

Microplastics in the Ocean

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SEA Semester[®]

Environmental Studies at Woods Hole & at Sea





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North Pacific Ocean, Oct. 2012

aka "Great Pacific Garbage Patch"



Images from Sea Education Association



Subtropical ocean aka “Garbage Patches”



Images from Sea Education Association

Surface plankton net tow

Measuring microplastics

- Net mouth: 1 m x 0.5 m
- Net mesh: 335 μm
- Tow length: 1.8 km
- Ship speed: 2 knots



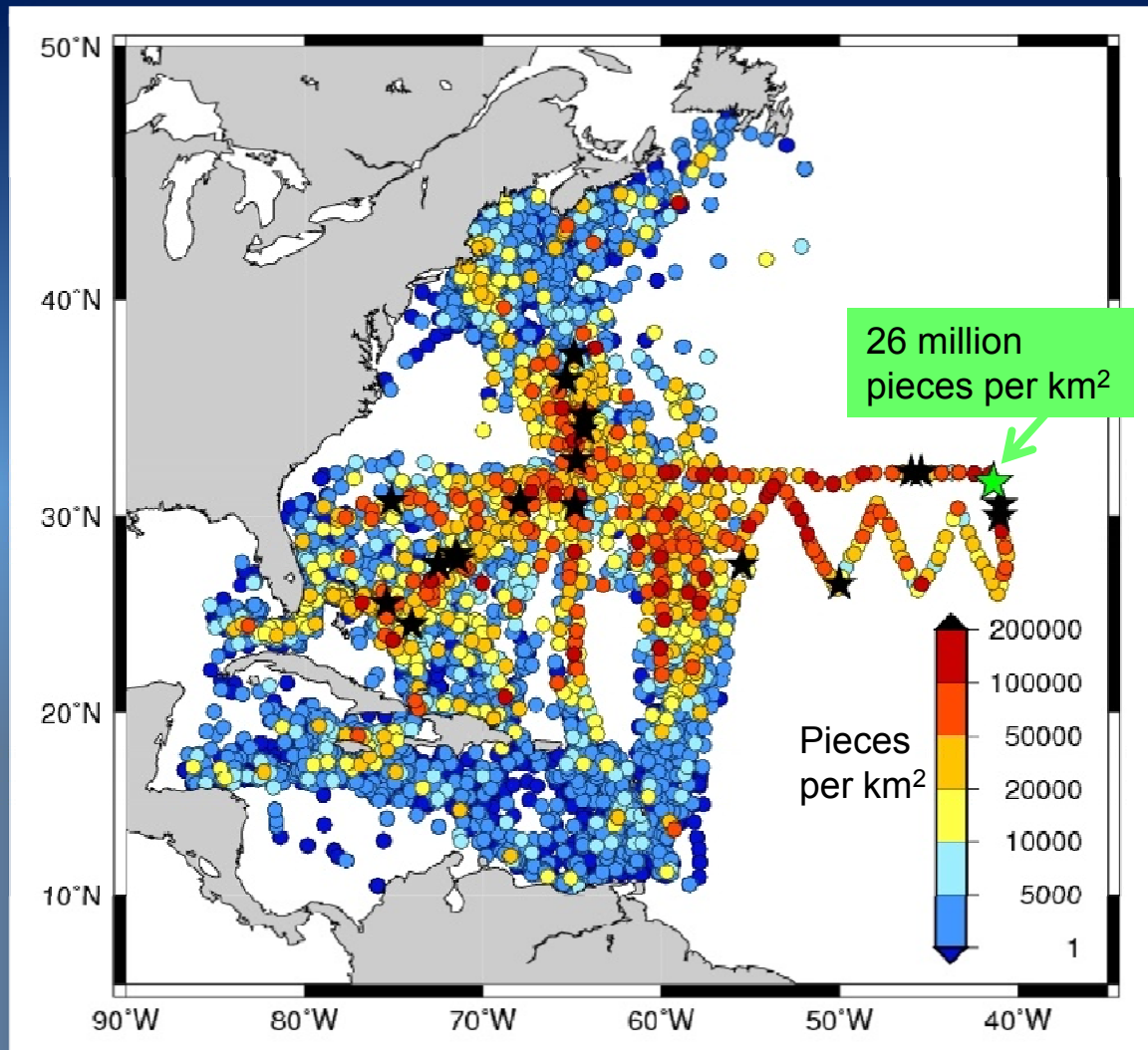


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Western North Atlantic



> 6600 surface net tows from 1986-2010



240 pieces
~ 130,000 pieces per km²

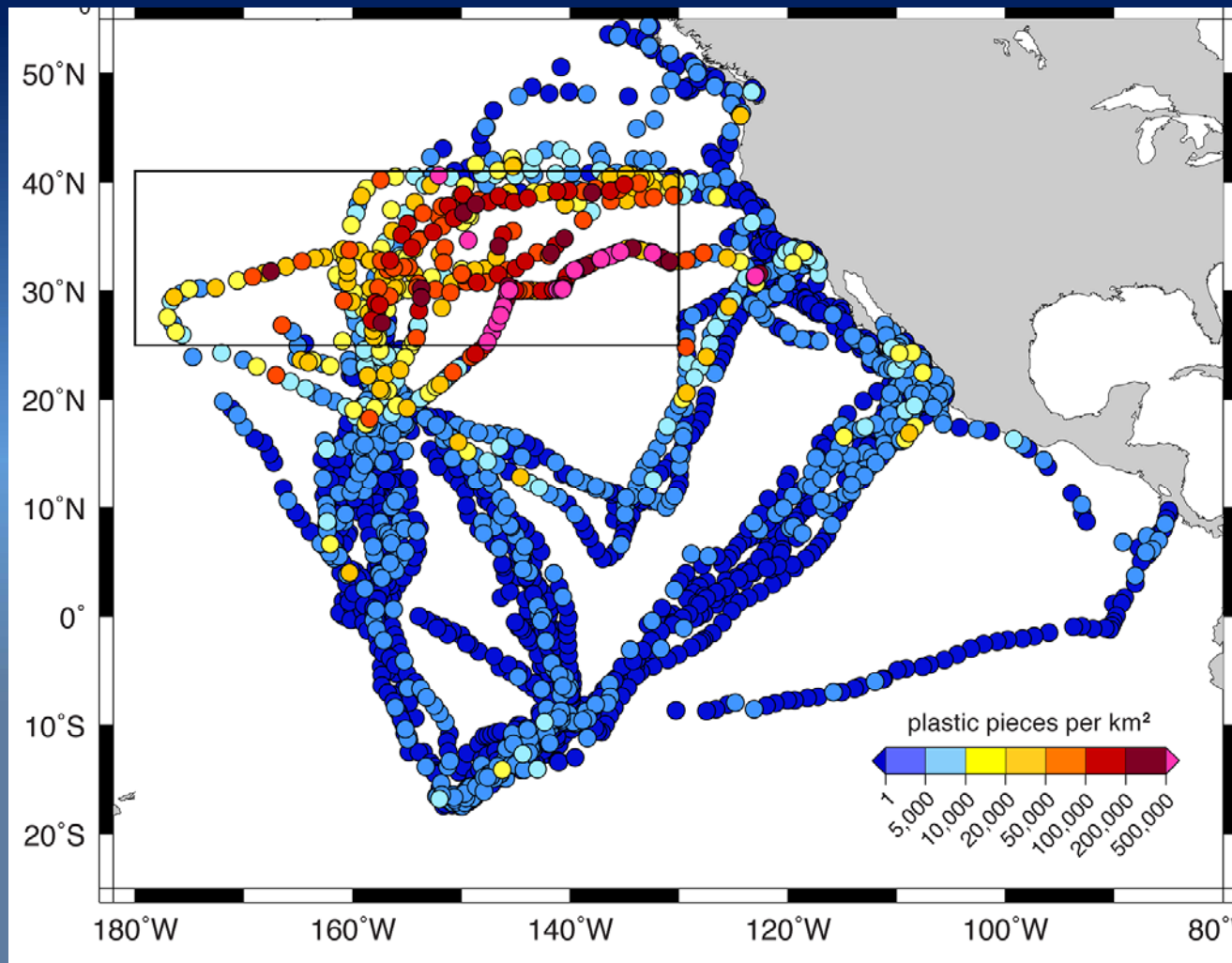
Law et al., *Science* 2010



