De plastic soep

Waar komt het vandaan?

Hoe lossen we het op?

Prof Dr **Erik van Sebille**

en het **oceanparcels.org/utrechtteam**

@UFollowtheOcean

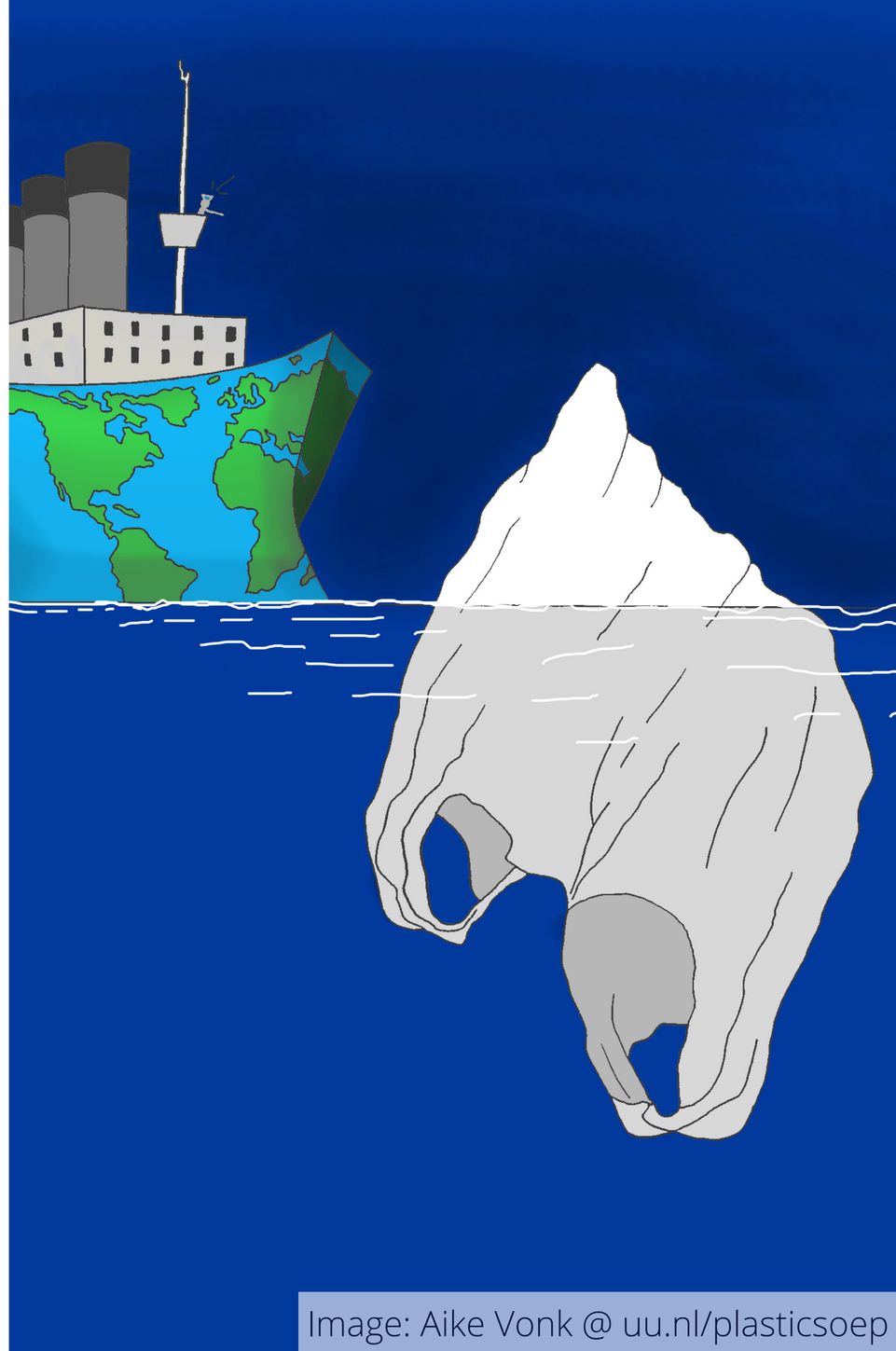


Image: Aike Vonk @ uu.nl/plasticsoep

Utrecht University

Institute for Marine and Atmospheric research Utrecht

Freudenthal Institute

Als je onderzoek in de Donald Duck staat...

@UFollowtheOcean

Donald Duck - augustus 2017

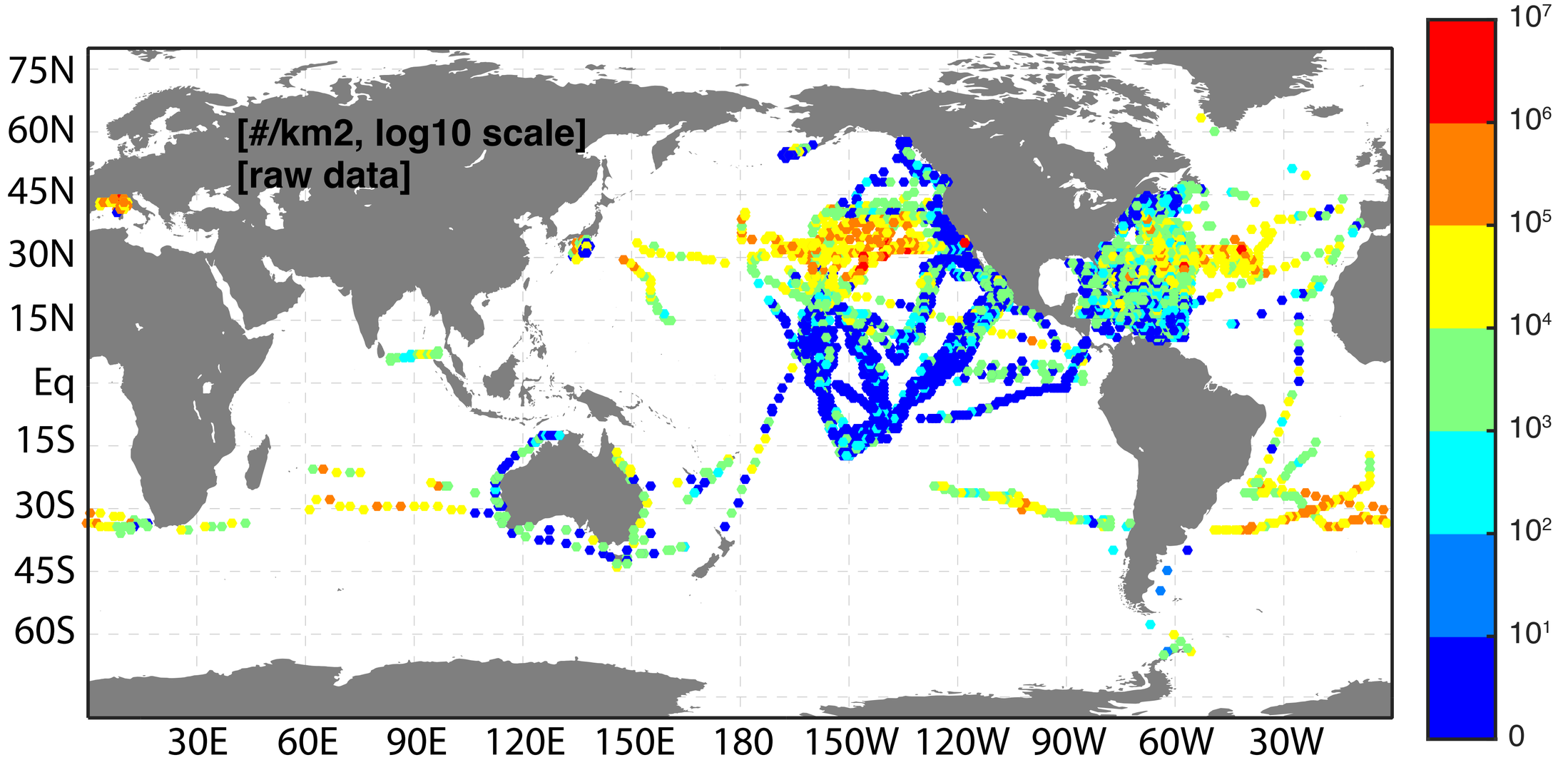
De echte plastic soep

@UFollowtheOcean

Moore (2008) *Environmental Research*

Metingen van over de hele wereld

@UFollowtheOcean



Utrecht University

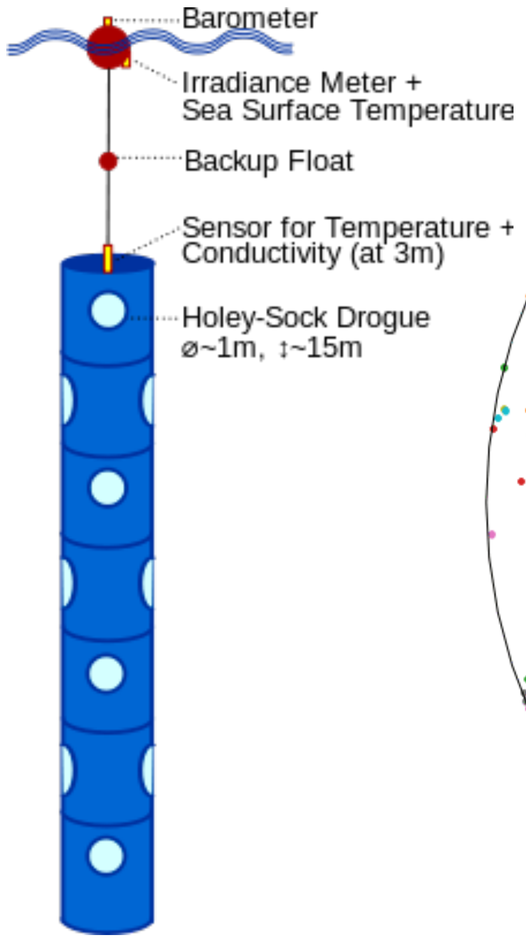
Institute for Marine and Atmospheric research Utrecht

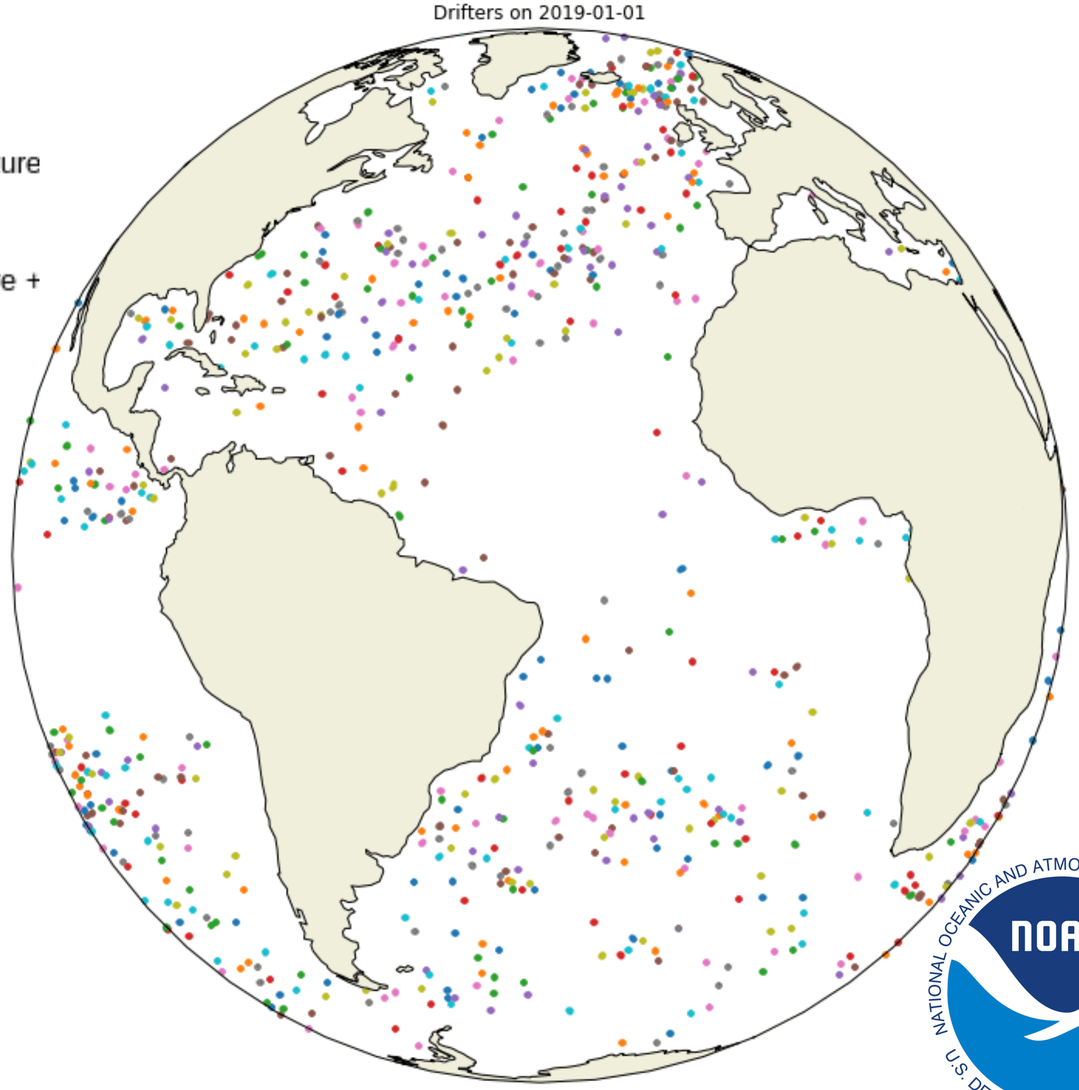
Freudenthal Institute

Van Sebille, Wilcox, Lebreton, Maximenko, Hardesty, van Franeker, Eriksen, Siegel, Galgani & Law (2015) *Environmental Research Letters*

