



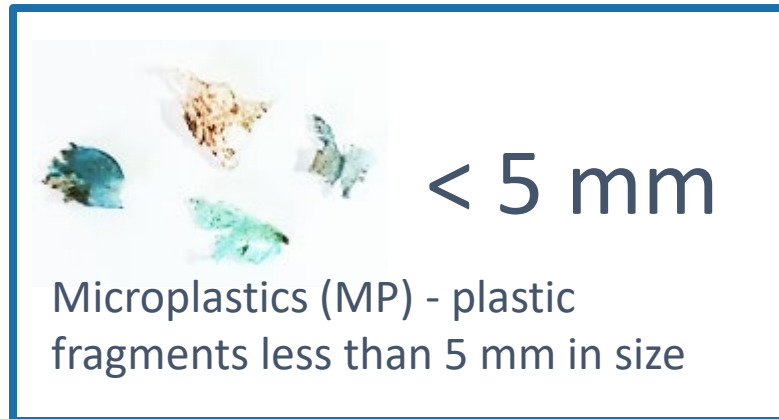
Modeling the influence of biogeochemical processes on microplastics transport in the Arctic Ocean

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Microplastics



Horizontal transport	Vertical transport
Currents and gyres	biofouling
	Ingestion by zooplankton

- Biogeochemical processes significantly affect the physical properties of MP, primarily its density and, therefore, buoyancy.
- Biofouling, uptake by zooplankton of MPs and its excretion are considered, when modeling the horizontal and vertical distribution of MP.

$$\frac{\partial C_i}{\partial t} + u \frac{\partial C_i}{\partial x} + v \frac{\partial C_i}{\partial y} + w \frac{\partial C_i}{\partial z} + \frac{\partial(w_{C_i} C_i)}{\partial z} - \frac{\partial}{\partial x} K_x \frac{\partial C_i}{\partial x} - \frac{\partial}{\partial y} K_y \frac{\partial C_i}{\partial y} - \frac{\partial}{\partial z} K_z \frac{\partial C_i}{\partial z} = R_{C_i}$$

(Berezina et al., 2021)

BioPlast

Microplastics:

- biofouling
- ingestion by zooplankton
- sedimentation with detritus

OxyDep

Biogeochemistry

- seasonal cycling in production and destruction of organic matter

(Yakushev et al., 2011)

(Bruggeman and Bolding, 2014)

FABM

Framework for Aquatic Biogeochemical Models
Coupling of biogeochemical models with transport models, such as GETM, NEMO, FVCOM

(Yakushev et al., 2020)

2DBP

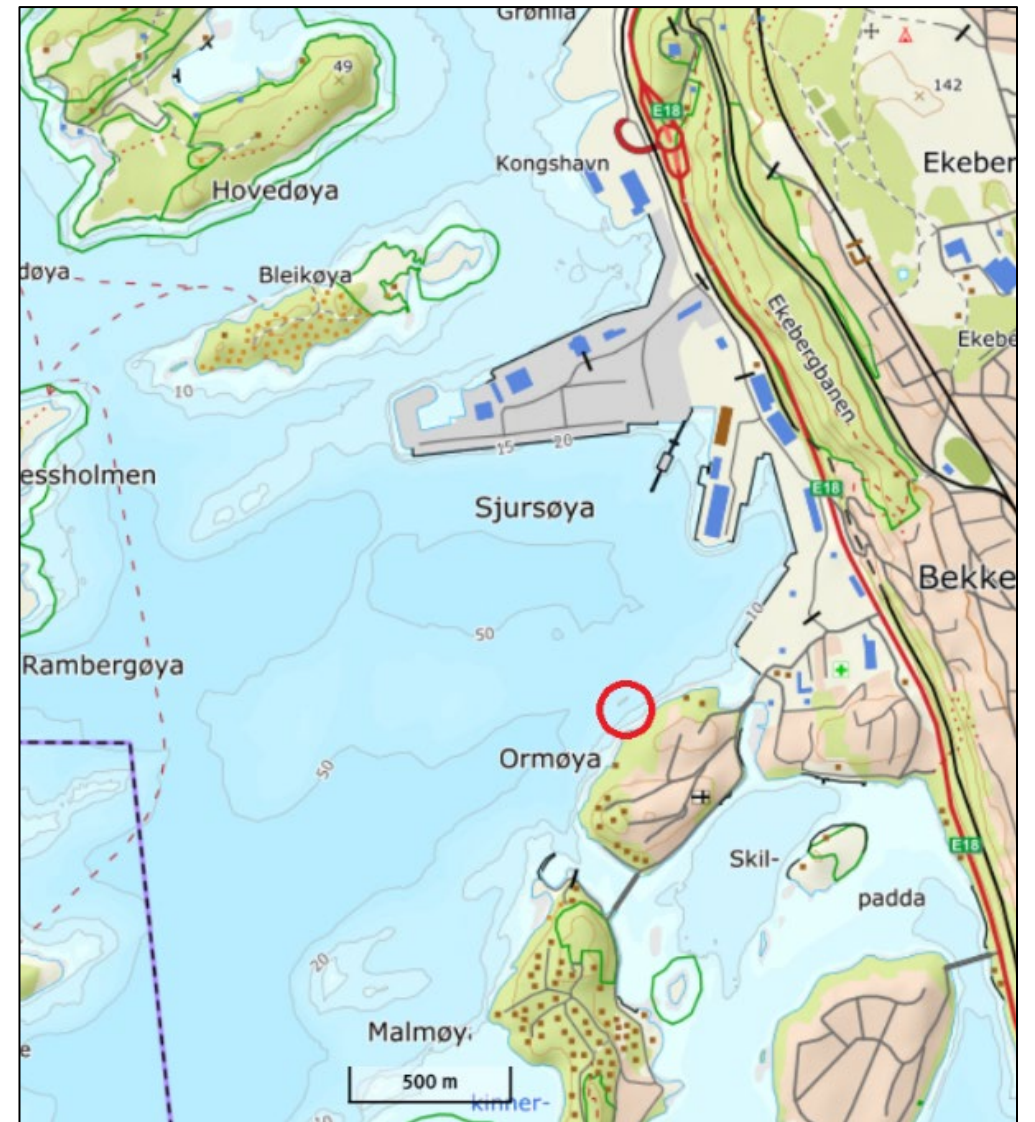
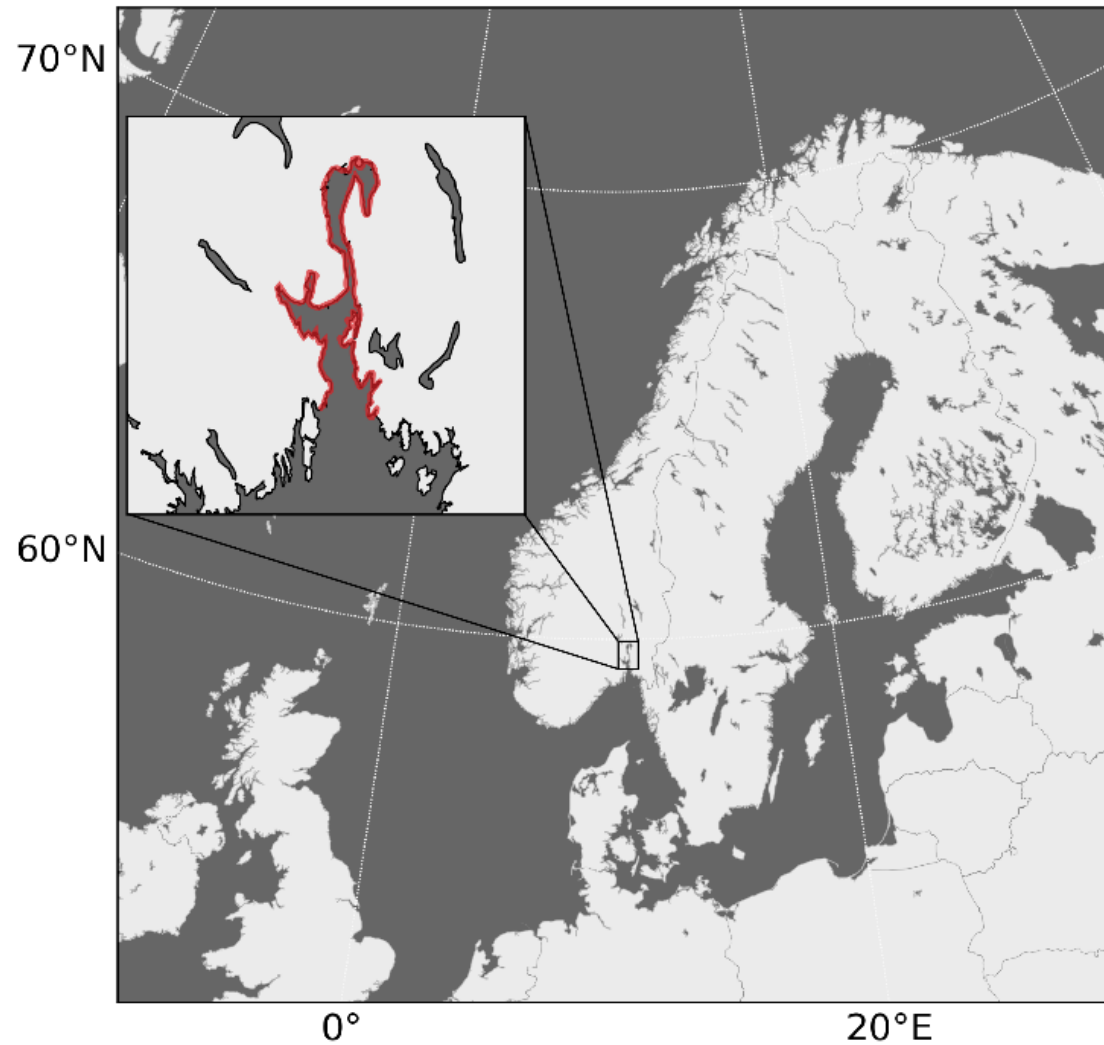
2D dimensional benthic-pelagic model.
[Oslofjord]

