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Diapycnal oxygen supply to the tropical North Atlantic oxygen minimum zone

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The replenishment of consumed oxygen in the open ocean oxygen minimum zone (OMZ) off West Africa in the tropical North Atlantic Ocean is studied, with a focus on oxygen transport across density surfaces (diapycnal flux). The latter is obtained from a large observational set of oxygen profiles and diapycnal mixing data from years 2008 to 2010. Diapycnal mixing is inferred from different sources: a large scale tracer release experiment, microstructure profiles, and shipboard acoustic current measurements plus density profiles. The average diapycnal diffusivity in the study area is $1 \cdot 10^{-5}\, m^2\, s^{-1}$. No significant vertical gradient of average diapycnal diffusivities exists in the depth interval from 150 to 500 m. The diapycnal flux is found to contribute substantially to the oxygen supply of the OMZ. Within the OMZ core, 1.5 $\mu mol\, kg^{-1}\, a^{-1}$ of oxygen is supplied via diapycnal mixing, contributing about a third of the total demand. The oxygen that is contributed via diapycnal mixing originates from oxygen that has been laterally supplied within the overlying Central Water layer by advective and eddy fluxes. Due to the existence of a separate shallow oxygen minimum at about 100 m depth throughout most of the study area, there is no direct net vertical oxygen flux from the surface layer of the study area into the Central Water layer. Thus all oxygen supply of the OMZ is associated with remote pathways.