

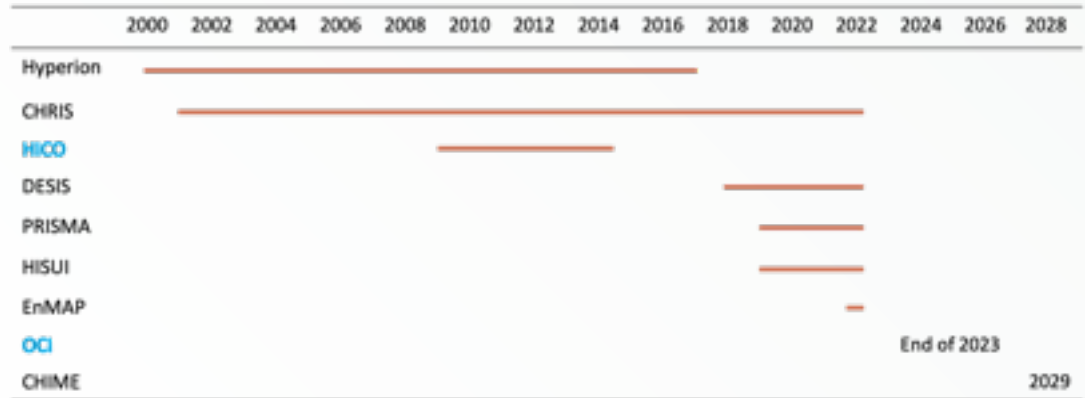
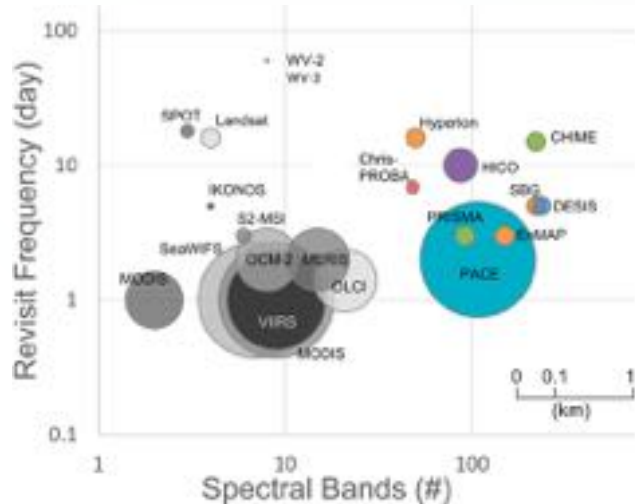
# Water Colour Remote Sensing with Imaging Spectroscopy and Synergistic Sensors: Moving Forward

M. A. Soppa, L. Alvarado, P. Gege, P., S.Loza, I. Dröscher I. and A. Bracher



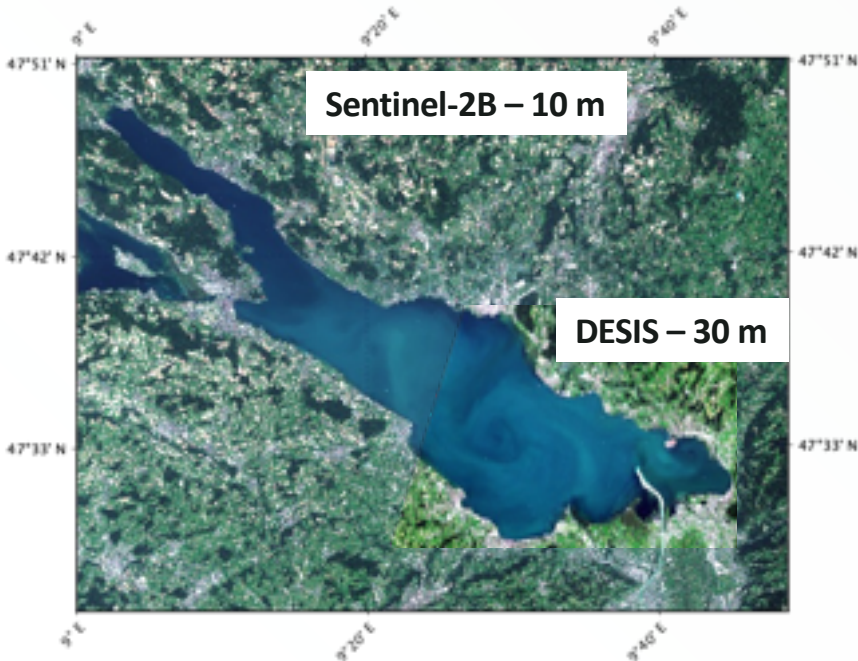
# Hyperspectral Missions

- ✓ Several missions have started since the launch of the first hyperspectral spaceborne sensor - Hyperion, BUT no single mission can satisfy all water applications.



