From surface to the bottom: Ocean color retrievals and Argo floats

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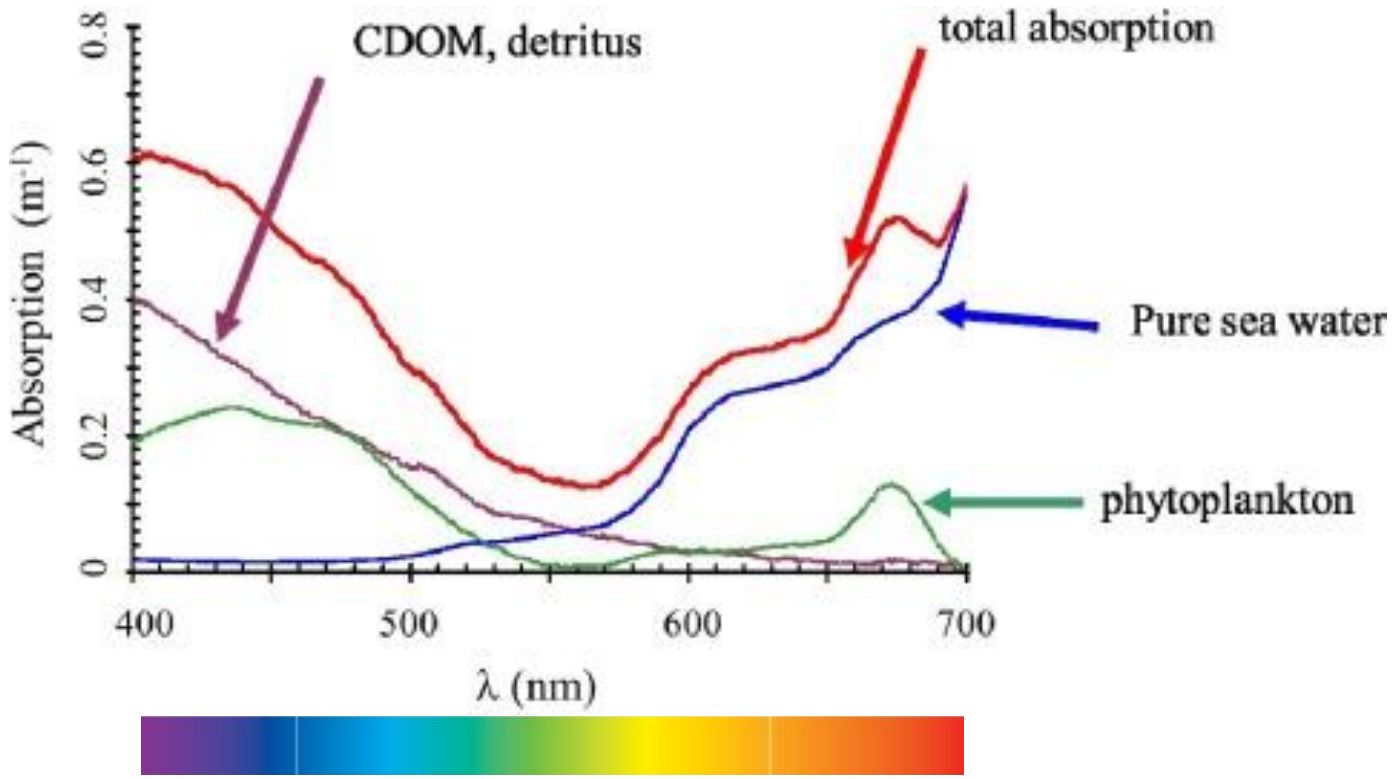
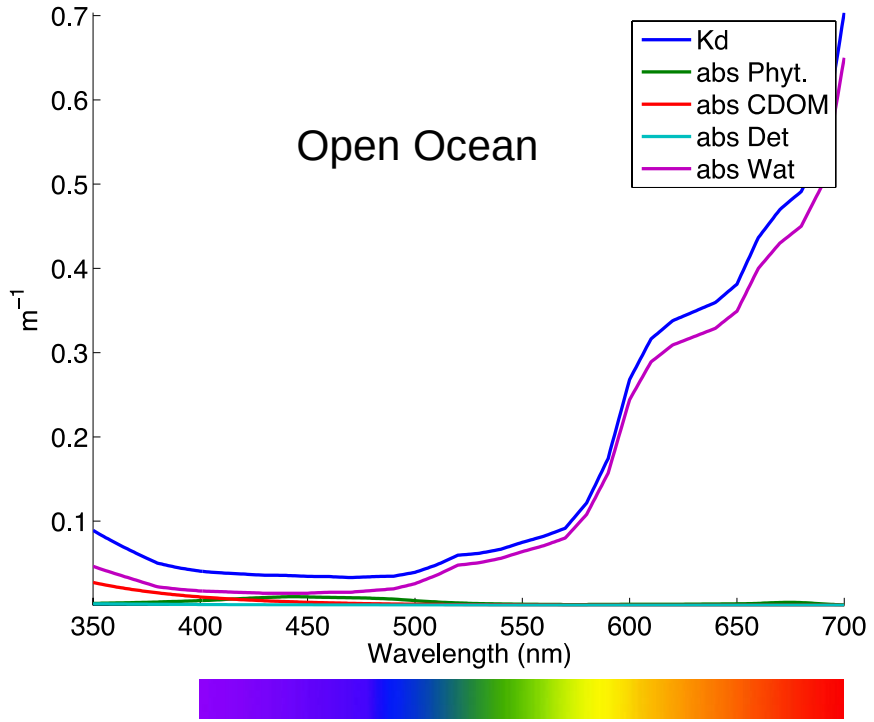
Optically active constituents of water

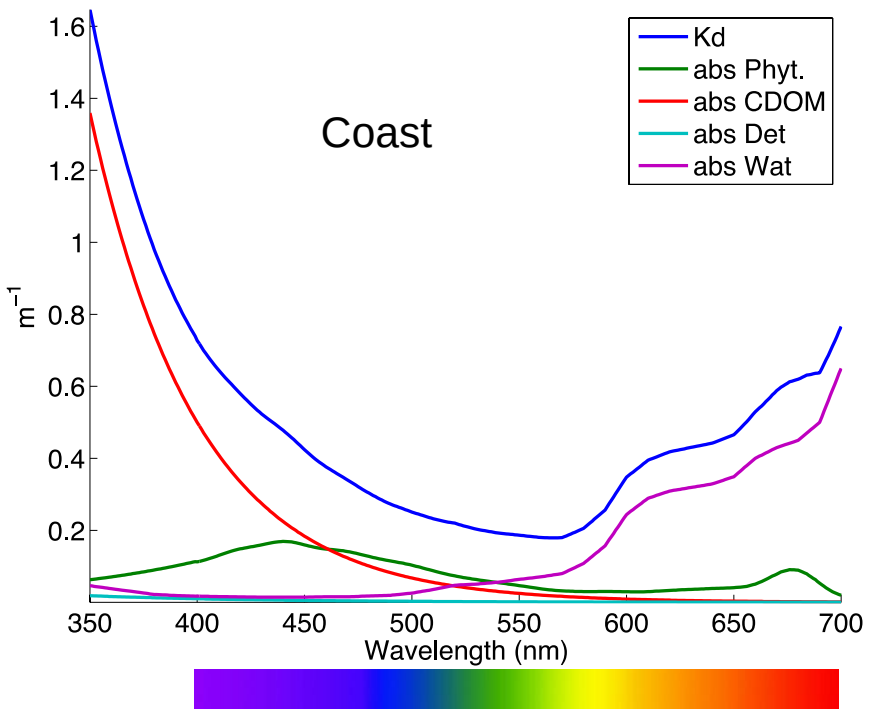
- Water
- Phytoplankton
- Sediments and detritus/inorganic
- Dissolved organic matter (DOM)



