones. The hazard from these sources is computed based on the standard Cornell approach (Cornell, 1968). The assumption of the module is that within a source zone, seismicity is evenly distributed by unit area and thus all points might be potential earthquake focus. The sources corresponding to seismogenic faults are those included in the SHARE Database (Giardini *et al*., 2013), alongside those proposed by Papazachos *et al*., (2001). These are modeled both as area and line sources, with the latter resulting from the intersection of the fault with the ground surface.

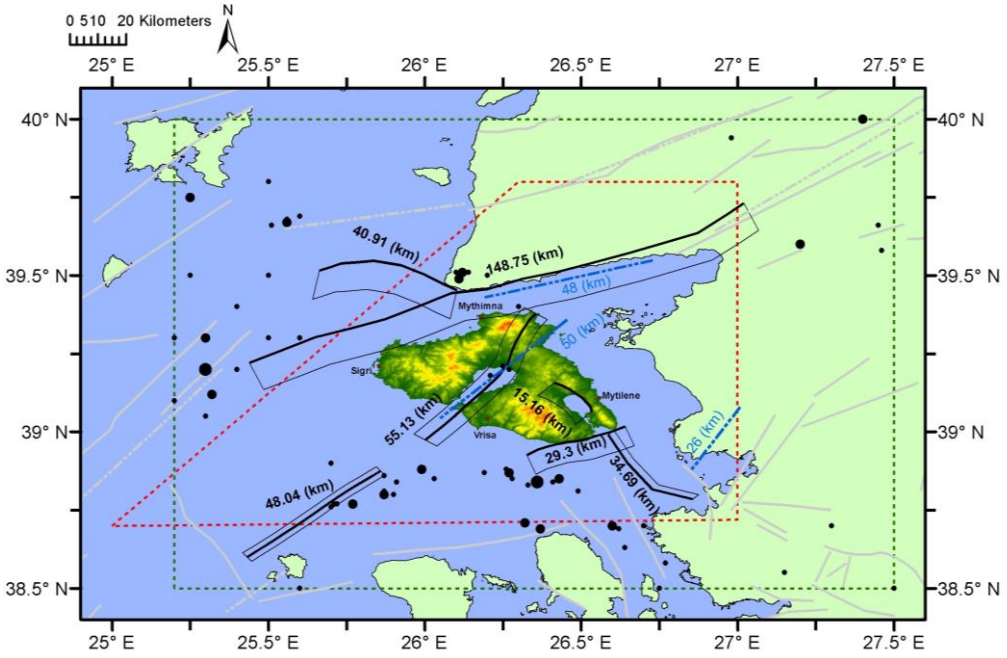


**Figure 1. Seismic sources used in the hazard assessment. Black circles denote the seismicity (M≥4.5) for the period 1964-2019. The red dashed lines delineate the Lesvos Zone (Papaioannou and Papazachos, 2000). The black lines denote the SHARE seismic sources, while the blue dashed lines denote the line sources from Papazachos *et al.*, (2001).**

The seismicity parameters, from a complete earthquake catalog spanning 106 years, were calculated within the area delimited by the green dashed line in Figure 1. The Lesvos Zone no (61), as proposed by Papaioannou and Papazachos, (2000) was also considered as an alternative zone model to the aforementioned. Using the Logic Tree approach, the six (6) in total different source models are combined into a single one, to account for the epistemic uncertainty in the hazard estimation.

The intensity measures used are Peak Ground Acceleration, (PGA), Peak Ground Velocity, (PGV), and Spectral Acceleration, (SA at T=0.2 sec). We calculated hazard curves for selected sites on the island: the capital Mytilene (Fig. 2), the village of Vrisa, in southeastern coast, which was partially ruined by the 12 June 2017 Mw 6.3 earthquake (Kiratzi, 2018 among others), Mythimna and Sigri, in the northwestern and southwestern part of the island, respectively. Hazard Maps are also presented in terms of all three intensity measures, for mean return period of 475 years (or 10% probability of exceedance in 50 years, assuming a Poisson process).

The spatial distribution of PGA in the hazard maps, using equal weights to all models, is between 0.27 g and 0.48 g, for

PGV between 19 cm/s and 30 cm/s while the spectral values SA (0.2 sec) between 0.62 g and 1.0 g. According to the New Greek Seismic Code (EAK, 2003), Lesvos belongs to Zone II of 0.24 g.

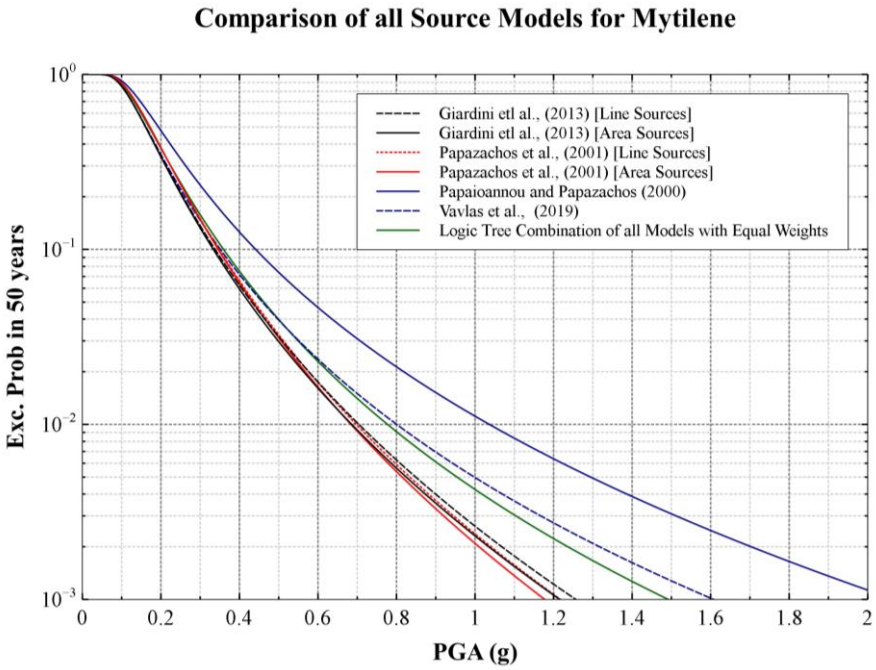


**Figure 2. Seismic hazard (PGA) curves for the capital city of Mytilene for individual models and combined logic tree model.**

Finally, the results regarding the two (2) area source models, which represent seismogenic faults, were disaggregated to depict the relative contribution of different earthquake sources and magnitudes to the results. The Edremit fault, right opposite of the northern shore of Lesvos, seems to contribute the most in the northern part of the island, which is something to be expected, being one of the most hazardous seismic sources in the broader region. The Agia Paraskevi right lateral fault (Chatzipetros *et al*., 2013), that cuts off the central part of Lesvos from N to S, has a significant contribution around the central part of the island, and especially in the village of Vrisa where small distance and big magnitude bins show elevated values.

The sources proposed by Giardini *et al*., (2013), except the two ones already mentioned, do not seem to contribute much to the final result. The most important factor leading to this are the activity rates, which, calculated from the average slip rate, are relatively low (<0.01 eq/yr). For a mean return period of 475 years, activity rates that low appeared insignificant in the calculations.

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