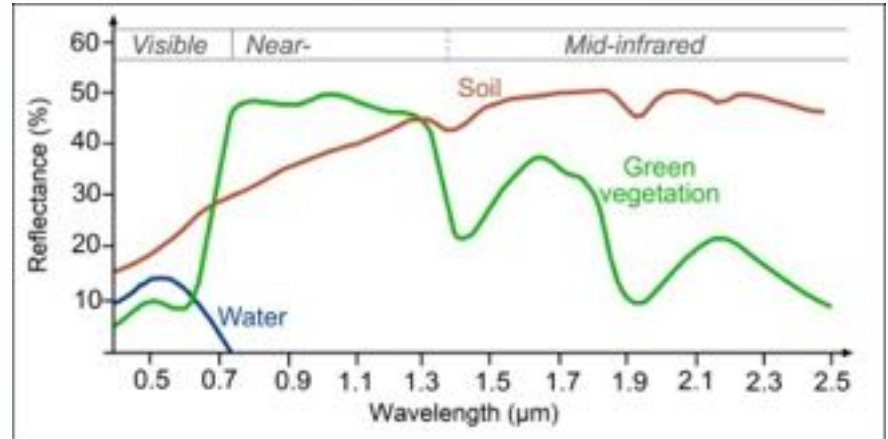
# Aquatic Ecosystems

Highly dynamic



Lake Constance RGB - 14.08.2021

Dark surfaces require enough signal-to-noise and large dynamic range

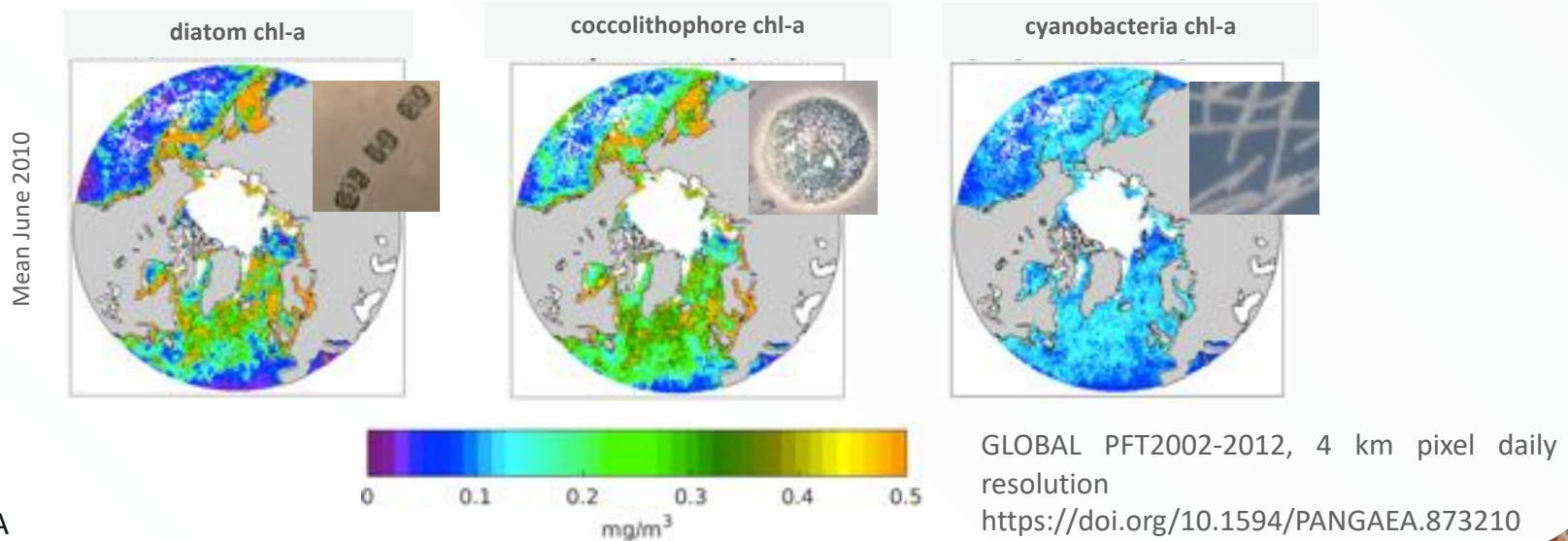


<https://seos-project.eu/classification/classification-c01-p05.html>

# SynSenPFT Project (2014 -2016)



- *Synergistic Exploitation of Hyper-and Multispectral Sentinel-Measurements to Determine Phytoplankton Functional Types (PFT) at Best Spatial and Temporal Resolution*
- SCIAMACHY with 1 nm resol. and about 0.5 deg pixel size merged with OC-CCI data set with 6 bands and 4 km resolution.

