



PECC International Project Sustainable Management of Marine Resources 2011-2012

Concluding Seminar The Management of Deep Sea Marine Resources and Oceans as a Means of Communication

Plastic Pollution in Marine System

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Many volunteer sailors

December 4-5, 2012, Auckland, New Zealand

Sources of marine pollution – marine debris in particular

Global

Land based: littering
river runoff
extreme natural events (hurricane, tsunami)

80% marine debris are land based (5gyres.org)

Ocean based: fisheries (derelict gear)
ocean cargo and cruise industry



Photo Charles Moore



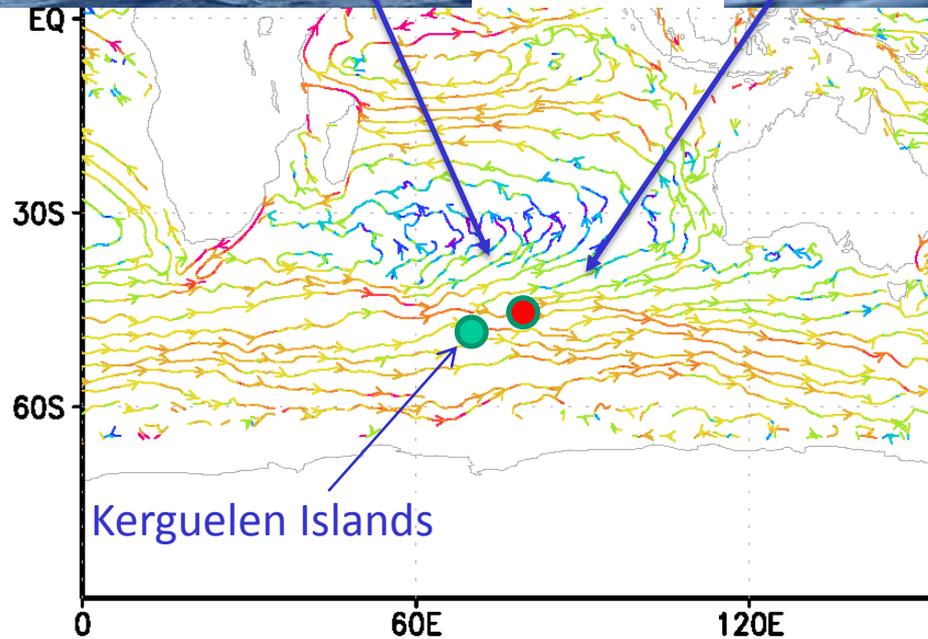
2011 March tsunami in Japan

James Mackey: plastic in the Indian sector of the Southern Ocean

Plastic barrel

Approx. 46S, 80E

Plastic bottle



Wikipedia:
Population
70 (winter)
110 (summer)

Threats of marine pollution:

Ecology: marine life, entanglement, ingestion of plastic, accumulation of organic pollutants in marine life tissues.
human health – introduction of organic pollutants in the marine life food chain up to human consumption



Scripts Institution of Oceanography, UCSD, 2009
lantern fish, 1/3 with plastic



Threats of marine pollution:

Navigation: hazards to navigation, collisions with submerged objects



17-19 Sept. 2012 floating dock

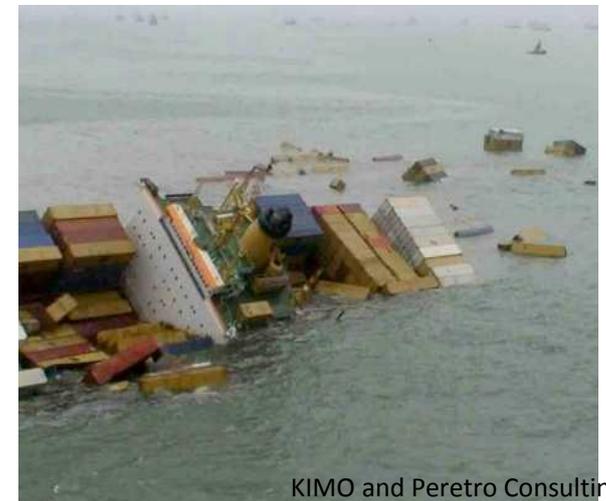


Photo: Department of National Defense

20 March 2012 150 nm south off Queen Charlotte Islands BC



03 Oct. yellow tanks East of Big Island



KIMO and Peretro Consulting

Threats of marine pollution:

Shoreline: damages to corral reefs
economy - fisheries, tourism

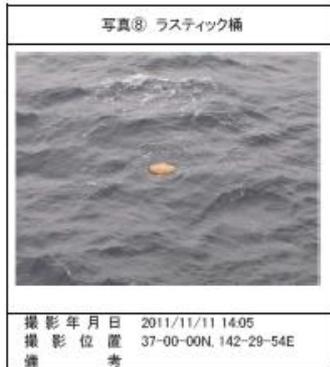


Problem with description of the motion of the marine debris and pollution

March 2011



November 2011



Problem with the marine pollution and debris

Large types of marine debris – **very sparse**



Randall Reeves S/V Murre N. Pacific June 2012

Micro-plastic: in addition to dispersion in horizontal it mixes in depth too
strong winds and waves transport micro-plastic up to 100 m depths



Net trawl – South Pacific



Capt. Charles Moore

Detection: **very problematic**

remote sensing extremely challenging

(multispectral, SAR, Mace 2011, *Mar. Pol. Bull*)

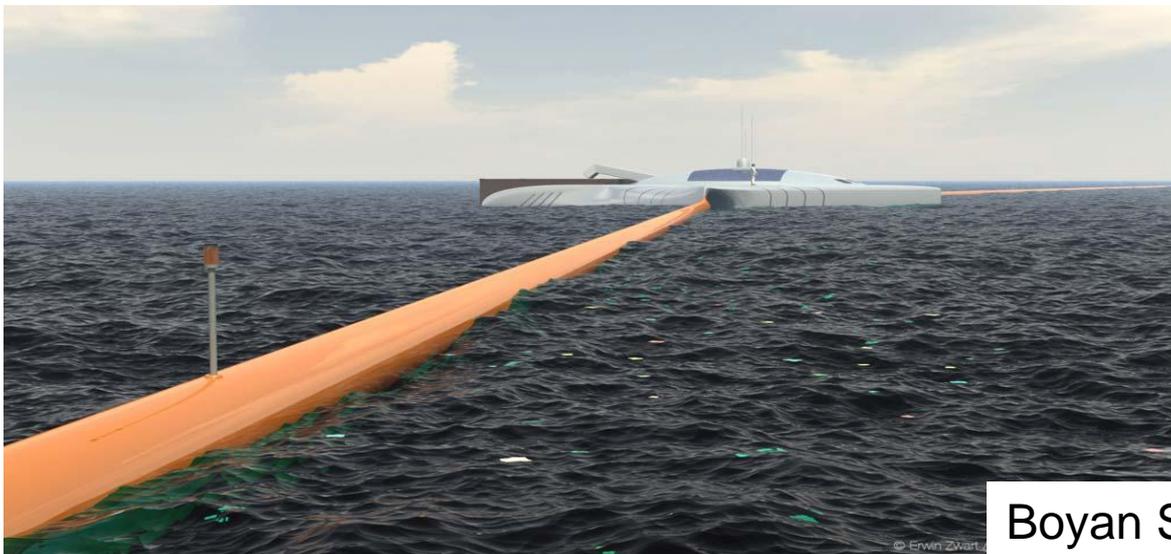
only in situ observations are reliable, but coverage is minimal compared to the extent of the ocean

