OPERA: Organic Particle Export, Remineralization and Advection in the North Atlantic mesopelagic layer

Description

The mesopelagic layer of the oceans, also known as the Twilight Zone, extends between ~200 and 1000 m depth and is one of the vastest contiguous ecosystems on Earth. It plays a pivotal role in global biogeochemical cycles and climate, and hosts a massive biomass of zooplankton and small fish. However, scientific understanding and predictive capacity of biogeochemical processes in the mesopelagic zone are still in their infancy, primarily as a consequence of the dearth of observations.

Mesopelagic functioning depends on the biological transformation and physical transport of organic matter produced mostly in the overlying sunlit layer of the ocean. So far, attempts to balance mesopelagic carbon budgets have failed as estimates of organic carbonconsumption generally exceed inputs, sometimes by an order of magnitude or more. Poor observation estimates of particle transformations and fluxes, especially those associated with small slow-sinking and suspended particles (with size ranging 1-50 ¼m), stands out among the commonly invoked explanations for the mesopelagic carbon budget imbalance. Particle transformations and transports occur in a wide range of spatio-temporal scales that are technically impossible to fully observe.

In this context, ocean biogeochemistry models informed by the available observations are the best tool at hand to gain detailed understanding of mesopelagic carbon budgets. Advances in observation of ocean particles with autonomous robots (biogeochemical Argo floats) and recent developments in the representation of small detrital particles in a state-of-the-art ocean biogeochemistry model PISCESv2 now enable comprehensiveestimates of mesopelagic particulate organic carbon (POC) cycling pathways. The aim of the OPERA project is to quantify mesopelagic POC budgets and constrain their sources of uncertainty. By exploiting synergies between observations and models, we will tackle the poorly understood biogeochemical cycling and advective transport of small particles in the North Atlantic, a region that features wide latitudinal, seasonal and interannual variations in ocean dynamics.

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