12th FerryBox Workshop
1-2 October 2024, Helsinki

SMHI

FERRYBOX PLANKTON OBSERVATIONS IN THE BALTIC SEA AND THE KATTEGAT-SKAGERRAK USING BIO-OPTICS AND AUTOMATED IMAGING IN FLOW - FOCUS ON CYANOBACTERIA BLOOMS

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Ferrybox Tavastland

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pCO2

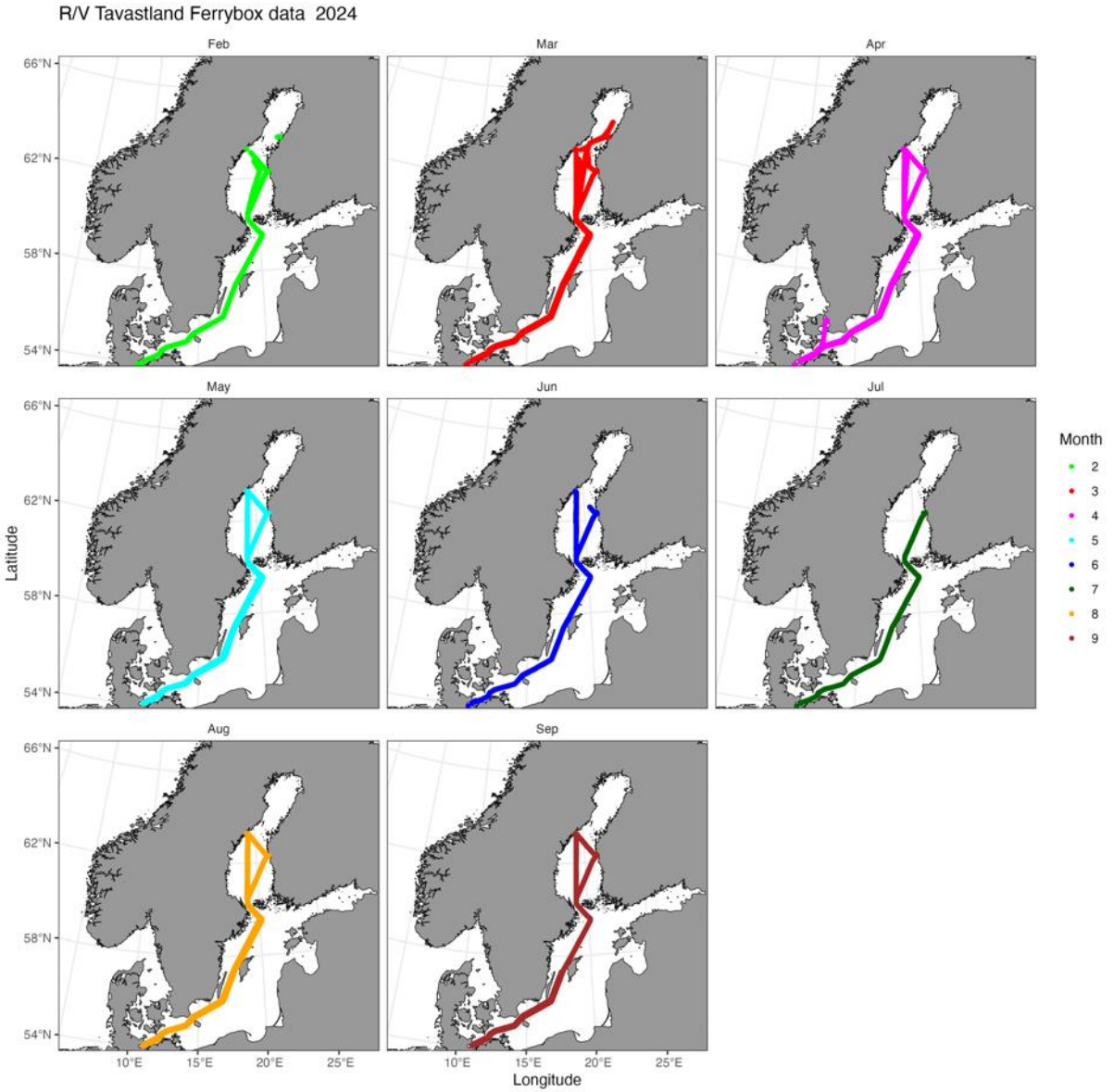
fluorescence:

- chl
- phycyanin
- CDOM

salinity

temperature

Track in 2024

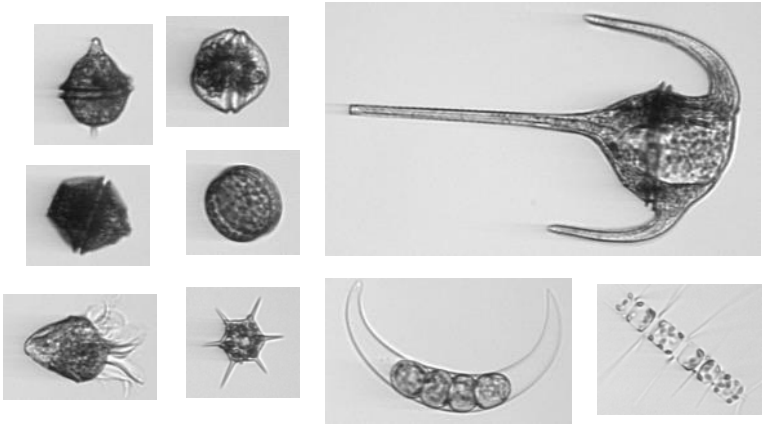


Ferrybox R/V Svea

Monthly cruises

Baltic Proper

Kattegat-Skagerrak



pH

pCO2

fluorescence:

- chl
- phycyanin
- phycoerythrin
- CDOM

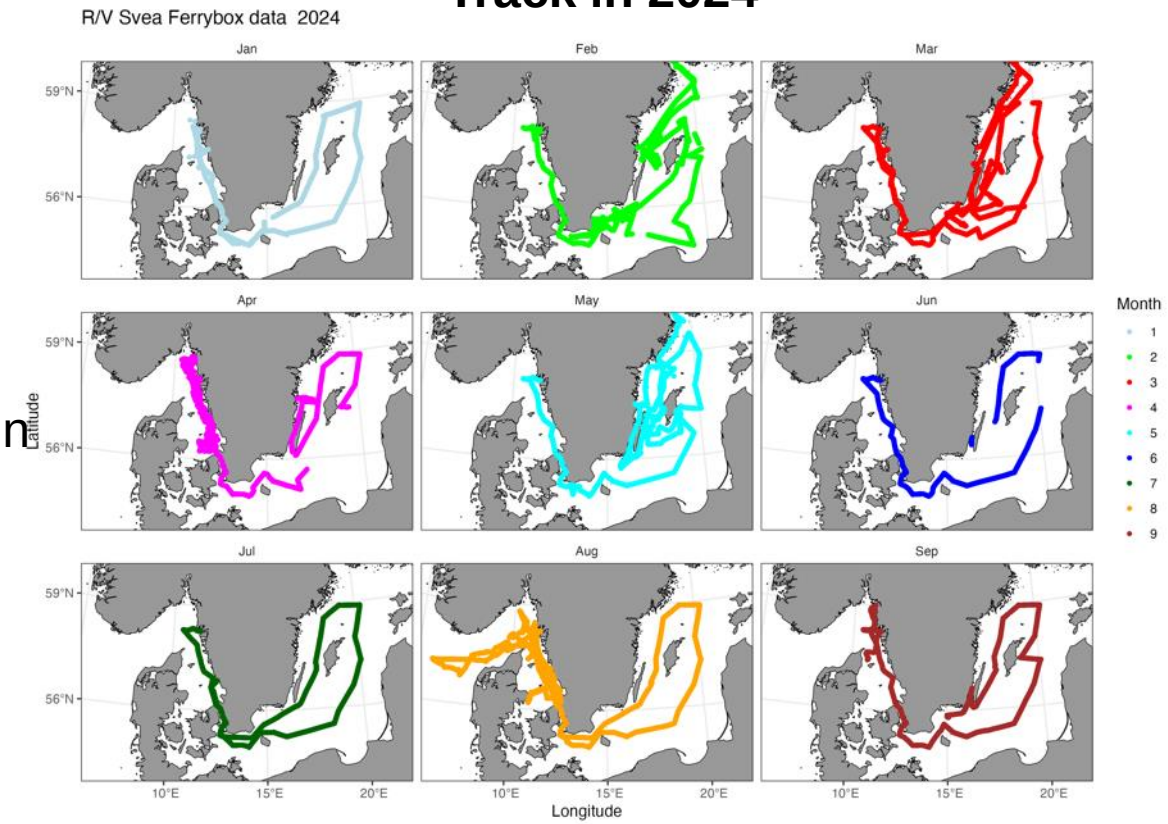
salinity

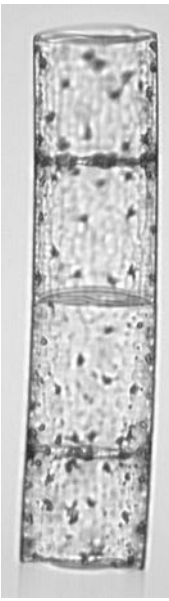
temperature

meteorology

PAR

Track in 2024





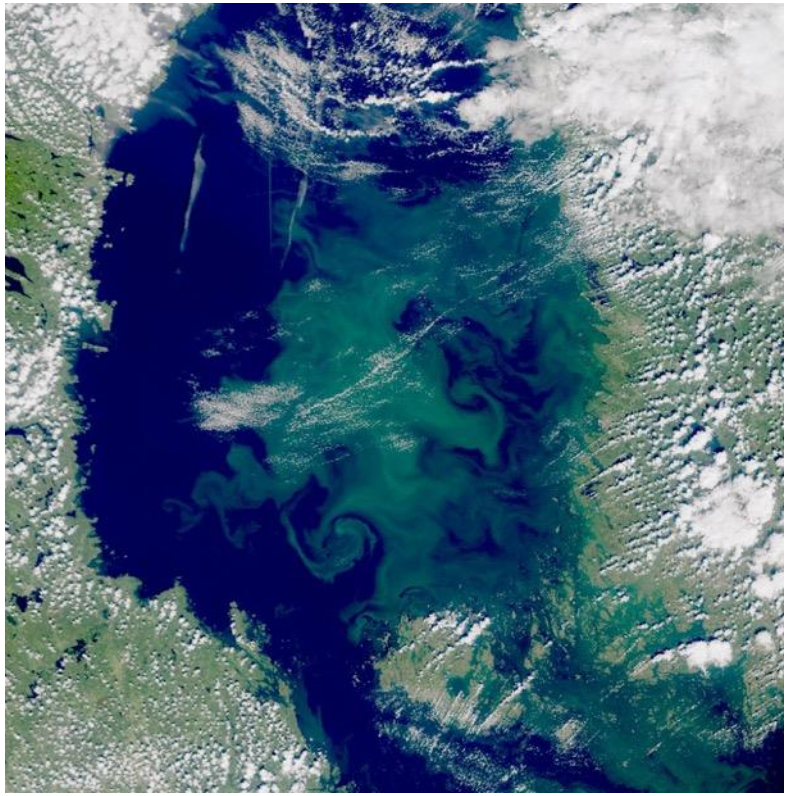
IFCB, automated plankton sampling every ~25 minutes

AI-assisted analysis

Cyanobacteria

Dolichospermum* sp., *Nodularia spumigena* and *Aphanizomenon flosaquae

SW Baltic Proper
Suomi-NPP, 20230908, 1129



Gulf of Bothnia
Sentinel-3B 20230724, 0920

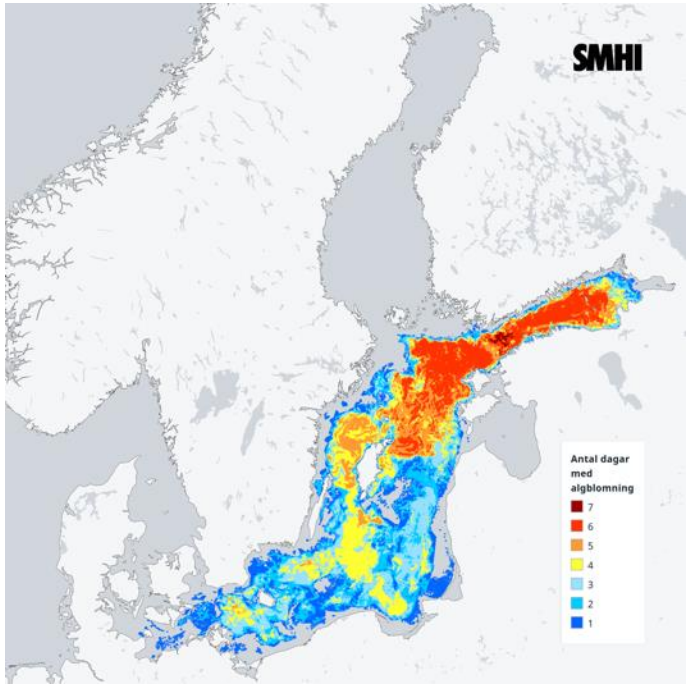
https://www.smhi.se/data/oceanografi/algsituationen

