Ocean Circulation and Climate: Chapter 31. Marine Ecosystems, Biogeochemistry, and Climate (International Geophysics)

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Ocean physics plays a central role in structuring the large-scale patterns and functioning of ocean ecosystems, and climate variability impacts marine biota in a wide variety of ways. Primary production by phytoplankton forms the base of the pelagic-ocean food web and is modulated by temperature, nutrient supply, light, and mixed layer depth. Temperature influences a host of organism physiological rates, and temperature and circulation are determining factors in the geographic ranges of many marine species. Climate variations alter predator–prey interactions, interspecies competition, the seasonal timing of biological events or phenology, the spread of diseases, parasites and invasive species, and the biogeochemical cycling of carbon, nutrients, and many trace chemicals. Ocean biology, in turn, can affect climate by influencing the atmospheric composition of radiatively important trace gases such as carbon dioxide, nitrous oxide, and dimethyl sulfide; chlorophyll also modifies the vertical absorption profile of solar radiation and thus influences sea-surface temperature and mixed layer depth. Based on historical observations, biological effects are already evident in response to anthropogenic ocean warming and sea-ice melt. Future climate change impacts are expected to grow in magnitude due to further warming and other physical changes as well as synergistic effects with other human stressors such as ocean acidification, deoxygenation, and coastal nutrient eutrophication.

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