

Emergency Ocean-Surface Environmental Monitoring and Drift Simulation of Marine Debris arising from the 2011 Great East Japan Earthquake

Purpose

The purpose of this work is to perform a numerical simulation toward the better identification and characterization of the pathways of drifting matters washed out following the tsunami arising from the Great East Japan Earthquake in 2011, forecast their cloud distribution by using the leading-edge data assimilation systems, assess our potential with satellite imagery and other in-situ observational reports, and provide greater information useful for the required adaptation policies and scientific understanding of debris movements than that obtained from earlier methods. This presentation is in line with the proper provision of information to the nations concerned and supports the ongoing collaboration with the USA.

Simulation Results

The new type of the debris that has the vertical profile of “beneath sea surface: above sea surface=1:4” is calculated in this year, in addition to the previous types with the profile of 1:0, 1:1, and 1:2. For the ocean current and surface wind field, MOVE and JCDAS datasets are used until June 2012 as a “reanalysis dataset”, while the dataset derived from K7 are used for forecast experiments from July 2012. Figures 1 shows the simulation results on April 15, 2012, and Figures 2 and 3 show the prediction results on October 15, 2012 and April 15, 2013, respectively.

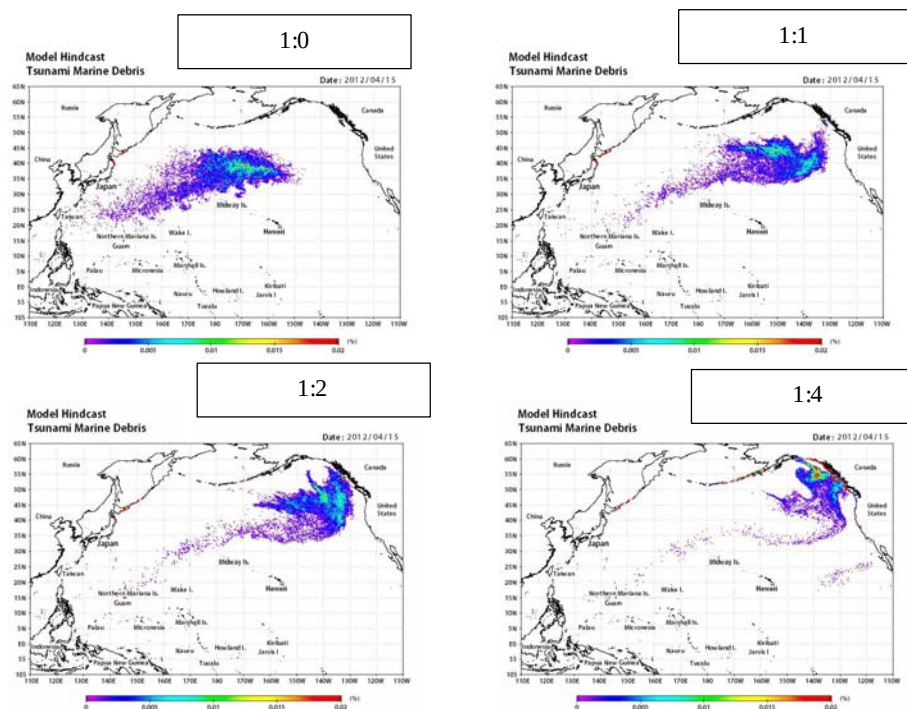


Figure 1. Distributions of marine debris (four types) on April 15, 2012. The color of each panel represents percentage (%) of particles in a computational grid against the total particles released.