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Eastern Pacific Ocean

> 2500 surface net tows from 2001–2012

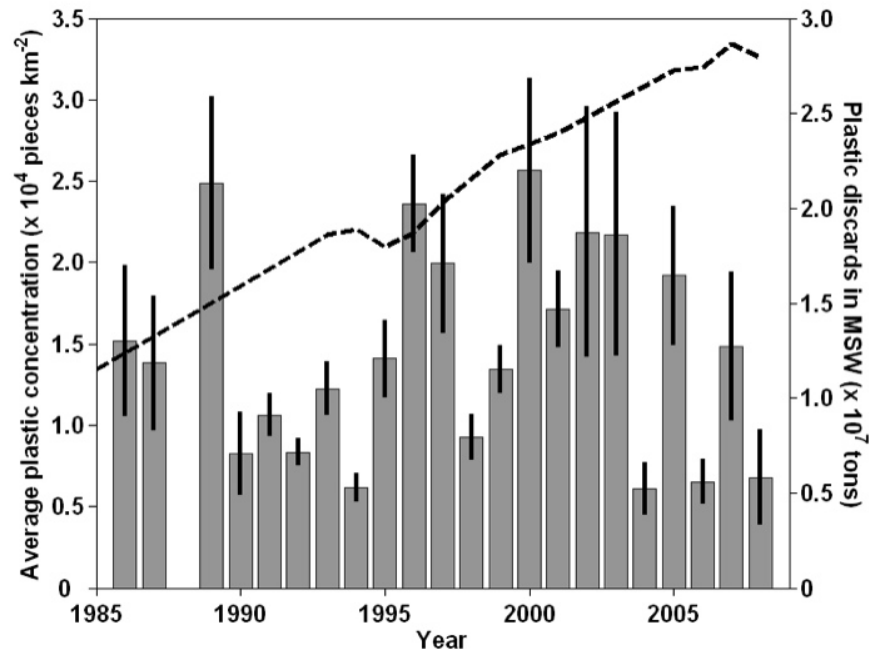




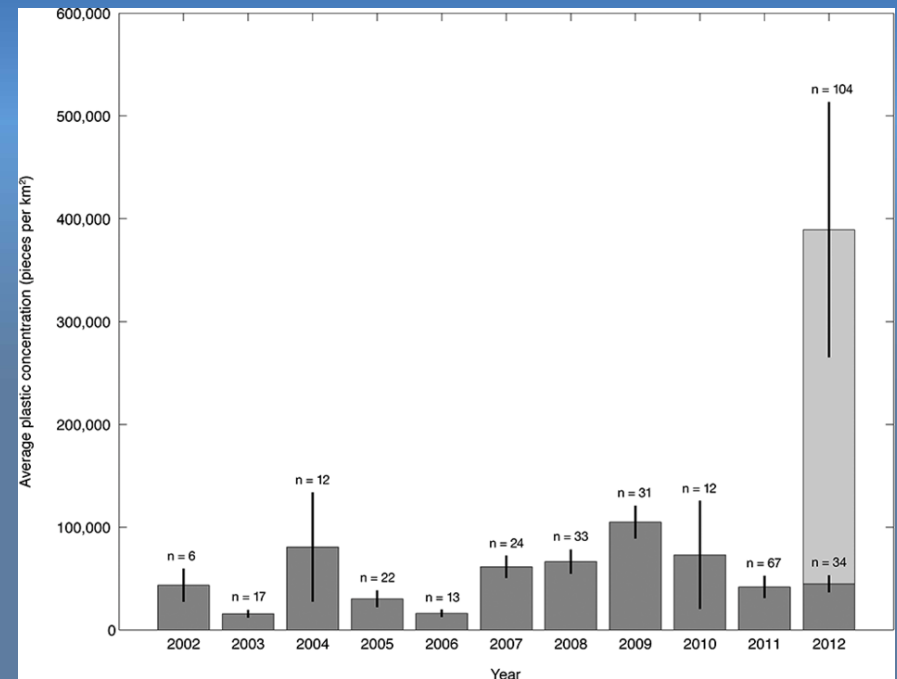
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Spatiotemporal variability

Western North Atlantic



Eastern North Pacific





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Wind-driven vertical mixing

(T. Kukulka, U. Delaware)



