

Modeling distribution of marine debris before and after tsunami of March 11, 2011

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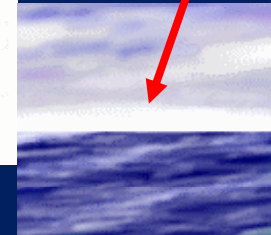
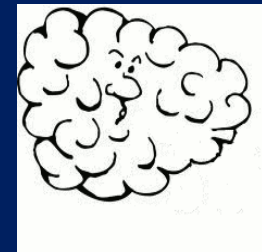
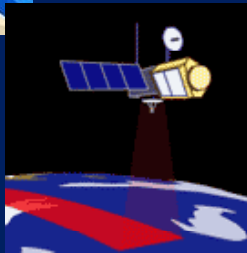


1. **SCUD** = Surface CUrrents from Diagnostic model

SCUD - Surface CUrrents from Diagnostic model

AVISO sea level

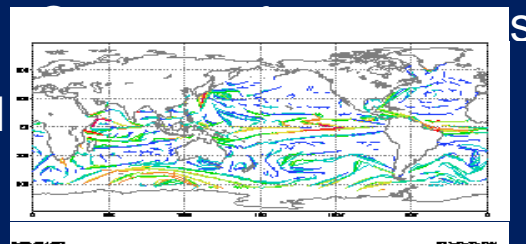
QSCAT/ASCAT ocean surface wind



SCUD



Daily maps of ocean surface currents on 1/4 deg. lon/lat grid



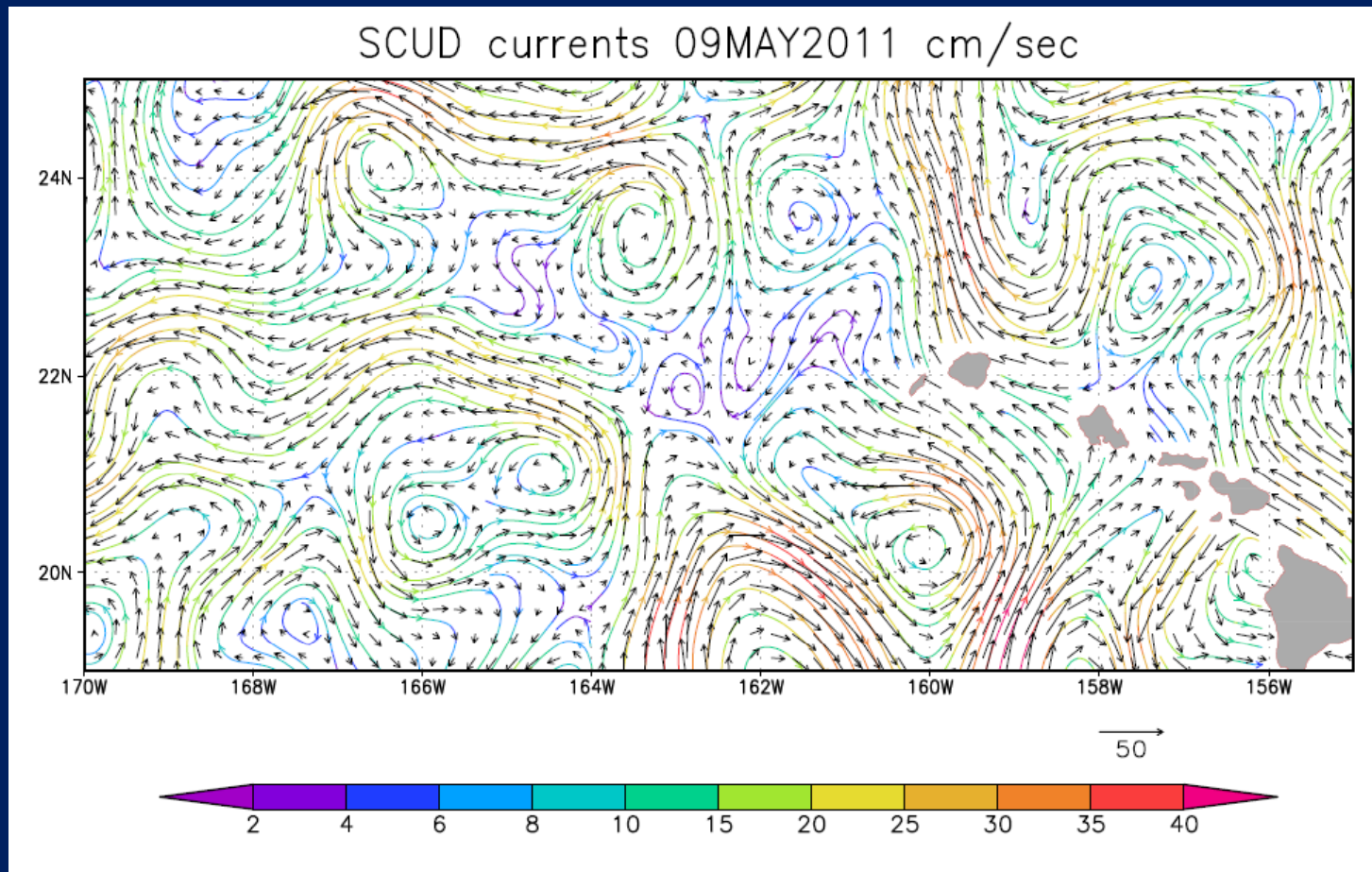
Starting 01 AUG 1999
ending 18 NOV 2009
extended into real time

