High-resolution modelling of marine biogenic aerosol precursors in the Arctic realm

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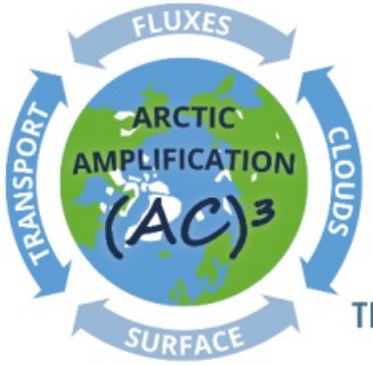

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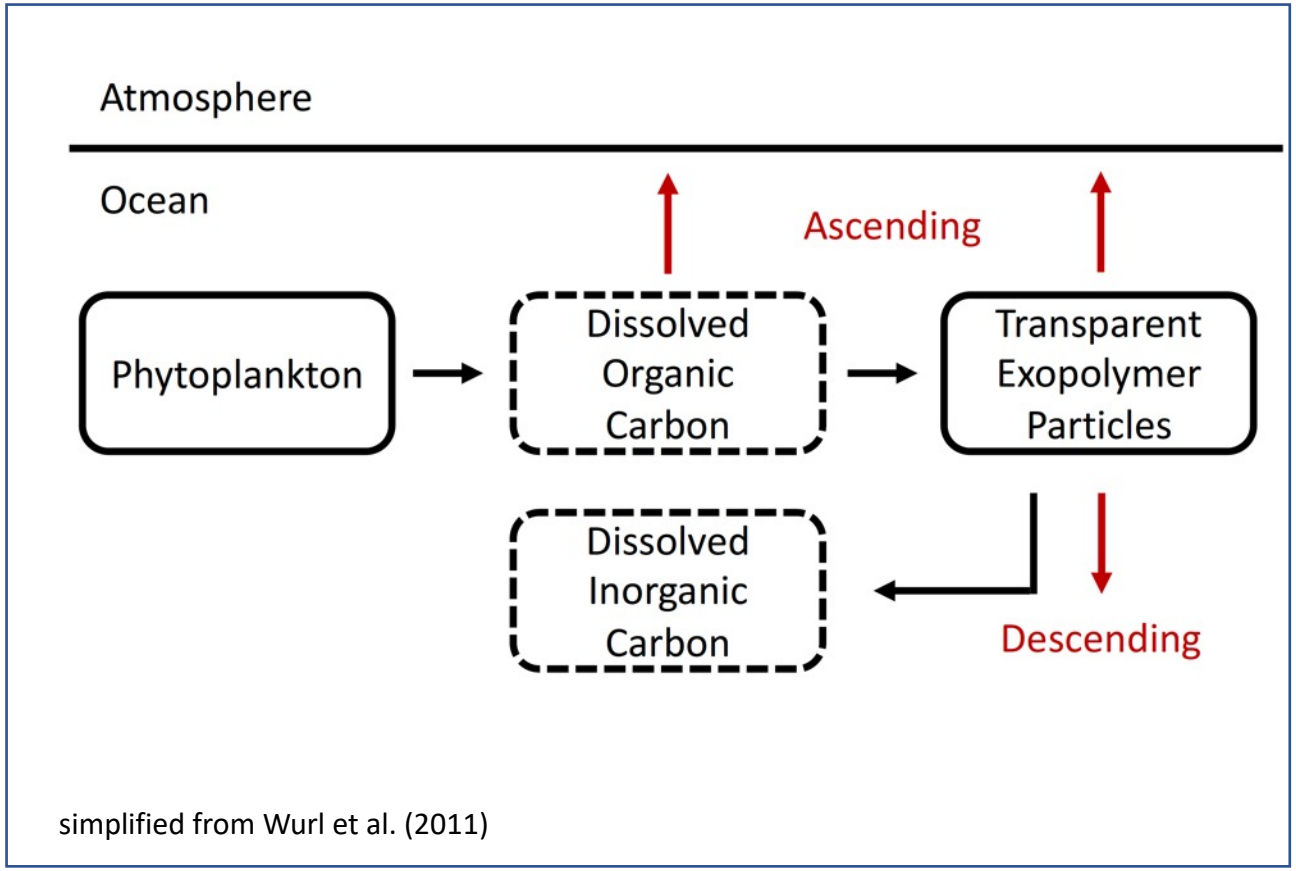
Biogenic aerosols in remote regions



simplified from Wurl et al. (2011)

- important aerosol source: biogenic ice-nucleating particles (Wilson et al. 2015; Hartmann et al., 2020)
- free sugars or TEP as tracers (Zeppenfeld et al., 2019; Park et al., 2019)
- FESOM2 (Danilov et al., 2017; Koldunov et al., 2019; Scholz et al., 2019) coupled to REcoM2 (Schourup-Kristensen et al., 2018; Hauck et al., 2020)
- addition of particle aggregation (Thoms, 2006; Schartau et al., 2007)
- approx. 4 km resolution
- 2000-2019 monthly output