Marine debris is persistent in the ocean

causing damage in the environment, e.g., leaching of chemicals (POP), derelict gear harms marine life



Removal at the sea – no current technology feasible, various NGO groups working on solution (e.g. Ocean Voyages, Project Kaisei)



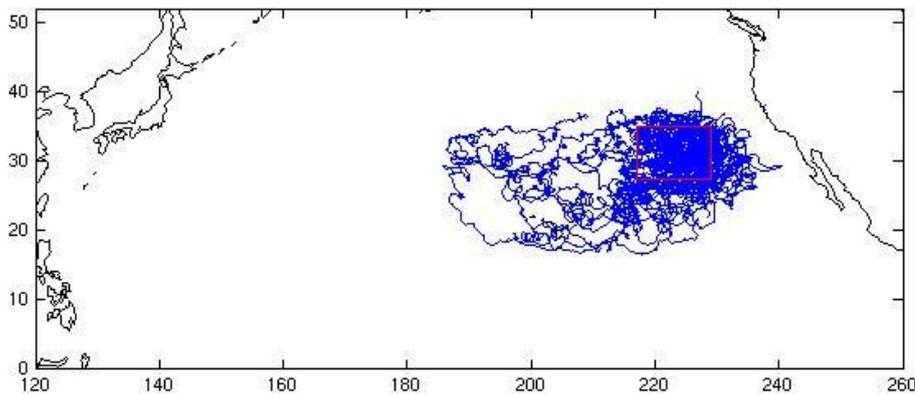
Boyan Slat, proposed Marine litter extraction

Research activity at the IPRC/SOEST University of Hawaii

Expertise in the field of physical oceanography

Applicable on the general problems of marine pollution and marine debris in particular

Knowledge, skills and tools to address the problem
specifically to study the transport of marine debris
from their sources to their sinks
the long range transport of marine pollution by oceanic currents
the role of gyres – accumulation of marine debris serves as
reservoir



**Trajectories of drifters starting from the
North Pacific convergence**

Research activity at the IPRC/SOEST University of Hawaii

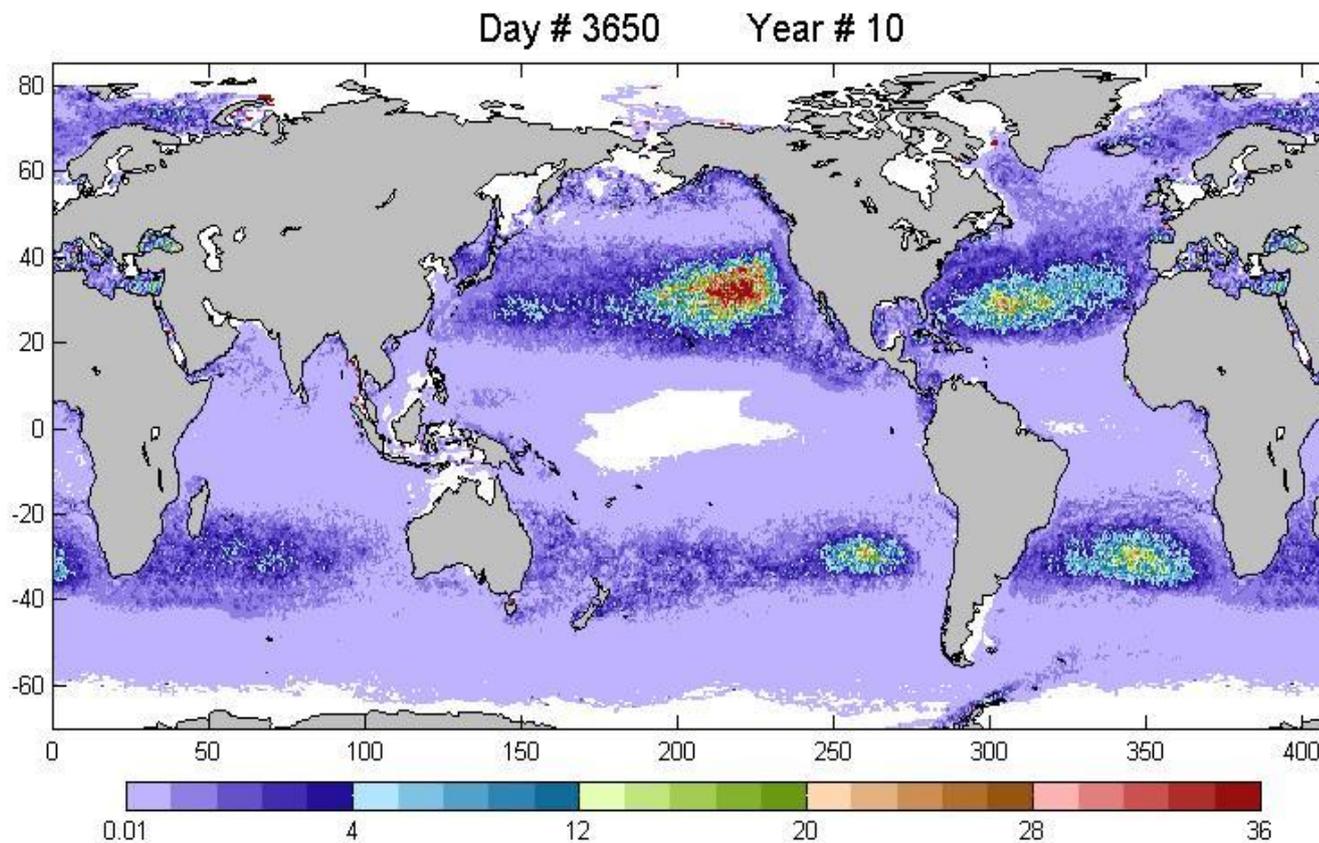
Particular question: where does plastic in the ocean go?

