

Determination of planktonic primary production parameters in the Atlantic Ocean using *in situ* inherent optical properties

Lowe, C. PhD thesis

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Abstract:

Bio-optical measurements from three of the Atlantic Meridional Transect programme cruises in 2003-2004 were examined to determine spatial variation and correlations between phytoplankton variables. These cruises each crossed approximately 100° of latitude between the UK and the Falkland Islands, covering a range of environments in the Atlantic Ocean.

Measurements of primary production were made using a Fast Repetition Rate Fluorometer (FRRF), concentration of phytoplankton pigments using High Performance Liquid Chromatography (HPLC) and *in situ* particle absorption using a novel double cast technique with an ac9+ nine wavelength absorption/attenuation meter. Ancillary data in the form of salinity, temperature and chlorophyll concentration profiles were used to determine the communities spatial distribution of and to provide data for calibration. Cluster analysis of pigment data, using multivariate Brae-Curtis statistical analysis, produced effective partitioning of the cruises into functional regions for further work.

The study showed that reference blanking was important in oceanic measurements with the FRRF and that separate blanks were required for each chamber. Blanks of unfiltered water from below the euphotic zone coincided best with blanks taken under *in situ* irradiance in the water column. Positive log linear relationships were shown between FRRF photosynthetic quantum efficiency ($(F_v)/(F_m)$) and, contrary to expectations, between photosystem II cross sectional area (S_{PSII}) and measurements of chlorophyll a concentration. Comparisons between FRRF and automated flow cytometry data suggested that the photochemistries of the prokaryotes *Synechococcus* and *Prochlorococcus* are significantly different and that the photochemistry of *Prochlorococcus* is similar to that of eukaryotes.

The concentration ratio of chlorophyll a:total pigment was found to follow a positive log linear relationship with chlorophyll a concentration, similar to that of the FRRF variables. A possible causative link between the relative loads of chlorophyll a and total pigment with FRRF variables was suggested.

The novel twin filtered and unfiltered casts of the ac9+ produced acceptable particulate absorption spectra. Spectra representing chlorophyll a and total pigment concentrations, and demonstrated the same positive log linear relationship of the pigment measurements suggesting that this method could be used to determine pigment concentrations and therefore primary production parameters.

Direct correlations were found between FRRF primary production parameters and both pigment ratios and absorption ratios, suggesting that absorption measurements could be used to a proxy for primary production parameters.