

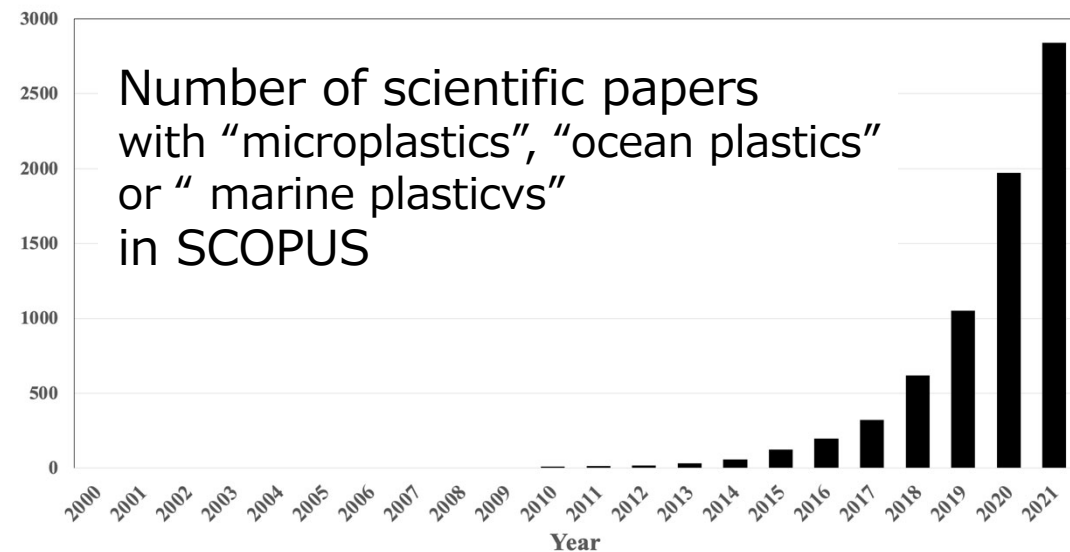
Marine Plastic Pollution from Scientific Point of View

- Research Result from

Environment Research and Technology Development Fund, 4-1502 & SII-2

Tadashi TOKAI

(Tokyo University of Marine Science and Technology, Japan)





Prof Takada, Tokyo University of Agriculture and Technology

Baseline Plastic pellets washed ashore
Measurement of persistent organic pollutants (POPs) in plastic resin pellets
from remote islands: Toward establishment
of background concentrations for
International Pellet Watch

Marvin Heskett ^a, Hideshige Takada ^b, Rei Yamashita ^b, Masaki Yuyama ^b, Maki Ito ^b,
Yeo Bee Geok ^b, Yuko Ogata ^b, Charita Kwan ^c, Angelika Heckhausen ^d, Heidi Taylor ^e, Taj Powell ^e,
Carey Morishige ^f, Doug Young ^g, Hugh Patterson ^h, Bryson Robertson ^h, Elizabeth Bailey ^j,
Jorge Mermoz ^k



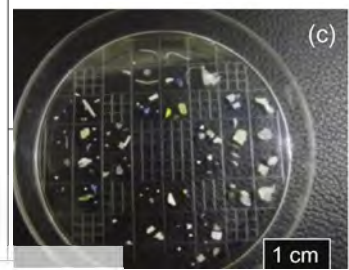
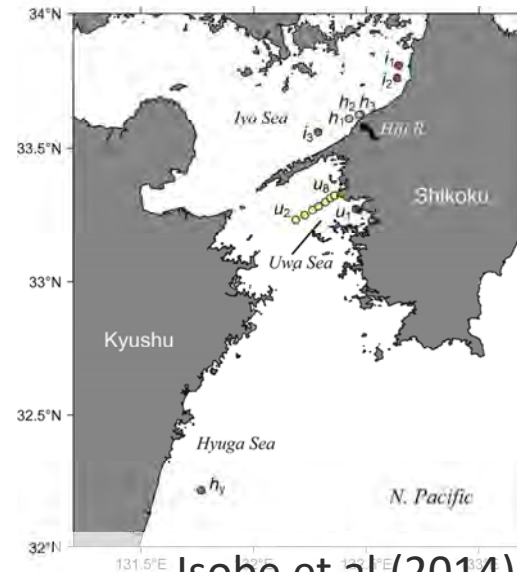
Heskett, Takada, et al. (2012)
doi.org/10.1016/j.marpolbul.2011.11.004



