Vertical flux of microplastics in the deep Sea within the Kuroshio Extension Recirculation Gyre

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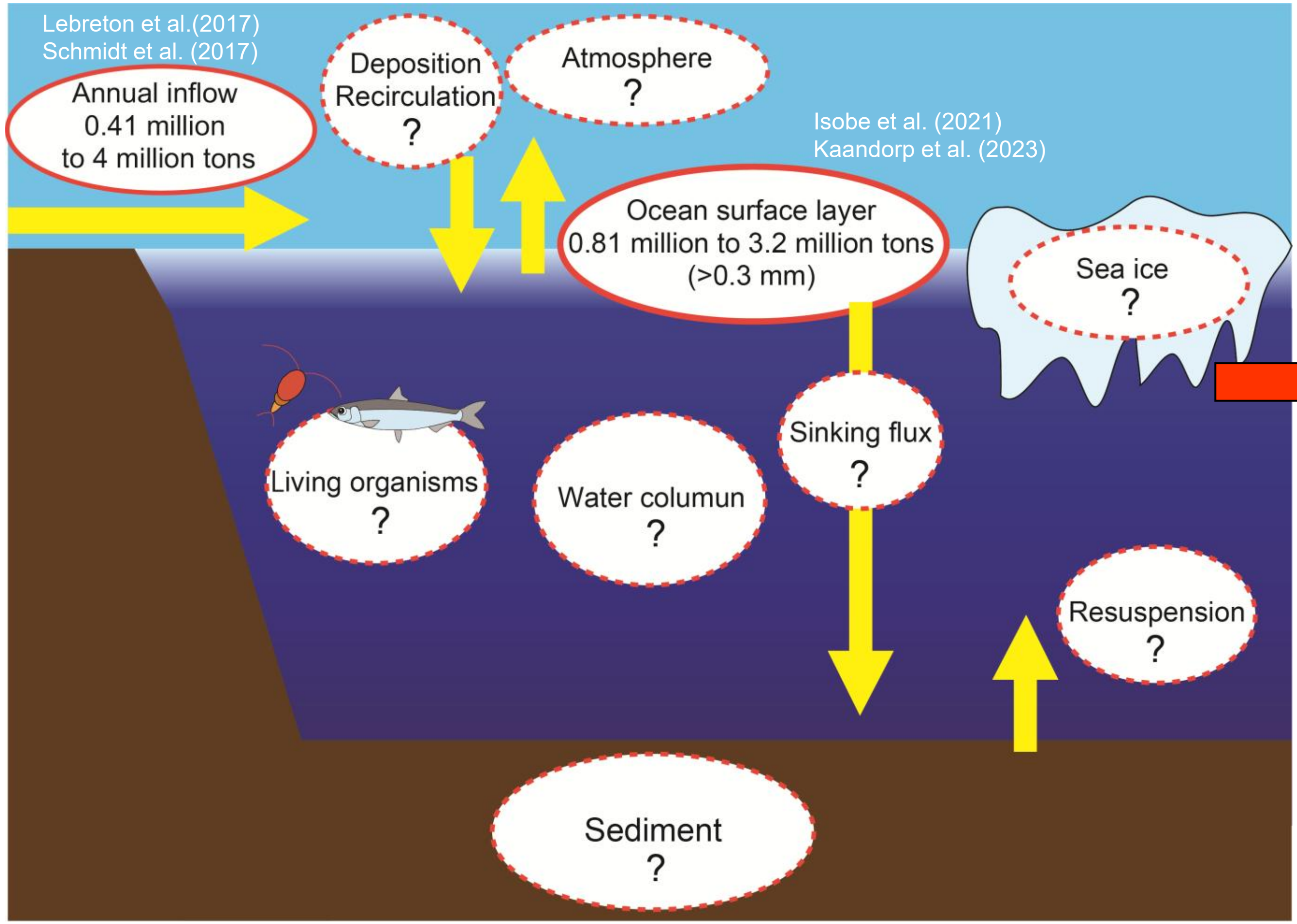
Total mass of plastic in each marine reservoir and the transportation between them is unknown



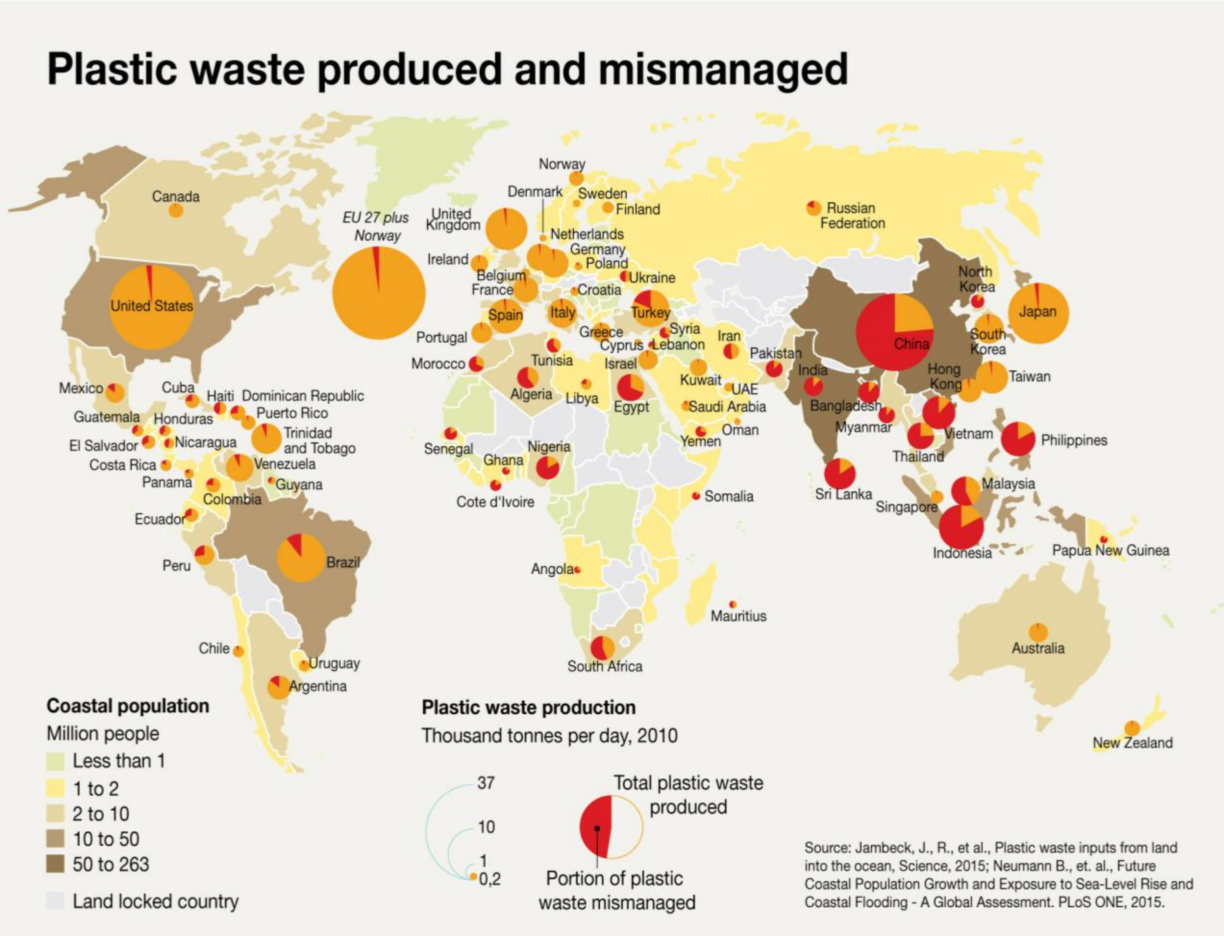
Accumulation in the ocean from 1960 to the present 25 million tons
（Isobe and Iwasaki, 2022.）

