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Marine debris movement and concentration within the North Pacific Ocean

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Overview

- Marine debris
- Mechanisms for N. Pacific marine debris concentration, transport, and retention
- Mesoscale features
- Japan tsunami marine debris

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Marine Debris


NOAA MDP


NOAA SEFSC

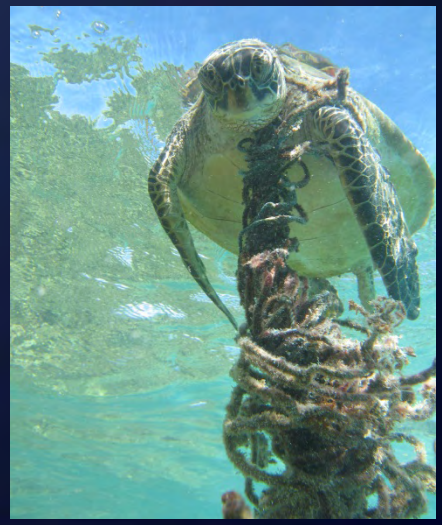

NOAA MDP


NOAA MDP

NOAA and the US Coast Guard define marine debris as…
"any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment or the Great Lakes."

Impacts include…

- Eyesore on shores
- Habitat damage
- Entanglement
- Ingestion
- Alien species transport
- Navigation hazard
- Human health and safety
- Economic cost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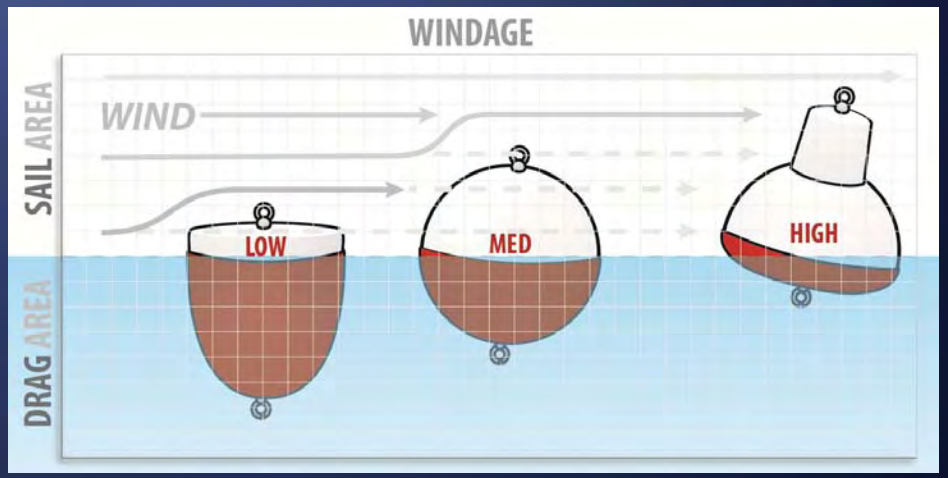
Marine Debris Movement

Characteristics of a debris item will affect how it moves with ocean currents and winds.

Windage = Combination of sail area and drag

- **Low** = slow (e.g., wood)
- **Medium** = moderate (e.g., fishing vessel)
- **High** = fast (e.g., unoccupied inflatable life raft)