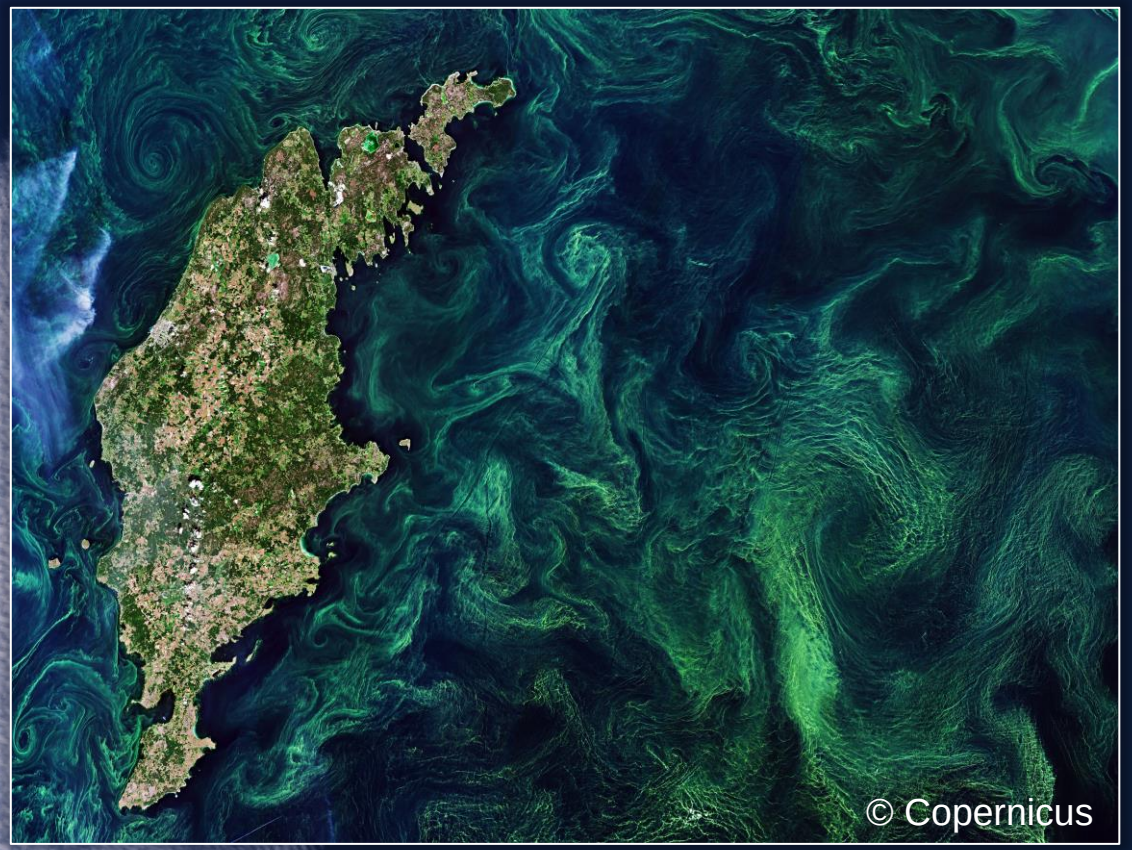
Chami & Harmel (2016)

Optically active constituents of water





Nuup Kangerlua
Godthåbsfjord
Nuuk Fjord



Nuuk

6 Aug 23
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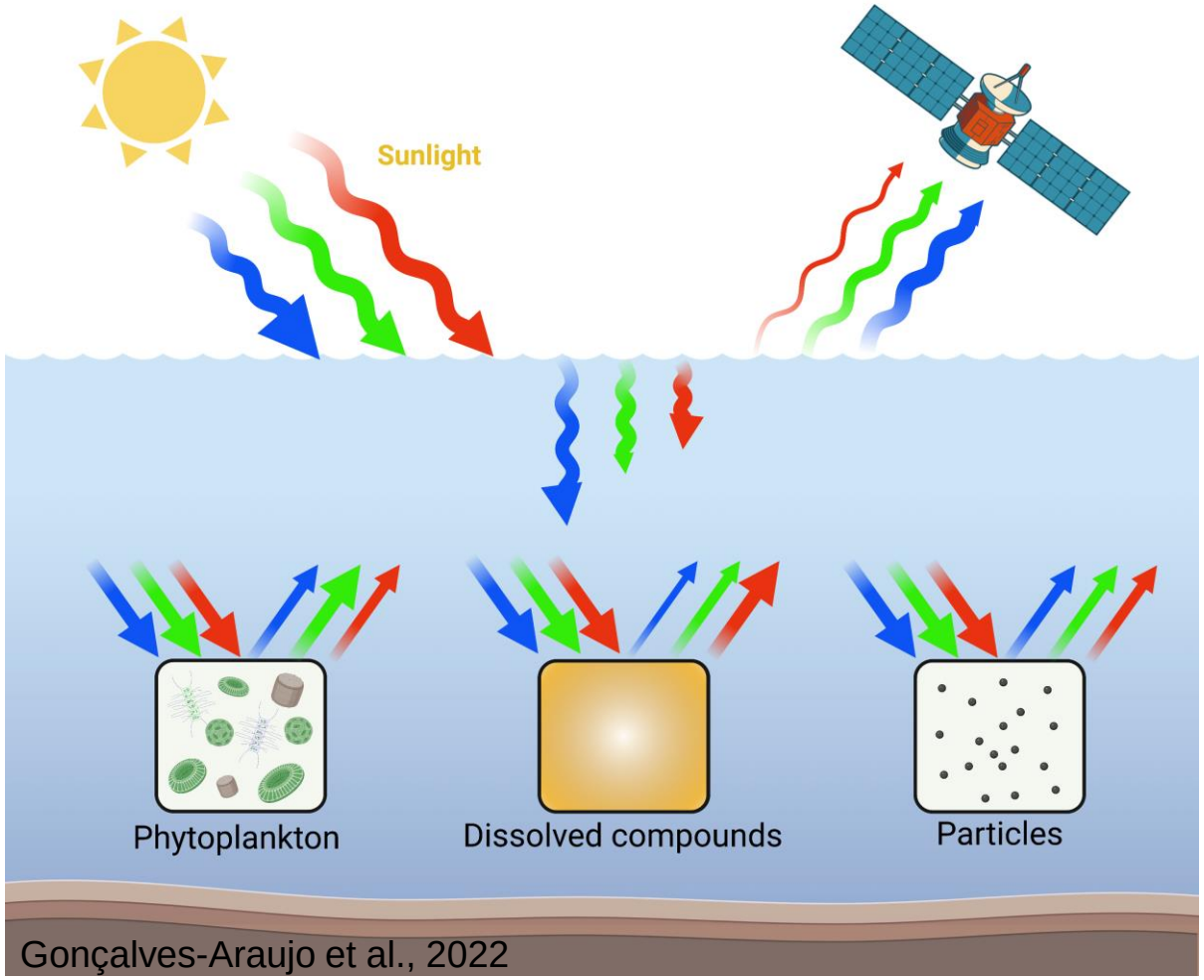
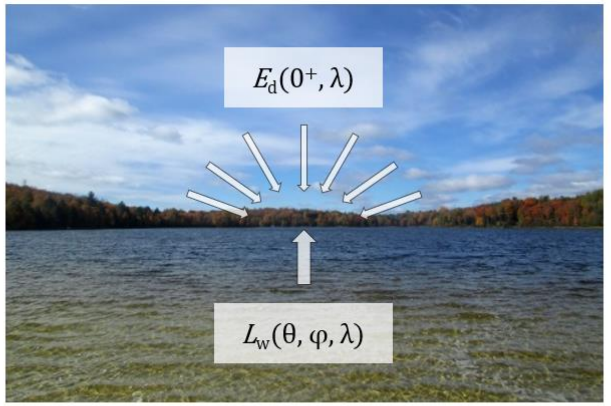
Ocean color remote sensing



Gonçalves-Araujo et al., 2022

Remote Sensing Reflectance (Rrs)



$$R_{rs}(\theta, \varphi, \lambda) = \frac{L_w(\theta, \varphi, \lambda)}{E_d(0^+, \lambda)}$$