Prof Isobe, Kyushu University

Selective transport of microplastics and
mesoplastics by drifting in coastal waters

Atsuhiko Isobe ^a, Kenta Kubo ^b, Yuka Tamura ^c, Shin'ichio Kako ^d, Etsuko Nakashima ^e,
Naoki Fujii ^f



Isobe et al. (2014)
doi.org/10.1016/j.marpolbul.2014.09.041

By using university's training ships,



the Umitaka-maru and Shinyo-maru
Tokyo Univ. of Marine Science & Technology

Visual observation of marine debris floating on the ocean surface



Trawl surveys targeting marine seabed litter



“Researches on marine debris floating on the ocean surface and settled on the seabed in offshore areas around Japan” (Since FY2014)

funded by Ministry of the Environment, Japan

Neuston net sampling
micro & meso plastics

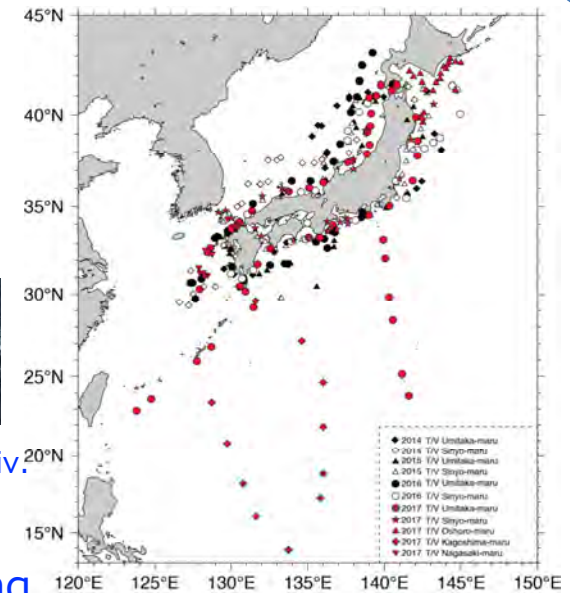


2017



Hokkaido Univ., Nagasaki Univ. & Kagoshima Univ.

About 100 sites per year for visual observation and microplastic sampling

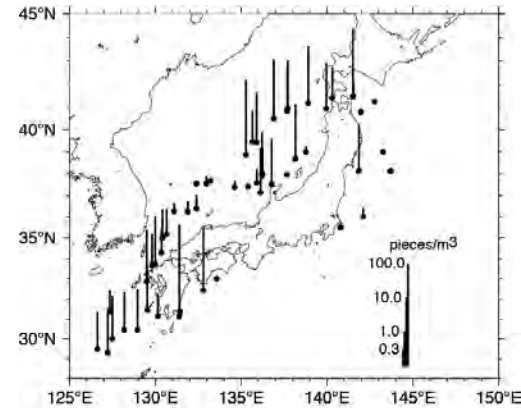


Isobe A, Uchida K, Tokai T, Iwasakia S.

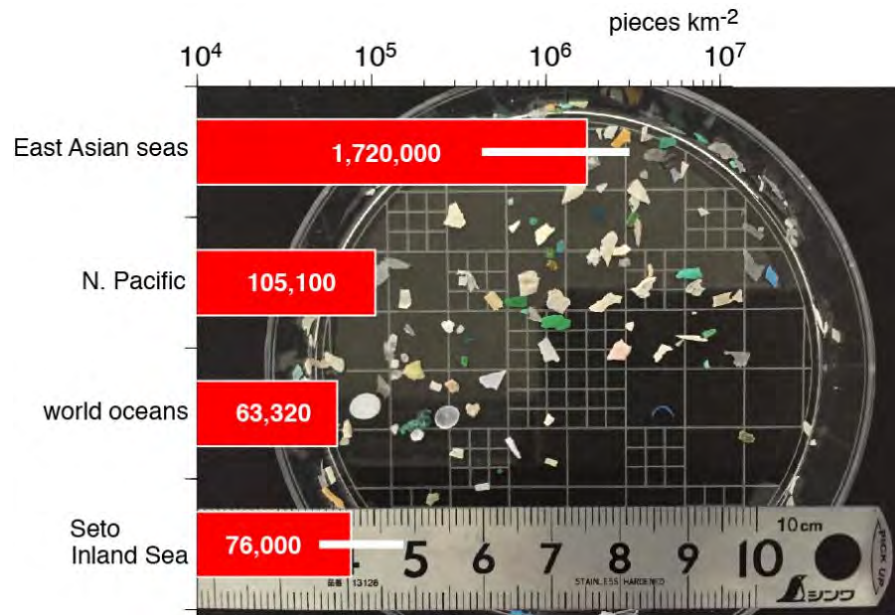
East Asian seas: A hot spot of pelagic microplastics

Marine Pollution Bulletin, Available online 29 October 2015.