ROMS

3D transport model.
[Arctic Ocean]

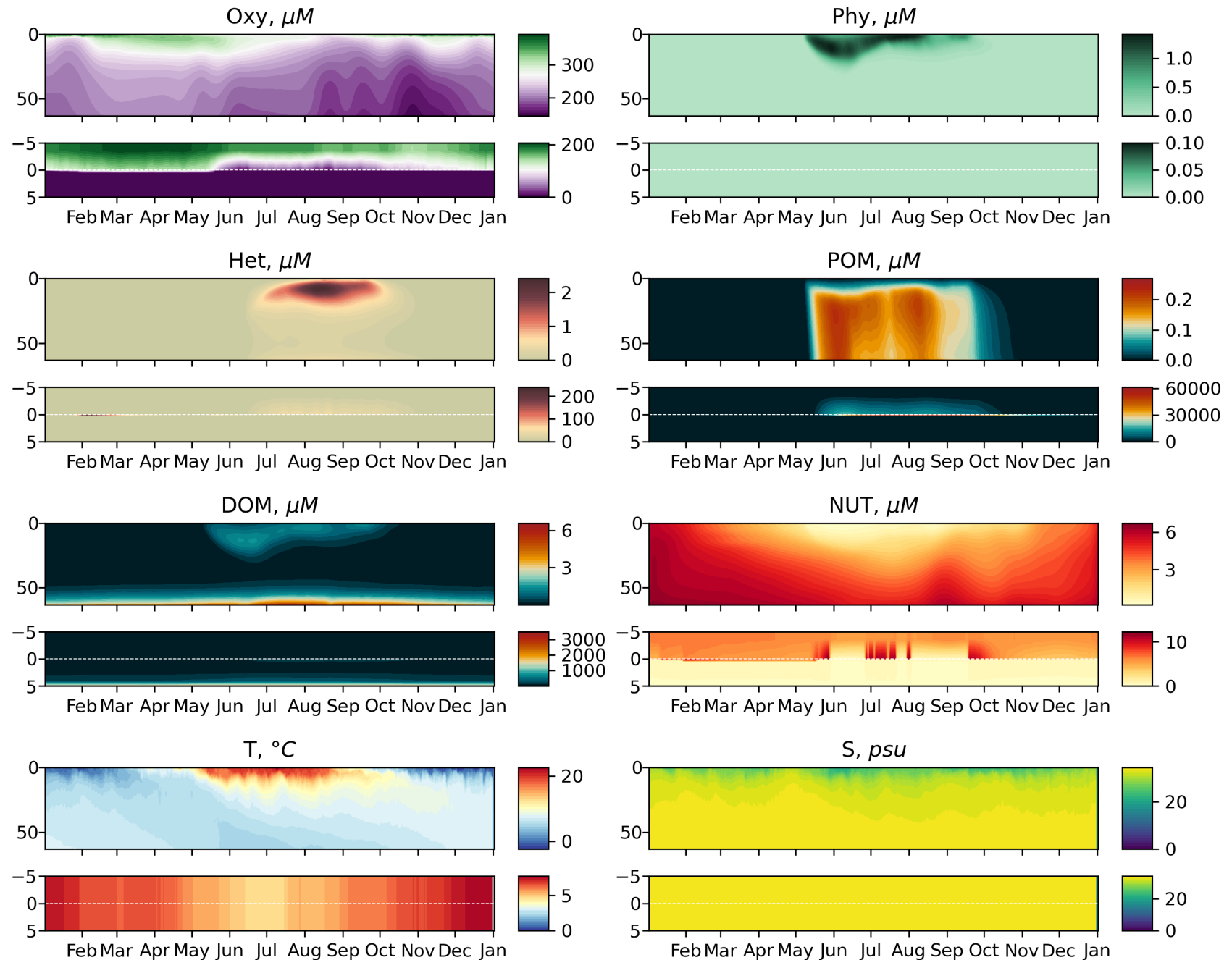
(Schepetkin et al., 2003)

2D-case: Oslofjord



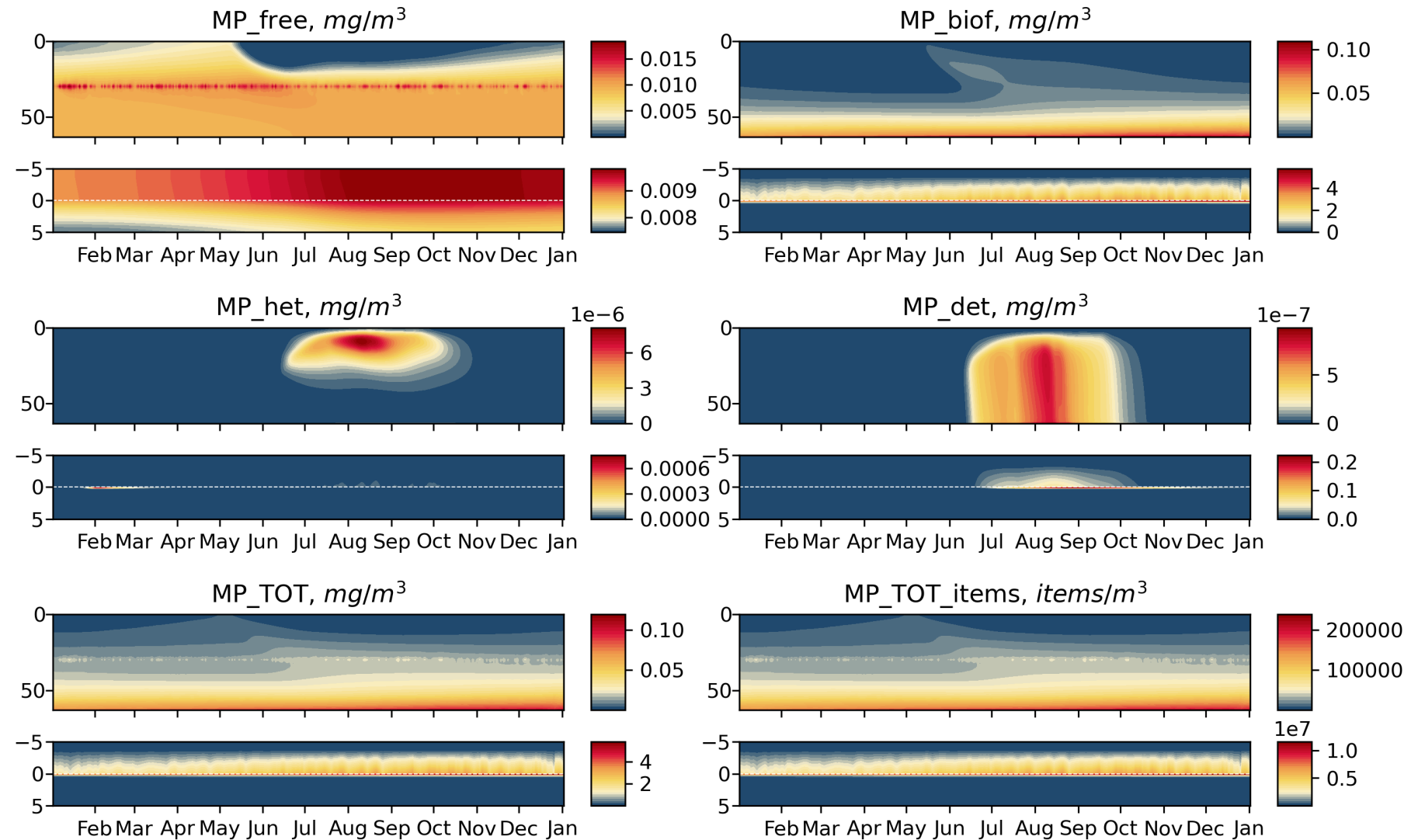
Seasonal variability of biogeochemical parameters

