Phytoplankton Functional Types Products

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DATA

A simple model designed to estimate chlorophyll concentrations of two phytoplankton size classes (pico- <2µm, nano- plus micro-phytoplankton >2µm) was adapted from Brewin[1]. The model assumes small cells are incapable of growing beyond a particular chlorophyll concentration. Abundance data (bio-volume) were provided in biomass form (µg/l) with size categories based on the greatest axial length diameter (GALD) measurement. For Lake Balaton, this consisted of 189 taxonomic samples covering all months ranging from August 07 until December 13. Conversion between chlorophyll-a concentration (*Chl*) and biomass was implemented using a polynomial function.

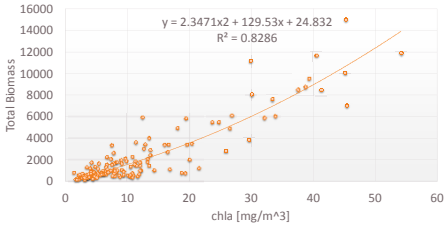

Figure 1. Relationship between total biomass and Chl

METHODOLOGY

The model can be expressed through two simple exponential equations, with the Chl concentration of picophytoplankton population (C_1), and the combined pico-nanophytoplankton population ($C_{1,2}$), being expressed according to;

$$C_1 = C_1^m[1-\exp(-S_1C)], \quad (1)$$

$$C_{1,2} = C_{1,2}^m[1-\exp(-S_{1,2}C)] \quad (2)$$

C_1^m and $C_{1,2}^m$ are the asymptotic maximum values for the associated size classes and $S_{1,2}$ and S_1 determine the increase in size-fractionated chlorophyll (<20μm and <2μm respectively) with increasing total chlorophyll (C). The fraction of each size class is then determined by;

$$\%\ \text{pico} = C_1/C \times 100, \quad (3)$$

$$\%\ \text{nano + micro} = (C-C_1)/C \times 100 \quad (4)$$

PRODUCTS

To test the feasibility of estimating size-fractionated biomass for cells <5µm and >5µm from satellite data, we estimated total biomass from satellite chlorophyll, then applied the two component model (eqn. 1 & 2) to the satellite estimates of total biomass to estimate size-fractionated biomass for cells <5µm and >5µm. Results were then compared with in situ estimates, as shown in Fig 2.

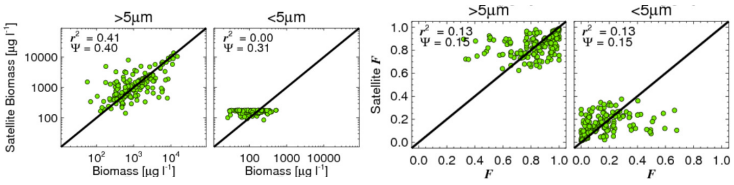

Figure 2. Biomass and fraction (*F*) for picoplankton and micro + nanoplankton estimated from satellite data plotted against *in situ* measurements.

In general the satellite estimates explain only part of the variance in the in situ data. However, root-mean-square-error statistics (ψ) suggest satellite estimates of *F* are within 15% of the in situ data, and ψ values for absolute biomass are comparable to ψ estimates of total chlorophyll concentration in the open ocean, indicating potential in the approach.

Fig 3 shows size class percentages calculated for a MERIS image of August 10. The general spatial distribution of surface PSC is consistent with current knowledge of the region. Large cyanobacteria are predominant in the eutrophic western basins accounting for a higher percentage of nano + microplankton, while smaller phytoplankton increase in relative abundance in the east.

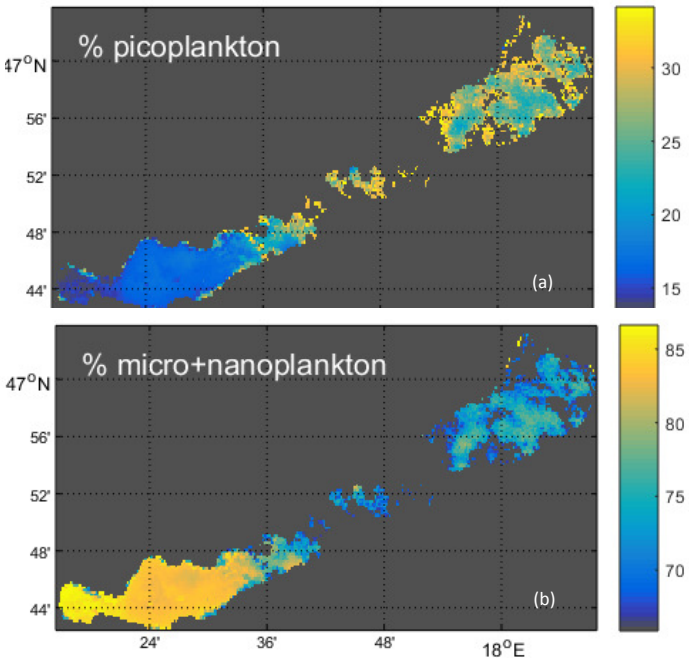

Figure 3. MERIS image of Balaton on 21st August 2010 showing (a) percentage of picoplankton biomass and (b) percentage of micro + nanoplankton biomass.

REFERENCES

[1] Brewin, R. J. W., Sathyendranath, S., Hirata, T., Lavender, S. J., Barciela, R. and Hardman-Mountford, N. J. (2010). A three-component model of phytoplankton size class for the Atlantic Ocean. *Ecological Modelling*, 221, 1472–1483, doi: 10.1016/j.ecolmodel.2010.02.014.

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