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Quantification of tsunami hazard on Canada's Pacific Coast; implications for risk assessment

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Our assessment of tsunami hazard on Canada's Pacific Coast (i.e. the coast of British Columbia) begins with a review of the 1964 tsunami generated by The Great Alaska Earthquake (M9.2) that resulted in significant damage to coastal communities and infrastructure. In particular, the tsunami waves swept up inlets on the west coast of Vancouver Island and damaged several communities; Port Alberni suffered upwards of $5M worth of damage. At Port Alberni, the maximum tsunami wave height was estimated at 8.2 m above mean sea level and was recorded on the stream gauge on the Somass River located at about 7 m a.s.l, 6 km upstream from its mouth. The highest wave (9.75 m above tidal datum) was reported from Shields Bay, Graham Island, Queen Charlotte Islands (Haida Gwaii). In addition, the 1964 tsunami was recorded on tide gauges at a number of locations on the BC coast. The 1964 signal and the magnitude and frequency of traces of other historical Pacific tsunamis (both far-field and local) are analysed in the Tofino tide gauge records and compared to tsunami traces in other tide gauges in the Pacific Basin (e.g., Miyako, Japan). Together with a review of the geological evidence for tsunami occurrence along Vancouver Island's west coast, we use this tide gauge data to develop a quantitative framework for tsunami hazard on Canada's Pacific coast. In larger time scales, tsunamis are a major component of the hazard from Cascadia megathrust events. From sedimentological evidence and seismological considerations, the recurrence interval of megathrust events on the Cascadia Subduction Zone has been estimated by others at roughly 500 years. We assume that the hazard associated with a high-magnitude destructive tsunami thus has an annual frequency of roughly 1/500. Compared to other major natural hazards in western Canada this represents a very high annual probability of potentially destructive hazard that, in some coastal communities, translates into high levels of local risk including life-loss risk. Our analysis further indicates that in terms of life-loss risk, communities on Canada's Pacific Coast that are exposed to high tsunami hazard, experience the highest natural risk in Canada. Although sparsely populated, the (outer) coast of British Columbia has important critical infrastructure that includes port developments, shoreline facilities related to forest resource exploitation, a large number of First Nations Reserves, small municipal centres, towns, and villages, (some of which are ecotourism and sport fishing centres), and a limited number of industrial facilities. For selected areas on the west coast of Vancouver Island inundation maps have been prepared for a range of tsunami scenarios. We find that key facilities and critical infrastructure are exposed to the hazards associated with tsunami inundation.