

Detecting changes in ocean production and plankton diversity in polar regions through improved regional Earth observation capacity



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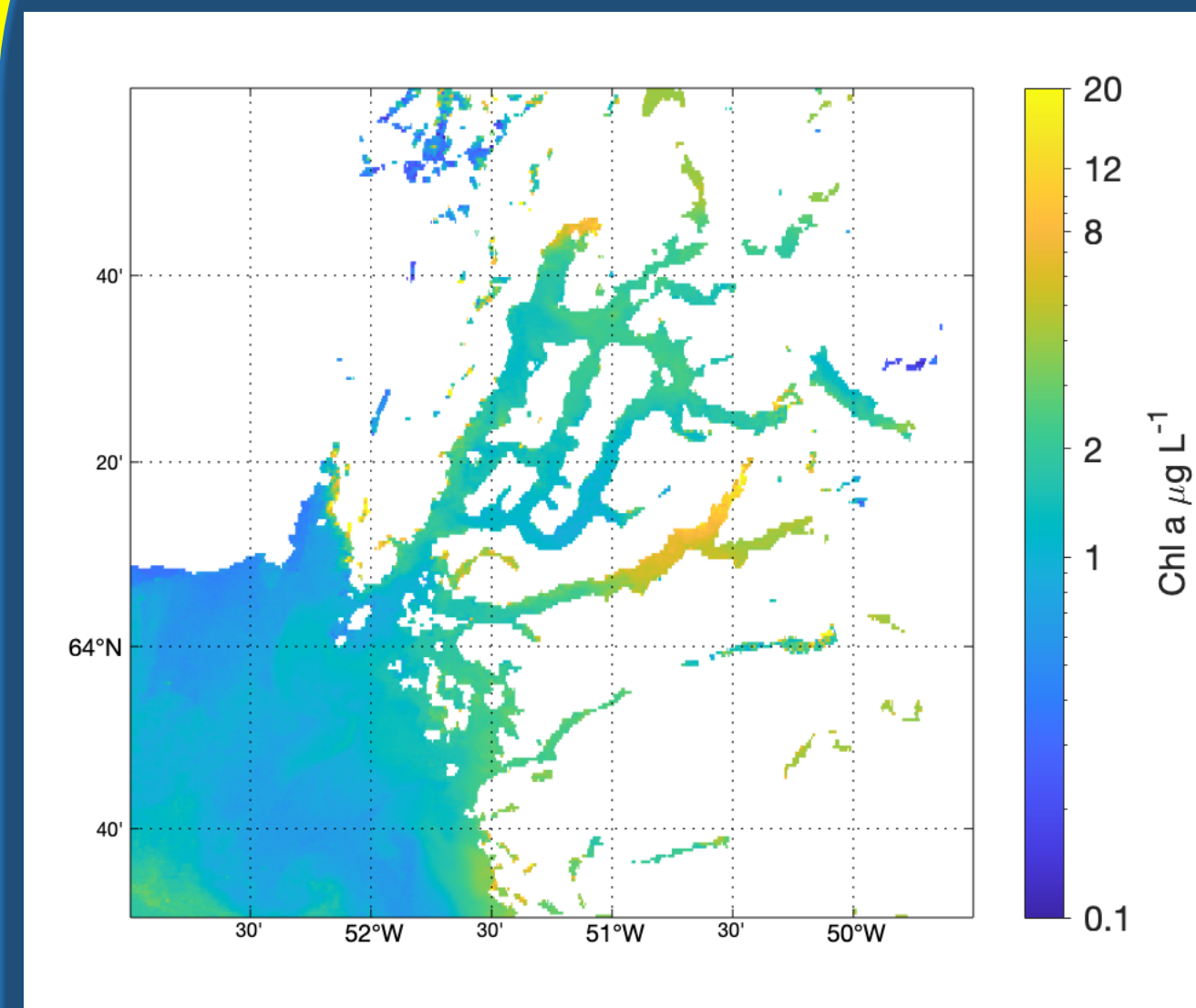
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Assessing Sentinel-3 Chl-a products for Nuup Kangerlua (Nuuk Fjord)



Example of a daily Chl-a map for 29 July 2021

Data Source: OLCI Sentinel-3 Chl-a retrievals.

