

# Harmonization of marine plastic litter monitoring and database, implementation in Japan

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Ministry of the Environment, JAPAN

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Efforts to understand the state of marine plastic litter in Japan

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the world's ocean by Kyushu University

Operation of deep-sea debris database and scientific  
research by JAMSTEC



Data and  
findings feeding  
into the data  
sharing project

# Towards harmonization of monitoring methods and data sharing for ocean surface microplastics

Ministry of the Environment, Japan (MOEJ) has been working on harmonization of monitoring methods and data sharing for ocean surface microplastics since 2016 based on agreements concluded at the G7 Schloss Elmau Summit in 2015, the G20 Osaka Summit in 2019, and related international workshops.

- 2019 May MOEJ published the “**Guidelines for Harmonizing Ocean Surface Microplastic Monitoring Methods**”.
- 2020 June MOEJ revised the Guidelines
- Added guidelines for small vessels such as fishing boats, and guidelines for monitoring in sea area with many floating substances like fish eggs.
  - Published the “Data Entry Form Sheet & Data List Sheet”.
- 2020 Sep. MOEJ hold the “G20 Workshop on harmonized monitoring and data compilation of marine plastic litter” and proposed a “**Marine Plastic Litter Monitoring Data Sharing Project**”.

# Purpose of harmonizing monitoring methods and data sharing

Purpose of harmonizing monitoring methods and data sharing discussed at the **“G20 workshop on harmonized monitoring and data compilation of marine plastic litter”** (held on 7 September 2020) are to



- ✓ Understand the current status of the pollution
- ✓ Estimate their negative impacts on biota
- ✓ Identify the sources and hotspots
- ✓ Predict pollution
- ✓ Develop measures and verify their effectiveness
- ✓ Establish targets and milestones
- ✓ Promote public awareness and environmental education



**Obtain science knowledge essential for efficient policy making to reduce marine plastic on a global scale**

# Guidelines for Harmonizing Ocean Surface Microplastic Monitoring Methods

The Guidelines propose ways of harmonizing methodologies for monitoring microplastic densities at the ocean surface to deliver comparable results. The Guidelines indicate the rationale for various sample collection methods, sample handling and processing, analytical procedures, reporting requirements, and other matters necessary or desirable for harmonization

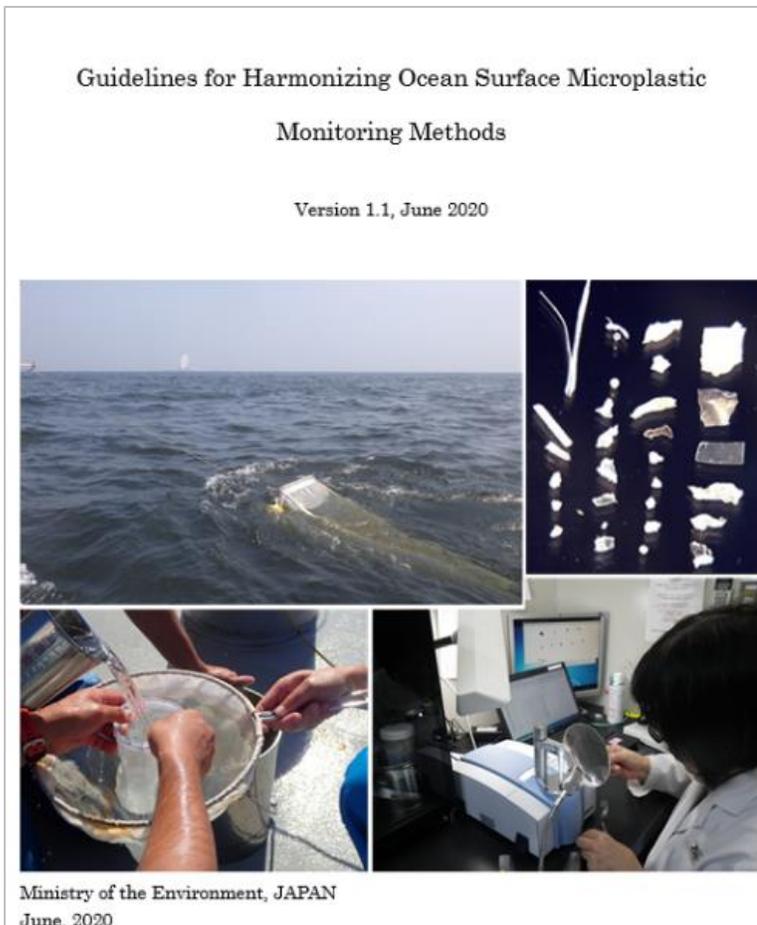
- ver. 1.1 revised in June 2020 is the latest version.
- Written by 25 international experts.
- Available on the MOEJ website and IODE's Ocean Best Practice website.

Guidelines web page :

[http://www.env.go.jp/en/water/marine\\_litter/guidelines/guidelines.pdf](http://www.env.go.jp/en/water/marine_litter/guidelines/guidelines.pdf)

Data Entry Form Sheet & Data List Sheet web page:

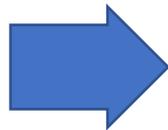
[http://www.env.go.jp/water/post\\_76.html](http://www.env.go.jp/water/post_76.html)



# Guidelines for Harmonizing Ocean Surface Microplastic Monitoring Methods

## Background

- Marine litter including microplastic is a global urgent matter. Measures against marine litter and microplastics need to be considered and taken based upon scientific knowledge.
- Understanding the actual status of pollution is important, however
- Comparing and synthesizing measured data of microplastic abundance obtained by various researchers were difficult due to the diversified monitoring methods taken.



**Harmonization of monitoring methods**  
**Exploring how to compare existing data**

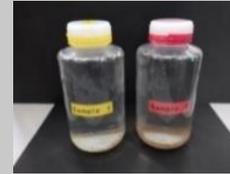
## Concept

- Focus on net sampling and sample analysis methods
- **Goal is to develop distribution map of microplastics on sea surface**
- Identify technical parameters to be harmonized
- Consider minimum requirements and specific needs

# Guidelines for Harmonizing Ocean Surface Microplastic Monitoring Methods

## Process

- 2015: At an international workshop held as a follow-up to the G7 Elmau Summit, it was agreed that Japan would take the lead in harmonizing monitoring methods for marine surface microplastics.
- 2016: The Ministry of the Environment initiated a study for harmonization. **Reviewed papers** and invited experts from Japan and abroad to initiate **international expert meetings**.
- 2017: For examining analytical methods, an **inter-laboratory comparison** (ILC) was conducted by 12 laboratories in 10 to cross-check standard samples
- 2018: For examination of sampling approaches, **comparison of microplastic sampling methods** was conducted using a research vessel
- 2019: **Guidelines were released** in May
- 2019: Additional comparison was implemented in field
- 2020: **Guidelines were revised** in June. Notes on conducting surveys with small vessels and in waters with a lot of floating debris were added. **Data entry form for reporting items required for harmonization was released**.



◀ Two types of standard samples were prepared to mimic the open ocean and inner bay, including microplastics and particles of natural objects.



◀ 'Man-made' microplastics

▼ Particles of natural objects



Results of ILC2017 was published in Marine Pollution Bulletin (Isobe et al., vol.146, 2019, P.831-837), titled "An inter-laboratory comparison experiment to quantify the abundance of microplastics in standard sample bottles ."



▲ Net



Port

Starboard

Pilot projects were conducted on site to investigate differences in sampling results by net type, net mesh opening, tow duration and tow position.

