Geophysical Research Abstracts
Vol. 20, EGU2018-3021, 2018
EGU General Assembly 2018

Variability of the Atlantic North Equatorial Undercurrent and its impact on oxygen

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The North Equatorial Undercurrent (NEUC) in the Atlantic Ocean flows eastward between 4°N and 6°N in a depth range of 50m to 400m. Although its core velocity is low (0.1m/s to 0.3 m/s) it is one of the main oxygen supply routes towards the Oxygen Minimum Zone (OMZ) in the Eastern Tropical North Atlantic (ETNA). Changes in the NEUC strength have been suggested to be associated with changes in the ETNA OMZ. Here we investigate the variability of the NEUC on interannual time scales and its impact onto oxygen levels in the ETNA OMZ.
The variability and driving mechanisms of the NEUC are not well understood. NEUC transport estimates from observations and models are difficult, mainly because the cores of the NEUC and the North Equatorial Countercurrent (NECC) above cannot be clearly distinguished over most of the year. For our analysis we are using observational data from 20 ship sections along 23°W from 2002 to 2016 and the output of a high resolution ocean model in which a 1/10° nest covering the tropical Atlantic is embedded into a global 1/2° model. The model captures the zonal current field of the tropical Atlantic reasonably well although the NEUC tends to be too strong compared to observations. Utilizing a new algorithm to investigate its location and intensity, we find that almost half of the NEUC variability on interannual time scales can be explained by the wind field in the central tropical Atlantic. These large-scale wind field changes are related to the Atlantic Meridional Mode (AMM), a climate mode that represents an interhemispheric SST gradient in the tropical Atlantic. Interannual variations in both the position and the intensity of the NEUC are significantly correlated with the AMM index. Composites further show a weakening and a southward shift of the NEUC during positive AMM phases and vice versa. Those changes are associated with decreased oxygen concentrations in the NEUC and ETNA OMZ region.