- Phytoplankton bloom in June
- Detritus flow in the summer period



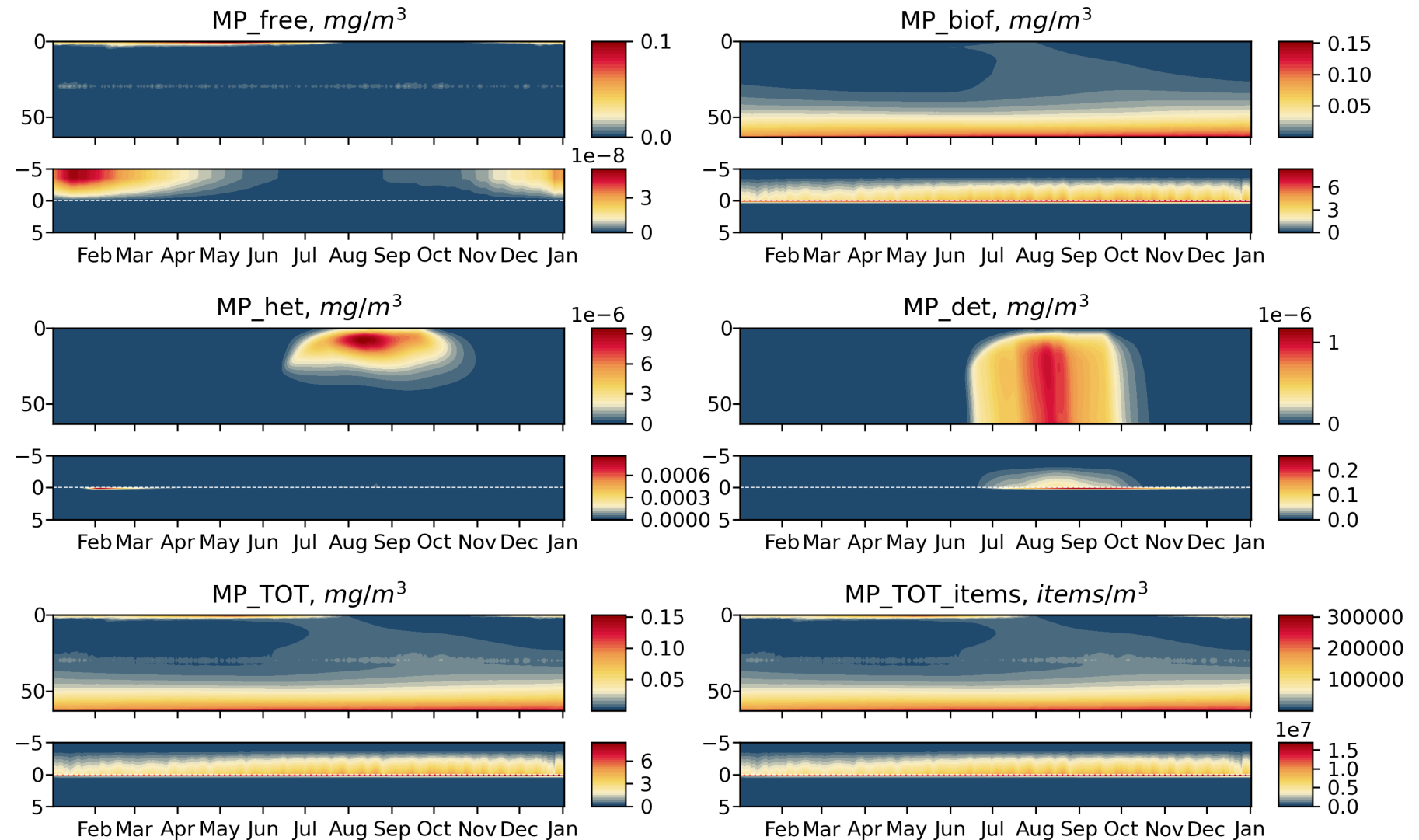
Seasonal variability of MP

$W = 0$ m/d



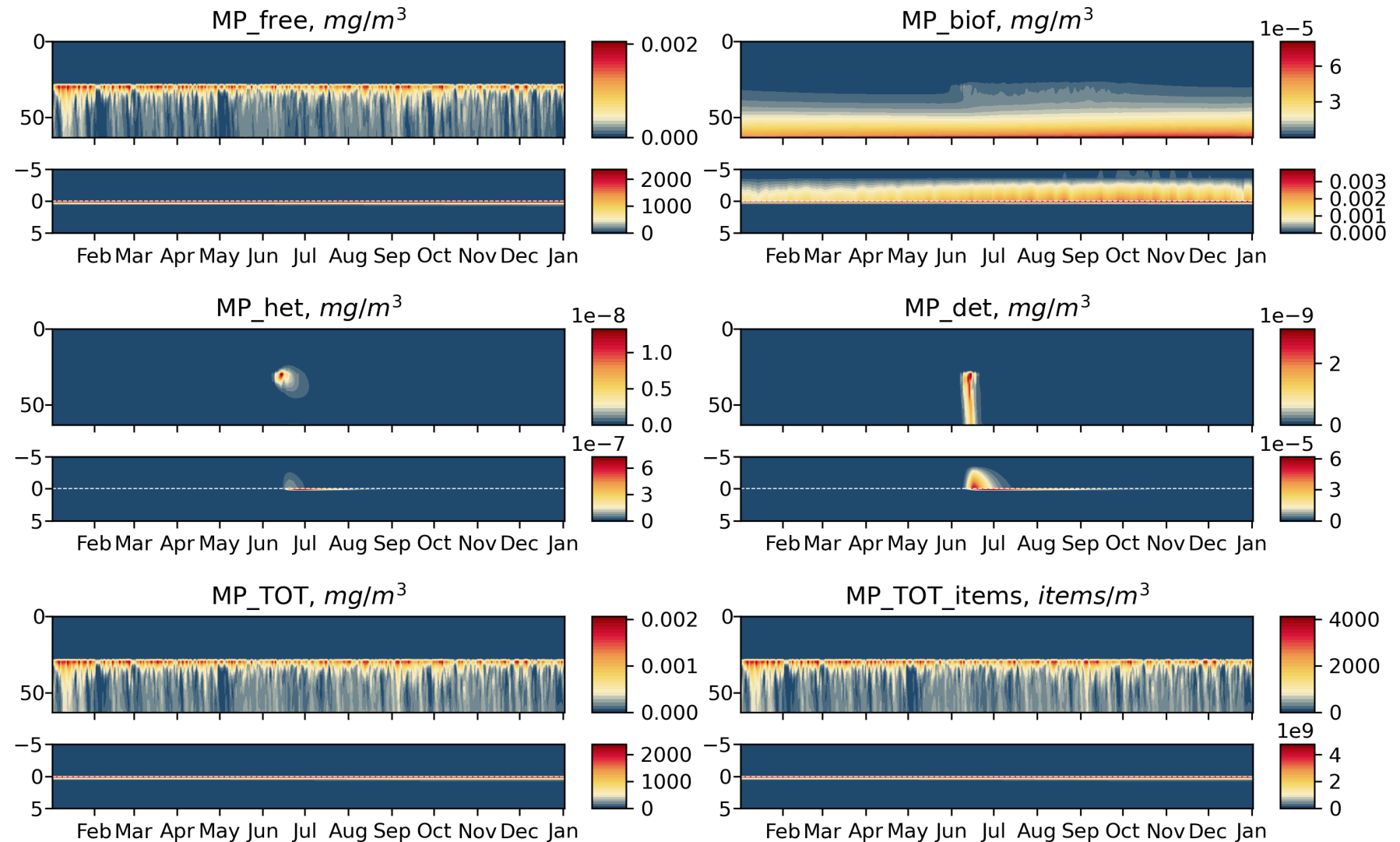
Seasonal variability of MP

$W = 0.5 \text{ m/d}$