ArctiC Amplification: Climate Relevant Atmospheric and SurfaCe Processes and Feedback Mechanisms (AC)³

Succession of blooming and TEP formation

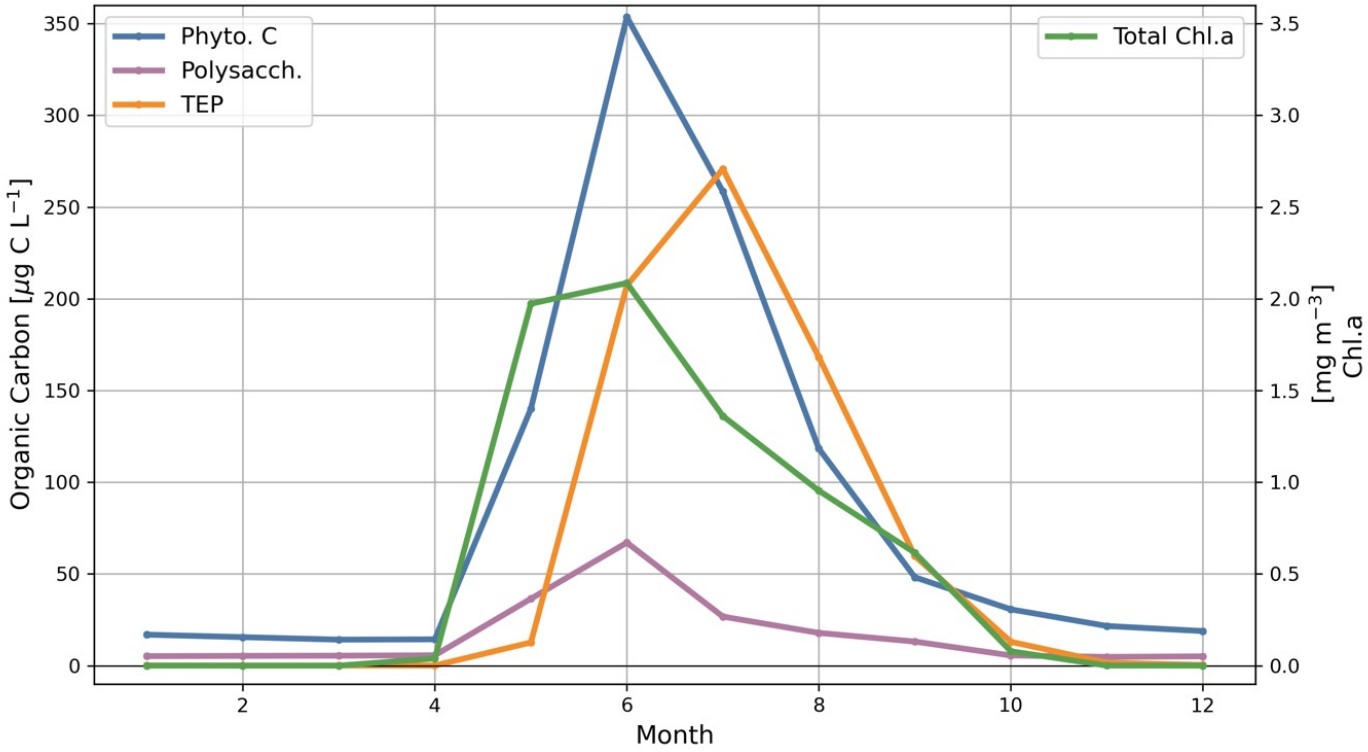
Phytoplankton Carbon

↓

Polysaccharides (dissolved)

↓

TEP (particulate)



Eastern Fram Strait, 2002-2012, vw-mean 0-30 m

- model data as 10-years mean for Eastern Fram Strait
- blooming: increase of phytoplankton Carbon (blue) and Chl.a (green)
- subsequent excretion of dissolved organic carbon, partly as polysaccharides
- aggregation to TEP
- remineralisation in autumn