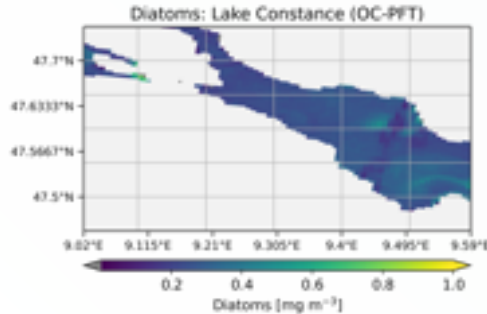


# TypSynSat Project (2019 -2022)

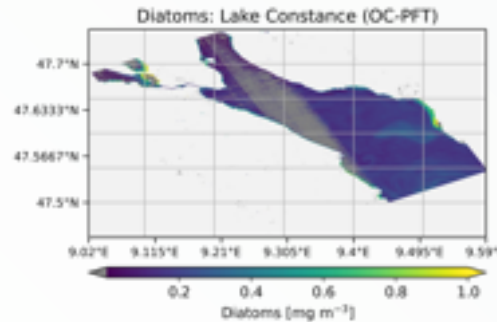
- Monitoring the Phytoplankton Functional Types (PFTs) by Synergistic Exploitation of Multi- and Hyperspectral Satellite Observations

Diatoms

OLCI

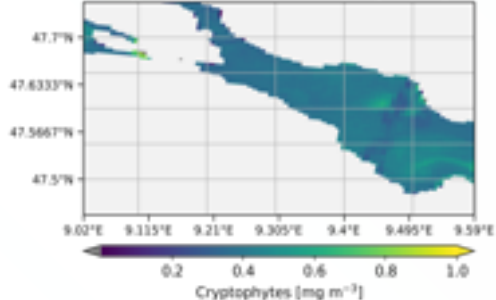


DESIS

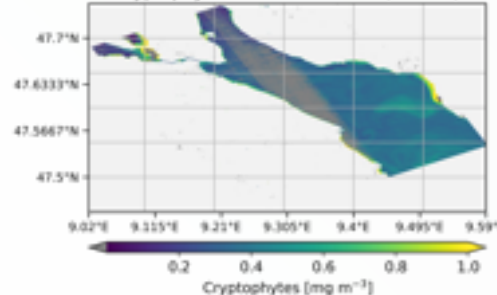


Cryptophytes

Cryptophytes: Lake Constance (OC-PFT)



Cryptophytes: Lake Constance (OC-PFT)



OLCI and DESIS PFT retrievals using OC-PFT empirical algorithm in 06.08.2020

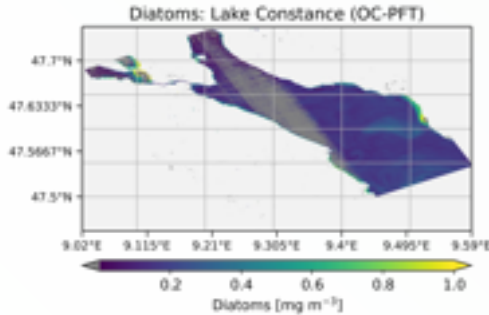
Alvarado, L. et al. 2022. Retrievals of the Main Phytoplankton Groups at Lake Constance Using OLCI and Evaluated with Field Observations. 12th EARSeL Workshop on Imaging Spectroscopy, Potsdam, Germany, 22 June 2022 - 24 June 2022 .

# TypSynSat Project (2019 -2022)

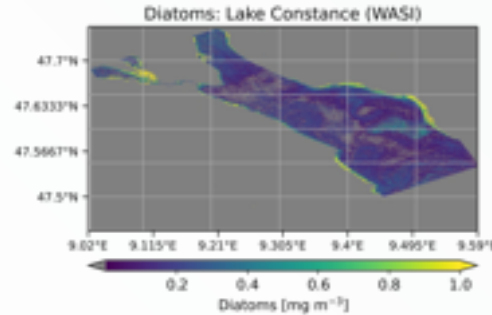
- Monitoring the Phytoplankton Functional Types (PFTs) by Synergistic Exploitation of Multi- and Hyperspectral Satellite Observations