# Diagram of towing methods recommended by the Guidelines



Wind speed:  
**less than 5m/s**

Wave height:  
**less than 0.5m**

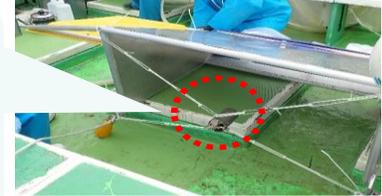
Beaufort scale:  
**less than 3**



Neuston net with flow meter



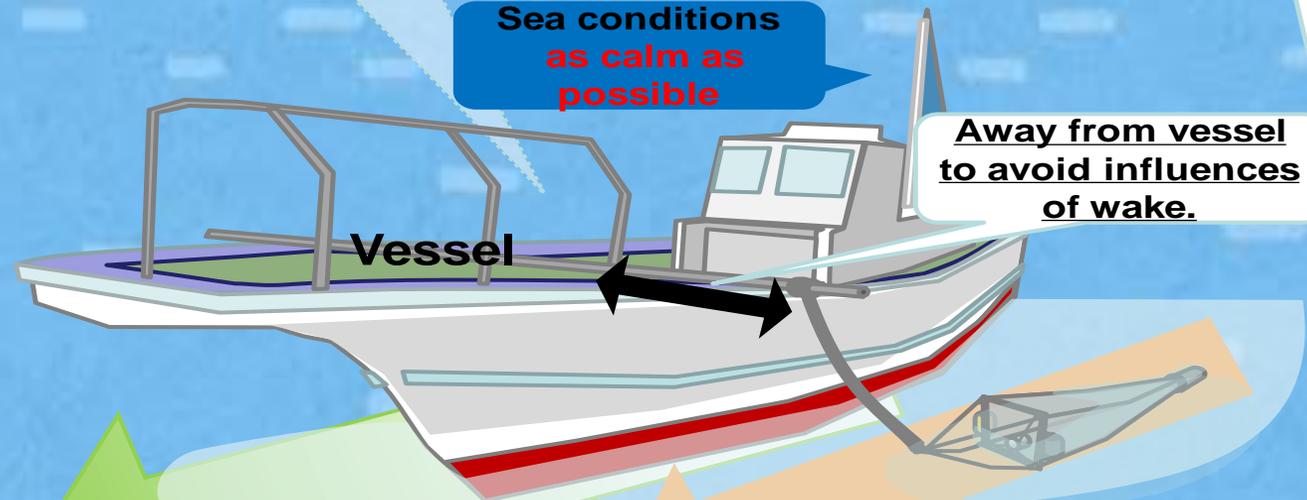
Flow meter



Manta net with flow meter

Sea conditions  
**as calm as possible**

Away from vessel  
to avoid influences  
of wake.



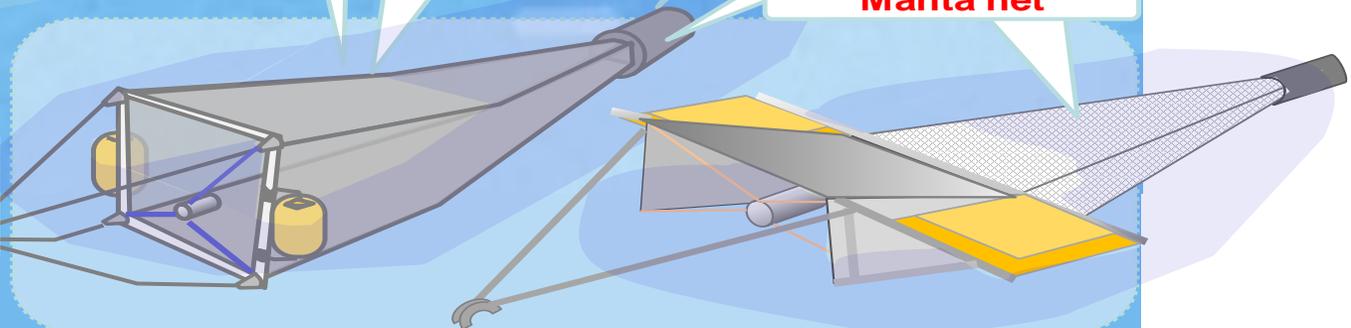
Cod end

Net type  
**Neuston net or Manta net**

**Vessel speed**  
**1~3knots**  
\*When using a small fishing boat, 1-2 knots

**Trawl sweep area**  
**about 1,000 m<sup>2</sup>**  
(corresponding to 200-500 m<sup>3</sup> of filtered water volume)

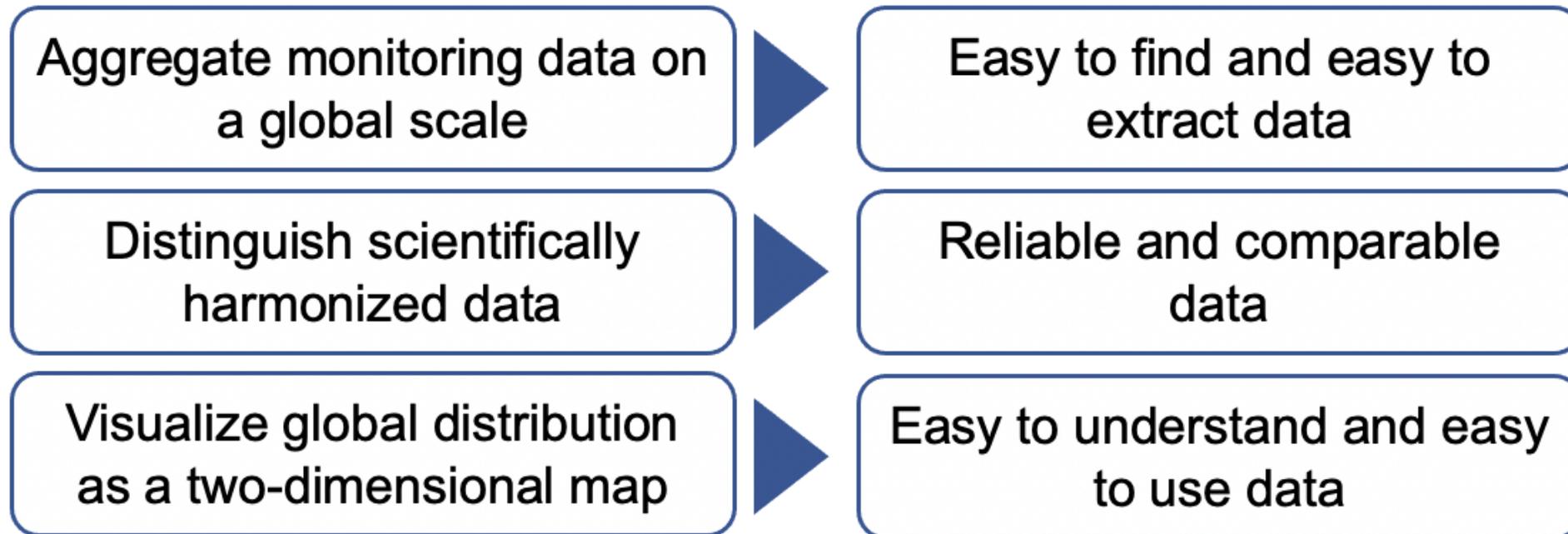
**Tow duration**  
**Approximately 20 min.**



# Marine Plastic Litter Monitoring Data Sharing Project

- **Collect** monitoring data of ocean surface microplastics
- **Organize** comparable dataset utilizing the Guidelines
- **Visualize** the global density distribution as a 2D map
- **Open** to the public

