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Upwelling and associated heat flux in the Equatorial Atlantic inferred from helium isotope disequilibrium

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Upwelling velocities w in the equatorial band are too small to be directly observed. Here we apply a recently proposed indirect method, using the observed helium isotope (3He, 4He) disequilibria in the mixed layer. The helium data were sampled on three cruises in the eastern tropical Atlantic in September 2005 and June/July 2006. A one - dimensional two box model was applied, where the helium air-sea gas exchange is balanced by upwelling from 3He- rich water below the mixed layer and by vertical mixing. The mixing coefficients Kv were estimated from microstructure measurements. Helium disequilibrium was observed on 54 stations, with 48 % of the calculated upwelling velocities smaller than 1.0 x10-5 m/s. The highest upwelling velocities were found in late June 2006. Meridional upwelling distribution indicated an equatorial asymmetry with higher vertical velocities between the equator and 1°-2° south compared to north of the equator, particularly at 10°W. Associated heat flux into the mixed layer could be as high as 138 W/m-2, but depends strongly on the chosen depths where the upwelled water comes from. By combining upwelling velocities with SST and productivity distributions, mean monthly equatorial upwelling rates were inferred.