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Characterisation of low oxygen extreme events in the Eastern Tropical Pacific between 1979 and 2016

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The oxygen minimum zones (OMZs) in the Eastern Tropical Pacific (ETP) have expanded over the past 50 years, likely leading to more frequent and more intense low oxygen extreme events. This has potentially far-reaching implications for e.g., the production of the climate-relevant gas nitrous oxide or the reduction of habitat for fish and zooplankton. Yet, to date our understanding of the distribution and characteristics of low oxygen extreme events in the ETP remains limited.

To fill this gap, we study low oxygen extremes in the ETP using results from an eddy-resolution hindcast simulation with the coupled physical-biogeochemical model ROMS-BEC for the Pacific from 1979 to 2016. Our setup permits us to simulate oxygen variability in the ETP affected by processes on a broad range of scales, from climate modes down to mesoscale dynamics. We detect and track low oxygen extreme events in the upper 500 meters of the ETP, by applying temporally constant statistical thresholds to the hindcast simulation and

requiring a minimum event duration of 5 days. While most extremes last less than 10 days and are of small volumetric extent, about 15% of the extremes exist for over a month. The diversity of the long-lasting extremes is dominated by westward propagating low oxygen eddies, which are mostly generated in the near-coastal area. Superimposed inter-annual variability associated with the El Niño-Southern Oscillation (ENSO) leads to a decrease in mesoscale extremes during El Niño periods. Along the boundaries of the ETP OMZs transient shoaling events of the oxycline linked to ENSO dynamics or the seasonal cycle contribute to the generation of further pronounced low oxygen extreme events.

The presented detection and tracking of low oxygen extremes is an important step towards a better understanding of extreme event occurrences and characteristics and lays the groundwork for further research such as the biogeochemical impact of such extremes.