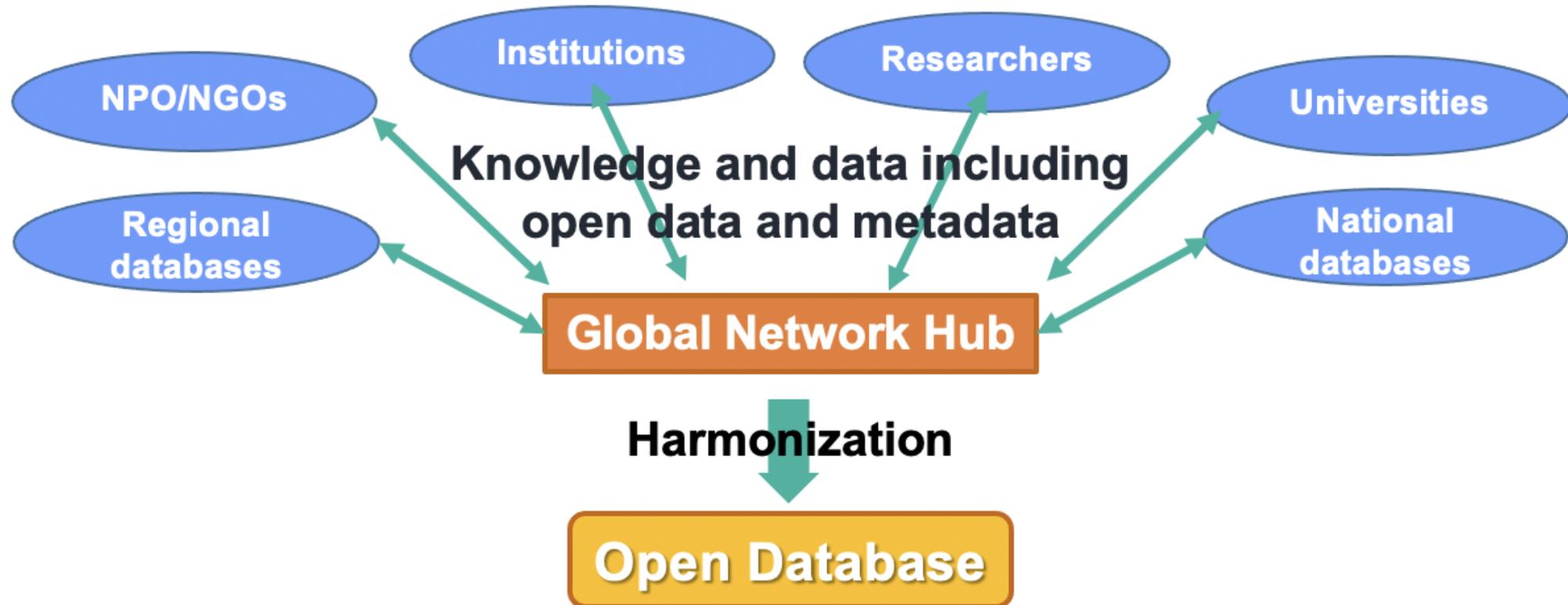
Assumed users : researchers, policy-makers, general public



- The database can be used in any country and has the potential to contribute to the achievement of the SDGs Goal 14, Ocean Decade, and Osaka Blue Ocean Vision.
- The database will be launched in JFY 2023 (TBD).

# Marine Plastic Litter Monitoring Data Sharing Project

- The project aims to develop a global network hub to **share and compile monitoring data** of ocean surface microplastic in collaboration with existing and future additional initiatives.
- The project **produces additional values by harmonization** of the data.
- Policy makers, researchers, and the general public will benefit from not only the collected datasets, but also **comparable data and easy-to-understand maps** (such as survey location map and particle density map) provided by the database.



# Harmonization: Implementation in Japan

~2D mapping project of surface microplastic abundance in the world's ocean ~

Isobe et al. *Microplastics and Nanoplastics* (2021) 1:16  
<https://doi.org/10.1186/s43591-021-00013-z>

Microplastics and  
Nanoplastics

(Isobe et al., 2021, *Micropla. & Nanopla.*)

RESEARCH ARTICLE

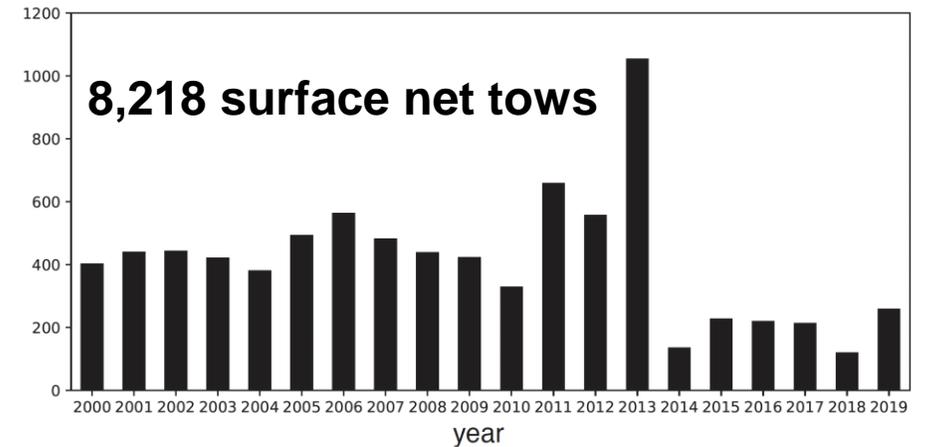
Open Access

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

Atsuhiko Isobe<sup>1\*</sup>, Takafumi Azuma<sup>2</sup>, Muhammad Reza Cordova<sup>3</sup>, Andrés Cózar<sup>4</sup>, Francois Galgani<sup>5</sup>, Ryuichi Hagita<sup>6</sup>, La Daana Kanhai<sup>7</sup>, Keiri Imai<sup>8</sup>, Shinsuke Iwasaki<sup>9</sup>, Shin'ichiro Kako<sup>10</sup>, Nikolai Kozlovskii<sup>11</sup>, Amy L. Lusher<sup>12,13</sup>, Sherri A. Mason<sup>14</sup>, Yutaka Michida<sup>15</sup>, Takahisa Mituhasi<sup>2</sup>, Yasuhiro Morii<sup>16</sup>, Tohru Mukai<sup>17</sup>, Anna Popova<sup>11</sup>, Kenichi Shimizu<sup>18</sup>, Tadashi Tokai<sup>19</sup>, Keiichi Uchida<sup>19</sup>, Mitsuharu Yagi<sup>18</sup> and Weiwei Zhang<sup>20</sup>



Number of observations



2000~2019

Microplastics > ~0.3 mm, but filaments were discarded in analyses.

sponsored by Ministry of the Environment, Japan



Coauthors:

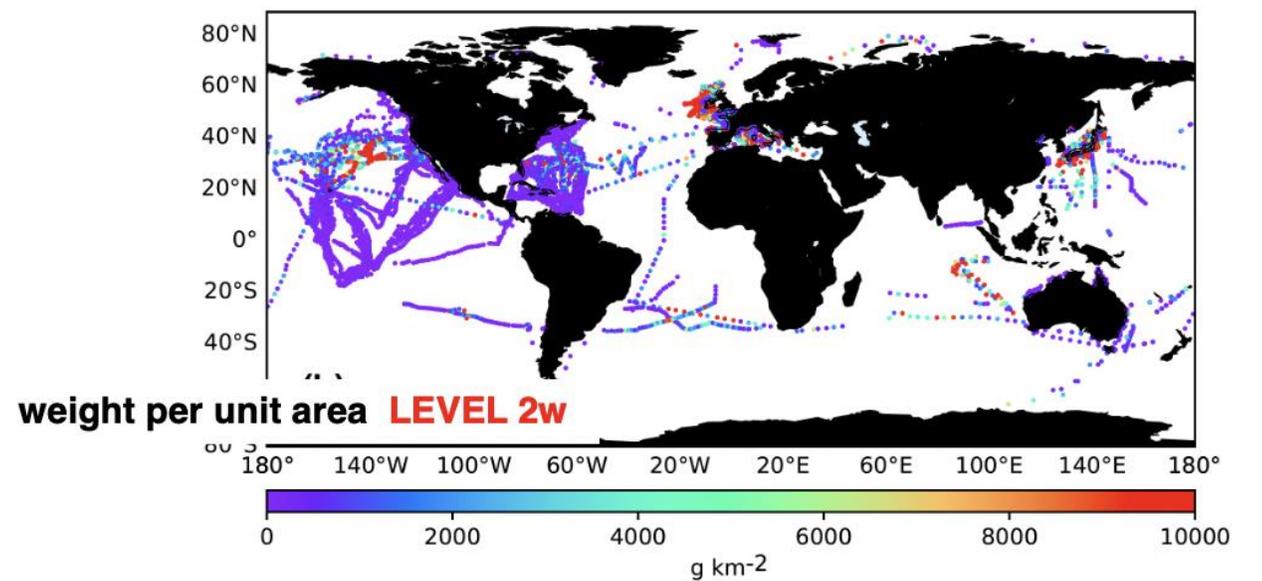
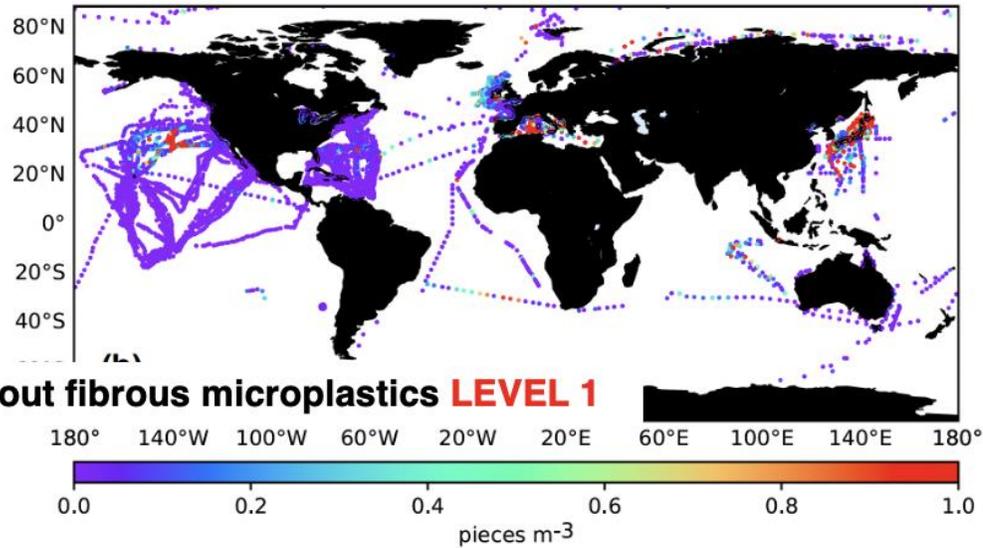
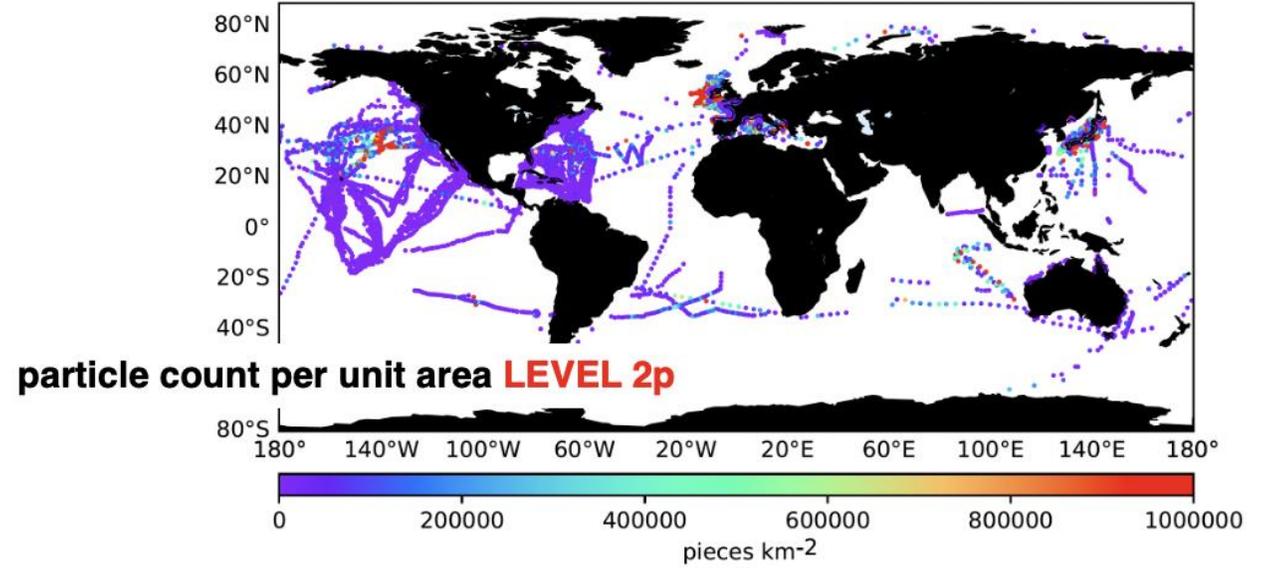
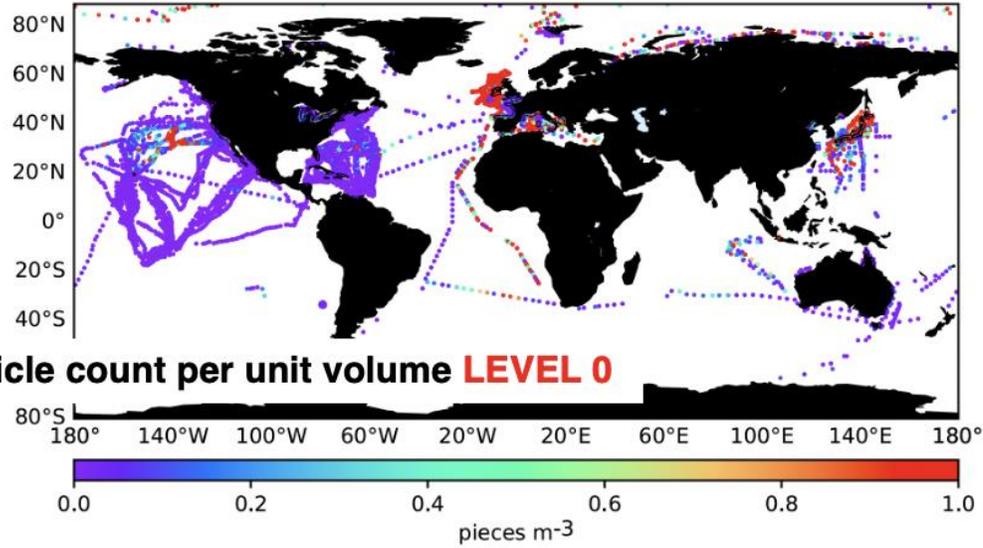
Japan, China, Indonesia  
Spain, France, Russia, Norway  
USA, Trinidad & Tobago,

reliable dataset of ocean plastic debris

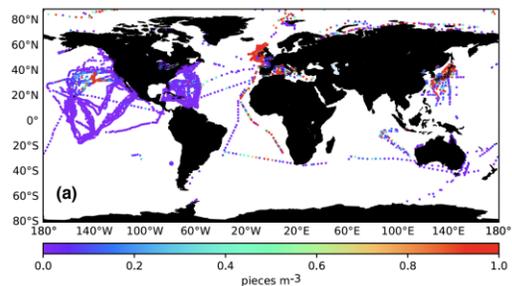
- future prediction
- policy making
- public awareness