$L_w(\theta, \varphi, \lambda)$ - Water leaving radiance

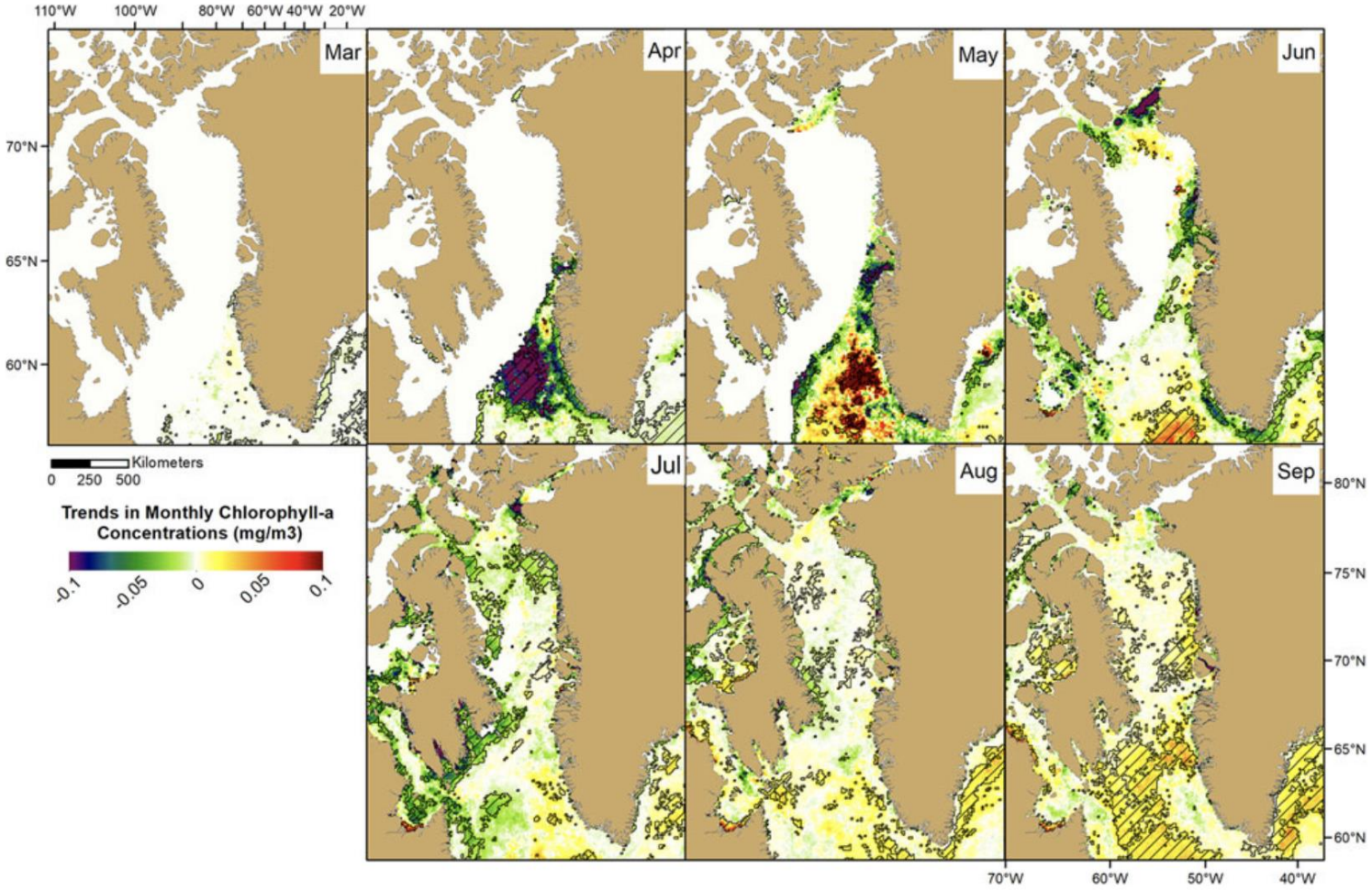
$E_d(0^+, \lambda)$ - Downwelling irradiance

Source: WDNR, USA

Algorithms for retrieving geophysical properties

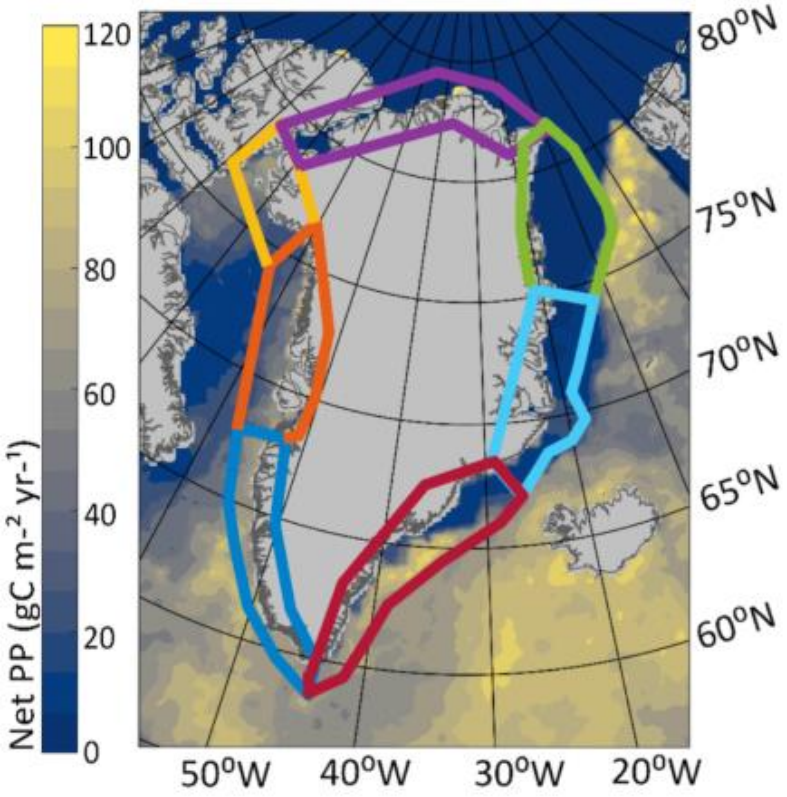
- Chlorophyll-a

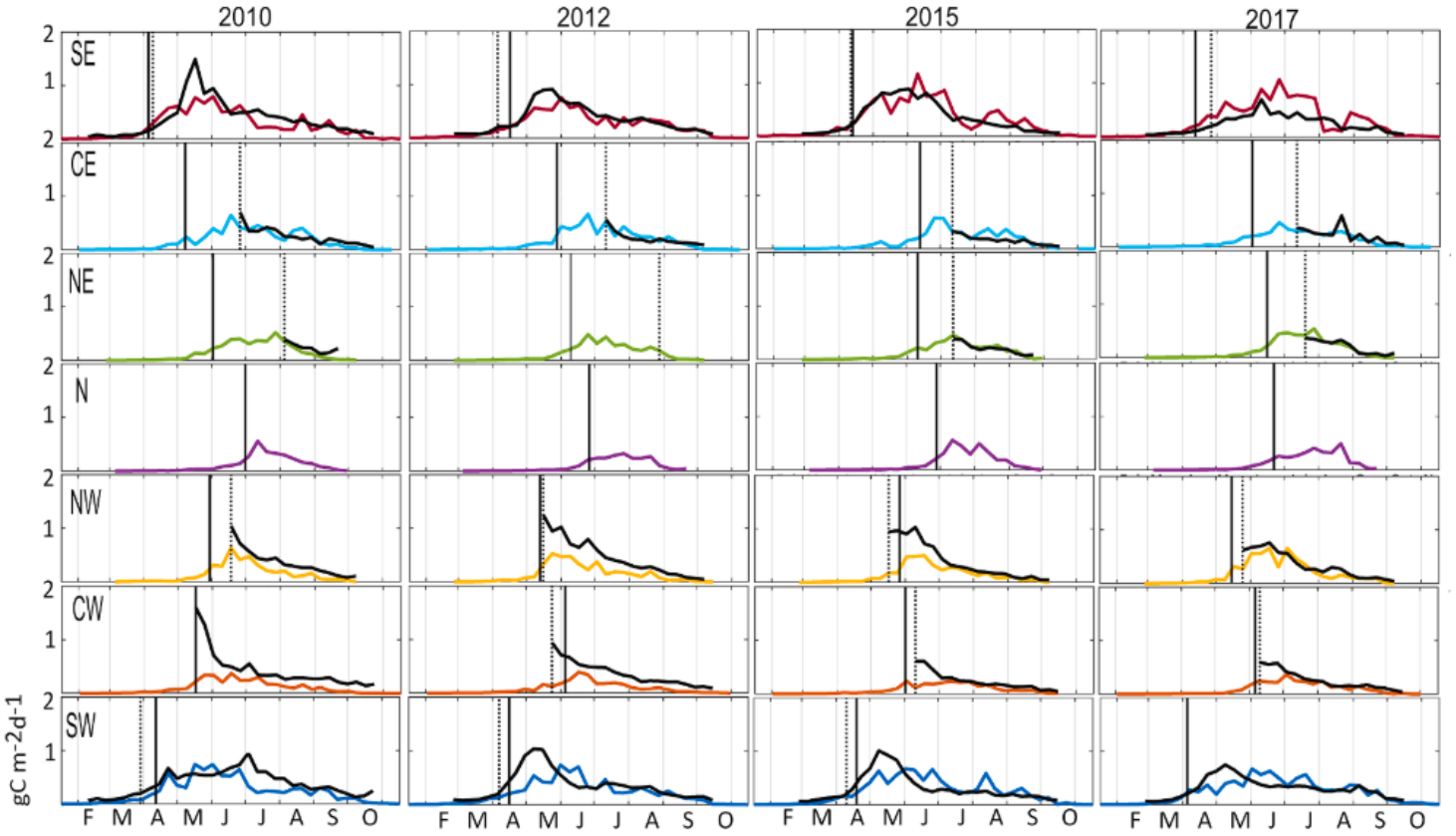
Ocean color remote sensing



York et al. (2020)