Technique

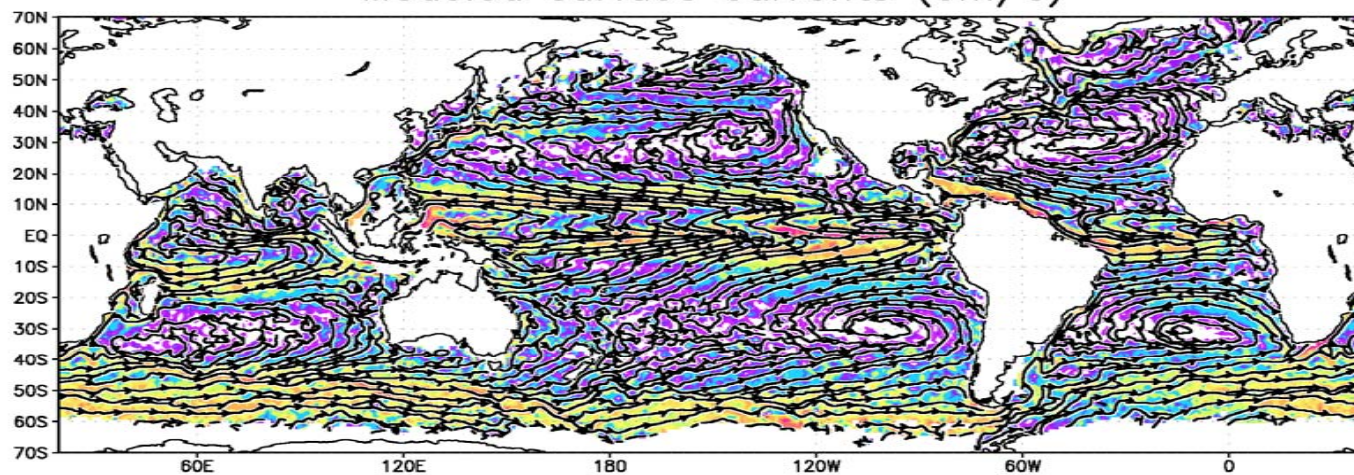
$$U_{\text{SCUD}}(x,y,t) = U_0 + u_{hx} \cdot \nabla_x h(x,y,t) + u_{hy} \cdot \nabla_y h(x,y,t) + u_{wx} \cdot w_x(x,y,t) + u_{wy} \cdot w_y(x,y,t),$$

$$V_{\text{SCUD}}(x,y,t) = V_0 + v_{hx} \cdot \nabla_x h(x,y,t) + v_{hy} \cdot \nabla_y h(x,y,t) + v_{wx} \cdot w_x(x,y,t) + v_{wy} \cdot w_y(x,y,t) ,$$

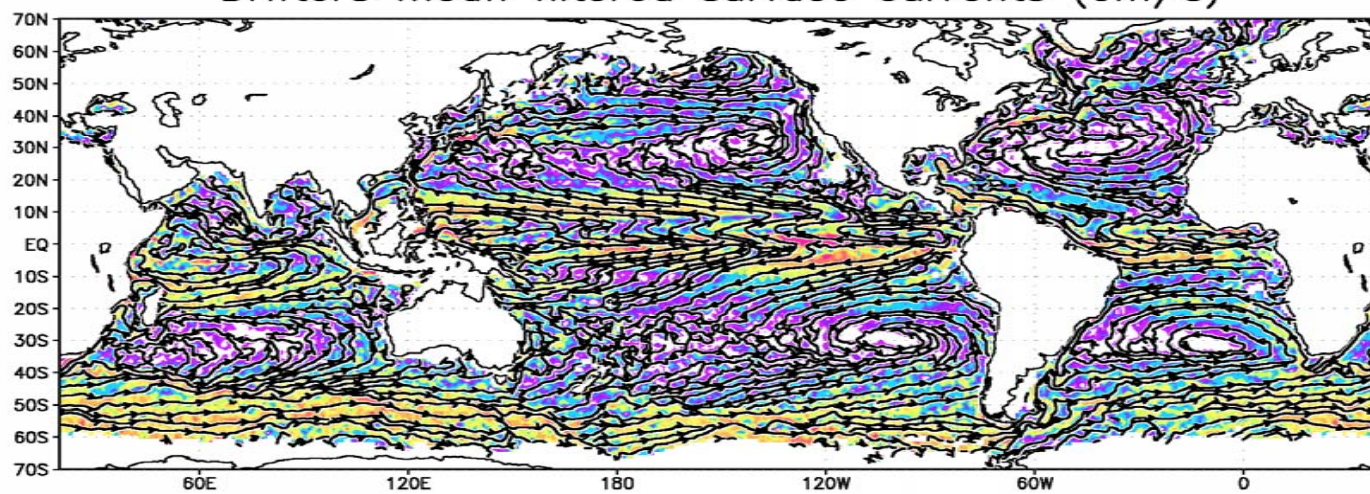
Example of SCUD surface currents on June 9, 2011



Modeled surface currents (cm/s)

