VARIABILITY IN EFFICIENCY OF PARTICULATE ORGANIC CARBON EXPORT

National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

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1. A global biogeochemical model is used to investigate spatial and seasonal variability in e-ratio (fraction of primary production (PP) that is exported). Our aim is to examine how the lag between PP and export leads to seasonal variability in e-ratio, and how that may affect how we interpret sparse in situ data.

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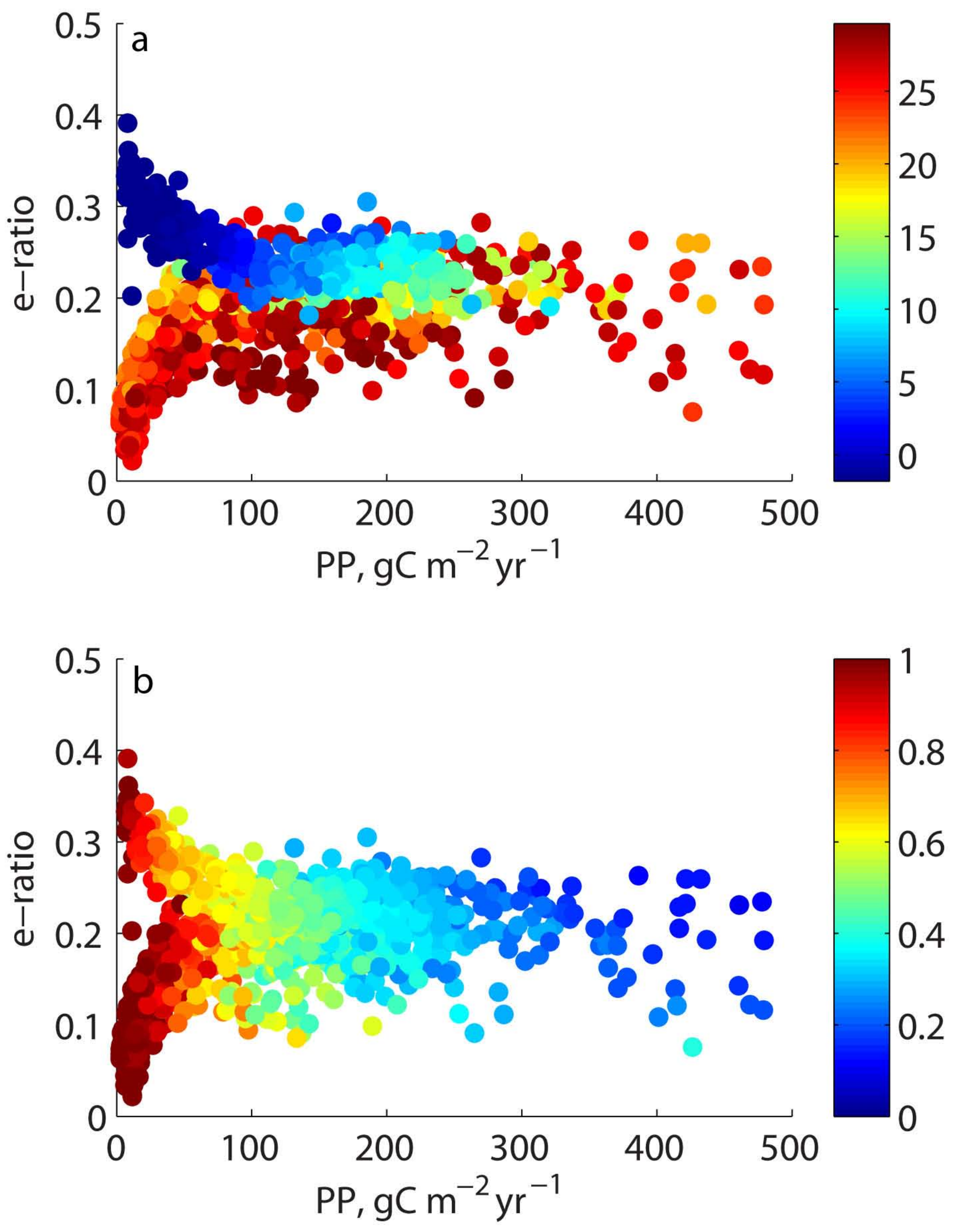

2. Annual PP vs e-ratio with points coloured by SST (top) and fraction of slowly sinking export (bottom). At low PP, e-ratio may be either lower or greater than at high PP, depending on the temperature. In low latitudes, slow sinking particles are rapidly remineralised in the upper ocean, but at high latitudes very cold temperatures slow remineralisation to such an extent that a relatively large proportion of slow sinking particles can escape the upper ocean.