Ocean color remote sensing

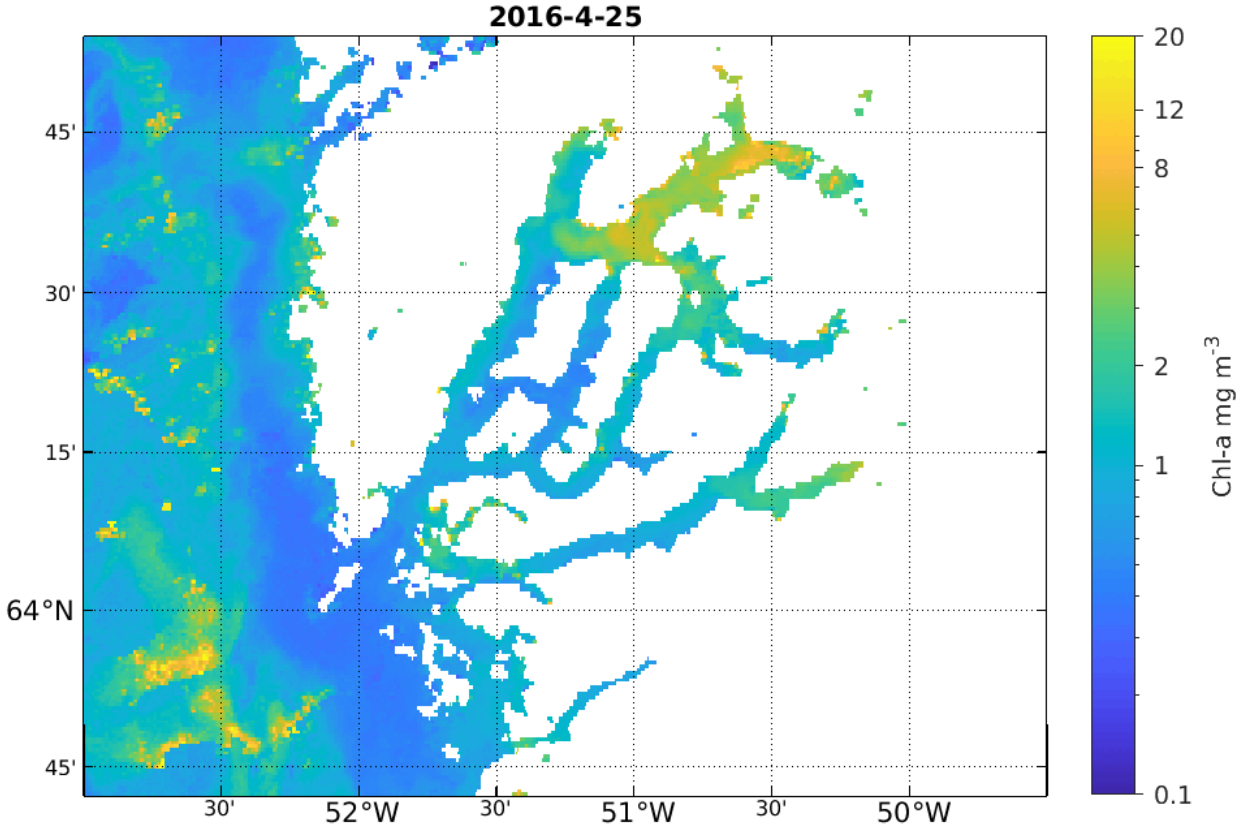




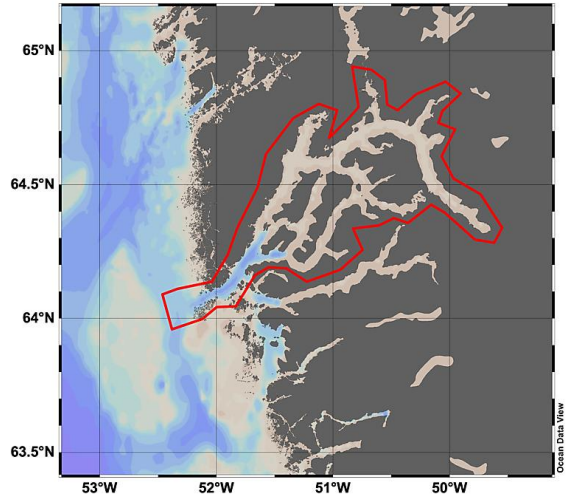
Vernet et al. (2020)

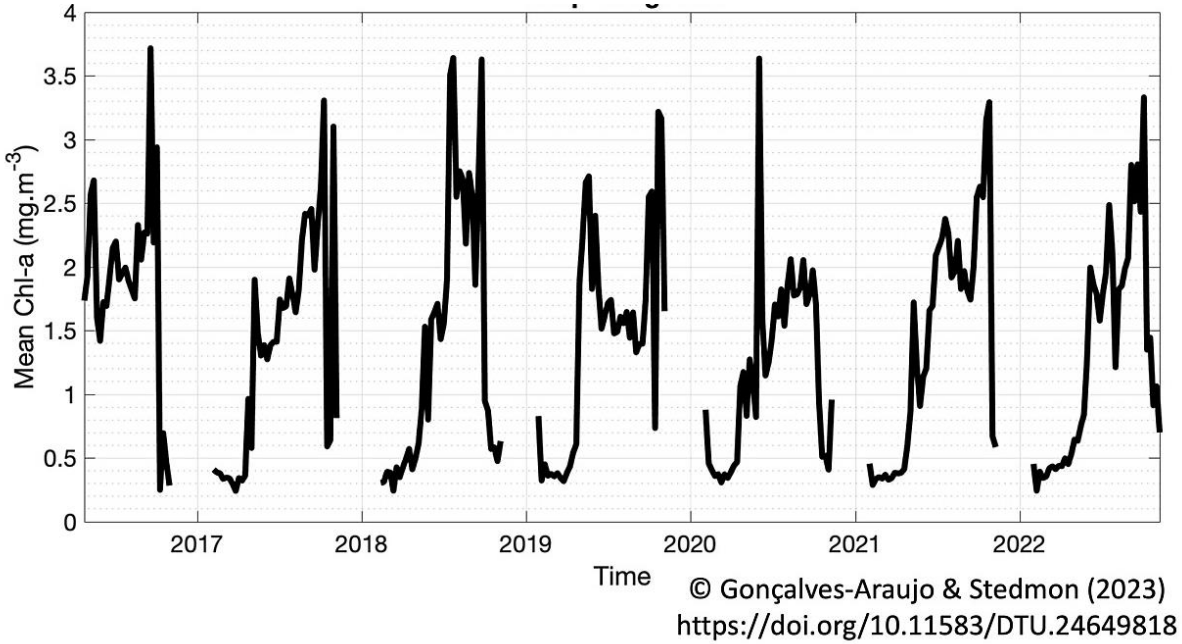
Ocean color remote sensing

Weekly Chl-a S3 Averages



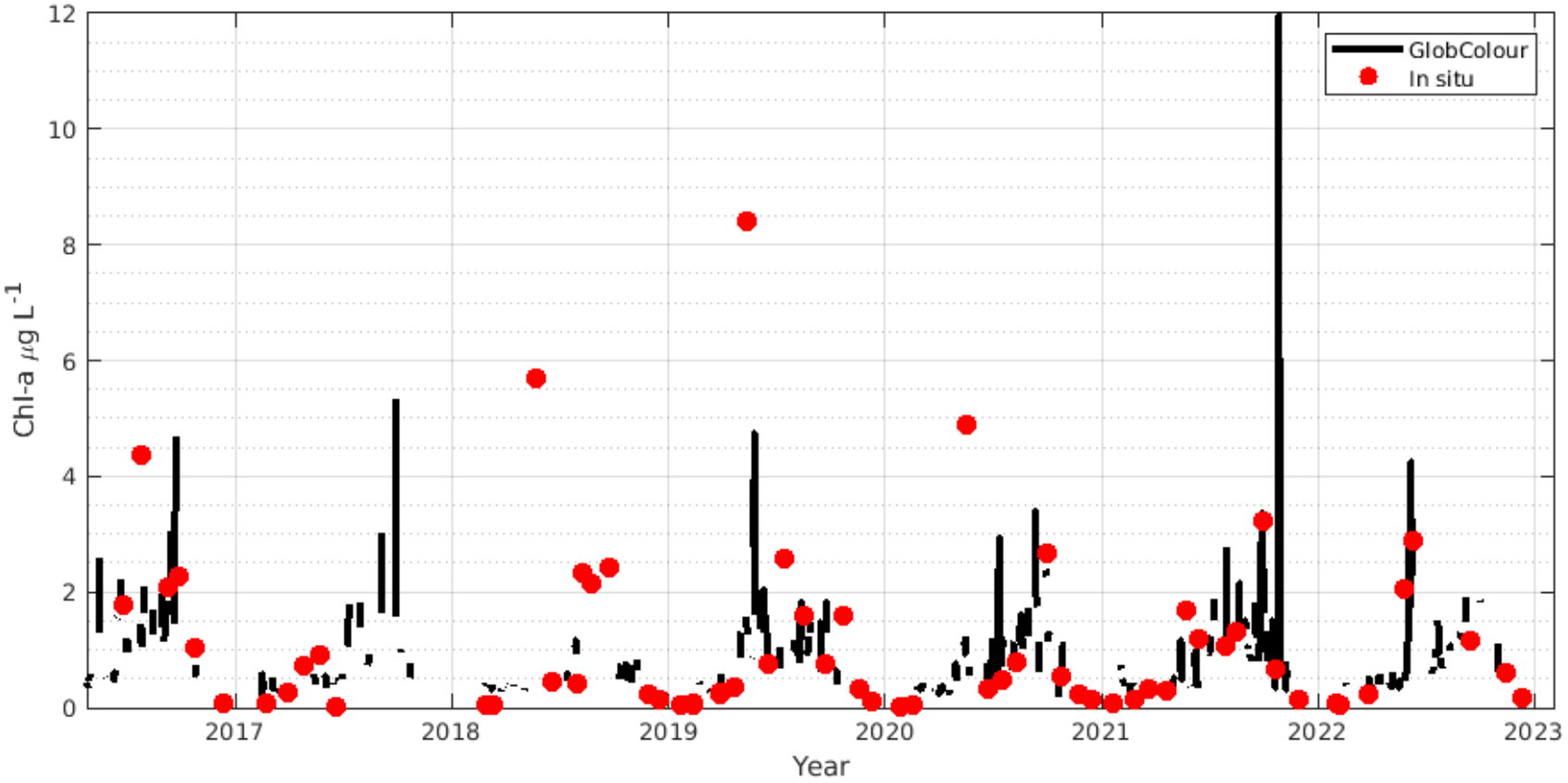
Gonçalves-Araujo et al. (in prep)





