Synthetic data sets from modelling with Hydrolight, GIOP and coupled atmosphere-ocean RTM SCIATRAN

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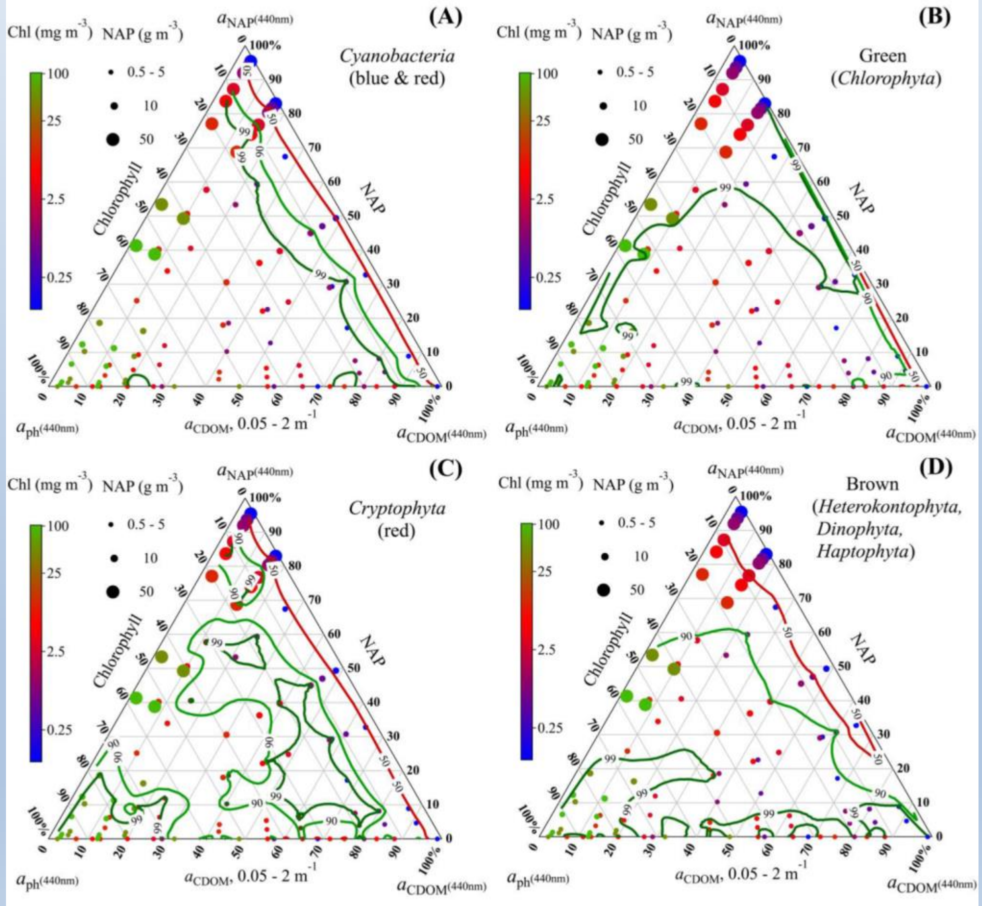
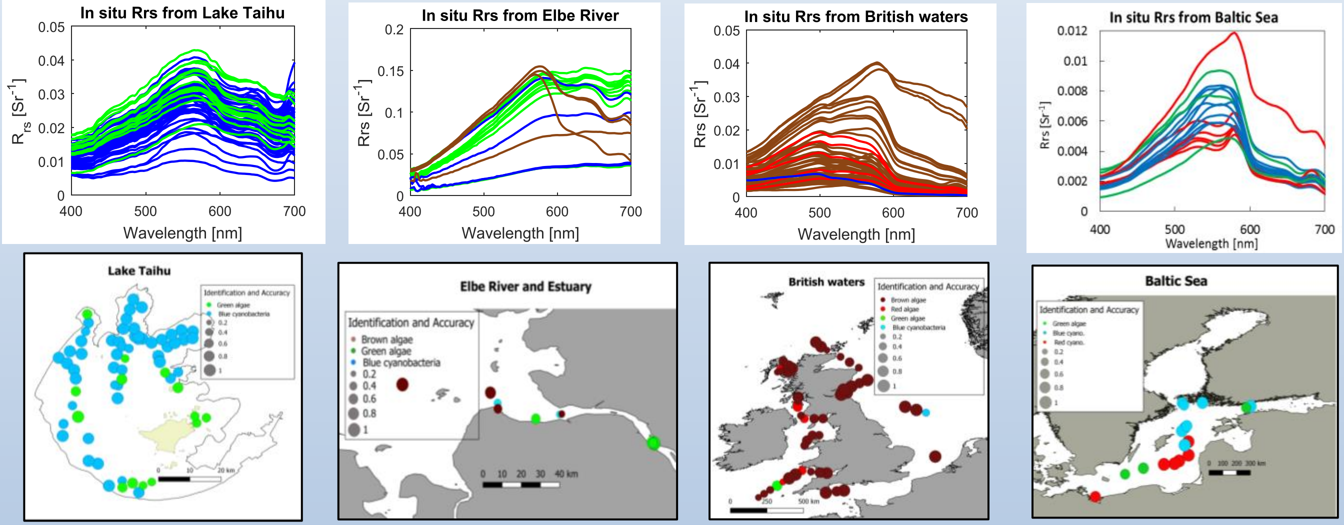
HydroLight simulated hyper. Rrs for phytoplankton group identification

