

Monitoring marine debris from the March 11, 2011 tsunami in Japan with the diagnostic model of surface currents

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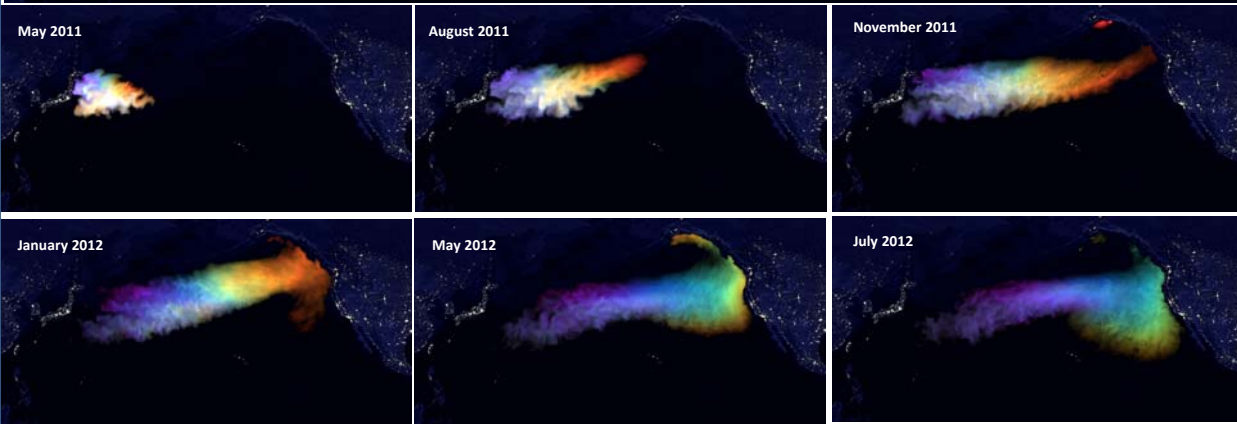
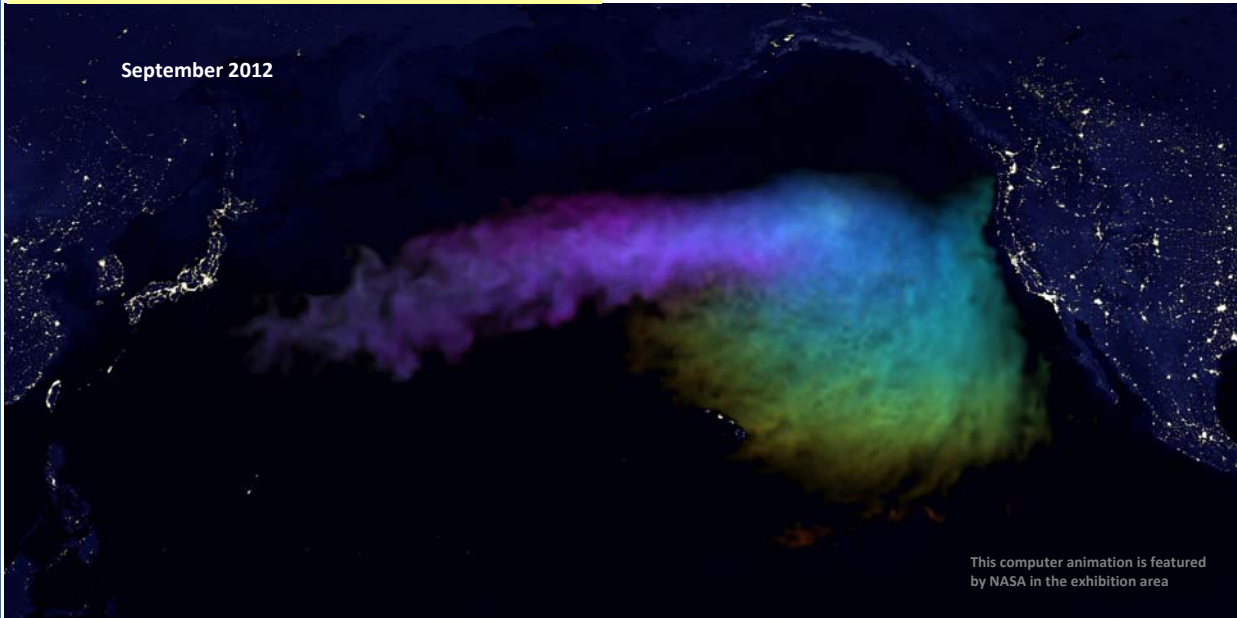
Project updates: http://iprc.soest.hawaii.edu/news/marine_and_tsunami_debris/debris_news.php, contact: maximenk@hawaii.edu

