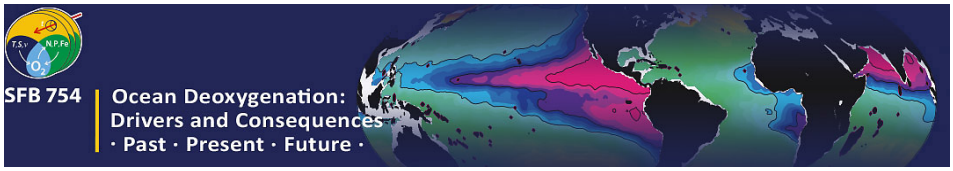

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Time scales of oxygen variability in the eastern tropical North Atlantic

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In the framework of the German collaborative research centre SFB754 and associated programs, a large data set consisting of shipboard and moored observations has been collected in the eastern tropical North Atlantic (ETNA) during the past 10 years. This data provides an unprecedented comprehensive insight into the variability of oxygen, hydrography and velocity of the oxygen minimum zone (OMZ) of the ETNA, centered at 11°N, and the well-ventilated equatorial regime south of it. Here, we discuss the variability observed from intraseasonal up to even decadal time scales throughout the SFB754 period.

The ETNA is subject to a coherent decadal oxygen change pattern with a strong oxygen decrease at the depth of the upper OMZ boundary (200-400m), whereas a moderate oxygen increase is found below the core depth of the OMZ (500-800m). Hydrography and zonal velocity also changed which suggest that the decadal oxygen change pattern we observe is likely due to circulation changes: a weakening of the shallow wind-driven circulation at depth of the upper OMZ boundary and an intensification of the latitudinally alternating zonal jets below the OMZ core depth.

Seasonal and interannual oxygen variability in the upper 500m is at least partly connected to variations of zonal currents, which are either due to meridional shifts of the current core or transport variability associated with the current. Below about 500 m close to OMZ core, a well-defined seasonal cycle is observed, most likely associated with horizontal shifts of the lateral OMZ boundaries due to propagation of seasonal Rossby waves.

Intraseasonal variability is driven by mesoscale eddies and baroclinic Rossby waves. At the depth of the OMZ core, they contribute to a net lateral oxygen flux into the OMZ. At depths above 300m, anomalous low oxygen concentrations episodically appear, which are induced by mesoscale eddies with enhanced biological activity on top of the isolated eddy core. This phenomenon is well described for latitudes at around 16-20°N, but the dynamics and origin of these eddies are so far unknown for lower latitudes (8-12°N).

The decade-long intense shipboard and moored observations enabled identifying key regions for oxygen variability in the OMZ. Future observing efforts in the ETNA after the SFB754 are most likely less intense. In an effort to establish sustained oxygen observations for the ETNA we have added oxygen sensors to selected moorings of the PIRATA buoy network, recently even allowing real-time oxygen data access.

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