Source

Land based

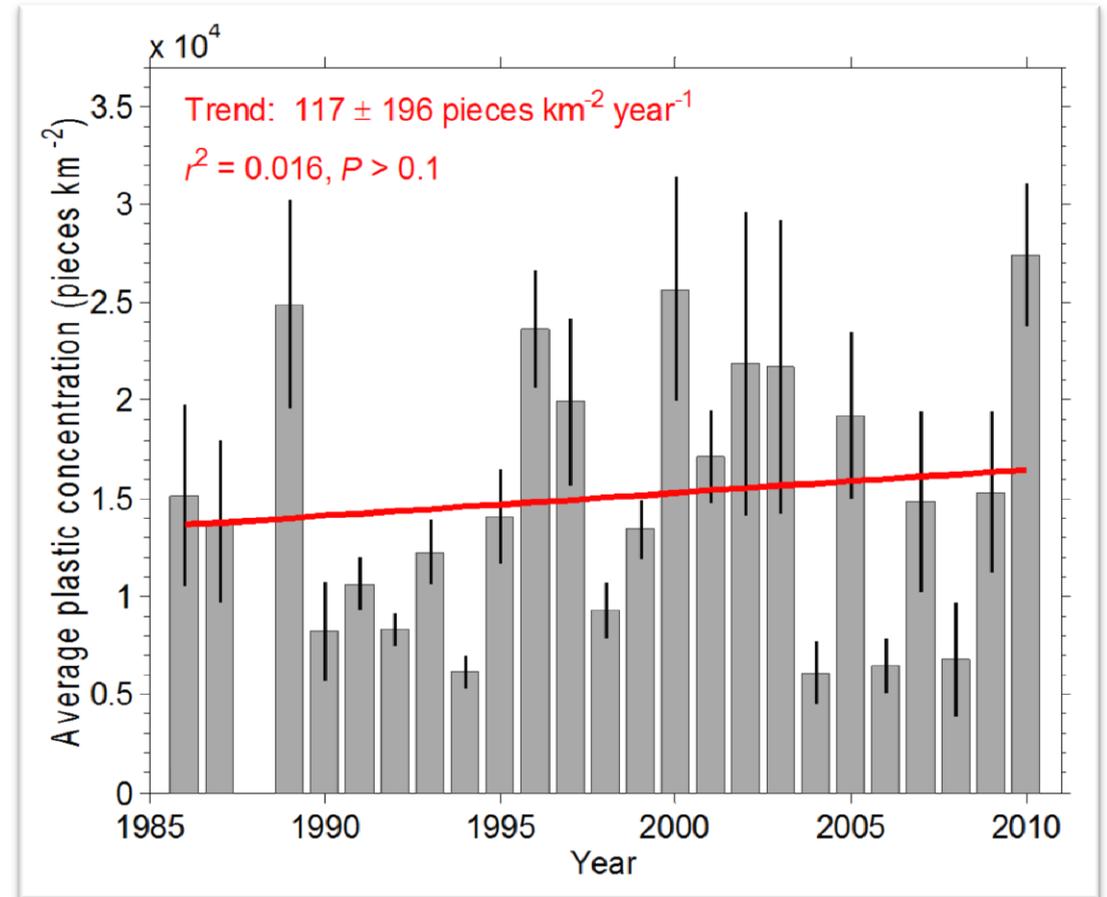
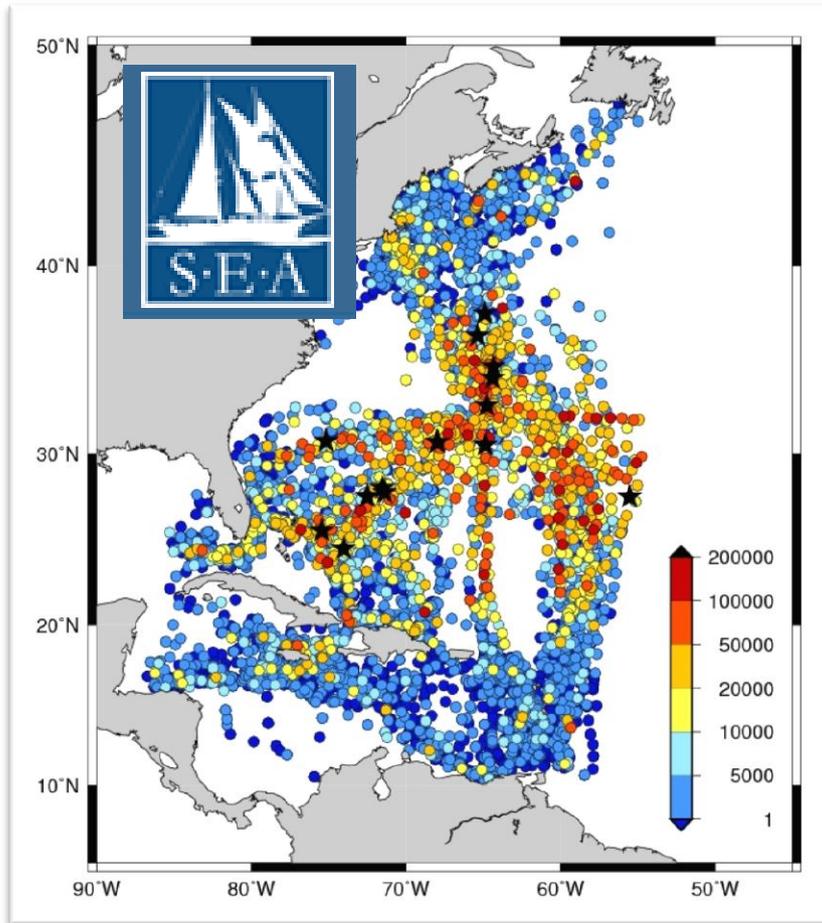
Transport by ocean currents 

**Sinks
???**



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

Trends in the plastic accumulation in in the ocean



Particular question: where does plastic go?

Source
Land based

Transport by ocean currents 

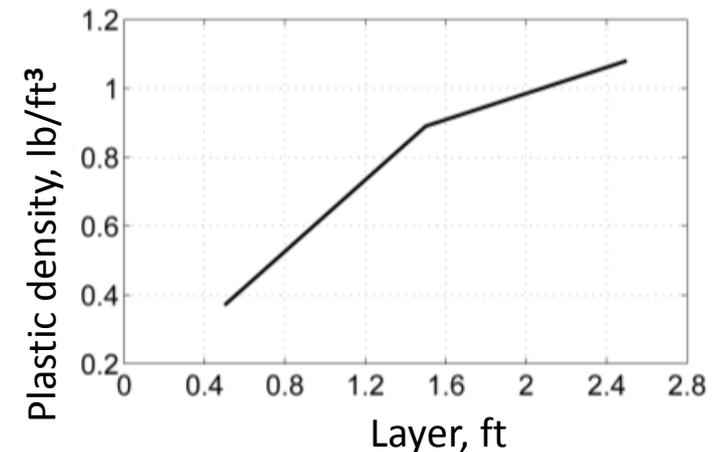
Sinks
???

