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Developing a high resolution coupled ocean-atmospheric model to understand reef fish distribution in the Eastern Tropical Pacific in the present and future climate

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In the last 20 years the anthropogenic pressure on the ocean and its ecosystems have been increasing, inducing considerable oceanographic and biogeochemical changes. The global warming impact is projected to increase further in the next decades. Consequently, changes in reef fish distribution, and the subsequent cascading effects on biodiversity, ecosystem function, reefs' services, climate feedbacks, and socio-economic wellbeing are inevitable. To understand the extent and the impact of these changes, it is of fundamental importance to have reliable climate information at high spatio-temporal resolution, integrating interannual-to-long-term atmospheric-oceanic variability. Earth System Models are too coarse to fully resolve key features at the local scales. A challenge that can be overcome with dynamical downscaling, a powerful tool to increase our understanding of future changes in coastal regions. We use the Coupled-Ocean-Atmosphere-Wave-Sediment Transport (COAWST) Modeling System to simulate the eastern tropical Pacific (ETP) circulation and biogeochemistry. The model includes an atmospheric component, the Weather Research and Forecast Model (WRF) and an oceanic component, the Regional Ocean Modeling System (ROMS) with a biogeochemistry module. Present (1995-2016) and future (2025-2050) years will be dynamically downscaled, at a 20 km and 4 km resolution, from global reanalysis and the Norwegian Earth System model NorESM. To investigate the variability and the extent of anthropogenic-induced climate change impact on the local ecosystem, two contrasting future scenarios, the "strong mitigation" (SSP1-2.6) and the "business-as-usual" (SSP5-8.5), will be simulated. The performance of the model, its reliability and improvements in projecting future changes are presented here. We thoughtfully validate the model output, by comparing present days results with reanalysis and satellite data to demonstrate its potential to deliver crucial information for investigating climate changes impacts on the distribution of reef fish throughout the ETP.