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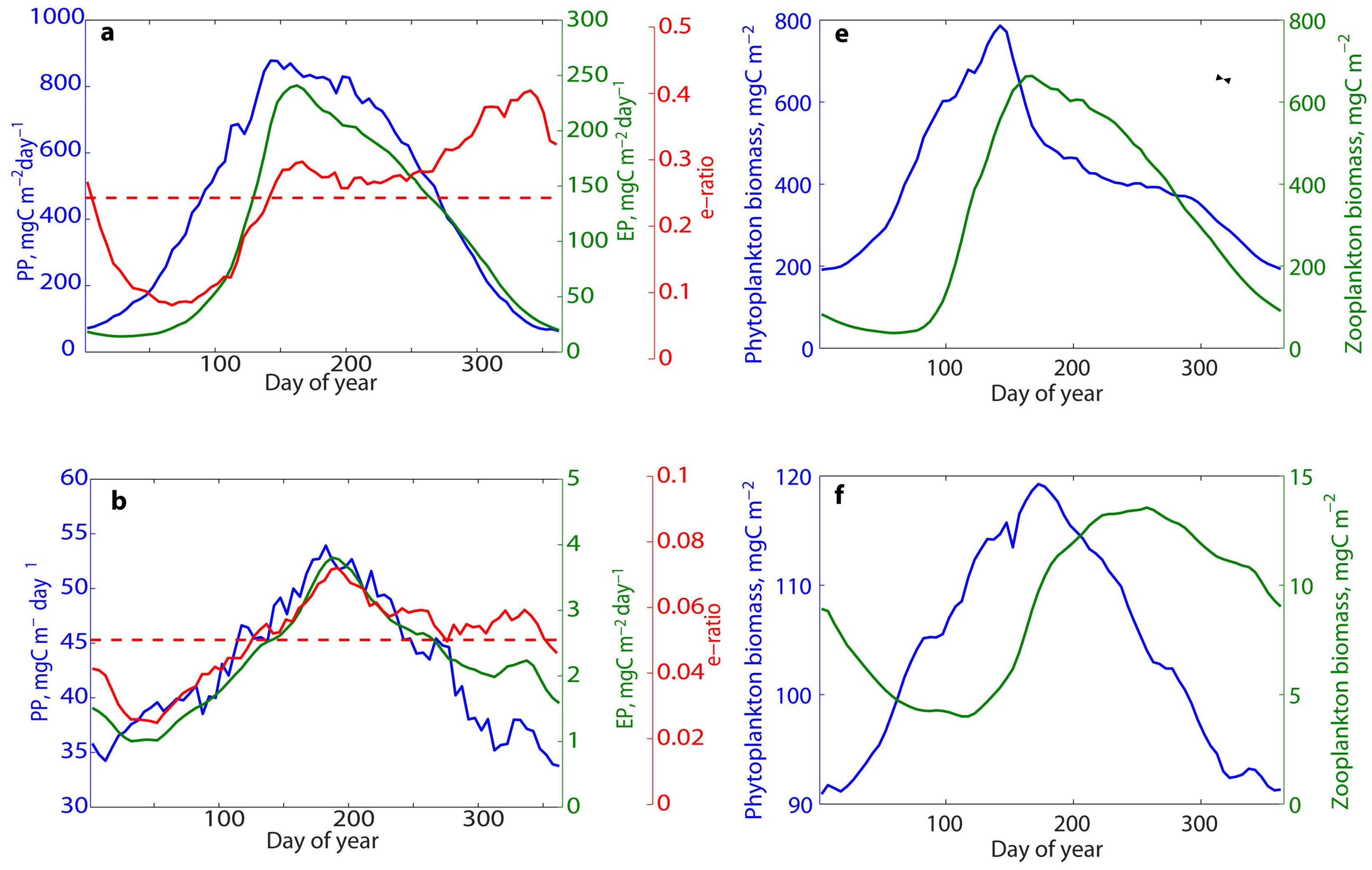

3. Lags between PP and export drive seasonal variability in e-ratio: examples shown are for subpolar (top) and subtropical (bottom) North Atlantic. These lags arise due to decoupling between phytoplankton and their grazers, which is more pronounced in high latitudes than in low. Note the effect on the relative magnitude of seasonal variability in e-ratio.