Stromingen in kaart brengen met drifters

@UFollowtheOcean





Utrecht University

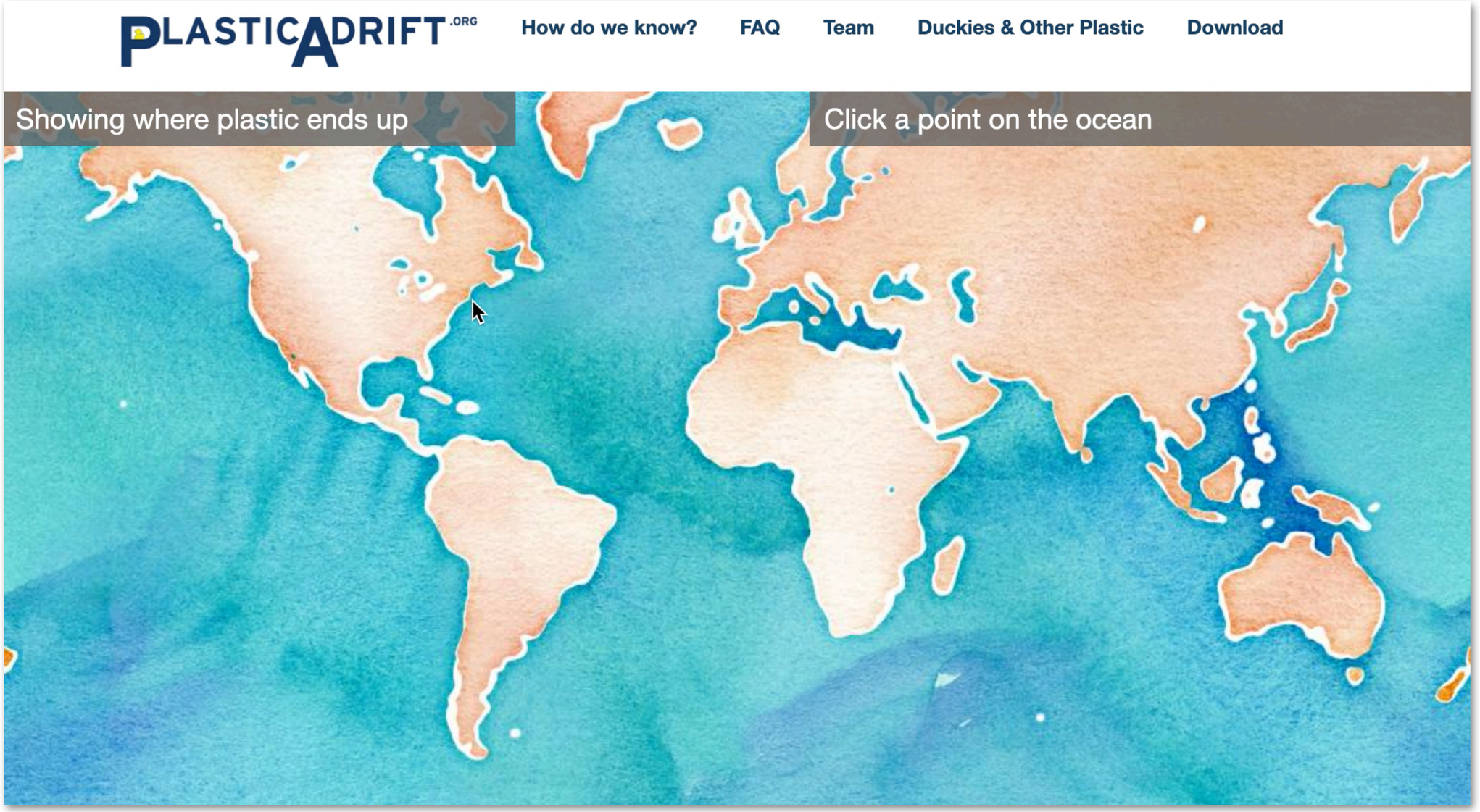
Institute for Marine and Atmospheric research Utrecht

Freudenthal Institute

Lumpkin, Özgökmen & Centurioni (2017) *Annual Review in Marine Science*

Drifter-gebaseerd transport model

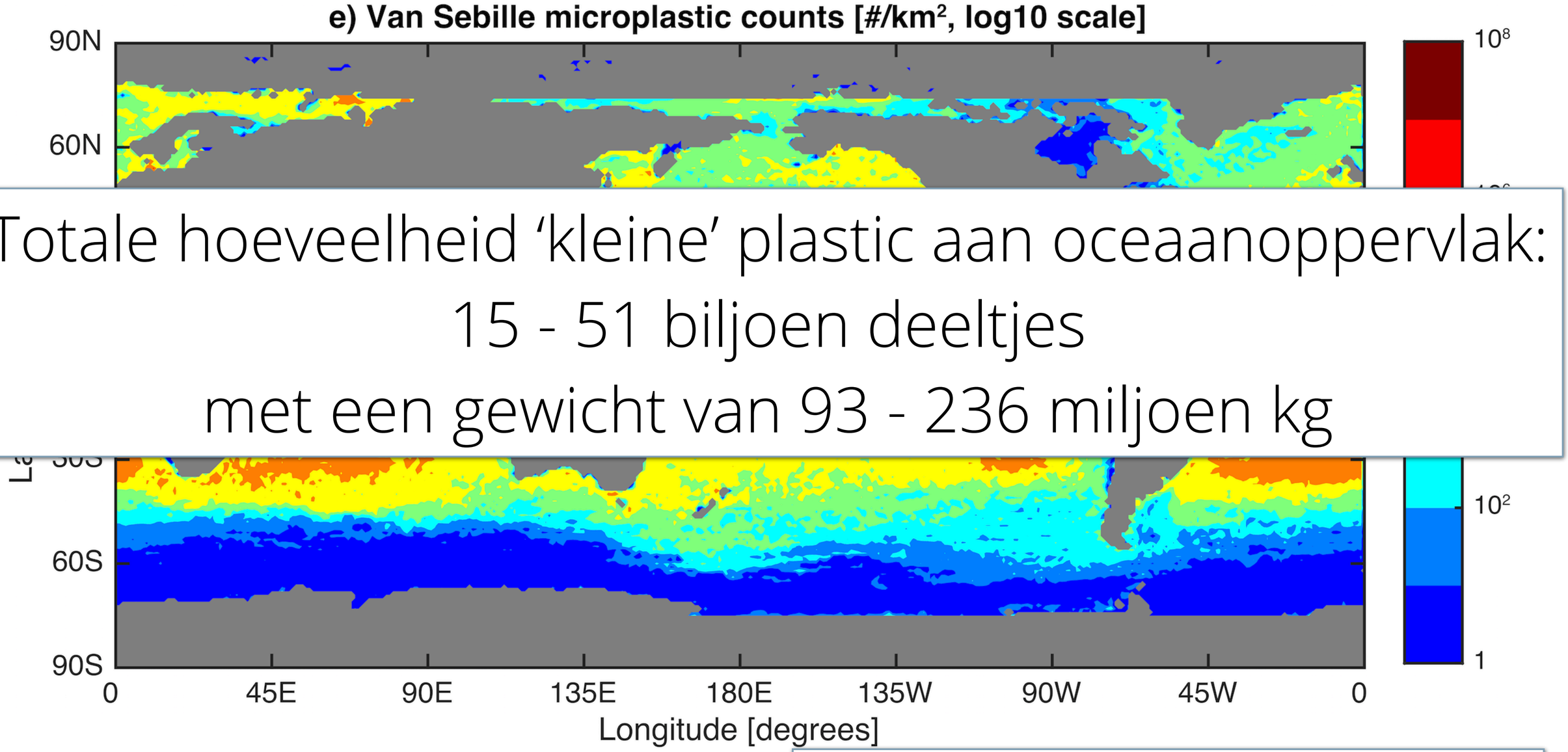
@UFollowtheOcean



Van Sebille (2014) *Journal of Experimental Marine Biology and Ecology*

Metingen en model samenvoegen

@UFollowtheOcean



Totale hoeveelheid ‘kleine’ plastic aan oceaanoppervlak:

15 - 51 biljoen deeltjes

met een gewicht van 93 - 236 miljoen kg

Utrecht University

Institute for Marine and Atmospheric research Utrecht

Freudenthal Institute

Van Sebille, Wilcox, Lebreton, Maximenko, Hardesty, van Franeker, Eriksen, Siegel, Galgani & Law (2015) *Environmental Research Letters*

De zaak van de 99% plastic dat zoek is

@UFollowtheOcean

> 5 miljard kg

ging alleen al in 2010 de ocean in
[Jambeck et al 2015]

?? kg

Kusten

< 250 miljoen kg
[Van Sebille et al 2015]

Oceaanoppervlak

?? kg

Te klein om te meten

?? kg

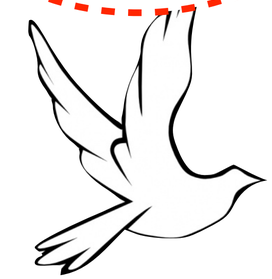
Waterkolom

?? tonnes

Oceaanbodem

?? kg

In biota (organismen)