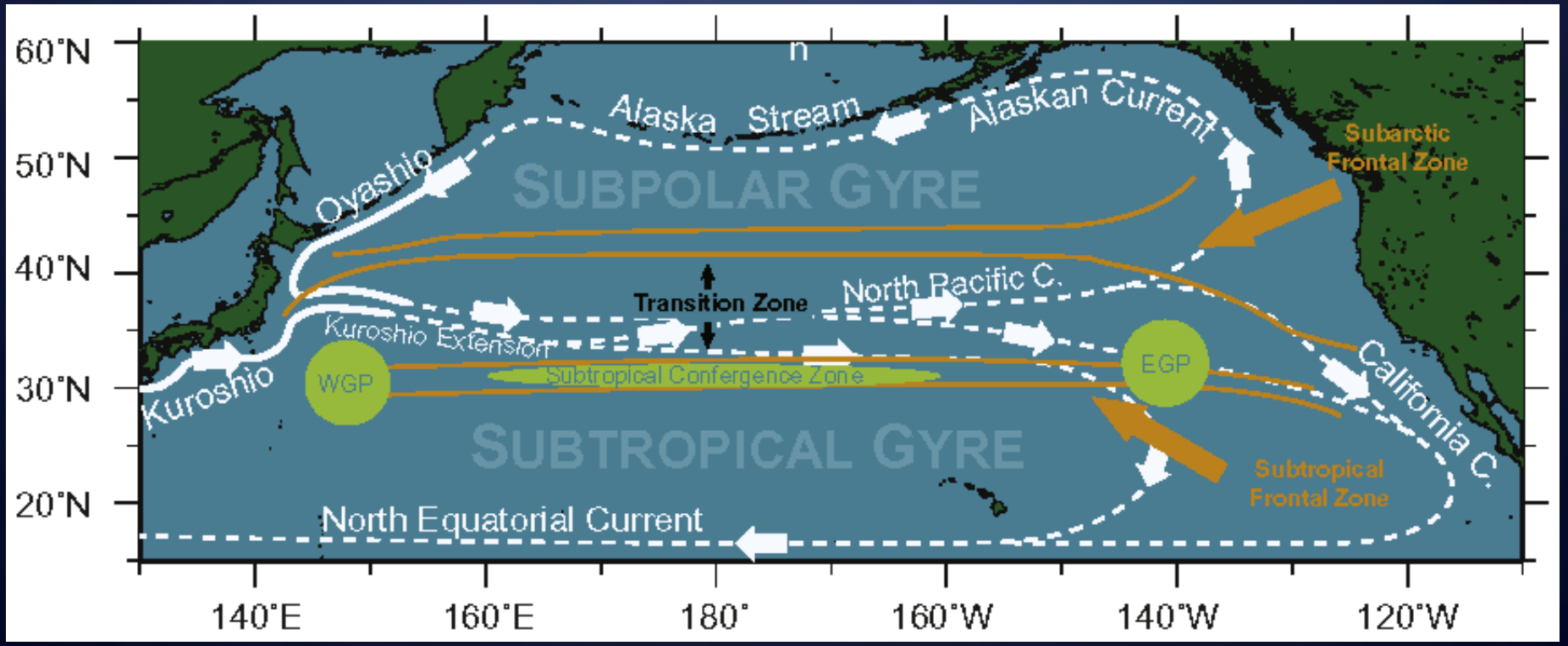
NOAA PIRO Observer Program

U.S. Coast Guard

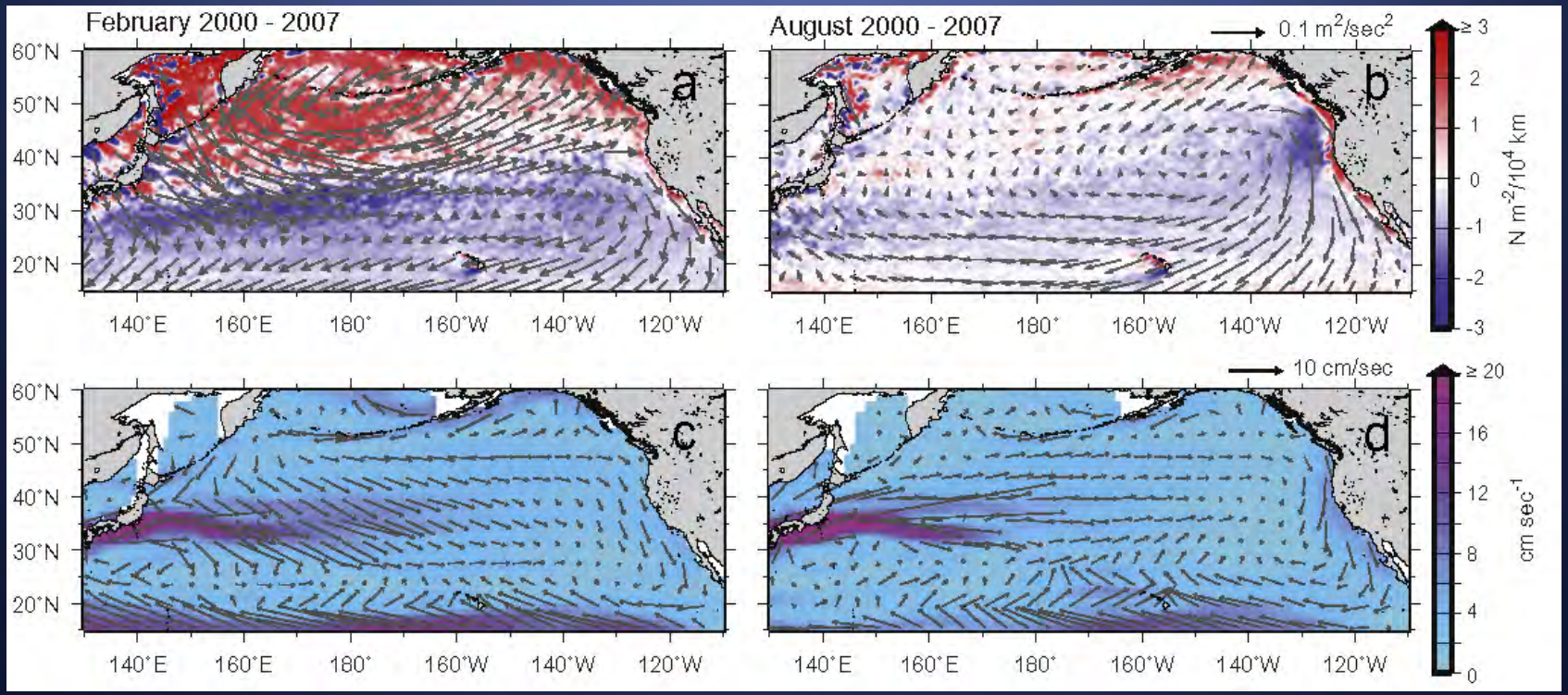
Sundstrom, RGBstock

Marine Debris Movement & Concentration

- Large and mesoscale climatological Spatial patterns
- Temporal variability (decadal, interannual, seasonal)



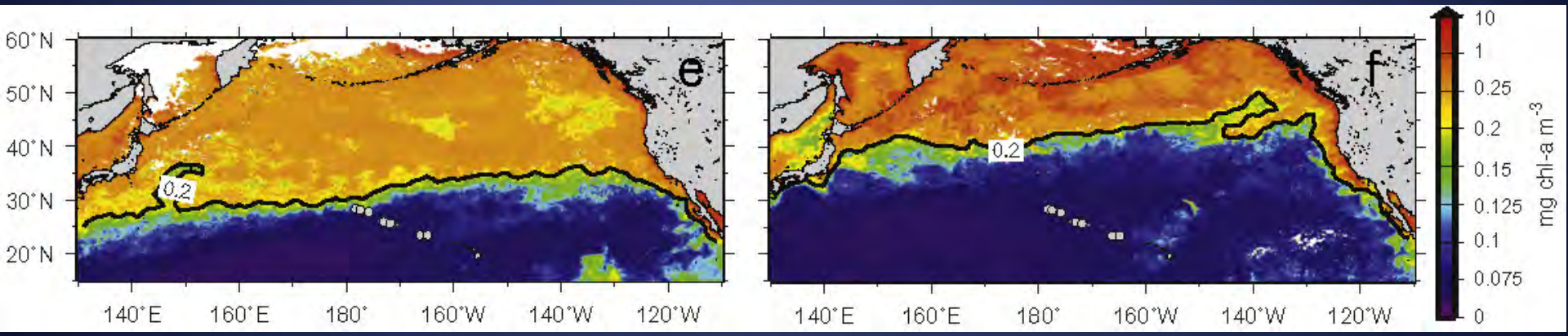
Climatological Wind/current patterns



Seasonality to wind fields – these affect surface currents in the North Pacific

Winds and resultant ocean currents transport debris and form large scale convergent areas that collect marine debris

N. Pacific Transition Zone & Subtropical Convergence Zone



- Southern edge of Transition Zone = Subtropical Convergence Zone
- Indicator = Transition Zone Chlorophyll Front

- Concentration of active and passive matter, including marine debris
- Mainly winter and early spring (Donohue et al., 2001; Donohue and Foley, 2007; Pichel et al., 2007; Polovina et al., 2001; Seki et al., 2002)
- Increased deposition of marine debris in the Northwestern Hawaiian Islands during El Nino, when STCZ nears islands (Donohue and Foley, 2007; Morishige et al., 2007)