Some goals

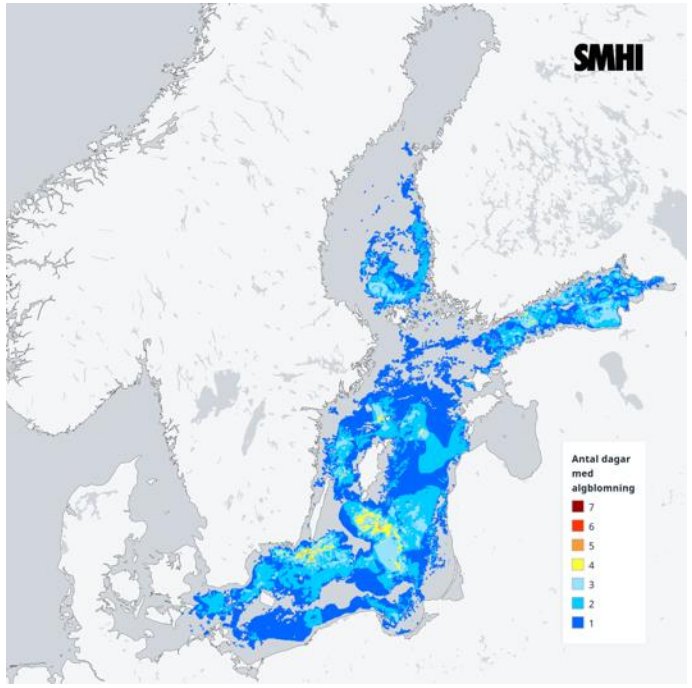
- Improve early warning of cyanobacteria blooms
  - Protect human health
  - Protect tourism industry
- Evaluate automated methods for long term monitoring of phytoplankton biomass and diversity

Cyanobacteria – satellite observations 2024

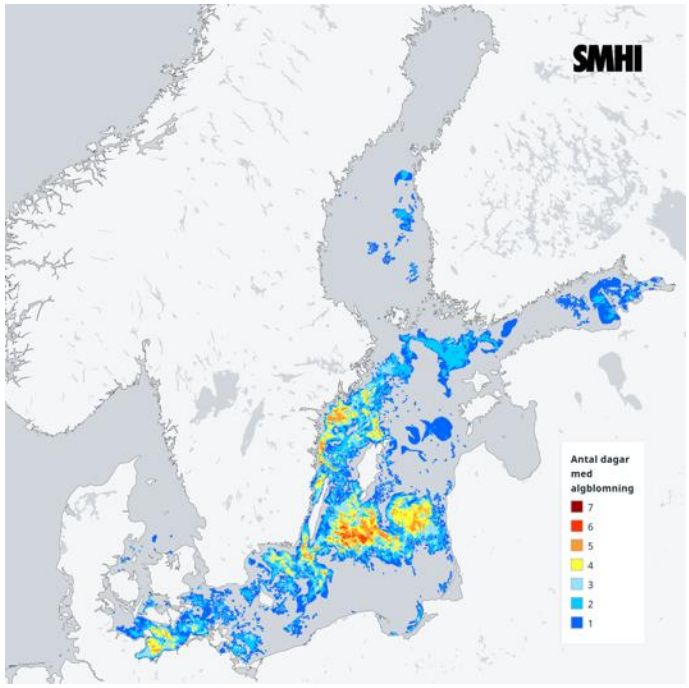
7-day composite images



30 June



18 July



6 August

SMHI Baltic Algae Watch System

Data presented daily in summer
https://www.smhi.se/data/oceanografi/algsituationen
Daily data, 7-day summaries

Eastern Gotland 22 June 2023

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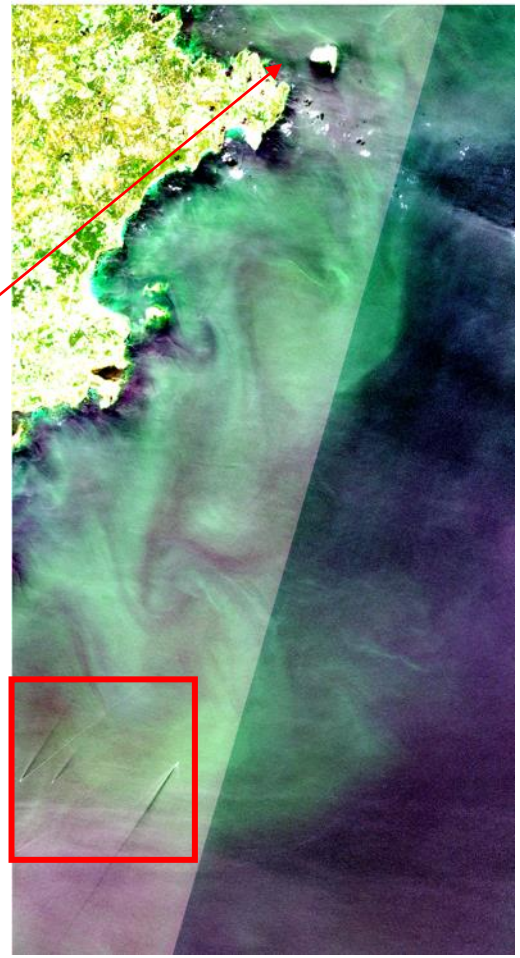
- ESA Sentinel 2
- ~10 m horizontal resolution
- Every ~ 5 days

