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CGD Seminar Series

Climatic Controls on Metabolic Constraints in the Ocean

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NCAR

Date: Tuesday 6 April 2021

Time: 11am – 12pm

For Zoom information, please contact Tracy Baker tbaker@ucar.edu

For live stream information, visit the CGD Seminar Webpage

ABSTRACT

Dissolved oxygen is a fundamental requirement for heterotrophic marine organisms and respiratory demand for oxygen increases with increasing temperature. Observations and models indicate that the ocean is warming and losing oxygen, posing a compound threat to marine ecosystems. In this study, we leverage a compilation of physiological data quantifying the temperature sensitivity and oxygen requirements of metabolic rates for a range of marine species adapted to specific conditions ("ecotypes"). We use these data to evaluate the ocean's "metabolic state," the ability of environments to support aerobic metabolisms. Using the Community Earth System Model Large Ensemble, we investigate how natural climate variability and human-driven external forcing drive fluctuations in the extent of viable habitat for each ecotype on interannual to multi-decadal timescales. Warming and deoxygenation projected over the next several decades will yield a reduction in physiological safety margins for some organisms, curtailing the volume of viable habitat for some sensitive ecosystems. Fluctuations in temperature and oxygen associated with natural variability are distinct in character from those driven by external forcing over large regions in the upper ocean. Considering variations in temperature and oxygen jointly can marginally advance the time at which forced signals can be distinguished from national variability. Our results demonstrate that the perturbations underway in the ocean at present strongly exceed those associated with the natural system; in many regions, organisms will be pushed closer or beyond their physiological limits, driving extirpation in some cases and leaving the ecosystem more vulnerable to extreme events.