Sprinter 10

Phytoplankton community structure from ocean colour: methods, validation, intercomparison and application

Co-chairs: Astrid Bracher (Uni Bremen/AWI), Takafumi Hirata (Hokkaido University)

IOCS meeting
6-8 May 2013 Darmstadt Germany

International Ocean Colour Science Meeting 2013 | Advancing Global Ocean Colour Observations

Goal of Splinter 10 -Phytoplankton community structure from ocean colour

Report community efforts to derive PFTs from in situ / satellite measurements

Seek a way to bring PFT products to operational

Seek a community consensus as to current knowledge of PFT retrieval from OC

Agenda Splinter 10 -Phytoplankton community structure from ocean colour

1. Welcome & Goal of Session (T. Hirata-HU)

2. Update of IOCCG working group PFT- satellite types (S. Sathyendranth-PML/Bedford)

3. Overview PFT satellite products (A. Bracher-AWI/N. Hardman-Mountford-CSIRO)

4. In situ/laboratory classification of phytoplankton types – data base: efforts/goals (L. Clementson-CSIRO)

5. Validation/Intercomparison of PFT satellite products (T. Hirata-HU/T. Kostadinov UR/R. Brewin- PML/S. Lavender Pixalytics)

6. Application of PFT satellite products in ecosystem modeling (C. Rousseaux-NASA)

IOCCG Working Group on Phytoplankton Functional Types

Shubha Sathyendranath (PML)

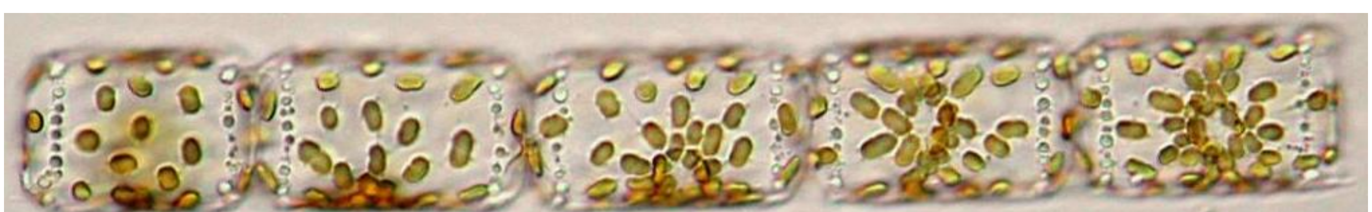
Established in 2006 with Cyril Moulin as Chair

Chair passed on to Shubha Sathyendranath in 2008

Terms of Reference of the WG (on IOCCG website):

Prepare a report to be published within the IOCCG series.

Report underway (most chapters finished) to consider relevance, definition, current understanding, review existing techniques, compare algorithms, applications including primary production, biogeochemical models, recommendations