Study Area: Nuup Kangerlua (Nuuk fjord)

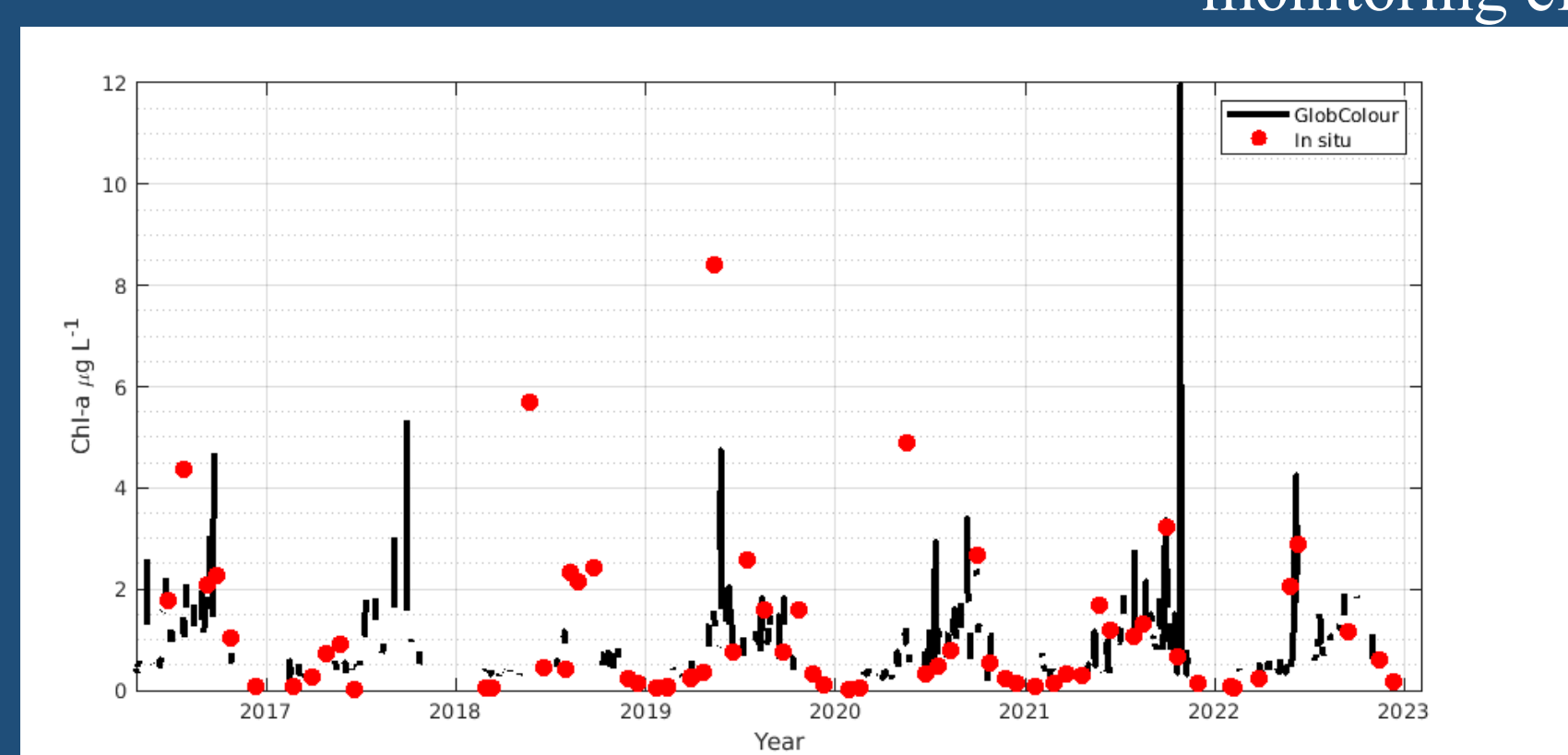
Data Access: <https://doi.org/10.11583/DTU.24649818>

Key Challenges:

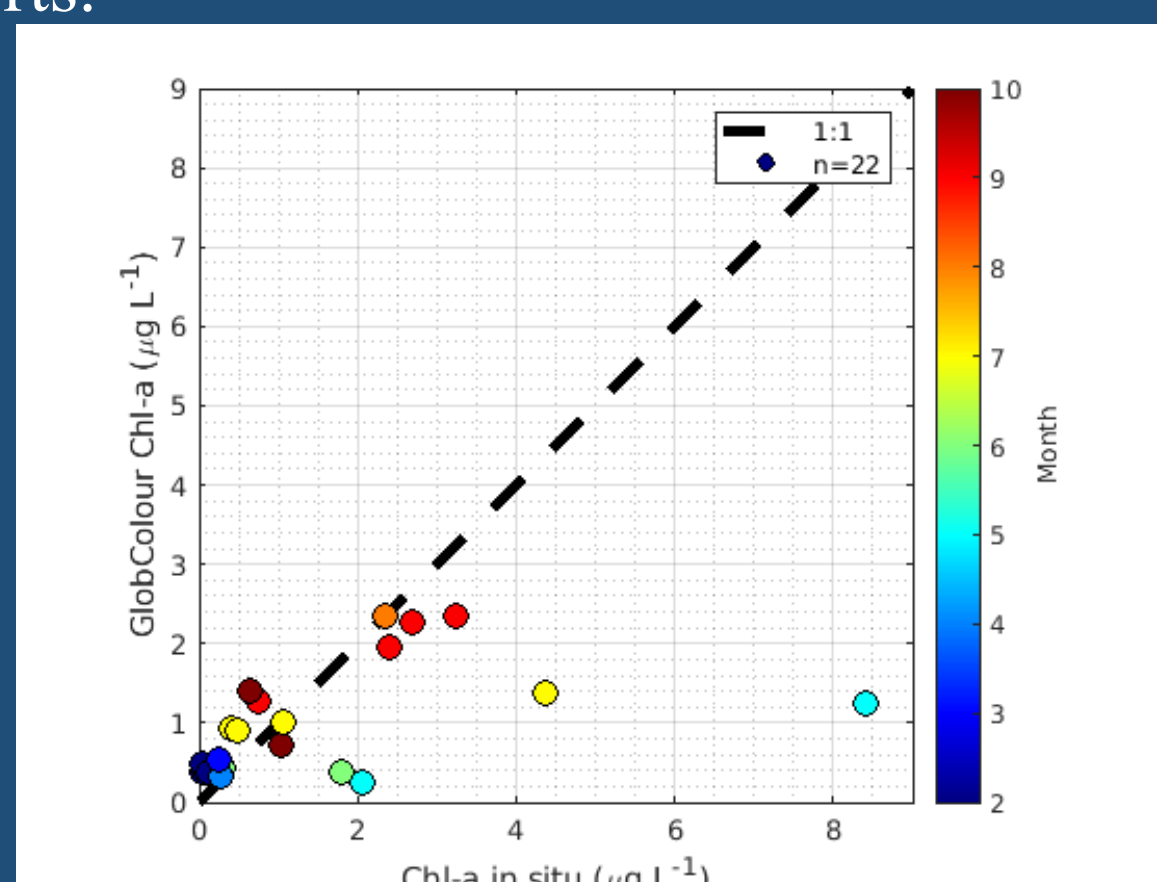
Early Season Underestimation: Presence of deep Chl-a maxima, which are not captured effectively by the satellite sensors.

Late Season Overestimation: Glacial flour—fine sediment particles from glacier meltwater—confuses retrieval algorithms, resulting in overestimated Chl-a levels.