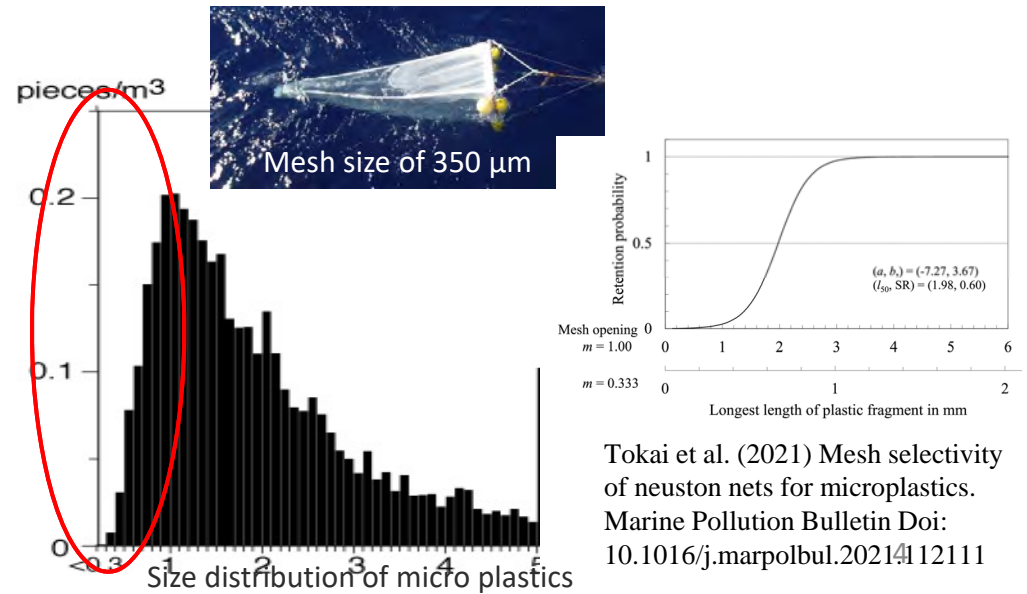
doi:10.1016/j.marpolbul.2015.10.042 Open Access



Density of microplastics floating around Japan (particles / m³)



16 (27) times greater than
in the North Pacific (world oceans)



Tokai et al. (2021) Mesh selectivity
of neuston nets for microplastics.
Marine Pollution Bulletin Doi:
10.1016/j.marpolbul.2021.112111

The Environment Research and Technology Development Fund

4-1502 (FY2015-2017)

Study on behavior and environmental risk of microplastics drifting in coastal waters and open oceans



Project leader Prof Isobe; Theme leaders, Prof Takada, Prof Tokai & Prof Hinata (Report in Japanese)

SII-2 (FY2018 – 2020, partially 2021)

Comprehensive studies on oceanic transport, environmental risk, and advanced monitoring of marine plastic debris



(Report in Japanese)

SII-2-1 Studies on transport and spread of marine plastic debris from coastal to the world's oceans (Prof Isobe)

• To estimate a budget of ocean plastic mass based on a combination of numerical particle tracking and linear mass-balance models.

🔍 ocean-beach exchanging process; settling process into the deeper layer

SII-2-2 Evaluation of impacts of microplastics and associated chemicals on marine ecosystem (Prof Takada)

• To clarify the uptake and excretion of microplastics (MPs) by aquatic organisms, and the exposure and transfer of the chemicals from ingested MPs to biota.

🔍 particle toxicity, hazardous chemicals in MPs

SII-2-3 Studies on Advanced Monitoring of Marine Plastic Debris (Prof Tokai)

• To advance monitoring system for marine plastic debris.

🔍 MPs (smaller than 300 μ m) @ sea surface, midwater, & seabed; aerial vehicle beach surveys with deep learning.