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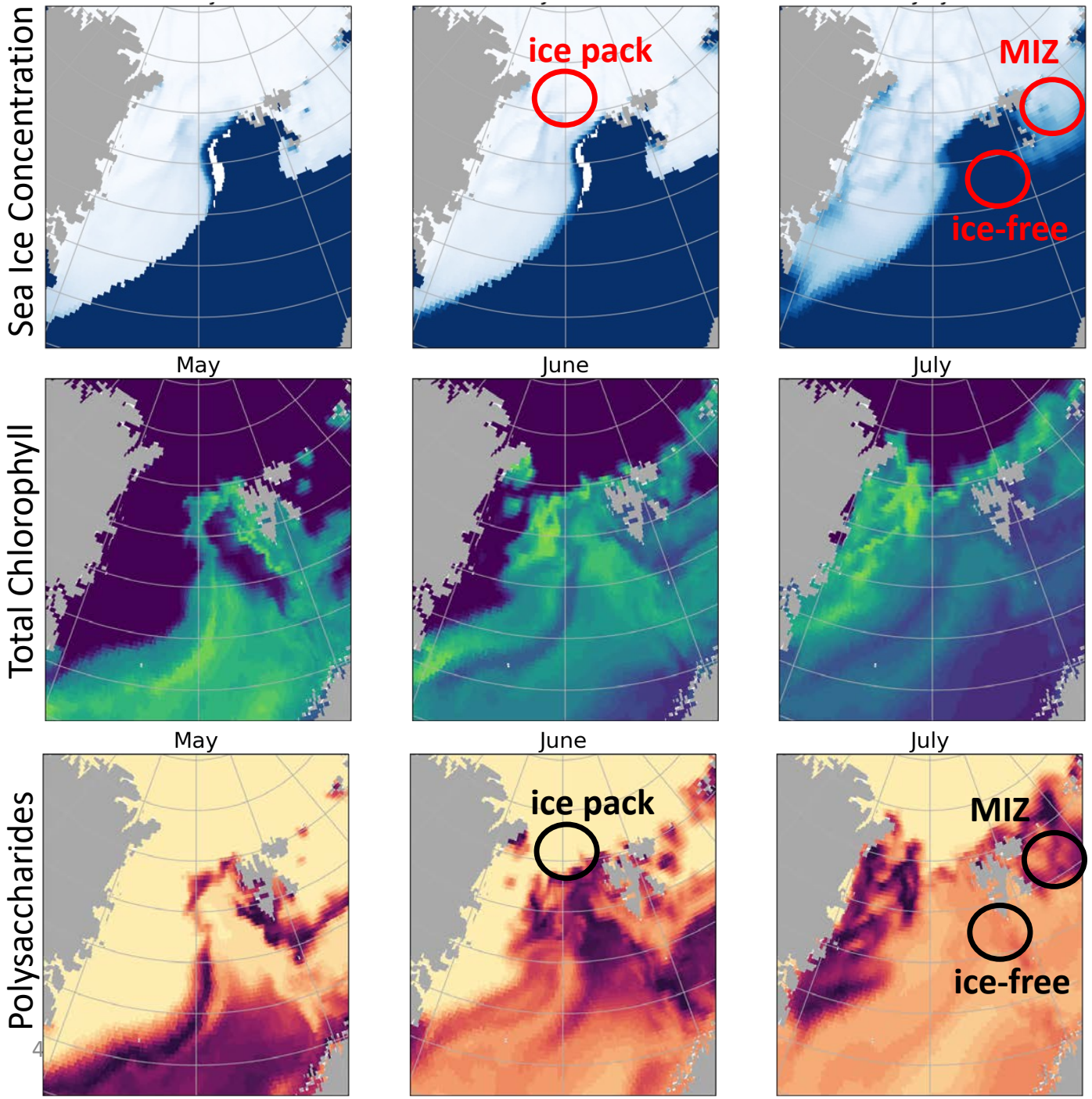
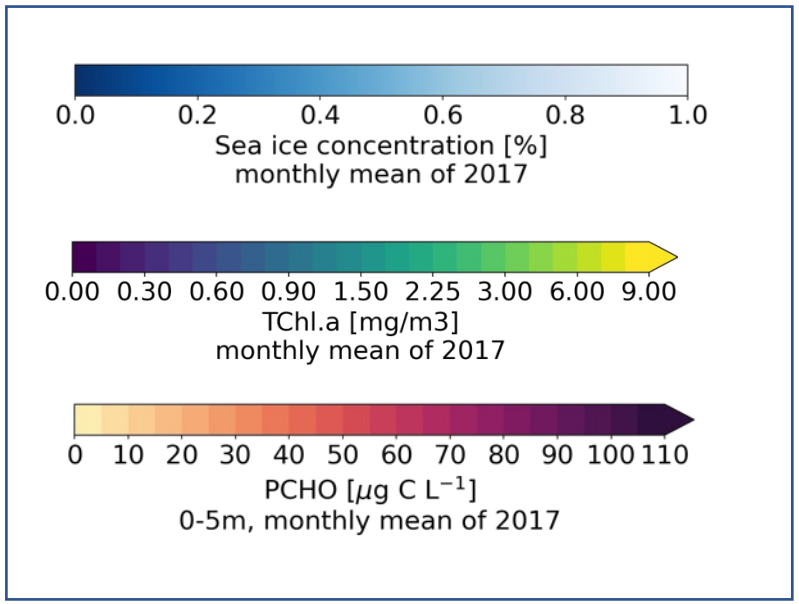
Polysaccharides





Campaign data of PASCAL, June-July 2017
Zeppenfeld et al. (in prep)