Only known for the surface layer

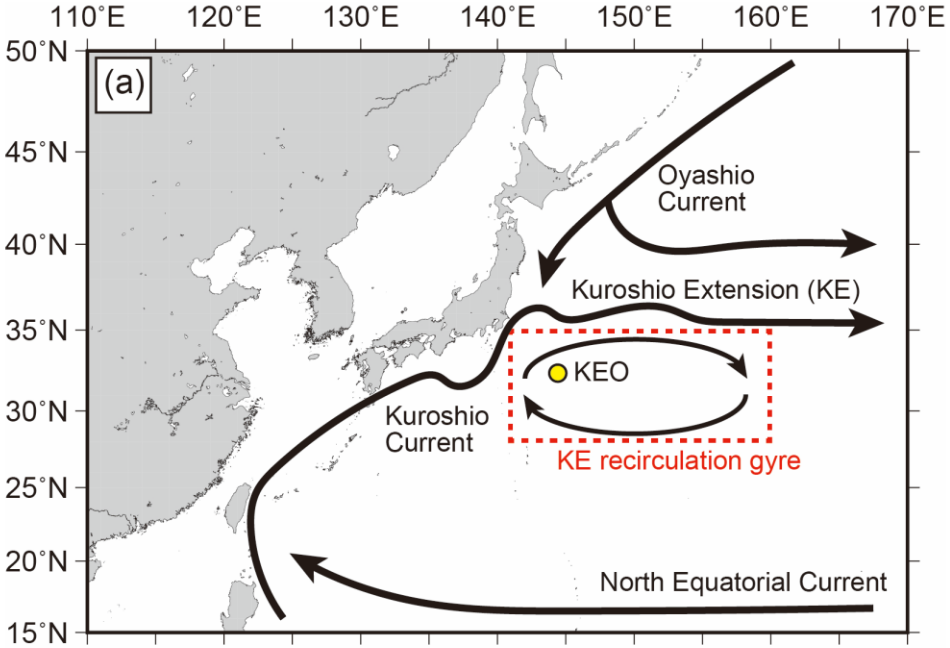
Amount transferred between reservoirs is also unknown

Determining the sinking flux of microplastics is an urgent task for predicting the fate of plastic debris

Plastic debris survey within Kuroshio Extension Recirculation Gyre



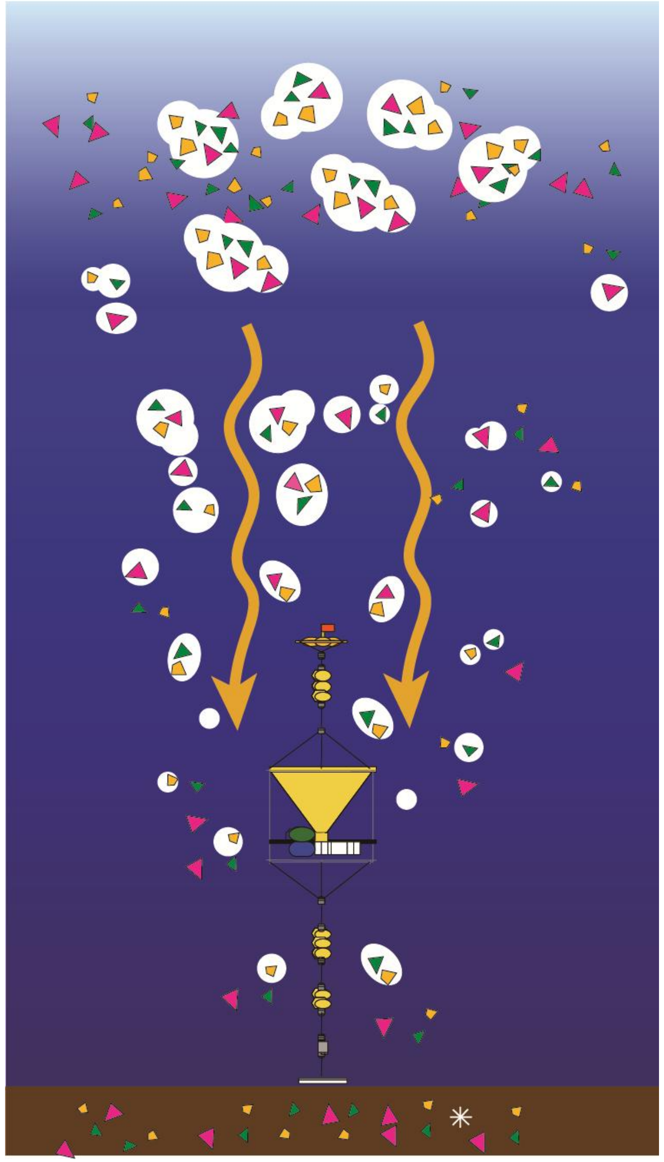
Fabres et al. (2016)