SII-2-2 Evaluation of impacts of microplastics and associated chemicals on marine ecosystem



SCIENTIFIC REPORTS

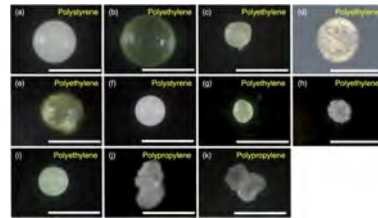
Microplastic fragments and microbeads in digestive tracts of planktivorous fish from urban coastal waters

Kosuke Tanaka & Hideshige Takada

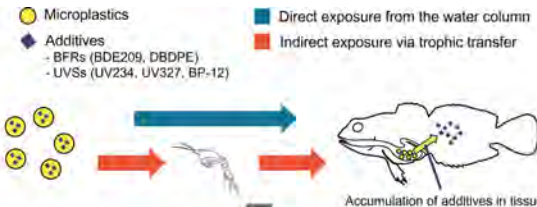
Microbeads ingested by Japanese anchovy (*Engraulis japonicus*). Scale bar 500 μm .

Tanaka & Takada(2016)
doi.org/10.1038/srep34351

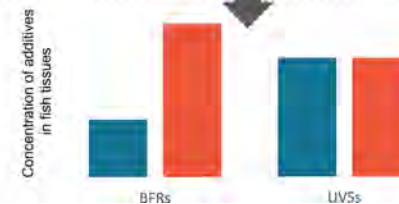
MPs were found in 80% of Japanese anchovy caught in Tokyo Bay



The significance of trophic transfer of microplastics in the accumulation of plastic additives in fish: An experimental study using brominated flame retardants and UV stabilizers.

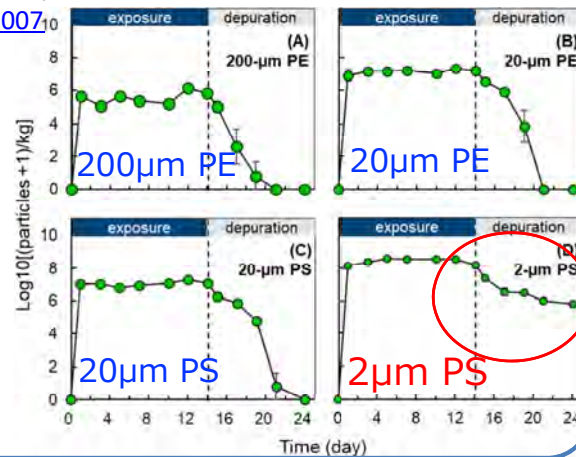
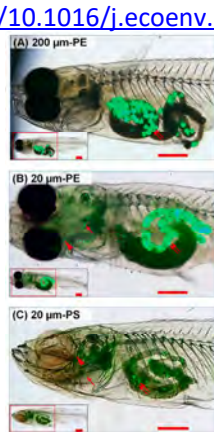


Hasegawa et al. (2022)
Marine Pollution Bulletin
DOI:
10.1016/j.marpolbul.2022.114343



Higher concentrations in fish (*M. brandti*) fed microplastic-contaminated prey mysids (*Neomysis*) than fish exposed to microplastics in the water.

Liu et al. (2007) Uptake and depuration kinetics of microplastics with different polymer types and particle sizes in Japanese medaka (*Oryzias latipes*)
Ecotoxicology and Environmental Safety
doi.org/10.1016/j.ecoenv.2021.112007



Current Biology



In Vivo Accumulation of Plastic-Derived Chemicals into Seabird Tissues
Tanaka et al. 2020.

Current Biology 30, 723-728.
DOI: 10.1016/j.cub.2019.12.037

Highlights

- UV-stabilizers and BDE-209 were industrially compounded into plastic resin pellets
- The pellets were fed to seabird chicks under environmentally relevant conditions
- The additives were detected in liver and adipose at 101–105 times above controls
- This study provides evidence of transfer and accumulation of plastic additives