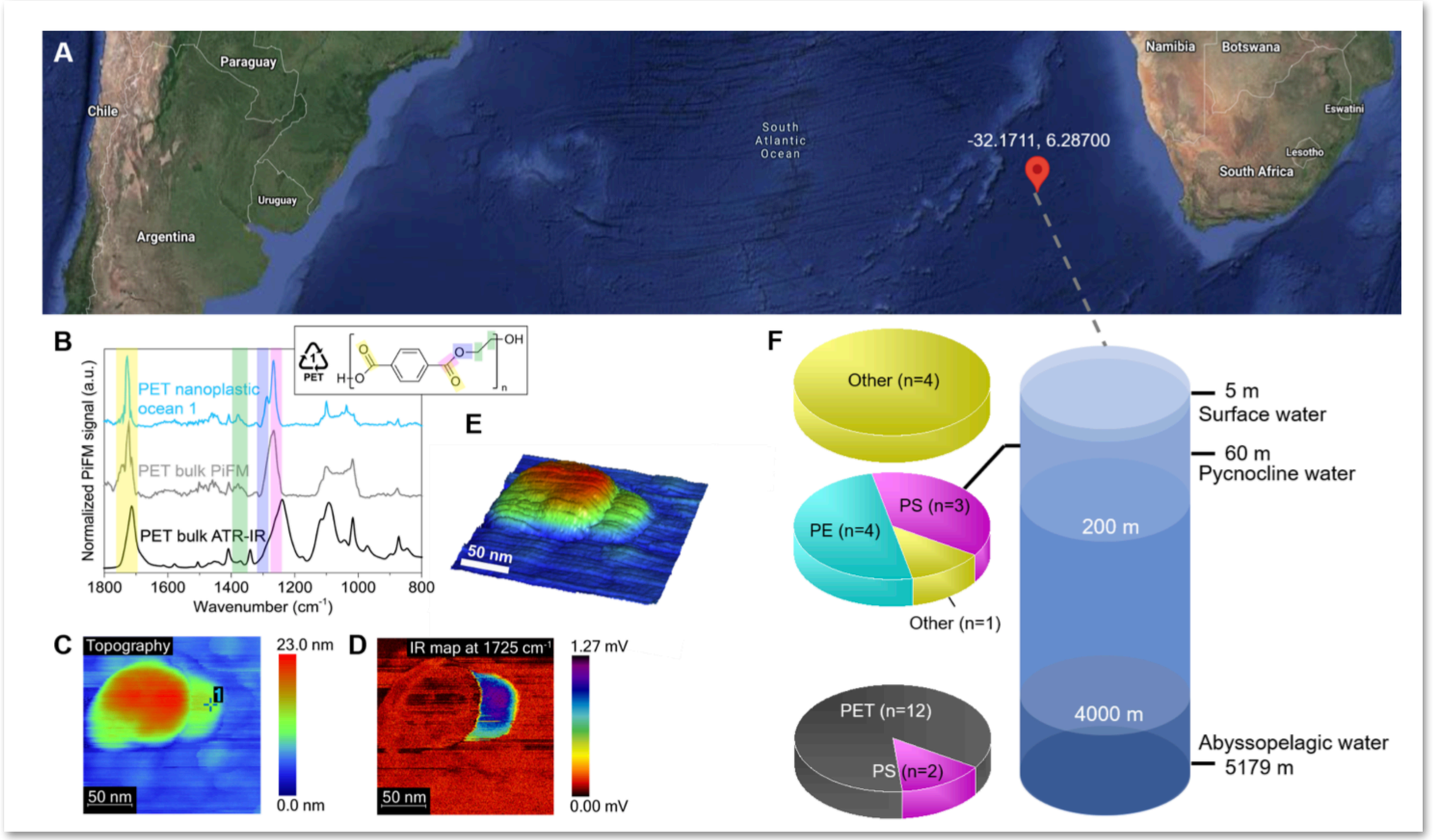
Utrecht University

Institute for Marine and Atmospheric research Utrecht

Freudenthal Institute

Nanoplastic meten met photo-induced force microscopy

@UFollowtheOcean



Utrecht University

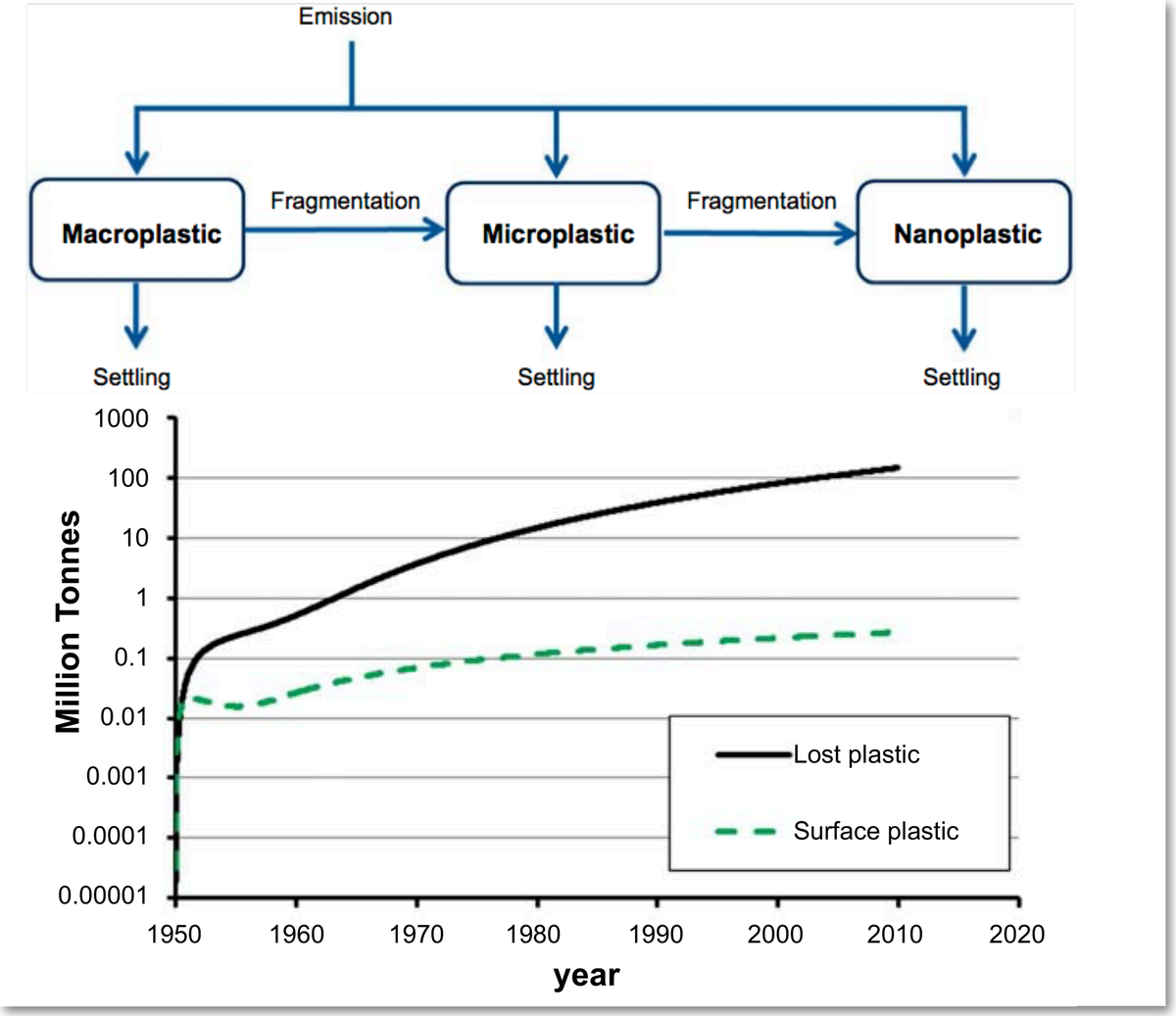
Institute for Marine and Atmospheric research Utrecht

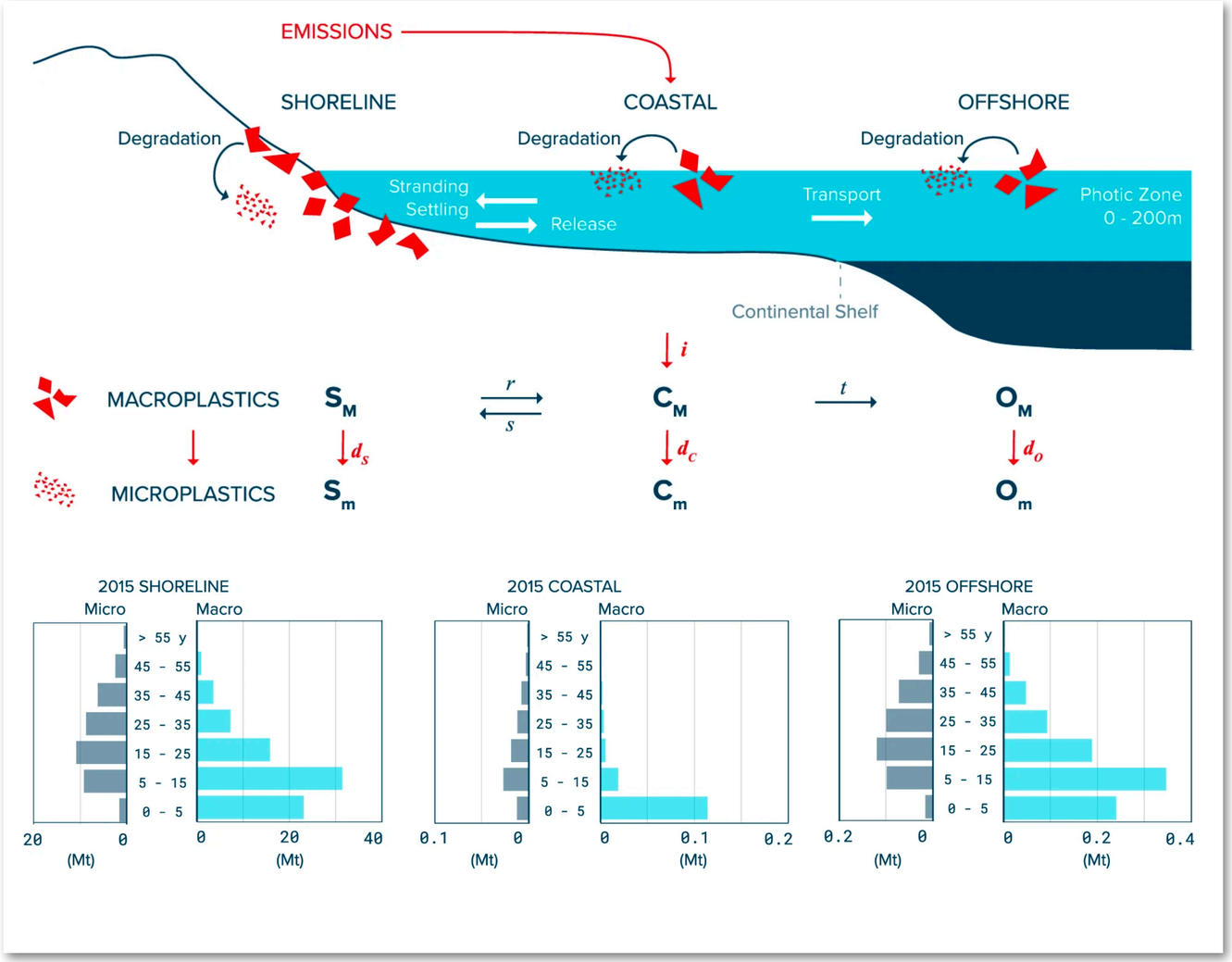
Freudenthal Institute

Meirer, Ten Have, Oort, Zettler, Van Sebille, Amaral-Zettler & Weckhuysen (2021) *Submitted*

Geidealiseerde modellen geven geen uitsluitsel over reservoirs

@UFollowtheOcean





Koelmans, Kooi, Law & Van Sebille (2017) *Environmental Research Letters*

Lebreton, Egger & Slat (2019) *Scientific Reports*

Utrecht University

Institute for Marine and Atmospheric research Utrecht

Freudenthal Institute

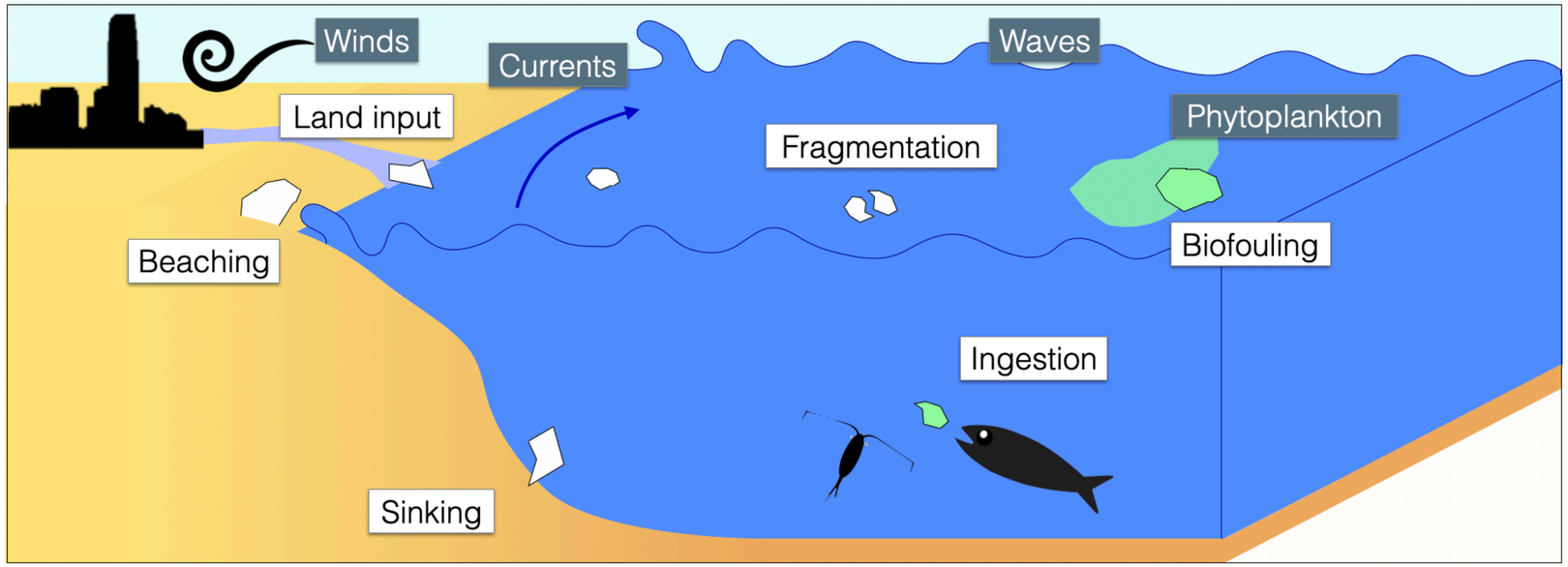
Virtuele deeltjes: Lagrangiaanse analyse in een oceaanmodel