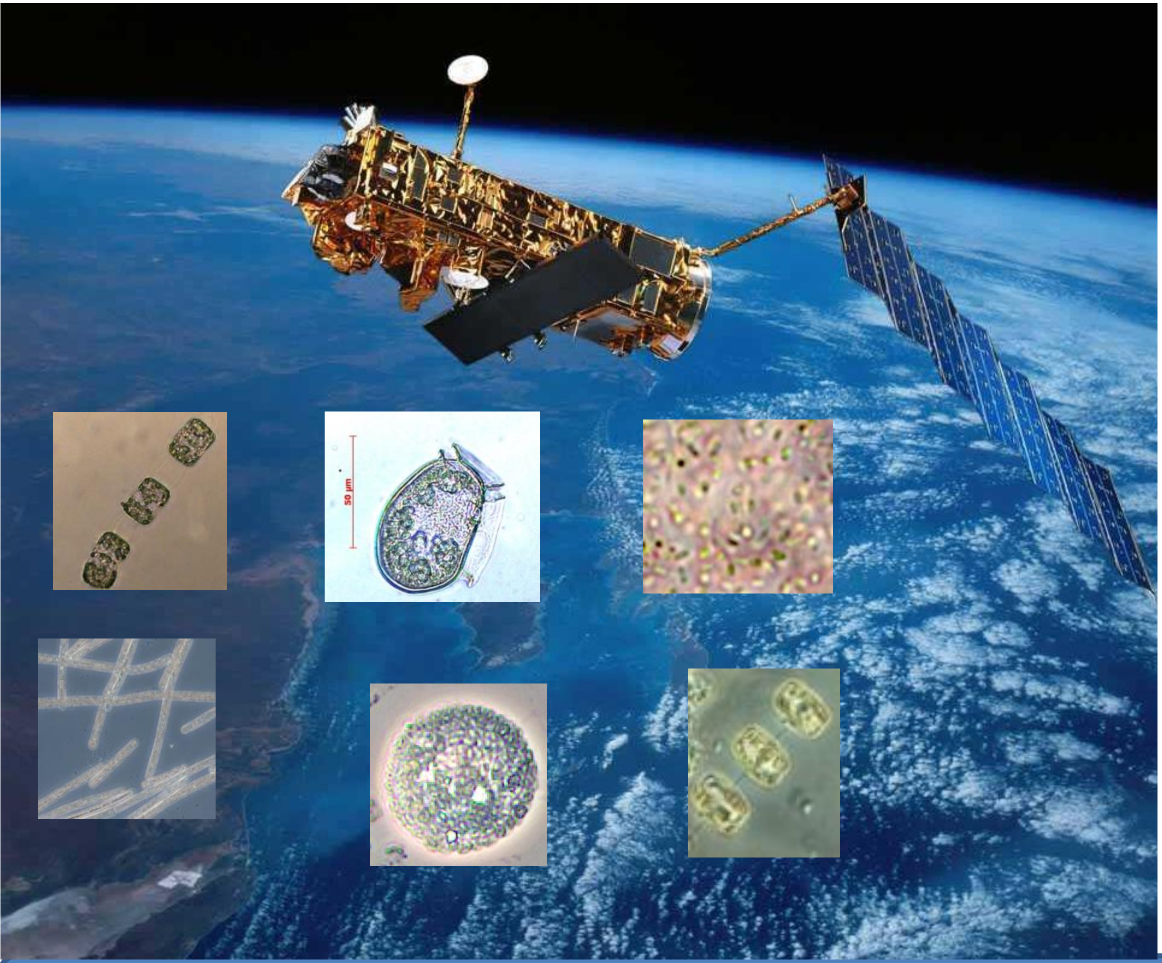
Phytoplankton group products from ocean colour satellite data

Universität Bremen

AWI

Astrid Bracher, Nick Hardman-Mountford

CSIRO



Contributions from: Robert Brewin (PML), Astrid Bracher (AWI), Annick Bricaud (LOV) & Aurea Ciotti (INPE), Cecile Dupoy (IRD), Taka Hirata (HU),Toru Hirawake (HU), Tiho Kostadinov (UR), Emmanuelle Organelli (LOV), Dave Siegel (ERI), Shuba Sathyendranath (PML), Emmanuel Devred (UL)

Overview

Main principles of different phytoplankton groups - basics of different algorithms' approaches

Short overview of current (not complete!!!) multiple phytoplankton functional types (PFT) or size class (PSC) algorithms and satellite products:

a) Abundance based - biomass/dominance of different PSC/PFT:
- **using chl only (combined with a443)**
- **empirical reflectance ratios (via marker pigments conc.)**

b) Spectral
- **reflectance anomalies - dominant PFT**
- **size-class specific phytoplankton absorption (and bbp) - PSC conc.**
- **PFT absorption spectra (hyperspectral!) - PFT conc.**
- **particle backscatter to infer particle size distribution**

