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

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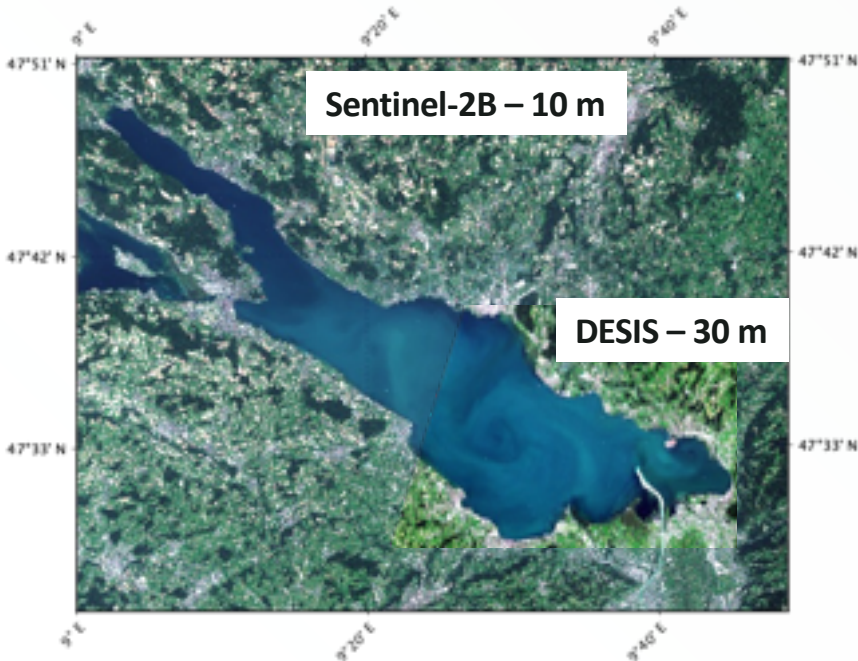
Hyperspectral Missions

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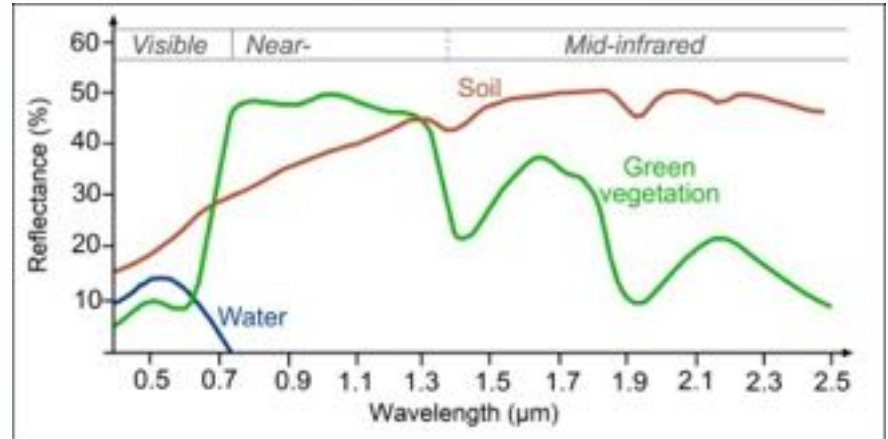

Image reprinted from Dierssen et al. (2021).
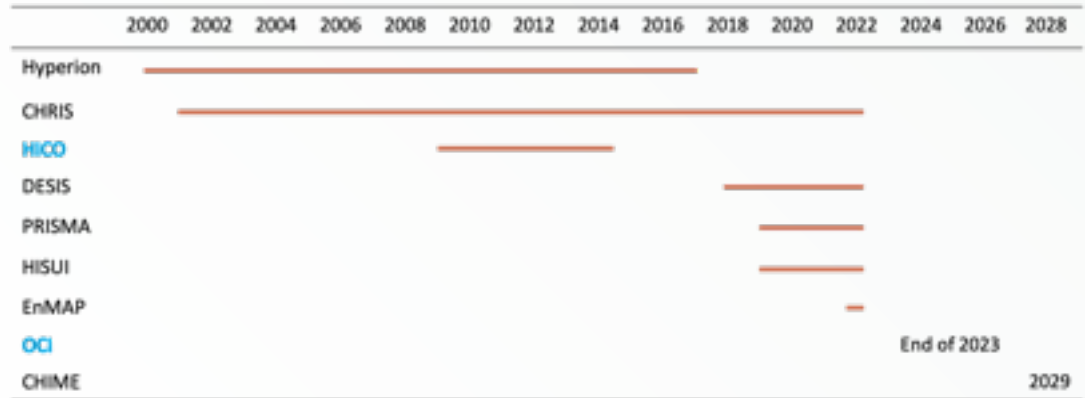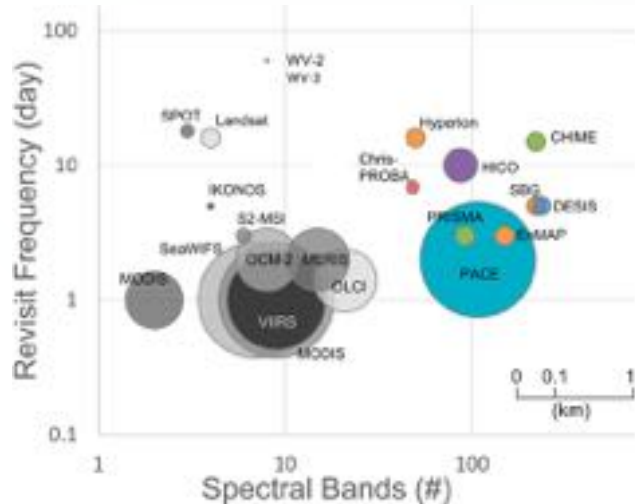
Aquatic Ecosystems

