# FINITE VOLUME METHODS AND ADAPTIVE REFINEMENT FOR GLOBAL TSUNAMI PROPAGATION AND LOCAL INUNDATION.

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## ABSTRACT

The shallow water equations are a commonly accepted approximation governing tsunami propagation. Numerically capturing certain features of local tsunami inundation requires solving these equations in their physically relevant conservative form, as integral conservation laws for depth and momentum. This form of the equations presents challenges when trying to numerically model global tsunami propagation, so often the best numerical methods for the local inundation regime are not suitable for the global propagation regime. The different regimes of tsunami flow belong to different spatial scales as well, and require correspondingly different grid resolutions. The long wavelength of deep ocean tsunamis requires a large global scale computing domain, yet near the shore the propagating energy is compressed and focused by bathymetry in unpredictable ways. This can lead to large variations in energy and run-up even over small localized regions.

We have developed a finite volume method to deal with the diverse flow regimes of tsunamis. These methods are well suited for the inundation regime—they are robust in the presence of bores and steep gradients, or drying regions, and can capture the inundating shoreline and run-up features. Additionally, these methods are *well-balanced*, meaning that they can appropriately model global propagation.

To deal with the disparate spatial scales, we have used adaptive refinement algorithms originally developed for gas dynamics, where often steep variation is highly localized at a given time, but moves throughout the domain. These algorithms allow evolving Cartesian sub-grids that can move with the propagating waves and highly resolve local inundation of impacted areas in a single global scale computation. Because the dry regions are part of the computing domain, simple rectangular cartesian grids eliminate the need for complex shoreline-fitted mesh generation.