Summary

Summary

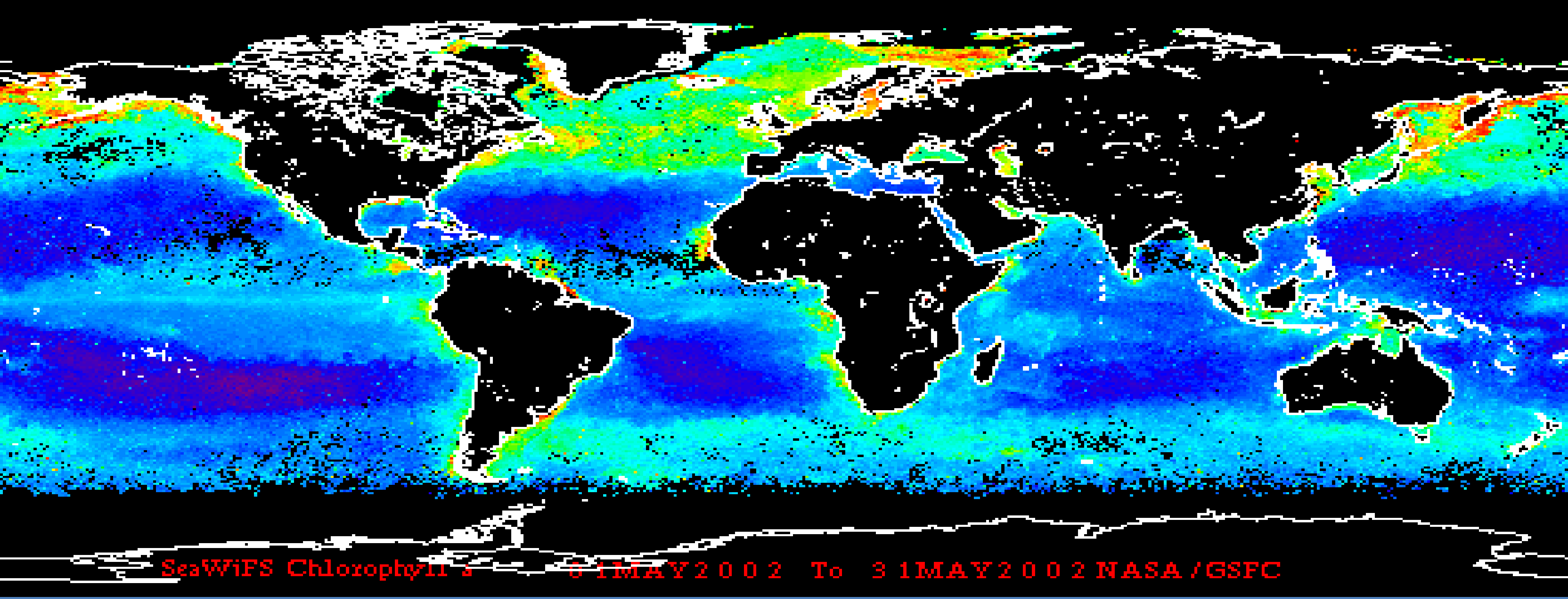
Variety of approaches shown to get multiple phytoplankton size class (PSC) or functional type (PFT)

Techniques to retrieve the abundance or spectral differences of PSC or PFTS range from
- fast and simple (abundance) versus getting direct physiological interpretation via spectral variations
- purely empirical to more theoretical/physical (accounting for imprints of PSC or PFTs on radiative transfer)

Most techniques shown were global or with potential for global

Applications of using these satellite PFTs have started, mostly for evaluation of biogeochemical/ecosystem models, also inferring atmospheric emissions

In order to become operational, these algorithms have to be validated, intercompared and adaptated to new sensors in a concise way



In situ/laboratory classification of phytoplankton types - database: efforts and goals

Lesley Clementson (CSIRO), Ray Barlow (BCRE) and Toru Hirawake (HU)

IOCS meeting, Darmstadt, 06-08 May 2013

- **CSIRO MARINE AND ATMOSPHERIC RESEARCH**

International Working Group for PFT Algorithm Development

In-situ data base for validation of phyto-plankton group (PFT) algorithms:

Task evolved within the PFT Algorithm Intercomparison 2nd round group:

• In situ database for the development of robust regional and global algorithms, validation of PFT algorithms and, enhancement of standard global algorithms in the future.