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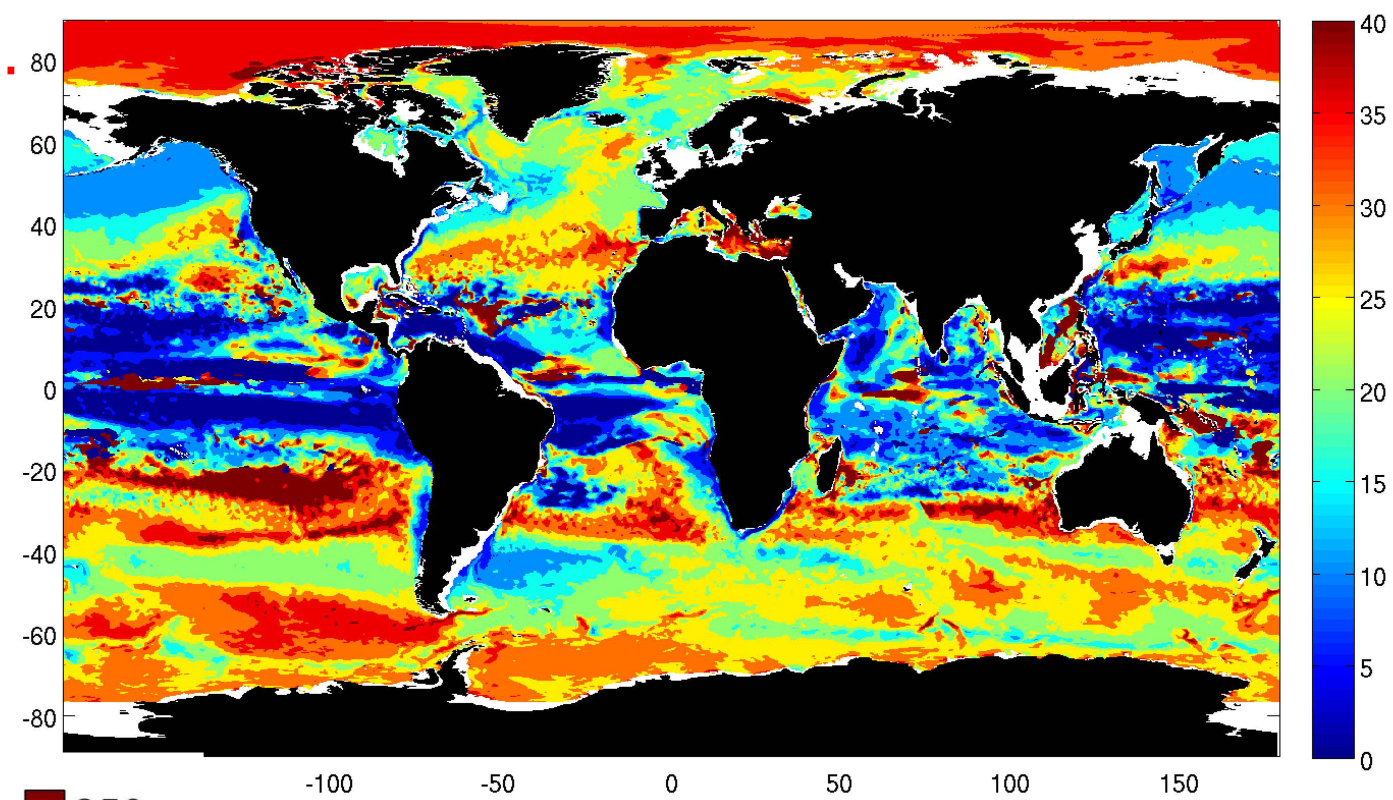

4. Lag (in days) between PP and export shows longest offsets in high latitudes and around the edges of the oligotrophic gyres. Shortest lags occur in upwelling areas.