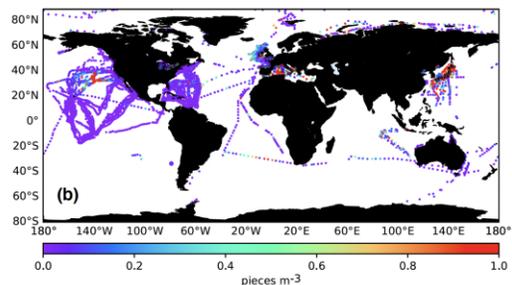
# 8,218 surface net tows in the world's ocean, including both published and unpublished data (Isobe et al., 2021)



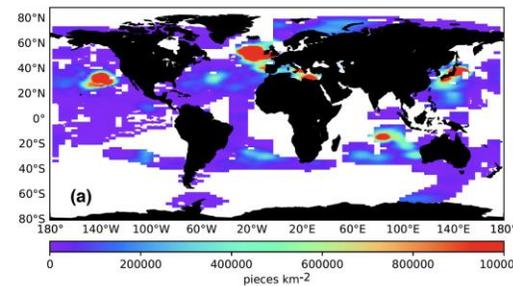
# Ministry of the Environment, Japan has a plan to open these data as a “microplastic dataset” available publicly on the Internet



With fibrous plastics  
**LEVEL 0**



Without fibrous plastics  
**LEVEL 1**

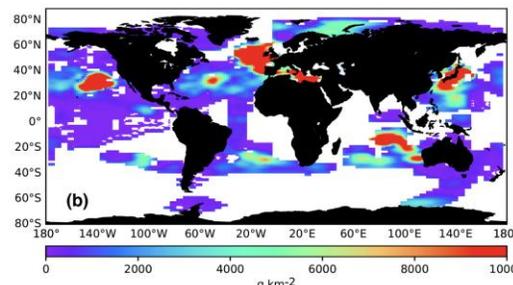


particle count per unit area  
**LEVEL 3p**

$$A_g = B_g + \sum_{i=1}^N (O_i - B_i) W_i,$$

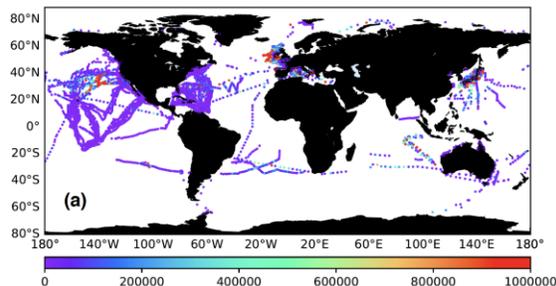
$$\sum_{j=1}^N \sum_{i=1}^N (\mu_{ij} W_i) = \mu_{ig},$$