GEOPHYSICAL RESEARCH LETTERS, VOL. 39, L07601, doi:10.1029/2012GL051116, 2012

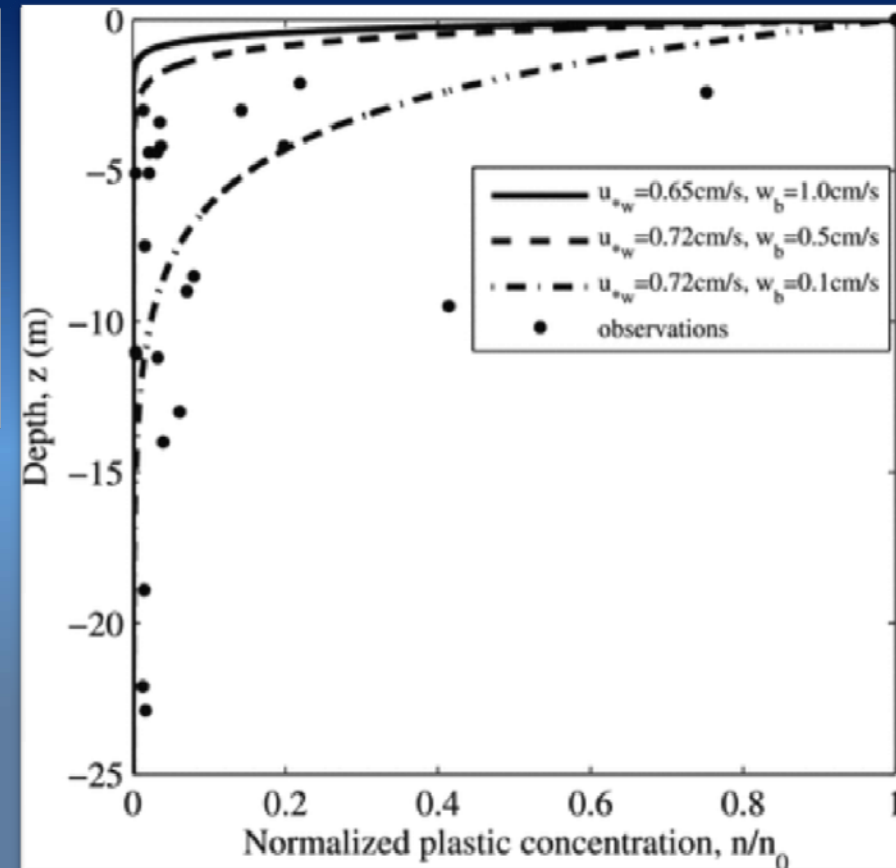
The effect of wind mixing on the vertical distribution of buoyant plastic debris

T. Kukulka,¹ G. Proskurowski,^{2,3} S. Morét-Ferguson,² D. W. Meyer,^{2,4} and K. L. Law²

Received 27 January 2012; revised 5 March 2012; accepted 7 March 2012; published 3 April 2012.

[1] Micro-plastic marine debris is widely distributed in vast regions of the subtropical gyres and has emerged as a major open ocean pollutant. The fate and transport of plastic marine debris is governed by poorly understood geophysical processes, such as ocean mixing within the surface boundary layer. Based on profile observations and a one-dimensional column model, we demonstrate that plastic debris is

central North Atlantic. The observations and model predictions in the North Atlantic clearly show that plastic is most highly concentrated within the large-scale subtropical convergence of the surface velocity field created by the wind-driven Ekman currents and geostrophic circulation [Law *et al.*, 2010]. Despite an increasing public awareness of ocean plastic, the abundance, distribution, and temporal and



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Research Article

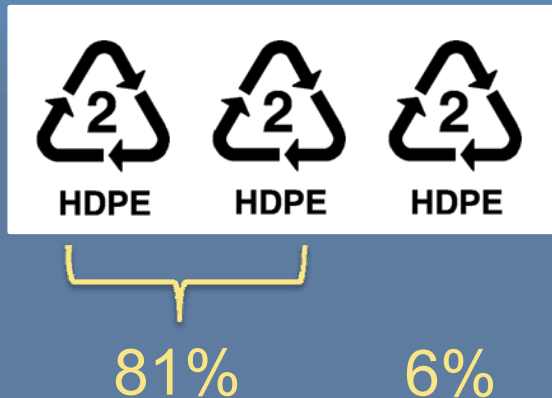
Passive buoyant tracers in the ocean surface boundary layer: 2. Observations and simulations of microplastic marine debris

