Landslide-generated Tsunamis on the Pacific Coast of North America – Observation and Modeling

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The Pacific coasts of Alaska and British Columbia are characterized by a high risk of catastrophic tsunamis caused by underwater and subaerial landslides both on the continental margin and in coastal waters. Several such landslide-generated tsunamis have been documented. Some are clearly related to seismic events in southeast Alaska and near the Queen Charlotte Islands of British Columbia where local failures in fjords and coastal embayments have given rise to large tsunamis. Other failures have no relationship to seismic events but have created extremely damaging waves. For Example, near Kitimat, British Columbia in 1975, a slope failure (debris flow) along the steep fjord resulted in an 8-m high wave. Similarly, in 1994, a catastrophic failure (primarily flow slide) took place in Skagway Harbor, Alaska resulting in a 5-6 m tsunami. Both the Kitimat and Skagway failure/tsunami events took place during extreme low tide and both appear to have been related to construction activities which placed increased loads on the steep underwater slopes.

The three-dimensional numerical model of Jiang and LeBlond (1994) for a viscous landslide with full slide-wave interaction was modified and improved to simulate tsunami wave generation in natural basins with complex geometry and seafloor morphology. The model was verified against the Skagway failure/tsunami event for which there were eye-witness accounts and a tide gauge record. Subsequently, the model was used to assess tsunami risk from postulated failures in the Strait of Georgia, Malaspina Strait and the subaqueous Fraser River delta of British Columbia. Both block slides and viscous flows were modelled.

Future development of the model will focus on four aspects: (1) advanced formulation of the initial few seconds of failure and the coupling to the sea surface; (2) evolution of failures in time and space and their implication for the resultant wave regime; (3) consequences of combined subaerial and submarine failures for wave generation and propagation; and (4) tsunami inundation and run-up in complex coastal areas.