Contents lists available at ScienceDirect

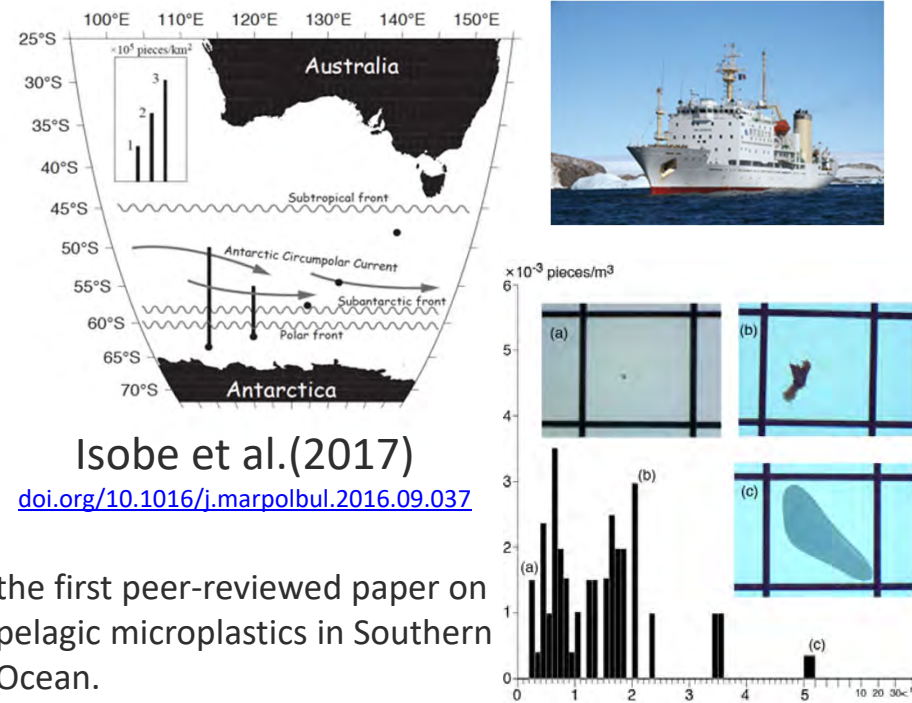
Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

Baseline

Microplastics in the Southern Ocean

Atsuhiko Isobe^{a,*}, Kaori Uchiyama-Matsumoto^b, Keiichi Uchida^c, Tadashi Tokai^c



Isobe et al. (2019, Nature Communications)

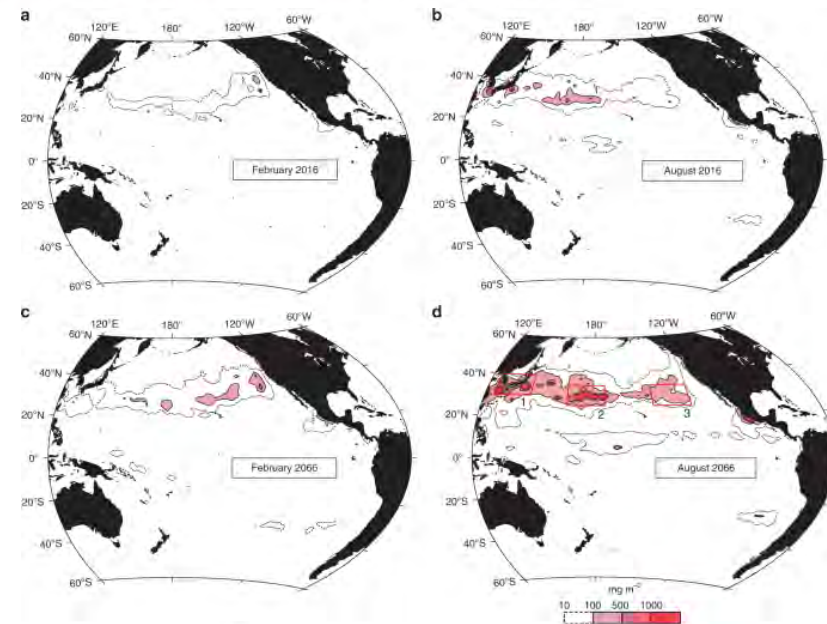
ARTICLE

<https://doi.org/10.1038/s41467-019-08316-9>

OPEN

Abundance of non-conservative microplastics in the upper ocean from 1957 to 2066

Atsuhiko Isobe¹, Shinsuke Iwasaki², Keiichi Uchida³ & Tadashi Tokai³



Abundance of microplastics in the present and future. The panels represent the weight concentrations averaged in February (a) and August (b) in 2016, and February (c) and August (d) in 2066 at the sea surface. The weight concentrations are shown by a red stippling in the line with the scale at the bottom of d.