(Xi et al., 2015, 2017)

- Main goal is to identify dominant phytoplankton groups in natural waters
- **C2X database** – **Hydrolight simulated** with 100,000 diverse water optical conditions with five phytoplankton groups included

Approach test with in-situ datasets





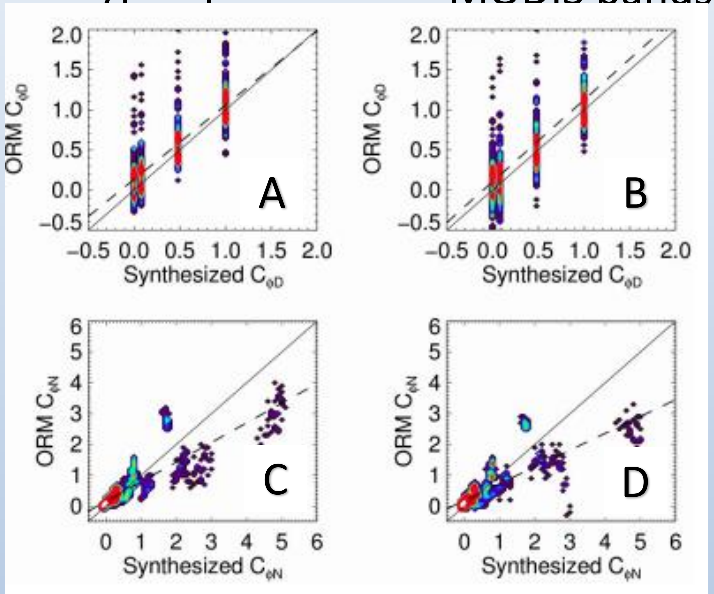
Successful at most optical occasions except for waters

- with <u>low phytoplankton contribution to the total non-water absorption</u>
- <u>dominated by non-algal particles</u>

GIOP – Ocean color Inversion models for PFT retrieval with synthetic Rrs (hyper- / multi-spectral)

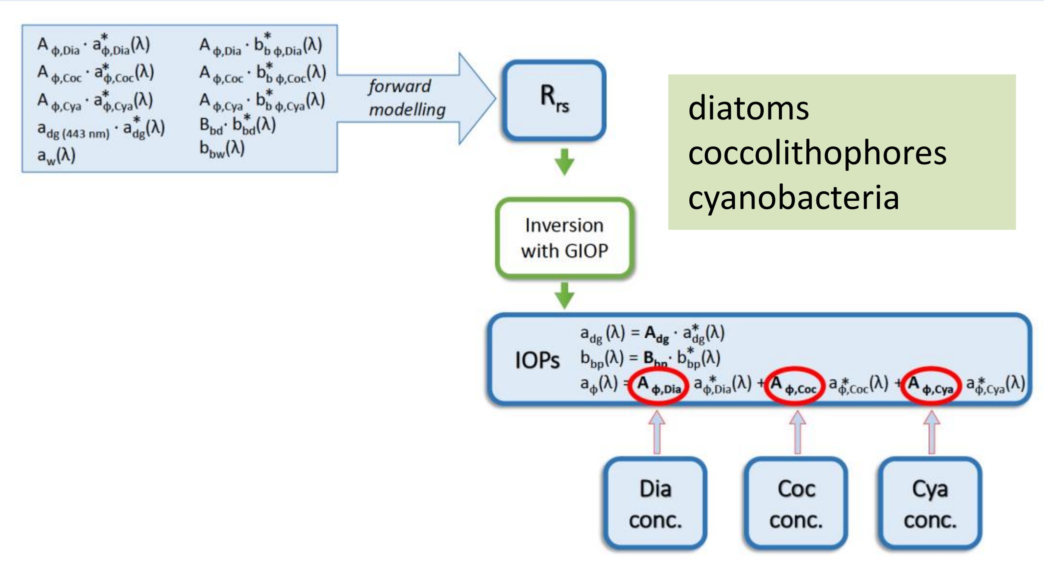
GIOP for retrieving diatoms and noctiluca (Werdell et al. (2014)