• Get a HPLC data base for PFT validation- international effort:

HPLC is the most commonly used data source in the parameterisation of algorithms.

- relatively large number of data points available in all ocean environments

Challenges:

- Uncertainties involved in the PFT-HPLC data, needs verification by other in-situ data
- Establish data base by gathering data from others, secure citation of data producers

• Database established as the Australian PFT data base (IOCS Poster by Clementson et al.): interrogative database of bio-optical parameters for Australian waters established by the AEsOP project, funded by the EOI-TCP. Maintenance later by agency services?

PFT satellite algorithm intercomparison + validation plan

T. Hirata (Hokkaido Univ., JPN)
R.J.W. Brewin (Plymouth Marine Lab., GBR)
S. Lavender (Pixalytics Ltd, GBR)
T. Kostadinov (Univ. Richmond, USA)

Summary

1. Only Micro & Picoplankton (PSCs rather than PFTs) are common products among 9 algorithms so far – still open to new global algorithms
2. Discrepancy were obvious between SeaWiFS-based PFTs and SCIAMACHY-based algorithms in mission means
3. Optics-based and abundance-based algorithms showed some differences in spatial distribution of PSCs, but our (=satellite algorithm developers) understandings of the spatial distribution seems consistent in general, except for higher latitudes (as expected since even chl-a is not very good there!)
4. Validation exercise of algorithms is being planned against in-situ PFT (HPLC), globally and for time series stations' data
5. Different representation of phytoplankton groups within algorithms (e.g. "Micro" defined by physical size but represented by HPLC(DPA, CHEMTAX), a_{ph}, etc) may largely explain differences/consistencies of the results.

Application of PFT satellite products in ecosystem mo

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[2] Universities Space Research Association, USA
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NOBM Group part of MARine Ecosystem Model Intercomparison Project (MAREMIP)

Exercise of comparison of satellite (Hirata et al. 2011) and NOBM model phytoplankton groups

Will help to improve model parametrizations

Many other ongoing activities of PFT models - algorithms intercomparisons.

NOBM might assimilate the sateliite PFT data as it does now for tot chl-a from SeaWiFS

IOCS Meeting, Frankfurt, 6-8 May 2013

Discussion: actions need international efforts for FUNDING!

Are phytoplankton types (PFT/PSC) products ready for applications?

Can we already study changes, variability and trends of phytoplankton types with the current products?

• For global large-scale biogeochemical and ecological research many current algorithms have shown potential

• but for coastal (HABs, coastal management, fisheries,…)? Much shorter time scales in dynamics systems (coast)!

Need of development of algorithms for coastal application (only one regional statistical approach shown; talk by Stewart Bernard on current efforts)…

•Time scale of data sets only ~10 years

Need for application of PFT algorithms to all available and upcoming sensors necessary!

• units of PFT products are chl-a or % of chl-a or dominance

Need for other untis for modellers: e.g. carbon conc., productivity, nitrogen, …

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Discussion: actions need international efforts for FUNDING!

PFT products: Observation or inference? Independent?

We need a joint effort to intercompare the products and validate (more in-situ data acquisition) them in a consistent way. We need sensitivity testing with radiative transfer models (RTM): Task group has been formed (very little funding)

What sets the limits on detection of phytoplankton types? Errors?

We have to check with now improved RTM

- how many PFT we can separate with optical methods and what spectral resolution for atmospheric corrected or not corrected spectra is necessary to do that.
- change of signal due to physiology (photoacclimation)

Actions and Recommendations to Agencies

Support in-situ HPLC, some other PFT parameters and optical data acquisition and processing for running and upcoming missions (MODIS, VIIRS, OLCI)

Support HPLC PFT validating with other data sets

Support PFT algorithm validation and intercomparisons activities with funding

Support activities to merge different techniques and multi-mission data sets

Support development of PFT methods also by radiative transfer modelling to hyperspectral data sets, including satellite and in-situ (gliders, buoy,…) measurements.

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