Near-realtime diagnostic model of near-surface ocean currents (SCUD²) is developed using the mean dynamic ocean topography² and satellite data of AVISO altimetry (sea level anomaly³) and IFREMER scatterometry (ASCAT vector wind⁴), with the coefficients optimized to reproduce concurrent velocities of drifting buoys, drogued at 15m depth⁵. Model experiments, simulating motion of debris from Tohoku area in Japan, are used to assess locations, patterns, and pathways of various kinds of debris. Effect of direct wind forcing on the objects with high profile are simulated by adding a part of wind velocity (windage) to the SCUD-estimated drift velocities. Model outcome is compared with reports of sightings of various types of debris.

A few weeks after tsunami, debris drifted off Japan shore, carried by the fast eastward-flowing ocean jets of the Kuroshio Extension and Subarctic Front. Westerly winds accelerated eastward drift of high-windage debris, which started coming on the US/Canada west coast as early as November 2011. From that time through April 2012, multiple reports have been published from British Columbia, Washington, and Oregon of unusual objects identified or suspected as tsunami debris from Japan. At the same the hardly accessible coastline of Alaska received unusually high amount of styrofoam and fishing buoys.

In Summer 2012, the volume of reports from the west coast went down. At the same time, the survey of the North Pacific, conducted by dozens of volunteer sailors, traveling to/from Hawaii, detected north, east, and northwest of the islands numerous objects (boats, docks, wood logs, containers, etc.) that were not memorable in previous years and, therefore, may be tsunami debris.

Our model, provides a framework that allows meaningful interpretation of fragmentary, scarce, and anecdotal information and helps project motion of tsunami debris in future months. According to this model, the flux of tsunami debris on the west coast has already passed its peak. Most of high-windage debris has already reached the west coast. Although development of the winter wind pattern will send additional debris towards the west coast, the main mass remaining in water will continue recirculating toward the south-southwest. Medium-windage debris is predicted to follow the trade winds through and around the chain of Hawaiian Islands, while low-windage debris will end in the convergent zone⁶ (so-called, "garbage patch"), where it will mix with older plastic. Recent reports on unusual objects in Hawaii support model prediction of the tsunami debris landfall in Winter-Spring 2012.



Colors on computer maps indicate windage of model tracer



Photographs show examples of marine debris from tsunami of March 11, 2011: 1-fishing gear, 2- wood, 3 - concrete docks, 4 - boats and ships, 5 - oyster buoys, 6 - plastic containers, 7 - styrofoam buoys, 8 - gas bottles

References
¹ Maximenko, N. A., and J. Hafner, 2010: SCUD: Surface Currents from Diagnostic model, IPRC Tech. Note 5, 17pp. http://aprcr.soest.hawaii.edu/projects/SCUD/SCUD_manual_02_17.pdf;
² <http://aprcr.soest.hawaii.edu/projects/DOT/>; ³ <http://www.aviso.oceanobs.com>; ⁴ <http://www.aoml.noaa.gov/phod/dac/index.php>;
⁵ Maximenko, N., J. Hafner, and P. Niller, 2012: Pathways of marine debris from trajectories of Lagrangian drifters. *Marine Pollution Bulletin*, 65 (1 - 3), 51-62, doi:10.1016/j.marpolbul.2011.04.016.

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