Satellite model of size fractionated phytoplankton production for the Celtic Sea.

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Introduction.

The fixation of atmospheric carbon by phytoplankton contributes significantly to carbon flux through different trophic pathways, which is dependant on the dominant phytoplankton group or size-class.

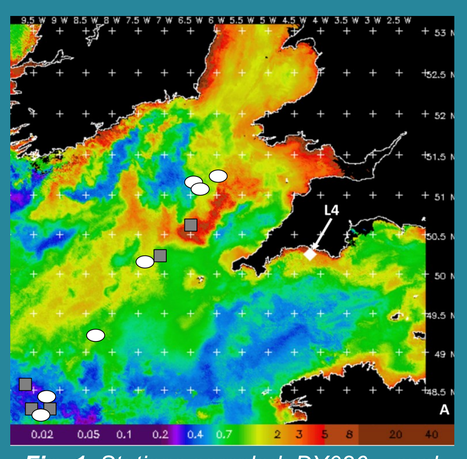

Fig. 1. *Stations sampled; DY026 – oval, DY029 – squares, L4 diamond.*

Over the past decade, a range of remote-sensing algorithms have been developed to detect the phytoplankton size-class biomass and production of micro-, nano- and pico-phytoplankton in the global ocean. Uncertainty remains as to the accuracy of these in shelf and coastal waters. In situ size fractionated 14C PE, a_{ph} and Chla data are needed to validate such models in these regions which is the subject of this paper.

Data and Methods.

Samples were collected weekly from the Western Channel observatory (WCO) at stations L4 and E1 during 2014 & 2015 (***Fig. 1***), and Celtic Sea cruises during summer (DY026 - August 2014) and spring (DY029 - April 2015; ***Fig. 1***).

Chlorophyll-a (Chl-a). Triplicate 200ml samples of seawater were sequential through a Satrorius 20µm, 2.0µm & 0.2µm polycarbonate filters, then stored at -18° C for 18 hours in 10ml 90% acetone and Chl-a was analysed using the Welschmeyer (1994) method.

Phytoplankton absorption coefficients (a_{ph}). For DY026 & 29, 700-1.5l of seawater was filtered onto Whatman 0.7, 2.0 & 20µm filters. Aph was determined spectrophotometrically following Kishino et al. (1985).

Photosynthesis-Irradiance (PE) Parameters. PE curves were measured using 14C uptake following the method of Tilstone et al. (2003) to determine maximum photosynthetic rates (PmB) and light limited slope, which were used with *Chl-a and* a_{ph}, to calculate primary production.

Size-fractionated *Chl-a* & *PmB*.

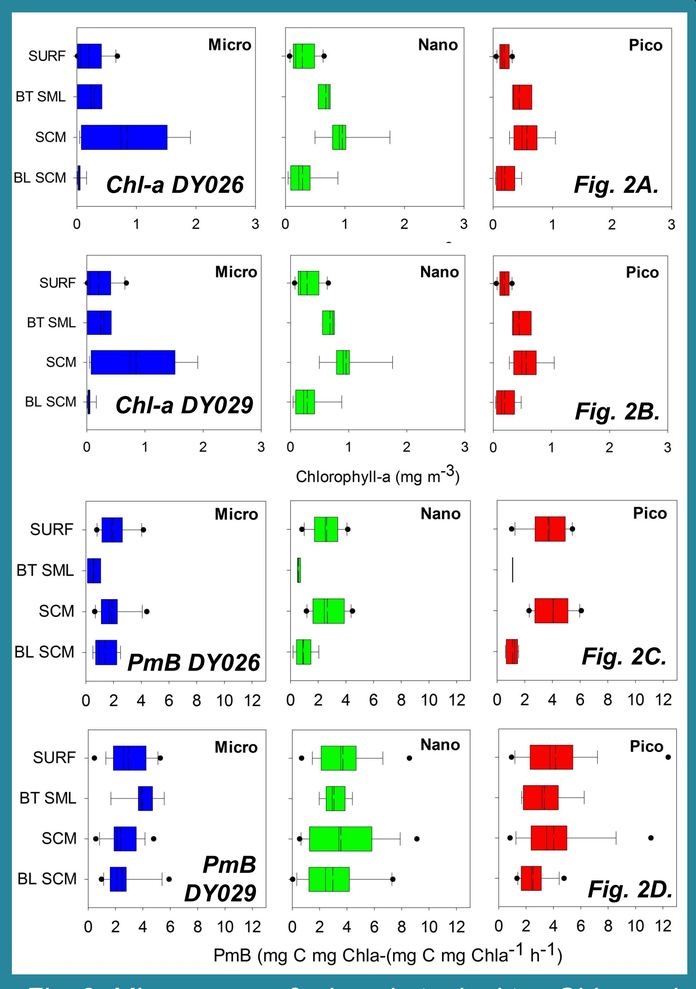

Fig. 2. Micro-, nano- & pico-phytoplankton Chl-a and maximum photosynthetic rates from (A. & C.) DY026, (B. & D.). BT SML is bottom of surface mixed layer, SCM is sub-surface Chla max, BL is bottom layer

Modelling size-fractionated phytoplankton absorption coefficients.

