The effect of nutrient limitation on temperature sensitivities of phytoplankton growth

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Abstract

The rising surface ocean temperature imposes strong effects on marine organisms in the sunlit ocean. Temperature sensitivity of phytoplankton growth rate is crucial for predicting the effect of global warming on oceanic primary productivity and the efficiency of the biological carbon pump. It has been quantified as activation energy (E_a) in the Boltzmann-Arrhenius equation (Brown et al. 2004), which describes the direct effect of temperature on metabolic processes yet barely considers the influence of resource availability. While previous laboratory studies have shown that phytoplankton thermal traits such as optimal temperature (T_{opt}) can be affected by nutrient availability, it is unclear whether this can be extrapolated to natural communities. In this presentation, I will introduce two recent studies conducted by my research group on how nutrient limitation can affect the thermal sensitivities of marine phytoplankton. In the first study, we find that the growth of *Prochlorococcus* is less susceptible to nutrient depletion (or availability) but more vulnerable to warming, while the effect of temperature on the growth of *Synechococcus* and will be constrained by nutrient availability. In the second study, based on the growth performance derived from *in situ* manipulation experiments and the analysis of a long-term dataset of natural diatom cell density, we reveal that abundant nutrients bolster marine diatoms in coping with warming. Our results highlight the importance of considering the influence of nutrient availability on thermal response of phytoplankton growth, which sheds light on how marine primary production may change under climate warming.