2011 Expedition to Big Island 2011

Rocky Hanalua beach, East Big Island of Hawaii, reveals 35 times more plastic below than on the surface.



At about 2 ½ feet depth there is an abundance of plastic debris, not even reaching the depth of maximum concentration.

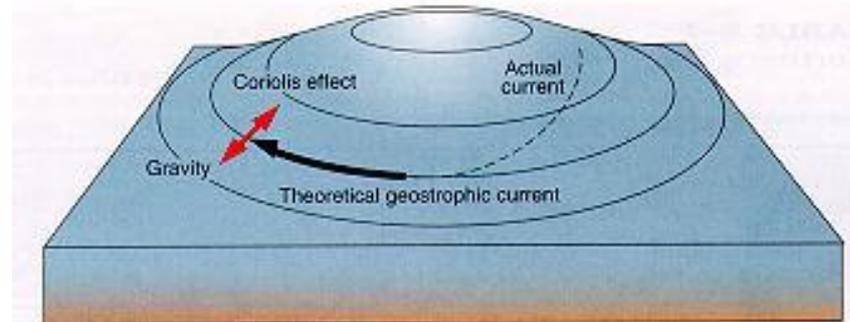
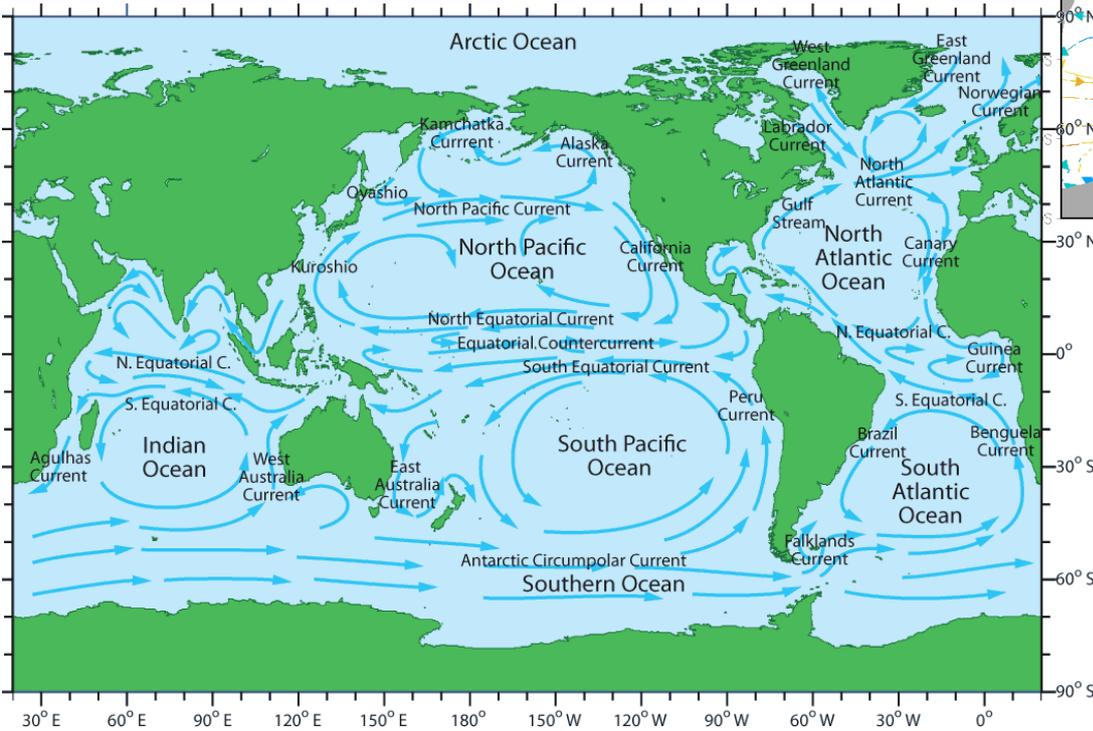
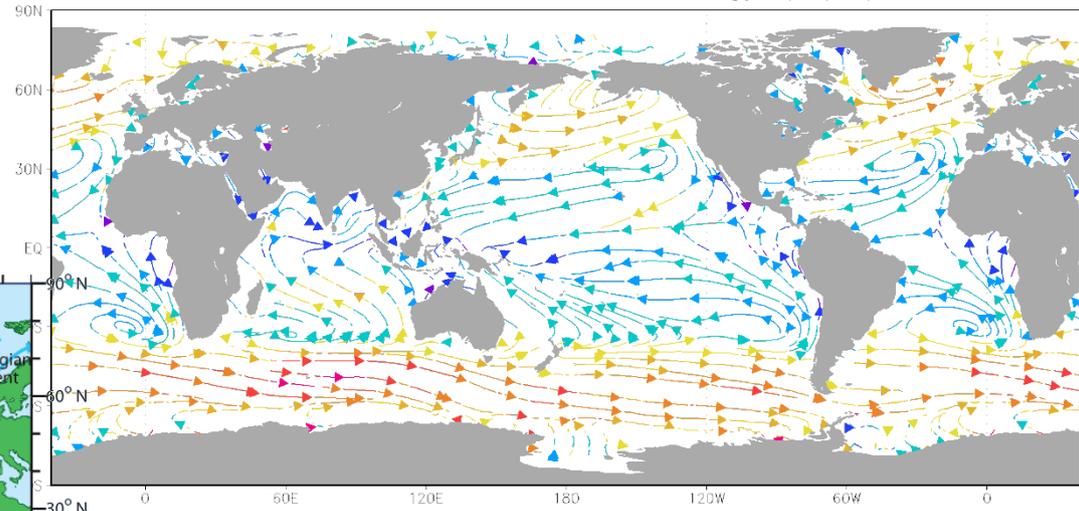


Ocean Surface Circulation

What controls the ocean currents

WIND

Global QSCAT Wind Climatology (m/s)