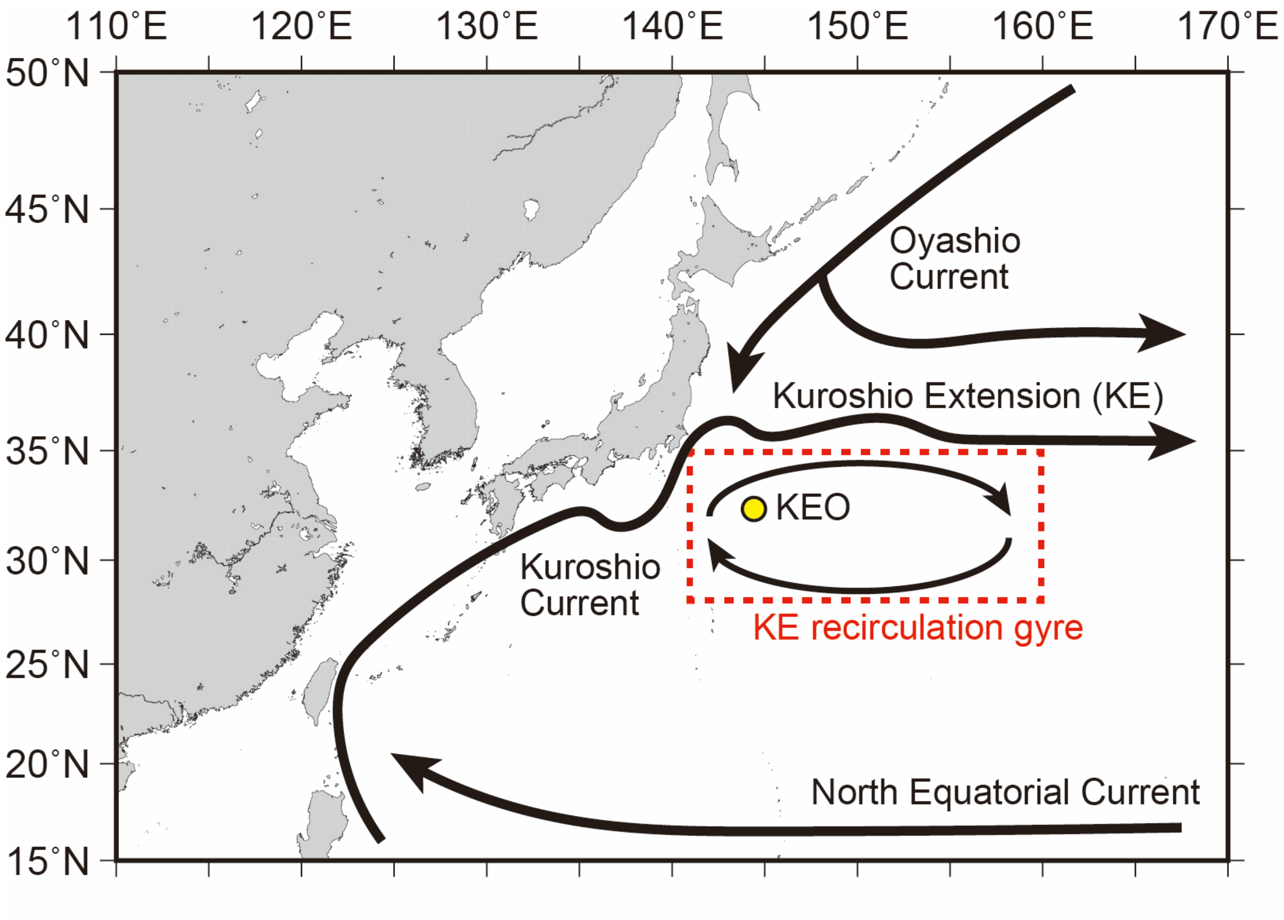
Approximately half of the huge amount of plastic waste flowing into the oceans originates from East and Southeast Asian countries.

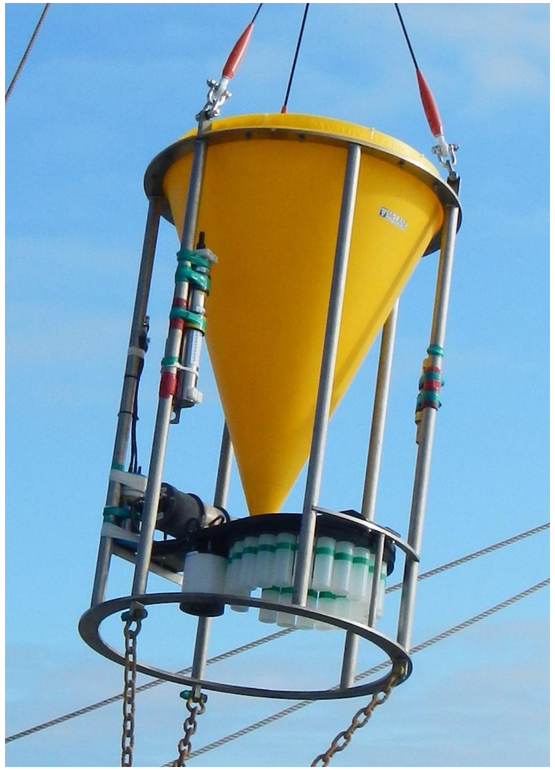
Marine sinking particles in the deep sea