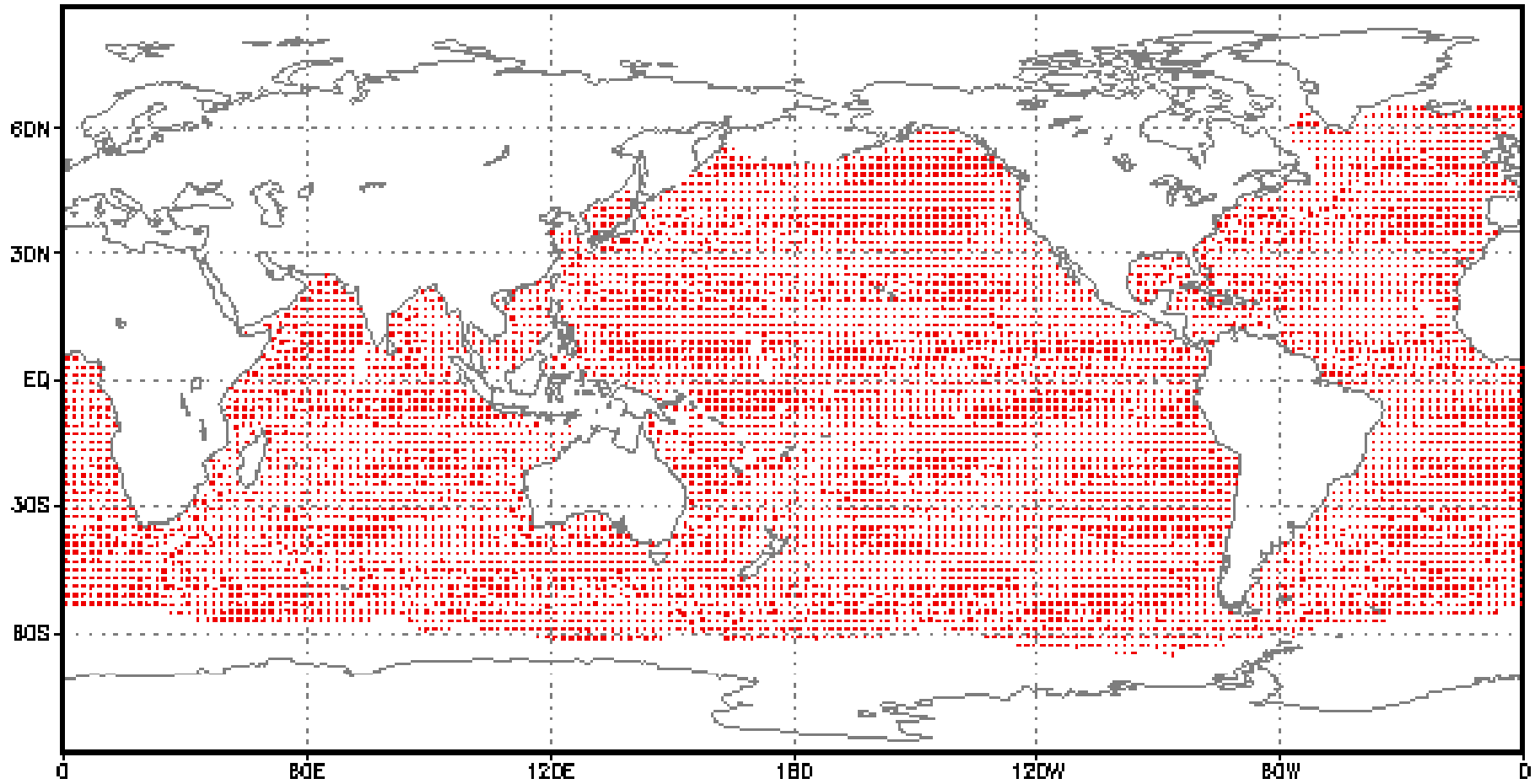


Drifters mean filtered surface currents (cm/s)

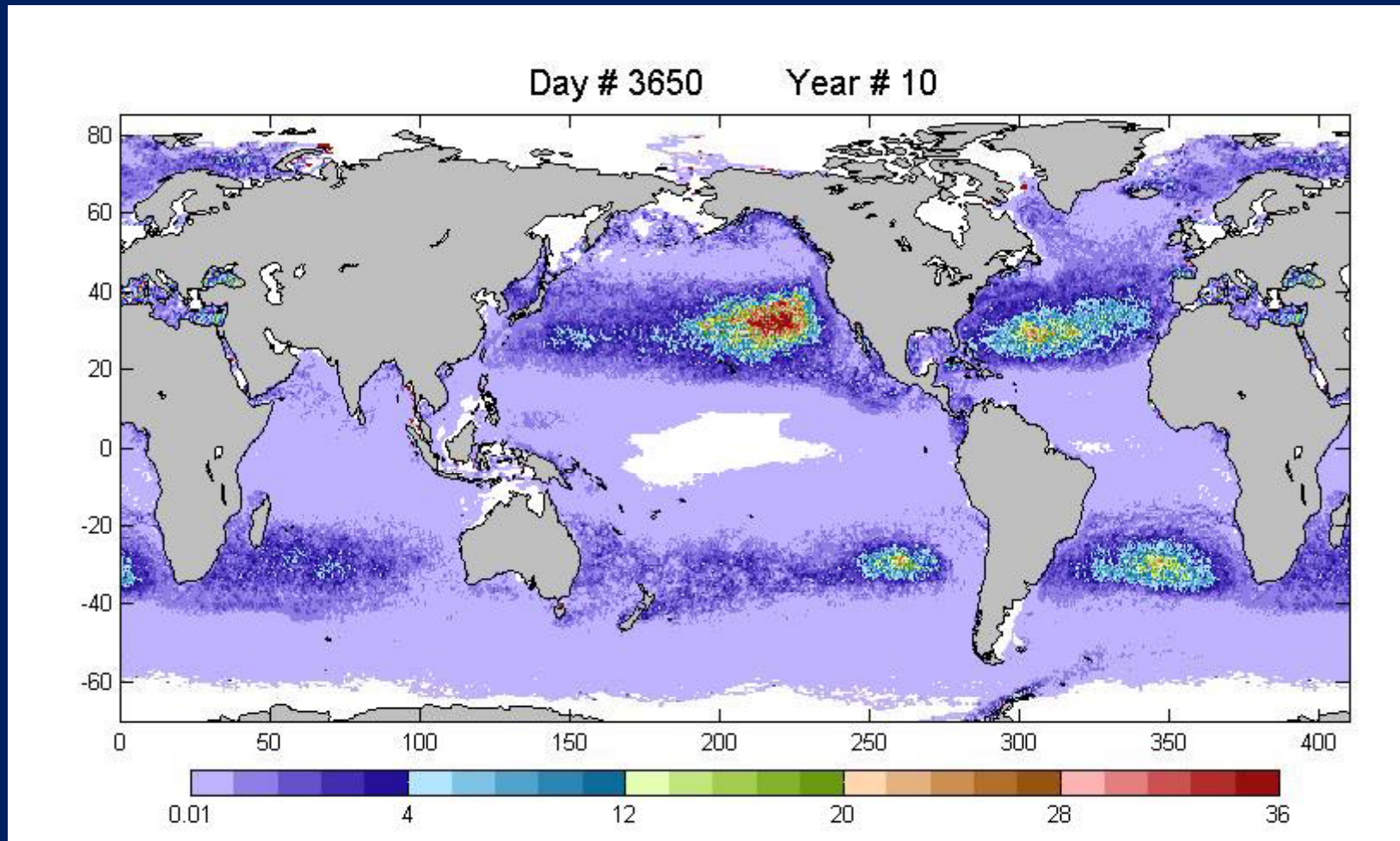


2. Pathways of marine debris

1999-08-02



UH: Model debris distribution from coastal sources (without tsunami)