	#	µg C/L	
ice pack	22	**11.6**	**± 9.8**
marginal ice zone	5	**51.1**	**± 37.0**
ice-free ocean	4	**17.2**	**± 5.2**

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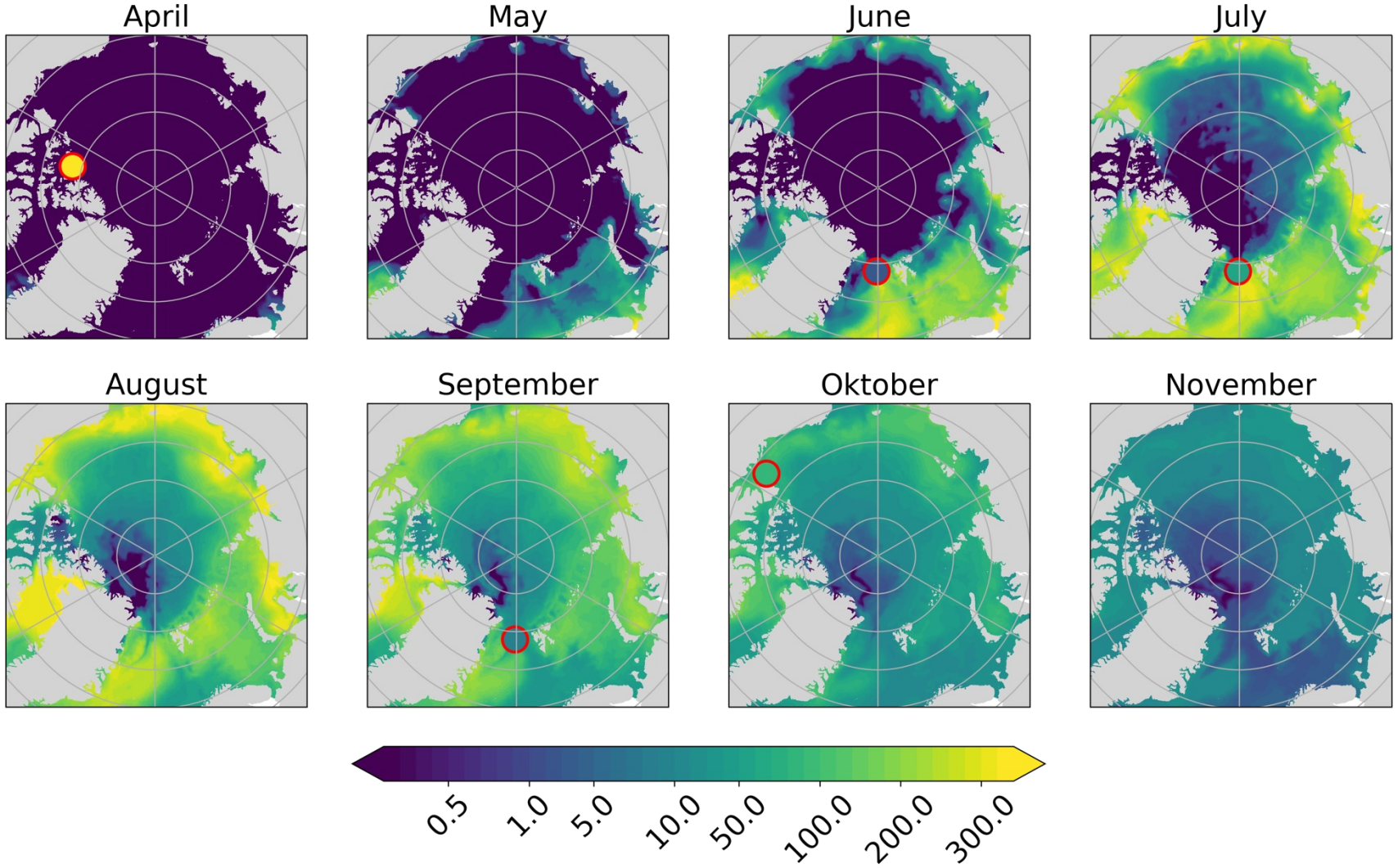
TEP (monthly mean)