Sediment-Trap : A device to collect marine sinking particles



Sediment-Trap Observations within KE Recirculation Gyre



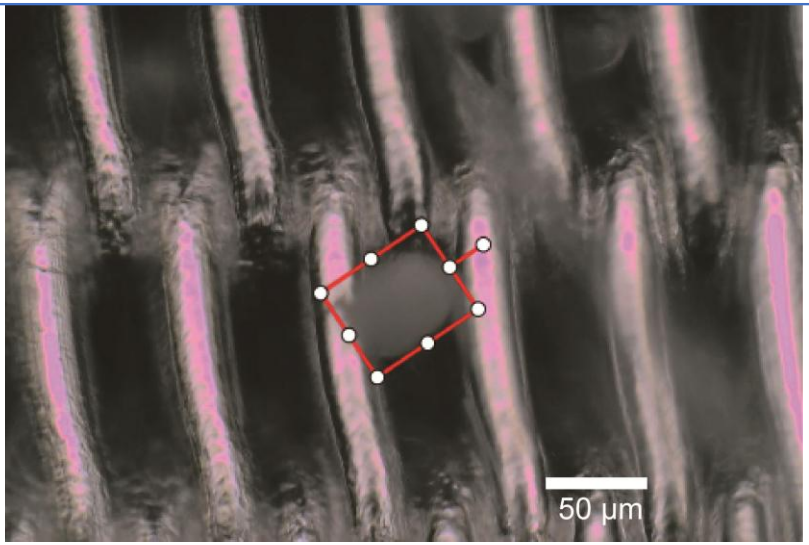


Station	Location	Sea floor depth (m) (Mooring depth)	Sampling duration
KEO	32°22'N, 144°25'E	5900 (4900)	July 1, 2014 to October 2, 2016 (18-21 day intervals）

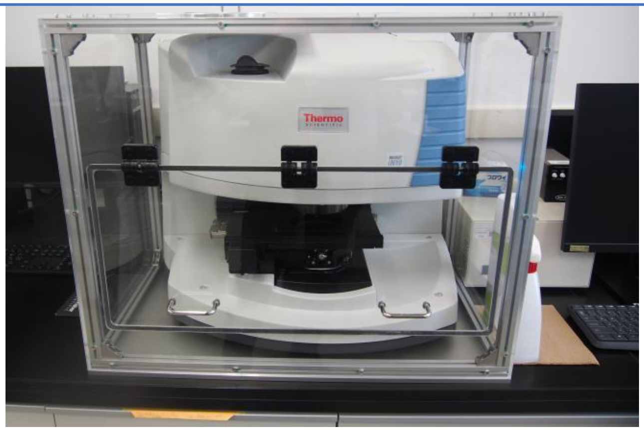
Microplastic identification using Micro-FTIR

Concentrated on stainless-steel filter

MPs on stainless-steel filter

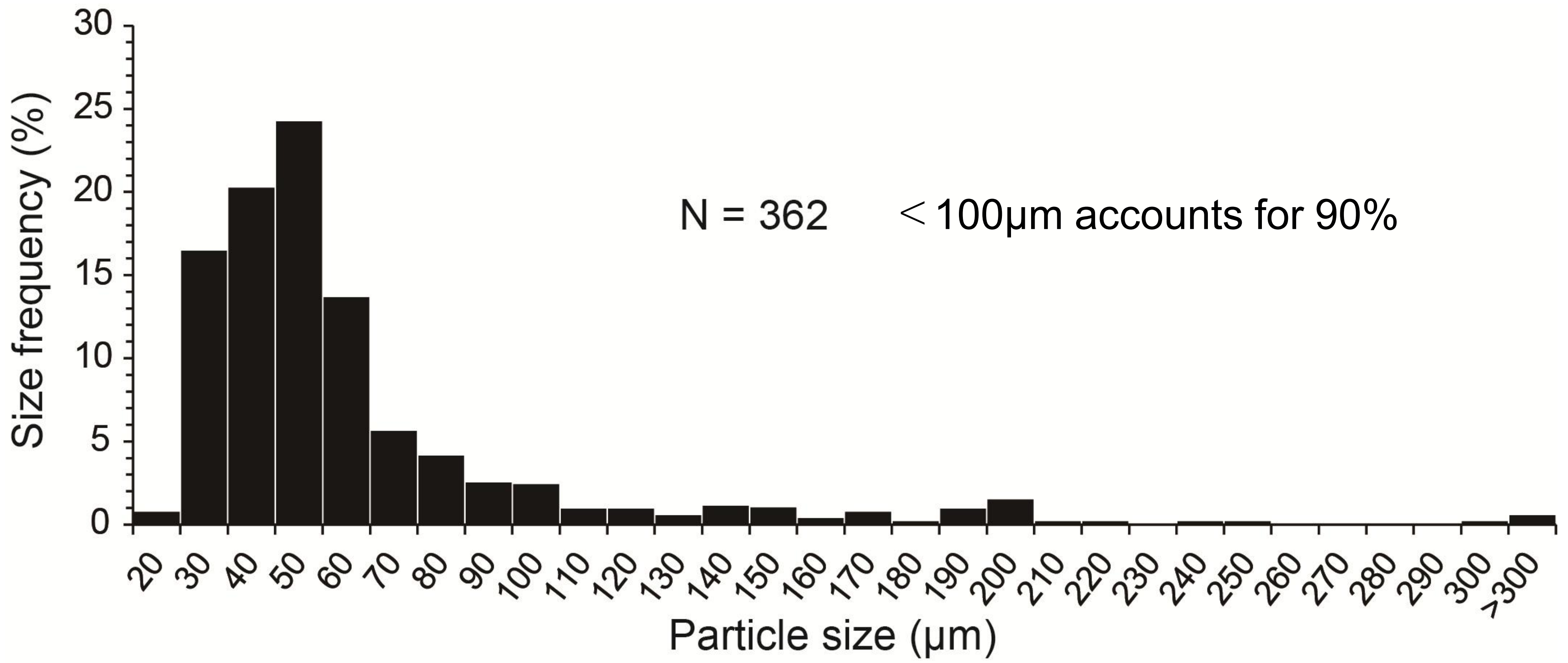


Micro Fourier Transform Infrared Spectrometer (Micro-FTIR)