© Gonçalves-Araujo & Stedmon (2023)
https://doi.org/10.11583/DTU.24649818

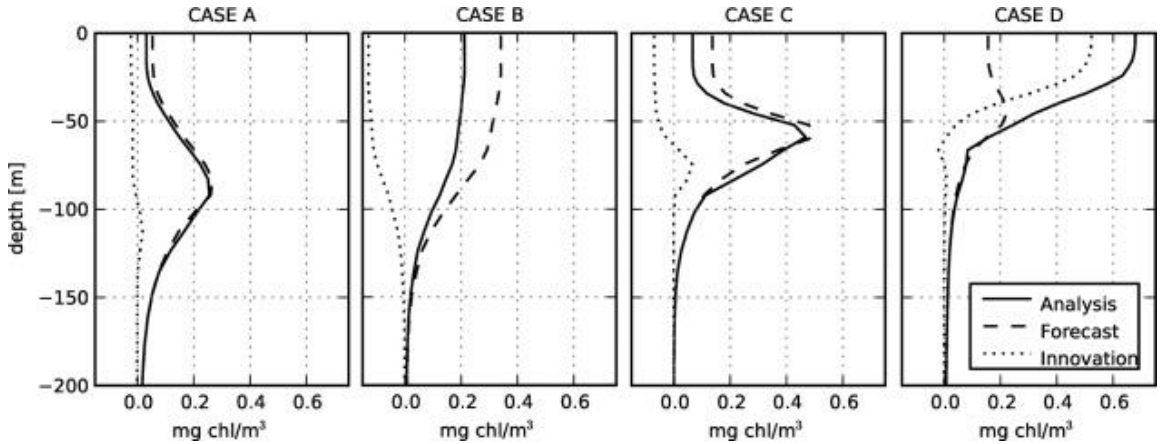
Ocean color remote sensing



Gonçalves-Araujo et al. (in prep)

Ocean Color remote sensing

- Allow for deriving several biogeochemical-relevant parameters
- Increased spatial and temporal sampling efforts
- Daily Global synoptic coverage
- Reaching climate-long time series
- Limitations
  - Limited to the surface
  - Optically complex waters in fjord systems → need for regional parametrizations/algorithms
  - No data under sea-ice, overcast, polar night



Teruzzi et al. (2014)

Need for complementary observation tool

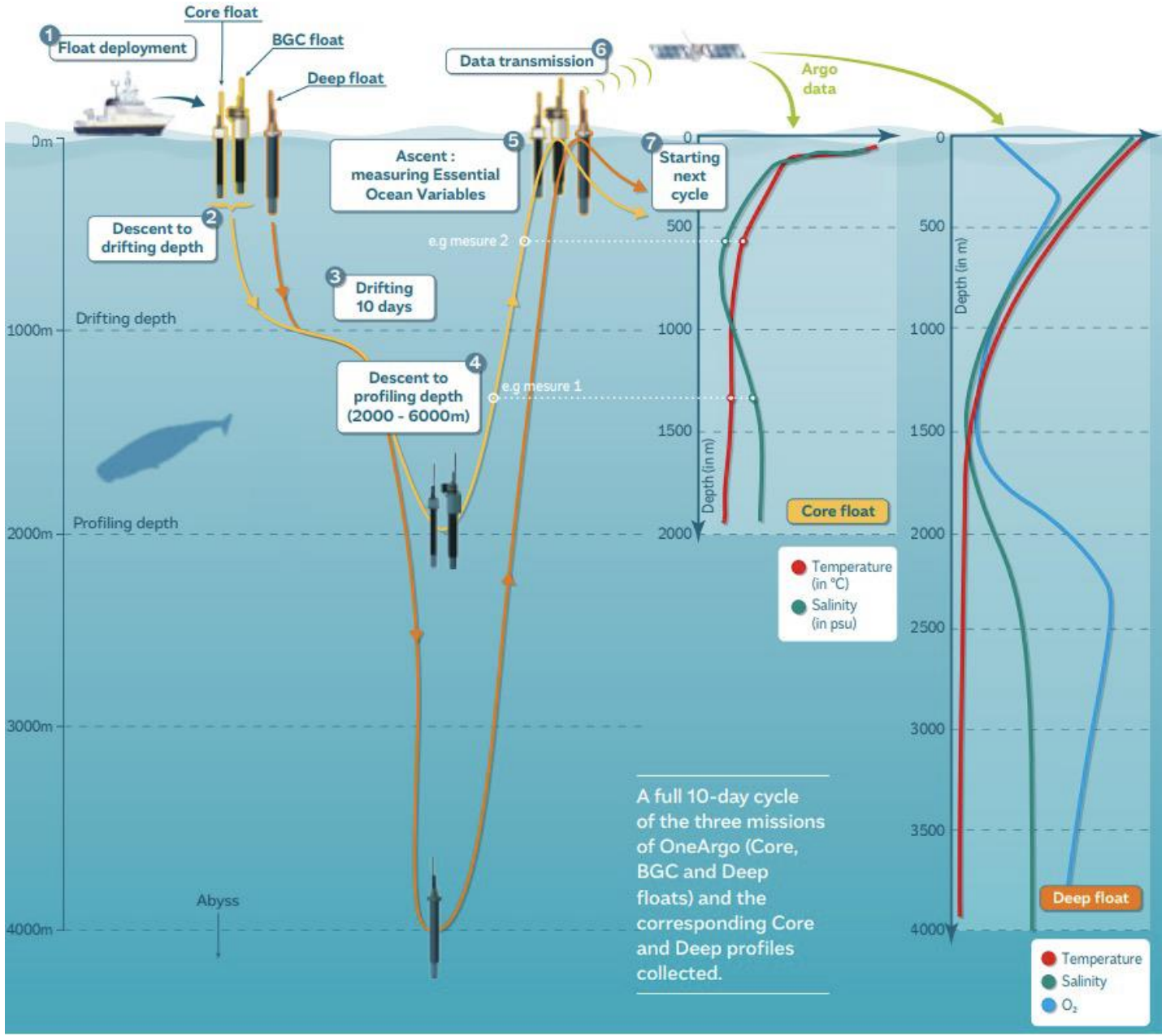
Argo floats

- Diverse types/manufacturers
- **Core parameters**
  - Temp, Sal, (Oxygen)
- **BGC**
  - Chlorophyll-a, CDOM
  - Backscatter
  - Light
  - Nitrate
- **Deep**
  - Below 2000m – Max. 6000m

