

The Marine Light Climate in a Changing Ocean

Photo: Trine-Lise Sviggum Helgerud



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Underwater light availability is important for marine ecosystems and is currently changing due to sea ice decline and increased freshwater run-off. I investigate this using numerical modelling and measurements linking optics with biogeochemistry and salinity.



The role of light in the ocean

Light is crucial for marine ecosystems. Marine photosynthesis contribute to more than half the global oxygen production. Most fish find food with visual search and can be out-competed in low-light environments. Despite their importance, are optical processes notoriously challenging to both observe and model.

Background and motivation

I did my PhD at UiB on scattering measurements in polar waters, from turbid glacial meltwater to clear waters on the North Pole. Afterwards, I've been a researcher with the Norwegian Polar Institute with field measurements that can help us better understand the role of light in marine ecosystems in the Barents Sea. This region is warming four times as fast as the global mean and is an important for fisheries. In my SEAS project, I will continue and expand upon this work towards Norwegian coastal waters and the central Arctic.

Main questions

- How has underwater light availability in the Barents Sea changed over the past four decades?
- What is the role of phytoplankton and run-off in the underwater light climate, compared to sea ice and cloud cover?
- Can simple sensors be used to estimate light extinction?

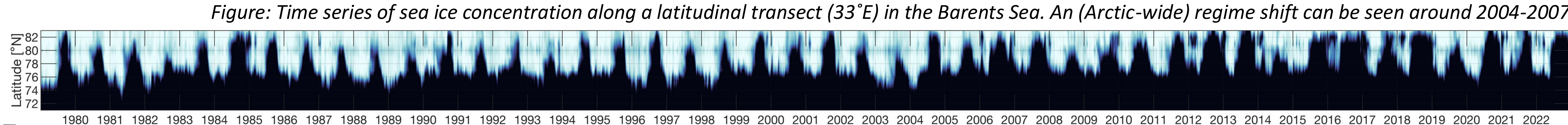


Figure: Time series of sea ice concentration along a latitudinal transect (33°E) in the Barents Sea. An (Arctic-wide) regime shift can be seen around 2004-2007.