Identification and counting of >20 μm size MPs using micro-FTIR

Relative microplastic particle size distribution

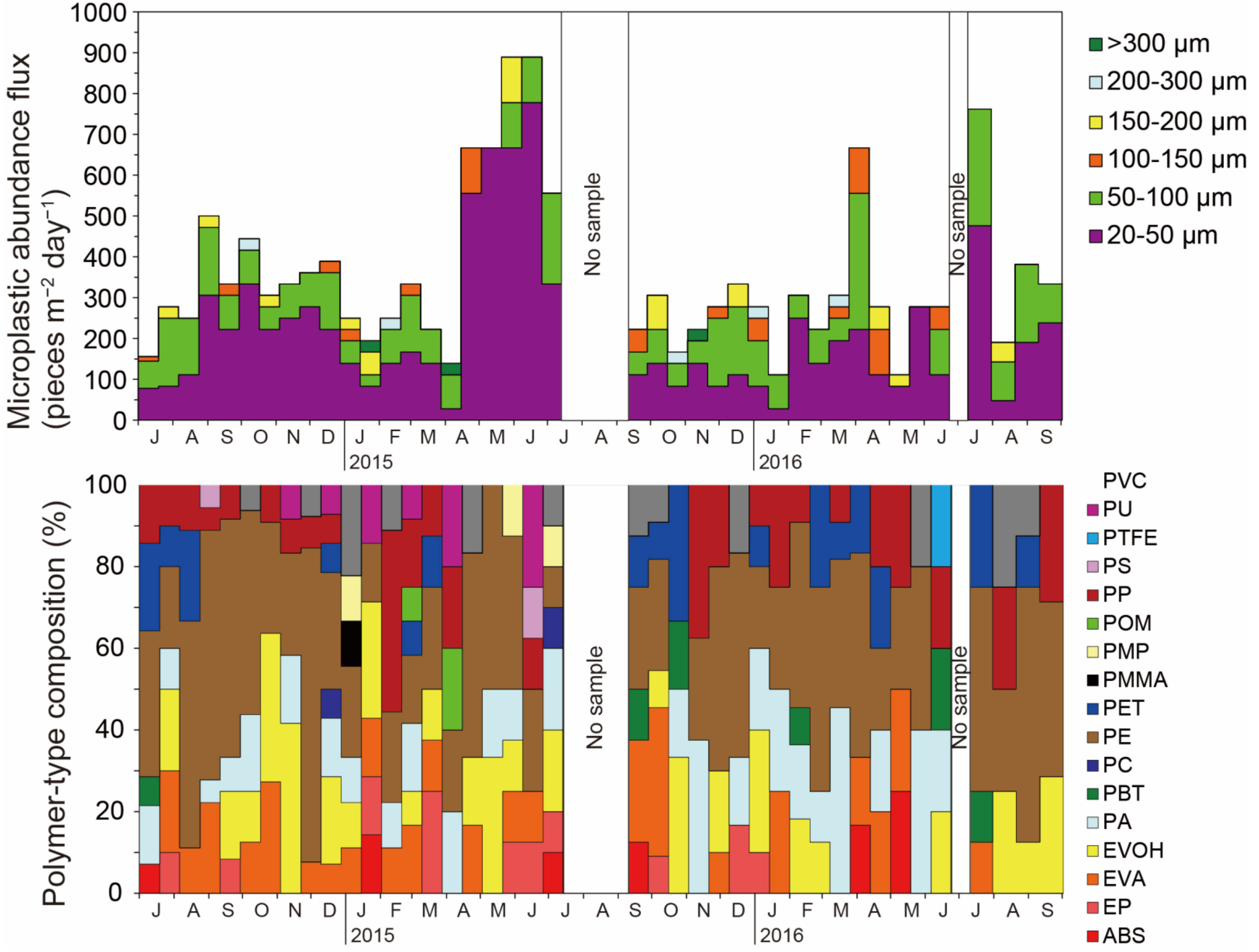


Ikenoue et al. (2024), ES＆T

Size range (μm)	Average size (μm)	Average aspect ratio
20-480	66	0.75

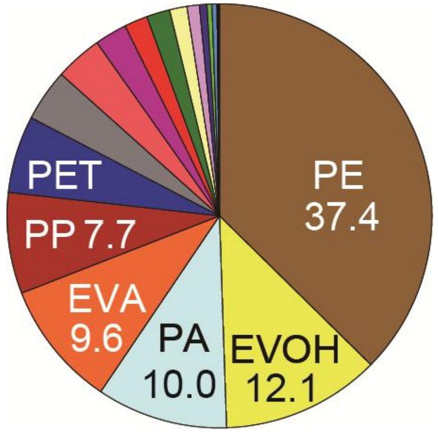
Particle size is small, similar to microplastics in deep-sea sediments, and close to square (spherical)
⇒ **indicating they originated far away and had been transported over long distances**

