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# A metabolic theory of the oceans: simple rules for complex systems

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Global climate change has profound effects on marine ecosystems at all levels of organization. A change in climate is irrevocably linked to a change in the physiology of species, to a modification of community composition and ecosystem metabolism and to a modulation of biogeochemical cycles. Ultimately, all these biological changes will trigger a change in climate, generating a feedback loop. The complexity of these climate-ecosystem interactions is in stark contrast with the oversimplistic representation of biological processes in current global climate models. We are faced with the need for a theoretical framework that not only provides a synthetic view of the effects of climate on marine communities but that can also be easily integrated in coupled climate/carbon-cycle models. Here, I advocate that the emerging field of marine macroecology can serve that purpose. I show how an extension of the Metabolic Theory of Ecology (MTE) to marine communities can help understand the possible effects of global warming on planktonic organisms; and that MTE can be used to scale these effects from organisms to ecosystems and to biogeochemical cycles in a manner that can be easily incorporated into global climate models. I validate the predictions of MTE using global databases of planktonic metabolism, community composition and structure to show that the theory fits the data and that it challenges current understanding of how warming and shifts in ecosystem trophic state will modify oceanic carbon cycle feedbacks to climate change.