“Great Pacific Garbage Patch”

- Climatalogical atmospheric high pressure zone; N. Pacific Subtropical High
- Anticyclonic surface currents
- Known area for marine debris concentration
- Anecdotal and scientific data to support
- Much of the debris found here: microplastics and small plastic pieces

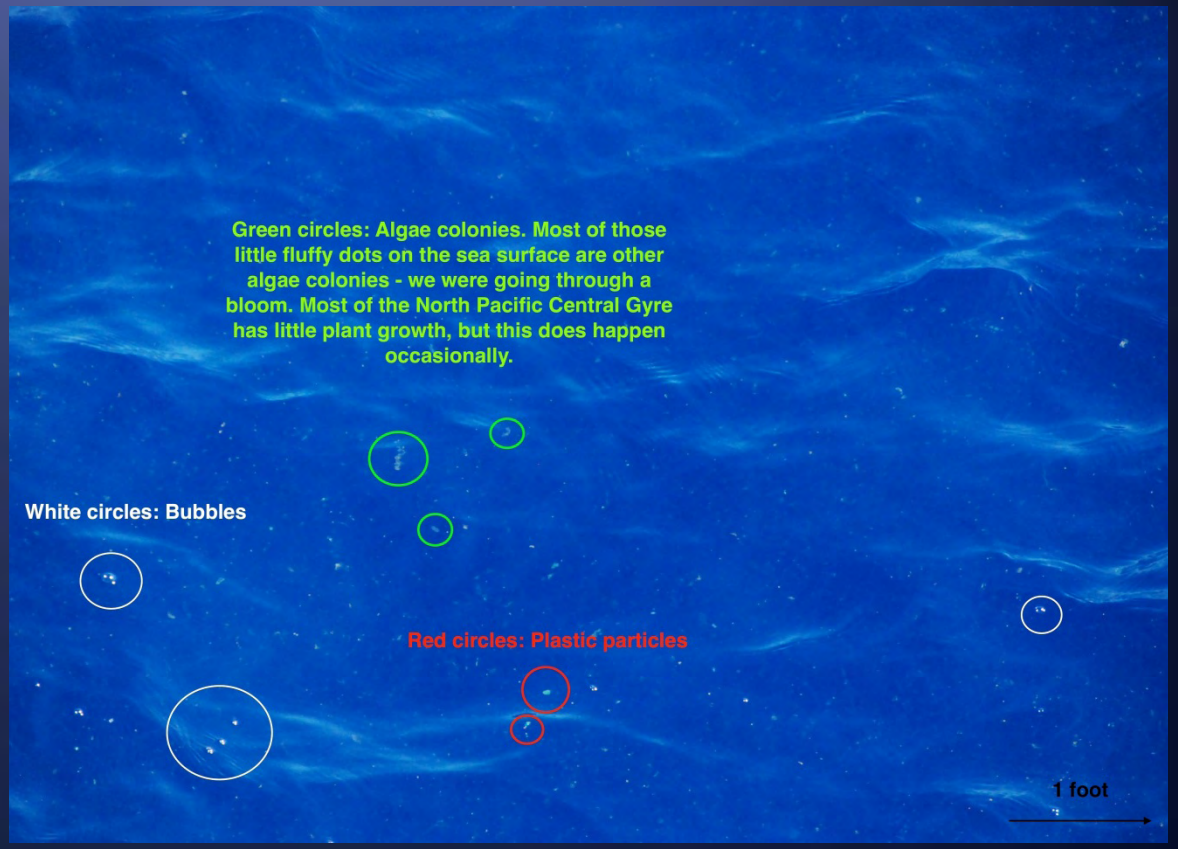
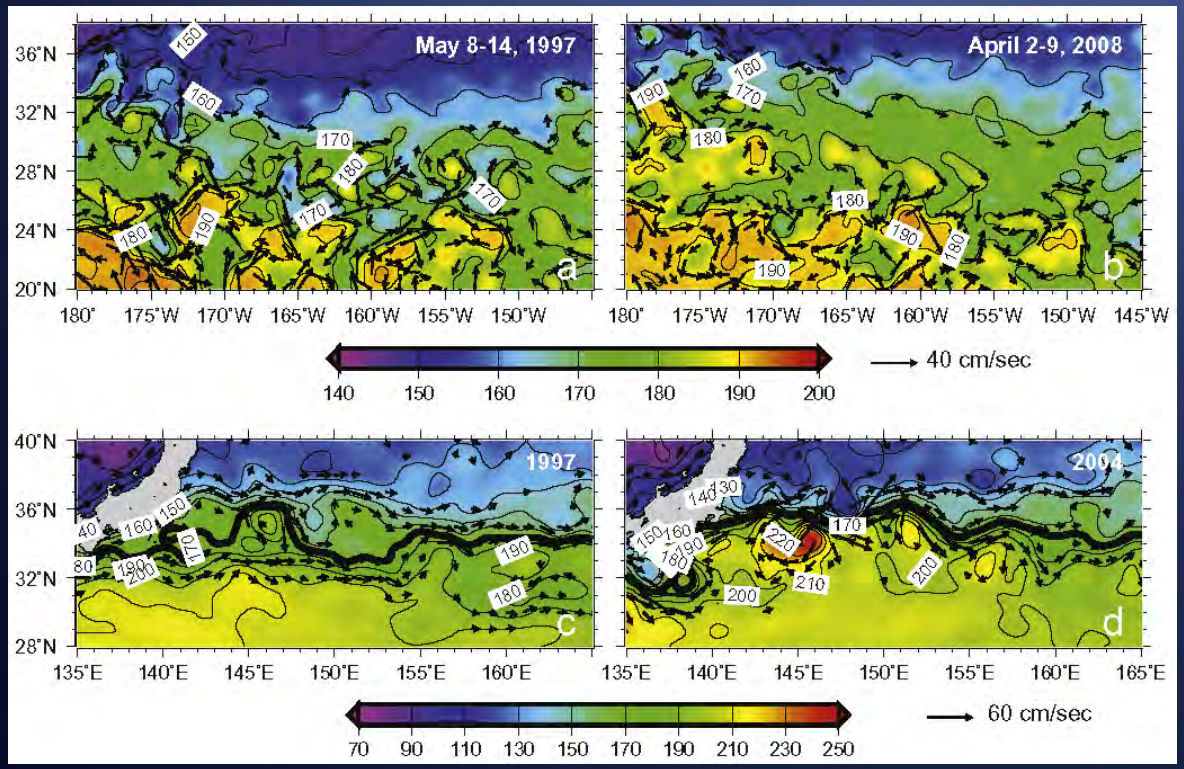