Diatoms

## OC-PFT (Polymer AC)



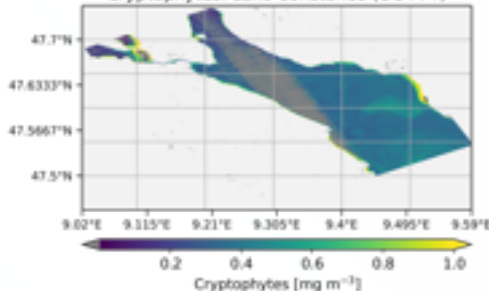
## WASI (PACO AC)



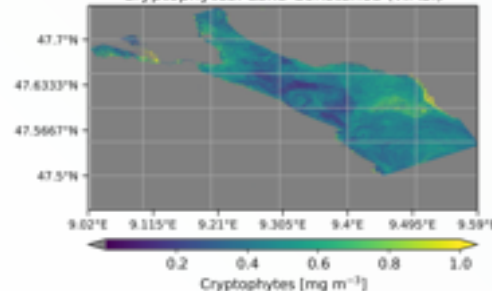
Different atmospheric correction and PFT algorithms

Cryptophytes

## Cryptophytes: Lake Constance (OC-PFT)



## Cryptophytes: Lake Constance (WASI)



# PhySyn Project: Synergy between ocean colour and biogeochemical and ecosystem models (2015 – 2019)

- Biogeochemical models struggle to reproduce the dynamics and co-existence of key phytoplankton functional types (PFTs) in the polar regions.

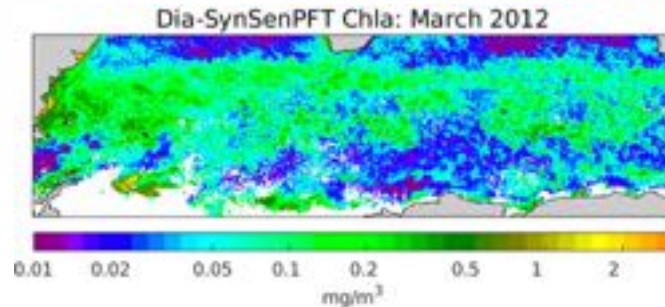
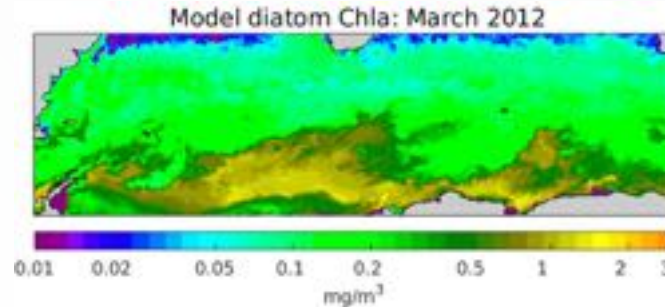
Remote sensing on  
phytoplankton abundance  
& diversity



Improve phyto-plankton  
modelling especially in  
Polar Regions



Assess feedback & impact of  
surface BGC (phytoplankton  
diversity, radiation,...) to  
climate change



Losa et al. 2019. On modeling the Southern Ocean phytoplankton functional types. Biogeosciences Discussions, <https://doi.org/10.5194/bg-2019-289>

# Final remarks: critical needs

- **In situ measurements:**
  - **hyperspectral radiometric measurements** over waters for validation and algorithm development;
  - **ship based** and **fixed autonomous** stations as AERONET-OC, WATERHYPERNET, WISPstation network, Lucinda Coastal Observatory, Datalakes, Moby and Boussole bio-optical buoys.
- **Satellite sensors:**
  - dedicated sensors with large dynamic range;
  - high signal-to-noise ratio.
- **Round robin exercises** (algorithms and *in situ* measurements).
- **User community Training:** HyperEdu



<http://lucinda.it.csiro.au/>



Funding: BMWi/DLR, H2020



# Summary

- ✓ **Synergies:** Hyper and multispectral sensors, but also remote sensing and biogeochemical and ecosystem models, and *in situ* measurements.
- ✓ **Support** for acquisition of **hyperspectral radiometric data** in coastal and inland waters for fixed automated stations for **improving sensor calibration**.
- ✓ Check out:
  - ✓ the **EnMAP-Box**: <https://enmap-box.readthedocs.io/en/latest/>
  - ✓ **HyperEdu** <https://eo-college.org/courses/beyond-the-visible/>
  - ✓ **Massive Open Online Course (MOOC)**: collection of videos and interviews <https://www.youtube.com/channel/UCxseMj2r9jMDq-LjKzUOIVg>

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Thank you!