Highly dynamic

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

Lake Constance RGB - 14.08.2021

Sentinel-2B – 10 m

DESIS – 30 m

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.
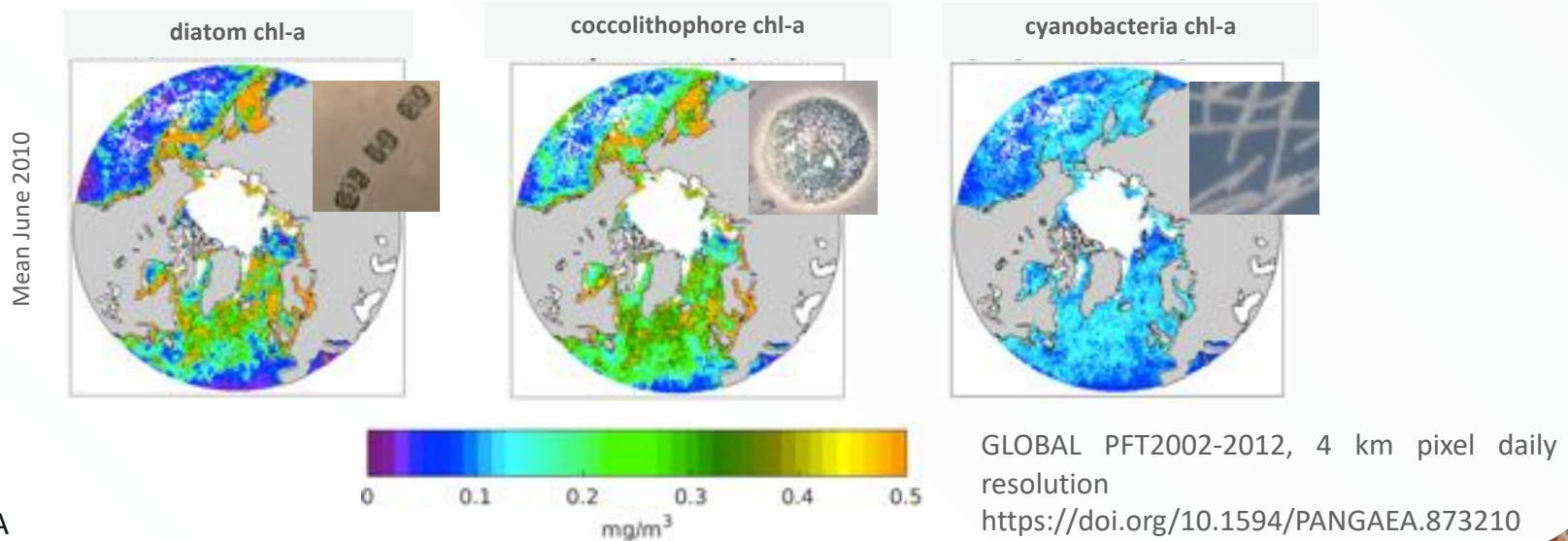
GLOBAL PFT2002-2012, 4 km pixel daily resolution
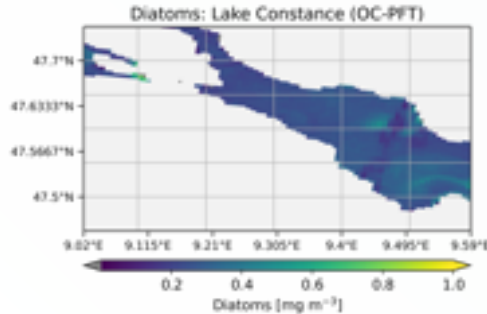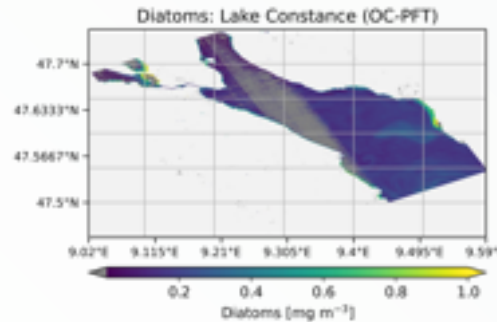https://doi.org/10.1594/PANGAEA.873210

TypSynSat Project (2019 -2022)