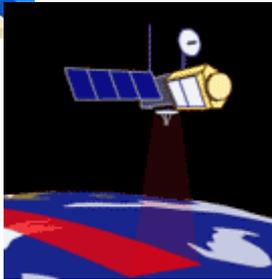
Seas level shape

Research activity at the IPRC/SOEST University of Hawaii

SCUD - Surface CUrrents from Diagnostic model

AVISO sea level

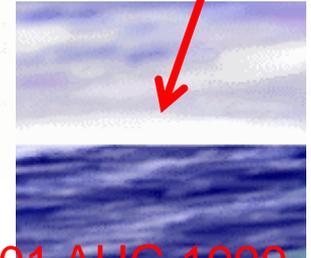
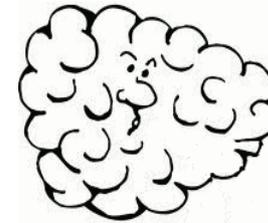
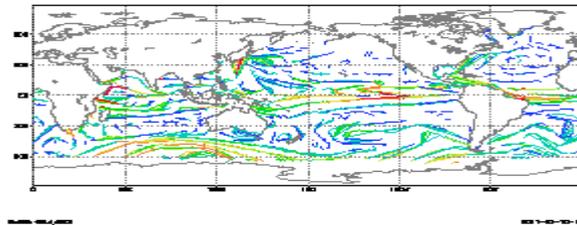
QSCAT/ASCAT ocean surface wind



SCUD



Ocean surface currents



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

Data access:

<http://apdrc.soest.hawaii.edu/projects/SCUD/>

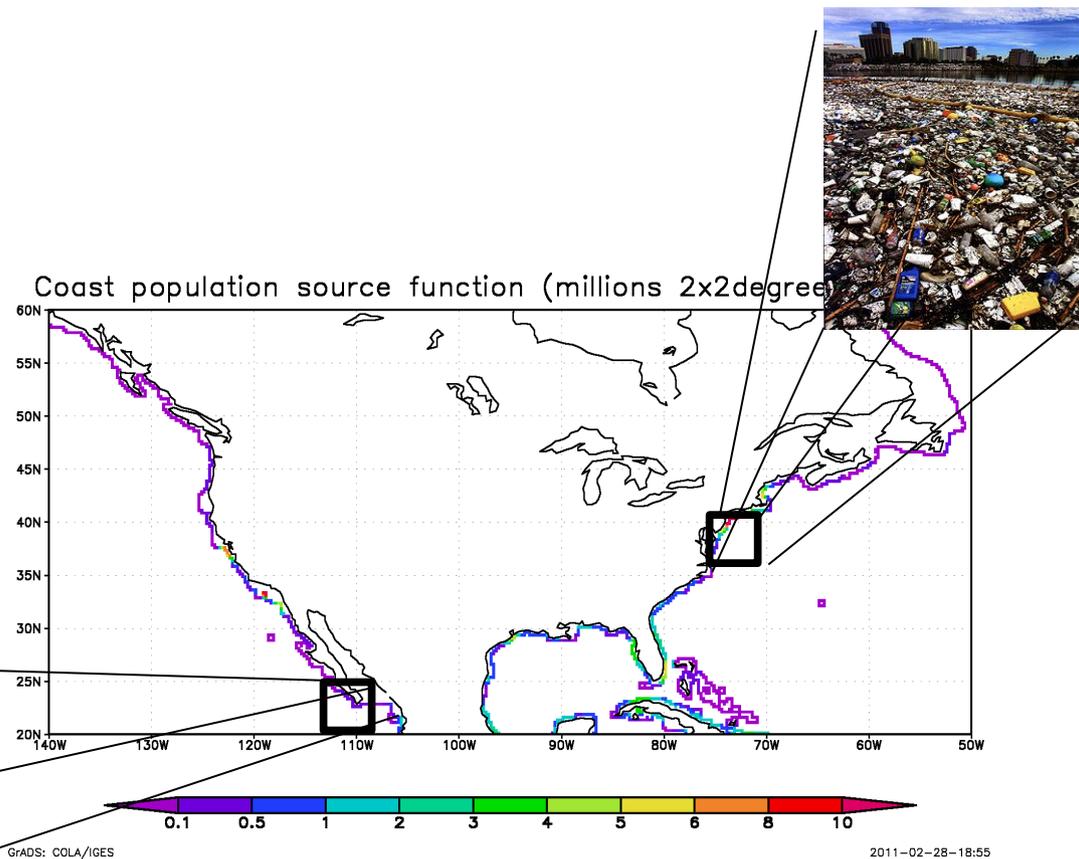
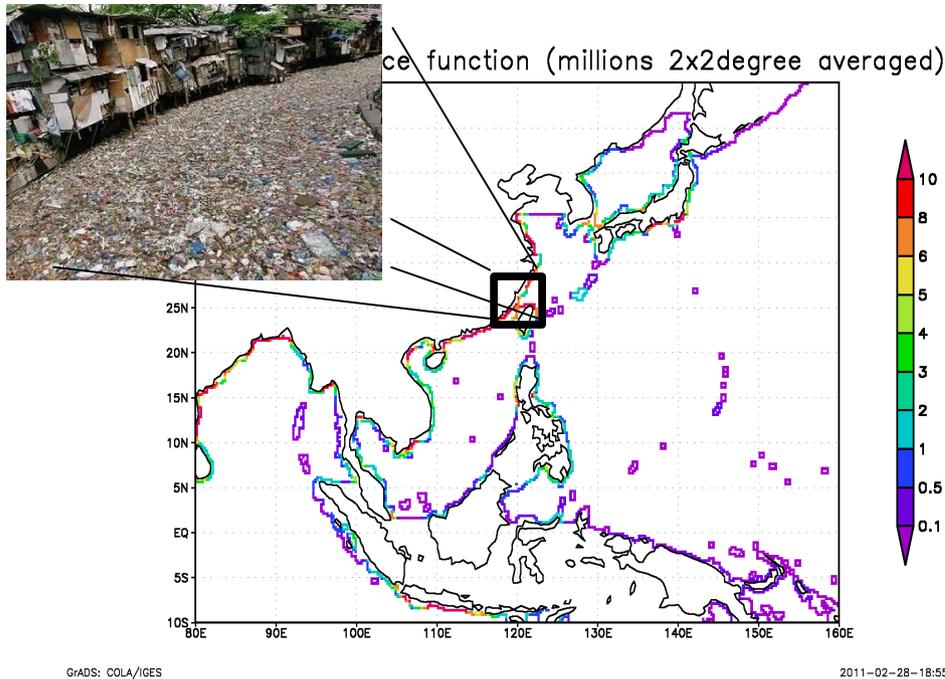
http://oos.soest.hawaii.edu/pacioos/data_access/download.php

Research activity at the IPRC/SOEST University of Hawaii Applications: Marine Debris

Where the marine debris goes?
How it gets there ?