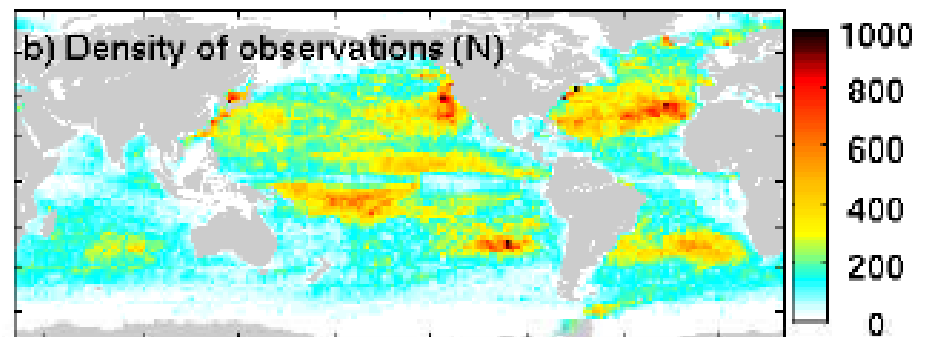
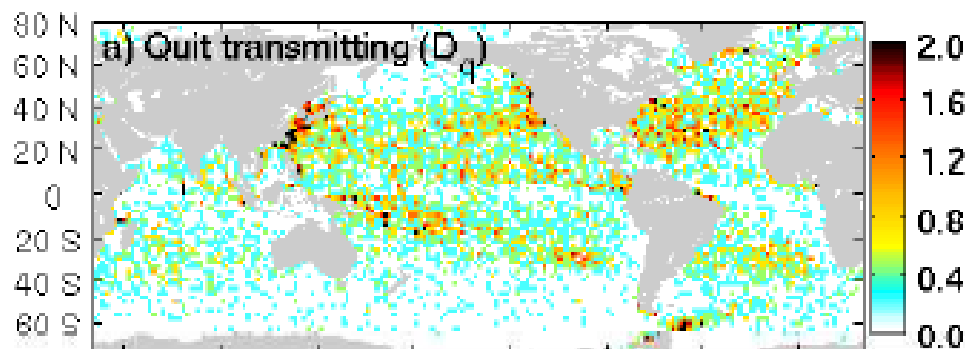
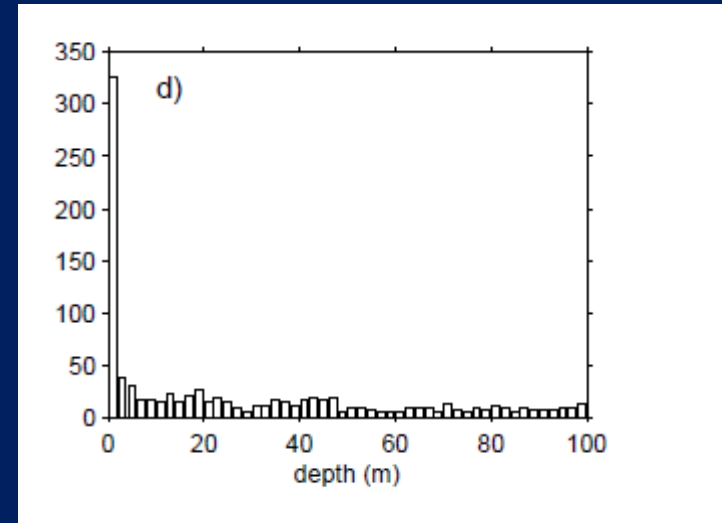
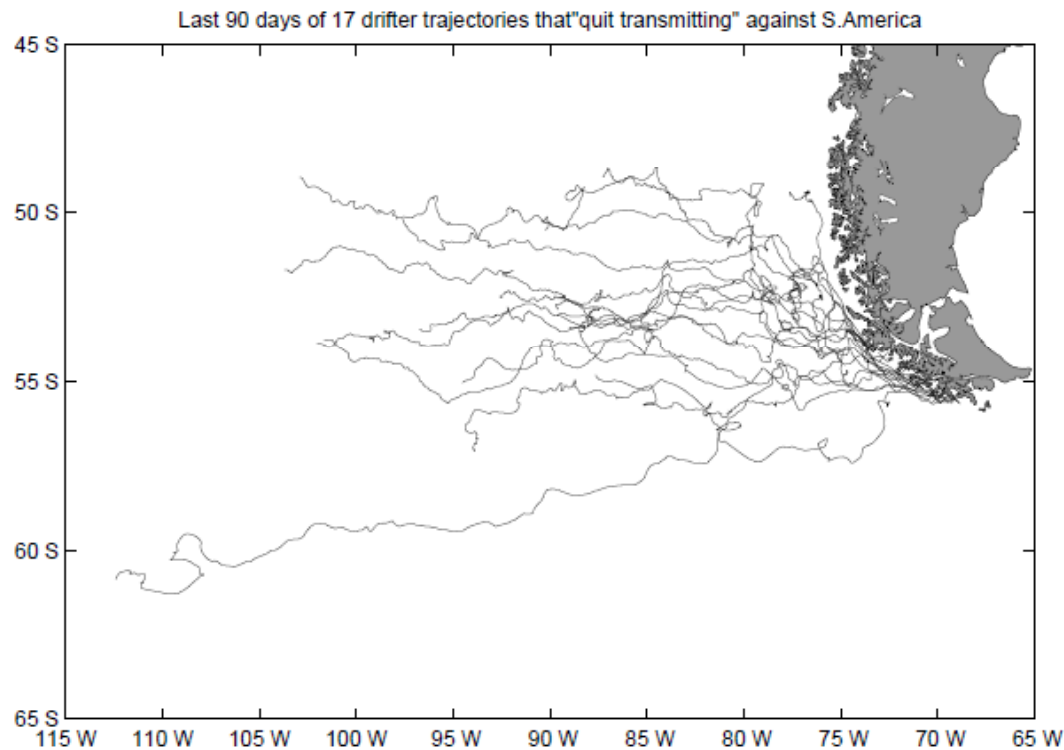