SII-2-3 Studies on Advanced Monitoring of Marine Plastic Debris

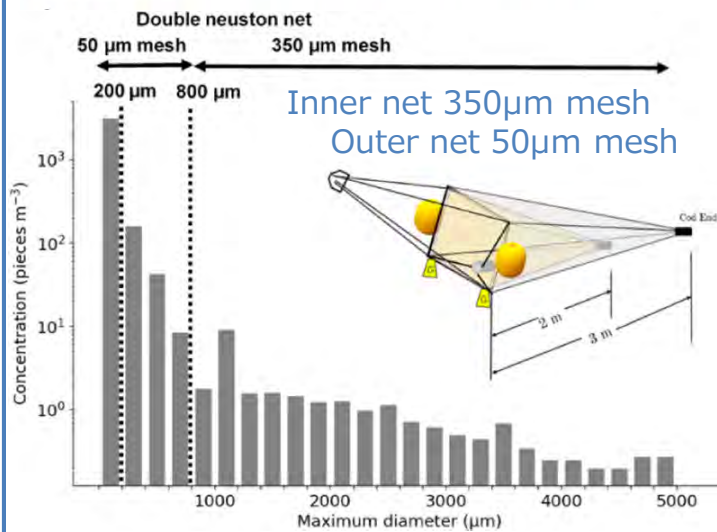


Marine Pollution Bulletin
Volume 185, Part A, December 2022, 114245



Contamination of sea surface water offshore the Tokai region and Tokyo Bay in Japan by small microplastics

Haodong Xu, Haruka Nakano, Tadashi Tokai, Tadashi Miyazaki, Hiroaki Hamada, Hisayuki Arakawa



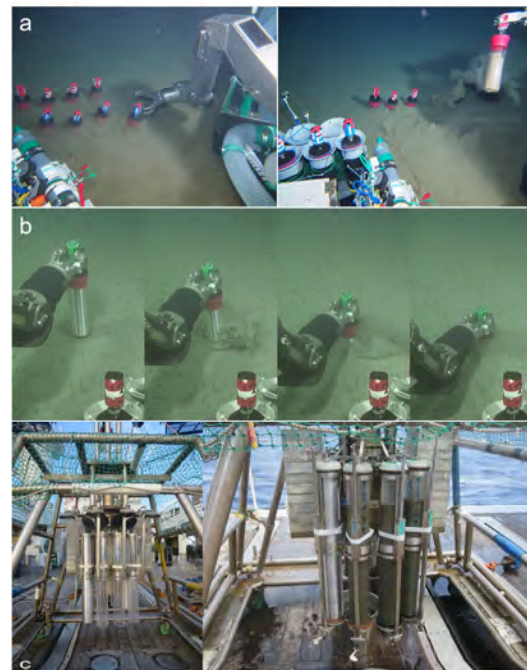
MethodsX
Volume 6, 2019, Pages 2662-2668



Method Article

Sediment sampling with a core sampler equipped with aluminum tubes and an onboard processing protocol to avoid plastic contamination

Masashi Tsuchiya, Hidetaka Nomaki, Tomo Kitahashi, Ryota Nakajima, Katsunori Fujikura



Kuroda et al. (2020)
The current state of marine debris on the seafloor in offshore area around Japan

[Marine Pollution Bulletin 161, Part A](#), 2020, 111670

DOI:10.1016/j.marpolbul.2020.111670



- Most of marine debris on the sea floor are plastic products.
- Plastic on the sea floor remain in shape for a long time without deterioration.