@UFollowtheOcean

OceanParcels.org

- Lagrangiaanse Oceaan Analyse: Volgen van virtuele deeltjes in 3D simulaties
- Parcels: "*Probably A Really Computationally Efficient Lagrangian Simulator*"
  - Een set **python classes en methodes** om Lagrangiaanse modellen te bouwen

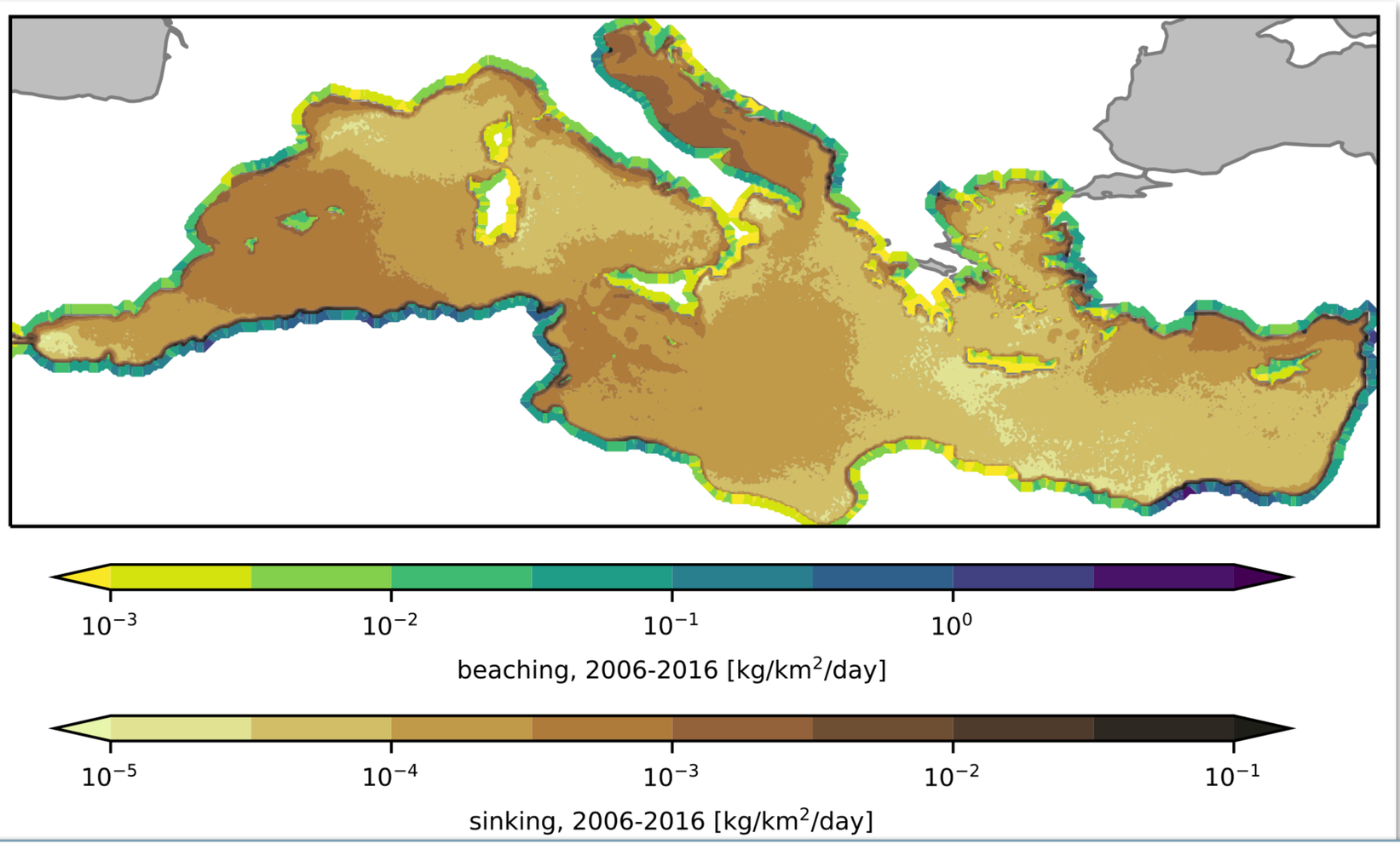
- '**Gedrag**' meenemen
  - Golfeffecten
  - Algenaangroei
  - Zinken
  - Fragmentatie
  - Stranding
  - Ingestie?



- **Parameteriseer** met lab en veld-observaties

Het plastic budget in de Middellandse Zee

@UFollowtheOcean



~50% op kust | ~40% in diepzee | ~10% nog drijvend

Utrecht University

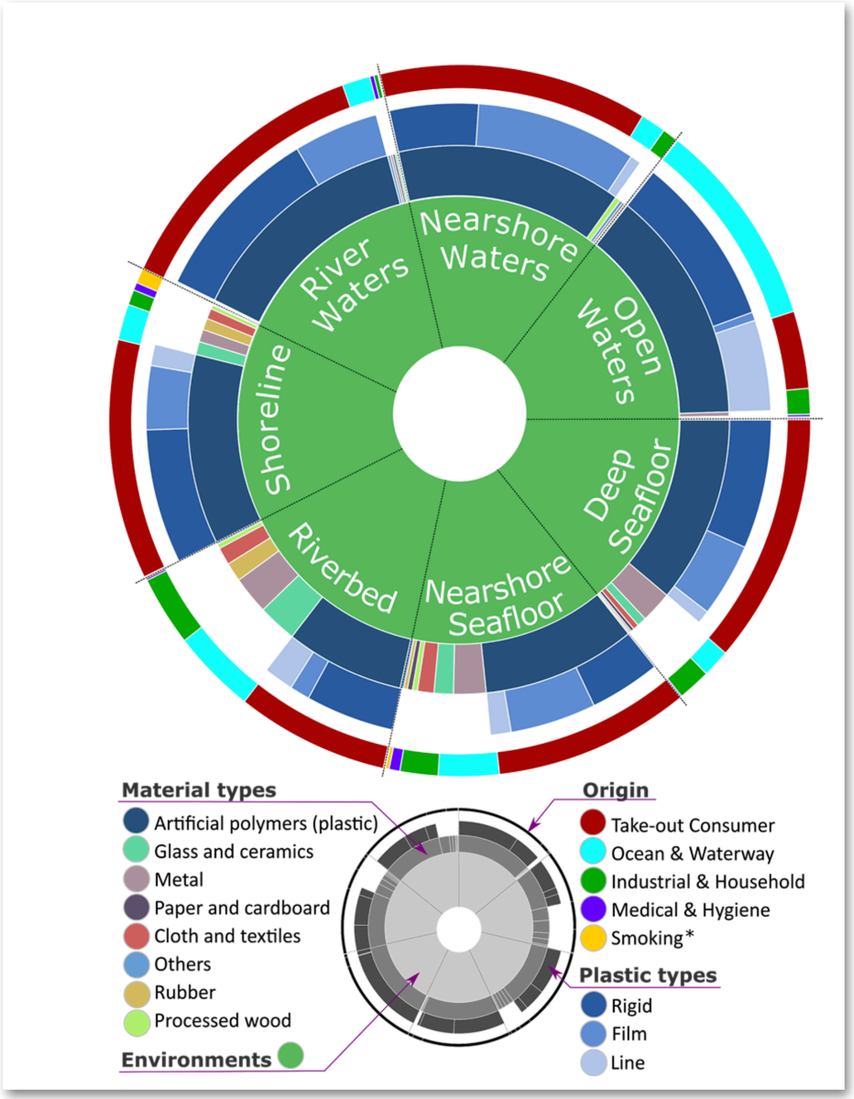
Institute for Marine and Atmospheric research Utrecht