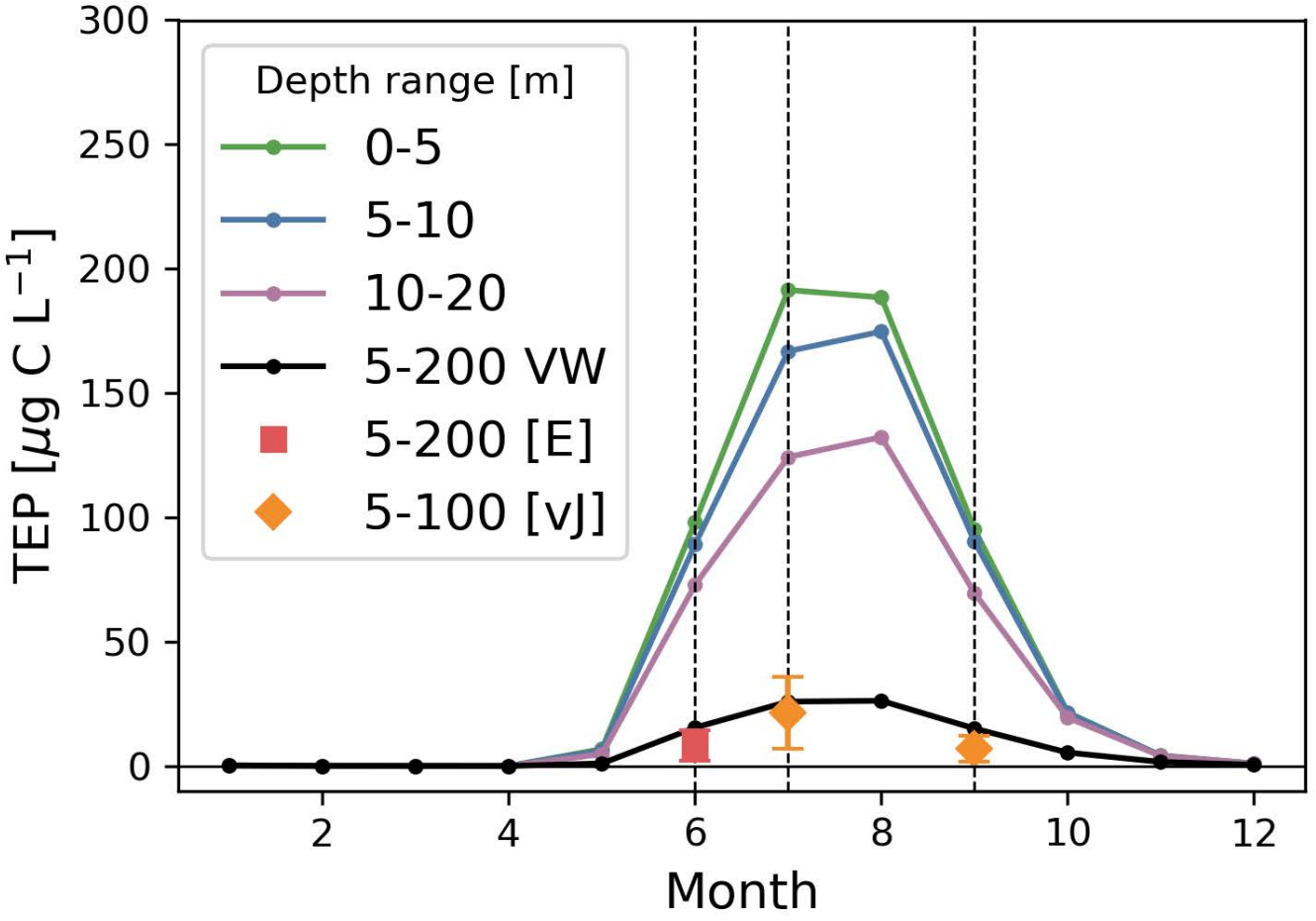
Volume-weighted mean of TEP (0-30 m) of 2009-2019

Observations

Apr: W11 (0-20m): **405** µg/L
Jun: E20 (5-200m): **8** µg/L
Jul: vJ20 (10-30m): **30** µg/L
Sep: vJ20 (5-30m): **9** µg/L
Oct: W11 (0-20m): **141** µg/L

Engel et al. (2020)
von Jackowski et al. (2020)
Wurl et al. (2011)

