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Spatial and temporal variability of the balance between marine plankton production and respiration

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The balance between marine plankton production (P) and respiration (R) determines the percentage of photosynthetically fixed carbon available for export and that available for return to the atmosphere as CO_2. An understanding of the variability of this balance is therefore crucial to our overall understanding of earth system carbon cycling. However, the paucity of representative open ocean P:R data means that our understanding of the substrate supply mechanisms and community structures which influence the P:R balance is at an early stage.

P:R data were collected during three cruises between the UK and the Falkland Islands in May and September 2003, and in May 2004, as part of the **A**tlantic **M**eridional **T**ransect program (AMT) (www.amt-uk.org). The cruise tracks in May 2003 and 2004 specifically sampled the centre of the North Atlantic Subtropical Gyre (NAST), measuring P:R further west within the province than anyone previously (29ºN, 37ºW). In September 2003, the cruise track turned east at 22ºN to sample the Mauritanian coastal upwelling. All 3 cruises sampled the same track within the sparsely sampled South Atlantic Subtropical gyre (SATL), crossing the equator at $\sim 25^{o}$W.

This unique dataset allows us to examine both the spatial and temporal variability of plankton metabolism within the Atlantic Ocean. Significant seasonal and inter-annual differences were observed in P, R and P-R, which have implications for potential carbon export. We consider this variability within each of the biogeographic provinces traversed by the cruise track in the context of previously published data and inter-annual surface chlorophyll variability derived from remotely sensed ocean colour.

We also observed significant spatial variability both within and between provinces. A collation of our data and all published data from the NAST indicates that overall, R is significantly higher than P within the province, in agreement with previously pub-

lished data. However, this published data was collected at the eastern periphery of the NAST, and despite AMT significantly extending the sampling area, data is nevertheless biased towards the heavily-sampled NE edge. In contrast to published results, our data collected further west shows a balanced or net autotrophic (P>R) state, indicating that the region may be less imbalanced than previously thought. It is also evident that the observed net heterotrophy (R>P) in the NAST is strongly influenced by samples collected in late summer/autumn. Respiration only persistently exceeds production in an area between 25 and 40ºN, which may point to a "plume" of upwelled organic nutrients extending around the gyre edge.

It is evident that greater temporal and spatial resolution would improve our understanding of plankton metabolism and carbon cycling, and although the AMT programme is addressing this, by regularly sampling the same cruise track, we are limited by the current *in vitro* methods used to measure metabolic rates. We will explore the possibility of using *in situ* dissolved oxygen concentrations together with inferred air-sea gas exchange to provide a more temporally and spatially integrated estimate of the balance between P and R.