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A New Scaling Method for a Tsunami Scenario Database: the Effect of Dispersion

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The current prediction strategy of the Australian Tsunami Warning System is based on a database of pre-computed tsunami scenarios (T1), which provide solutions for four different earthquake magnitudes at each earthquake source location. A convenient way to obtain the solution for an earthquake with a magnitude intermediate to these scenarios is to linearly scale the wave solution from the nearest scenario according to the rupture geometry. This can be achieved by assuming a fixed correlation between the earthquake moment magnitude and the total volume of the sea-floor displacement. If this strategy is adopted, scaling of the solution with each of the width, slip, and length of the rupture is possible, but each of those dimensions have different effects on the physics of the wave propagation. Scaling with slip is the most easily exploited due to the linearity of wave solution in deep water. However, slip is not as strongly correlated with moment magnitude as width and length (Welsh and Coppersmith, 1994). On the other hand, wave decay due to dispersion is related in a more complex way to the width of the rupture, water depth, propagation distance, and horizontal grid size.

This study outlines a practical method to quantify the dispersive effect associated with varying the rupture geometry in a widely-used numerical tsunami model, MOST (Titov 1997), Scaling arguments are applied to a series of numerical experiments in which the following parameters are varied: rupture slip and width, horizontal grid size and water depth. It is found that for most practical grid sizes and rupture widths, scaling by a power law is more preferable than linear scaling due to the large effect of numerical dispersion. The results are verified using several realistic case studies from the T1 scenario database.

References:

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