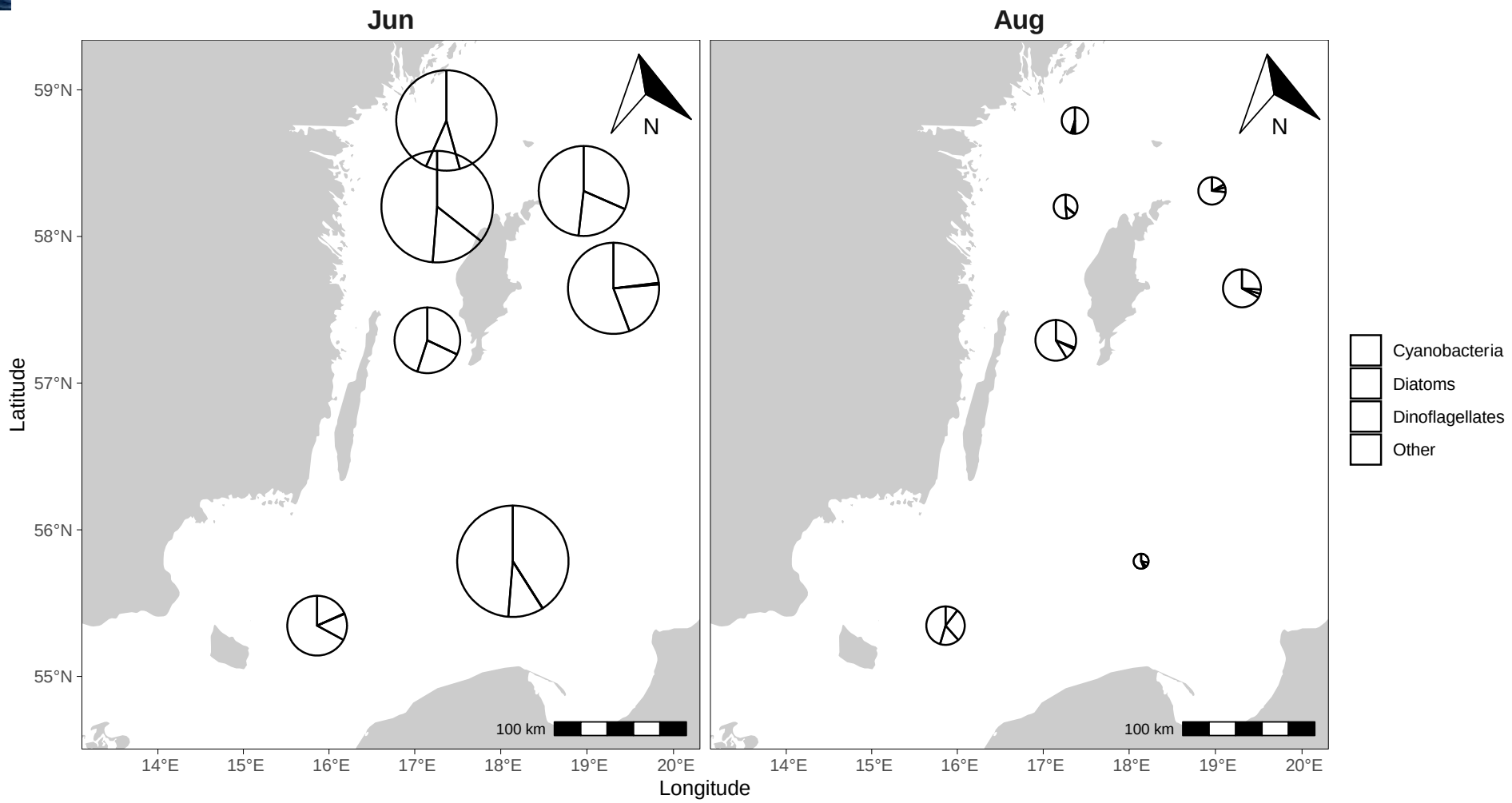


quasi true color = B04 (665 nm) + B03 (560 nm) + B02 (490 nm) with linear stretch

Processed by Christoffer Olsson, SMHI

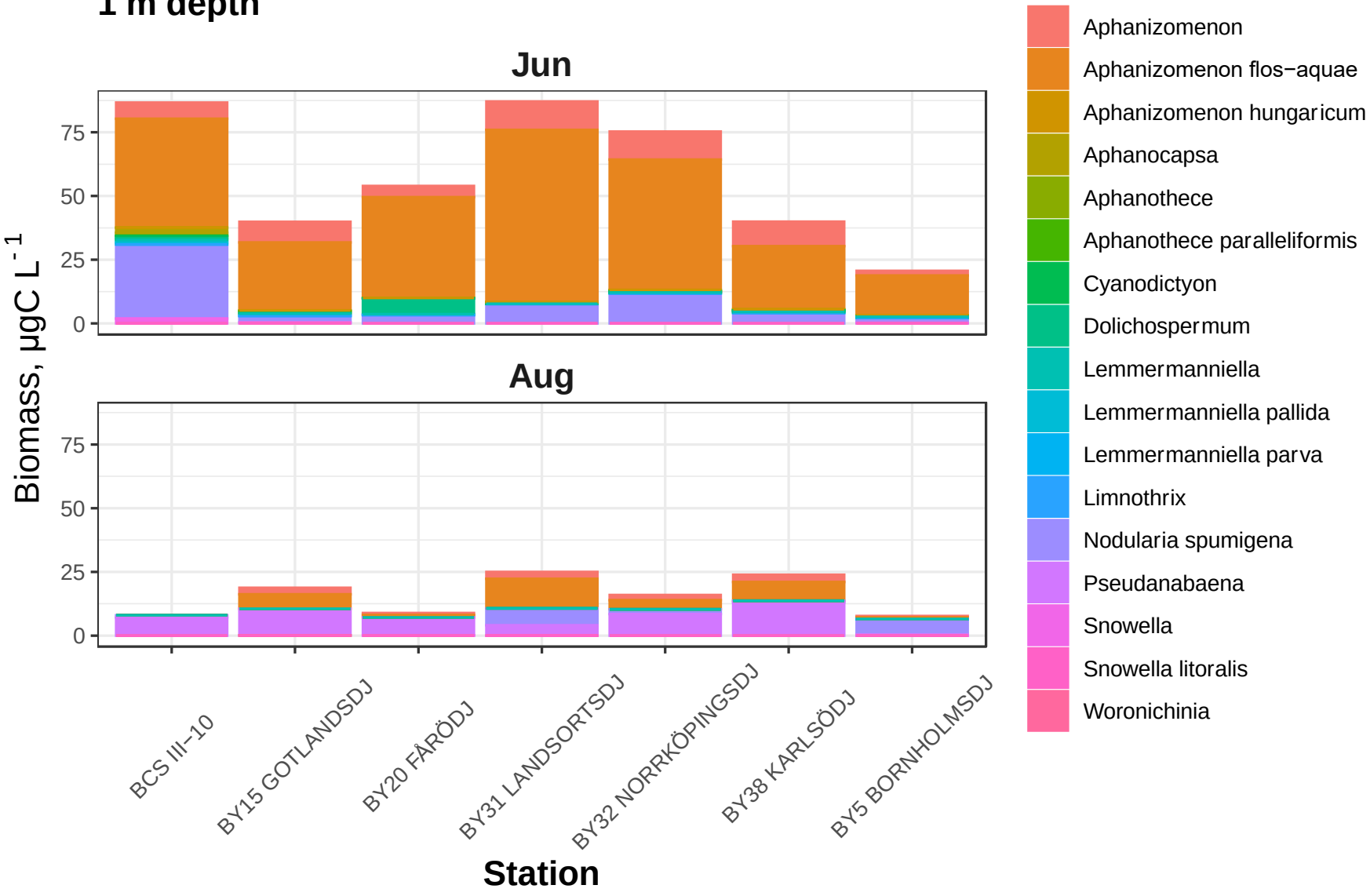
Phytoplankton biomass, major groups 2023

1 m depth



Cyanobacteria biomass summer 2023

1 m depth



Bio-optical sensors on R/V Svea

CTD

- RBRtridente (July-Sep. 2024)
- Wetlabs ECO FLNTU
- PAR

Ferrybox system

- Wetlabs ECO FLNTU
- Turner Designs phycoerythrin
- TriOS Nano flu phycocyanin
- TriOS Nano flu CDOM
- Imaging Flow CytoBot
- PAR (in air)