Hyperspectral MODIS bands

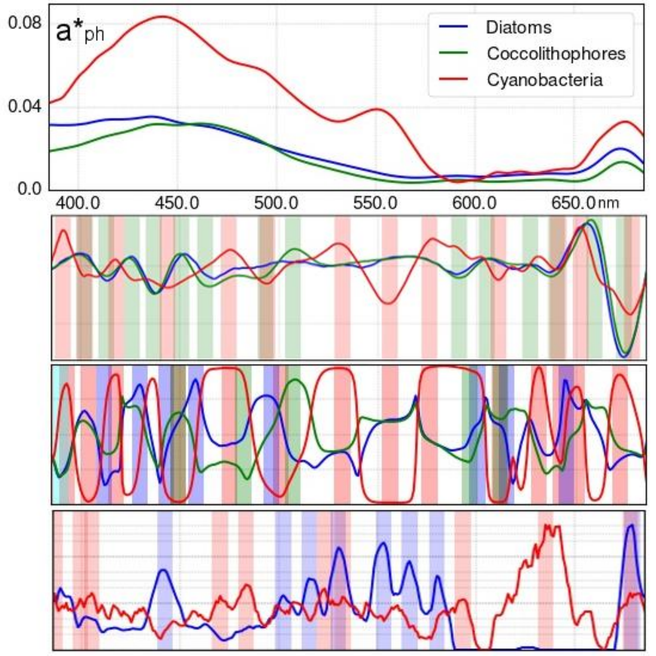


Ground truth (synthesized) versus GIOP retrieved concentrations of Diatom and Noctiluca

- Able to separate the N. miliaris and diatoms;
- Biased absolute estimates even under perfectly controlled conditions.



Spectral band requirements for PFT retrievals (Wolanin et al. 2016)



1. Hyperspectral data most beneficial for multiple PFTs
2. Sensors: MERIS best for diatoms & cyano., SeaWiFS for cocco.
3. No single bands setting led to best retrievals for all PFTs.
4. Adding bands to OLCI to enable optical retrievals of this 3 PFTs
5. Choice of band settings depends on chosen method/internal variability of the dataset/different PFTs (drive different spectral changes)

Coupled ocean-atmosphere RTM for testing sensitivity of hyper-spectral PFT retrievals: Examples SCIATRAN used for PhytoDOAS*