$$\mu = e^{\left( \frac{r_m^2}{L_m^2} - \frac{r_z^2}{L_z^2} \right)},$$

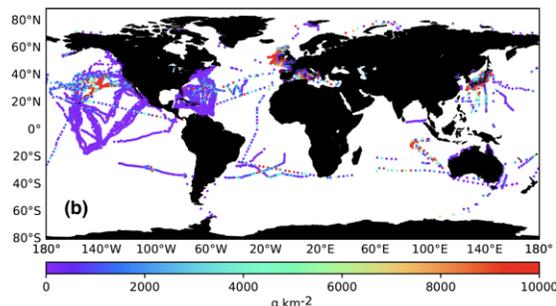


5° × 2° gridded data

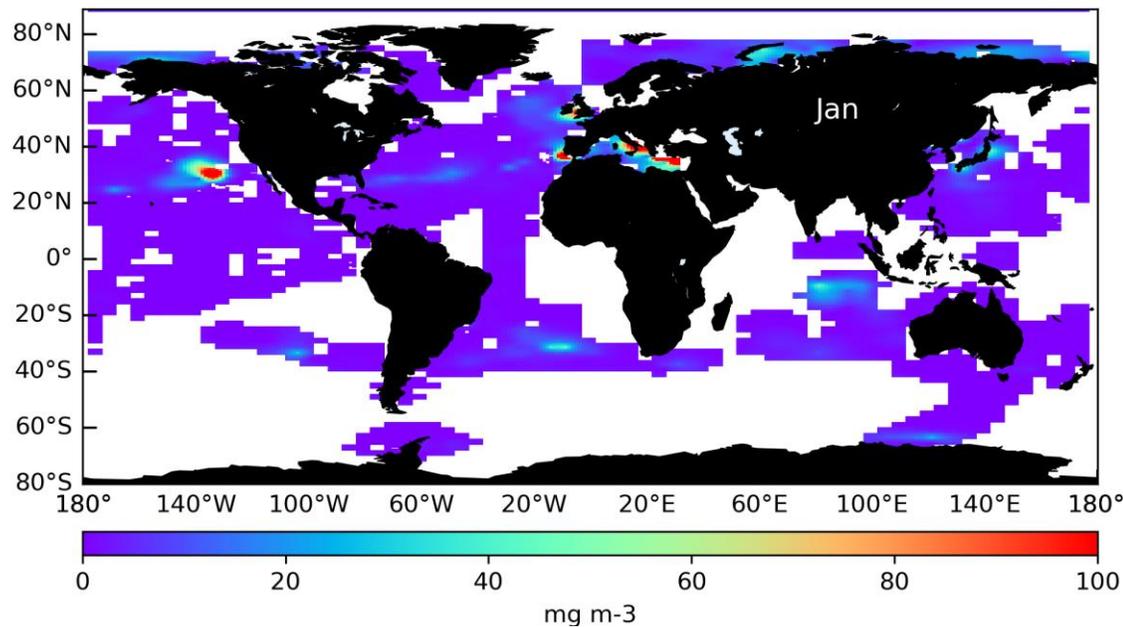
weight per unit area  
**LEVEL 3w**



particle count per unit area  
**LEVEL 2p**

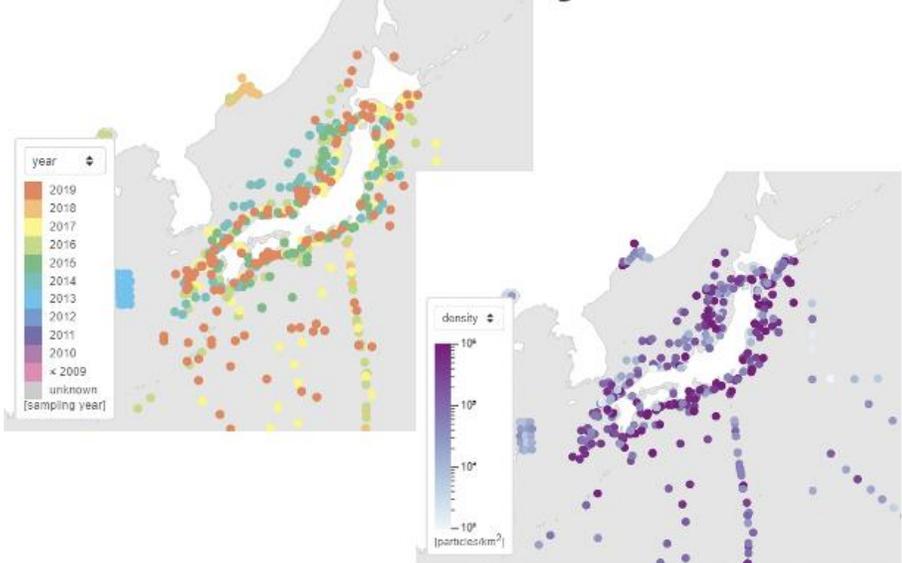


weight per unit area  
**LEVEL 2w**

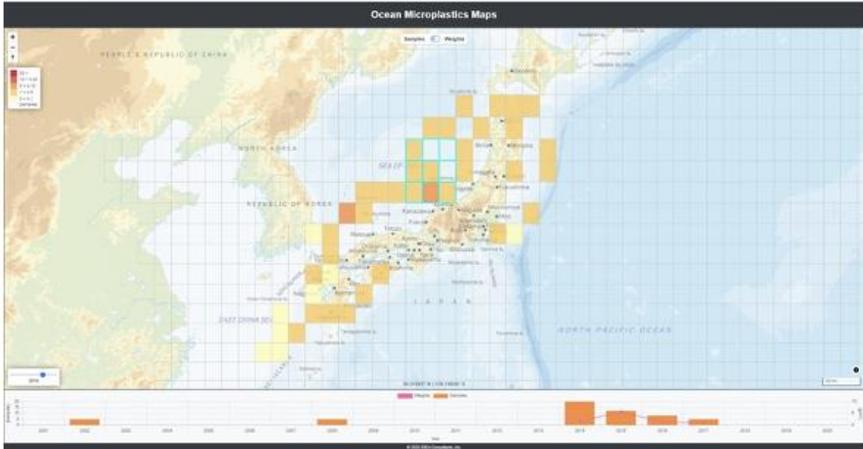


# Two-dimensional maps provided by the database (draft)

## Distributions of survey sites

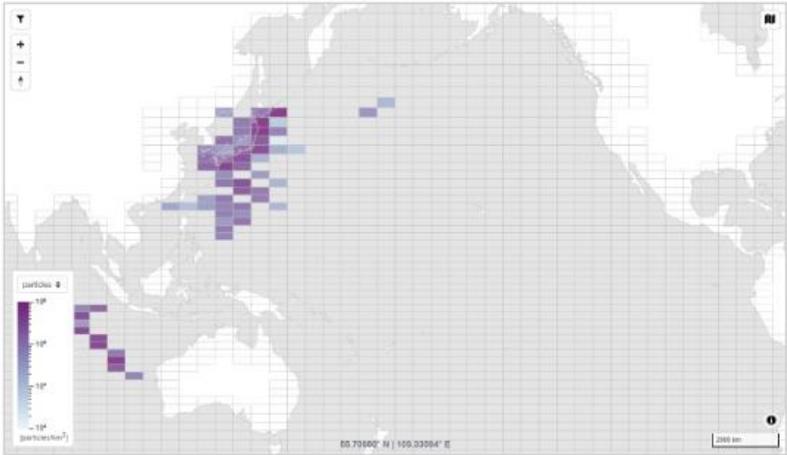


## Distributions of survey density

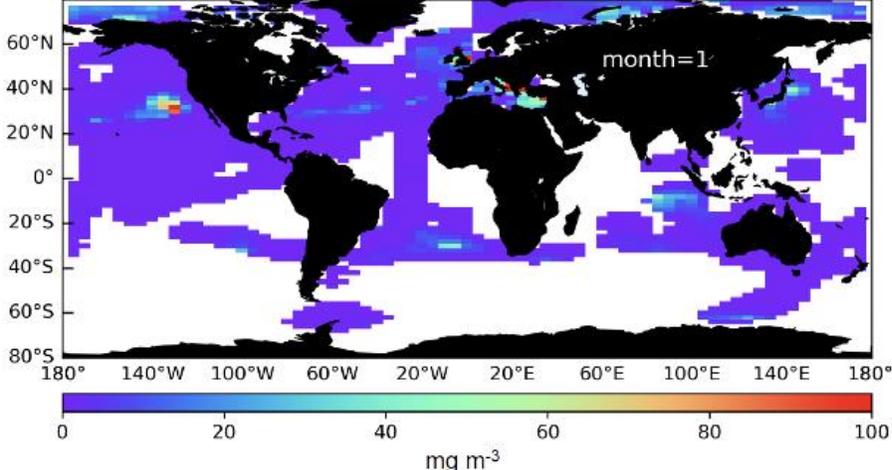


## Distributions of particle density

Simple aggregation by grid



Results of analysis by Isobe et al. (2021)



# Survey on marine litter organized by MOEJ

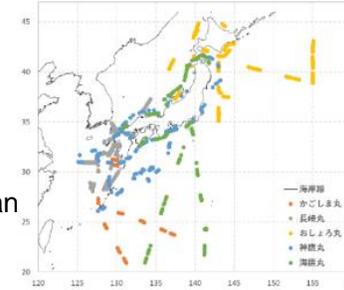
## Floating macro litter (Visual Observation) 2014~

Count floating macro litters on the sea surface from a ship in coastal and offshore areas and estimate the density and amount of debris in each area.

(Coastal: Approx.15 sites/year, Offshore: Approx.600 sites/year)

(Survey method)

- Coastal surveys are conducted by visiting a total of 13 bays in turns.
- Offshore surveys are conducted in the waters of east of the Philippines, an the area up to around 150 degrees east longitude.
- The amount (number), type, and size of litter are counted visually



## Seafloor litter 2014~

Collect seafloor litter by bottom trawl nets in coastal and offshore waters and classify the collected litter.

Estimate the density of litter by sea area.

(Survey method)

- For the coastal survey, classify litter collected during fishing operation by bottom trawling.
- Conduct offshore survey in the East China Sea, off Oarai and off Tomakomai. Classify the collected litter by bottom trawling.



## Floating microplastics 2014~

Survey the distribution of floating microplastics in the waters around Japan

(Coastal: Approx.15 sites/year, Offshore: Approx.100 sites/year)

(Survey method)

- Collect floating microplastics by net during cruises for floating macro litter survey in coastal and offshore areas.
- Identify of material using infrared rays, count the number using microscope, etc.
- Conduct laboratory analysis to examine the amount of PCBs and other harmful chemicals adsorbed on microplastics (offshore samples were examined on a yearly basis).



## Beach litter 2010~

Conduct monitoring survey to collect and summarize the amount, types, and composition of beach litter, and the language of plastic bottles in beaches.

(Survey method)

- Surveyed 28 sites nationwide over a 10-year period from 2010 (from 2015, 10 sites per year are selected for survey)
- All beach litter of 2.5 cm or larger within a 50-meter survey area is collected and classified at beaches that are not frequently cleaned.
- From 2020, the survey entity was change from MOEJ to local government. Promote the expansion of survey sites, and continuous surveys at the same sites to understand the changes over time.
- From 2014 to 2019, microplastics were also collected in order to examin the amount of PCBs and other harmful chemicals adsorbed on microplastics.

# Survey on floating microplastics

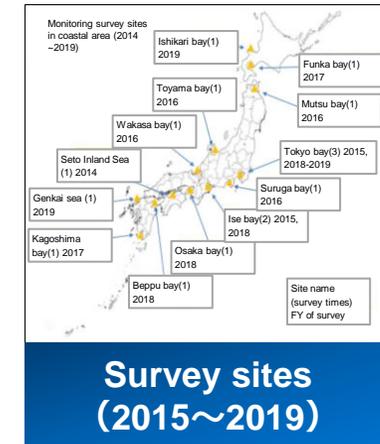
## Coastal waters

2015~2019

- Conducted surveys by visiting a total of 13 bays in the coastal area in turns to understand the distribution status of ocean surface microplastics. (In some sites, surveys are conducted multiple years in a row.)
- Conduct laboratory analysis to examine the amount of PCBs and other harmful chemicals adsorbed on microplastics.

