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Expansion of the eastern North Pacific OMZ and the associated denitrification regime

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At this point ocean deoxygenation is well documented, including in oxygen minimum zones (OMZs). Within the large OMZs of the Arabian Sea and eastern Pacific are imbedded areas where oxygen concentrations are so low that they are undetectable by routine CTD sensors (oxygen deficient zones, ODZs). How do we determine if these ODZ are losing O₂? Furthermore, denitrification occurs in oxygen minimum zones (OMZs) so one might hypothesize that denitrification is likewise expanding if oxygen is decreasing. This is important because the ocean's fixed nitrogen inventory limits the productivity over large marine areas.

We have investigated these questions in the largest OMZ, the eastern tropical North Pacific (ETNP) through an analysis of 6 repeats of a 1000 km transect along 110° West in the heart of the ETNP ODZ between 1971-2019. We use N*, a stoichiometric parameter calculated from nitrate and phosphate, as our indicator of denitrification. The more Negative N* the more denitrification has occurred. After secondary QC the values of O₂ concentration between potential density 24.75 and 1000m along with N* were integrated across the transect and over the depth of the ODZ.

The results show a clear decrease in oxygen inventory along with an increase in N*, suggesting deoxygenation and intensification of denitrification over during the 50 year period. We discuss potential mechanisms for denitrification signal increase including ENSO, Pacific Decadal Oscillation, tropical hurricane intensity, and variations in thermocline depth.