Time-series of microplastic fluxes at Stn. KEO



Microplastic fluxes (pieces m^{-2} day^{-1})
111～889

Average: 352±194

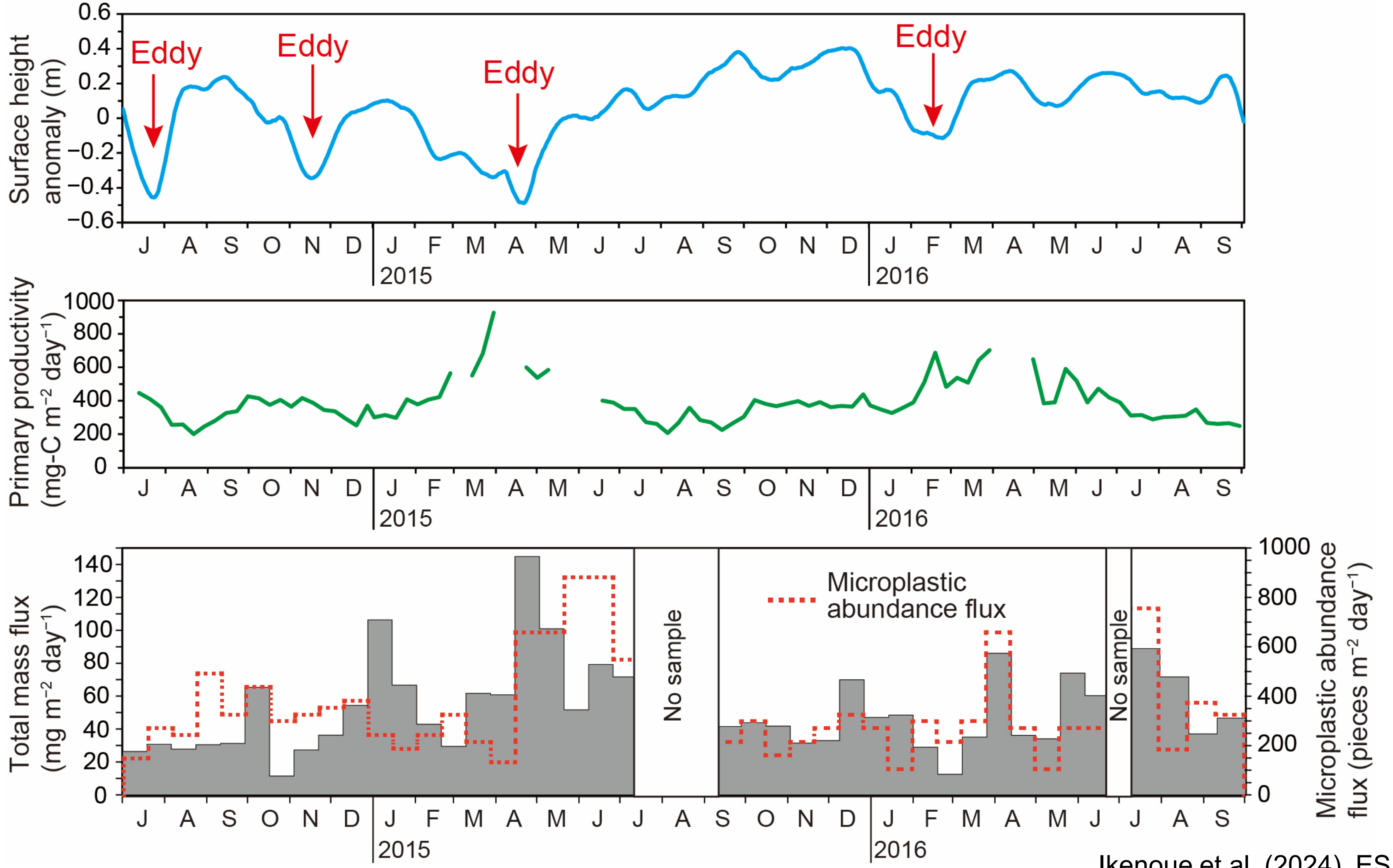


MPs with a specific gravity higher than seawater account for 44%

⇒Even high-density MPs are transported long distances by currents like the Kuroshio

Ikenoue et al. (2024), ES＆T

Relationship between MP flux and biological pump

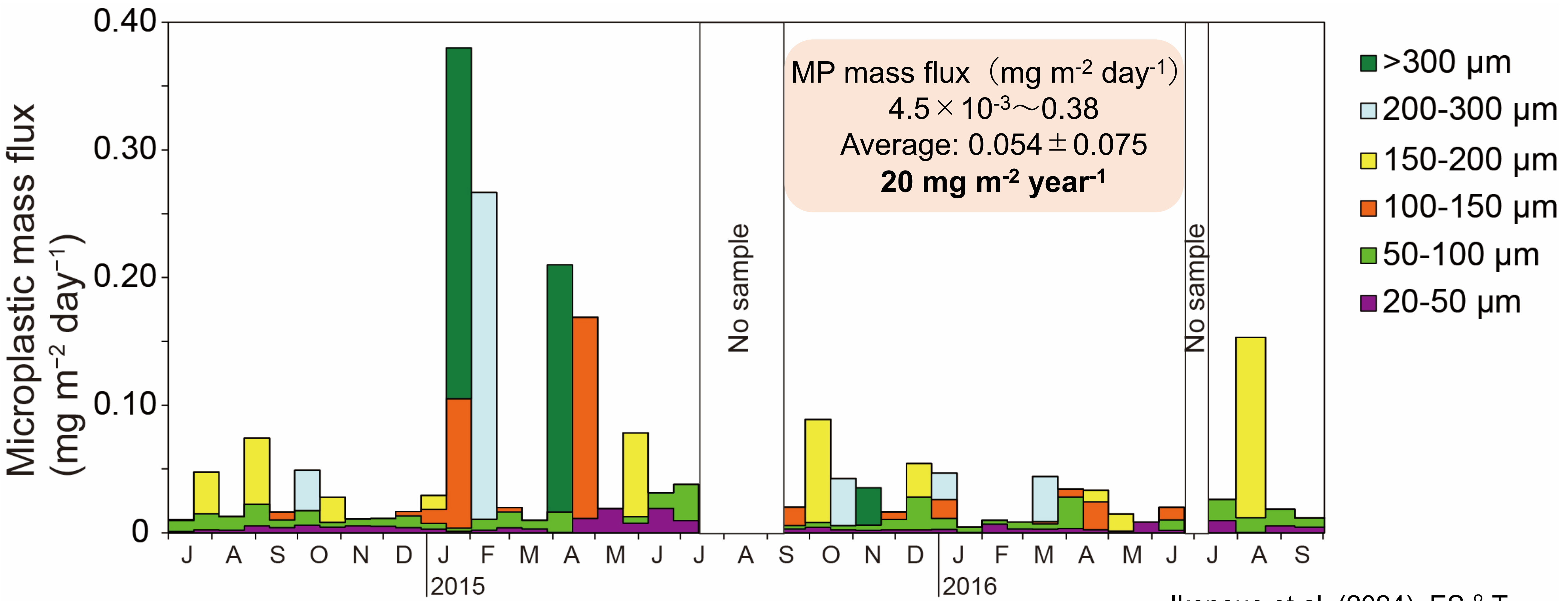


Ikenoue et al. (2024), ES＆T

Microplastic sinking was driven by increased sinking particles attributable to spring surface primary production

