Seasonal and regional variability of upper ocean diapycnal heat flux in the Atlantic Cold Tongue.

Rebecca Hummels[1], Marcus Dengler[1], Bernard Bourlès[2]

[1]GEOMAR | Helmholtz-Zentrum für Ozeanforschung Kiel, Germany
[2]IRD, LEGOS, CRHOB, Cotonou, Benin

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Abstract:

SST variability within the Atlantic cold tongue (ACT) region is of climatic relevance for the surrounding continents. A multi cruise data set of microstructure observations is used to infer regional as well as seasonal variability of upper ocean mixing and diapycnal heat flux within the ACT region. The variability in mixing intensity is related to the variability in large scale background conditions, which were additionally observed during the cruises. The observations indicate fundamental differences in background conditions in terms of shear and stratification below the mixed layer (ML) for the western and eastern equatorial ACT region causing critical Froude numbers (Fr) to be more frequently observed in the western equatorial ACT. The distribution of critical Fr occurrence below the ML reflects the regional and seasonal variability of mixing intensity. Turbulent dissipation rates ( ) at the equator (2°N-2°S) are strongly increased in the upper thermocline compared to off-equatorial locations. In addition, is elevated in the western equatorial ACT compared to the east from May to November, whereas boreal summer appears as the season of highest mixing intensities throughout the equatorial ACT region, coinciding with ACT development. Diapycnal heat fluxes at the base of the ML in the western equatorial ACT region inferred from ε and stratification range from a maximum of 90 Wm^{-2} in boreal summer to 55 Wm^{-2} in September and 40 Wm^{-2} in November. In the eastern equatorial ACT region maximum values of about 25 Wm^{-2} were estimated during boreal summer reducing to about 5 Wm^{-2} towards the end of the year. Outside the equatorial region, inferred diapycnal heat fluxes are comparably low rarely exceeding 10 Wm^{-2}. Integrating the obtained heat flux estimates in the ML heat budget at 10°W on the equator accentuates the diapycnal heat flux as the largest ML cooling term during boreal summer and early autumn. Critical to the enhanced diapycnal heat flux in the western equatorial ACT region is elevated meridional velocity shear in the upper thermocline. It is thus suggested that TIWs are crucial contributors to mixing in the upper equatorial thermocline and to the development and maintenance of the ACT from boreal summer to mid-autumn.