



The ballast hypothesis: not pulling its own weight?

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The uptake of dissolved carbon by phytoplankton in the surface ocean and its subsequent remineralization from sinking particles of organic matter in the ocean interior, a mechanism known as the biological pump, is thought to provide a significant control on atmospheric CO₂. Regression analysis of particle fluxes in deep sediment trap data has been influential in identifying a plausible 'ballasting' mechanism (Klaas and Archer 2002), whereby the flux of organic matter is linked to the flux of denser minerals such as calcium carbonate (CaCO₃). However, to date these analyses have mainly been conducted at a global scale, potentially missing important spatial variability in flux relationships.

We applied Geographically Weighted Regression (GWR) to an updated sediment trap dataset (>1500m), performing the same regression analysis but now objectively allowing the statistics to vary in space. Our analysis reveals significant spatial variability in the relationships between organic matter and minerals, particularly for CaCO₃, questioning whether a simple ballasting mechanism exists. The spatial variability is reminiscent of biogeochemical provinces, suggesting potential alternative mechanisms related to ecosystem function. However, further interpretation of spatial variability is hindered by the relatively sparse sampling of sediment traps. To address this issue, we are currently exploring the use of inverse techniques to generate synthetic particle flux estimates from tracer data. This will facilitate in verifying the results of our GWR analysis and provide further data to interpret the mechanistic controls on sinking particle fluxes.