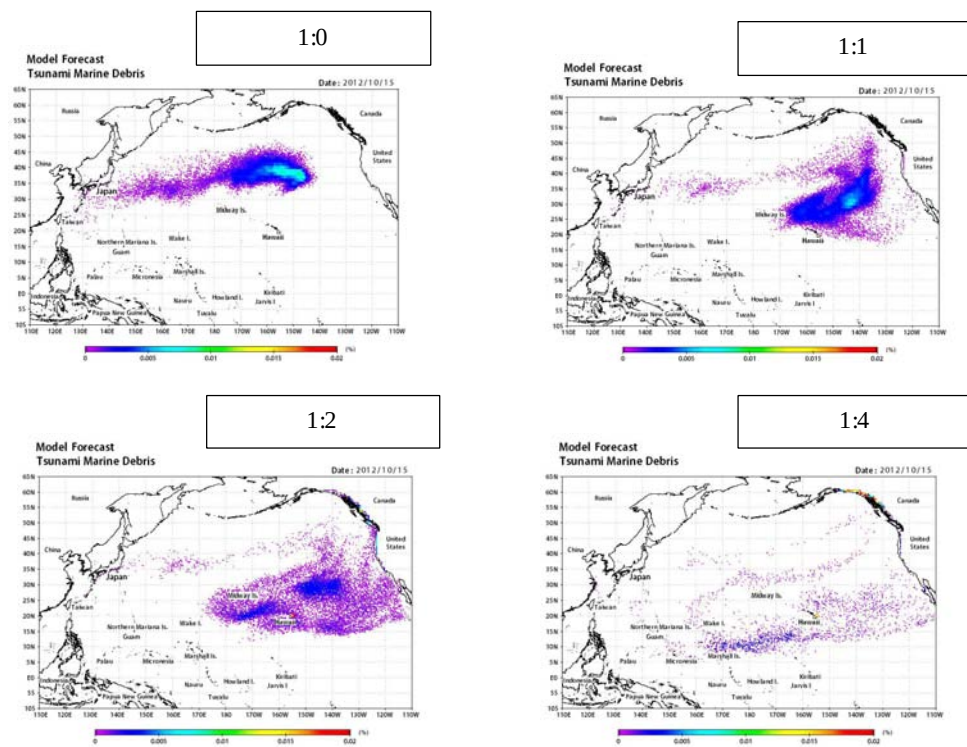


Figure 2. Same as Fig. 1, but for Oct. 15, 2012.

