

An estimate of the tsunami-debris quantity washed ashore on the US and Canadian beaches, based on a webcam monitoring and a particle tracking model experiment

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The 3.11 Earthquake occurred in 2011 triggered a great tsunami in the Tohoku area, Japan. The Ministry of Environment, Japan estimated that about 5 million tons of Japanese tsunami marine debris (JTMD) flowed out into the North Pacific, and that 1.5 million tons (30%) of JTMD is still floating in the North Pacific. Thus, they have a potential to reach the North American and Pacific Islands' coasts even at present time. In particular, an attention is placed on coastal Japanese species carried by JTMD because these invasive species might damage the indigenous marine ecosystem. Particle tracking models (PTMs) might be capable of computing JTMD motion in the ocean circulation. However, it is difficult to determine by the PTMs alone if modeled particles in the ocean are washed ashore onto the land, because the stranding must be dependent on nearshore processes that might not be resolved in modeled ocean currents (hence, PTMs) sufficiently. Also, re-drifting processes of stranded particles into the ocean should be incorporated into the PTM; otherwise the estimate of debris quantity on beaches remains unreliable. The webcam monitoring on a beach in Newport, Oregon, provides us with a simple scenario of stranding/re-drifting processes: the debris on the beach increased during the downwelling-favoring winds, and rapidly decreased under the onshore-winds at spring tides by re-drifting. The PTM in the present study consists of two models: one is a PTM to reproduce the JTMD motion in the North Pacific using an ocean reanalysis product (ocean circulation) and satellite-derived winds (leeway drift), and the other is a "sub-model" to give the criterion whether or not the modeled particles are washed ashore on the neighboring land grid cell, and whether or not they return to the oceanic domain from the land. The satellite-derived winds on the grid cells neighboring the land boundary were used for the criterion in the sub-model. In the present study, we attempt to estimate the abundance of JTMD washed ashore on the western coasts of US and Canada during the period 2011 through 2016. We also attempt to find the beaches on which the massive amount of JTMD has been washed ashore to provide a "hazard map" of invasive species. As the results, in total, 30,000 tons of JTMD potentially exists on the US and Canadian beaches at the present time. Furthermore, the model results states that the invasive species on the tsunami debris have not washed ashore widely on the entire US and Canadian beaches. They have been washed ashore on the relatively narrow area (<1000 km) around Vancouver Island, which might act as a "gate" of the invasive species carried by the tsunami debris.

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