Collaborations with the SEA, “5 Gyres”, KAISEI/Ocean Voyages, Jim Mackey et al. helped to validate accumulation of microplastic in all five subtropical convergences

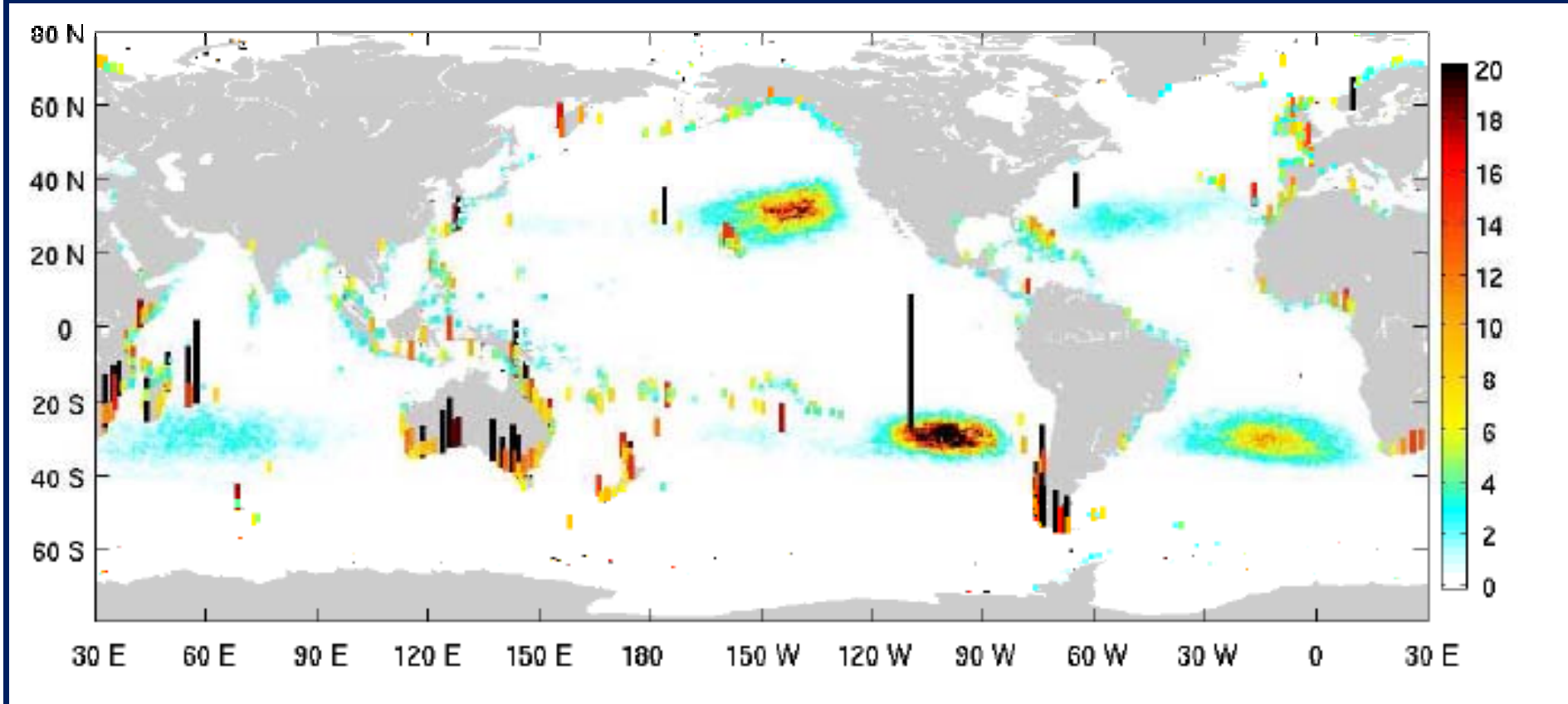
3. Debris deposition on shore

Drifters' end of lives: "stopped transmitting" group includes many "ran aground buoys"