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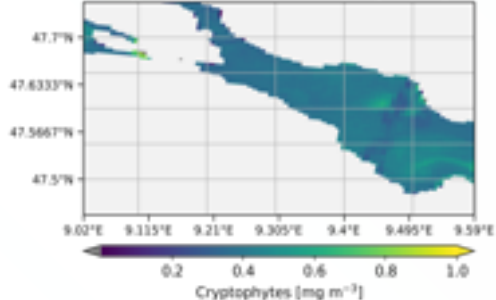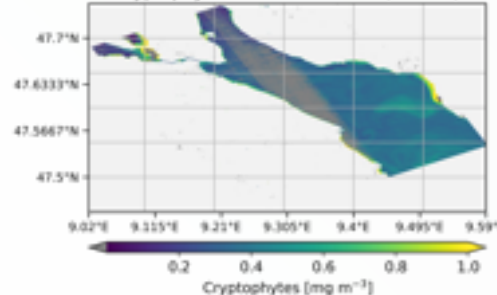
OLCI

DESIS

Diatoms

Cryptophytes

**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 .
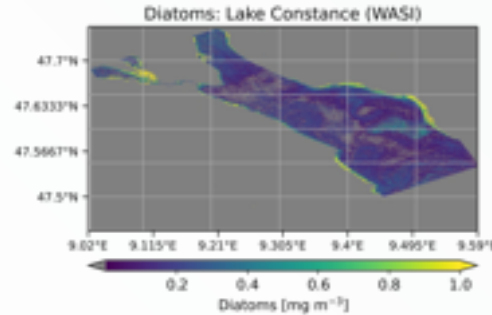
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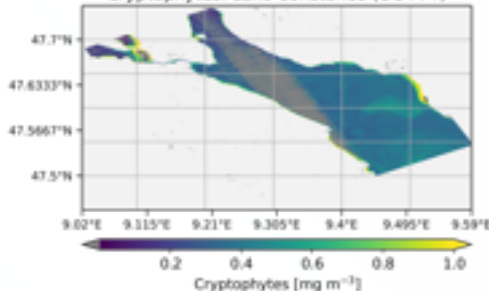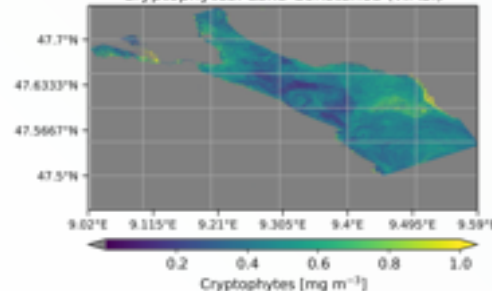

OC-PFT (Polymer AC)   WASI (PACO AC)

Diatoms
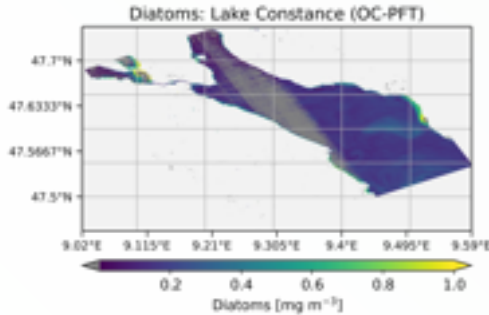
Cryptophytes

Different atmospheric correctionand PFT algorithms

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.
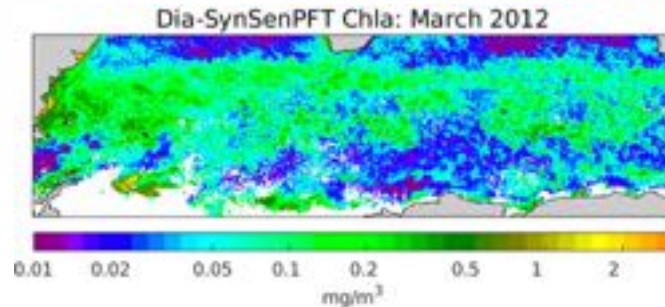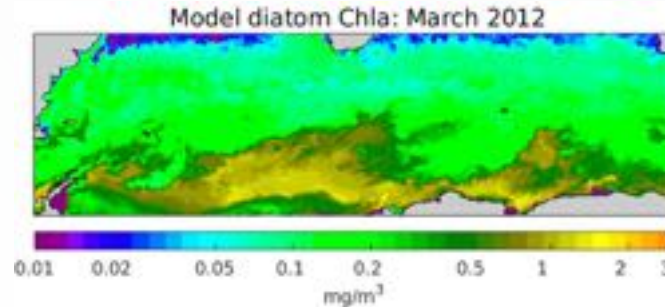
Remote sensing on phytoplankton abundance & diversity

↓

Improve phyto-plankton modelling especially in Polar Regions

↓

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

Model diatom Chla: March 2012

0.01 0.02 0.05 0.1 0.2 0.5 1 2 3
mg/m³

Dia-SynSenPFT Chla: March 2012

0.01 0.02 0.05 0.1 0.2 0.5 1 2
mg/m³

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/

By Stefan Plattner

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

Acknowledgements

Thank you!