Not synchronized with passage of the eddies

Time-series of microplastic mass fluxes

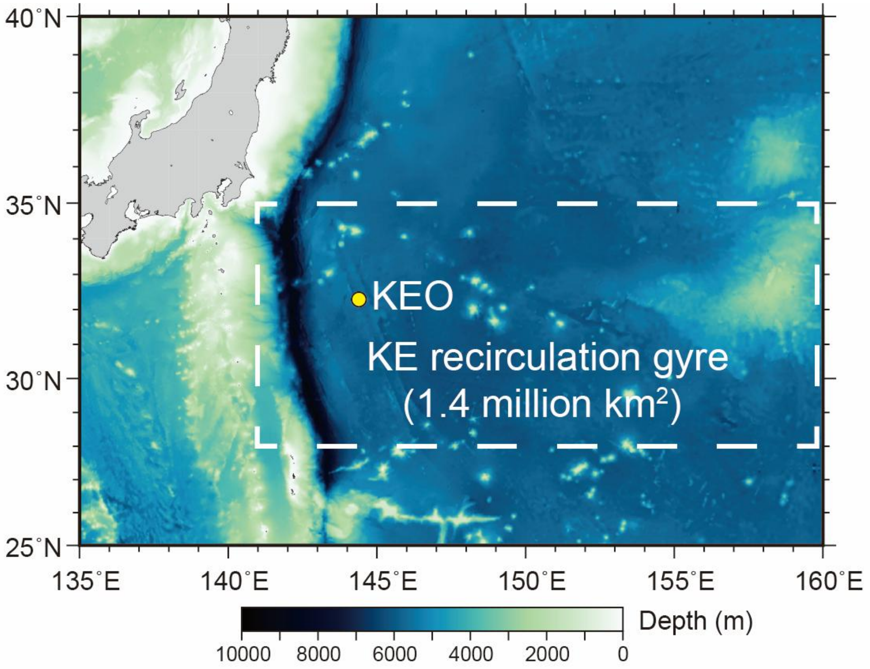


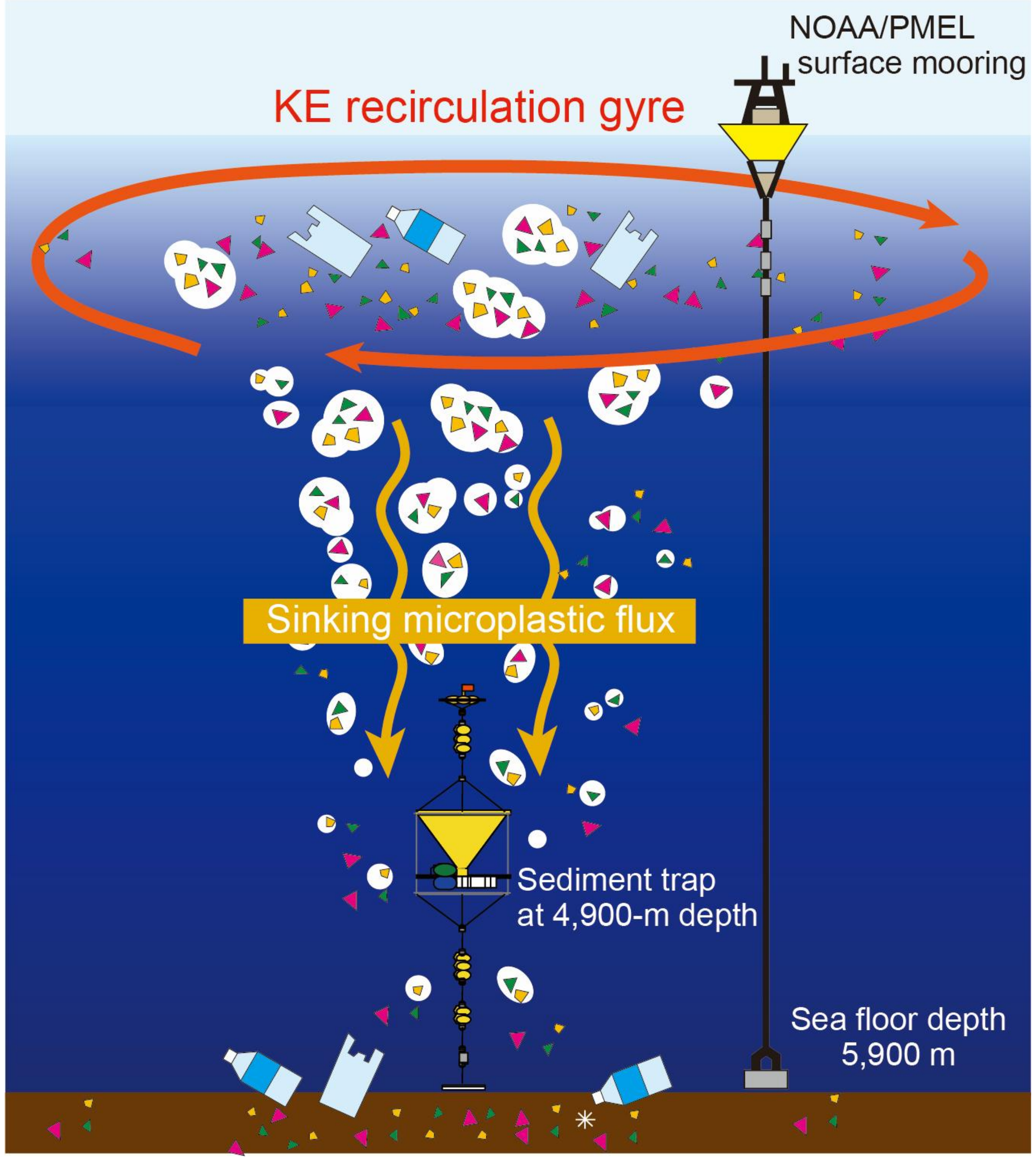
Ikenoue et al. (2024), ES＆T

Changes in MP mass flux are influenced more by size (volume) than by number

MP carbon accounted for an average of **1.5%** and a maximum of **9.6%** of the total organic carbon content in sinking particles

Annual MP flux within the KE recirculation gyre





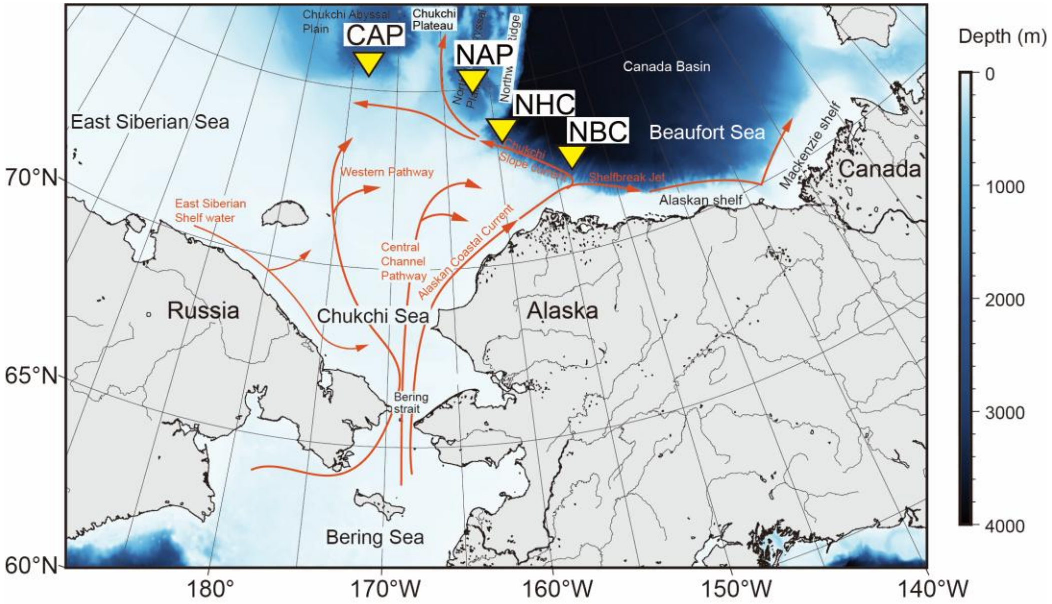
Sinking microplastic flux at 4,900-m depth