Number of "quit transmitting" drifters as a function of local depth

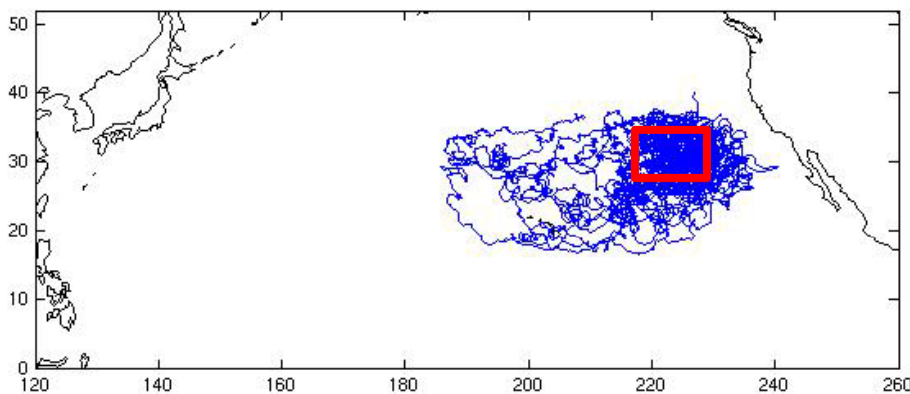
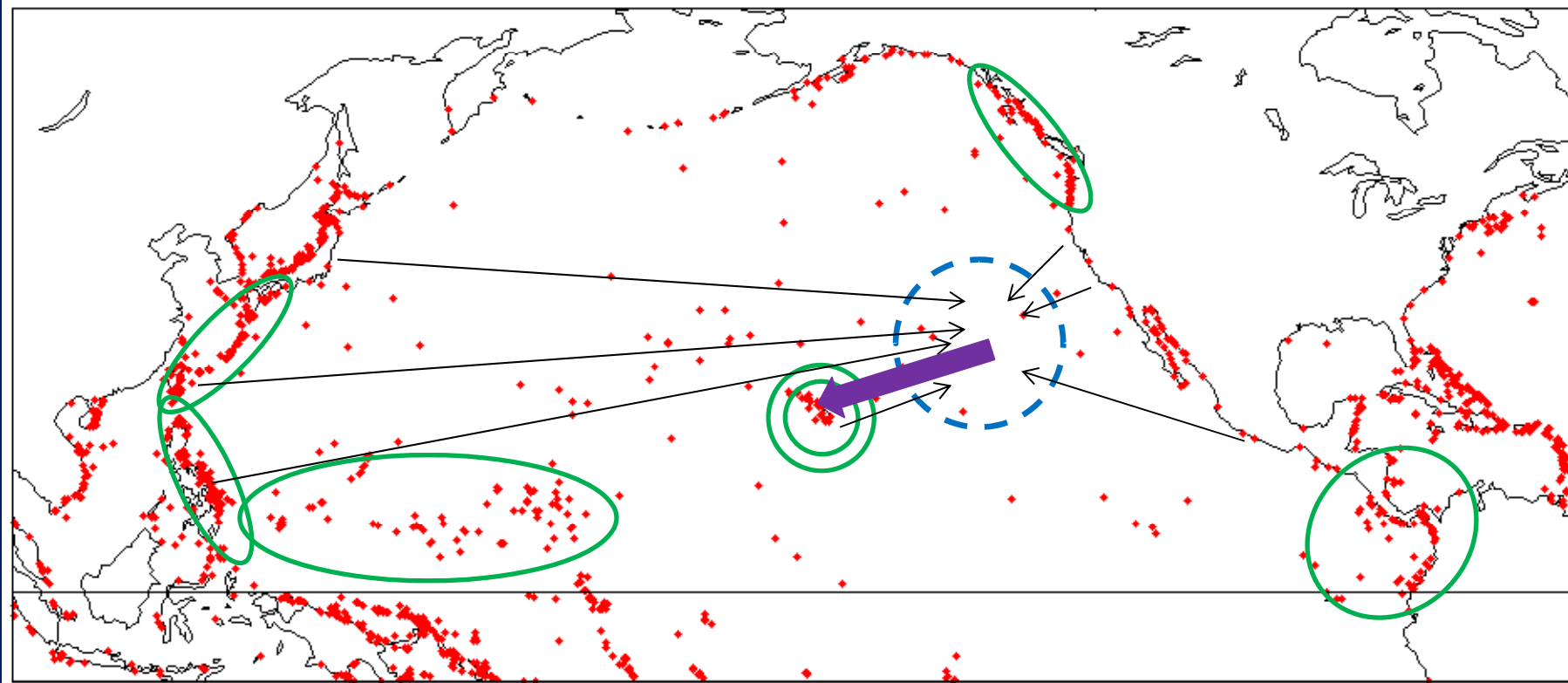


Model debris in water and on shore after 10 years of integration from initially homogeneous condition



Lumpkin et al (JTECH, under review)

Sinks of debris in the North Pacific. Red dots show grounded drifters.



