



# Investigation of the role of phytoplankton functional types in CO<sub>2</sub> flux variability

## Stage 1 Intercomparison of PFT techniques: Microplankton

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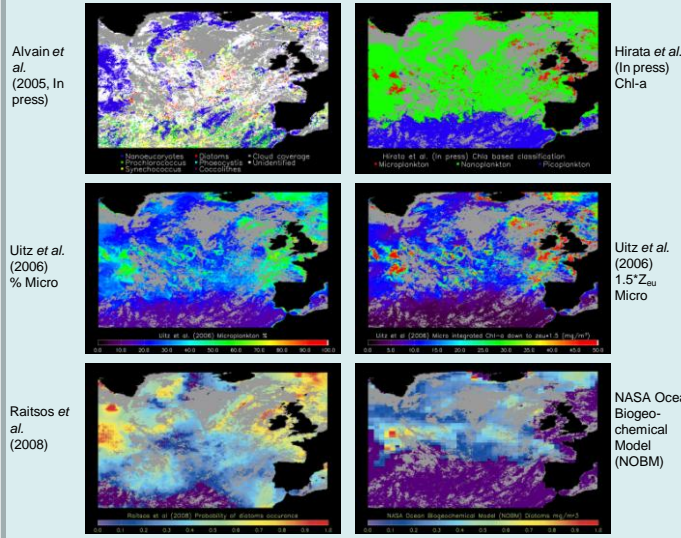
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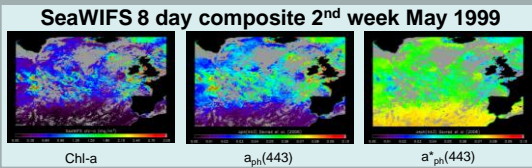
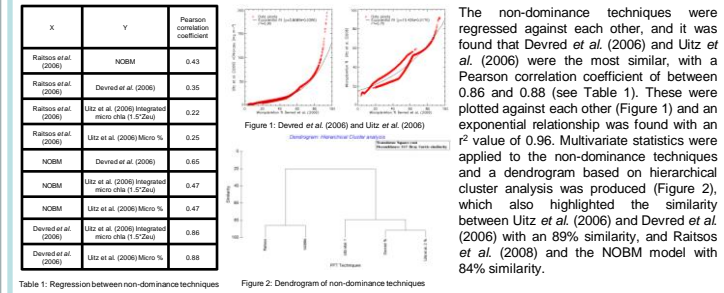
### ABSTRACT

Satellite remote sensing of ocean colour is currently the only way of measuring synoptically wide-area ocean properties such as phytoplankton abundance (Lavender et al. 2005). Recent bio-optical and ecological methods have been established that use satellite data to differentiate between certain phytoplankton functional types (PFTs) e.g. Ciotti et al. (2002); Sathyendranath et al. (2004); Alvain et al. (2005); Uitz et al. (2006); Devred et al. (2006); Raitosos et al. (2008); and Hirata et al. (In press). We apply these techniques to an 8 day SeaWiFS ocean colour dataset from May 1999, and compare the results to an *in situ* dataset from the CPR database, in order to assess their ability to detect microplankton in the North Atlantic. Uitz et al. (2006) and Devred et al. (2006) were found to have the closest degree of correlation, and Hirata et al. (In press) and Alvain et al. (2005) were found to predict the highest amount of dominant microplankton pixels. From the *in situ* comparison, Hirata et al. (In press) was found to have the highest percentage match up (60-63%), and Devred et al. (2006) and Raitosos et al. (2008) had the highest non-dominance factor, indicating that these three techniques were most accurate at identifying microplankton. However, a need for more *in situ* data was highlighted. For future work, focus will also be put on picoplankton and nanoplankton, and output from the intercomparison will be compared to CO<sub>2</sub> flux variation hindcasts developed within the FOAM-HadOCC system, to better understand the contribution of different PFTs to global CO<sub>2</sub> variability.