Source: Euro Argo

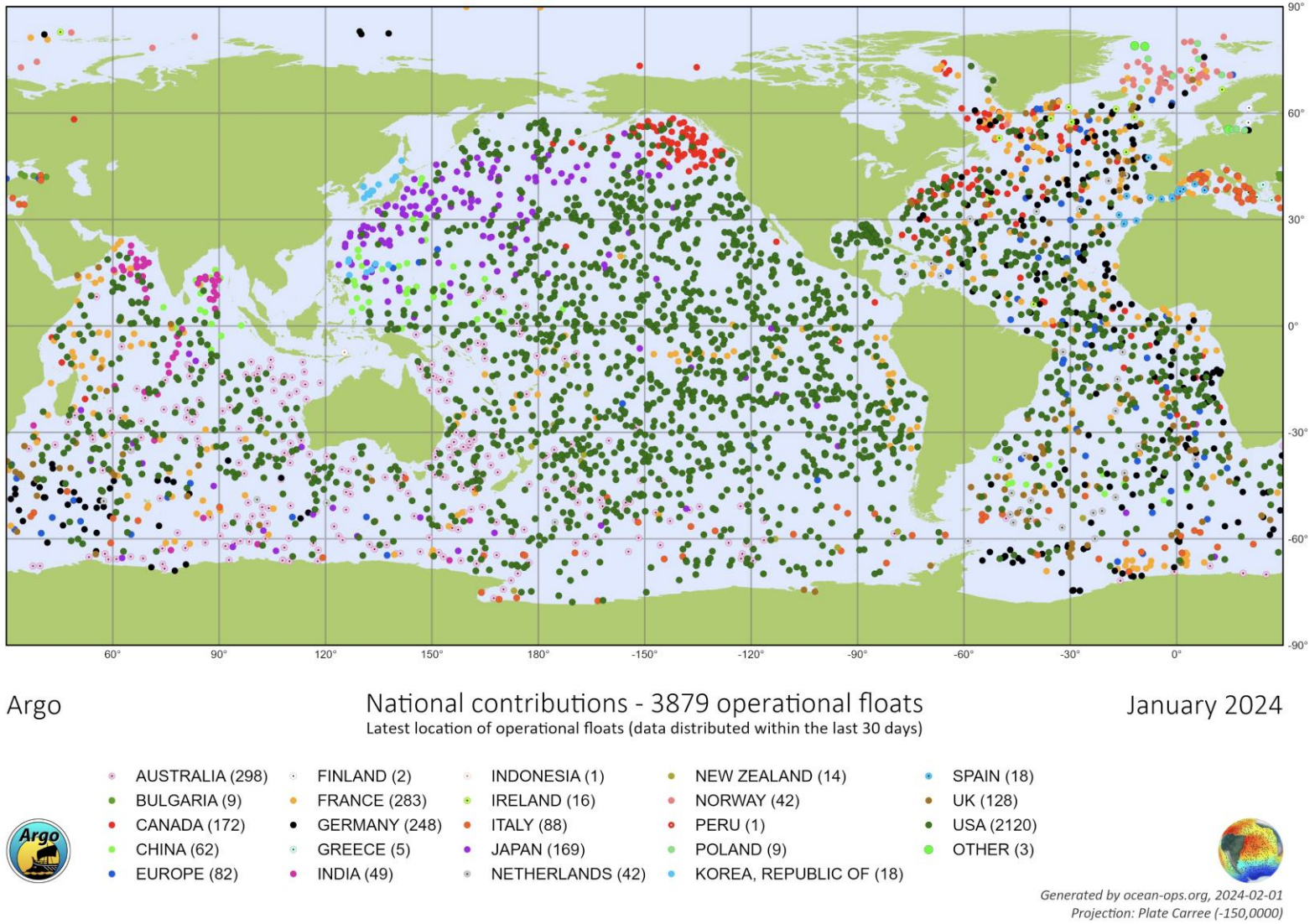
Argo floats

- Deployment from ship
- Start pre-programmed mission
- Conduct a test cycle
- Check GPS and data transmission
- Update configuration or continue mission
- Data becomes available to everybody via global data acquisition centers (GDAC)



