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Assessing future uncertainties: earthquake tsunami hazard in the Java trench, Indonesia.

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Historical earthquakes in the Java subduction zone have given genesis to tsunami affecting the southwest coasts of the island of Java, in Indonesia. The most recent earthquake on the 17th of July 2006, has given rise to a tsunami that killed more than 600 people. The tsunami was difficult to escape due to the small amount of ground shaking, which could have acted as an early warning, and due to the epicentre being very close to the shorelines, giving insufficient time for response. Historical data and scientific studies give little evidence for mega-thrust events in the Java trench, however such possibilities are not excluded and could have a devastating impact in the region. This work aims to assess the tsunami hazard occurring from a range of earthquake scenarios in the subduction zone. Taking as a benchmark the 2006 event, we initially validate our modelling approach against the wave observations recorded at three tide gauges. We then expand our work to account for future earthquake scenarios and their tsunamigenic consequences in the southern coasts of Java island. Bathymetry displacement is computed using the Okada elastic dislocation model. The nonlinear shallow water equation solver JAGURS is employed for the modelling of wave propagation. Our objective is to quantify the uncertainty of such events by using statistical surrogates: fast stochastic approximations of the model that can explore the likelihood of thousands of tsunami scenarios in a few moments of time. Gaussian process emulators are utilised to predict maximum wave amplification occurring from varying parameter distributions such as the moment magnitude of an earthquake. The resulting tsunami hazard footprints can be used in conjunction with existing socio-demographic information to assess tsunami risk in vulnerable areas. The end-data can eventually be used to inform policy making for better disaster mitigation planning.