*Bracher et al. 2009,Sadeghi et al. 2012

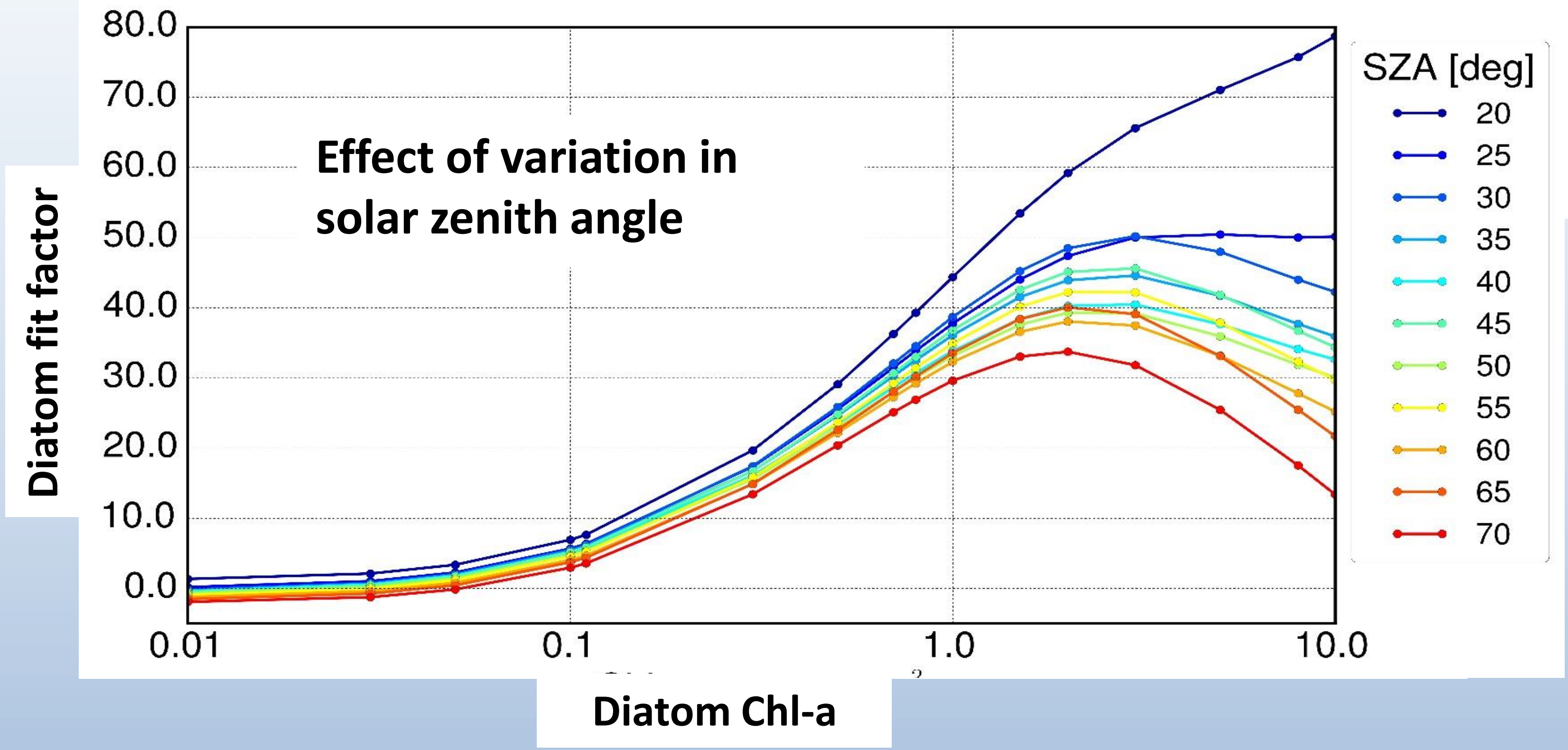
SCIATRAN

Rozanov et al. 2002, 2014 & 2017

http://www.iup.uni-bremen.de/sciatran/

Spectral range: 0.18–40µm

Rayleigh scattering
Absorption & scattering by aerosols & clouds
Absorption by gases
Surface effects (roughness)
Particle scattering
Elastic & inelastic scattering and absorption of water
CHL & DOM fluorescence
CDOM, CHL or PFT-CHL absorption
Ocean-Atmosphere interaction



RTM testing for Losa et al. Front. Mar. Sc. (2017); data set: Bracher et al. (2017) doi.pangaea.de/10.1594/PANGAEA.870486

Summary

- Major achievements
  - Synthetic data can represent well various optical conditions with multiple phytoplankton groups
  - PFT identification using synthetic data (e.g. HL) sets is possible
  - RTM is an effective way to test the sensitivity of PFT retrieval from hyperspectral data
- Gaps and questions
  - Though under well controlled conditions, absolute quantitative PFT retrievals remain challenging
  - Spectral resolution: band study shows the spectral requirements to obtain PFT from ocean colour data are beyond current multispectral sensors specifications
  - Limited knowledge of backscattering properties of PFTs. Complete data set for b_{bph} measurements from various phytoplankton types?
  - High similarity in a_{ph} spectra from different phytoplankton groups limited the capability of semi-analytical algorithms (e.g. GIOP) in accurately decomposing the phytoplankton absorption, resulting in unstable retrievals with > 2 PFTs as unknowns
  - Determination of a_{ph}^* for phytoplankton groups ($a_{ph}^* = a_{ph}/C_{chl\text{-}a}$): amplitude influenced by $C_{chl\text{-}a}$?
  - Satellite hyperspectral data versus synthetic data