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Hidden biosphere in an oxygen-deficient Atlantic open ocean eddy: future implications of ocean deoxygenation on primary production in the eastern tropical North Atlantic

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The eastern tropical North Atlantic (ETNA) is characterized by a highly productive coastal upwelling system and a moderate oxygen minimum zone with lowest open ocean oxygen (O_2) concentrations of approximately 40 μmol kg-1. The recent discovery of re-occurring mesoscale eddies with close to anoxic O_2 concentrations (<1 μmol kg-1) located just below the mixed layer has challenged our understanding of O_2 distribution and biogeochemical processes in this area.
Here, we present the first microbial community study from a deoxygenated anticyclonic modewater eddy in the open waters of the ETNA. In the eddy, we observed significantly lower bacterial diversity compared to surrounding waters, along with a significant community shift. We detected enhanced primary productivity in the surface layer of the eddy indicated by elevated chlorophyll concentrations and carbon uptake rates of up to three times as high as in surrounding waters. Carbon uptake rates below the euphotic zone correlated to the presence of a specific high-light ecotype of Prochlorococcus, which is usually underrepresented in the ETNA. Our data indicate that high primary production in the eddy fuels export production and supports enhanced respiration in a specific microbial community at shallow depths, below the mixed layer base. The O_2-depleted core waters eddy promoted transcription of the key gene for denitrification, nirS. This process is usually absent from the open ETNA waters.
In light of future projected ocean deoxygenation, our results show that even distinct events of anoxia have the potential to alter microbial community structure with critical impacts on primary productivity and biogeochemical processes of oceanic water bodies.