Geophysical Research Abstracts
Vol. 19, EGU2017-8288, 2017
EGU General Assembly 2017

Isopycnal diffusivity in the tropical North Atlantic oxygen minimum zone

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Isopycnal diffusivity plays an important role in the ventilation of the Eastern Tropical North Atlantic (ETNA) Oxygen Minimum Zone (OMZ). Lateral tracer transport is described by isopycnal diffusivity and mean advection of the tracer (e.g. oxygen), together they account for up to 70% of the oxygen supply for the OMZ. One of the big challenges is to separate diffusivity from advection. Isopycnal diffusivity was estimated to be K_y=(500 ± 200) m^2 s^{-1} and K_x=(1200 ± 600) m^2 s^{-1} by Banyte et. al (2013) from a Tracer Release Experiment (TRE). Hahn et al. (2014) estimated a meridional eddy diffusivity of 1350 m^2 s^{-1} at 100 m depth decaying to less than 300 m^2 s^{-1} below 800 m depth from repeated ship sections of CTD and ADCP data in addition with hydrographic mooring data. Uncertainties of the estimated diffusivities were still large, thus the Oxygen Supply Tracer Release Experiment (OSTRE) was set up to estimate isopycnal diffusivity in the OMZ using a newly developed sampling strategy of a control volume.

The tracer was released in 2012 in the core of the OMZ at approximately 410 m depth and mapped after 6, 15 and 29 months in a regular grid. In addition to the calculation of tracer column integrals from vertical tracer profiles a new sampling method was invented and tested during two of the mapping cruises.

The mean eddy diffusivity during OSTRE was found to be about (300 ± 130) m^2 s^{-1}. Additionally, the tracer has been advected further to the east and west by zonal jets. We compare different analysis methods to estimate isopycnal diffusivity from tracer spreading and show the advantage of the control volume surveys and control box approach. From the control box approach we are estimating the strength of the zonal jets within the OMZ core integrated over the TRE time period.

References:

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