Polar Ocean Phytoplankton diversity

Investigating the biogeochemistry of the high latitudes during the period of rapid change: modelling and satellite retrievals

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In Short

- Polar regions
- Long time series of chlorophyll *a* for different PFTs
- Satellite retrievals and numerical modeling

The aim of this computing project is to obtain long-term (over decades) time series of ocean biogeochemical model simulations and satellite retrievals to analyse the changes in biodiversity and biogeochemical cycling observed over the last 20–30 years in the Polar regions (the Southern and Arctic Oceans) and to improve our understanding of possible interactions between the open water, sea ice, snow, ocean biogeochemistry and ecosystem and chemical composition of the Atmospheric Boundary Layer under the recently observed climate changes. Within the HLRN project, the coloured dissolved organic matter (CDOM) and phytoplankton dynamics as well as phytoplankton diversity in response to Arctic Amplification are simulated with the biogeochemical model Darwin [1] and REcoM [2] coupled to the Massachusetts Institute of Technology General Circulation Model (MITgcm, [3]). Satellite retrievals of chlorophyll *a* concentrations (Chla) for various phytoplankton functional types (PFTs) – diatoms, coccolithophores, cyanobacteria - are derived based on synergistic use (SynSenPFT, [4]) of multi-spectral-based [6,7] and hyper-spectral-based [9,10] phytoplankton absorption information. The SynSenPFT (Figure 1) will be further extended and updated to account for more information from current hyper-spectral (OMI) measurements and new multispectral Sentinel-3 data with better spatial and temporal coverage. The combined model and satellite-derived information on PFTs and CDOM absorption [8] will be used to investigate existing relationships and feedbacks between the Arctic climate change, the ocean biogeochemistry and atmospheric oxidative capacity, which is one of the scientific tasks of the related project "**A**rti**c** **A**mplification: **C**limate Relevant **A**tmospheric and Surfa**C**e Processes, and Feedback Mechanisms **(AC)^3**" within the establishment of Transregional Collaborative Research Centre TR 172. The time series of the satellite PFT Chla retrievals and MITgcm-Darwin biogeochemical model integrations (over the period of 1991 – 2016) for the Southern Ocean are to support the DFG research "Antarctic phytoplankton in response to environmental changes studied by a synergetic approach using multi- and hyper-spectral satellite data (PhySen)" within the framework of the DFG-Priority Program 1158 "Antarctic Research".

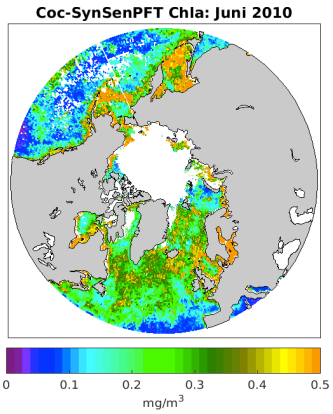

Figure 1: *SynSenPFT retrievals of coccolithophores Chla.*

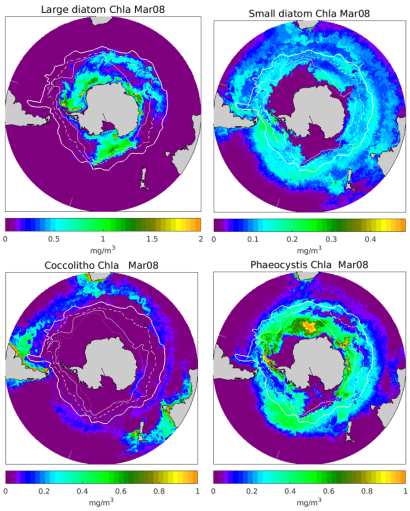

Figure 2: *Simulated spatial distribution of the dominant phytoplankton groups in the Southern Ocean.*

For independent evaluation of the model and satellite retrieved PFT data we use *in situ* marker phytoplankton pigments determined with high precision liquid chromatography (HPLC) sampled and compiled by AWI "Phytooptics" team in cooperation with other researchers from AWI since 2009 onwards [11] and within the currently running HGF-project FRAM in the Arctic Ocean (Greenland Sea, Laptev Sea, Central Arctic).

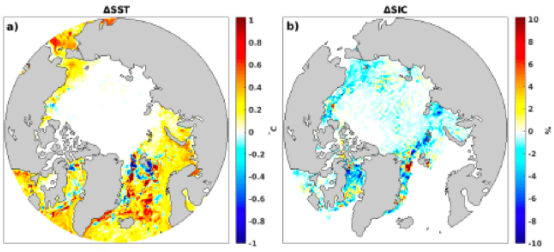

Figure 3: *Differences in the simulated Summer 2004 spatial distribution of sea surface temperature (SST) and sea ice concentration (SIC) due to CDOM absorption inclusion in shortwave radiation penetration.*

With the use of allocated NPLs we configurated the Darwin-MITgcm allowing for significantly improved simulations of the observed PFTs in the Southern Ocean (Figure 2), which was supported by *in situ* as well as by satellite derived information (SynSenPFT, [4]) and PFT Chla given OMI and Global Ozon Monitoring Experiments – 2 (GOME-2) measurements [5]. For the Arctic Ocean, we conducted a series of initial experiments with biological feedbacks to the sea-ice and ocean physics explicitly inroduced (Figure 2).

WWW

https://www.awi.de/ueber-uns/organisation/mitarbeiter/astrid-bracher.html

More Information

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