Fig. 3A. In situ* DY026 *aph.

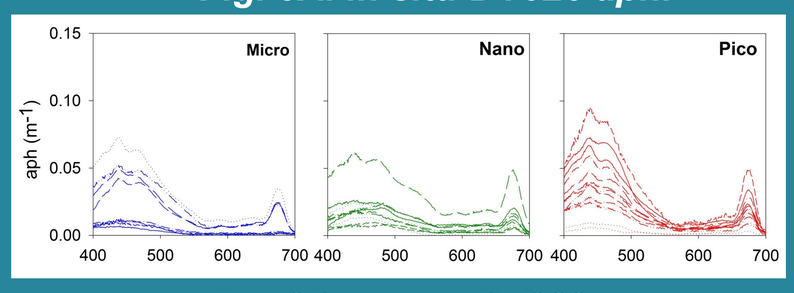

Fig. 3D. Uitz et al. (2008)* DY029 *aph.

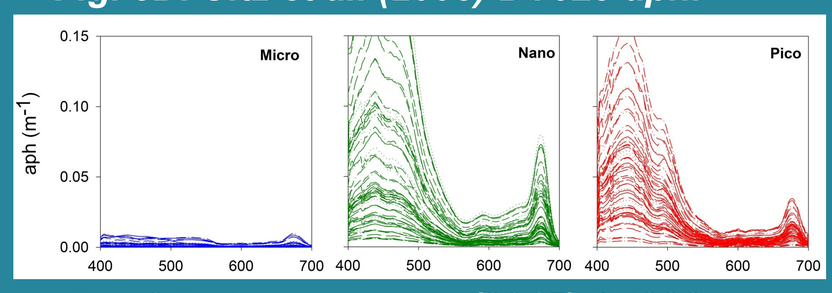

Fig. 3B. In situ* DY029 *aph.

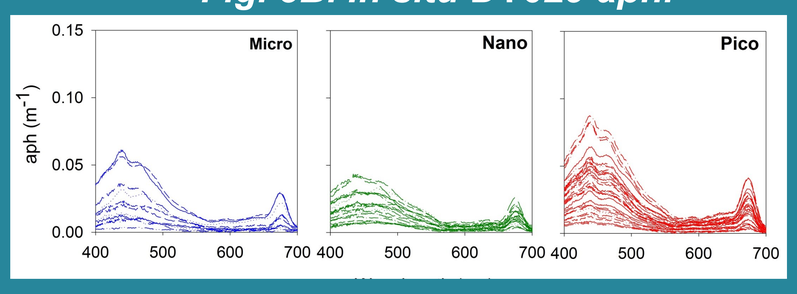

Fig. 3E. Varunan et al. (2015)* DY026 *aph.