Seasonal variability of MP

$W = -20 \text{ m/d}$

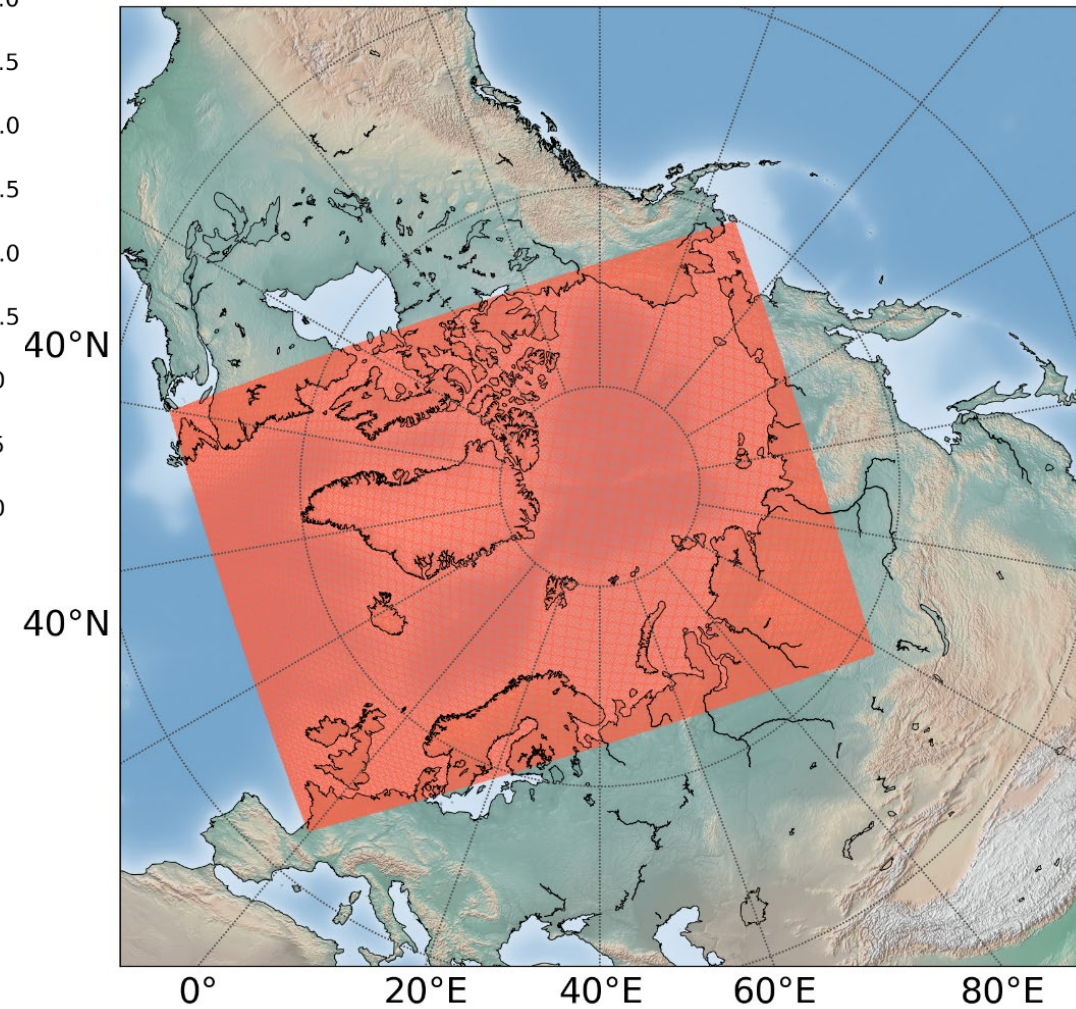
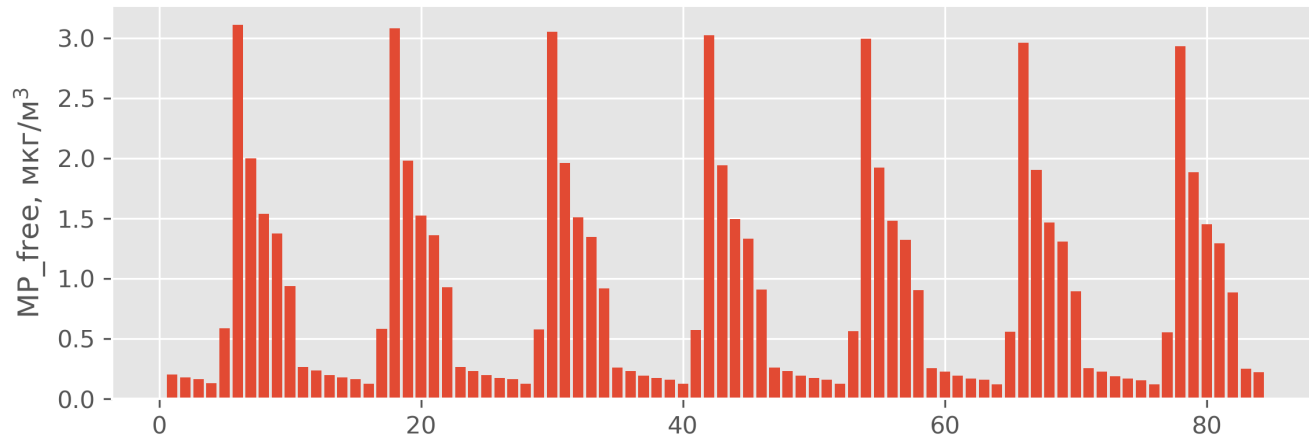
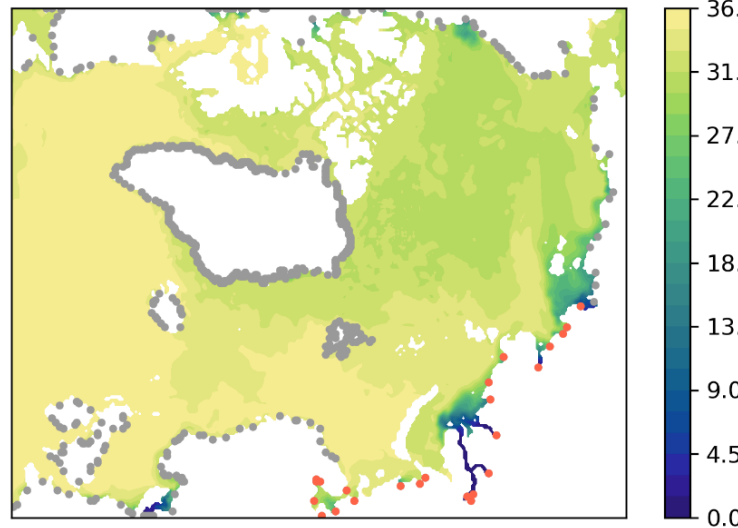


3D-case: Arctic Ocean ROMS-20

MP input scenarios

MP_{free} is supplied from Arctic rivers.