Comparison of TEP in Fram Strait

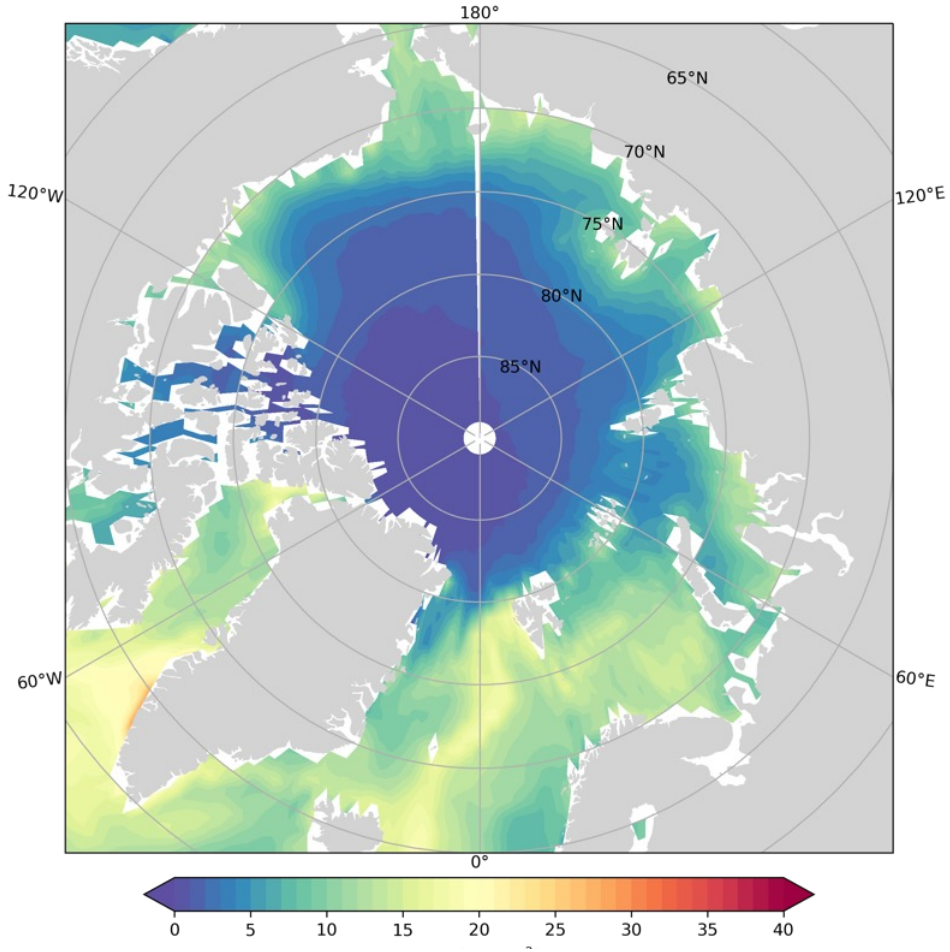


Fram Strait, 2005-2015

- model data as 10-years mean of Fram Strait
- clear seasonal cycle
- strong decrease of TEP with depth
- volume-weighted mean of model data (black) fits to observation data points (red, orange)
- model has no surface microlayer, but TEP would be enriched there

Engel et al. (2020)
von Jackowski et al. (2020)

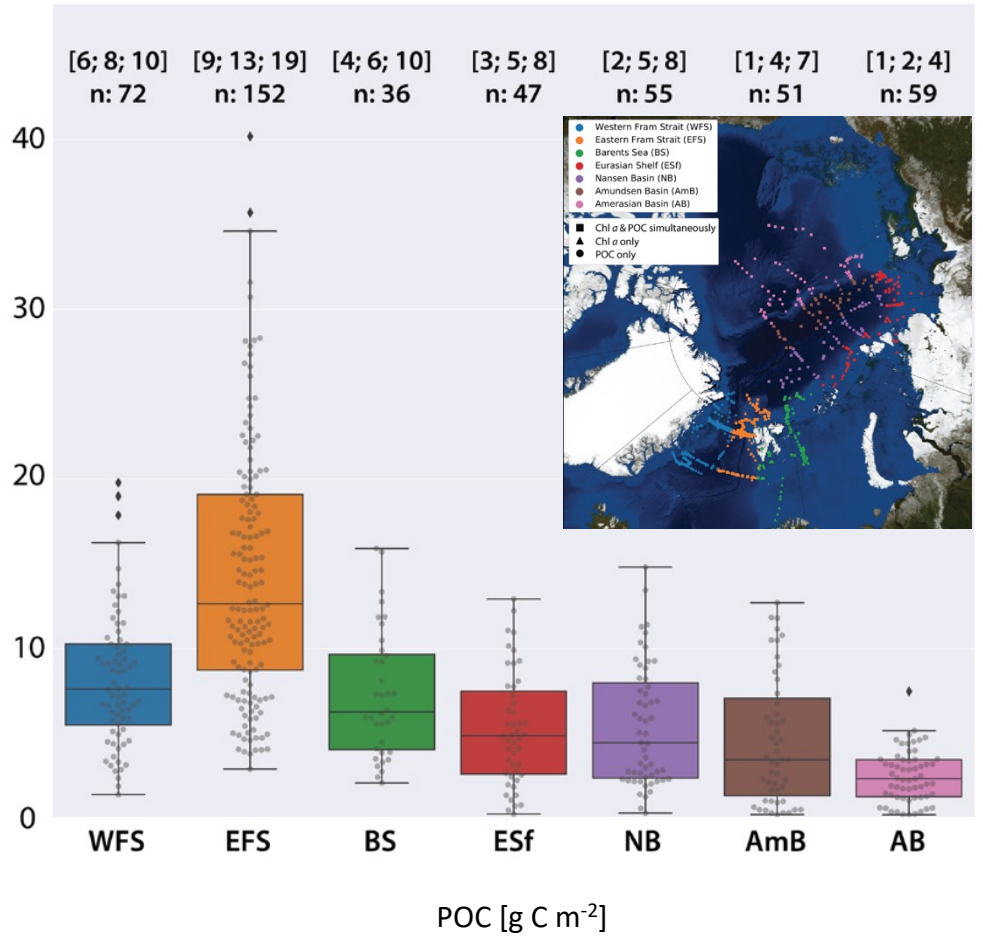
Validation: Particular Org. Carbon



POC [g C m^{-2}]

Integrated over 0-100m, mean May-Sept, 2005-2015

Sum of model variables PhyC, DiaC, Detritus Zoo1 & Zoo2, TEP



POC [g C m^{-2}]