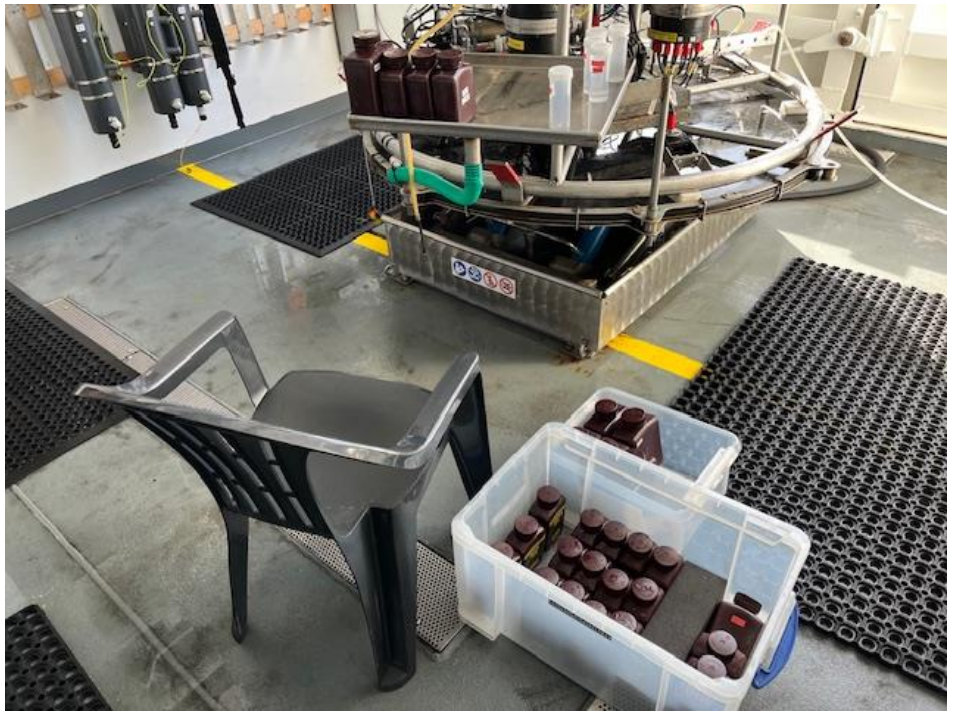
Moving Vehicle Profile

- Turner Desgns chlorophyll fluorescence

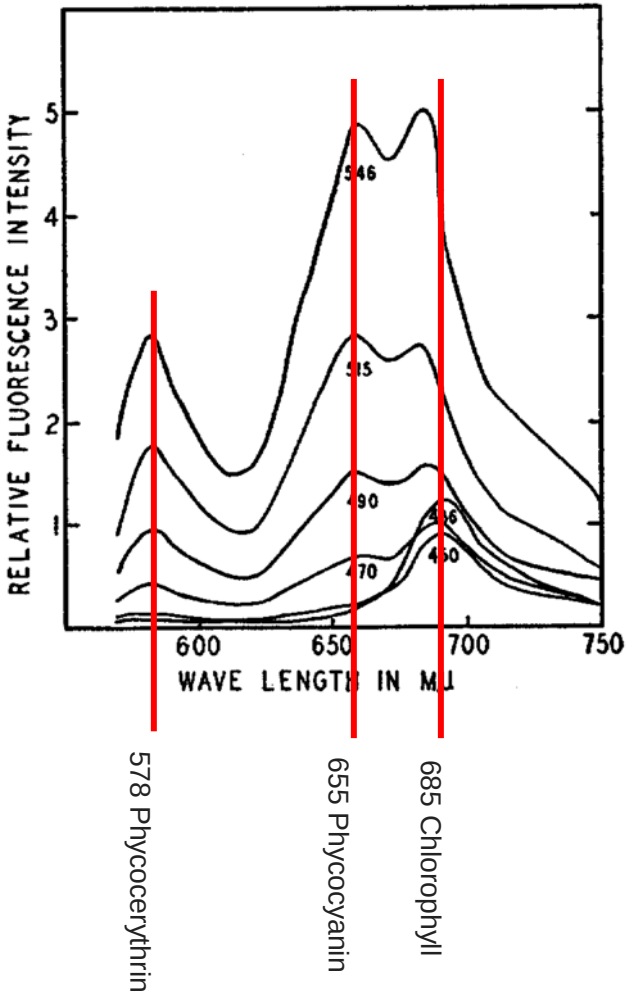
Reference sampling

Reference sampling

- Phytoplankton
  - Tube 0-10 m
  - August - Depth profile BY38
- Phycocyanin
  - Depth profile, six depths
  - June, July and August
  - Stations BY2, BY38



Fluorescence depends on both excitation and emission wavelengths



Porphyridium sp. Fluorescence spectra at different excitation wavelengths
French **et al** 1952