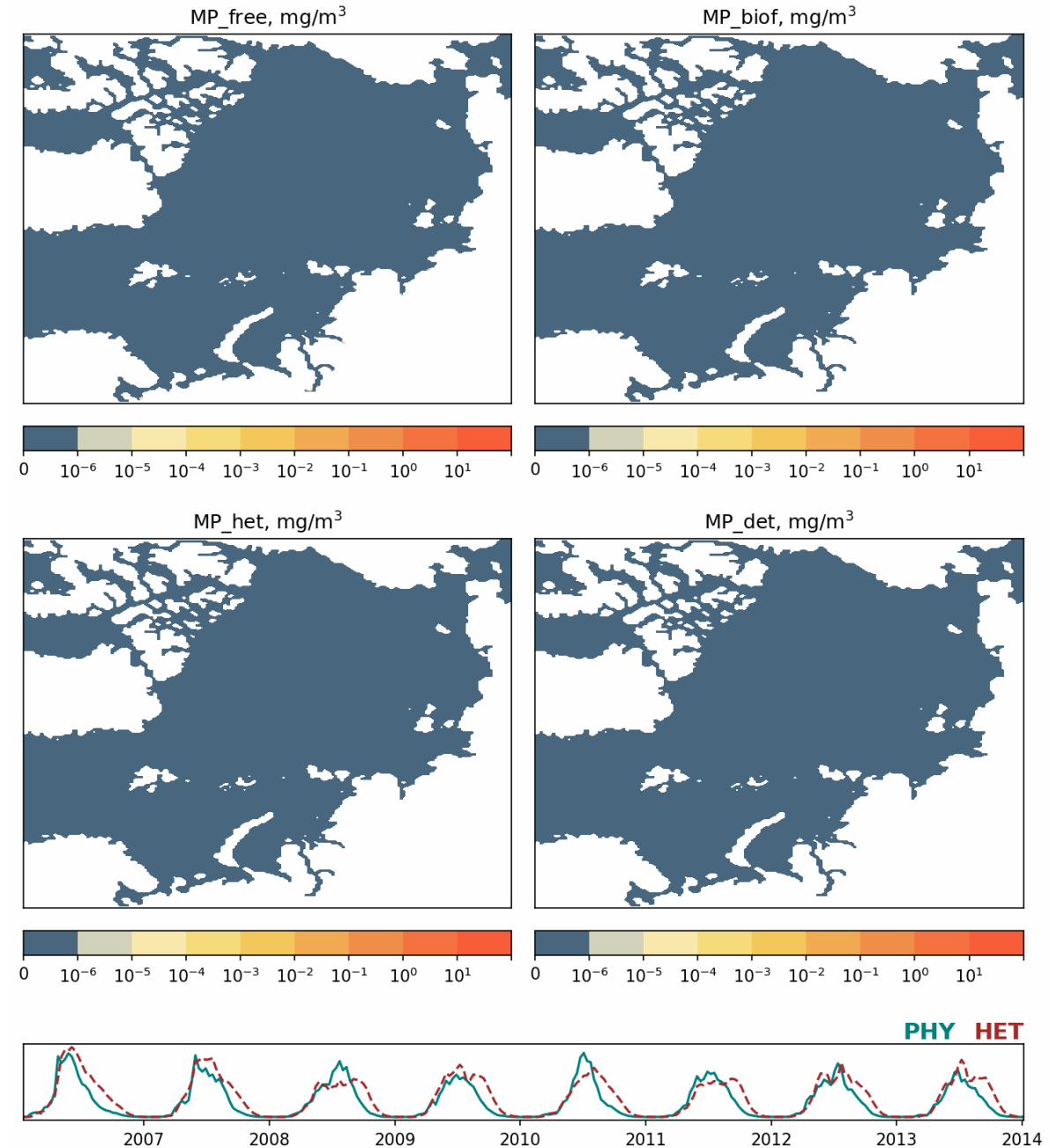
MP_{free} is supplied from North Atlantic (western boundary of the domain).



Spread of MPs from rivers

- Biofouling within the Ob-Enisey plume
- Transport of MPs through the Fram strait

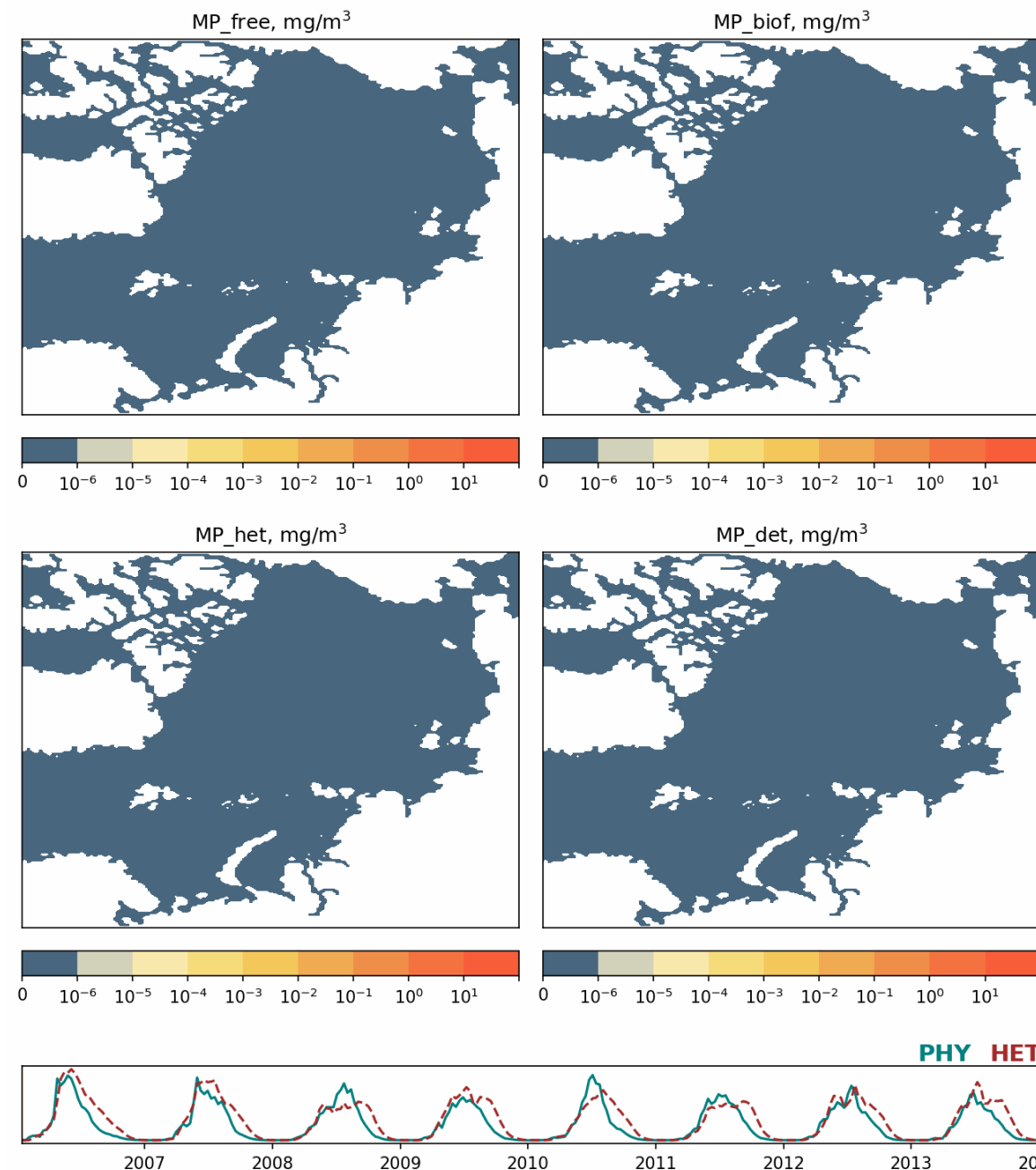
2006-01-15



Spread of MPs from the North Atlantic

- Waves of phytoplankton blooms
- Purification of surface layers at some places due to biofouling

