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How much bathymetry resolution do we really need? A spherical harmonics expansion

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Bathymetry maps play, perhaps the most crucial role in optimal tsunami simulations. Regardless of the simulation method, on one hand, it is desirable to include every detailed bathymetry feature in the simulation grids in order to predict tsunami amplitudes as accurately as possible, but on the other hand, large grids result in long simulation times. It is therefore, of interest to investigate a "sufficiency" level – if any – for the amount of details in bathymetry grids needed to reconstruct the most important features in tsunami simulations, as obtained from the actual bathymetry.

In this context, we use a spherical harmonics series approach to decompose the bathymetry of the Pacific ocean into its components down to a resolution of 4 degrees (l=100) and create bathymetry grids by accumulating the resulting terms. We then use these grids to simulate the tsunami behavior from pure thrust events around the Pacific through the MOST algorithm (e.g. Titov & Synolakis, 1995; Titov & Synolakis, 1998). Our preliminary results reveal that one would only need to consider the sum of the first 40 coefficients (equivalent to a resolution of $\sim$1000 km) to reproduce the main components of the "real" results. This would result in simpler simulations, and potentially allowing for more efficient tsunami warning algorithms.