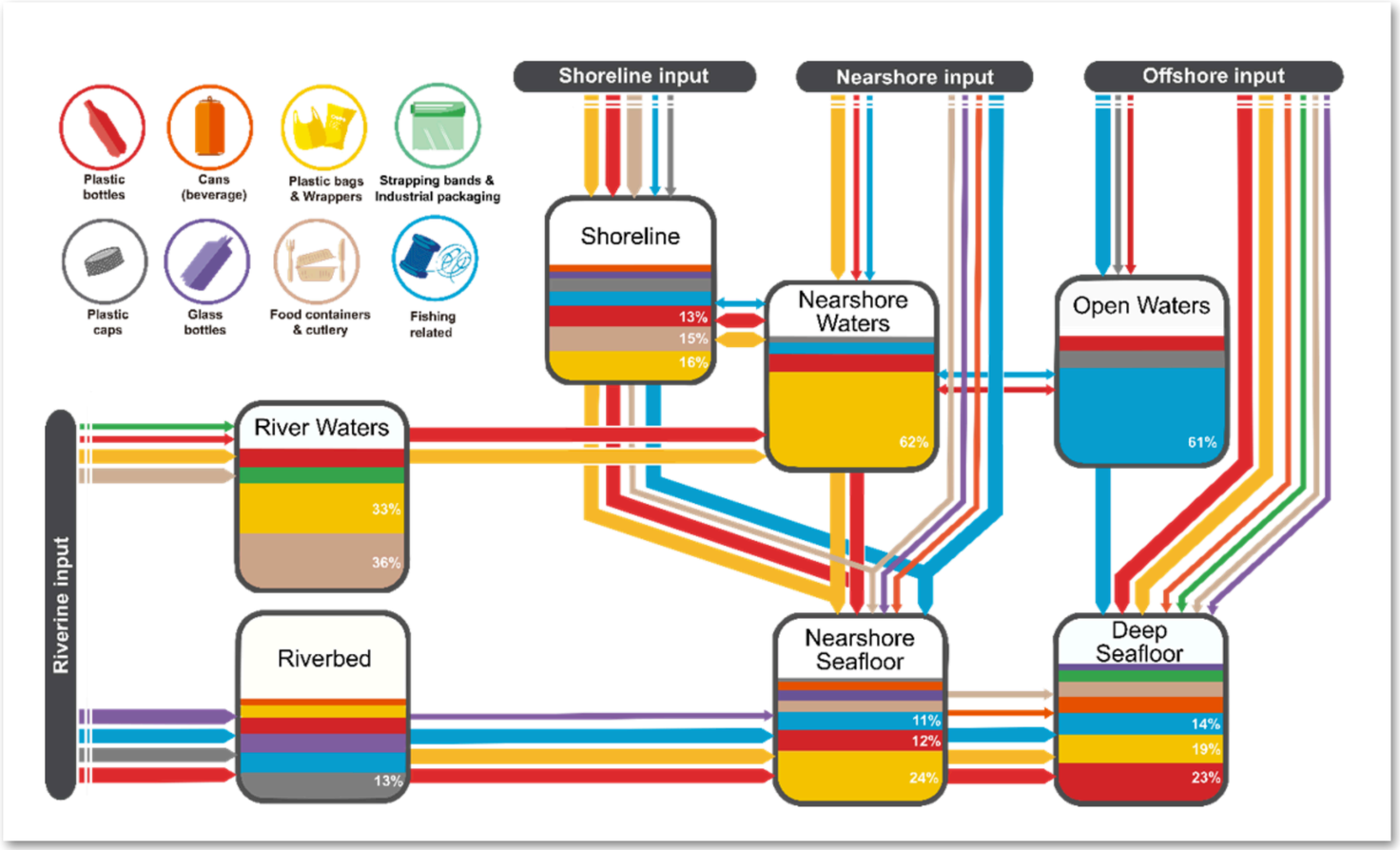
Freudenthal Institute

Kaandorp, Dijkstra & Van Sebille (2020) *Environmental Science & Technology*

Groot plastic blijft bij de kusten

@UFollowtheOcean





Utrecht University

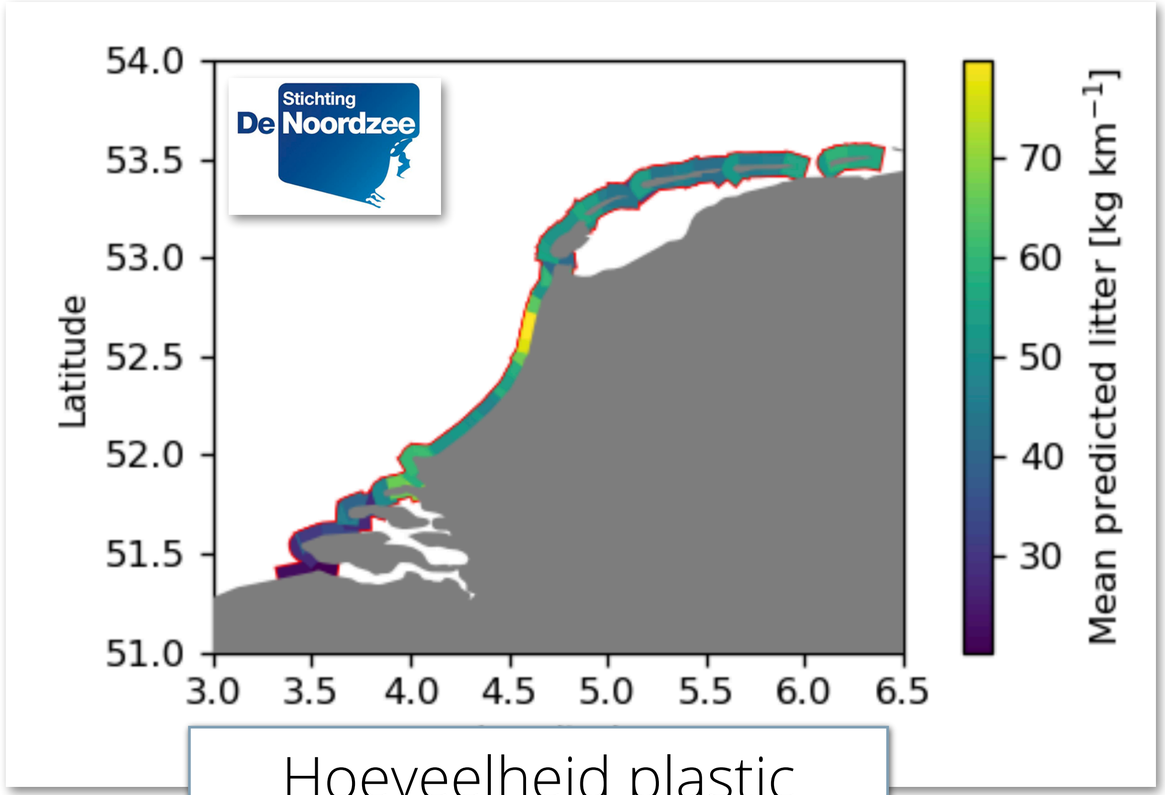
Institute for Marine and Atmospheric research Utrecht

Freudenthal Institute

Morales-Caselles, Viejo, Martí, González-Fernández, Pragnell-Raasch, González-Gordillo, Montero, Arroyo, Hanke, Salvo, Basurko, Mallos, Lebreton, Echevarría, van Emmerik, Duarte, Gálvez, van Sebille, Galgani, García, Ross, Bartual, Ioakeimidis, Markalain, Isobe & Cózar (2021) *Nature Sustainability*

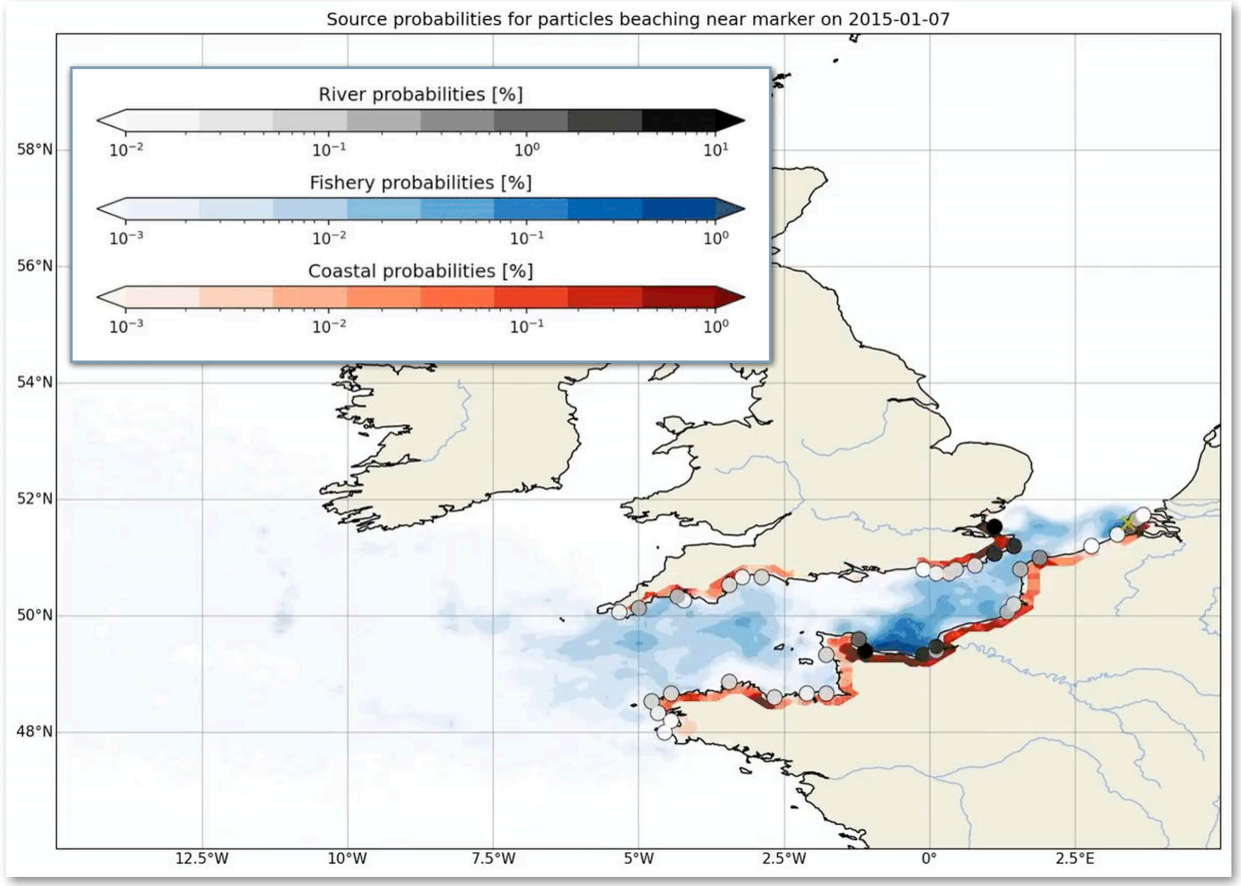
Machine learning gebruiken om Noordzee plastic te voorspellen

@UFollowtheOcean



Hoeveelheid plastic
op Nederlandse stranden
16,000 — 31,000 kg

Kaandorp, Ypma, Boonstra, Dijkstra & Van Sebille (submitted)



Van Duinen, Kaandorp & Van Sebille (submitted)

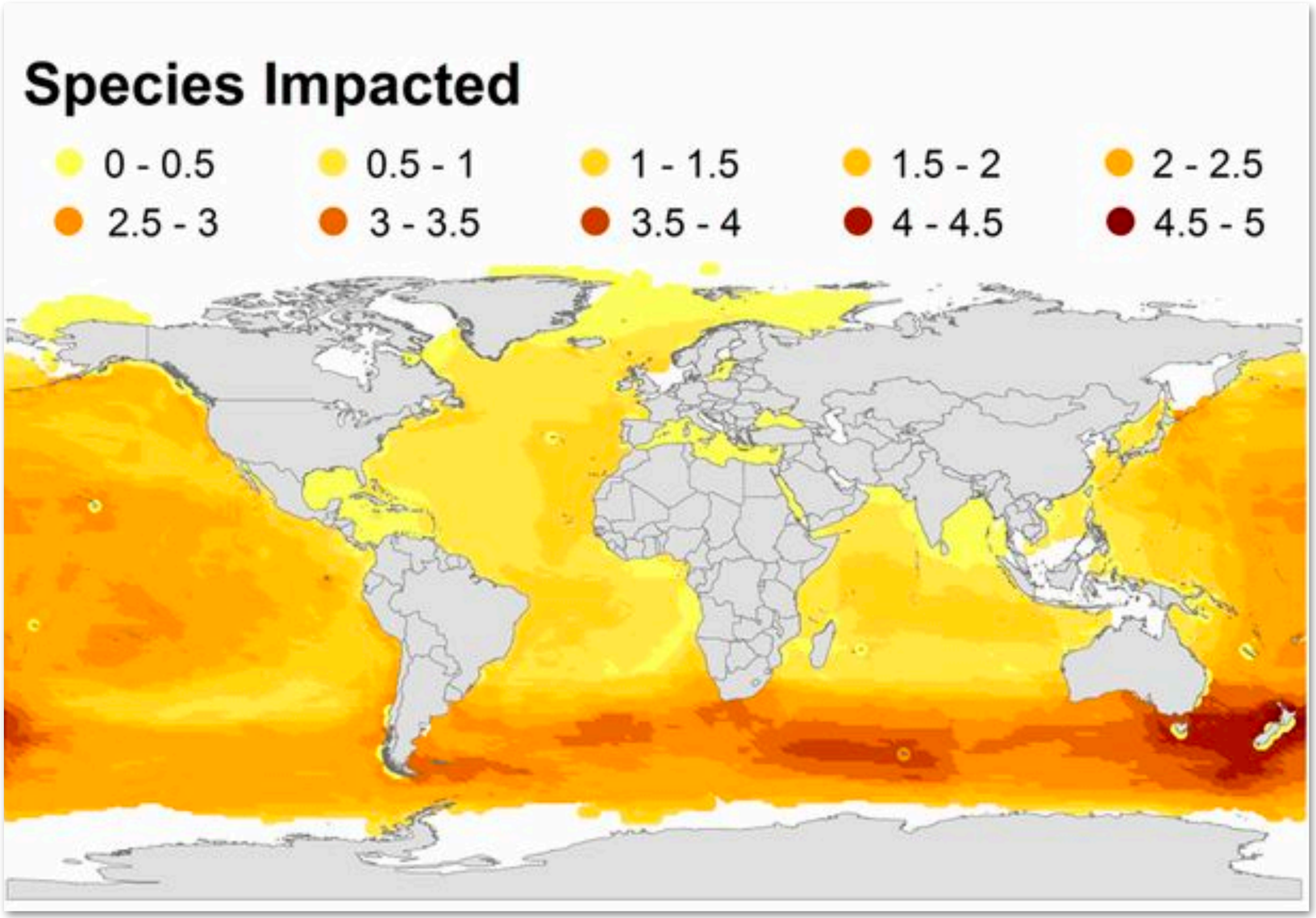
Utrecht University

Institute for Marine and Atmospheric research Utrecht

Freudenthal Institute

Welke impact heeft al dat plastic?

@UFollowtheOcean



Wilcox, Van Sebille & Hardesty (2015) *Proceedings of the National Academies of Sciences*

Is er al bewijs van schade?

