

Effect of Marine Debris Caused by the Great Tsunami of 2011

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The Great East Earthquake in Japan on March 11, 2011 created a massive tsunami, which washed about 5 million tons of debris into the Pacific Ocean (Ministry of the Environment [MoE], Japan, 2012). The Government of Japan estimates that 70% of that debris sank close to shore, leaving 1.5 million tons floating in the North Pacific with the potential to arrive on Canadian and American coastlines. In fact, debris is expected to continue to arrive for years.

What is the impact of tsunami-debris on North American coastal ecosystems?

1. Estimate the amount and timing of debris that will reach North America, including Hawaii,
2. Monitor for debris accumulation, and
3. Assess the risk and impacts from this debris, including associated invasive species.

Surveillance and Monitoring

Aerial surveys are cost-effective ways to monitor the vast coastlines where debris may be accumulating to identify hot spots. Over 150 small boats have been washed up on North American beaches in the last 6 months, some with fouling (potential invasive) species attached (see photos at right).

Beach monitoring for debris has been on-going for the past three years at over 160 sites along the North American West Coast and Hawaii to assess if there has been an increase due to the Japanese tsunami. NOAA Monitoring Protocols were implemented, and a thorough review and analysis of this data will inform areas that are experiencing an influx of debris and where research on impacts of this debris could be targeted.

Webcam monitoring is an established method to identify quantities and types of debris washed ashore, and trial sites will be implemented at key locations.



Photo credit: NOAA



Photo credit: Lightspeed Digital

Looking for marine debris: Government and citizen science beach surveys monitor incoming debris in an attempt to quantify and categorize marine debris (above). Aerial surveys look for tsunami debris, like Japanese skiffs (right) on remote beaches of Alaska and British Columbia.

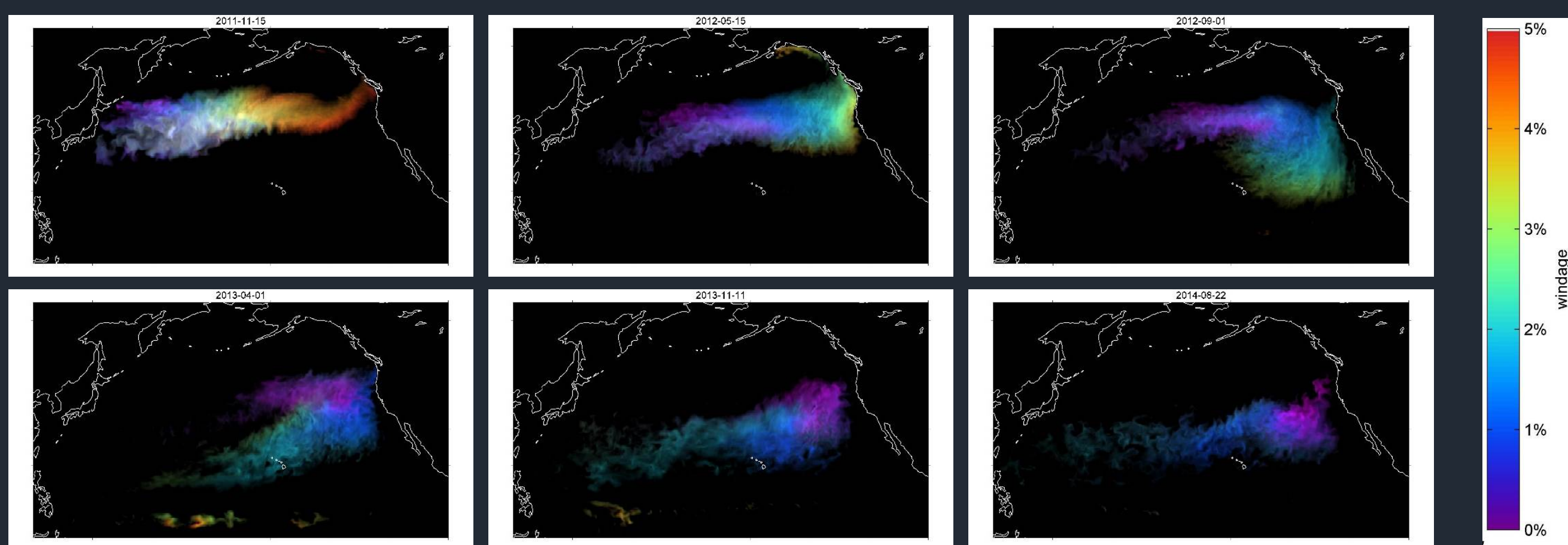


Photo credit: Will Soltau, LOS

Modeling Movement of Tsunami Debris

In the absence of a direct observing system capable of measuring concentration and trajectories of marine debris, models provide a framework to better understand the situation. Here a suite of numerical models was used to assess the movement of different types of debris under effects of ocean currents and atmospheric winds. The models successfully reproduced propagation of marine debris generated by the Japanese tsunami across the North Pacific and its arrival on the North American and Hawaiian coasts (see figure at left).

Future research will assess the current distribution and future fate of specific types of debris, such as skiffs and lumber, known to be often colonized by Asian species which may be capable of surviving the journey across the ocean.



Predicting debris drift: Motion of Japanese tsunami marine debris in SCUD model simulations from 2011-2014. Colors indicate windage of the debris (blue = low windage, red = high windage). Shown are maps, corresponding to November 15, 2011, May 15, 2012, September 1, 2012, April 1, 2013, November 11, 2013, and August 22, 2014.

Risks from Invasive Species

Species of Japanese origin attached to debris have the potential to impact ecosystems on the west coast of North America and Hawaii. Two docks that washed ashore in Oregon and Washington have been identified as tsunami generated debris (Oregon dock pictured at right). Combined they contained more than 140 living marine non-indigenous species which could potentially have impacts on the environment. Surveys of sites where these high-profile debris items landed will be conducted to monitor for establishment and spread of tsunami-debris associated species.

Further, since 2012, more than 250 debris objects with over 200 living Japanese biofouling species have landed in North America and Hawaii. Samples from existing and new debris items continue to be processed using both traditional taxonomy and genetic methods. Results will be used in a screening-level risk assessment to evaluate the risk these Japanese species associated with tsunami-debris could pose to North American ecosystems.



Photo credit: Bloomberg



Photo credit: Dana Cutler

Debris Hitchhikers: A surprising number of Japanese coastal species have been found live on debris washed up, such as the large floating dock on an Oregon beach (photo above). Stowaways including non-native kelp *Undaria pinnatifida* – top right - and striped beakfish *Oplegnathus fasciatus* – bottom right.



Photo credit: Travis Haring (WDFW)



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