2006-01-15



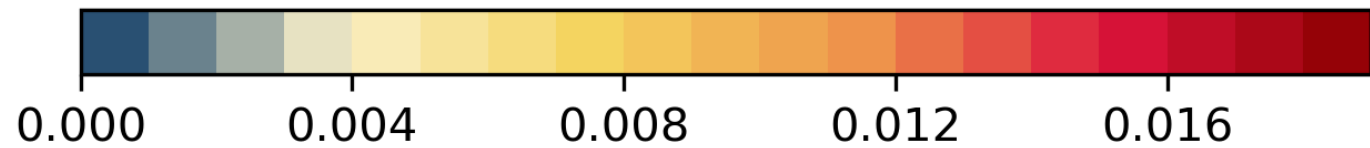
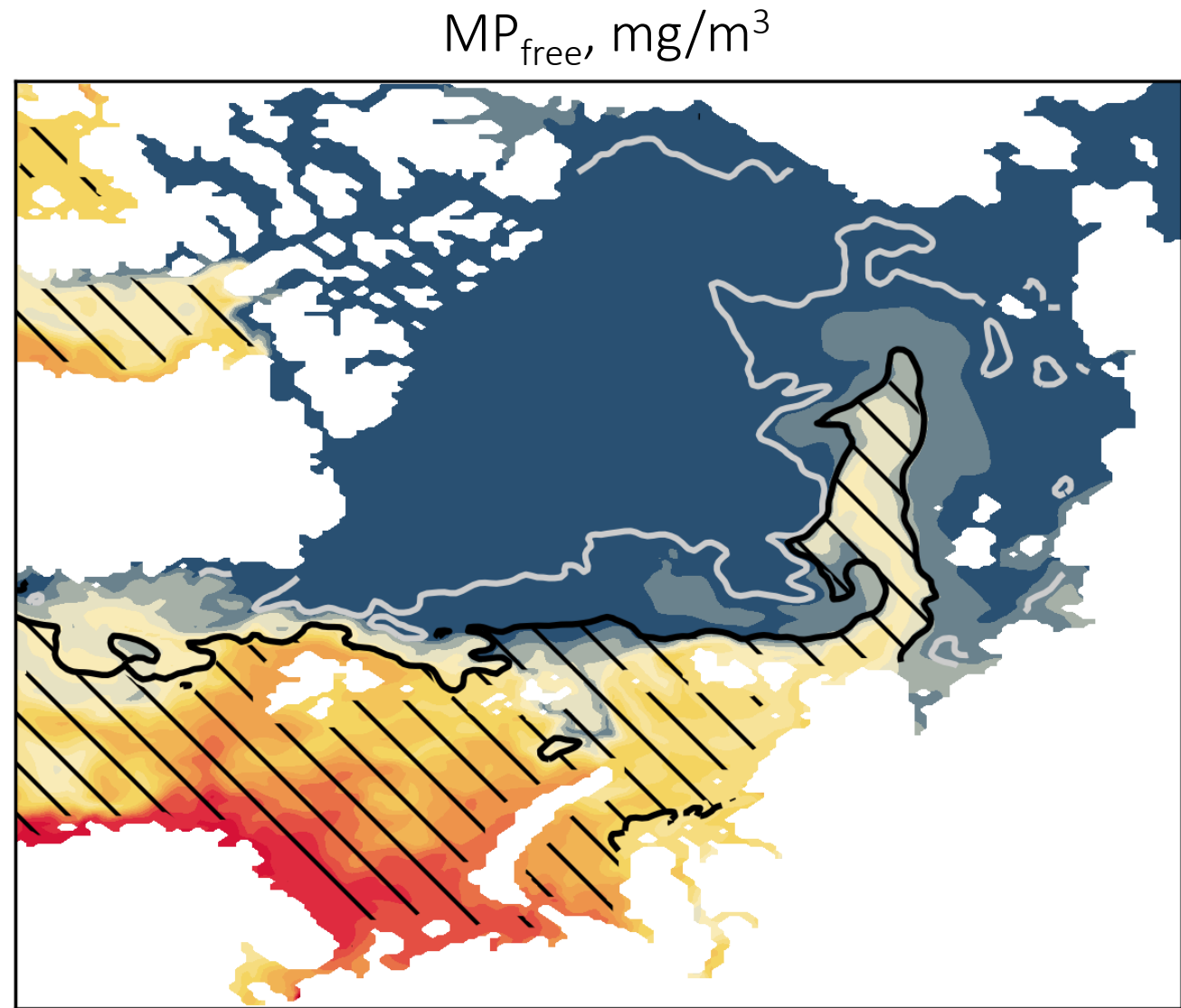
River MPs vs Atlantic MPs



- River MPs



- Atlantic MPs



River MPs vs Atlantic MPs



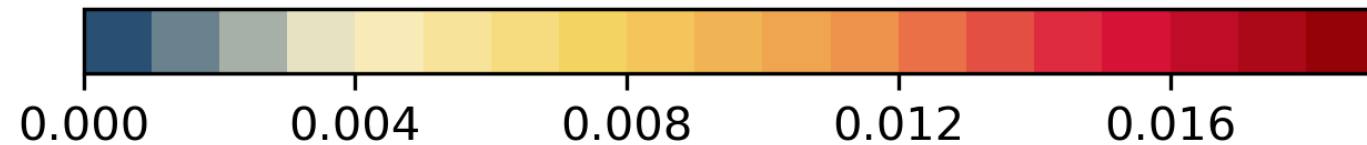
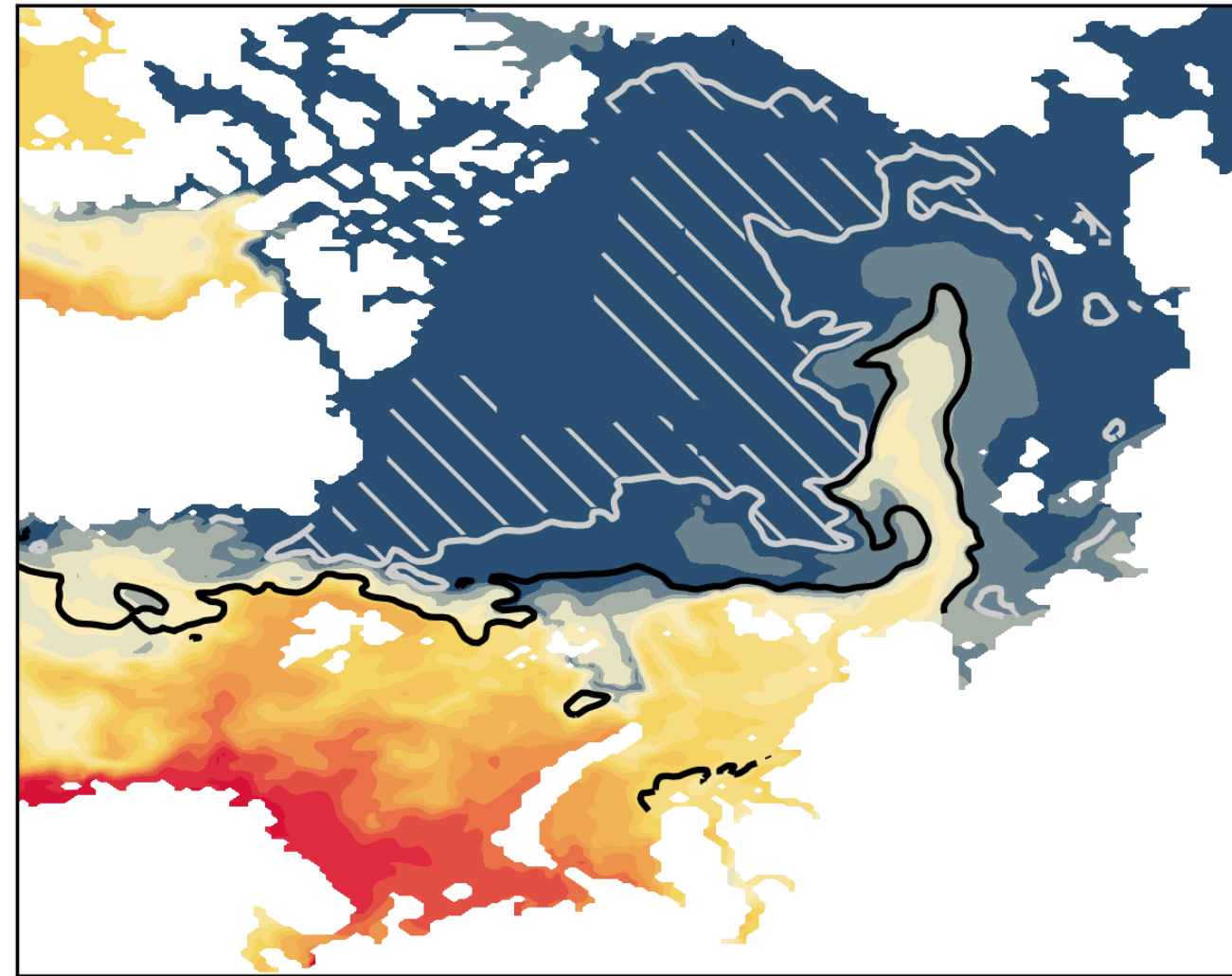
- River MPs