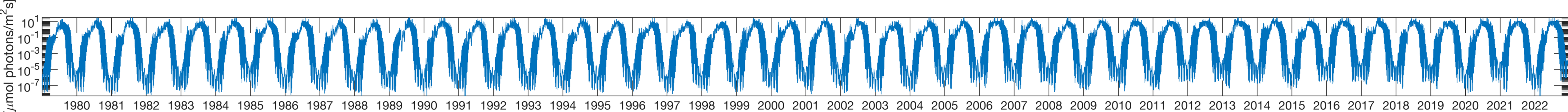
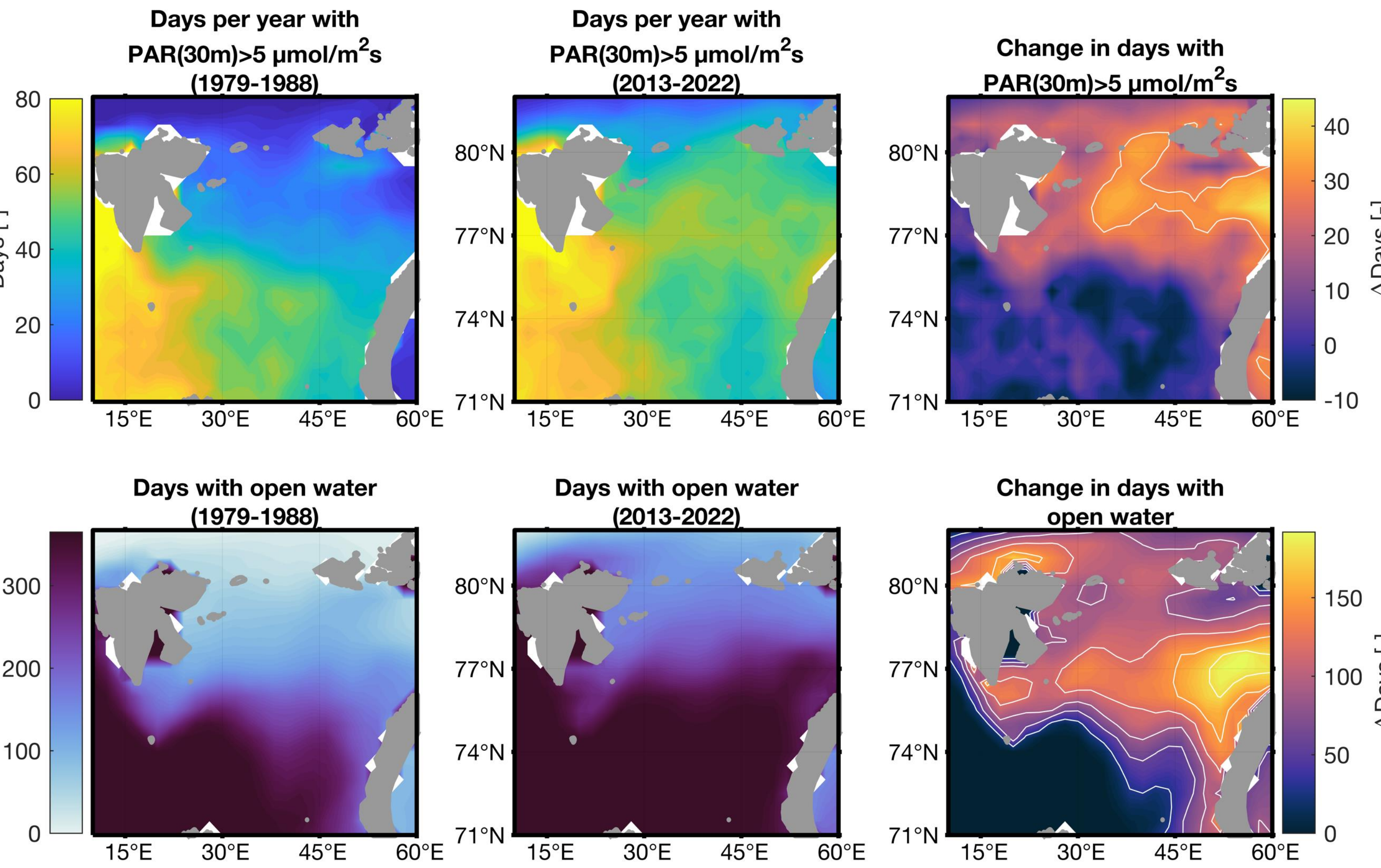


Figure: Modelled time series of PAR at 78°N, 33°E.



Marine sustainability

Increasing freshwater run-off from land. Sea ice retreat. Variability in cloud cover. Many factors are changing the marine light in the polar ocean and in coastal areas, yet we know little about its full impact in the upcoming decades and the effects on the marine ecosystem and fisheries. Will there be sustainable fisheries in the northern Barents Sea? And how will ecosystems in Norwegian fjords and coastal waters respond to climate change?

Aims and milestones

- Completing research stay Glasgow 2023-2025.
- Publication on Barents Sea light climate.
- Cruises around Svalbard 2025 and 2026, further fieldwork around Bergen.
- Publish Arctic Ocean data sets from 2022 and 2018.
- Create bio-optical algorithms to estimate light availability in the central Arctic Ocean and in Norwegian coastal waters.
- Foster collaborations and develop proposals for new projects.

Highlighted results and activities

- Publications:
- Sandven, H., Hamre, B., Petit, T., Röttgers, R., Liu, H., & Granskog, M. A. (2023). Seasonality and drivers of water column optical properties on the northwestern Barents Sea shelf. *Progress in Oceanography*.
 - Koenig, Z, Muilwijk, M., Sandven, H.,... & Granskog, M. A. (2024). From Winter to Late Summer in the Northwestern Barents Sea Shelf: Impacts of Seasonal Progression of Sea Ice and Upper Ocean on Nutrient and Phytoplankton Dynamics. *Progress in Oceanography*.
- Posters:
- Modeling changes in light availability in the Barents Sea and Arctic Ocean driven by sea ice decline over the last four decades. Sandven, H., Connan-McGinty, S.,... & McKee, D. (2024) *Ocean Optics XXVI*.
- Other activities:
- Instructor on the Useful Arctic Knowledge 2024 summer school

Supervisory team

Internal supervisor: Børge Hamre, UiB
Department of Physics and Technology
External supervisor: David McKee, University of Strathclyde
Internal co-supervisor: Camilla Sætre, UiB
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UiB co-supervisor: Anders Opdal, Department of Biology
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