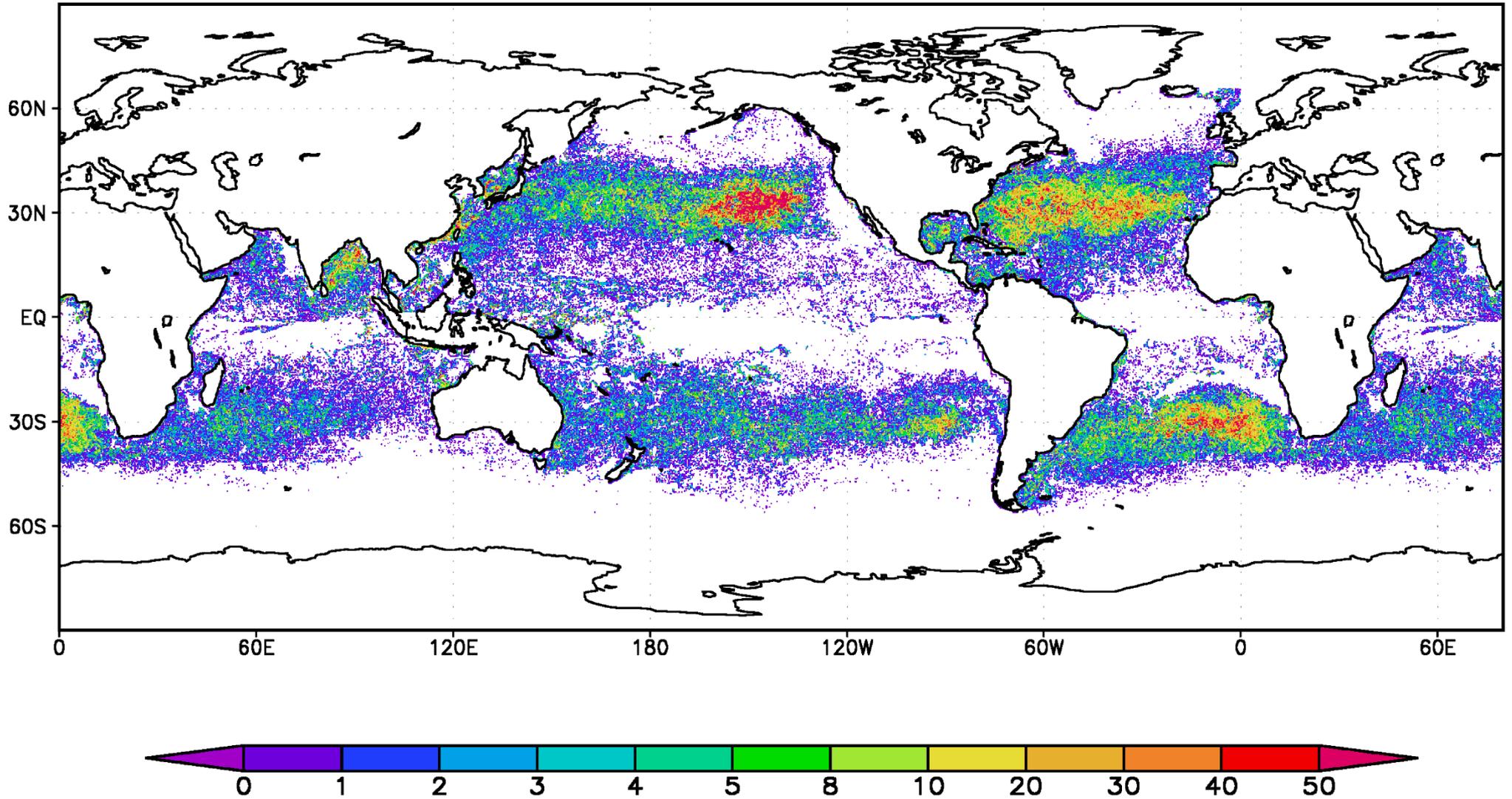


Numerical Experiment: SCUD currents applied on ocean tracers released daily from coast and weighted by coastal population count