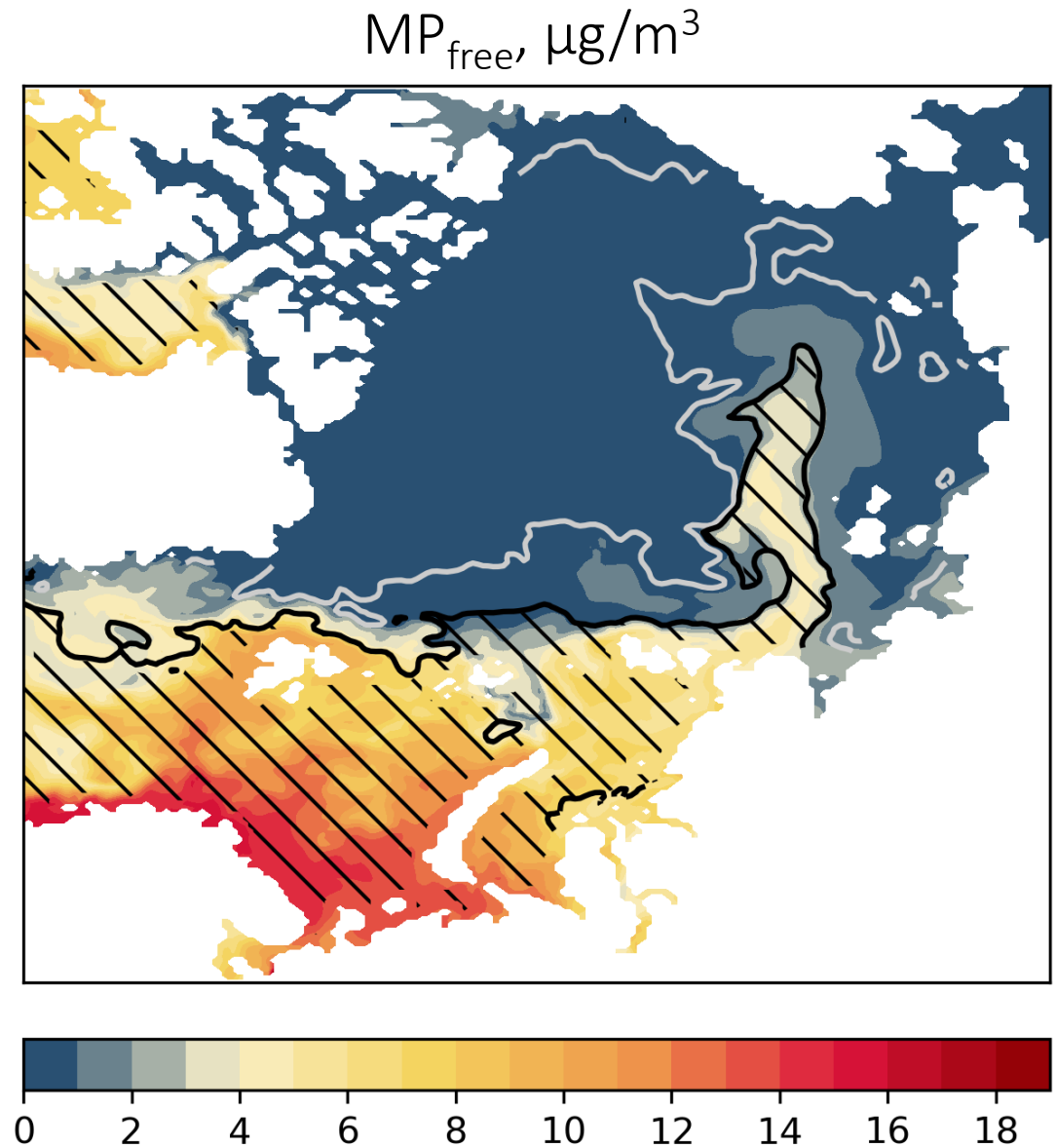
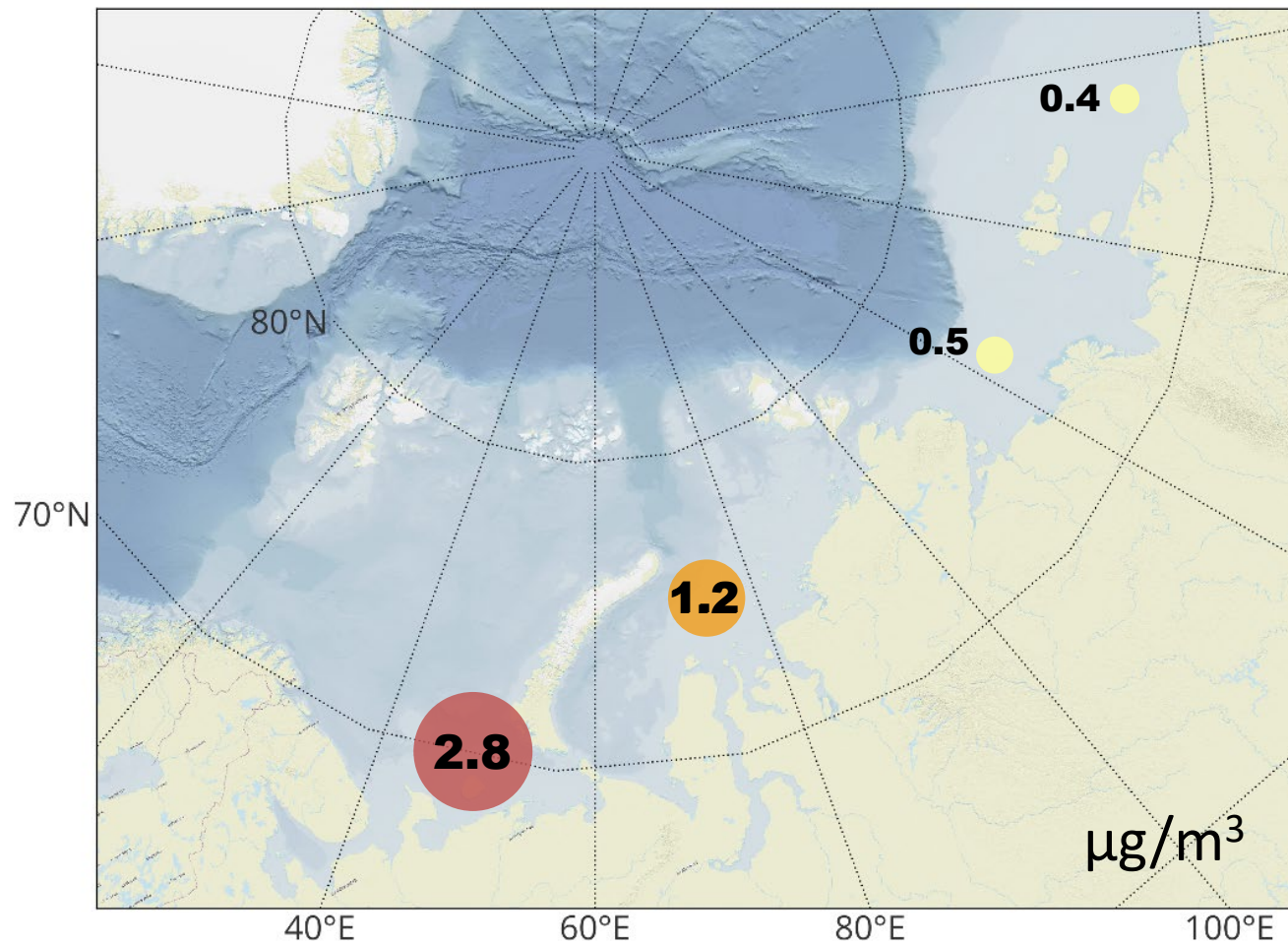