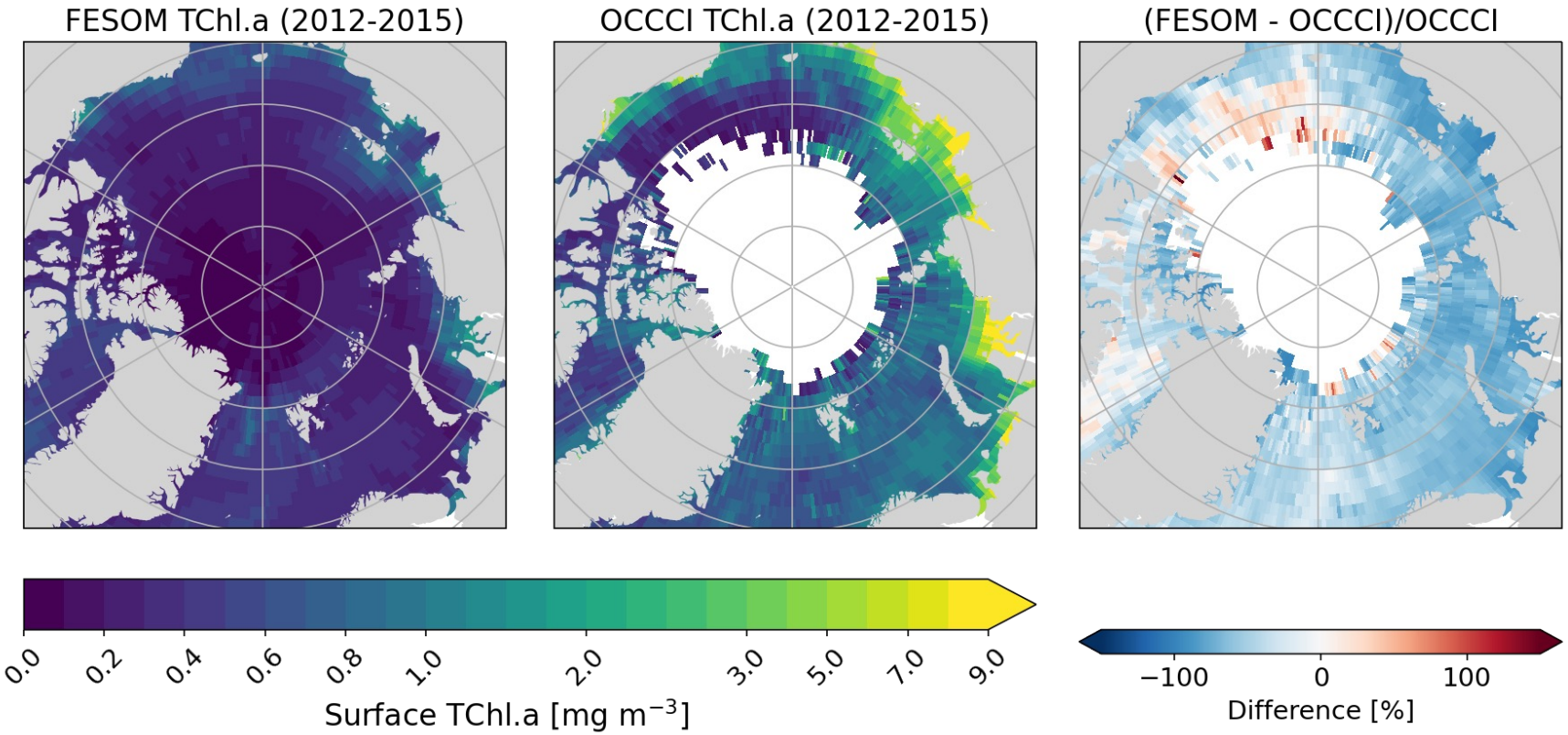
Integrated over 0-100m, mean May-Sept, 1991-2015

WFS (EFS): Western (Eastern) Fram Strait, a.o.

modified from Nöthig et al. (2020)

- model data in good comparison with observed data
- Western Fram Strait (WFS) lower than Eastern (EFS) also in model
- Amerasian Basin (AB) also lowest in model