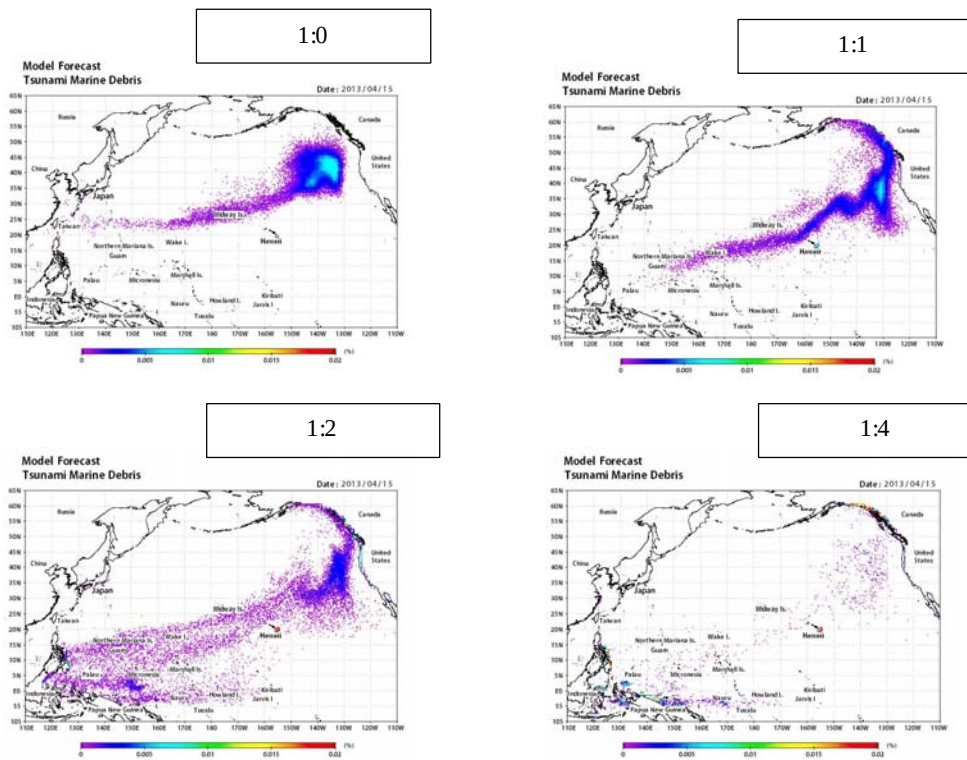
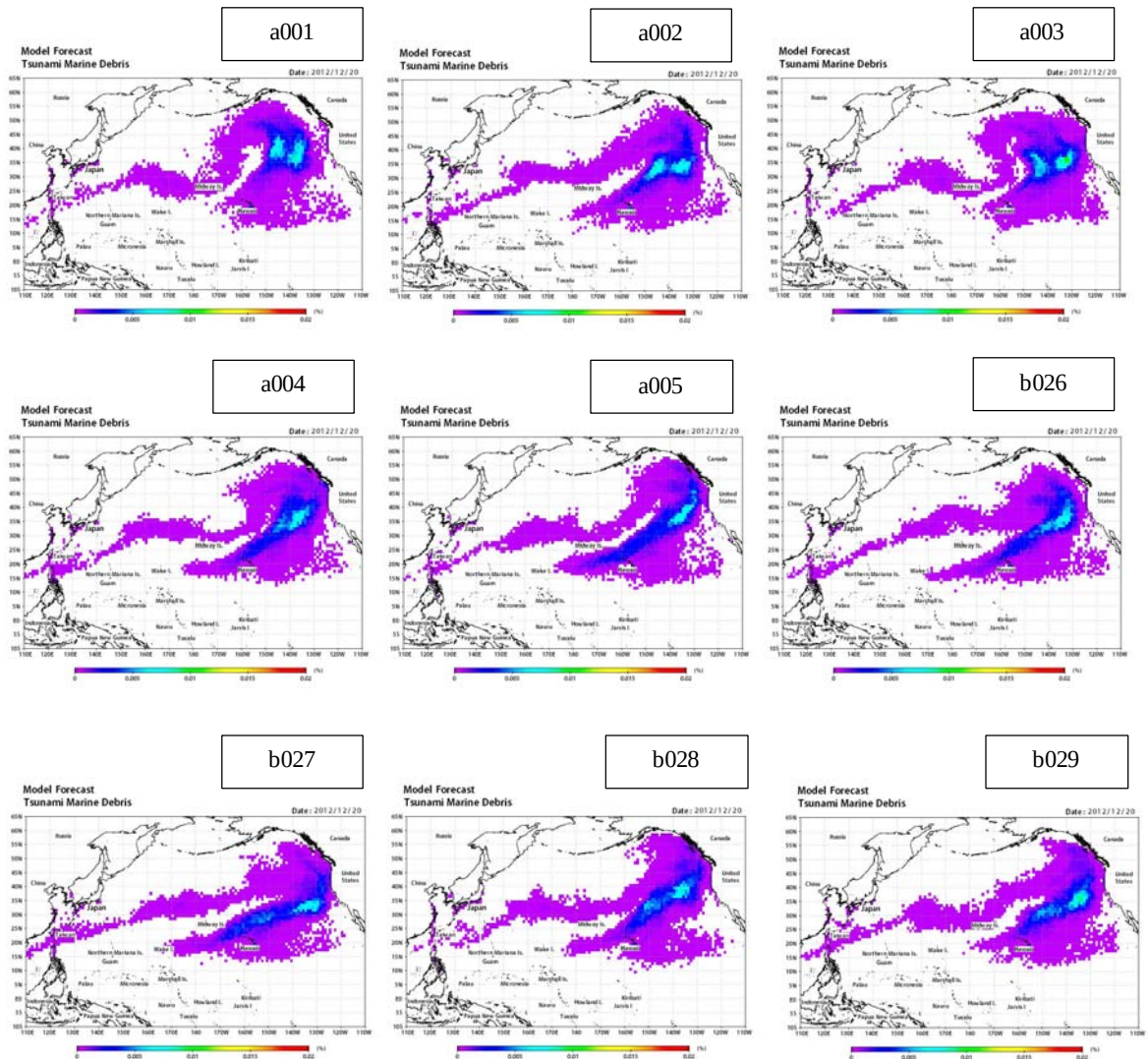


Figure 3. Same as Fig. 1, but for Apr. 15, 2013.

