Transport of marine debris in North Pacific: the case of Hawaii
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Introduction
Studies of marine debris transport over large distances are very limited. Long-term position tracking is required to collect the necessary data. In general the transport of marine debris is determined by the surface ocean currents and winds. The effect of wind on marine debris motion is called windage; high windage debris is affected by the wind more than low windage type. The 2011 tsunami in Japan was a very tragic event that generated a large amount of unusual debris. Data of tsunami debris were used as an experiment of the nature and many pieces could be directly traced back to origin (e.g. registration numbers on boats). SCUD (Surface Currents from Diagnostic model) model was employed to simulate the drift of tsunami debris from the coast of Japan across the N. Pacific to Hawaii.

Japanese Tsunami 2011
We applied SCUD model to simulate the drift of Japanese Tsunami Debris (JTMD) across the North Pacific Ocean. Virtual tracer was placed along the East coast of Japan and its magnitude was weighted by the reported number of damaged houses. Then the tracer was advected by model currents and winds. As to the effect of wind it was considered in the 0-5% range (0-5% windage).

The source function along the East Japanese Coast

Formulation of the diagnostic model
SCUD

$$\frac{\partial h}{\partial t} + \nabla \cdot (h \mathbf{V}) = h \mathbf{V} \cdot \nabla \mathbf{V}$$

$$\mathbf{V} = \mathbf{V}_i + \mathbf{V}_w$$

Where:

- \( h \) = sea level anomaly
- \( \mathbf{V} \) = total ocean current (modelled current components + surface wind)
- \( \mathbf{V}_i \) = modelled ocean current components
- \( \mathbf{V}_w \) = surface wind components
- \( \mathbf{V}_w \) = constant coefficient (mean)
- \( \mathbf{V}_w \) = component coefficients corresponding to local gradient + surface wind (function of x and y only)
- \( \mathbf{V}_w \) = component coefficients corresponding to local gradient + surface wind (function of x and y only)

Model solution

Timeline of JTMD in Hawaii

2012

Timeline of JTMD in Hawaii

2013

Timeline of JTMD in Hawaii

2015

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