K. Brunner, T. Kukulka , G. Proskurowski, K. L. Law

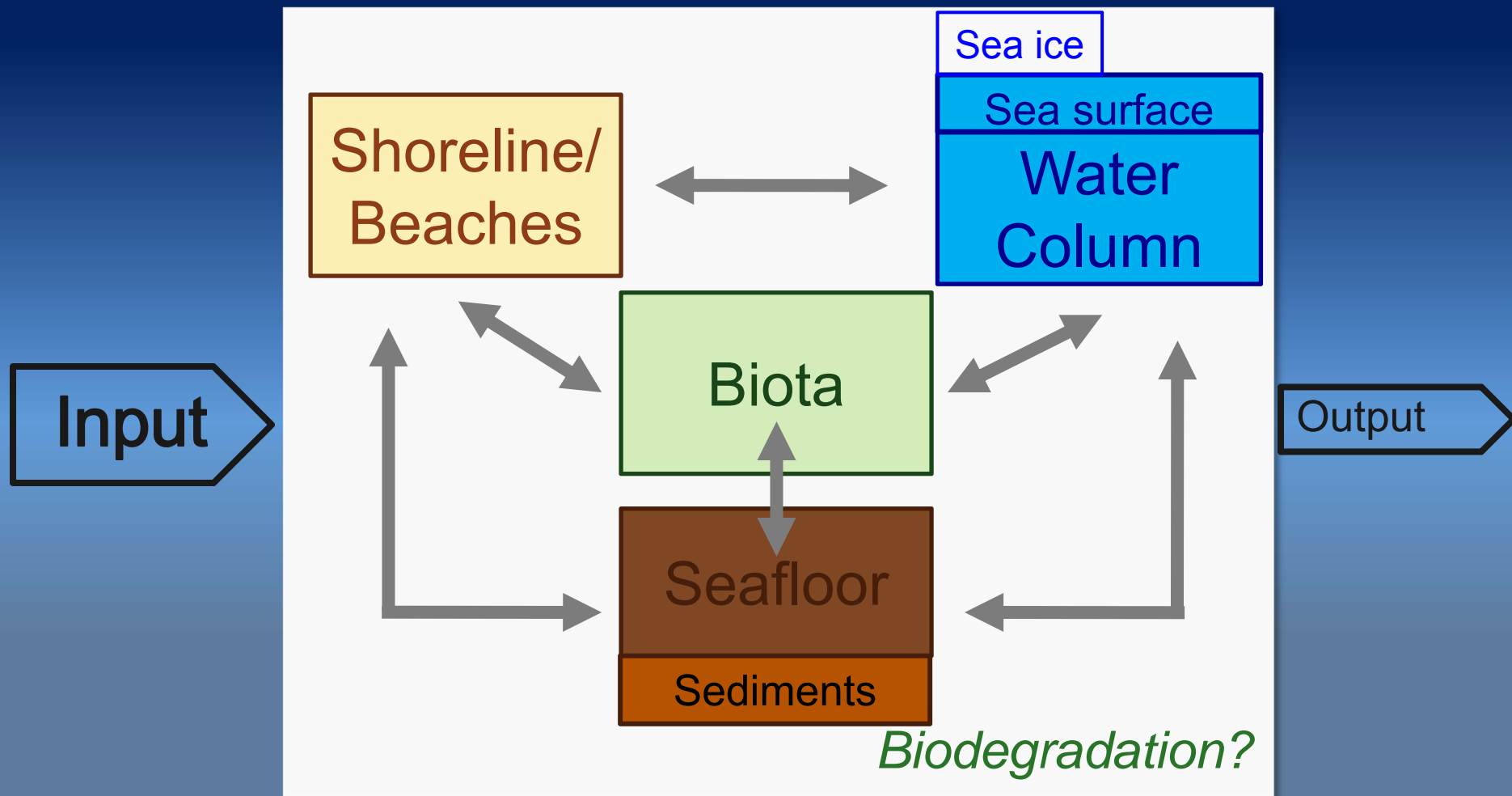
Accepted manuscript online: 30 October 2015 [Full publication history](#)

DOI: 10.1002/2015JC010840 [View/save citation](#)