### Methods of Identifying PFT from space (AOP)



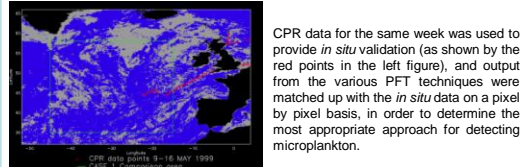
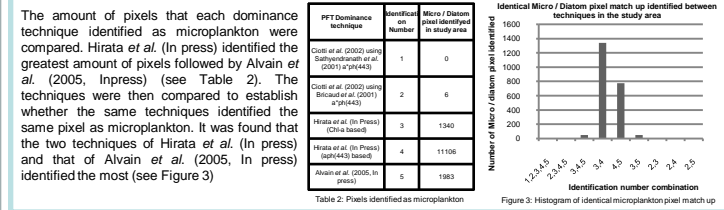
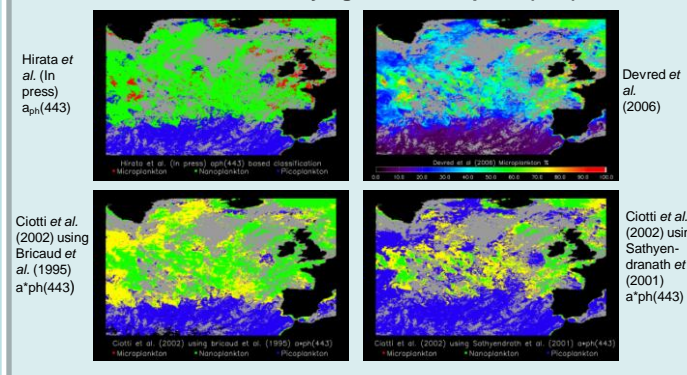
### RESULT 1: Intercomparison between the different PFT methods



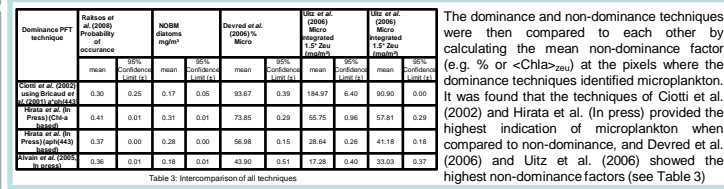
### METHODOLOGY

SeaWiFS 8 day composite for the 2<sup>nd</sup> week of May 1999 was downloaded from the NASA Oceancolor website (<http://oceancolor.gsfc.nasa.gov/>).  $a_{ph}(443)$  and  $a^*_{ph}(443)$  data for the week was calculated according to Bricaud et al. (1995). Sathyendranath et al. (2001) and Devred et al. (2006). Apparent Optical Property (AOP) approaches of Alvain et al. (2005, In press), Uitz et al. (2006), Raitosos et al. (2008), and Hirata et al. (In press) (using Chl-a), were applied to the dataset, and output from the NASA Ocean Biogeochemical Model (NOBM) for the week was also utilised. The Inherent Optical Property (IOP) approaches of Hirata et al. (In press) (using  $a_{ph}(443)$ ), Devred et al. (2006), and Ciotti et al. (2002) (using  $a^*_{ph}(443)$ ) were also applied to the dataset. Output was then split between the techniques that calculate dominance and those that calculate non-dominance (e.g. probability, percentage), and sub-sectioned to the CASE 1 comparison area (shown by the green box in the figure below). The non-dominance techniques were then regressed against each other in order to assess similarities and differences between the techniques, and the dominance techniques were compared by assessing the amount of pixels that identified microplankton. These two approaches were then combined by assessing where the dominance technique's assigned microplankton, to the respective values calculated according to the non-dominance technique's.

### Methods of Identifying PFT from space (IOP)



CPR data for the same week used to provide *in situ* validation (as shown by the red points in the left figure), and output from the various PFT techniques were matched up with the *in situ* data on a pixel by pixel basis, in order to determine the most appropriate approach for detecting microplankton.



### RESULT 2: In-situ validation

From a possible 66 *in situ* points, 22 diatom and 25 diatom and dinoflagellates were utilised, taking account of cloud coverage. It was found that the dominance technique of Hirata et al. (In press)  $a_{ph}(443)$  identified the highest amount of match ups between 60 and 63.4% of the *in situ* data. The non-dominance technique of Devred et al. (2006) was also found to have a mean of 50% ± 5.8% of microplankton at all the 22 and 25 *in situ* data points, and Raitosos et al. (2008) was found to have a probability of 0.55 ± 0.05%.

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### CONCLUSION

- An intercomparison between non-dominance techniques found that Uitz et al. (2006) and Devred et al. (2006) show the highest degree of similarity. Hirata et al. (In press) and Alvain et al. (2005, In press) were found to predict the highest amount of dominant microplankton pixels in the study area. From a basic comparison of dominance and non-dominance techniques, the dominance technique of Ciotti et al. (2002) and Hirata et al. (In press) provided the highest non-dominance factors (e.g. % or probability) indicating a more accurate prediction, and the non-dominance techniques of Devred et al. (2006) and Uitz et al. (2006) revealed the highest factors at these points.  
- From the *in situ* validation Hirata et al. (In press)  $a_{ph}(443)$  was found to have the highest percentage match up (60-63.4%), and both Devred et al. (2006) and Raitosos et al. (2008) were found to have higher non-dominance factors, indicating these three techniques are more accurate at predicting microplankton from satellite data.  
- However, in order to accurately conclude upon the most validated method a far greater amount of *in situ* data will need to be used, with increased spatial and temporal coverage. Future work will also need to focus on other PFTs such as nanoplankton and picoplankton, before being compared to the FOAM-HadOCC system.