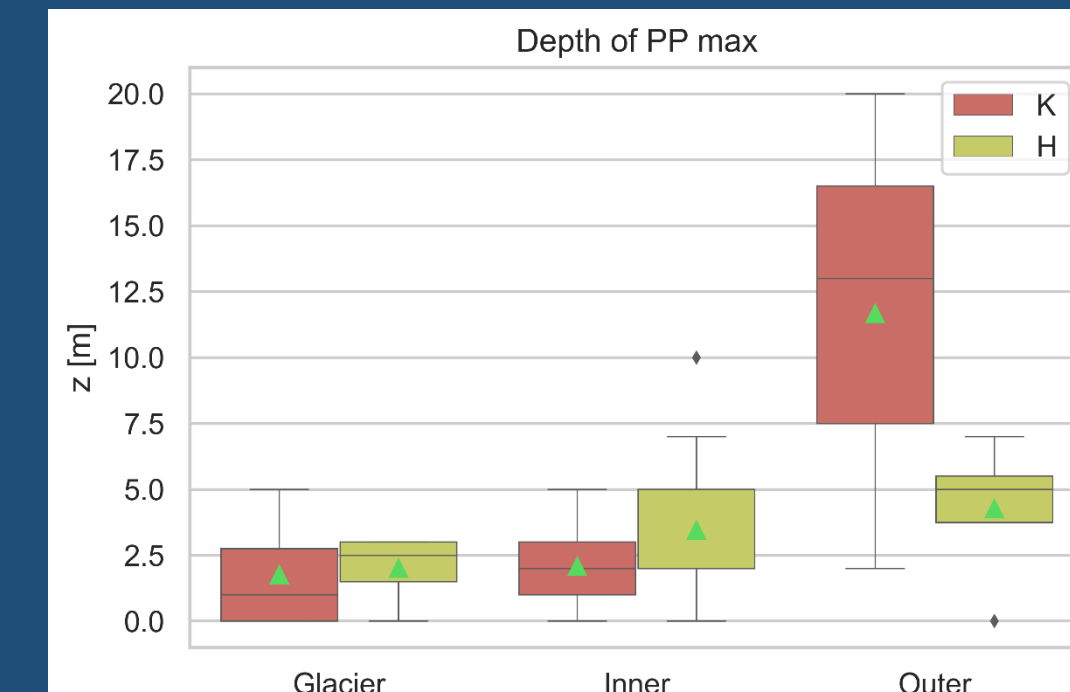
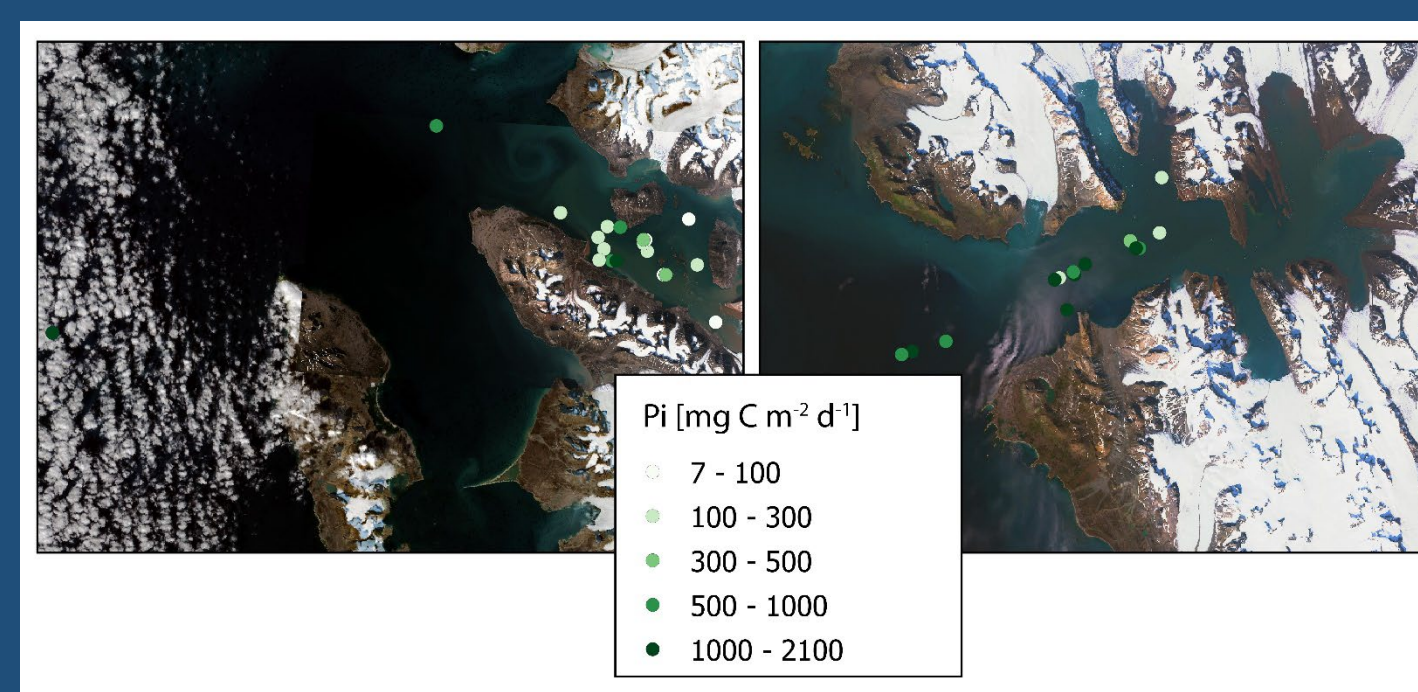
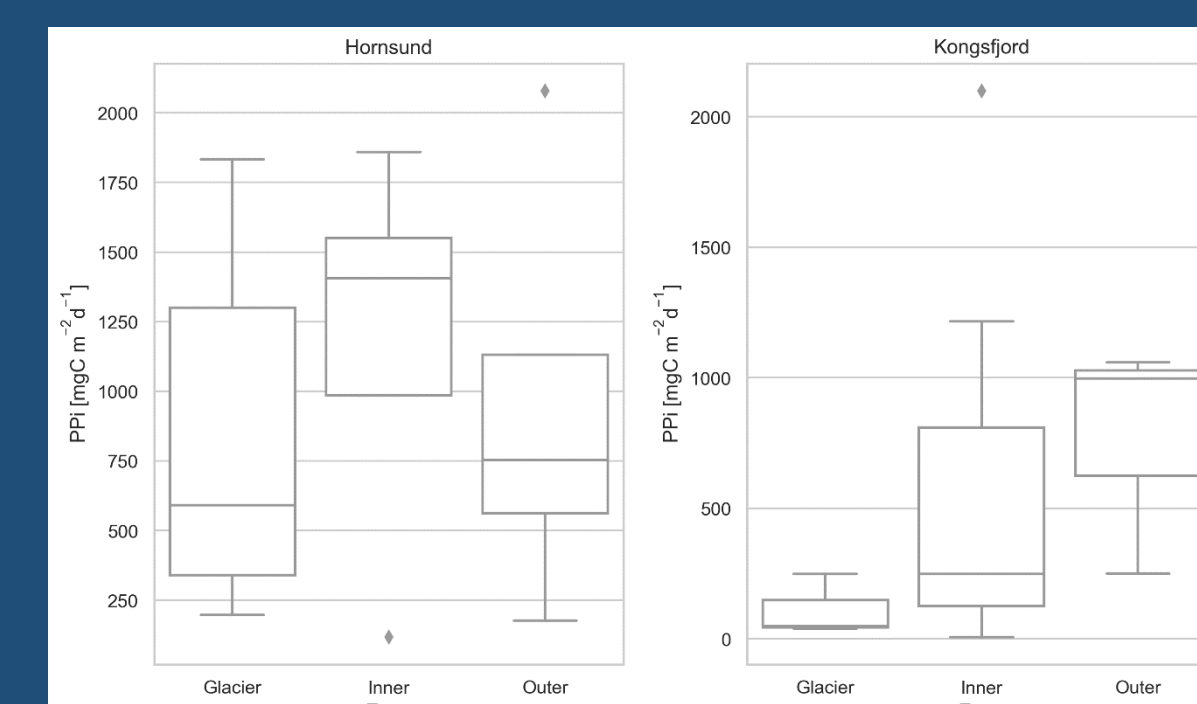
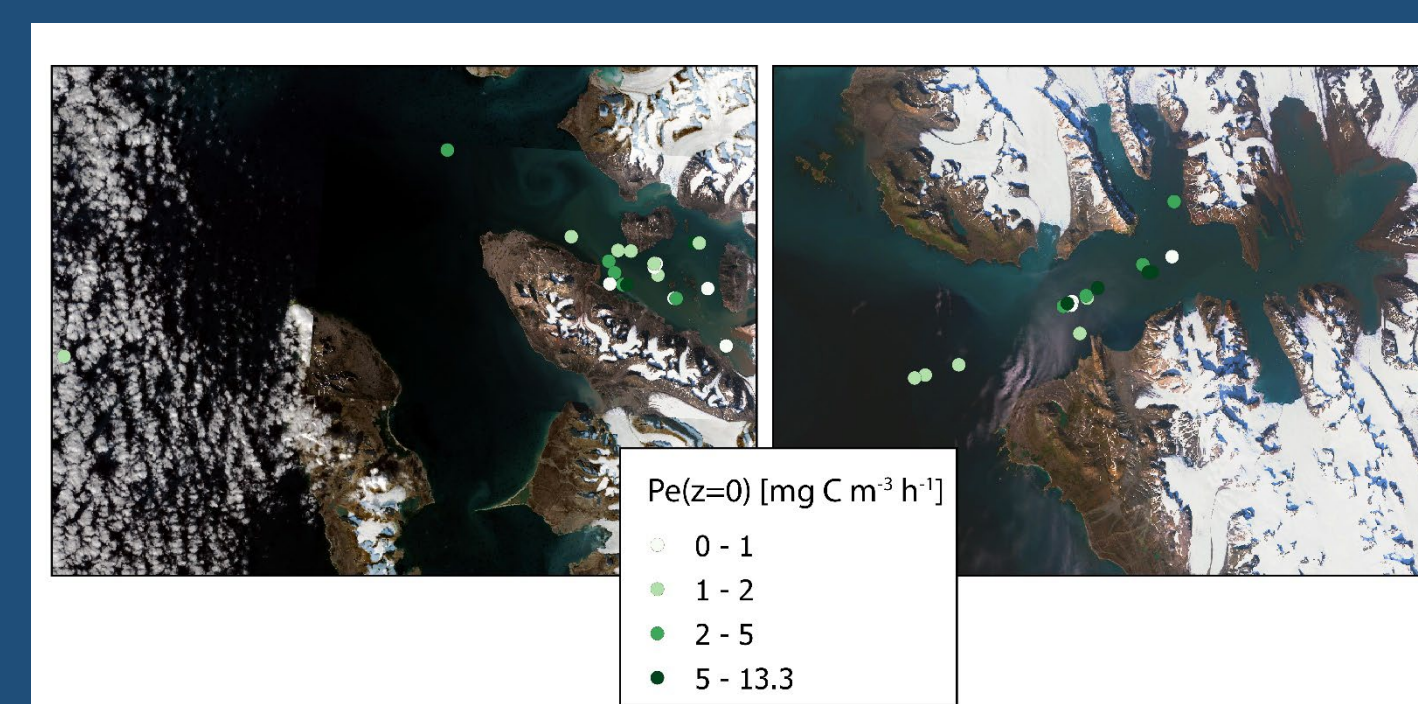
The way forward: Implementing region-specific algorithms, applying machine learning, and utilizing higher-resolution data from Sentinel-2 represent promising pathways for improving future satellite-based monitoring efforts.