Physical characteristics of net-collected microplastics



Mass balance framework

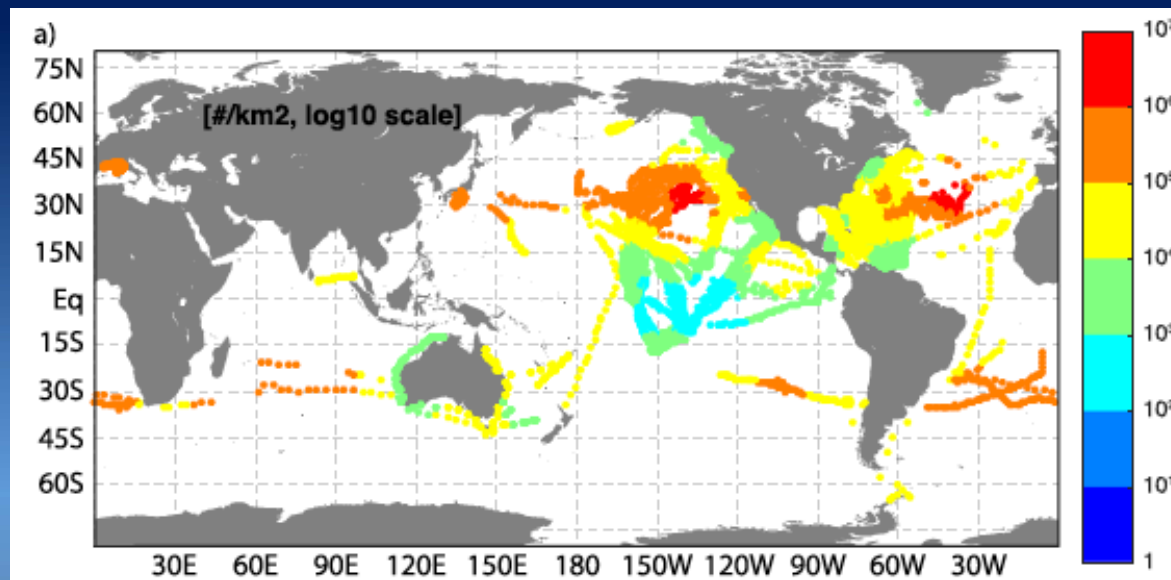


Input of plastic waste from land

Jambeck et al., *Science* 2015

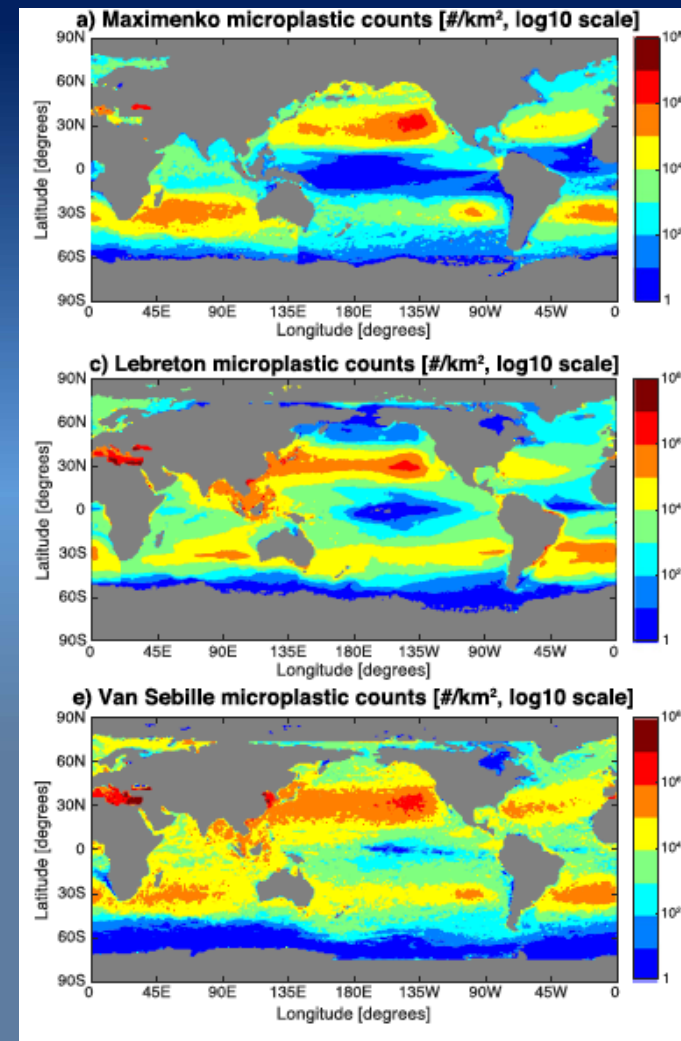


Global inventory of floating microplastics



96,000 to 236,000 metric tons
 << 8 million metric tons/year

Van Sebille *et al.* (2015)



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Michigan State U.