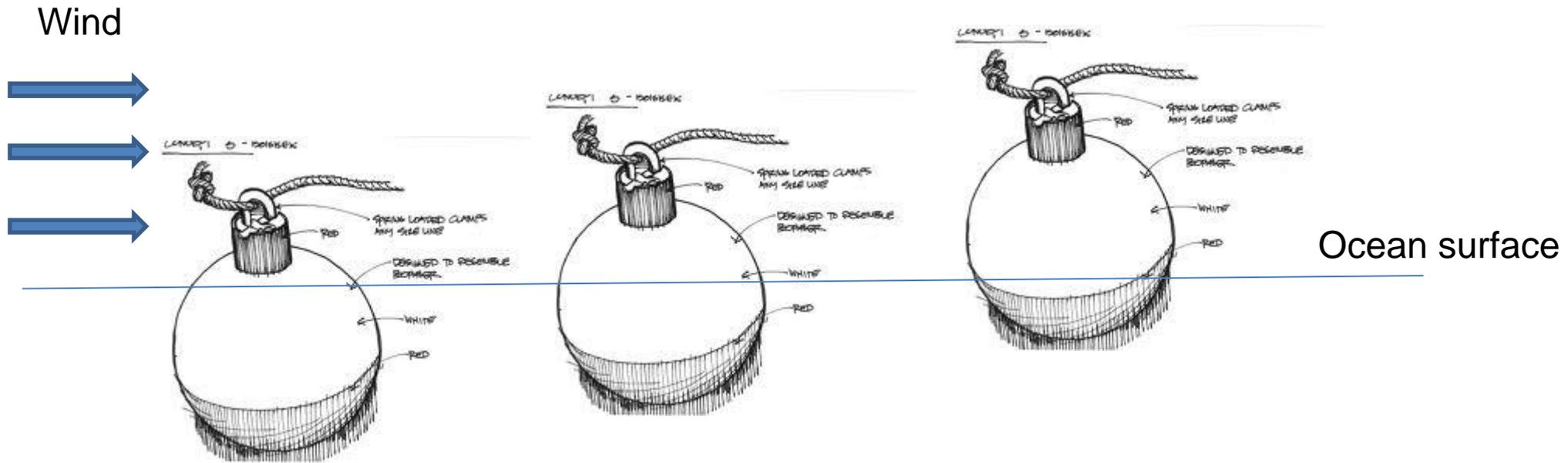


Research activity at the IPRC/SOEST

2009-11-18



Windage



**Low windage,
object sitting deep in water**



Photo: Charles Moore

**Medium windage,
object sitting half in water**



Photo: Randal Reeves

**High windage,
object sitting high on water**



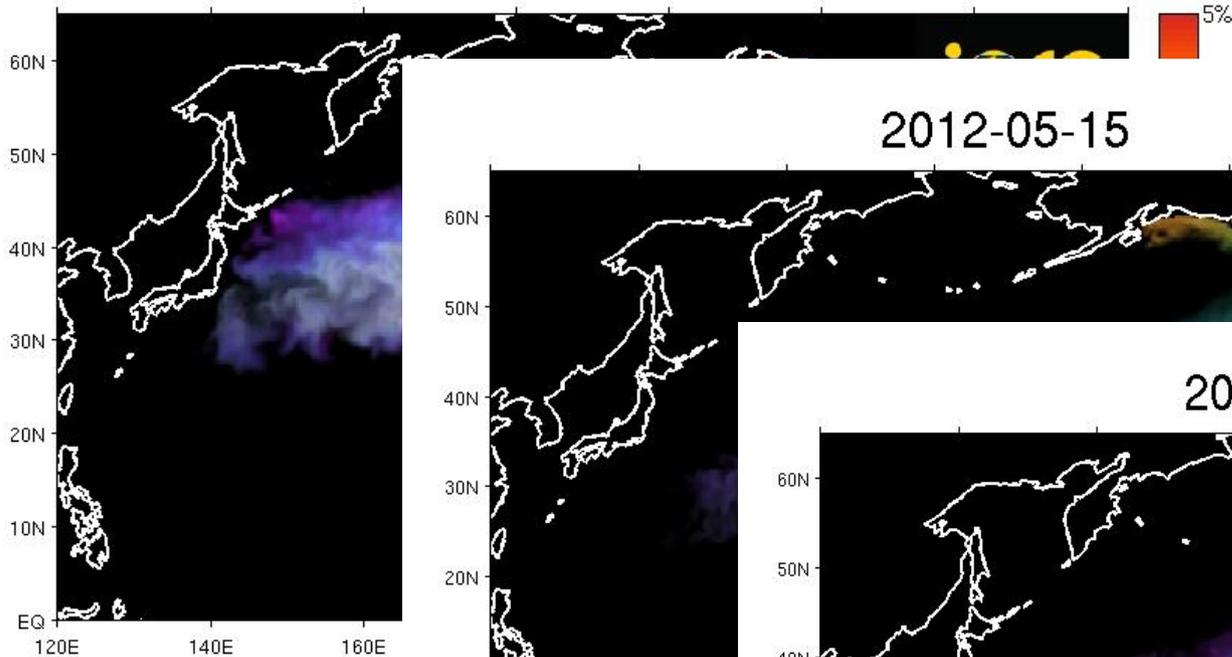
Photo: S/V "Tregoning"

For example 5% windage means an object is moving with the current + 5% wind speed