@UFollowtheOcean

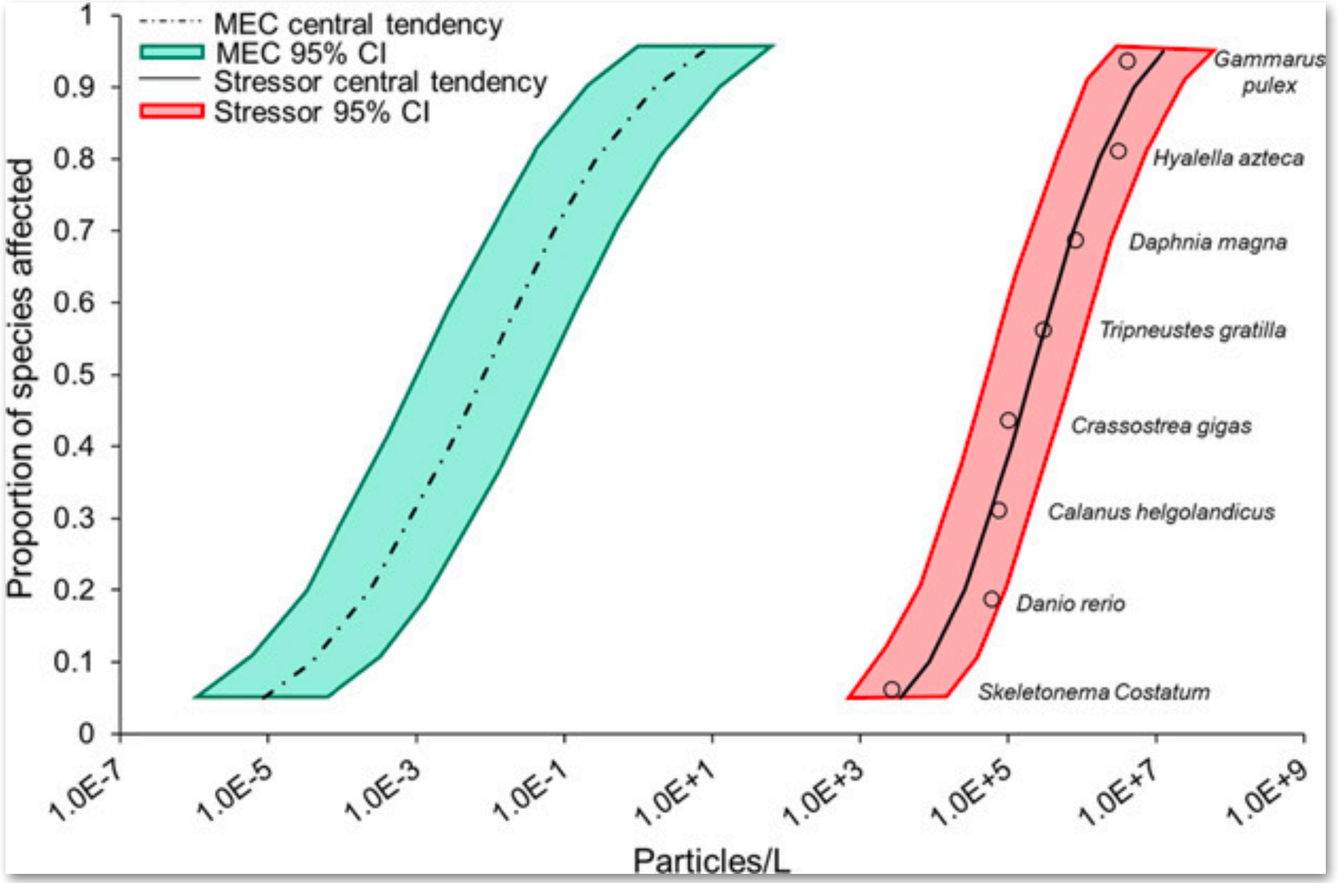
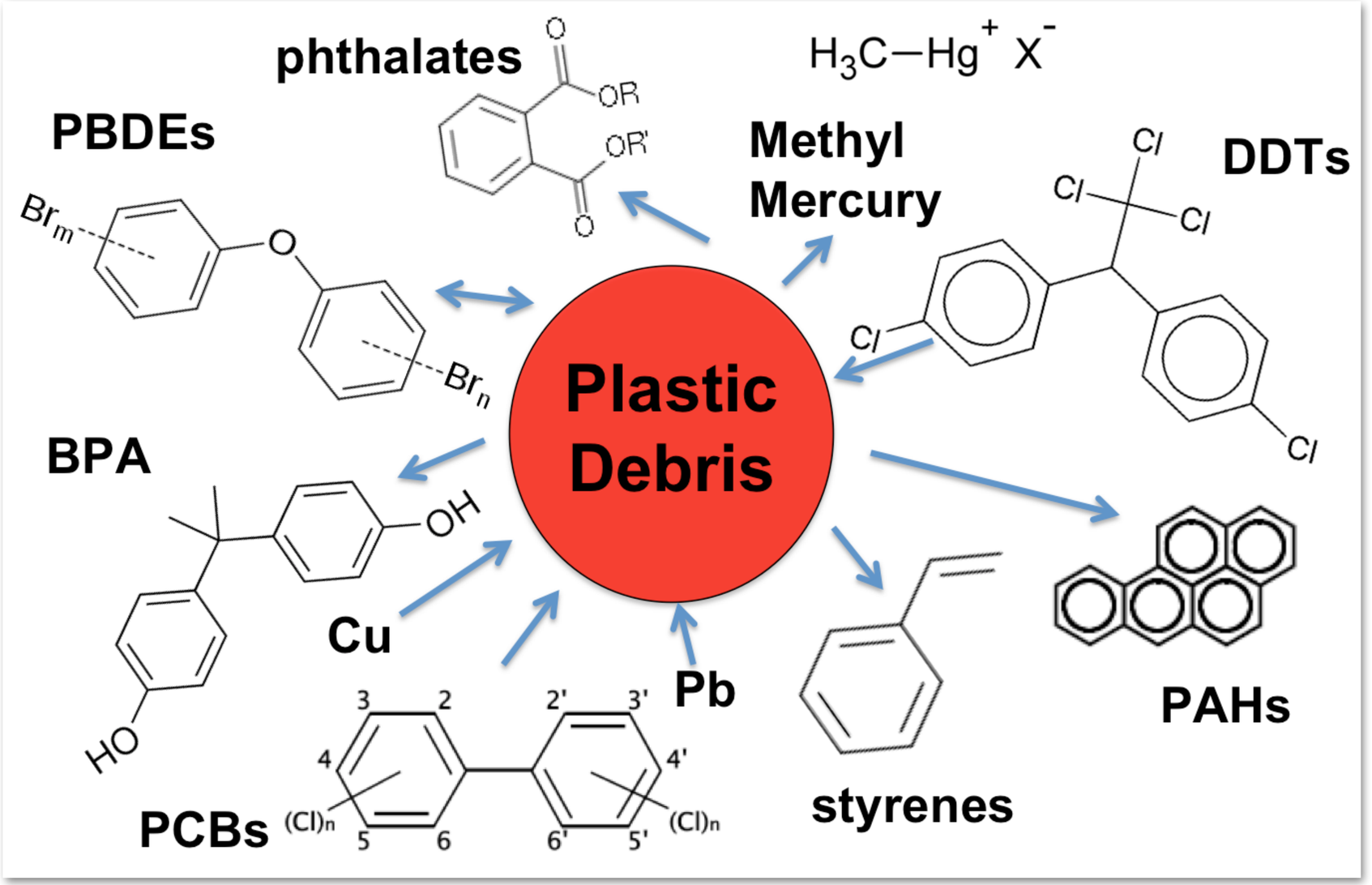


FIGURE 9: Species sensitivity distribution plotted with the 95% confidence interval (CI; red) based on no-observed-effect concentrations and lowest-observed-effect concentrations from studies of particles in the size range of 10 to 5000 μm (most relevant to environmental size distributions). The measured environmental concentration (MEC) cumulative distribution is also plotted (marine and freshwater MECs) with the 95% CI (green).

Burns & Boxall (2018) *Environmental Toxicology and Chemistry*

Hoe zit het met de interactie met toxische stoffen?

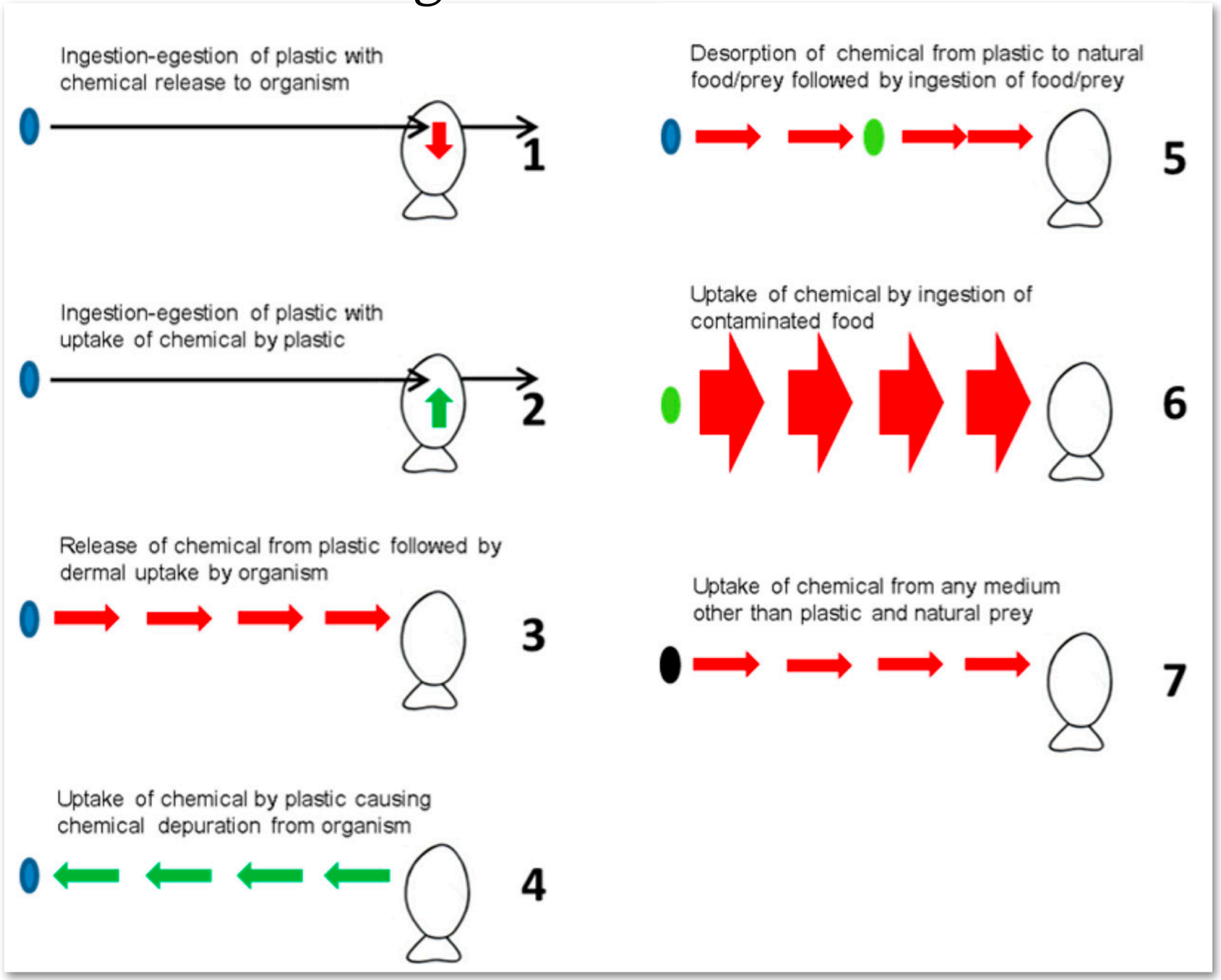
@UFollowtheOcean



Rochmann (2015) *Marine Anthropogenic Litter, Springer*

Wat doen toxische stoffen in organismen?