NC State U.

Trend in resin pellets

North Atlantic, 1986-2010

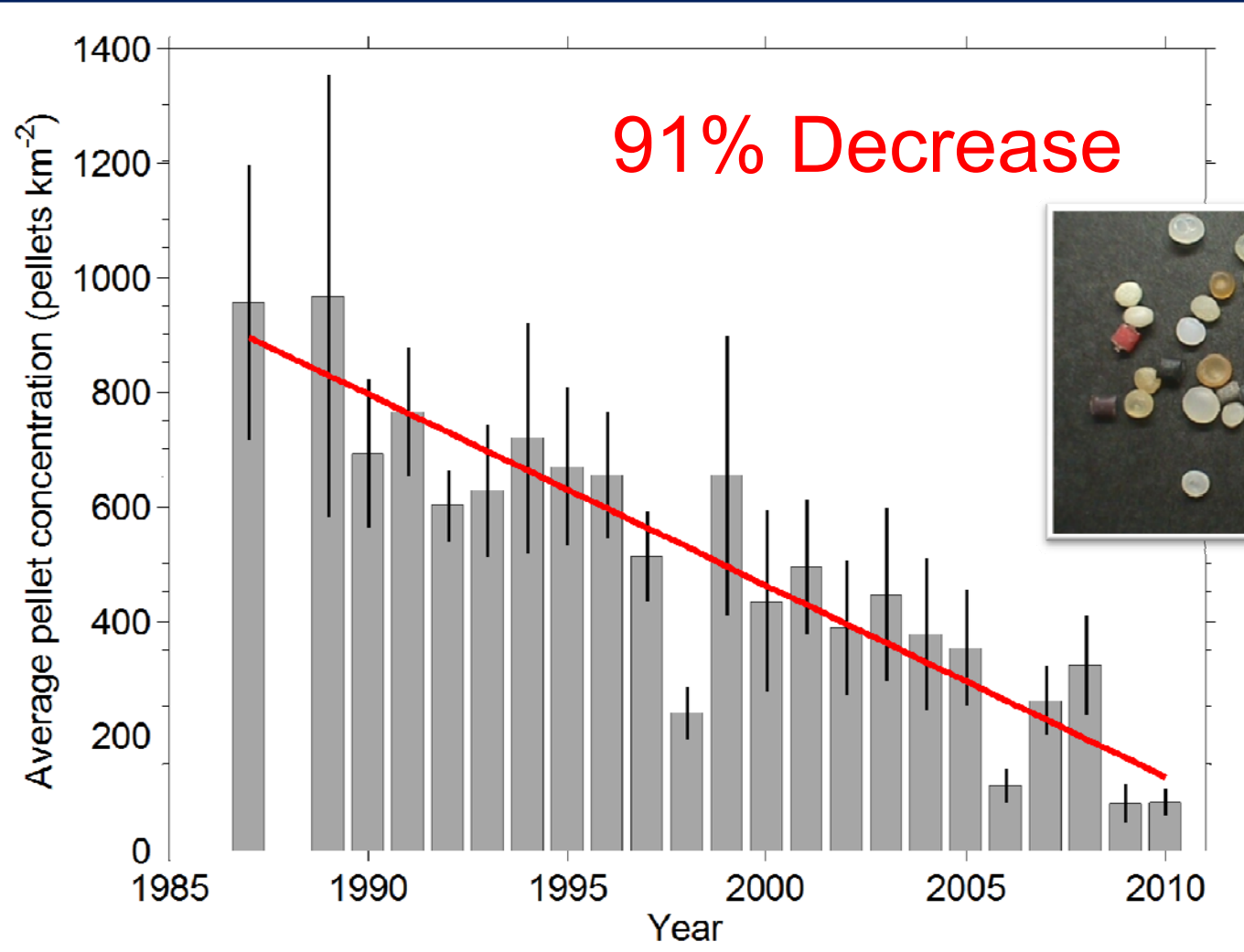


Photo: H. Takada

Shipboard visual surveys

(D. Hyrenbach, Hawaii Pacific U.)

“Macrodebris” and seabirds Summer 2008 Honolulu to San Francisco

