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Light and heat : influence on phytoplankton growth and export in a global ocean model

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As the ultimate source of organic material for the biological pump, phytoplankton play a central role in regulating the carbon cycle of the ocean. Quantifying this role for both the present-day and the greenhouse future is a crucial goal for biogeochemical modelling. While much effort is currently devoted to increasing the complexity and functional diversity of phytoplankton in models, this study focuses instead on the representation of phytoplankton growth processes. Primary production in the ocean occurs over extreme ranges of physical conditions : from the near-freezing poles to the hot tropics; and from sunlit surface waters to twilight conditions of deep nutriclines. Using a simple NPZD ecosystem model, we explore the roles played by light and temperature in the biogeochemical cycling of carbon in a medium resolution (1 degree x 1 degree) ocean GCM, OCCAM. The significance of alternative representations of these regulating factors is examined for both the absolute magnitude and spatio-temporal patterns of export production.