Results - depth distribution R/V Svea

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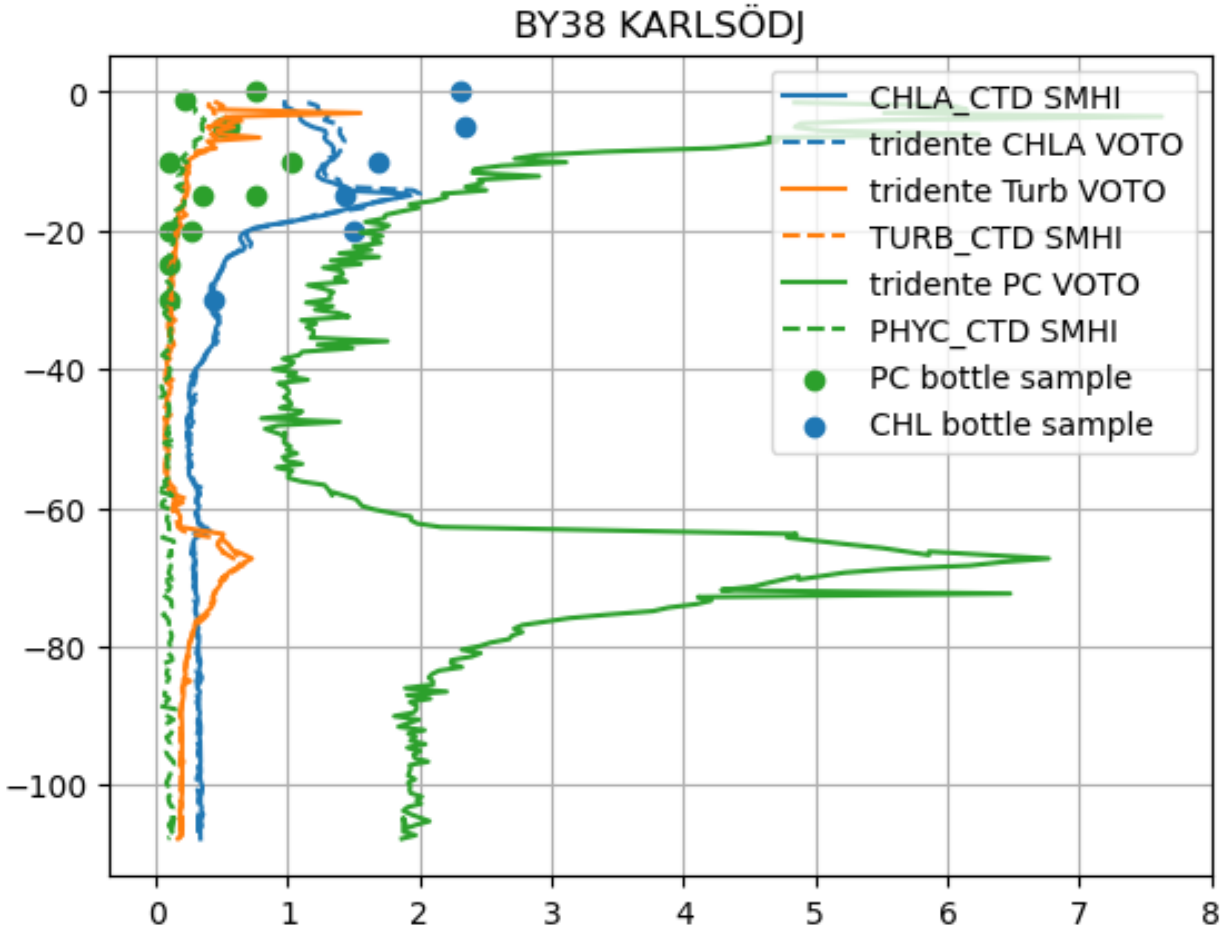
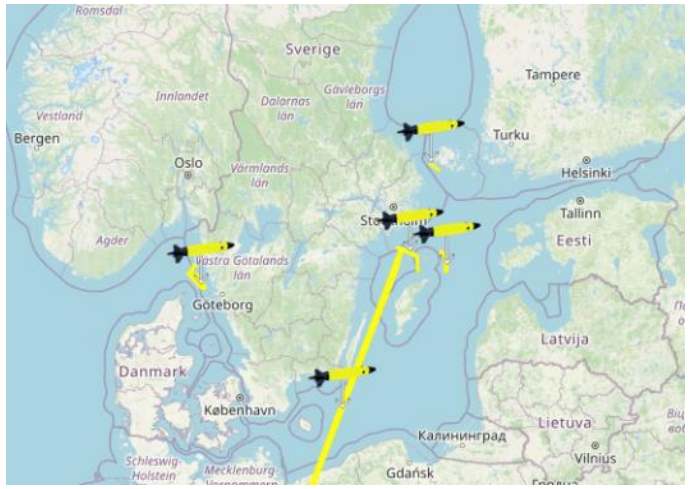
Bio-optical instruments

