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Oxygen changes in the tropical North Atlantic in connection to meridional overturning circulation and subtropical cell variability

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Ocean deoxygenation is well recognized with an observed reduction of about two percent in global oxygen content during the last 50 years. For the upper 1000m, about half of the observed oxygen loss can be explained by ocean warming associated with a reduction in oxygen solubility. The other half is linked to changes in ventilation (subduction, circulation, and mixing) being affected by warming, increased stratification, as well as changes in wind and buoyancy forcing. Impact of biology and/or biogeochemical feedbacks cannot be discarded, but will not be discussed. Here we will discuss and show possible evidence of the influence of the Atlantic meridional overturning circulation (AMOC) and the subtropical cells (STCs) on the oxygen distribution in the tropical Atlantic. Oxygen changes in the deep Atlantic Ocean (below 1500m) show a distinct pattern of oxygen increase and decrease that suggest an impact of long-term changes associated with the increase of North Atlantic convection activity and AMOC in the 90ies following decades of weak activities before. The presence of a mean state AMOC is responsible for the ventilation of the tropical North Atlantic oxygen minimum zone (TNA OMZ, 300-700m depth) predominantly from the southern hemisphere. Changes in the AMOC strength lead to changes of ventilation pathways toward and water mass characteristics within the TNA OMZ; here we will focus on the relation between salinity and oxygen and its long-term changes. Tropical OMZs are furthermore influenced by the circulation within the STCs connecting the subduction regions in the subtropics with the upwelling regions in the eastern tropics as was shown recently for the Pacific OMZs. The analysis of moored velocity observations at the equator, 23°W and wind products suggests that the Atlantic STCs increased during the last 10 years with multidecadal variability before. A shoaling of the STCs as expected under global warming due to poleward migrating density outcrops and increased stratification is the most likely reason for the observed oxygen reduction at the deep oxycline (∼300m depth) and enhanced ventilation above.