2020~

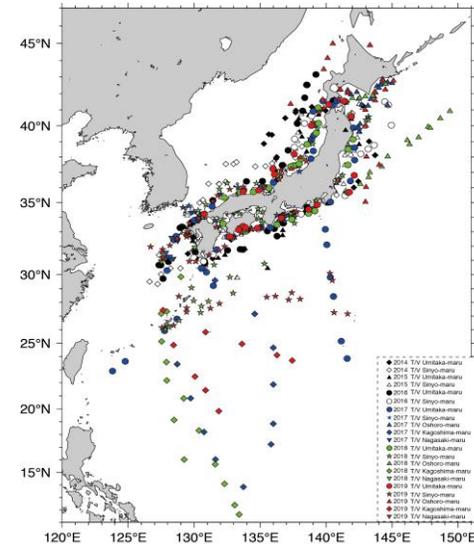
- Conduct fixed-point observations four times a year (spring, summer, fall, and winter) at three sites in coastal areas facing the open sea, which are affected by ocean currents, in order to understand annual changes and seasonal and sea-specific characteristics.



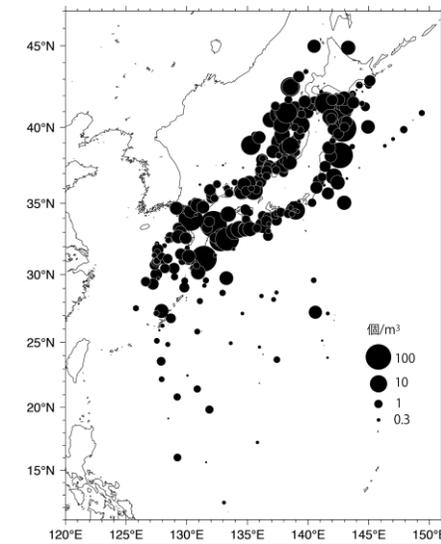
## Offshore waters

2014~

- Conduct surveys on the amount and types of floating microplastics. Surveys for approx. **100 sites per year** using five vessels have been conducted with the cooperation of four universities in Japan since 2017.
- The survey covers the offshore waters around Japan, as well as the southern and eastern seas, and the area up to around 180 degrees east longitude.
- Plan to conduct surveys in the Philippine Sea, off Kagoshima, and east of Hokkaido in the future.

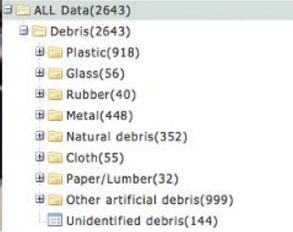


**Survey sites (2014~2019)**



**Density distribution (2014~2019)**

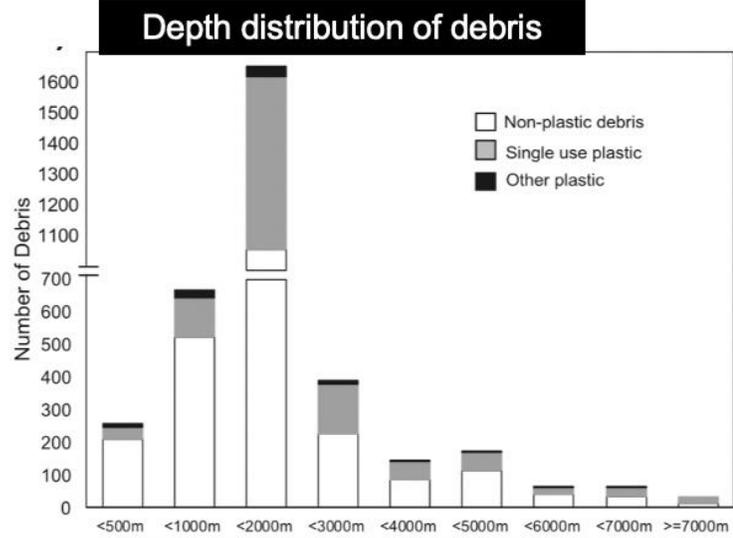
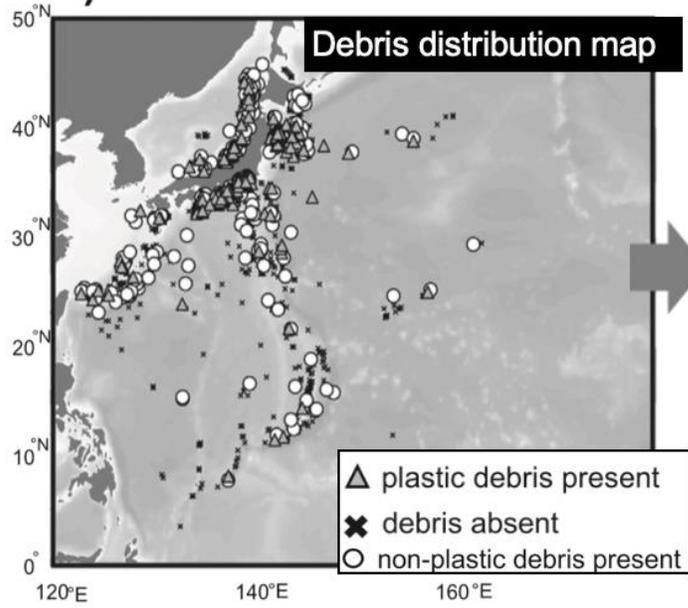
# Deep-Sea Debris Database: 30 years records of deep-sea plastic debris



Review and record in the database



Images taken by ROV/HOV  
Since 1983  
> 5000 dives  
> 3500 man-made debris items



The ratio of plastic to total debris increased with depth with the highest ratio at depths greater than 6000m.

**Deep-sea Debris Database**

It is the gallery page of videos and photos picked out from Deep-sea Debris Database.

Video Photo

Plastic bag/sheet (Sev... 1995/05/22 North Pacific Ocean Shooting depth: 1088m SHMKA0001 1037 Dive

Plastic bag 2007/10/14 North Pacific Ocean Shooting depth: 5432m SHMKA0001 1037 Dive

Artificial debris 2005/02/15 Central Indian Ocean Shooting depth: 5023m SHMKA0001 2332 Dive

Plastic bag (Several)... 1999/10/20 Central Indian Ocean Shooting depth: 1344m SHMKA0001 1140 Dive

Plastic bag (Many) 1995/02/13 South Pacific Ocean Shooting depth: 1389m DOLPHIN-3R 0311 Dive

Plastic bag (Several)... 1995/05/22 South Pacific Ocean Shooting depth: 1130m SHMKA0001 0187 Dive

Beverage can (Many), Ar... 1993/10/19 North Pacific Ocean Shooting depth: 1431m SHMKA0001 0705 Dive

Artificial debris, Plas... 2011/06/18 Central Indian Ocean Shooting depth: 1628m HYPERDOLPHIN 1311 Dive

Plastic bag/sheet 1995/07/14 Off East Indonesia Shooting depth: 5203m KAMD 0077 Dive

Plastic bag, Beverage c... 1995/05/22 South Pacific Ocean Shooting depth: 1144m SHMKA0001 0198 Dive

Tire, Plastic bag, Pac... 1995/05/22 South Pacific Ocean Shooting depth: 3076m SHMKA0001 0322 Dive

Beverage can, Fishing r... 1991/05/11 North Pacific Ocean Shooting depth: 1088m KAMD 0073 Dive

Can 2004/03/29 North Pacific Ocean Shooting depth: 5432m SHMKA0001 1037 Dive

Plastic bag 2006/12/16 North Pacific Ocean Shooting depth: 5432m SHMKA0001 1037 Dive

Piece of plant/wood (Ma... 1990/03/26 North Pacific Ocean Shooting depth: 1088m KAMD 0073 Dive

Beach ball, Packaging/... 1992/10/21 North Pacific Ocean Shooting depth: 1088m KAMD 0073 Dive