- RBR-Tridente
- Wetlabs ECO-FLNTU



Graph produced by Martin Mohrmann, VoTo

Glider with new bio-optical sensor

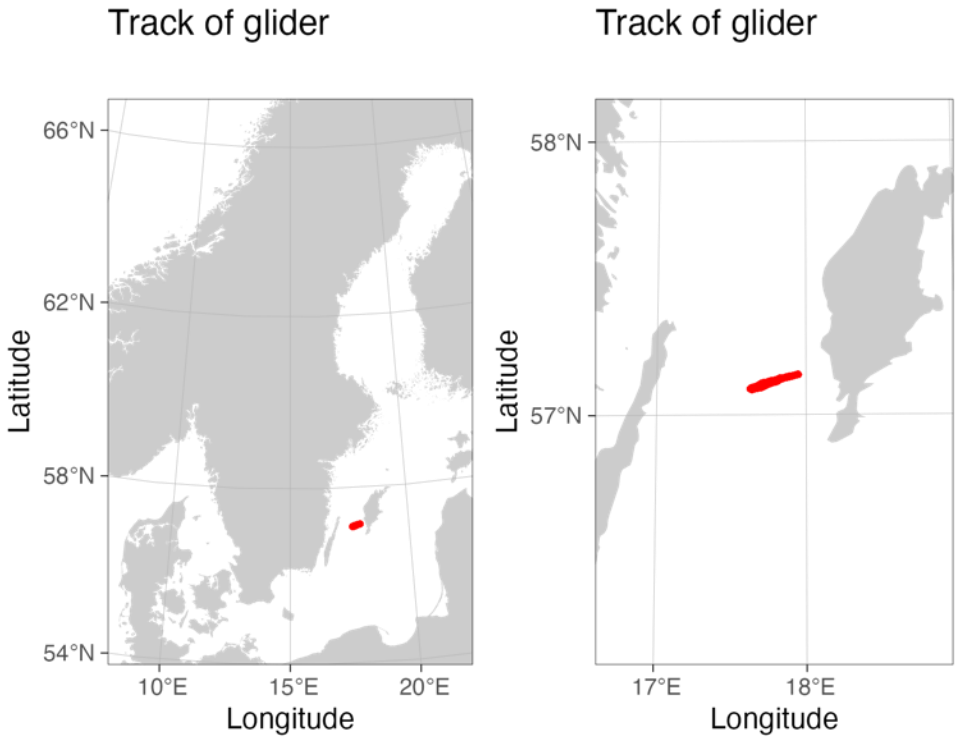


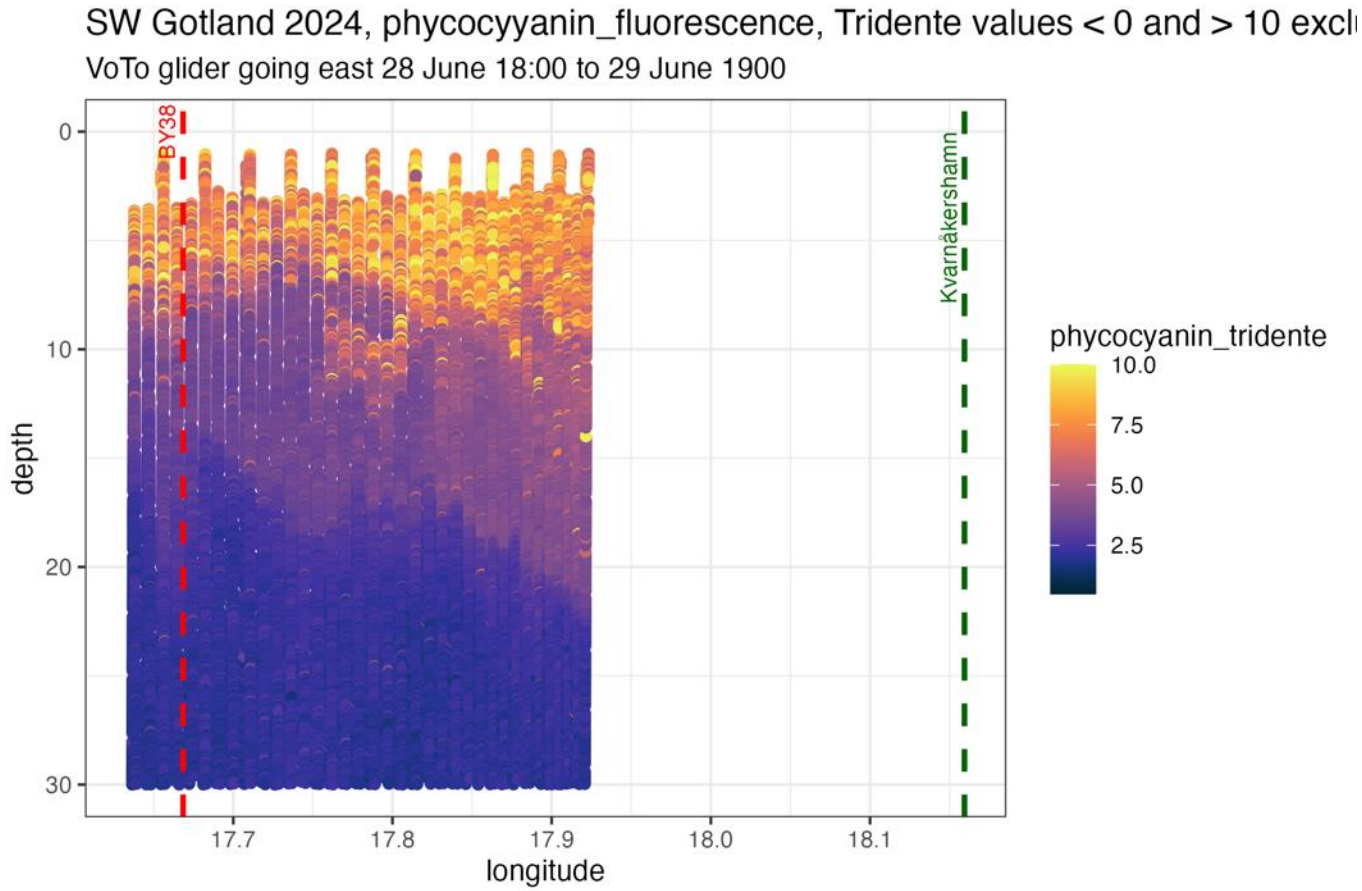
https://observations.voiceoftheocean.org

RBR tridente (new 2024)

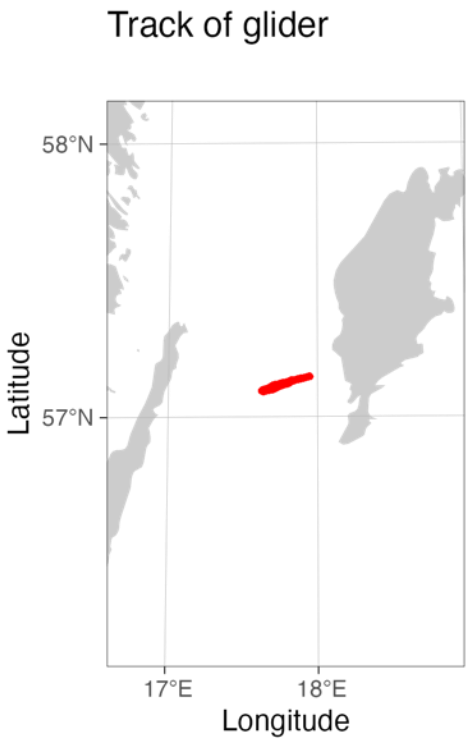
Results - depth distribution VoTo glider