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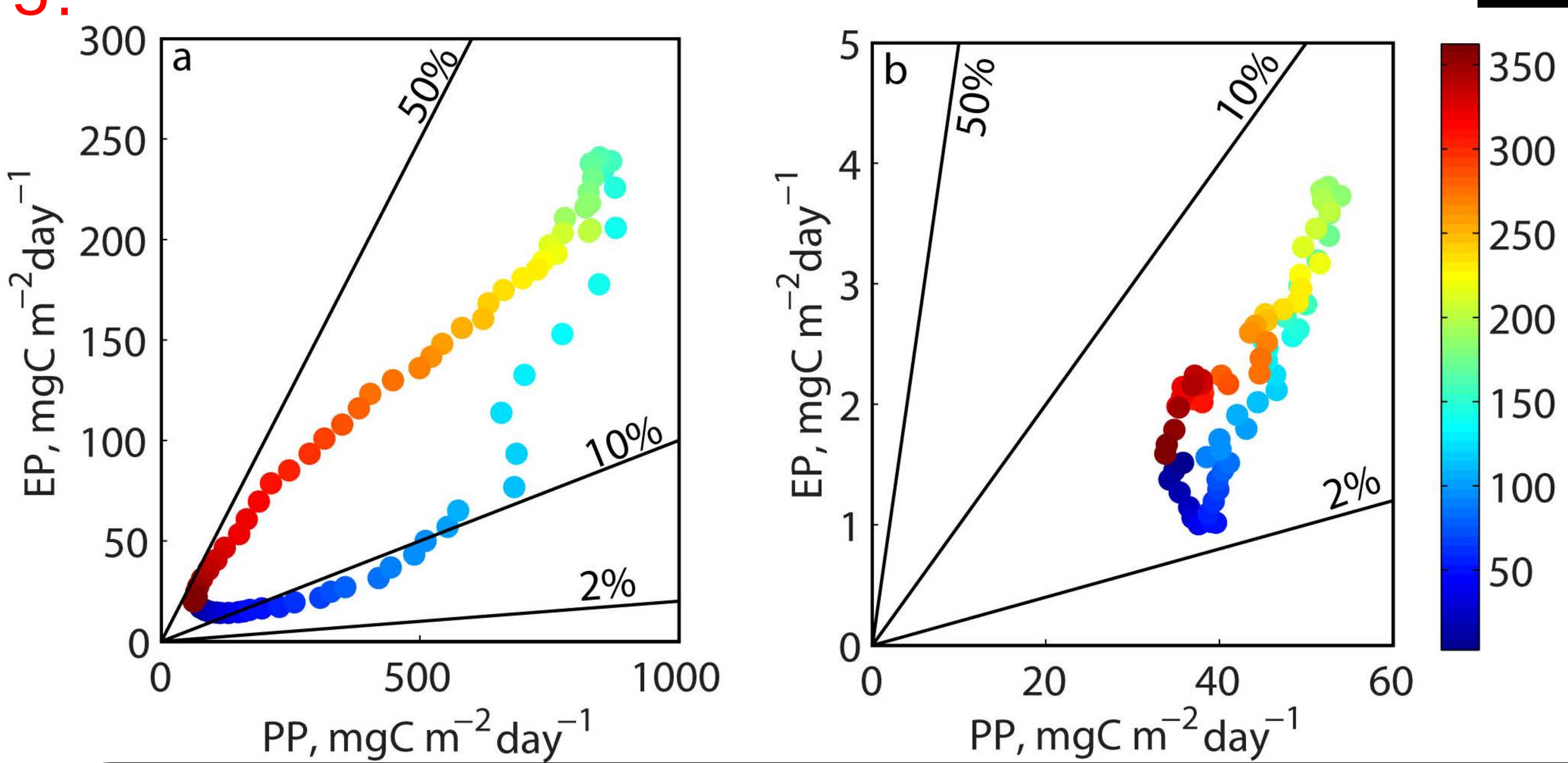

5. The evolution of PP and export shows variability in e-ratio over the course of a year in a subpolar (left) and subtropical (left) location (colours indicate day of year and straight lines are e-ratio). If e-ratio was seasonally invariant, the points would fall along a straight line. In subpolar regions, the trajectory is 'loopy' compared to the more 'linear' situation in the subtropics. This indicates a greater degree of trophic decoupling at high latitudes.

6. The implication for in situ sampling is that the perceived e-ratio is dependent on when in the seasonal cycle the measurements are made. The percentage difference between the model 'true' export and the export calculated assuming that e-ratio sampled 1 month after peak PP is representative of the whole year shows that errors can be >60% (and >-60% for sampling occurring prior to peak PP).