Trajectories of drifters starting from the North Pacific convergence

4. Debris from March 11, 2011 tsunami

March 11, 2011 tsunami in Japan



March 11, 2011 tsunami in Japan



LIVE

BREAKING NEWS

NHK WORLD

TSUNAMI HITS



LIVE

BREAKING NEWS

NHK WORLD

TSUNAMI HITS



LIVE

BREAKING NEWS



LIVE

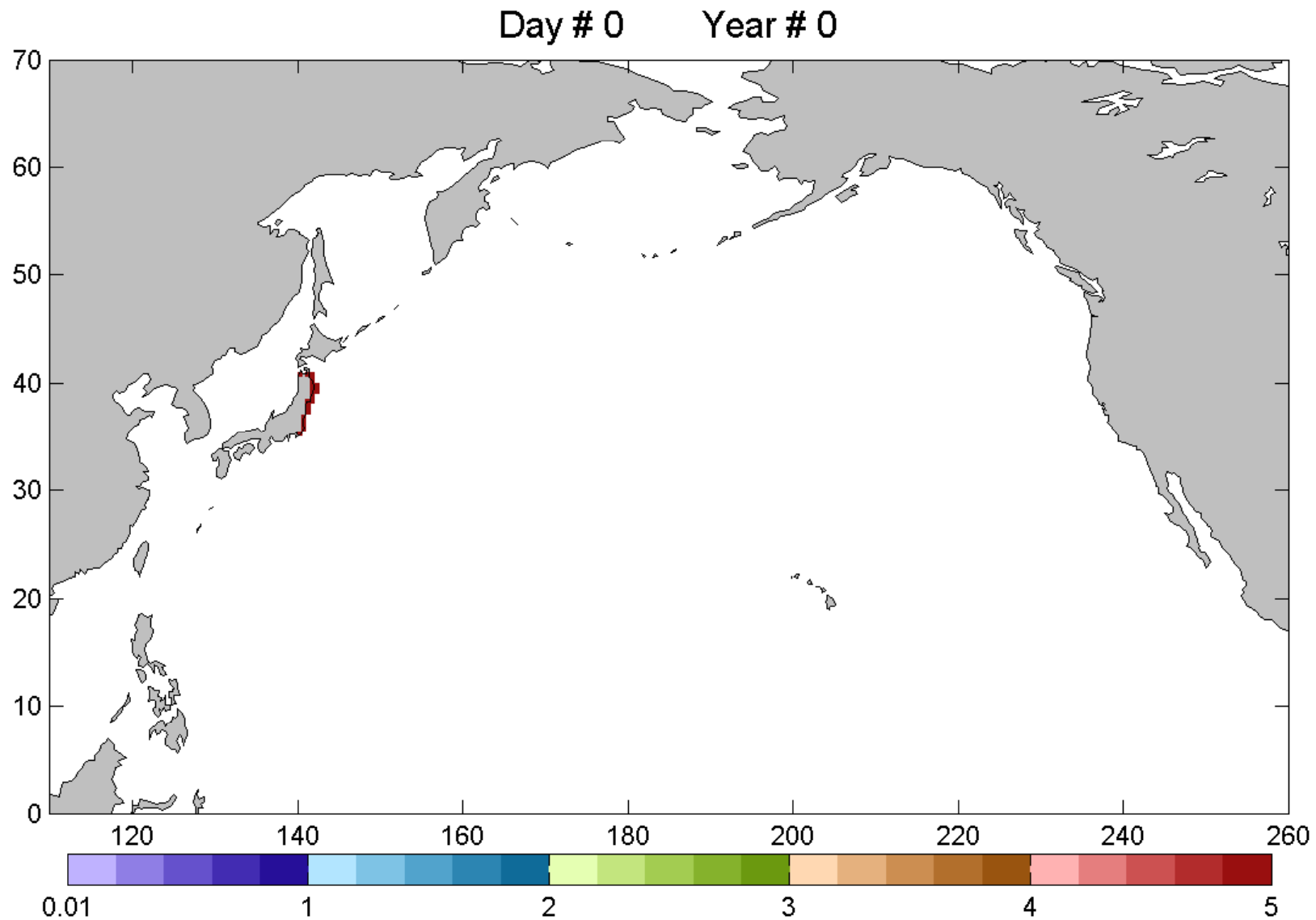
BREAKING NEWS

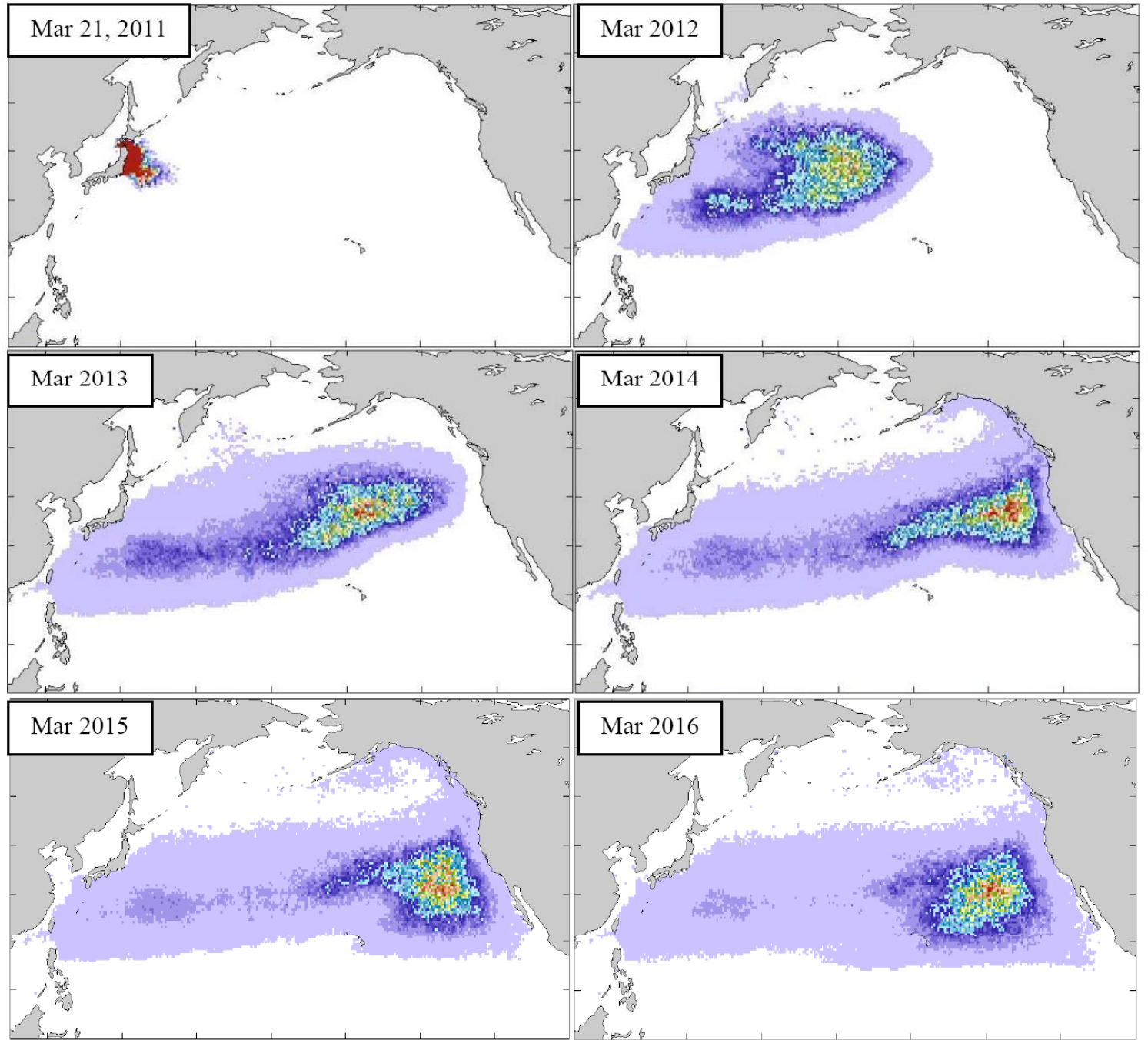
Photos of debris plume off Honshu after March 11, 2011 tsunami