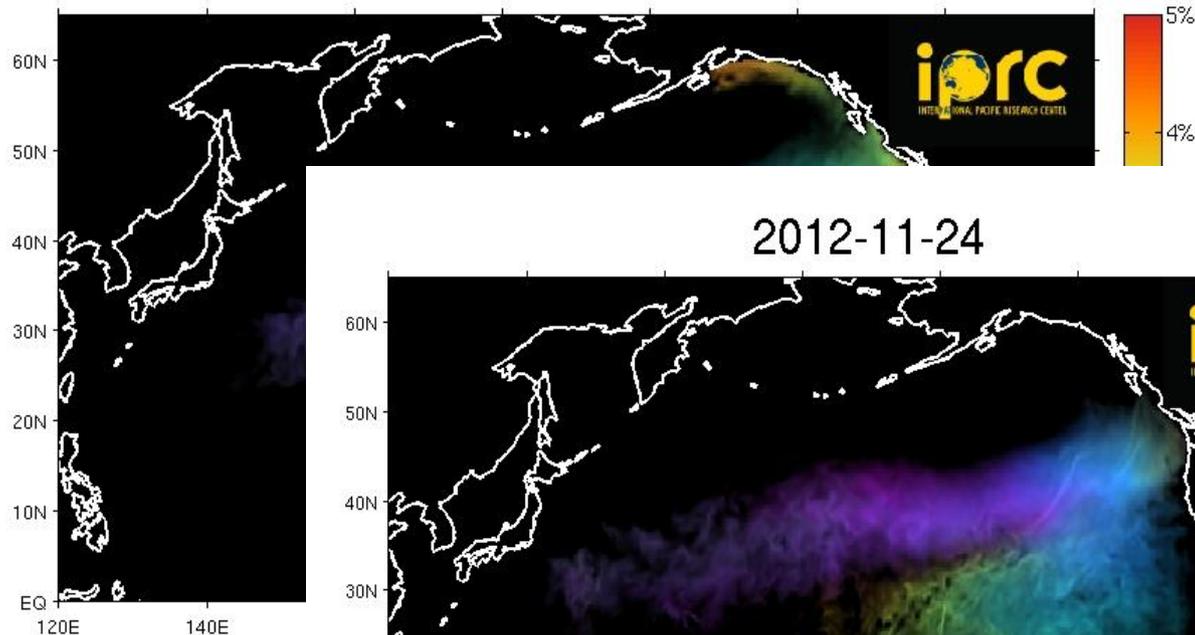
Research activity at the IPRC/SOEST

Tsunami Debris: Windage

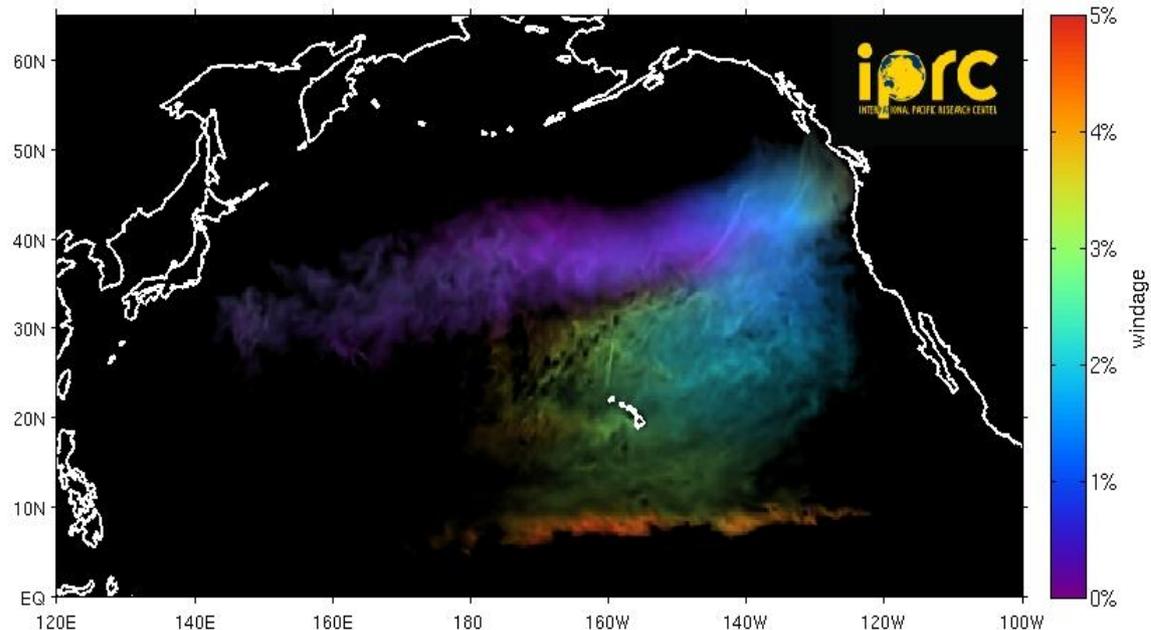
2011-11-15



2012-05-15



2012-11-24



Source: Maximenko & Hafner, IPRC/SOEST, Univ. of Hawaii

http://iprc.soest.hawaii.edu/news/marine_and_tsunami_debris/debris_news.php

(hint google IPRC tsunami debris) or email: marinedebris@soest.hawaii.edu

Other challenging areas related to marine pollution and marine debris

Research: marine pollution multidisciplinary, encompasses many scientific disciplines

- : new field of applied research, not firmly established
- : many different groups using different methods of data collection etc.
- : cooperation between scientific fields not established yet
- : creation of marine debris observing system, improved models, and closing the balance of marine debris (sources, transport and sinks) are needed

Legal: the high sea

- : marine pollution is global problem requiring multinational legal framework
- : generally pollution at high seas govern by international laws
London convention (1972), MARPOL 73/78



- : many national and multinational agreements controlling the marine pollution

Enforcement: practical only near shoreline, difficult at high seas
maritime international law issues

Concluding Remarks

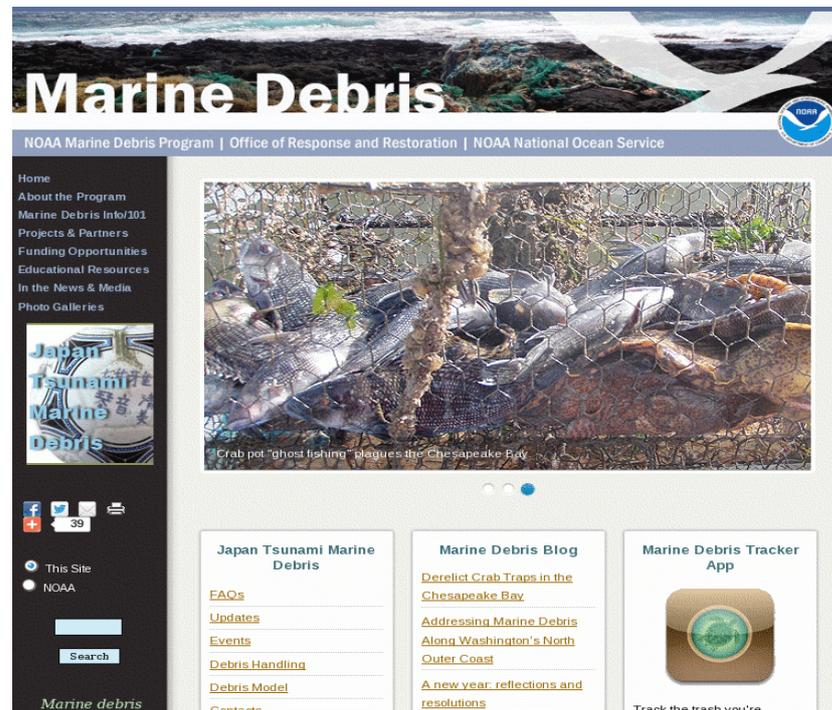
- Sources of marine pollution are mostly land based
- Extreme events (tsunamis) are rare and even the initial impact is extreme their contribution to the over all marine pollution is insignificant on large time scales. However, they can provide invaluable scientific data and improve our understanding of marine debris.
- Little international cooperation on a common set of standards and procedures regarding the protection of the ocean from the land based sources (MARPOL addresses ocean sources only)

Concluding Remarks

Proactive approach

In the USA the NOAA Marine Debris Program supports national and international efforts to reduce and mitigate the impact of marine pollution.

Established in 2005 with 3 field offices: West Coast and Alaska Region, the Great Lakes Region, Pacific Islands Region and headquarters in Silver Spring MD.

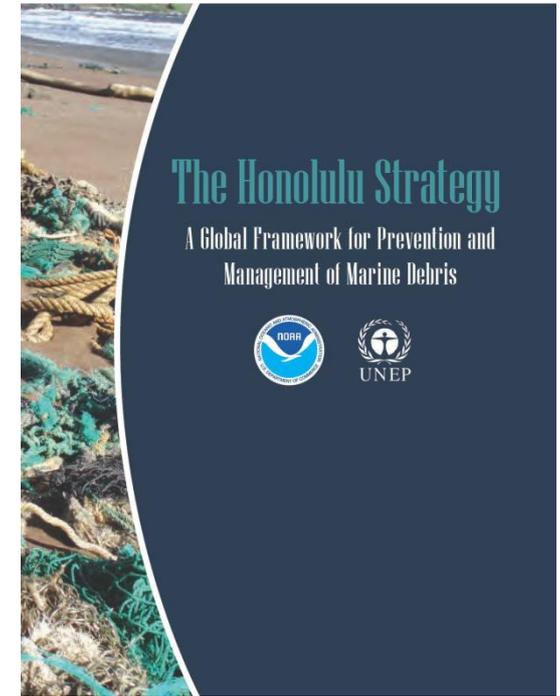


<http://marinedebris.noaa.gov/about/welcome.html>

Concluding Remarks

Proactive approach

In 2011 the NOAA Marine Debris Program organized the 5th International Marine Debris Conference in Honolulu. One of the main documents resulting from the conference was “The Honolulu Strategy. A global framework for prevention and management of marine debris.”



The key points are:

- “It is a framework for a comprehensive and global effort to reduce the ecological, human health, and economic impacts of marine debris globally.”
- “it is a planning tool for developing or refining spatially or sector-specific marine debris programs and projects”
- “it provides a common frame of reference for collaboration and sharing of best practices and lessons learned”
- “it is a monitoring tool to measure progress across multiple programs and projects.”

Concluding Remarks

The international and interdisciplinary cooperation is increasing, general public, NGO, governmental agencies.

The public awareness is growing, with increased media coverage of extreme marine pollution events (e.g. 2011 tsunami in Japan). This has positive implications on governmental policies and actions.

NOAA lead “Honolulu Strategy” provides a starting point for further cooperation on international level.

Probably in recent years more has been accomplished to solve the marine pollution problem than ever before. However, much more is needed to clean the oceans.



Thank you !