A 3-D globlal model of marine particles

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The ocean's biological carbon pump (BCP) controls atmospheric CO_2 by means of the generation and digestion of sinking marine particles by plankton. Photosynthesis in the surface ocean locks atmospheric carbon into organic particles which, as they sink and interact biogeochemically with their environment, can be monitored by sediment traps and imaging systems. Relevant as these data are for the understanding of the efficiency of the ocean's BCP, they are still scarce and very scattered. Modelling marine particles is thus fundamental to gaining insight into the fluxes of particulate material in the water column. Here, we present the first global model of dynamic marine particles using a Lagrangian and mechanistic description of BCP state variables [1].

A Lagrangian framework tracks in time and space a large ensemble of particles, from their production in the surface ocean, to their coagulation, fragmentation, dissolution and remineralisation as they sink through the water column and are transported by the 3-D ocean circulation [2]. These processes, which are treated quasi-stochastically, are a function of local environmental conditions as well as particle attributes such as size, porosity, settling speed and carbon and mineral content. We will show two relevant properties that emerge from the dynamics of the model: the power-law attenuation of particulate organic carbon flux with depth (the so-called 'Martin curve') and particle size and velocity spectra, both at a basin and seasonal scale.

[1] Jokulsdottir & Archer (2016) *Geosci Model Dev* **9**, 1455-1476. [2] Khatiwala (2007) *Global Biogeochem Cycles* **21**, 14, GB3001.