This time series show daily data (not week or monthly averages) only for the point where the monitoring program takes their monthly water sample in Outside Nuuk



Productivity of Spitsbergen fjords ecosystems in summer – spatial changes of *in situ* primary production in Kongsfjorden and Hornsund in the period 1994-2019



- ❑ Glacier meltwater impact on primary production, especially in the glacier zones
- ❑ Hornsund demonstrated higher productivity compared to Kongsfjorden
- ❑ In Kongsfjorden, the most productive area was identified as the outer shelf, while in Hornsund, the highest productivity was observed in the inner part
- ❑ Noticeable gradient in the depth of maximum primary production, increasing toward the fjord mouth, with Kongsfjorden showing more dynamic variations compared to Hornsund

Dragańska-Deja, K., Stoń-Egiert, J., Wiktor, J., & Ostrowska, M. (2024). Productivity of Spitsbergen fjords ecosystems in summer—Spatial changes of *in situ* primary production in Kongsfjorden and Hornsund in the period 1994–2019. *Ecology and Evolution*, 14, e11607. <https://doi.org/10.1002/ece3.11607>

Pigments changes in the Arctic over past 20 years

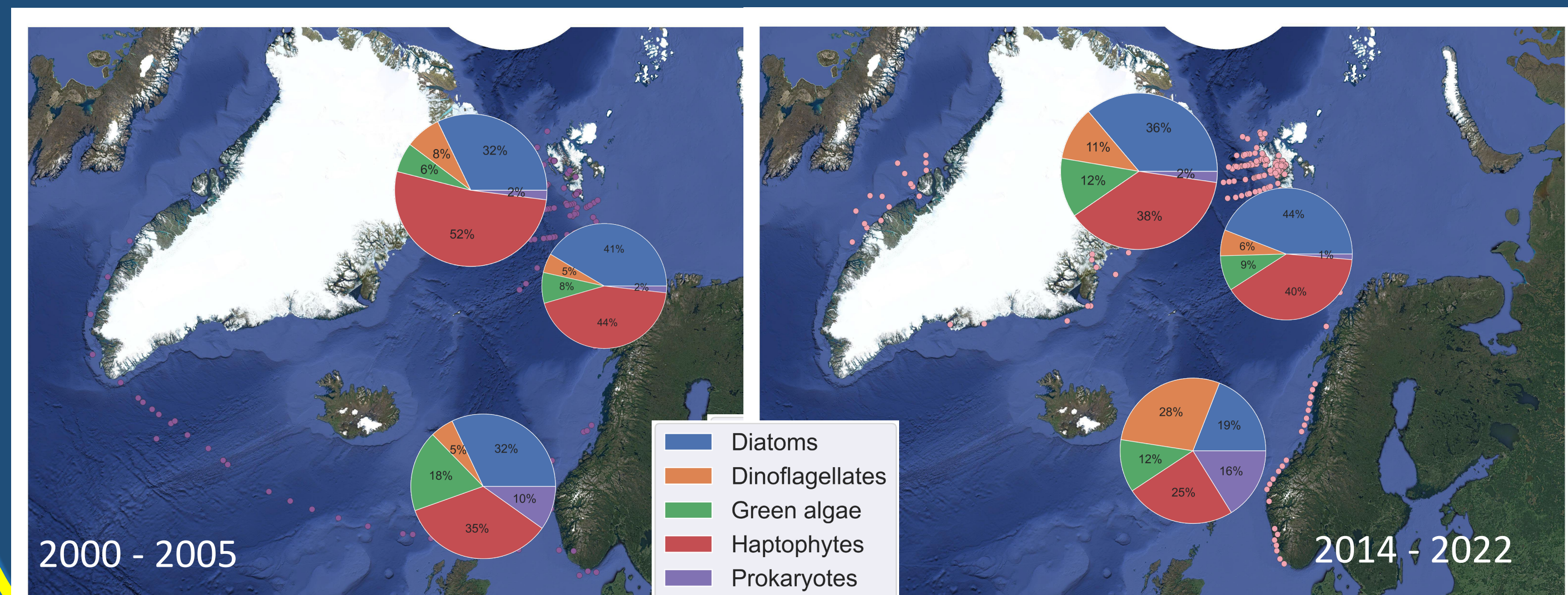
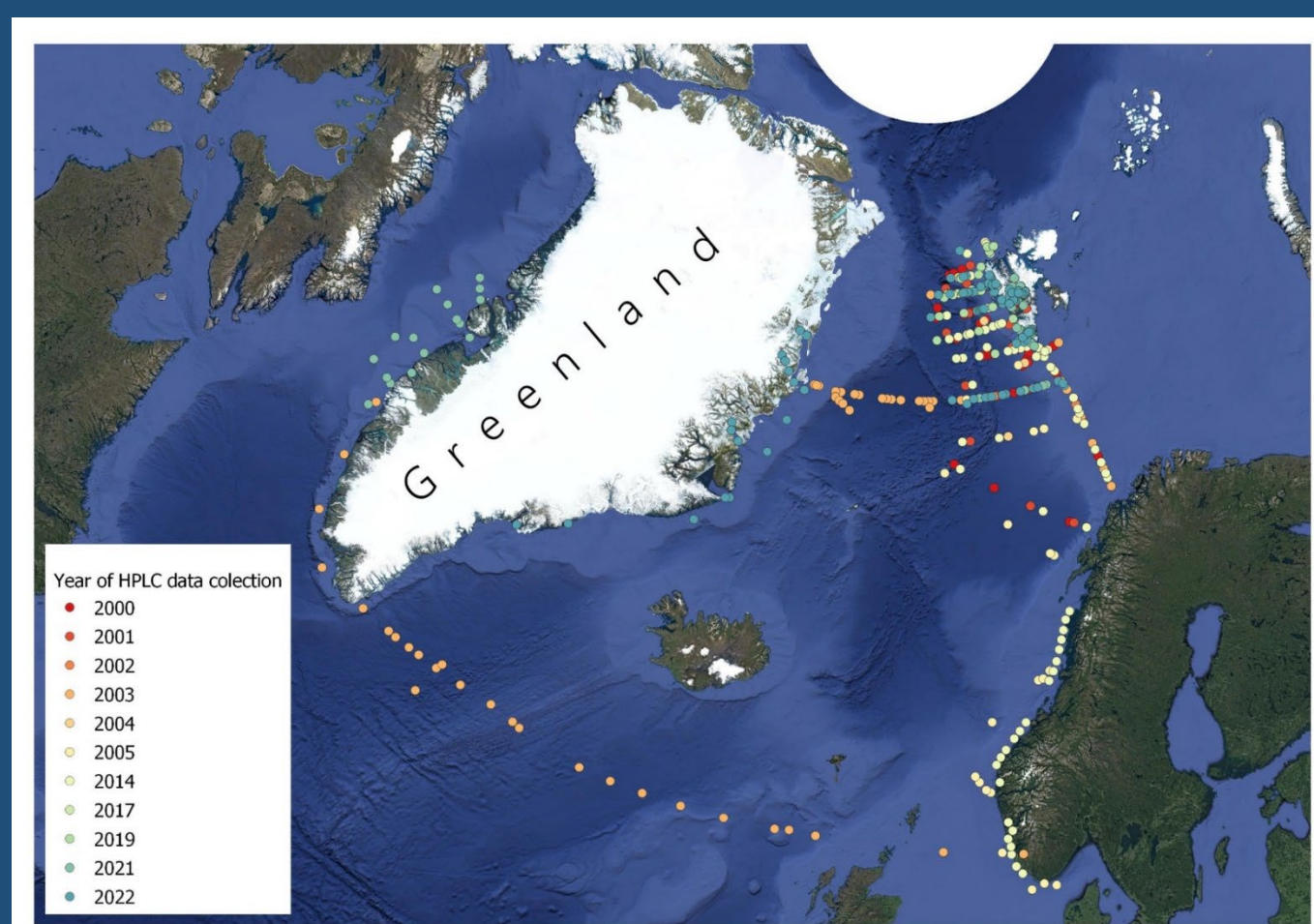
898 – samples (2000-2022)
496 – samples collected on surface