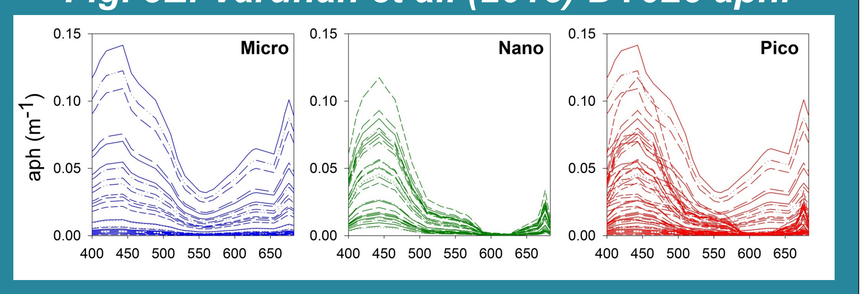

Fig. 3C. Uitz et al. (2008)* DY026 *aph

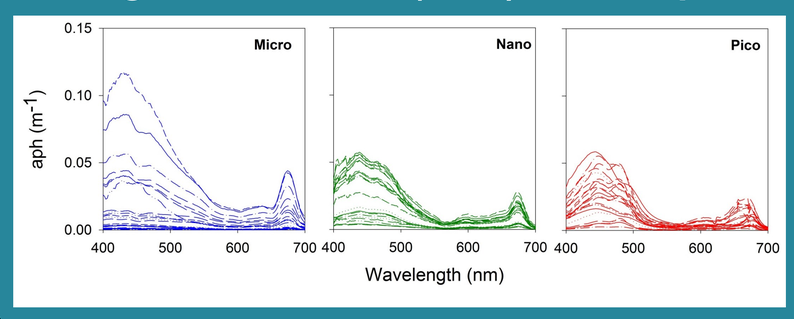

Fig. 3F. Varunan et al. (2015)* DY029 *aph

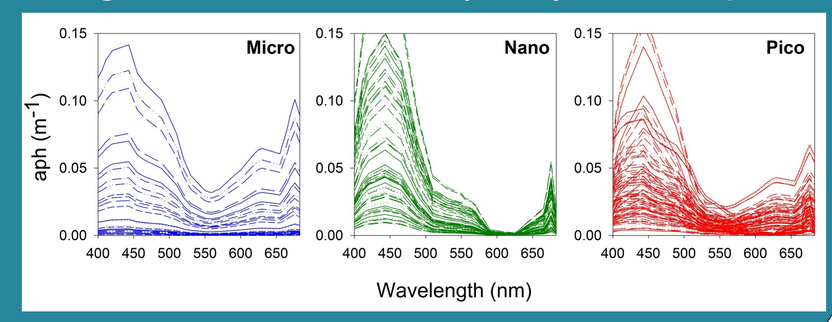

Fig. 3. *Micro-, nano- & pico-phytoplankton absorption coefficients for DY026 & DY029; (A. & B.) measured, (C. & D.) Uitz 2008 model (E. & F.) Varunam 2015 model.*

Sensitivity of Size-Fractionated PP to aph.

Fig. 4A. Primary production - In situ versus Uitz aph

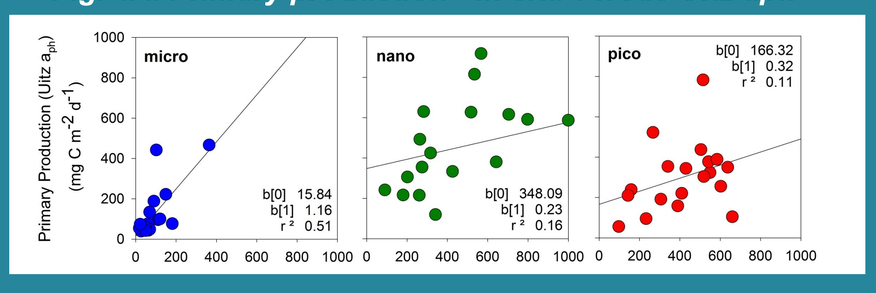

Fig. 4B. Primary production - In situ v HPLC reconstructed aph.

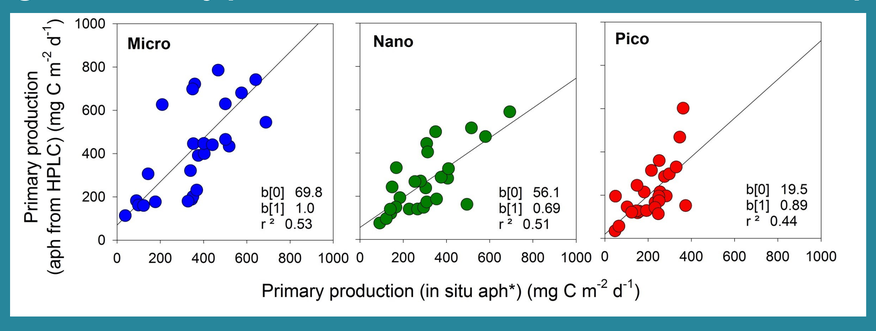

Fig. 4. *Comparison of primary production calculated using average in situ aph* and (A.) Uitz aph*, (B.) HPLC reconstructed aph**

Modelled PE parameters.

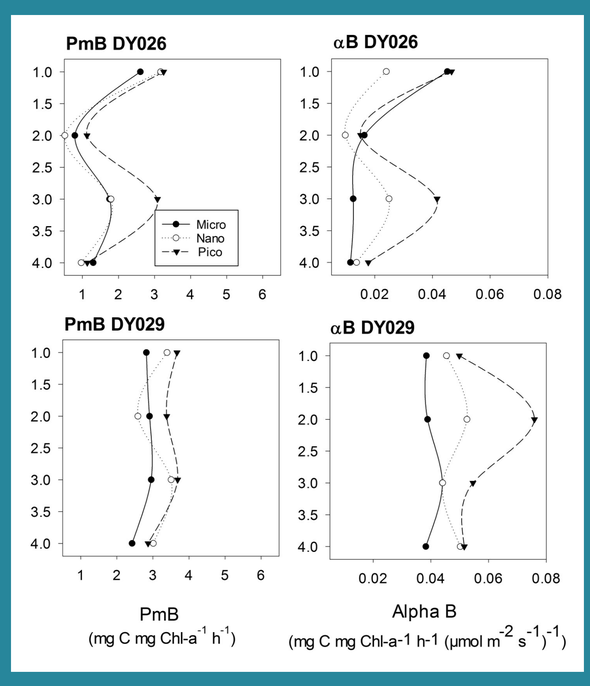

Fig. 5. *Mean PE parameter profiles for the Celtic Sea that will be used for the satellite model of primary production.*

Conclusions.

- A large data base of size-fractionated *Chl-a*, *aph* and phytoplankton photosynthesis parameters were collected during 2014-15 in the Celtic Sea and WEC (***Fig. 1, 2***).
- Different models were tested to reproduce *in situ aph* (***Fig. 3***) and its impact on primary production (***Fig. 4***). The pigment reconstruction model was the most accurate (***Fig. 4B***).
- Average size fractionated photosynthetic parameters were calculated which will be used in a remote sensing model of size fractionated primary production for the Celtic Sea (***Fig. 5***).

References.

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