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Oral
Within the returning branch to its deep water formation sites, the Atlantic Meridional Overturning Circulation (AMOC) transports large amounts of heat through the tropics to the North Atlantic Ocean making it a major component of the climate system. As a consequence of this return flow the upper ~1200m of the tropical Atlantic Ocean are characterized by a net northward transport that especially manifests in the western boundary current system. Here, the western boundary circulation is, in fact, a depth-dependent superposition of contributions from (i) the thermohaline circulation and (ii) the wind-driven shallow overturning circulations known as the Subtropical Cells (STCs) as well as of (iii) the western boundary compensation of the interior ocean Sverdrup transport. In particular, the equatorward North Brazil Undercurrent at the western boundary of the tropical South Atlantic is composed of all three transport components at thermocline level.
In this study, a combination of Argo float and shipboard velocity data is used, first, to investigate the capability of Argo-based transport estimates in reproducing the observed western boundary transport at 11°S and, second, to examine the tropical water mass transformation of surface, STC, lower central and intermediate water layers between 11°S and 10°N. It shows that high-resolution (1/6°) climatological Argo data yield a comparable mean western boundary transport of ~22 Sv (surface to ~1200m) at 11°S where multi-year shipboard and moored velocity data provide a reliable reference. We further identify a basin-wide diapycnal upwelling of ~2 Sv from the lower central water layer (~200 to 300m) into the STC/thermocline layer (~60 to 200m) which is considerably lower than pre-Argo observational estimates that ranged from 6 to 10 Sv. Interestingly, a comparable diapycnal transport of ~6 Sv is found when repeating the analysis with lower-resolved (1°) Argo data that substantially underestimate western boundary transports.
It is therefore concluded that a realistic representation of the mean western boundary circulation by Argo floats is generally possible but requires to resolve the density structure of the boundary current. Previous observational studies likely overestimated the tropical upwelling within the return flow due to sparse data coverage both in time and space especially at the western boundary.
Building up on the validation of the high-resolution Argo climatology, we further explore the preferred tropical pathways of the return flow within the individual water mass layers.
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