SII-2-3 Studies on Advanced Monitoring of Marine Plastic Debris



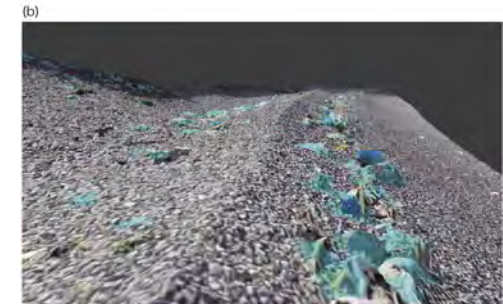
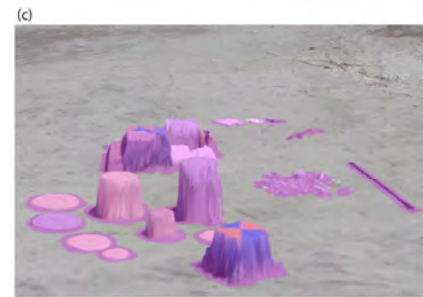
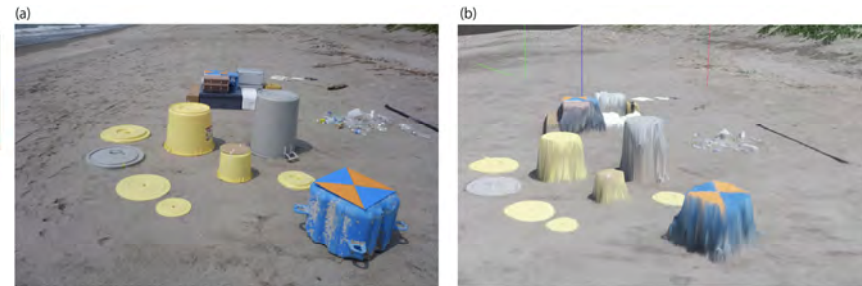
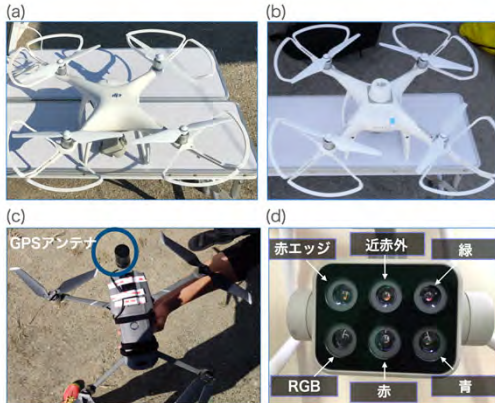
Marine Pollution Bulletin

Volume 155, June 2020, 111127



Estimation of plastic marine debris volumes on beaches using unmanned aerial vehicles and image processing based on deep learning

Shin'ichiro Kako ^a, Shohei Morita ^a, Tetsuya Taneda ^b



Highlights

- A new method of accurately calculating marine debris volumes on beaches is proposed.
- A UAV was used combined with an image processing method based on deep learning.
- Accuracy of the method was verified by estimating volumes of test debris.
- The new system can estimate marine debris volumes with an error of $\leq 5\%$.

SII-2-1 Studies on transport and spread of marine plastic debris from coastal to the world's oceans



Science of The Total Environment
Volume 825, 15 June 2022, 153935



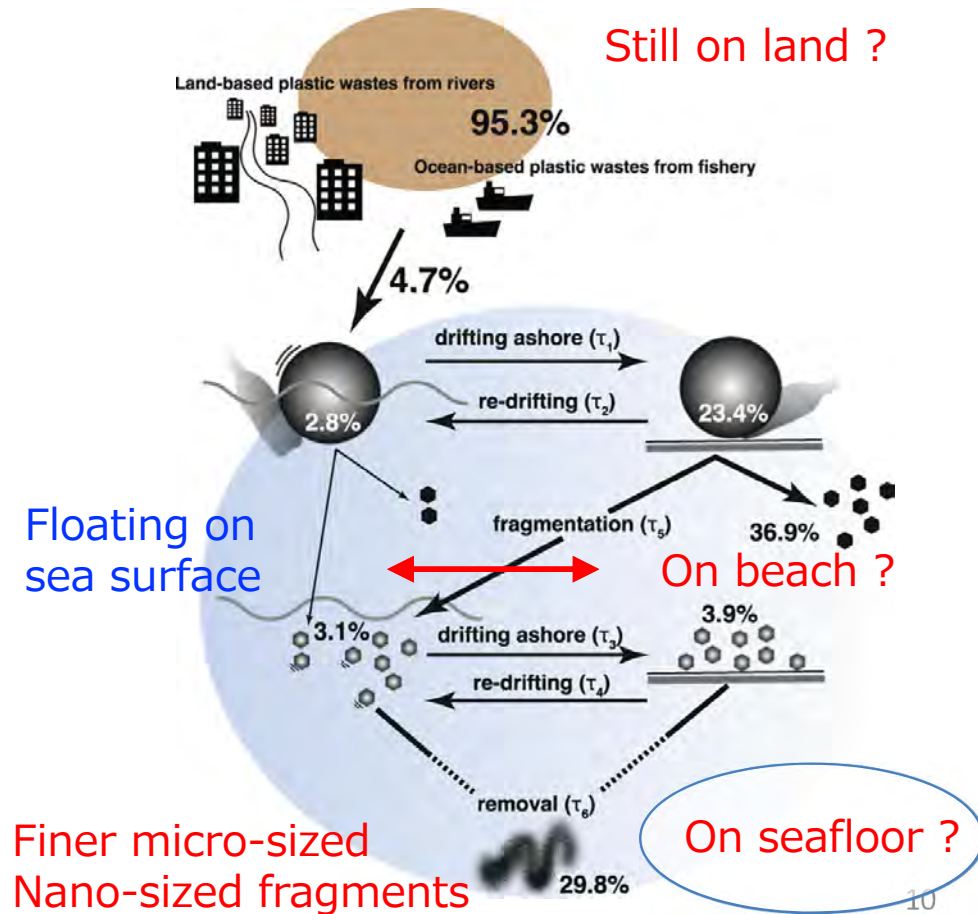
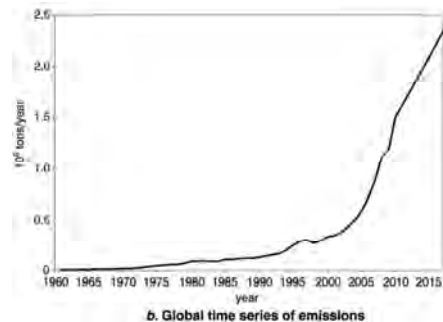
The fate of missing ocean plastics: Are they just a marine environmental problem?