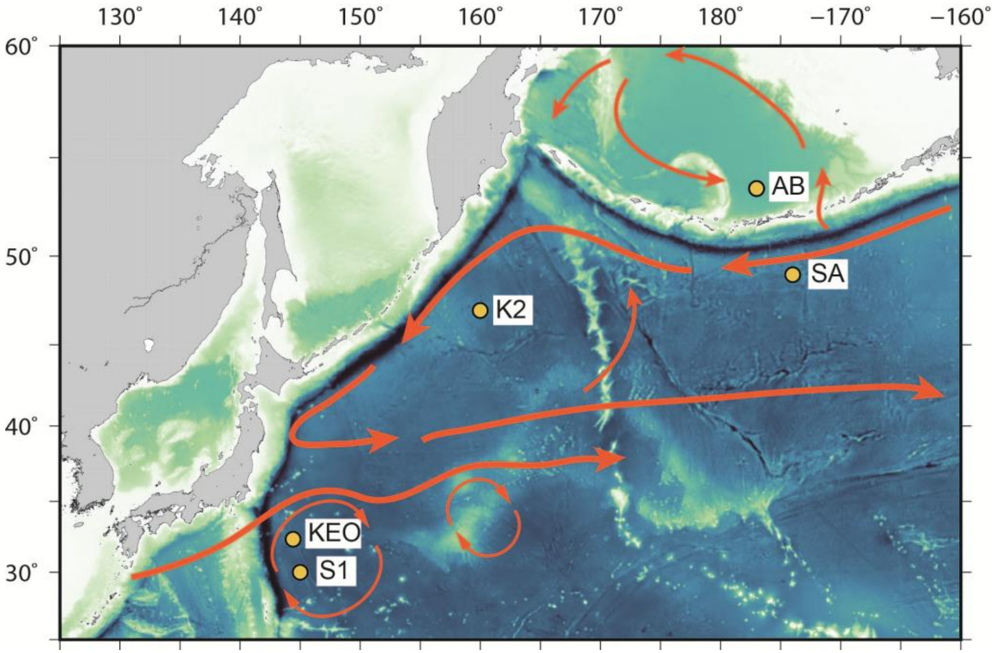
20 mg m^{-2} $year^{-1}$

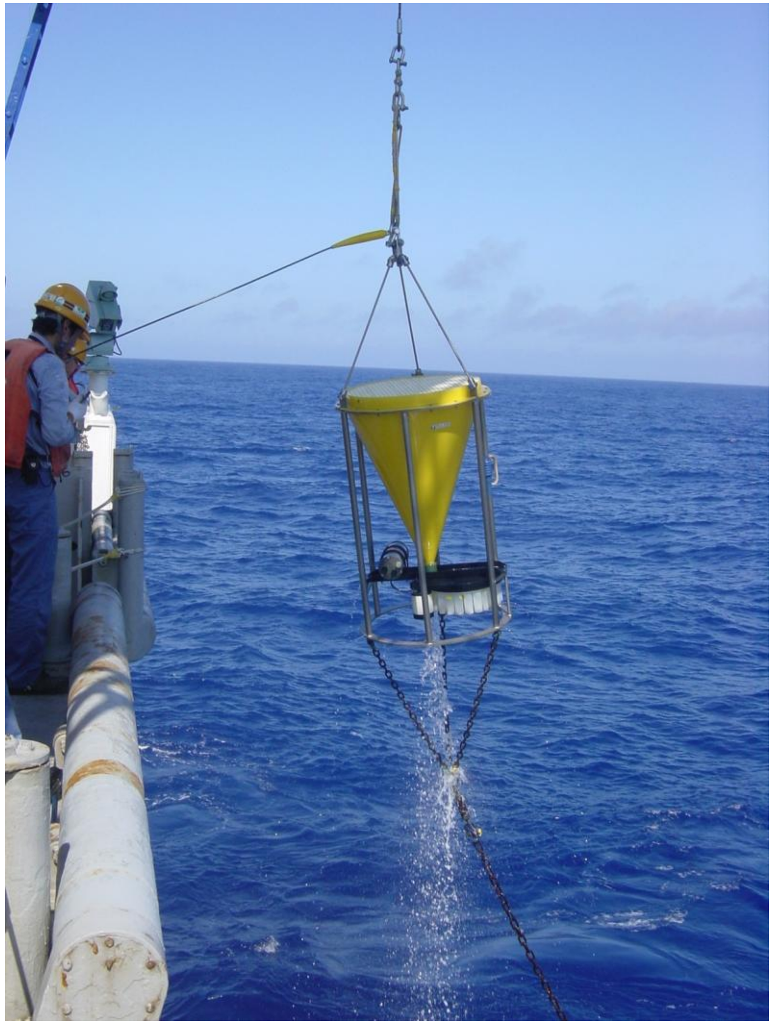
0.028 million metric tons $year^{-1}$
in KE recirculation gyre

Ikenoue et al. (2024), ES＆T

Toward understanding global marine plastic sinking fluxes







Thank you for your attention!

For further details, please refer to the following paper.

Ikenoue, T., Nakajima, R., Osafune, S., Siswanto, E., Honda, M.C. (2024). Vertical flux of microplastics in the deep subtropical Pacific Ocean: moored sediment-trap observations within the Kuroshio Extension recirculation gyre. Environmental Science & Technology, 58(36), 16121-16130. https://doi.org/10.1021/acs.est.4c02212.