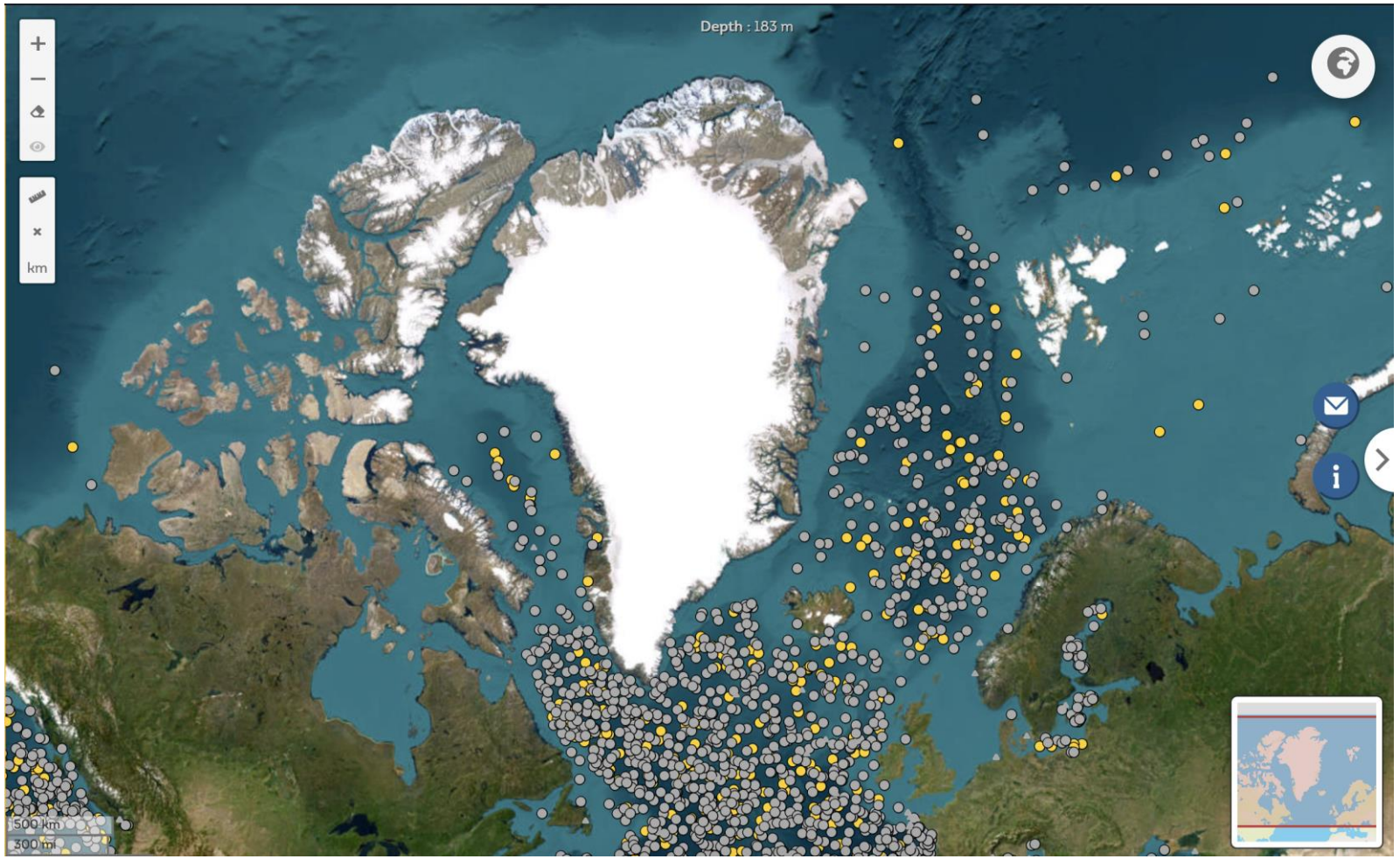
Source: Argo

Argo floats



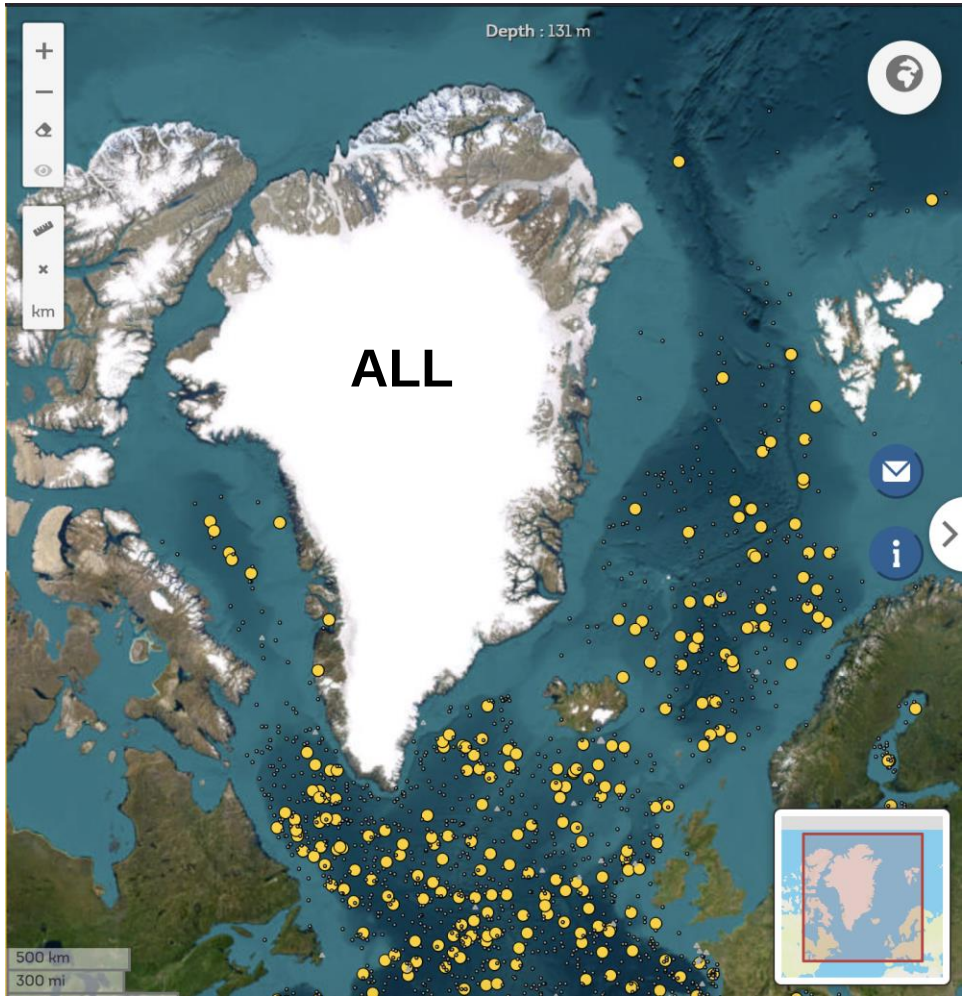
Source: Argo

Argo floats around Greenland



3 Sep 2024 – Source: Argo

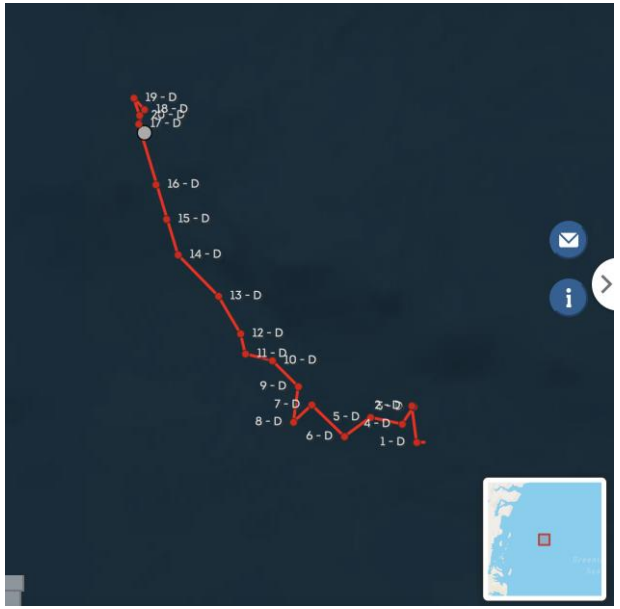
Operational Argo floats around Greenland