Validation: Model and OC-CCI Total Chl.a



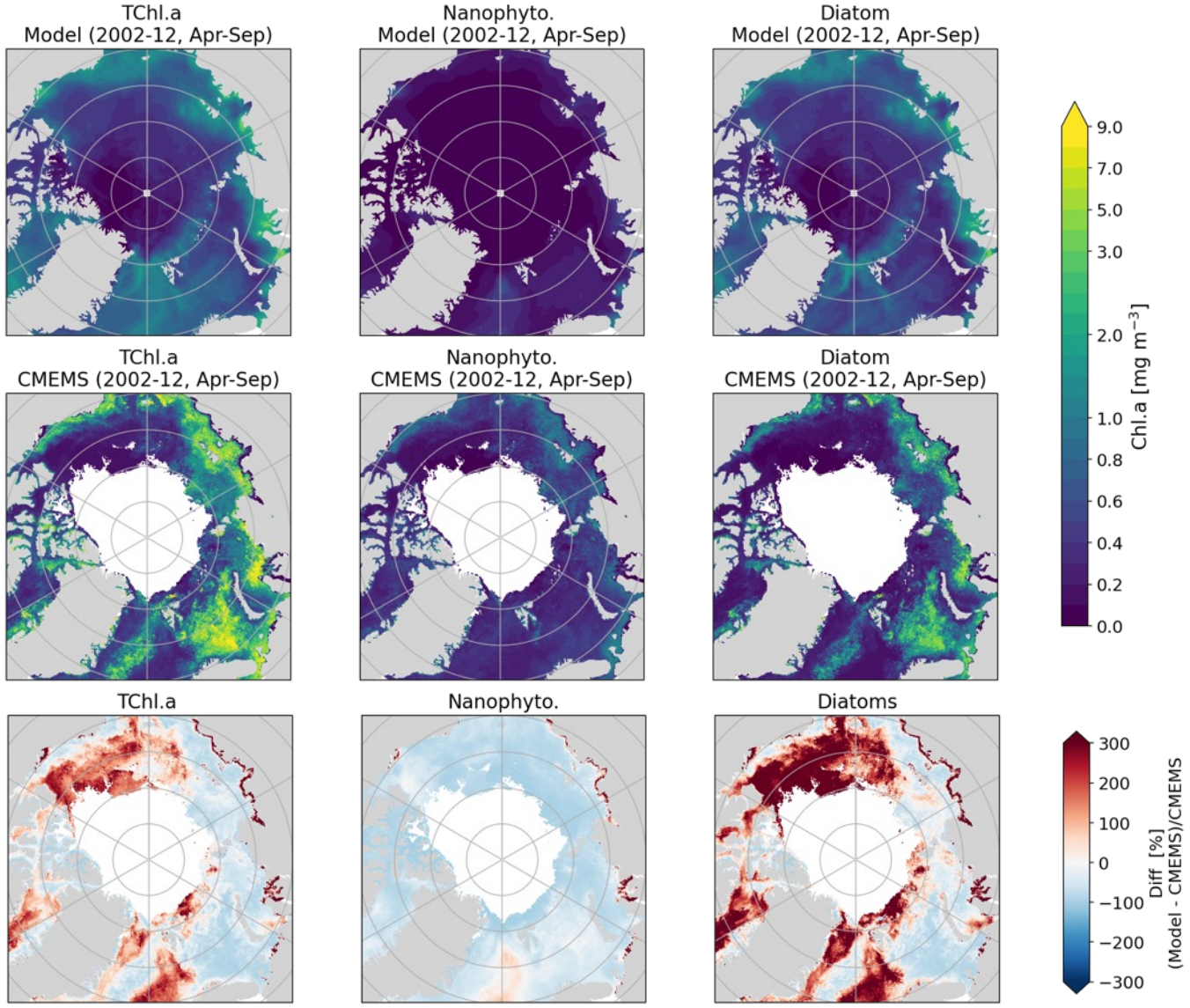
- model data as 10-years mean
- Model Total Chl.a is lower than OC-CCI provides
- Model Total Chl.a only in Canada Basin slightly elevated

Validation: Model and CMEMS Chl.a

Model

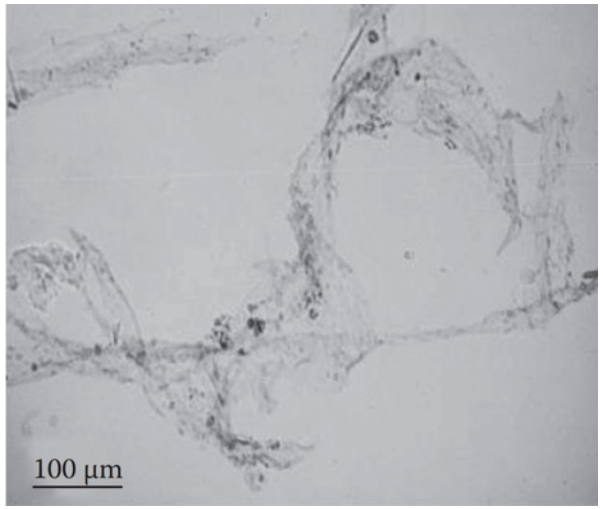
CMEMS
(Arctic reanalysis product)

DIFF



- model data as 10-years mean of summer season
- seperation of Total Chl.a into Chl.a of two modelled phytoplankton groups
- slightly lower model nanophytoplankton Chl.a
- model diatom Chl.a high especially in Canada Basin, but there also highest CMEMS errors

Summary



Engel et al. (2009)

1. **FESOM2-REcoM2** represents phytoplankton blooms and Organic Carbon dynamics well.
2. Model can contribute to **fill gaps** of observation.
3. Marine snow is not only falling “down”, important tracer for **biogenic aerosol precursors**.

Check out accompanying project of Anisbel Leon et al. (EGU22-8559) in AS2.13:
Modelling marine organic aerosol and its impact on clouds in the Arctic

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ArctiC Amplification: Climate Relevant Atmospheric and SurfaCe Processes and Feedback Mechanisms (AC)³

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