Plastic bag (Many) 2001/04/06 North Pacific Ocean Shooting depth: 1088m KAMD 0073 Dive

Launched in 2017



Contents lists available at ScienceDirect

**Marine Policy**

ELSEVIER

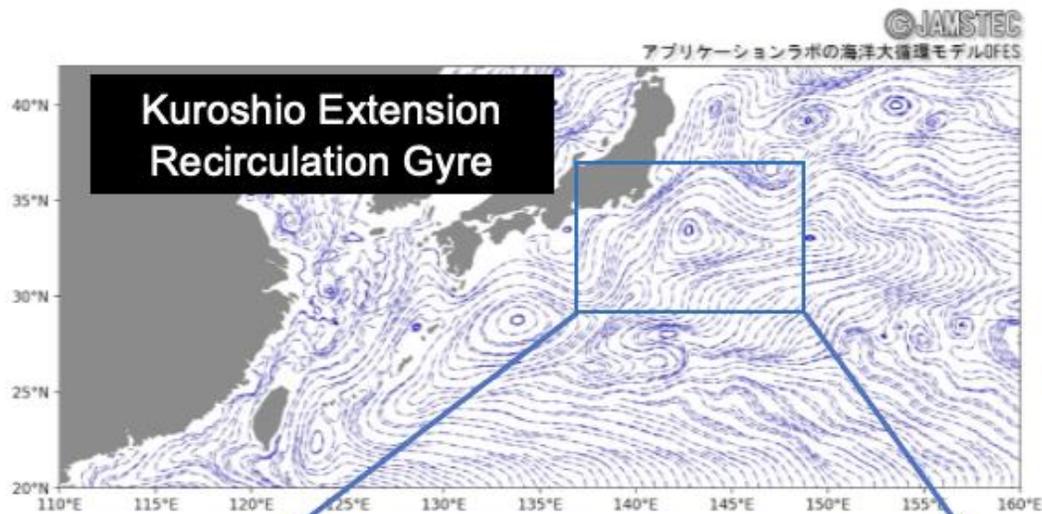
journal homepage: [www.elsevier.com/locate/marpol](http://www.elsevier.com/locate/marpol)

Human footprint in the abyss: 30 year records of deep-sea plastic debris

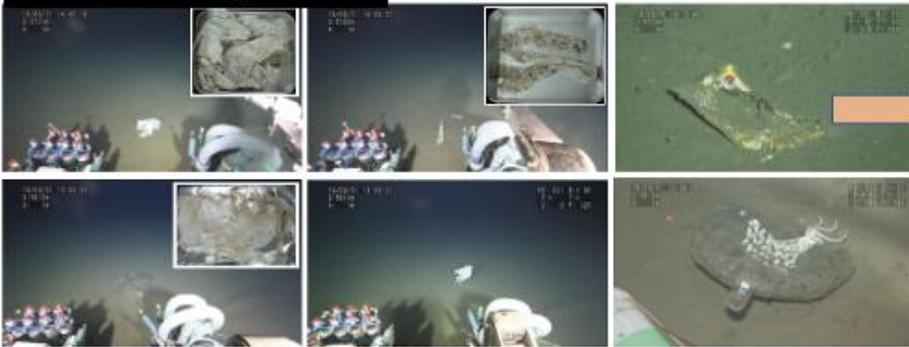
Sanae Chiba<sup>a,b,c</sup>, Hidenki Saito<sup>c</sup>, Ruth Fletcher<sup>b</sup>, Takayuki Yogi<sup>d</sup>, Makino Kayo<sup>d</sup>, Shin Miyagi<sup>d</sup>, Moritaka Ogido<sup>d</sup>, Katsunori Fujikura<sup>e</sup>

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<sup>d</sup> Marine Works Japan, Ltd., 224-3 Aza-Togayama, Nago 9052172, Japan  
<sup>e</sup> Department of Marine Biodiversity Research, Japan Agency for Marine-Earth Science and Technology (JAMSTEC), 2-15 Natsumihera, Yokosuka 2370061, Japan

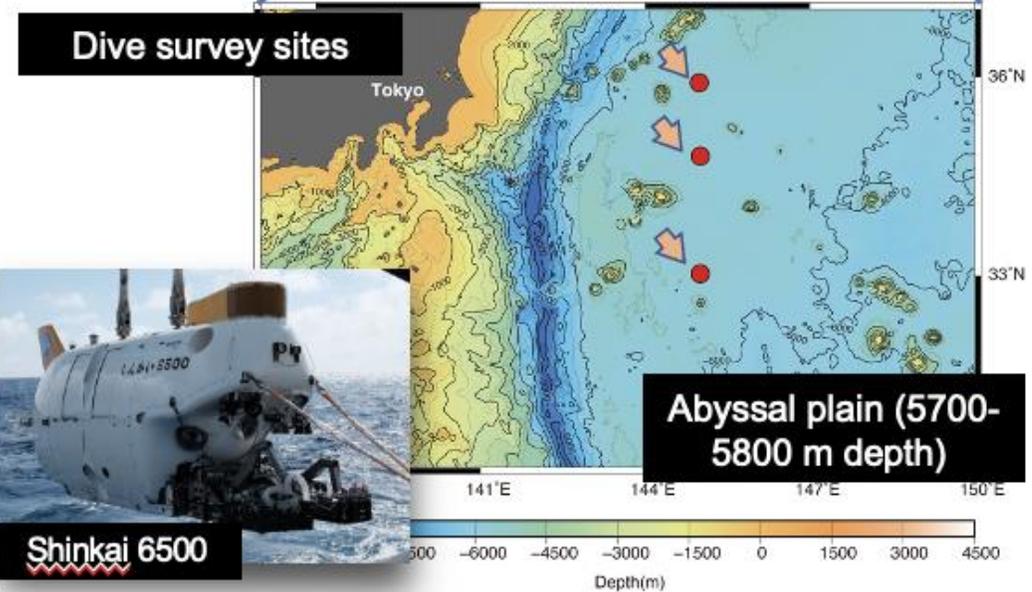
# A massive number of single-use plastics on the North Pacific's deep ocean floor



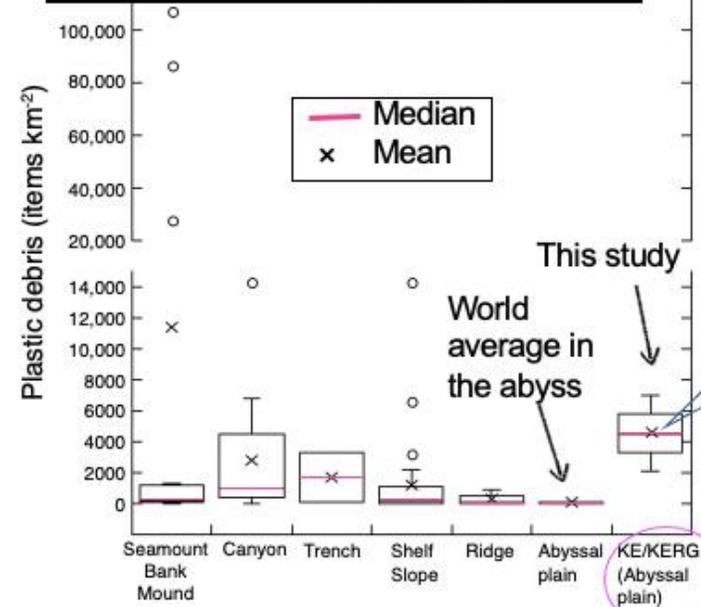
## Plastic everywhere



Packaging date: Sep 1984!



## Macroplastic densities per seafloor morphology



The highest on record for an abyssal plain

Mean density 4561 items/km²

The deep-sea basin in the Northwest Pacific: a significant reservoir of plastic debris?