Photo of ocean surface within the area of the “garbage patch”.
Credit: NOAA Okeanos Explorer

Western Pacific “Garbage Patch”



- Southeast of the Kuroshio Extension
- Semi-permanent, closed recirculation gyre
- Known area of marine debris concentration (Young et al., 2009; Yamashita and Tanimura, 2007; Day et al., 1990)
- Presumably similar debris type accumulation as in the Eastern GP

Japan Tsunami Marine Debris

- 11 March 2011 tsunami
- NOAA and NASA tracked debris fields until 14 April 2011 – debris dispersed
- Estimated 5 million tons swept into the ocean (Govt. of Japan, 2011)
- ~70% sank nearshore (Govt. of Japan, 2011)
- Numerous agencies working together to address this debris (U.S., Canada, and Japan)
- NOAA: Modeling, sightings tracking, contingency planning

Government of Japan, 3/9/12 press release with estimated amounts: http://www.env.go.jp/press/press.php?serial=14948

Marine Debris Modeling

No models exist yet specifically for marine debris of all shapes and sizes.

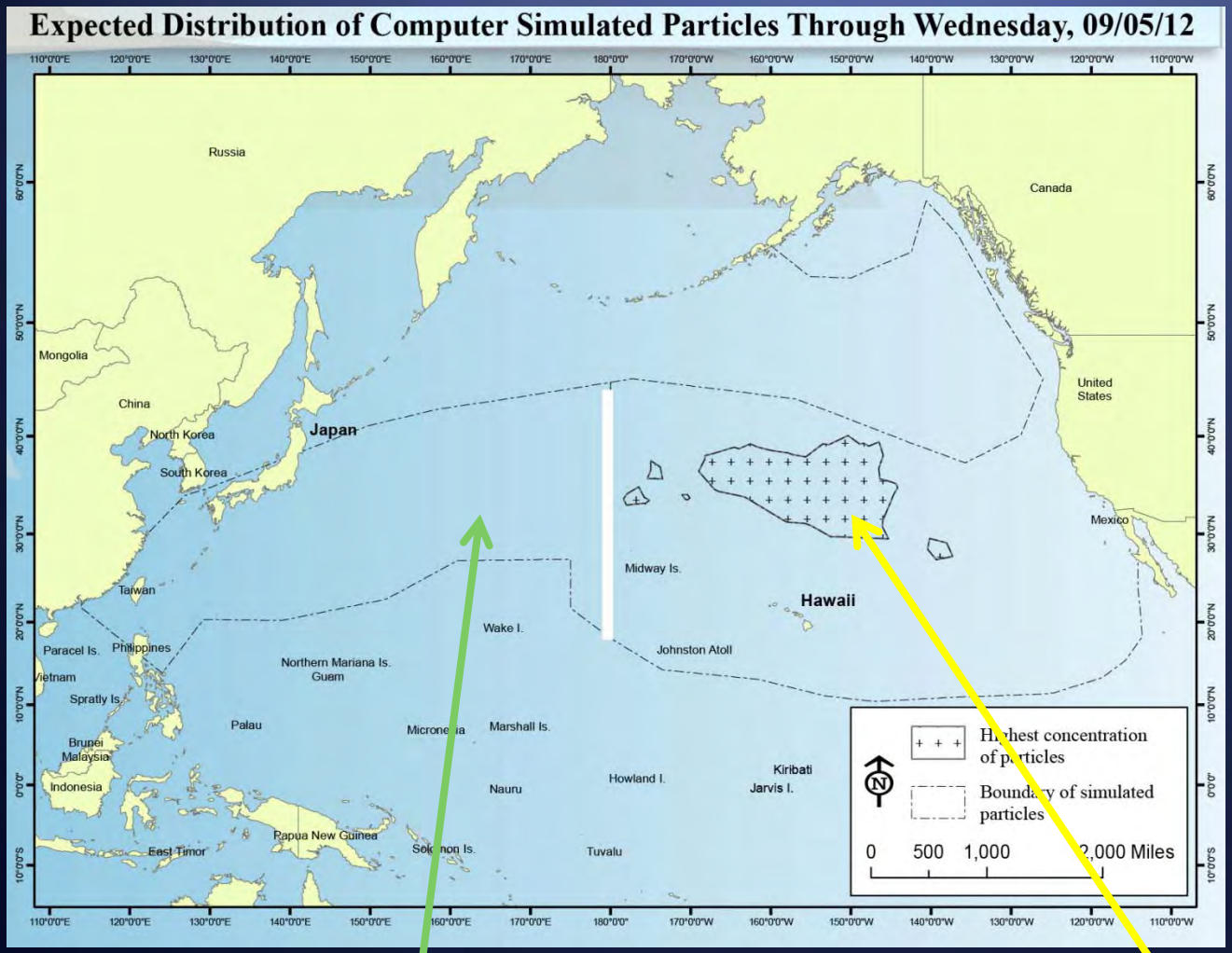
NOAA OSCURS (surface current model; Ocean Surface Current Simulator)

- Forecast; historical data; lower windage used
- NWHI-winter 2011/2012; W. coast and AK-2013; MHI-2014

NOAA GNOME (oil spill model; General NOAA Operational Modeling Environment)

- Hindcast; 1-5% windage or leeway
- Using Navy HyCOM (ocean currents) and NOAA data (wind)

