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What Level of Biology is Required to Model Marine Biogeochemical Cycling Globally?

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Recent technological advances now allow different groups of autotrophic and heterotrophic plankton to be discriminated. Such advances allow us to reflect the functional differences as well as similarities within autotrophic and heterotrophic plankton. Thus while all algae convert CO_2 through photosynthesis into organic carbon, the fate of the organic carbon will depend on the size of individual algal cells. Large diatoms will tend to export carbon from the surface waters while small picophytoplankton will tend remain in surface waters. A similar dichotomy in biogeochemical function is now perceived in planktonic herbivores. A decade ago it was believed that crustaceans dominated pelagic herbivory and as a result provided a mechanism by which algal carbon was exported into the oceans interior by the "biological pump". However we now know that tiny protozoans dominate herbivory in most of the ocean. The biogeochemical consequence of this is to increase remineralisation of organic carbon and to minimise the effectiveness of the biological pump. Molecular techniques now allow discrimination of different functional groups of bacteria and the consequences of this, particularly in relation to DMS biogeochemistry, are just beginning to be addressed. The ability to discriminate functional groups raises a dilemma about what level is required to adequately model and hence understand marine biogeochemical cycles. The talk will illustrate these points from recent ocean biogeochemical studies (JGOFS, OMEX), and will include modelling studies at various levels of biological discrimination. By applying models of widely differing complexity to some observational data sets, it will examine the question of how to construct models simple enough for inclusion in global ocean models in the face of the detailed ecosystem structure that is involved in the biogeochemical processes.