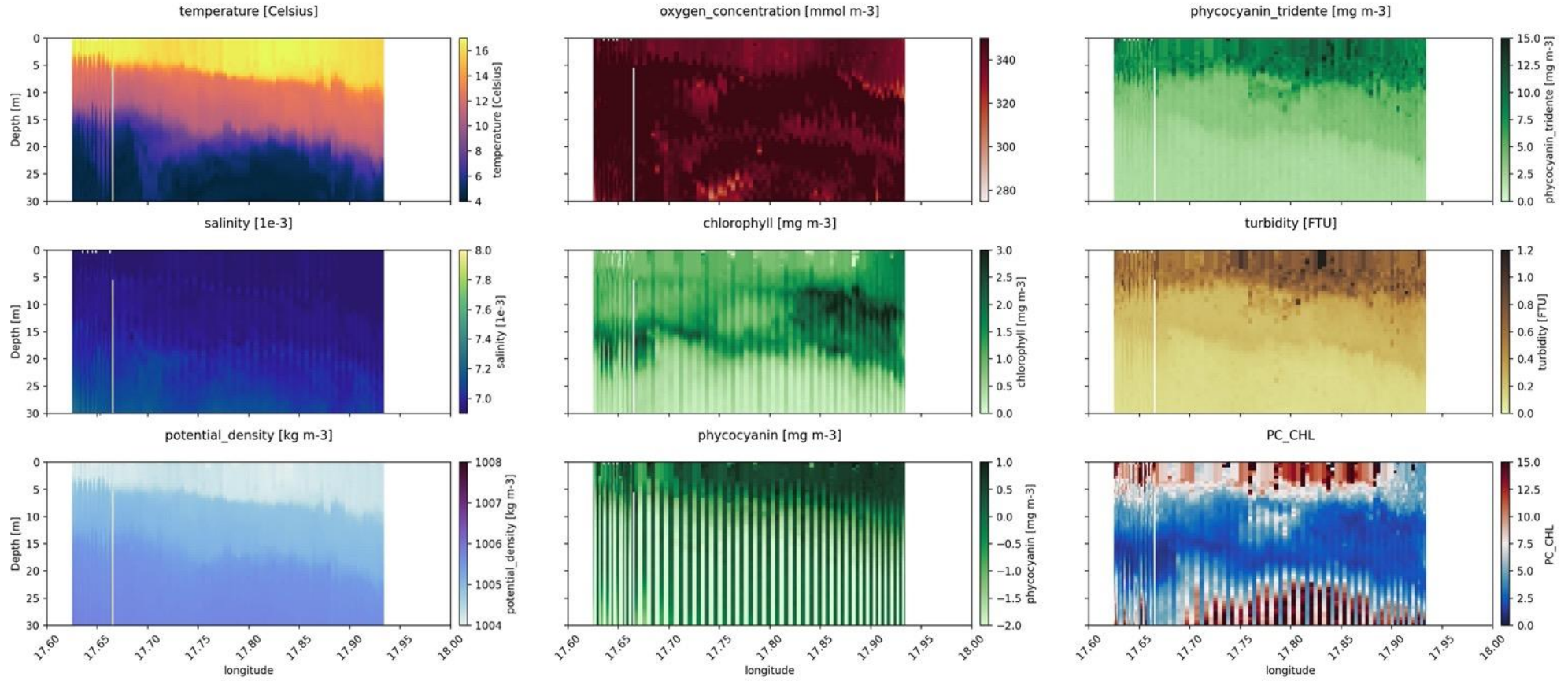
- Tridente phycocyanin fluorometer





Depth distribution and time series VoTo glider





Graphs produced by Martin Mohrmann, VoTo

Results - Imaging Flow Cytobot R/V Svea 2024

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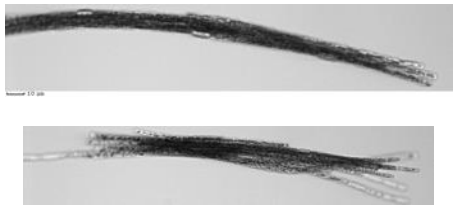
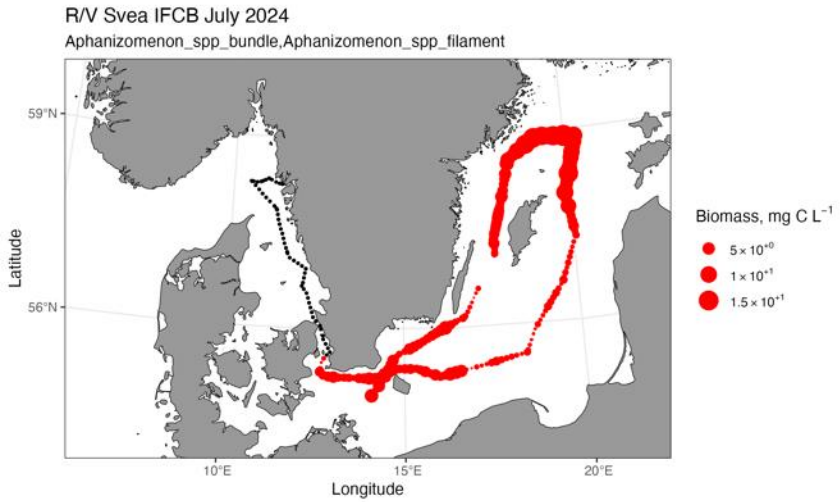
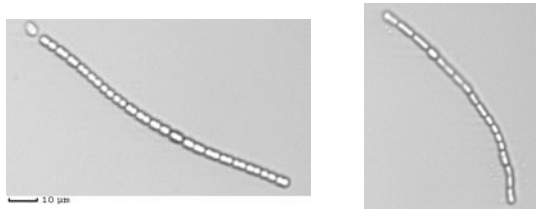
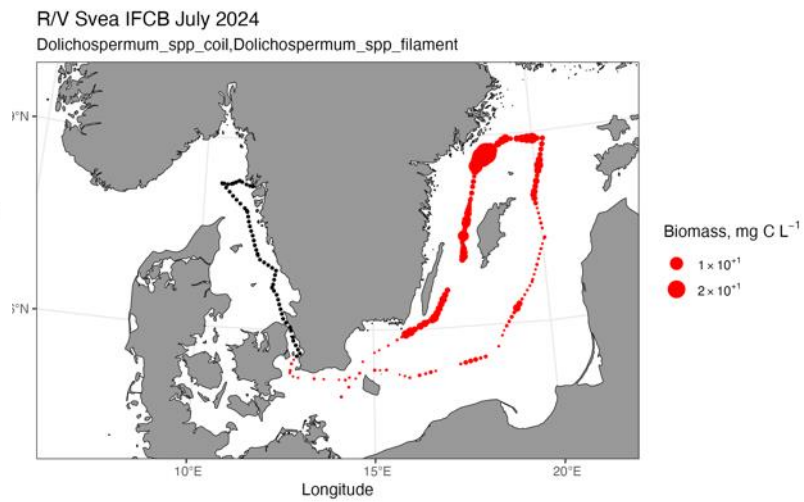
Aphanizomenon flos-aquae





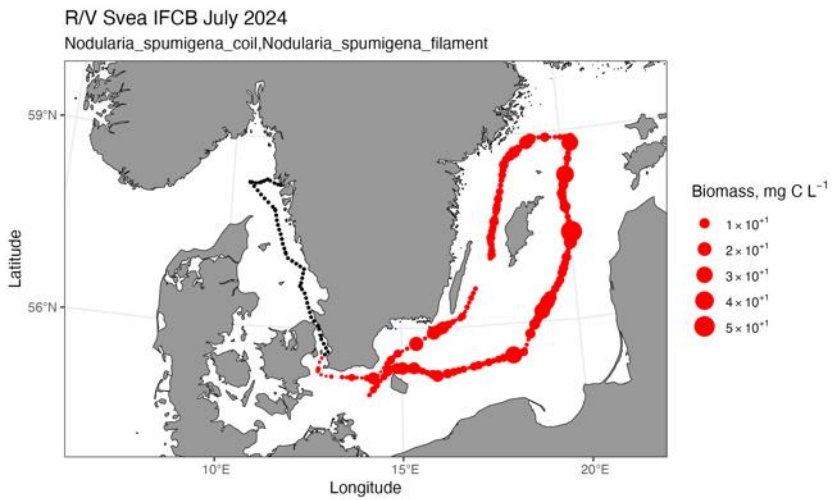
Dolichospermum spp.





Toxin producer

Nodularia spumigena



See poster by Anders Torstensson et al. about IFCB data flow
Digital Twin Ocean - BioFlow

Conclusions

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- Satellite ocean colour provide information on cyanobacteria near surface accumulations
- Ferrybox and gliders provides near real time data useful for early warning of harmful algae blooms
- Gliders and CTDs on research vessels provide information on depth distribution
- Phycocyanin fluorescence is a proxy for biomass of phycocyanin rich cyanobacteria - the wavelengths for excitation and emission are important
- IFCB provides detailed information on species - important to know if toxin producers are presents

Partners and funding sources

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FORMAS

WALLENIUS SOL

SciLifeLab

JERICO S3
Science - Services - Sustainability

Vetenskapsrådet

DTO Voice of the Ocean

KTH
Vetenskap och Konst

Copernicus Marine Service

ICOS National Network Sweden

SBDI

DTO-BioFlow
Integration of biodiversity monitoring data into the Digital Twin Ocean

SLU

Swedish Agency Marine and Water Management

Region Gotland

Stockholms universitet