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Predictability of Metabolic index and its application to fish catch prediction

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Climate change has caused shifts in the abundance, geographic distribution, and phenology of marine species. Spatial shifts of species due to global warming will cause a high local extinction rate and decrease fisheries catch and species richness at tropical latitudes. Predicting the migration of marine organisms in response to climate change holds significance not just from an ecological perspective, but also from an economic standpoint in terms of effectively managing marine living resources. This study investigates the predictability of metabolically viable habitats by utilizing an Earth system model (ESM) that incorporates a coupled physical-biogeochemical prediction system. The metabolic index, previously defined with dissolved oxygen and temperature, has a higher predictability compared to temperature, particularly in the subsurface tropics. The primary factor contributing to the high predictability of the metabolic index is the longer persistency of lateral oxygen advection at the boundary of the tropical oxygen minimum zone. Further investigations indicate that the interannual fluctuations in the catch of bigeye tuna within the exclusive economic zones (EEZs) in tropical regions can be predicted based on the metabolic index forecasted one year ahead, implying the potential application of ESM-based physiological prediction to dynamic management of marine living resources.