Ensemble prediction

In this year, in order to reduce the uncertainty inherent in the coupled ocean-atmosphere forecast, we have further performed an ensemble prediction from June in 2012, by using the Lagged Average Forecast (LAF) approach (Hoffman and Kalney, 1983) with eleven ensemble members. Also, to assess the present ensemble prediction, the marine debris simulation has also been performed by using the reanalysis data of MOVE ocean current and JCDAS sea surface wind until December, 2012.

Figure 4 shows the result of the ensemble prediction in December, 2012, for the standard marine debris case (1:1). The bottom right panel shows the analysis obtained from the MOVE reanalysis field. Note the presence of large dispersion among the eleven ensemble members as shown in Fig. 4 (a001 to b031) suggests the good ensemble forecast. The bottom left panel shows the ensemble mean distribution, which exhibits the broad agreement with the corresponding MOVE reanalysis result (bottom right panel).



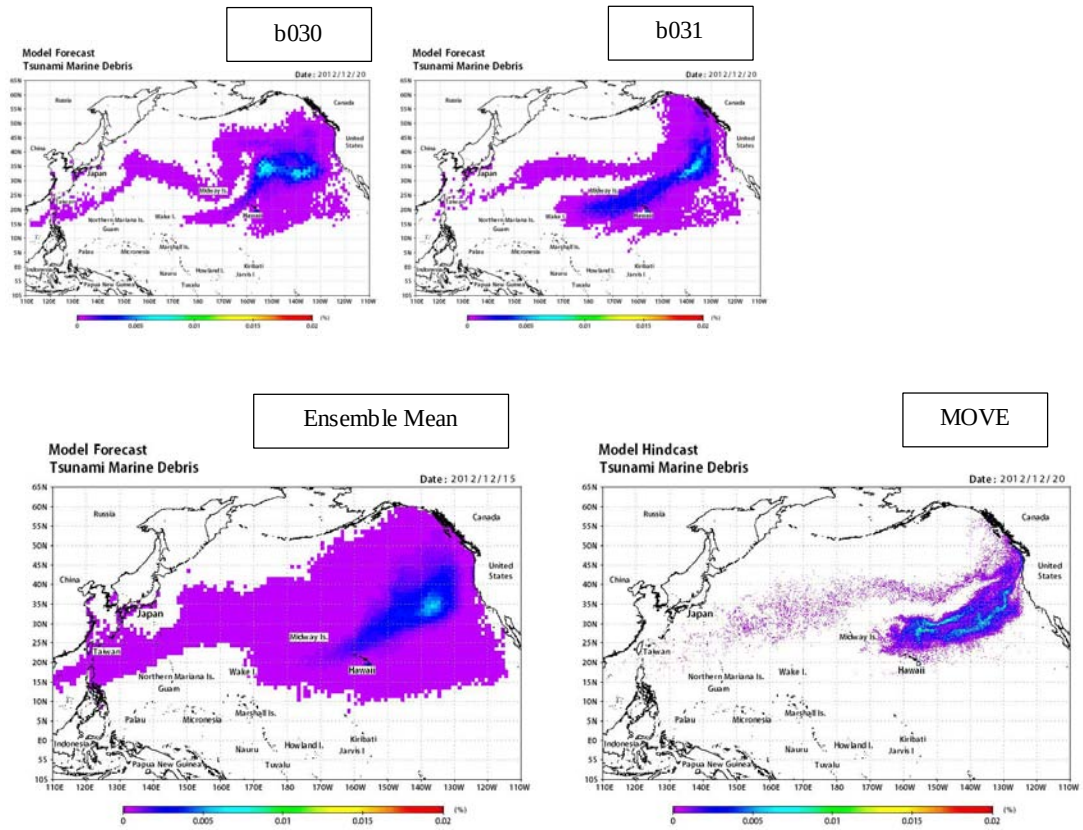


Figure 4. Calculation results of the standard marine debris case obtained from the ensemble prediction approach on December 15, 2012. Each forecast result of the ensemble member is shown in a001 - b031 together with the ensemble average result (bottom left panel). The bottom right panel shows the corresponding particle distribution obtained by the MOVE reanalysis field.