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Identifying tectonic parameters that influence tsunamigenesis

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The role of tectonics in tsunami generation is at present poorly understood. However, the fact that some regions produce more tsunamis than others indicates that tectonics could influence tsunamigenesis. Here, we complement a global earthquake database that contains geometrical, mechanical, and seismicity parameters of subduction zones with tsunami data. We statistically analyse the database to identify the tectonic parameters that affect tsunamigenesis. The Pearson's product-moment correlation coefficients reveal high positive correlations of $\sim$0.65 between, amongst others, the maximum water height of tsunamis and the seismic coupling in a subduction zone. However, these correlations are mainly caused by outliers. The Spearman's rank correlation coefficient results in more robust correlations of $\sim$0.60 between the number of tsunamis in a subduction zone and subduction velocity (positive correlation) and the sediment thickness at the trench (negative correlation). Interestingly, there is a positive correlation between the latter and tsunami magnitude. In an effort towards multivariate statistics, a binary decision tree analysis is conducted with one variable. However, this shows that the amount of data is too scarce. To complement this limited amount of data and to assess physical causality of the tectonic parameters with regard to tsunamigenesis, we conduct a numerical study of the most promising parameters using a geodynamic seismic cycle model. We show that an increase in sediment thickness on the subducting plate results in a shift in seismic activity from outerrise normal faults to splay faults. We also show that the splay fault is the preferred rupture path for a strongly velocity strengthening friction regime in the shallow part of the subduction zone, which increases the tsunamigenic potential. A larger updip limit of the seismogenic zone results in larger vertical surface displacement.