- Atlantic MPs

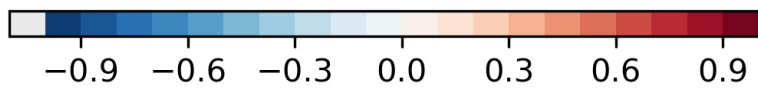
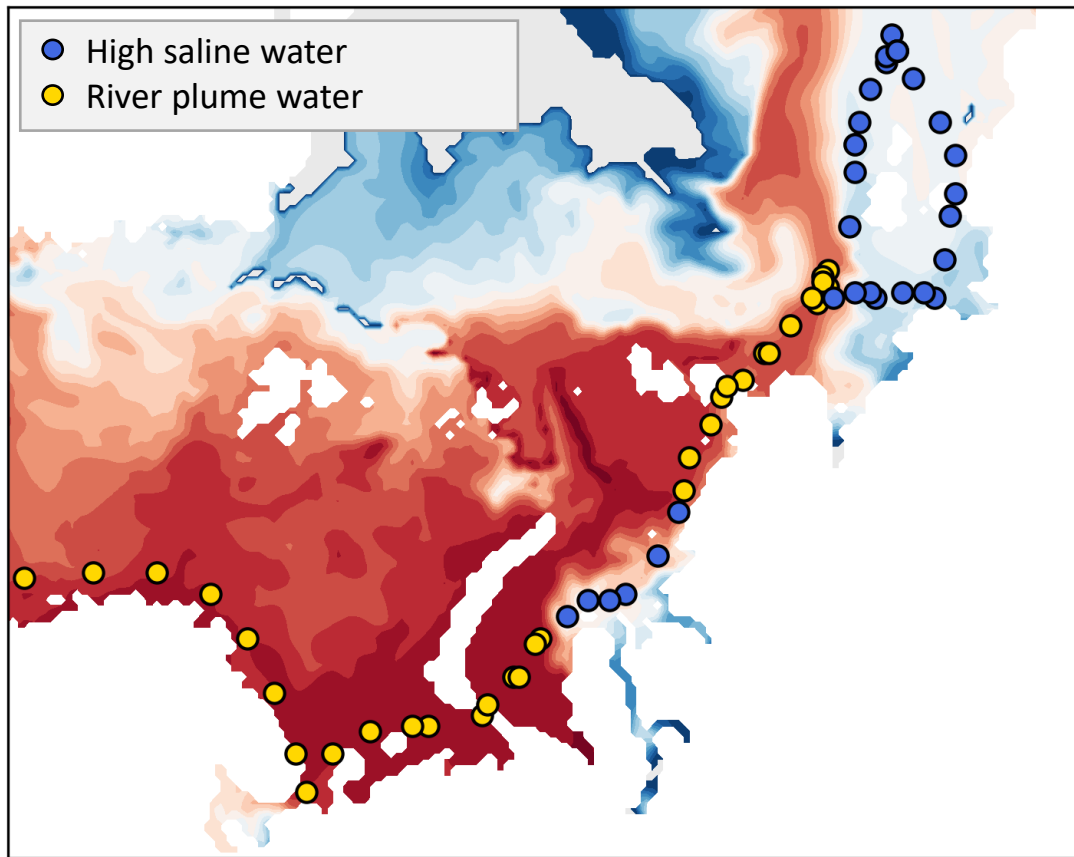
Higher MPs concentrations correspond to MPs from Atlantic Ocean.

MP_{free} , mg/m^3



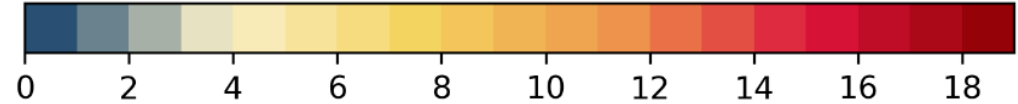
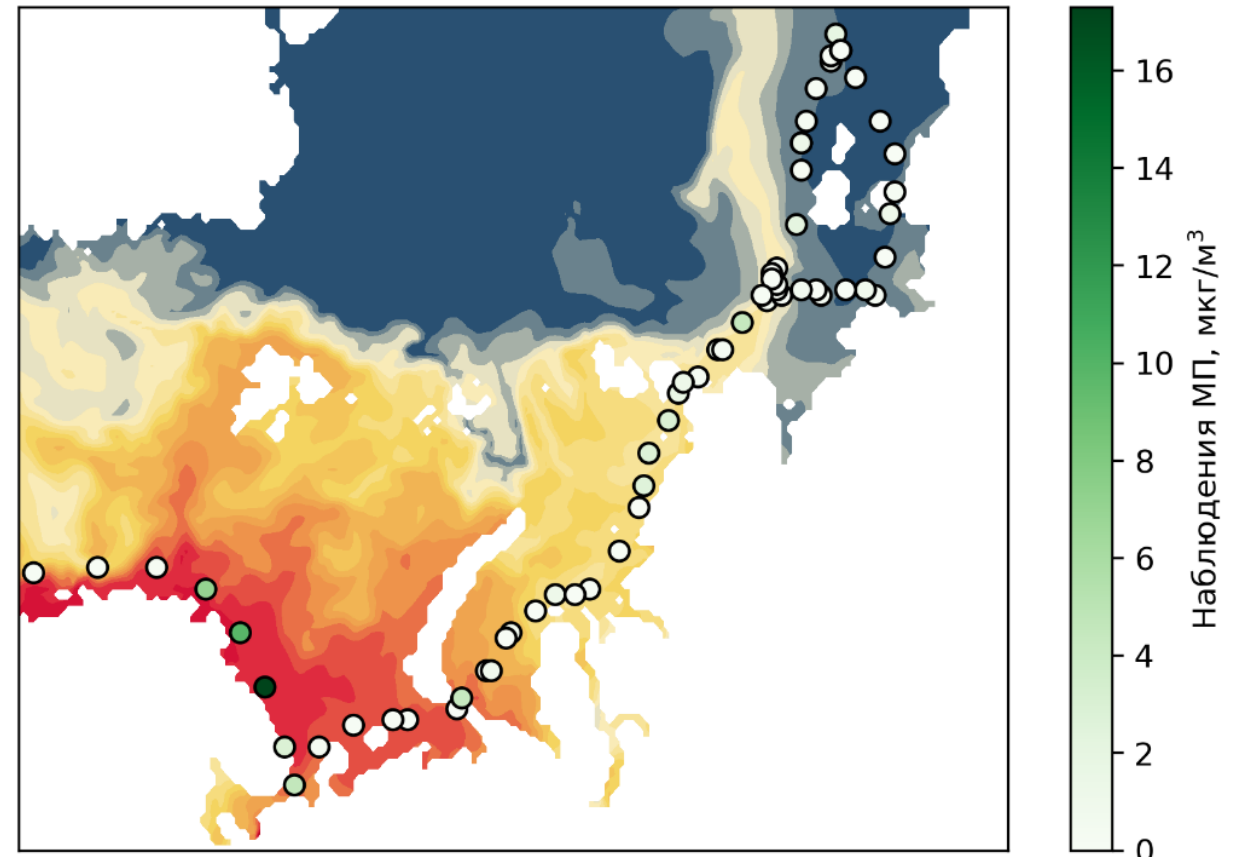


(Yakushev et al. 2021, Pakhomova et al. 2022, Zhdanov et al. 2022)



Riverine MP prevail

Atlantic MP prevail

MP_free, $\mu\text{g}/\text{m}^3$

(Yakushev et al. 2021, Pakhomova et al. 2022)

Future plans

- MPs source from Pacific Ocean
- MPs from maritime activity in Barents Sea
- MPs transport with ice

Thank you for your attention!



Berezina, A., Yakushev, E., Savchuk, O., Vogelsang, C., Staalstrom, A., 2021. Modelling the Influence from Biota and Organic Matter on the Transport Dynamics of Microplastics in the Water Column and Bottom Sediments in the Oslo Fjord. *Water* 13, 2690. <https://doi.org/10.3390/w13192690>