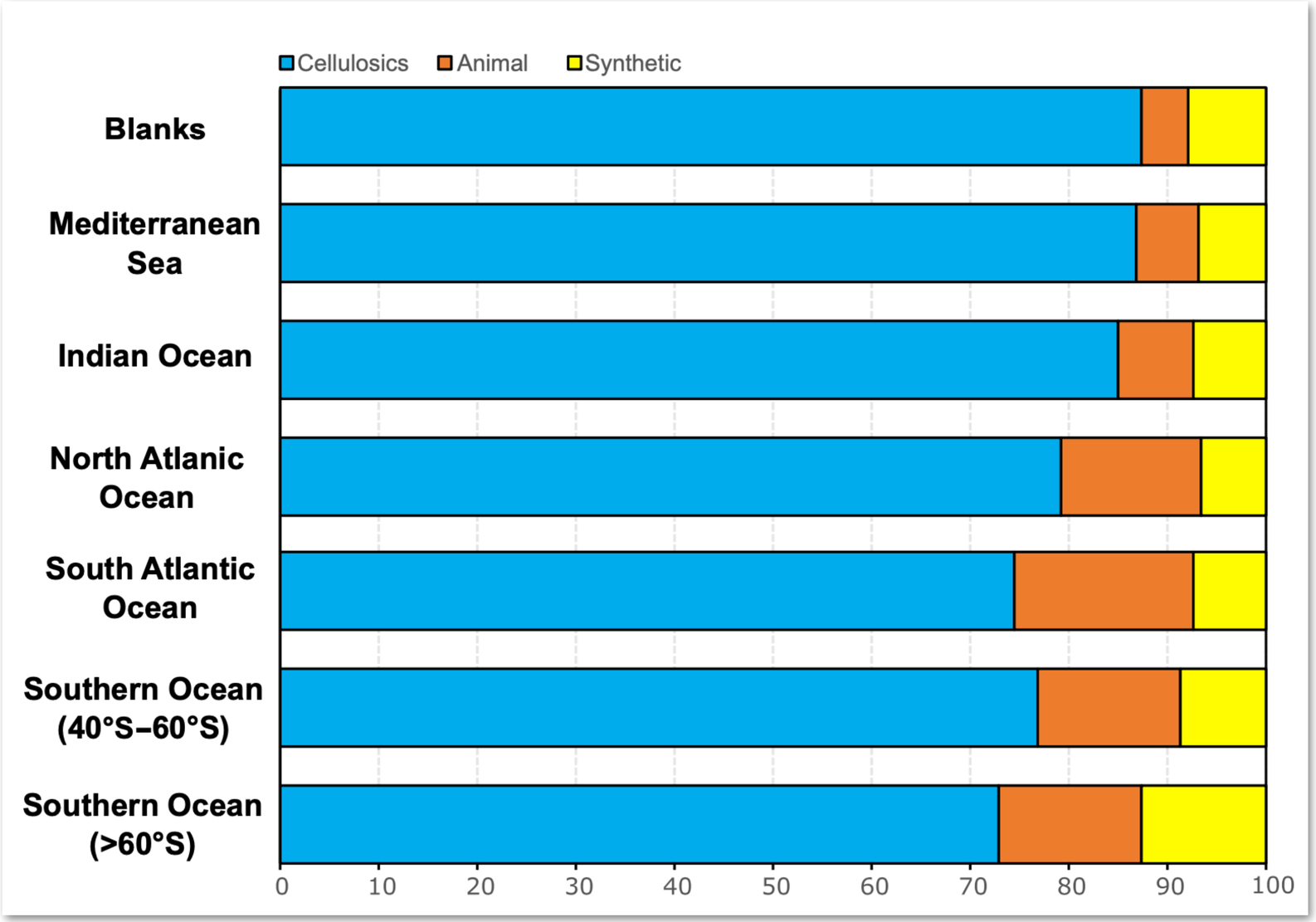
@UFollowtheOcean

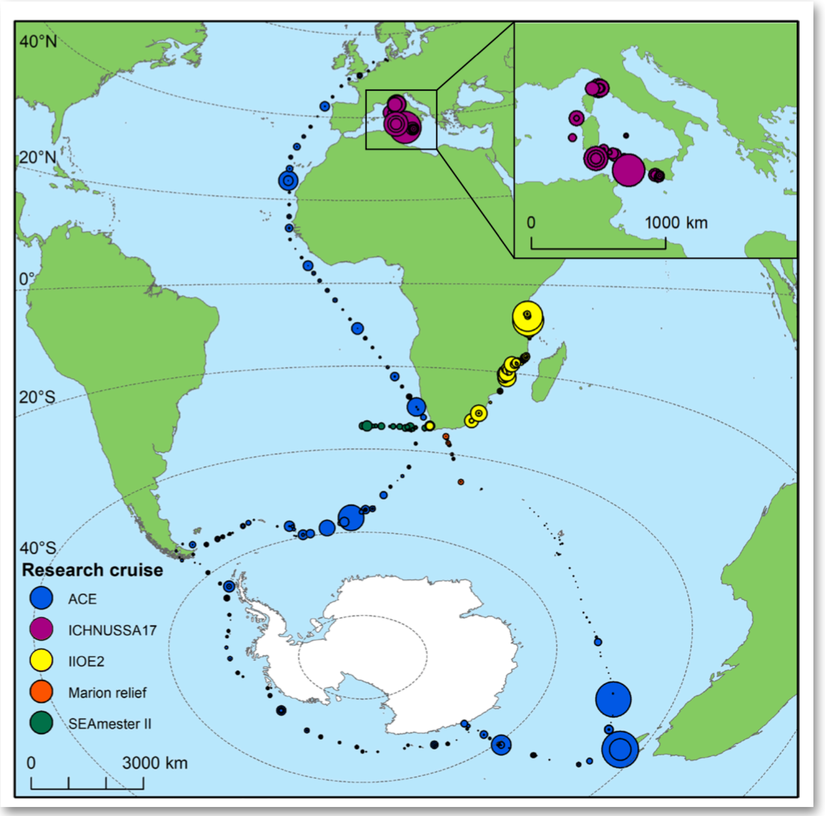


Koelmans, Bakir, Burton & Janssen (2016) *Environmental Science & Technology*

Zijn alle vezels ook van plastic?

@UFollowtheOcean





Utrecht University

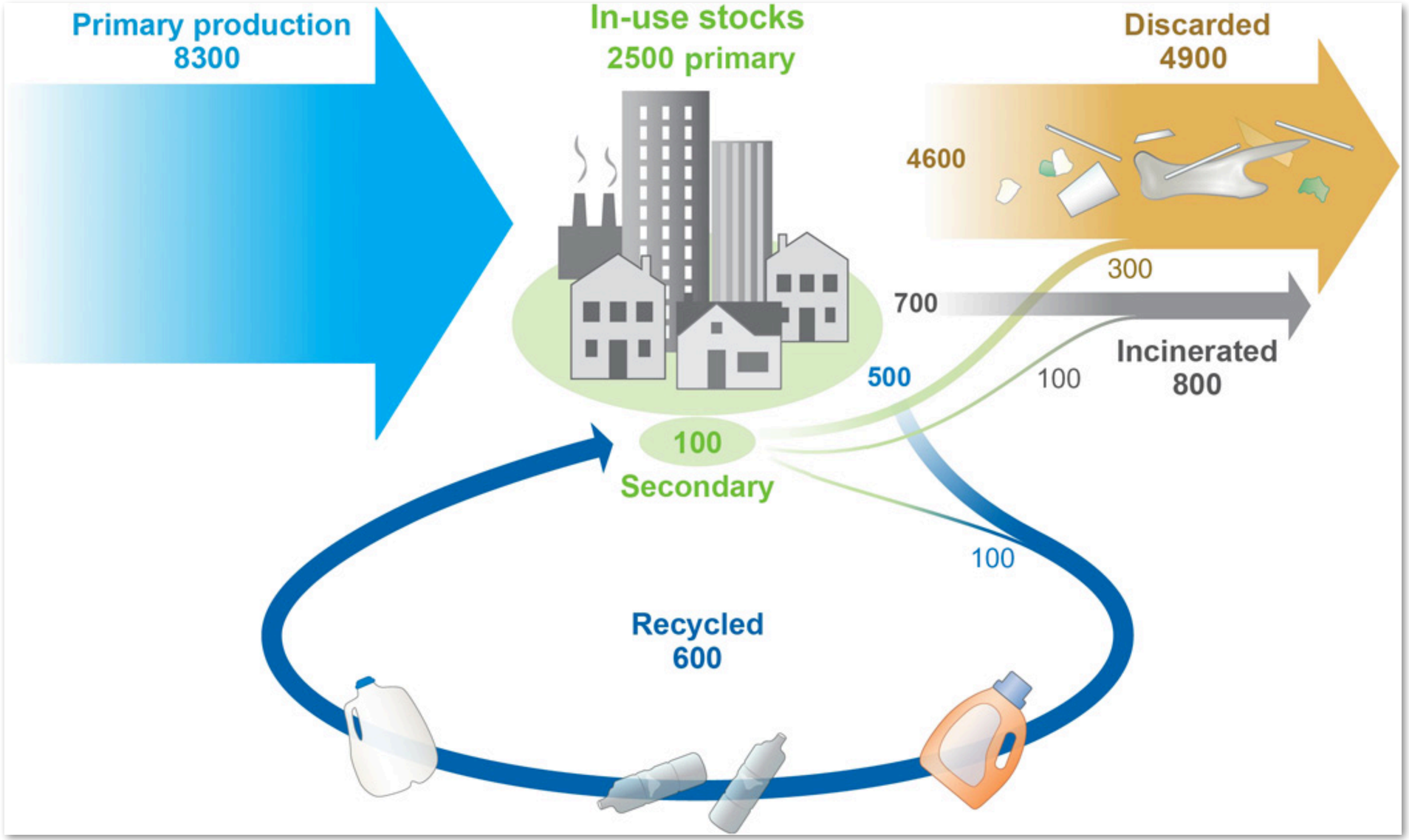
Institute for Marine and Atmospheric research Utrecht

Freudenthal Institute

Suaria, Achtypi, Perold, Lee, Pierucci, Bornman, Aliani & Ryan (2020) *Science Advances*

Plastic productie en recycling tot nu toe

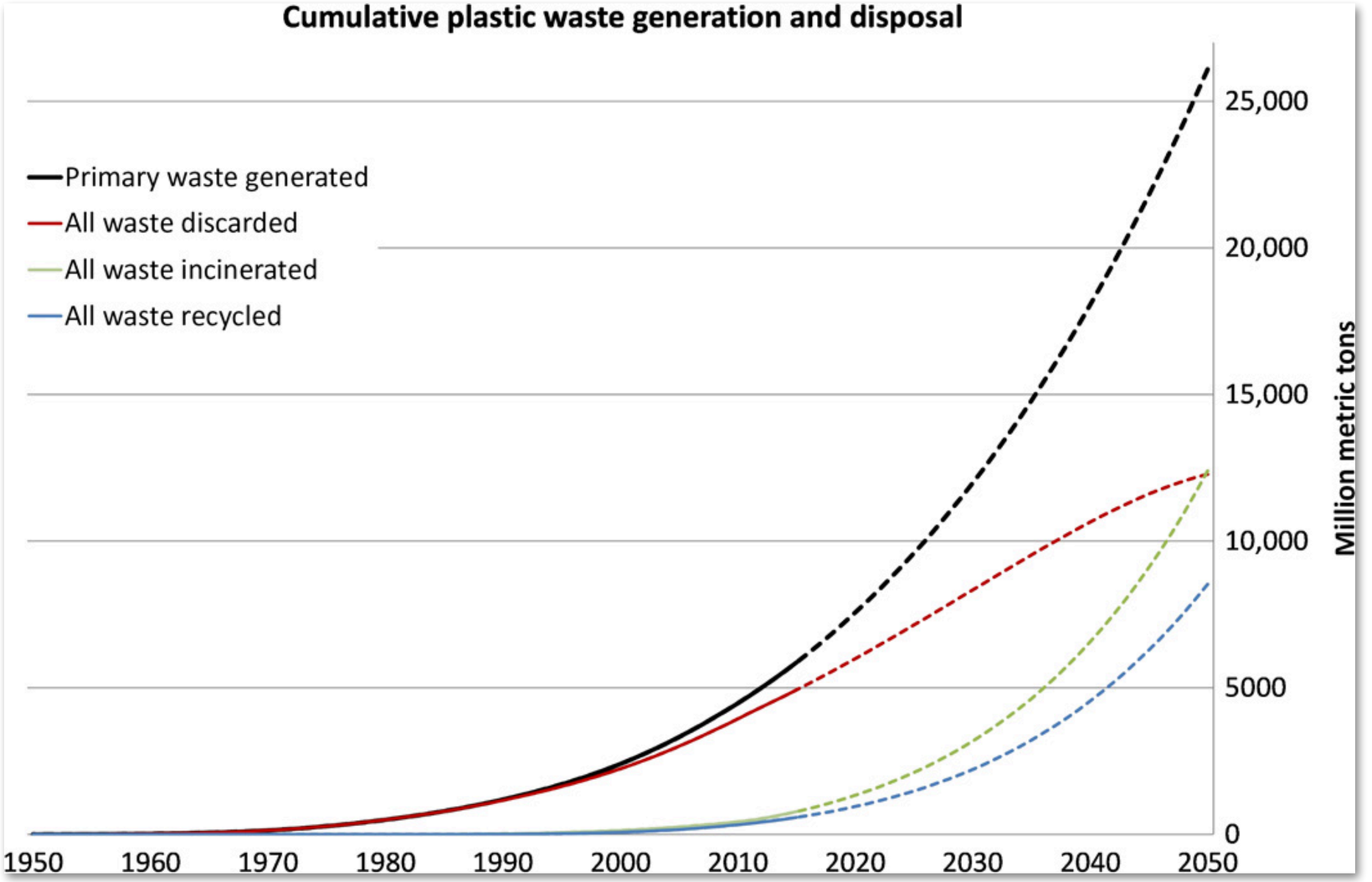
@UFollowtheOcean



Geyer, Jambeck & Law (2017) *Science Advances*

De toekomst van plastic productie en recycling

@UFollowtheOcean



Geyer, Jambeck & Law (2017) *Science Advances*

Wat zijn dan de oplossingen?

