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Ecosystems and ocean carbon biogeochemistry: transformation and partitioning by the “microbial hub”

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Ecosystem processes are key determinants of upper-ocean biogeochemical cycles that are affected by climate, and in turn influence climate. Although a large amount of information on elemental cycles, food webs and ecosystem processes has been collected over the past decades, the conceptual basis for incorporating this information into models is still incomplete. One of the key uncertainties is the quantitative role of planktonic heterotrophic microbes in carbon transformations and partitioning. We propose here that heterotrophic microbes form a "microbial hub" within the planktonic food web. Organic carbon is channeled into the microbial hub, from where it is redirected towards both CO2 (respiration) and larger heterotrophs (food web). The channeling of carbon into the microbial hub is regulated by the structure of the food web, which is largely controlled by inorganic nutrients and vertical mixing. In contrast, the partitioning between respiration and food-web transfer is regulated by microheterotrophic community structure and their activity, which is largely controlled by water temperature. Climate changes will influence inorganic nutrient supply and distribution, vertical mixing and seawater temperature Thus, changes in climate will influence both the channeling of organic carbon into the microbial hub, and the microbial hub-mediated partitioning of carbon between respiration and larger organisms. This approach provides the framework for incorporating in ocean-climate models the key food-web processes needed to link the forcing of planktonic food webs by climate changes to the biogeochemical feedbacks of ocean on climate.