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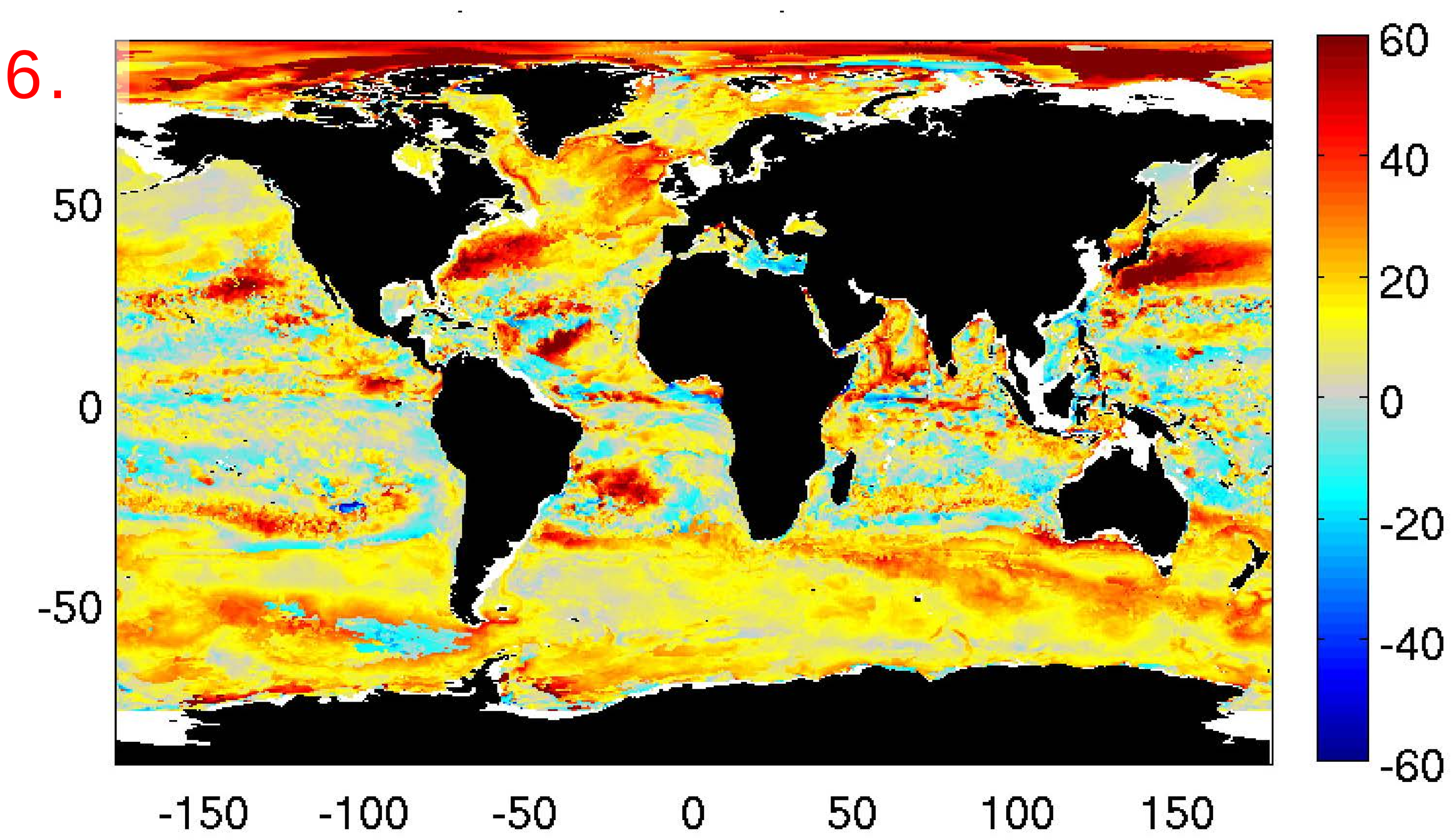

7. This model study suggests some hypotheses that could be tested in situ. For example, the divergence in e-ratio at low PP in cold/warm waters seems to be driven by the proportion of slow sinking particles. More seasonally-resolved observations of e-ratio are needed, particularly in high latitudes.

8. This work published in: *Henson et al. (2015), Global Biogeochem. Cycles*
Model details: *Yool et al. (2011), Geosci. Model Dev.*