@UFollowtheOcean

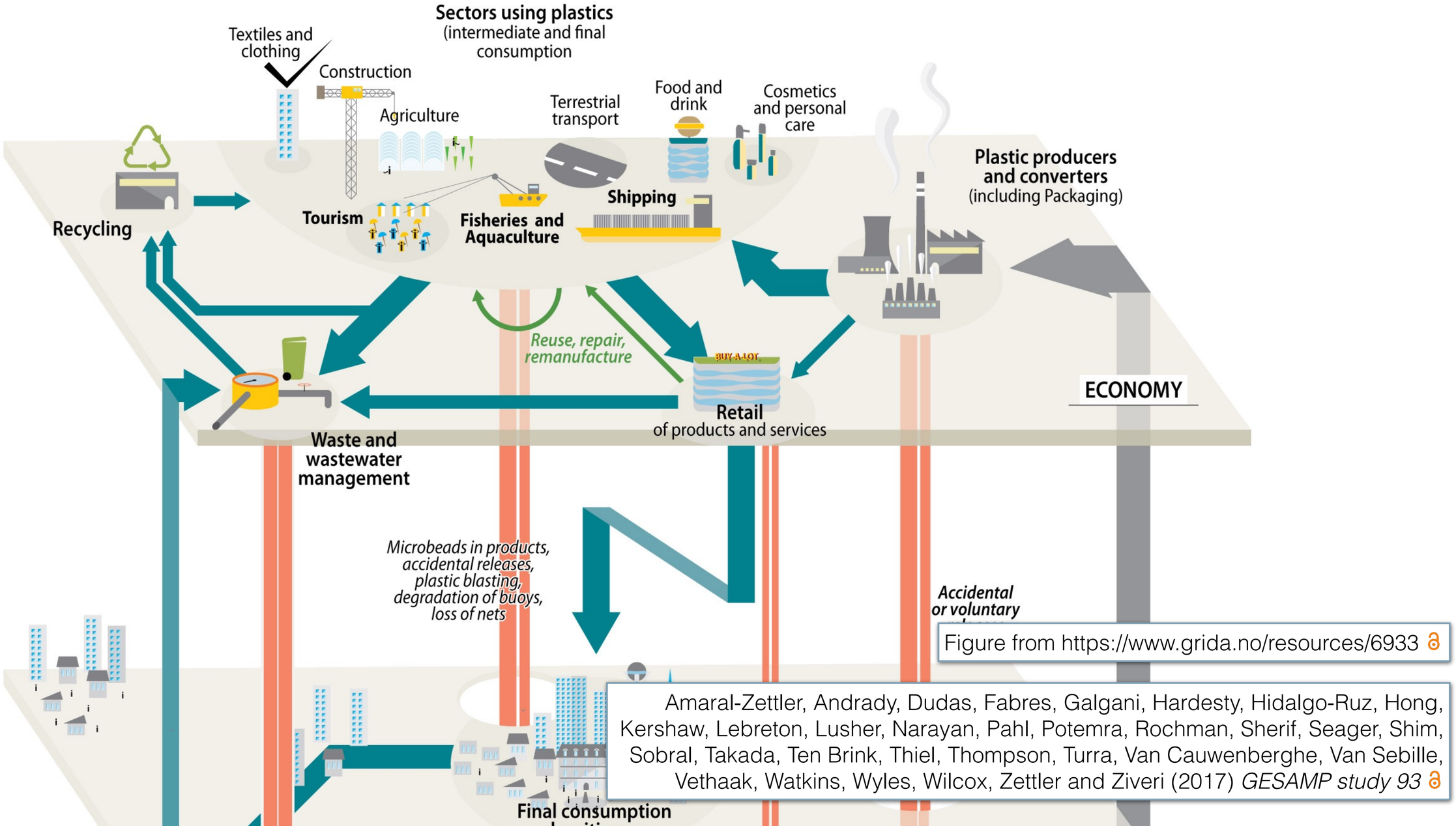


Figure from https://www.grida.no/resources/6933

Amaral-Zettler, Andrady, Dudas, Fabres, Galgani, Hardesty, Hidalgo-Ruz, Hong, Kershaw, Lebreton, Lusher, Narayan, Pahl, Potemra, Rochman, Sherif, Seager, Shim, Sobral, Takada, Ten Brink, Thiel, Thompson, Turra, Van Cauwenberghe, Van Sebille, Vethaak, Watkins, Wyles, Wilcox, Zettler and Ziveri (2017) *GESAMP study 93*

Utrecht University

Meer informatie?

@UFollowtheOcean

Universiteit Utrecht

Zoek in deze site

English

Alles over de plastic soep

Plastic | Land transport | Oceaan transport | Problemen | Kom zelf in actie | Over de site

Image: Aike Vonk @ uu.nl/plasticsoep

Utrecht University

Institute for Marine and Atmospheric research Utrecht

Freudenthal Institute

Nog meer informatie?

@UFollowtheOcean

Utrecht University

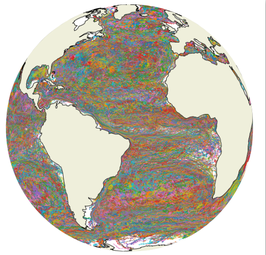
Institute for Marine and Atmospheric research Utrecht

Freudenthal Institute

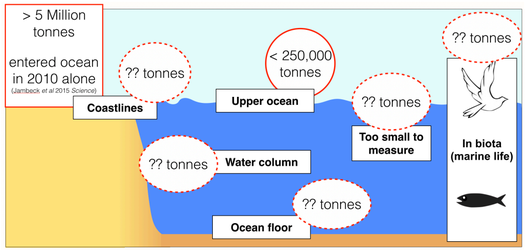
Conclusies

@UFollowtheOcean

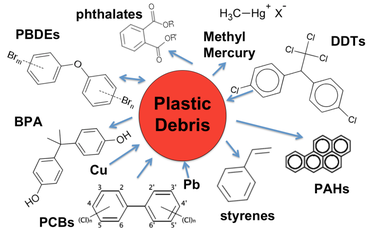
Oceaanstromingen transporteren plastic op een globale schaal tussen continenten.



Het overgrote deel van het plastic in de oceaan is ‘zoek’. Het in kaart brengen daarvan is spannend en mooi onderzoek!



Hoewel plastic in de oceaan een schande is, is het nog niet heel duidelijk hoe schadelijk dat plastic is voor ecosystemen. Toch is het waarschijnlijk niet gezond..



Utrecht University

Institute for Marine and Atmospheric research Utrecht

Freudenthal Institute

European Research Council
Established by the European Commission

esa

Galapagos Conservation Trust

International Council for Science
SCOR
Scientific Committee on Oceanic Research

NWO

Dank aan het @UFollowtheOcean oceanparcels.org/utrechtteam

@UFollowtheOcean

Erik van Sebille
Associate Professor
@ Utrecht University
Erik leads and coordinates the TOPIOS project. He is an expert in Lagrangian Ocean Analysis.

Philippe Delandmeter
Postdoc
@ Utrecht University
Philippe improves and optimises the Parcels code used in TOPIOS to simulate plastic transport.

Delphine Lobelle
Postdoc
@ Utrecht University
Delphine investigates how 3D ocean circulation impacts plastic transport.

Christian Kehl
Postdoc
@ Utrecht University
Christian develops and improves the Parcels code used in TOPIOS to simulate plastic transport.

Laura Gomez Navarro
Postdoctoral researcher
Laura investigates how to track floating material in currents from remote sensing.

Steffie Ypma
Postdoctoral researcher
Steffie creates a tool that supports plastic cleanup in the Galapagos.

Peter Nooteboom
Postdoc researcher
Peter investigates how to simulate the dynamics of tuna interaction.

David Wichmann
PhD student
@ Utrecht University
David investigates how ocean currents and waves transport plastic litter around.

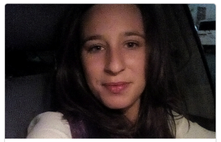
Mikael Kaandorp
PhD student
@ Utrecht University
Mikael investigates how to use machine learning to incorporate plastic distribution data into models.

Daan Reijnders
PhD student
@ Utrecht University
Daan investigates how turbulent flow transports nutrients

Darshika Manral
PhD researcher
Darshika investigates how plankton interact with nutrients and plastic in the Atlantic Ocean.

Claudio Pierard
PhD researcher
Claudio investigates the origin and fate of nanoplastics in our ocean.

Cleo Jongedijk
PhD student
@ Imperial Collge London
Cleo investigates how plastic litter ends up on beaches.



Rebeca de la Fuente
PhD student @ IFISC
Rebeca investigates how plastic litter sinks to the ocean floor.

Victor Onink
PhD researcher
Victor investigates the global dispersion patterns of marine plastic pollution.

Anneke Vries
MSc student
@ Utrecht University
Anneke investigates the role of sea ice in transporting plastic through the Arctic.

Maarten Muller
MSc student
@ Utrecht University
Maarten investigates how plastic crosses the Southern Ocean near Antarctica.

Arianna Olivelli
MSc student
@ Utrecht University
Arianna tracks the origin of micro- and nanoplastic in the South Atlantic gyre.

Reint Fischer
MSc student
@ Utrecht University
Reint investigates the flow around corals

Aike Vonk
MSc student
@ Utrecht University
Aike investigates how best to incorporate marine plastic research into school curriculums.

Tycho Bovenschen
MSc student
Tycho investigates the anisotropic nature of particle diffusion.

Mariana de Botton Falcon
MSc student
Mariana investigates how floating plastic accumulates in ocean eddies.

Sophie Schmiz
MSc student
Sophie investigates the distribution of floating plastic in the North Atlantic Ocean.

Deborah Bassotto
MSc student
Deborah investigates how plastic pollution is transported in the Black Sea.

Quinten Bohte
MSc student
Quinten uses machine learning to optimise beach-clean-ups in the Galapagos Islands.

Ina Nagler
MSc student
Ina investigates the sources of plastic ending on the Galapagos Islands.

Judith Ewald
MSc student
@ Utrecht University
Judith investigates how SKIM flow fields can be used to track microplastic.

Laura Chow
MSc student
@ Utrecht University
Laura creates puzzle boxes for high school students about marine plastic litter.

Michal Janssen
BSc student
@ Utrecht University
Michal simulates how debris from the MSC Zoe disperses through the North Sea.

Miriam Sterl
BSc student
@ Utrecht University
Miriam investigates how global tides impact the transport of plastic litter.

Nicoleta Tsakali
BSc student
@ Utrecht University
Nicoleta investigates how ocean currents transport plastic to the Galapagos Islands.

Ilja Deurloo
BSc student
Ilja investigates how plastics move through the Caribbean.

Bram van Duinen
BSc student
Bram investigates the origin of plastic found on Dutch beaches.

Utrecht University

Institute for Marine and Atmospheric research Utrecht

Freudenthal Institute

European Research Council
Established by the European Commission

esa

Galapagos Conservation Trust

Pacific Community
Communauté du Pacifique

NWO