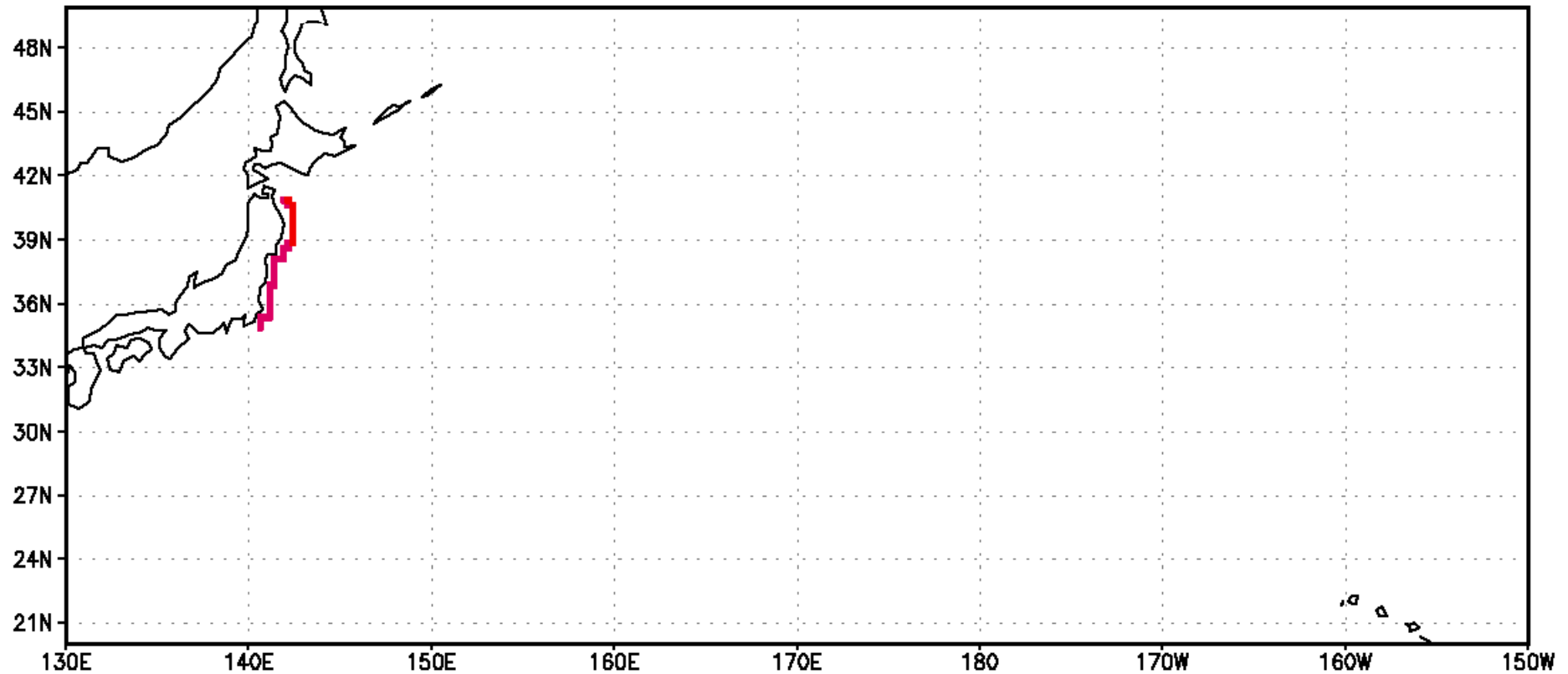
Courtesy of US Navy

Statistical model simulation of debris propagation released along the eastern shore of northern part of Honshu, Japan





00Z 11 MAR 2011



Daily public updates are available
at http://iprc.soest.hawaii.edu/users/hafner/PUBLIC/TSUNAMI_DEBRIS

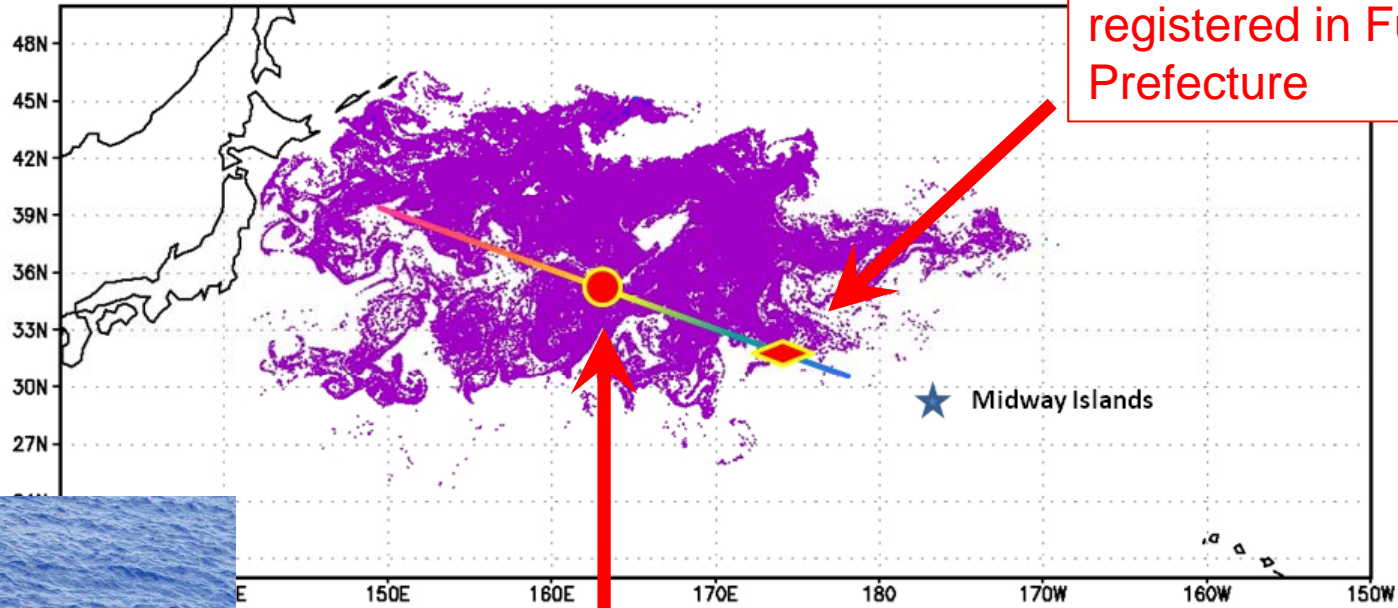
"Pallada"



“Pallada” found tsunami debris where SCUD predicted



00Z25SEP2011



Small fishing boat,
registered in Fukushima
Prefecture



Observed maximum
density of debris