NOAA GNOME Results



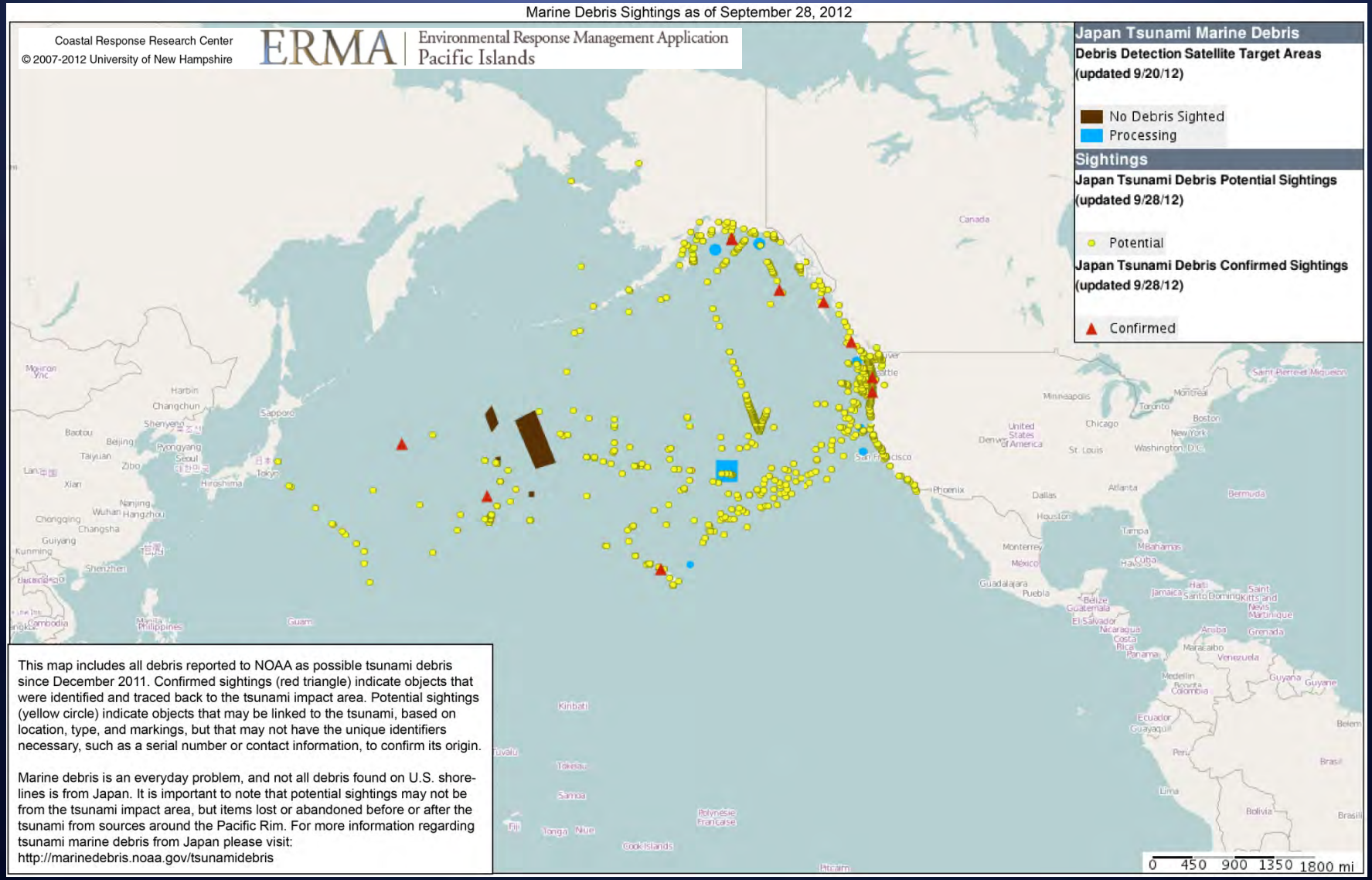
- 1,000 particles
- Random windage: low to high
- 8 locations (>3.5m)
- 0700, 11 March 2011 through 1 May 2012
- These do NOT represent fields/patches of debris

Area contains 95% of all simulated particles

Area with highest concentration of simulated debris with 1% windage

Reported Sightings to disasterdebris@noaa.gov

Marine Debris Sightings as of September 28, 2012



This map includes all debris reported to NOAA as possible tsunami debris since December 2011. Confirmed sightings (red triangle) indicate objects that were identified and traced back to the tsunami impact area. Potential sightings (yellow circle) indicate objects that may be linked to the tsunami, based on location, type, and markings, but that may not have the unique identifiers necessary, such as a serial number or contact information, to confirm its origin.

Marine debris is an everyday problem, and not all debris found on U.S. shorelines is from Japan. It is important to note that potential sightings may not be from the tsunami impact area, but items lost or abandoned before or after the tsunami from sources around the Pacific Rim. For more information regarding tsunami marine debris from Japan please visit: http://marinedebris.noaa.gov/tsunamidebris

Questions

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