

Transports and pathways of the tropical AMOC return flow from Argo data and shipboard velocity measurements

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The upper-ocean circulation of the tropical Atlantic is a complex superposition of thermohaline and wind-driven flow components. The resulting zonally- and vertically-integrated upper-ocean meridional flow is referred to as the upper branch of the Atlantic Meridional Overturning Circulation (AMOC) - a major component and potential tipping element of the global climate system. Here, we investigate the tropical part of the northward AMOC branch, i.e. the return flow covering the upper 1,200 m, based on Argo data and repeated shipboard velocity measurements. The western boundary mean circulation at 11°S is realistically reproduced from high-resolution Argo data showing a remarkably good representation of the volume transport of the return flow water mass layers when compared to results from direct velocity measurements along a repeated ship section. The AMOC return flow through the inner tropics (11°S-10°N) is found to be associated with a diapycnal upwelling of lower central water into the thermocline layer of ~2 Sv. This is less than half the magnitude of previous estimates, likely due to improved horizontal resolution. The total AMOC return flow at 11°S and 10°N is derived to be similar in strength with 16-17 Sv. At 11°S, northward transport is concentrated at the western boundary, where the AMOC return flow enters the inner tropics at all vertical levels above 1,200 m. At 10°N, northward transport is observed both at the western boundary and in the interior predominantly in the surface and intermediate layer indicating recirculation and transformation of thermocline and lower central water within the inner tropics.