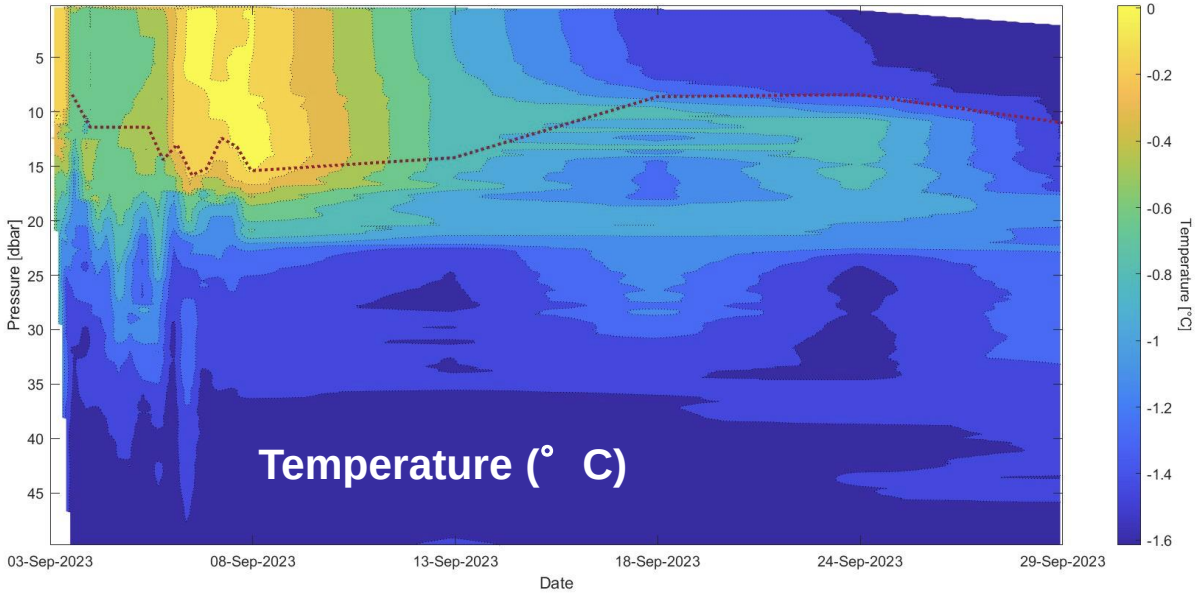


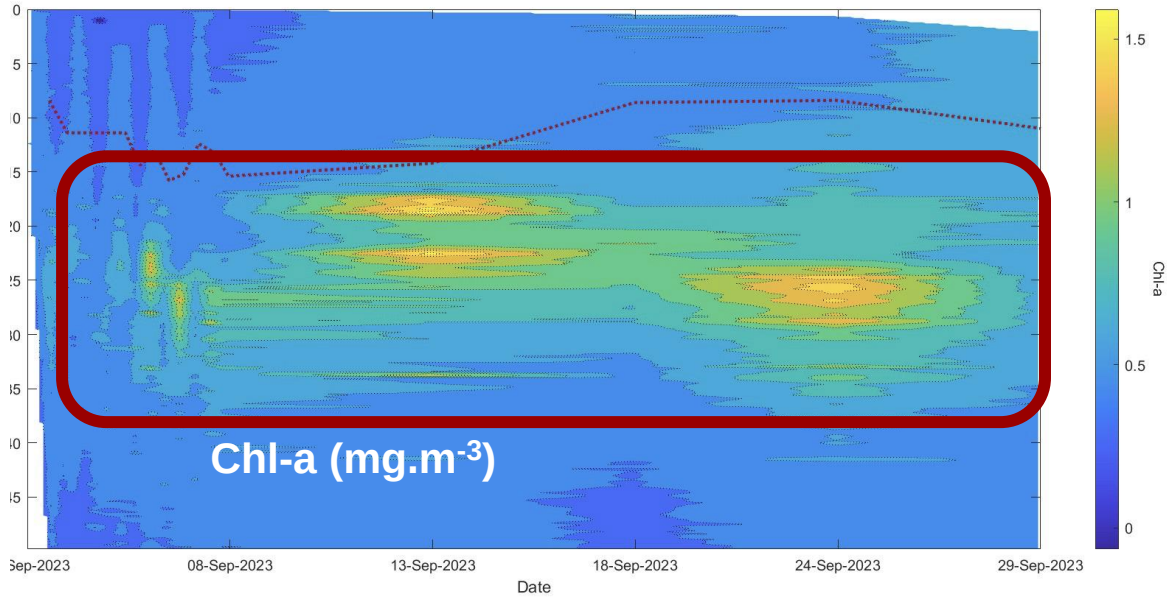
3 Sep 2024 – Source: Argo

Argo measurements around Greenland

- East Greenland Shelf – September 2023
- Sampled for almost one month



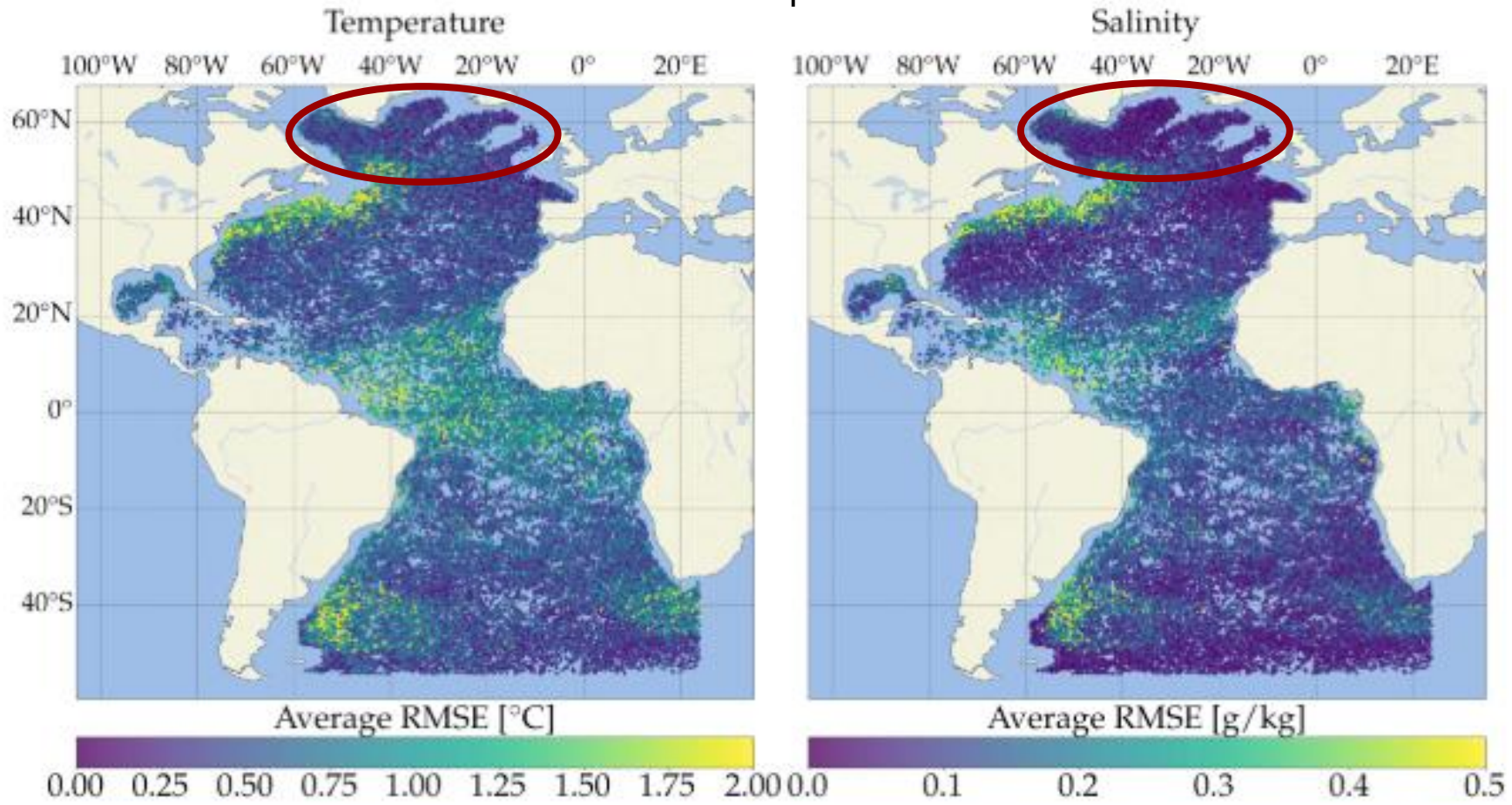




Credits: Bodil Toftegård / Colin Stedmon (DTU Aqua)

Combining Argo and satellite data using AI

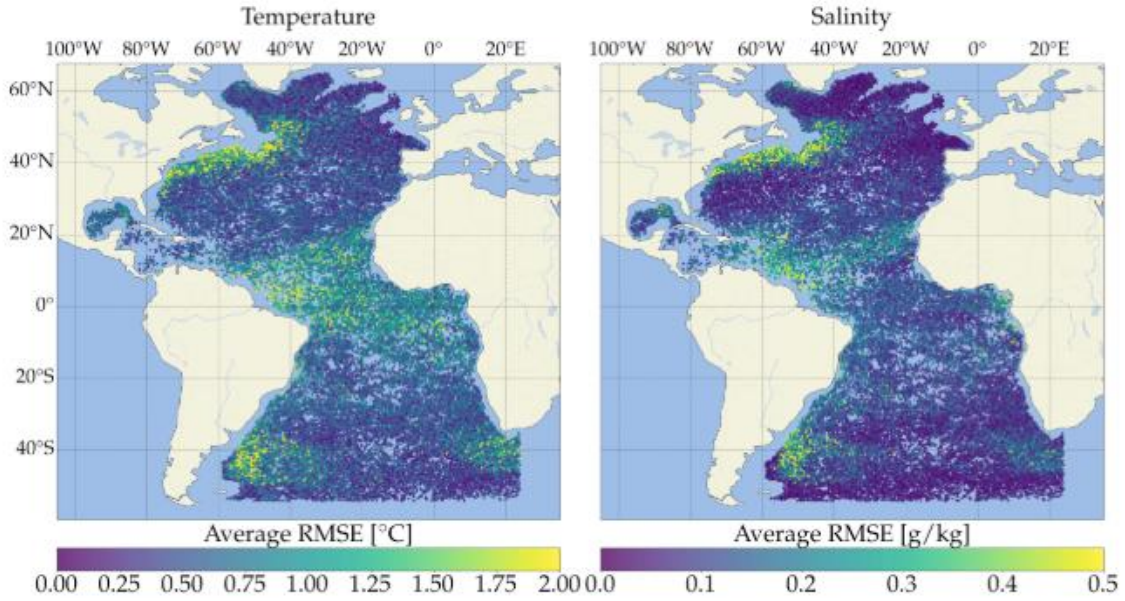
RMSE – top 200m



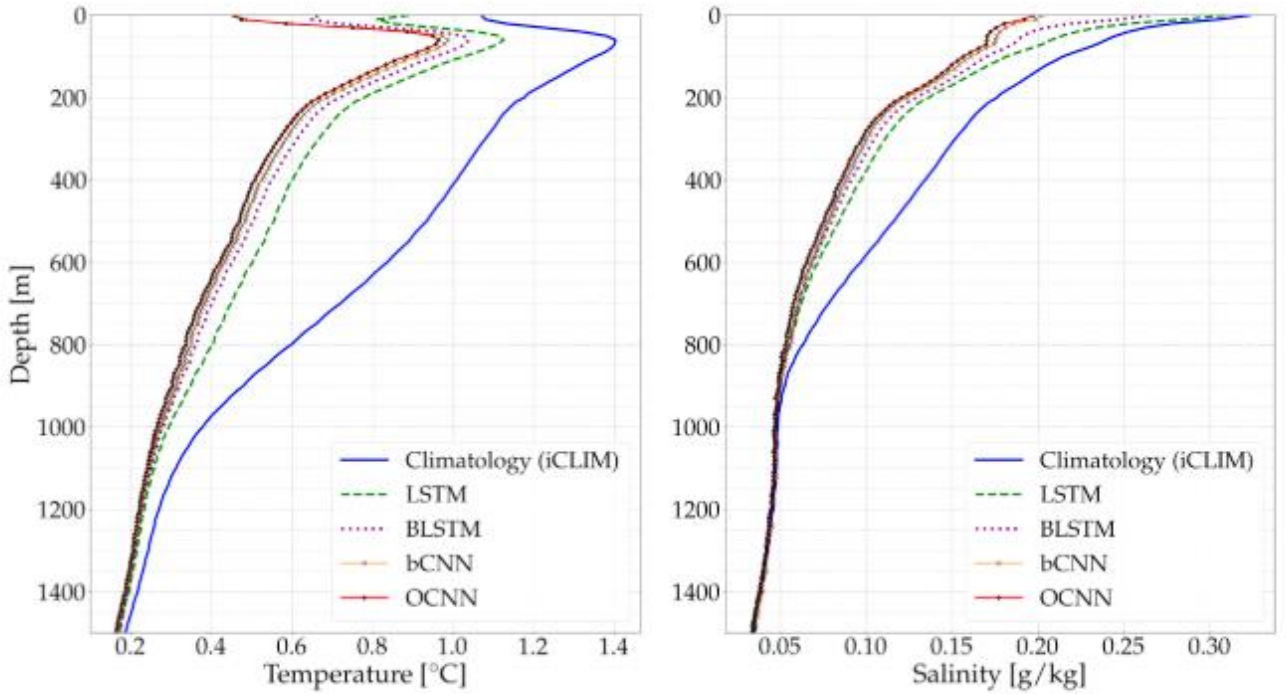
Smith et al. (2023)

Combining Argo and satellite data

RMSE – top 200m



Smith et al. (2023)



Final remarks

- Ocean color → high resolution coverage of the oceans' surface
  - Limitations
  - Need for development of local algorithms for the optically complex fjord waters
    – Employ AI to differentiate the different optical components (e.g., Hieronymi et al 2017)

- Argo floats provide a vertical perspective of the ocean structure

- Combining Argo floats to satellite using AI techniques
  – Solve the puzzle of how to predict vertical distribution of phytoplankton biomass (Chl-a)

- **More initiatives and funding for expanding the observational capacity by Argo floats**
- **Funding for expanding in situ observation for validation and development of local OC algorithms**

Thank you!

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