

# Oxygen extreme events in the Eastern Tropical South Pacific (ETSP)

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## How is the biogeochemistry of the ETSP affected by low oxygen extreme events?

- The oxygen minimum zone (OMZ) of the ETSP grows and intensifies under global ocean deoxygenation (Stramma et al. 2008)
- How do increased low oxygen extreme events affect the marine nitrogen cycle?

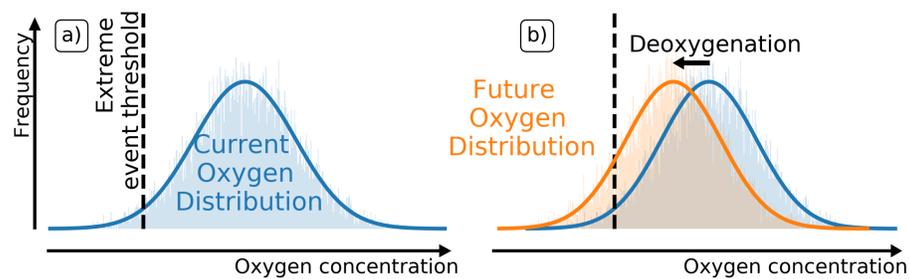


Figure 1: Comparison of oxygen extreme event occurrence frequencies under present day (a) and more deoxygenated future conditions (b).

## Low oxygen eddies are hotspots for fixed nitrogen loss

- Preliminary results match observations, showing intense denitrification in individual low oxygen eddies (Altabet et al. 2012)

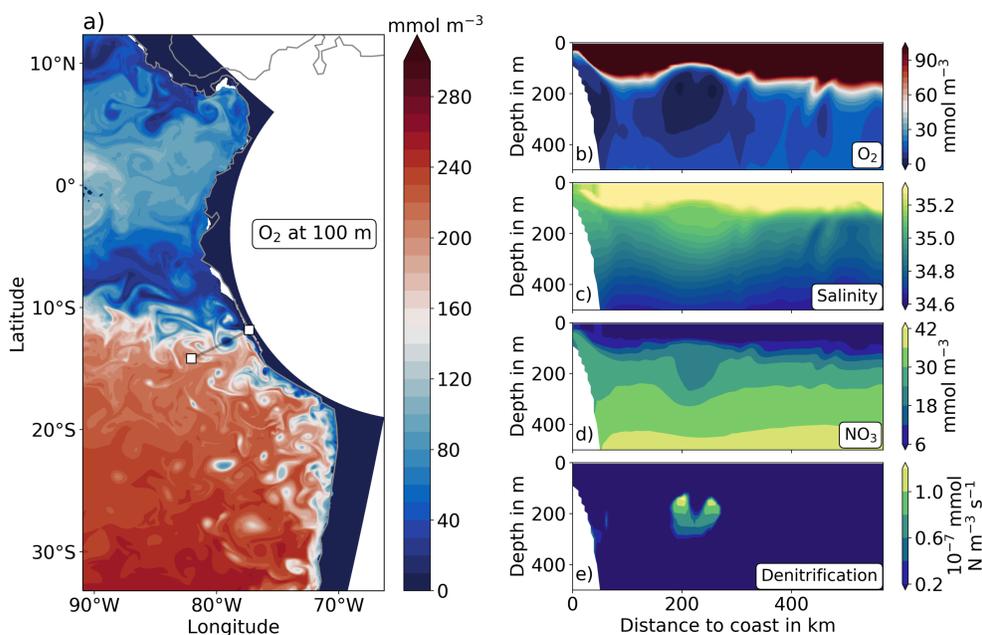


Figure 3: A low oxygen anticyclonic mode water eddy in the ETSP. a) Model snapshot of oxygen distribution at 100 m depth. Vertical sections of b) oxygen, c) salinity, d) nitrate and e) denitrification are shown along the gray line between the white squares in a).

## Research outlook and open questions

- To assess the variability of oxygen in the ETSP OMZ due to mesoscale dynamics
- To quantify the overall effect of mesoscale dynamics on the nitrogen budget of the ETSP OMZ
- To understand how the nitrogen cycle is further affected by compound events, involving extremes in oxygen and e.g. temperature or pH.