2000 – 2005
353 samples
189 surface samples

2014 – 2022
545 samples
312 surface samples

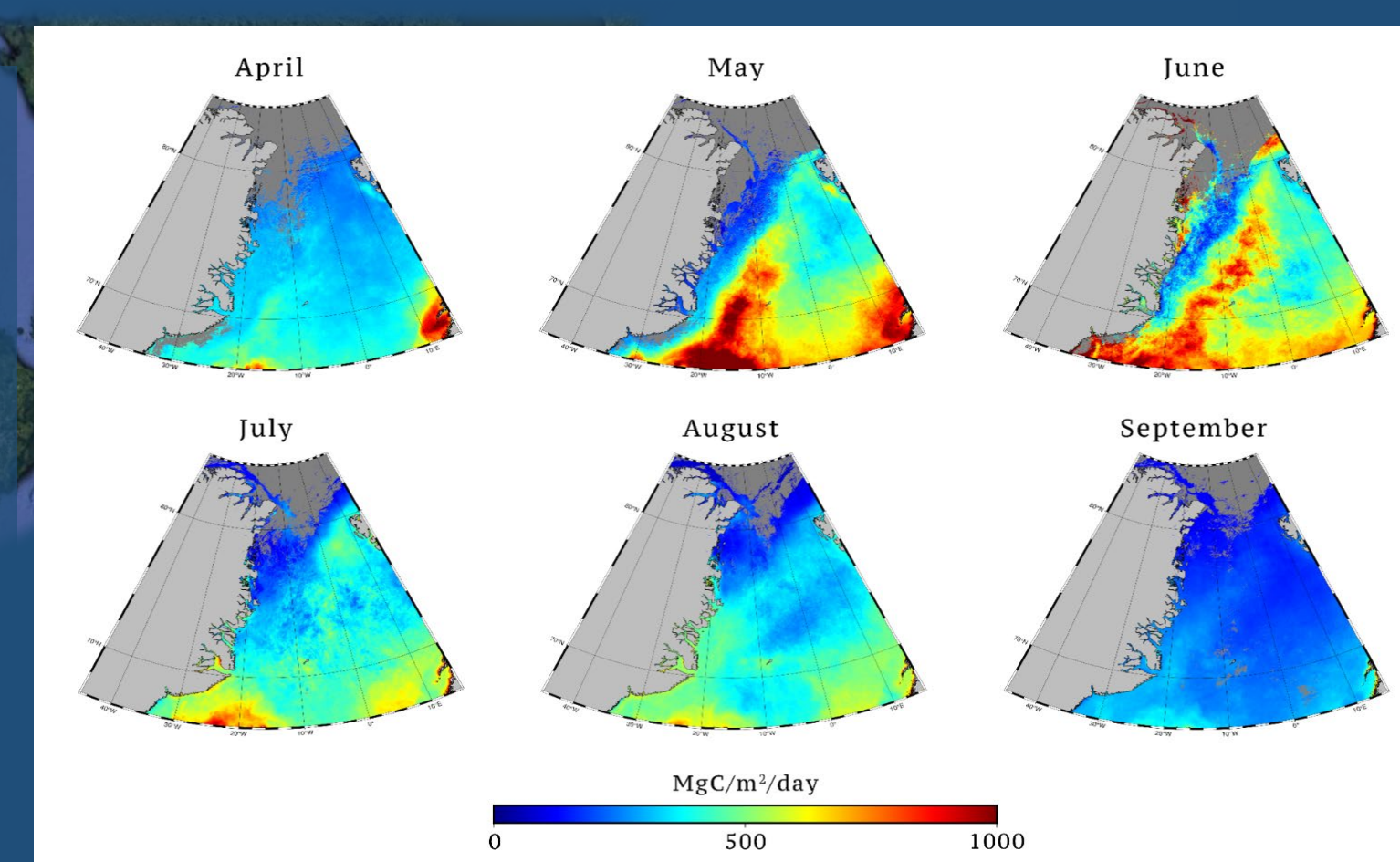
87 matchups with satellite data! With our matchup sets, we can develop a local algorithm of phytoplankton functional types in the Arctic region.

- ❑ Strong latitudinal phytoplankton species composition gradients
- ❑ Restructuring of the plankton community composition in last two decade
- ❑ Newly available dataset with satellite match-ups exhibits potential for significantly improving existing capacity to model changing distributions of phytoplankton functional types from space



Greenland Sea primary production in 1998–2022: monitoring and parameterization using satellite and field data

Cherkasheva, A., Manurov, R., Kowalczyk, P., Loginova, A. N., Zabłocka, M., and Bracher, A.: Greenland Sea primary production in 1998–2022: monitoring and parameterization using satellite and field data, *EGU sphere* [preprint], <https://doi.org/10.5194/egusphere-2023-2495>, 2023.



	This study	Hill et al. (2013)	Arrigo and van Dijken (2015)	Ardyna et al. (2013)
period	1998-2022	1998-2007	1998-2012	1998, 2007
annual (TgC/year)	330-346	308	136	228-230
monthly range (TgC/month)	33-77	13-122	ND	ND

Why is it larger? possible reasons:

- account for local and not Arctic dataset (5 points vs 45 points),
- more spatial coverage in the northern part,
- account for CHL maximum (n.a. for Hill et al, 2013)

- ❑ Algorithm is operational with Python codes uploaded online and can be expanded to 2023 and later
- ❑ Accuracy of the selected model setups to reproduce the field data in terms of RMSD (RMSD=0.4) is better than in the related Arctic studies (RMSD=0.61-0.67)*. Still, Arctic is more challenging for modelling than most parts of WO, and RMSD is poorer than for the related global studies (RMSD=0.3).
- ❑ Model versions that performed best when validated against field data included local chlorophyll-a profile and local absorption spectrum in their setup and used Level 2 PAR data as input. In terms of choice of chlorophyll input data and integration depth there was no dependency

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