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Pathways of marine debris in statistical and diagnostic ocean circulation models

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Statistical and diagnostic models are used in this study to describe long-term dynamics of objects floating at the sea surface. The statistical model is based of the particle displacement probability density function, derived from trajectories of drifting buoys, and is supplemented by the probability of running aground. This model reveals five main areas of debris accumulation in the subtropical ocean, all confirmed with direct observations. It also reveals the global pattern of shores impacted by marine debris, correlated with dominant winds.

The diagnostic model (SCUD - Surface CUrrents from Diagnostic) utilizes satellite data of altimetry and QuikSCAT/ASCAT winds to assess near-real time surface velocities and its parameters are optimized using drifter trajectories.

Numerical experiments with various sources and life times of the model debris help to understand main pathways of the tracer and distributions of its properties within and across individual oceans.

Applications of statistical and diagnostic models help to assess probable motion of the debris, generated in Japan by tsunami of March 11, 2011. The timeline, derived from the statistical model, and maps, computed with SCUD, are used to coordinate operational at-sea and on-coast observations and preparations for the debris impact. Most of debris is drifting from Japan towards east, while dispersing over increasing area. After passing Hawaii in the north it is expected to recirculate into the so-called North Pacific Garbage Patch - the area, located between Hawaii and California, where convergent surface currents collect all floating waste. Only a small fraction of tsunami debris, on the edge of the debris field, will "touch" Hawaii and US/Canada west coast. Yet the amount and composition may be anomalous. Mixed with the older waste, tsunami debris will slowly leak from the patch, polluting Hawaiian Islands.