Atsuhiko Isobe ^a, Shinsuke Iwasaki ^b

Isobe and Iwasaki (2022)

Highlights

- A budget for ocean plastic mass was estimated using numerical particle tracking and linear mass-balance models.
- Two models were validated using a worldwide ocean plastic dataset.
- 66.7% of ocean plastics are unmonitorable under current observation frameworks.
- 516.9 MMT of the mismanaged plastic have been lost on land.



Guidelines for Harmonizing Ocean Surface Microplastic Monitoring Methods

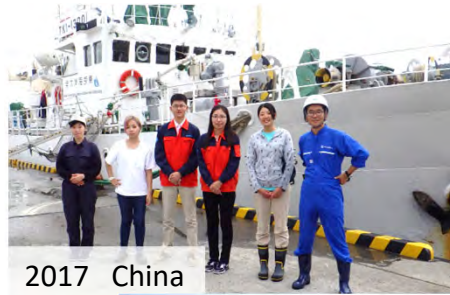
MICHIDAY, CHAVANICH S, CHIBA S, CORDOVA MR, CÓZAR CA, GALGANI F, HAGMANN P, HINATA H, ISOBE A, KERSHAW P, KOZLOVSKII N, LI D, LUSHER AL, MARTÍ E, MASON SA, MU J, SAITO H, SHIM WJ, SYAKTI AD, TAKADA H, THOMPSON R, TOKAI T, UCHIDA K, VASILENKO K, WANG J

Version 1.1, June 2020



Ministry of the Environment, JAPAN
June, 2020

Training in research methodology



2017 China



2017 Thai, Indonesia

2018 Thai, Indonesia



2019 Indonesia, Thai, Viet Nam, Cambodia



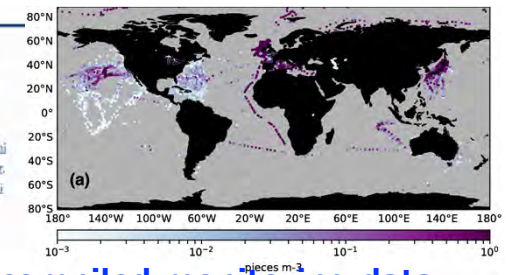
SpringerLink

Research Article | Open Access | Published: 09 September 2021

A multilevel dataset of microplastic abundance in the world's upper ocean and the Laurentian Great Lakes

[Atsuhiko Isobe](#), [Takafumi Azuma](#), [Muhammad Reza Cordova](#), [Andrés Cózar](#), [François Galgani](#), [Ryuichi Hagita](#), [La Daana Kanhai](#), [Keiri Imai](#), [Shinsuke Iwasaki](#), [Shin-ichiro Kako](#), [Nikolai Kozlovskii](#), [Amy L. Lusher](#), [Sherri A. Mason](#), [Yutaka Michida](#), [Takahisa Mituhashi](#), [Yasuhiro Morii](#), [Tohru Mukai](#), [Anna Popova](#), [Kenichi Shimizu](#), [Tadashi Tokai](#), [Keiichi Uchida](#), [Mitsubaru Yagi](#) & [Weiwei Zhang](#)

Microplastics and Nanoplastics 1, Article number 16 (2021) | [Cite this article](#)



MOEJ has organized a globally-compiled monitoring data to promote a worldwide network for data sharing.