## Modeling the biogeochemistry of the ETSP OMZ

- Coupled ROMS-BEC hindcast from 1979-2016 using ERA-Interim atmospheric forcing and increasing atmospheric pCO<sub>2</sub>
- A telescopic grid allows for increased horizontal resolution towards the Peruvian coast (down to 4 km)
- Analyze sub-seasonal to inter-annual oxygen variability

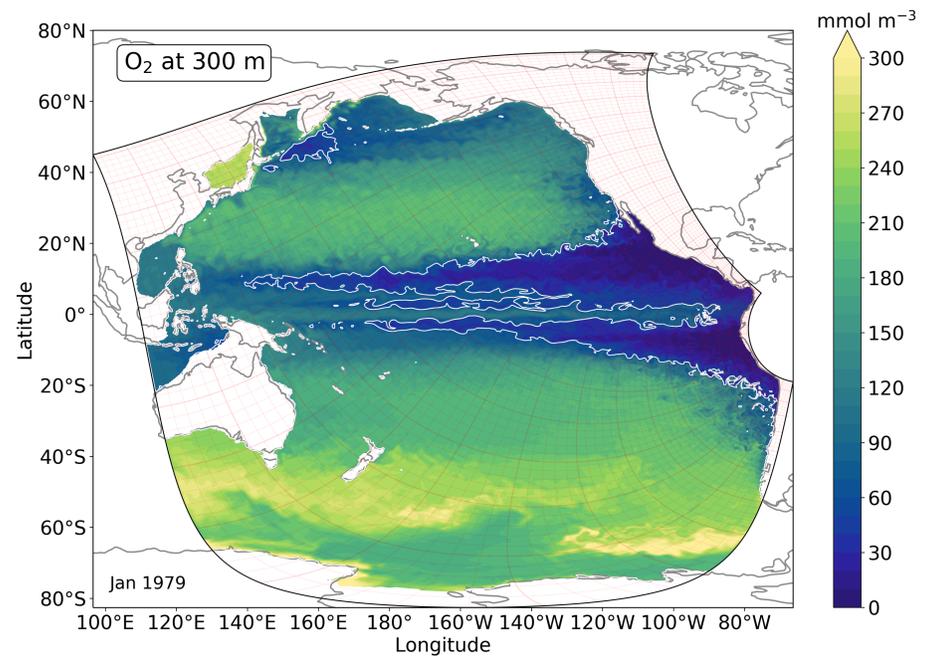


Figure 2: Snapshot of O<sub>2</sub> distribution in mmol m<sup>-3</sup> at 300 m depth during the ROMS-BEC Pacific hindcast.

## Compound events – Their biogeochemical impact depends on their definition

- How is the nitrogen cycle affected during compound events, i.e. if other environmental variables in addition to oxygen, undergo extreme conditions?

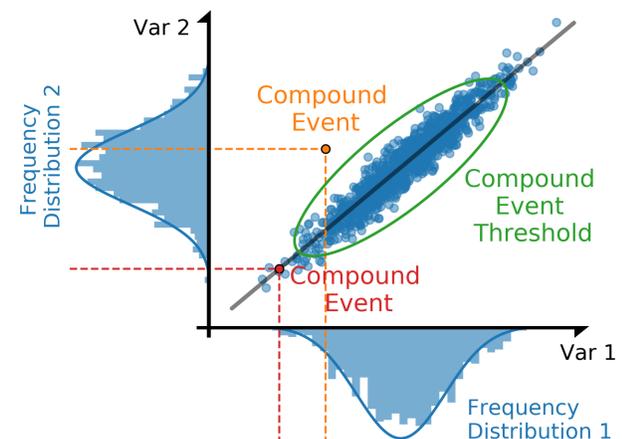


Figure 4: Compound events can be defined as extremes in individual distributions (red) or as outliers in the joint distribution (orange).

## References

- Altabet, M. A., Ryabenko, E., Stramma, L., Wallace, D. W. R., Frank, M., Grasse, P., and Lavik, G.: An eddy-stimulated hotspot for fixed nitrogen-loss from the Peru oxygen minimum zone, *Biogeochemistry*, 9, 4897–4908, doi:10.5194/bg-9-4897-2012, 2012.
- Stramma, L., Johnson, G. C., Sprintall, J., and Mohrholz, V.: Expanding oxygen-minimum zones in the tropical oceans, *Science*, 320, 655–658, 2008.