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Numerical Modeling of Tectonic and Submarine Landslide-Generated Tsunamis in Whittier, Alaska

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Tsunami waves are a threat for many Alaska coastal locations, and community preparedness plays an important role in saving lives and property. The Geophysical Institute of the University of Alaska Fairbanks participates in the National Tsunami Hazard Mitigation Program by evaluating and mapping potential tsunami inundation of selected coastal communities in Alaska. We develop hypothetical tsunami scenarios based on the parameters of potential underwater earthquakes and landslides for a specified coastal community. The modeling results are delivered to the community for local tsunami hazard planning and construction of evacuation maps.

For the community of Whittier, located at the head of Passage Canal, tsunami potential from tectonic and submarine landslide sources must be evaluated for comprehensive inundation mapping. The purpose of the project is long- term prediction of potential landslide-generated tsunamis in Passage Canal, and public education on landslide-related tsunami hazard. In order to construct tsunami inundation maps for Whittier, we use an approach that combines modeling of the historical tsunami events of 1964 in Passage Canal for model verification, and assessing the landslide tsunami hazard by simulating hypothetical landslide scenarios.

We use a three-dimensional numerical model of an incompressible viscous slide with full interaction between the slide and surface waves to simulate tsunami waves. The long-wave approximation is used for both water waves and slides. The equations of motion and continuity for the slide and for surface waves are solved simultaneously using an explicit finite-difference scheme. We create hypothetical landslide scenarios that are based on the underwater sediment accumulation areas derived from the bathymetry difference profiles. Numerical simulations yield runup heights, extent of maximum inundation for chosen tsunami scenarios, depths of inundation on dry land, and maximum velocity current distribution in inundation zones. We deliver modeling results to the community for local tsunami hazard planning and construction of evacuation maps.