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Property Changes of Abyssal Waters in the Western Tropical Atlantic

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Flowing northward towards the equator, Antarctic Bottom Water (AABW) encounters the lighter overlying North Atlantic Deep Water (NADW), both water masses creating an abyssal stratification and gradually mixing across their interface. Changes in the associated water mass formation and/or along-path transformation, observable in the evolution of water mass volume and characteristics, might impact the deep oceans uptake of anthropogenic CO_2 or its contribution to global sea level rise. We compile historic and recent shipboard measurements of hydrography and velocity to provide a comprehensive view on water mass distribution, pathways, along-path transformation and long-term temperature changes of abyssal waters in the western South and Equatorial Atlantic. We are able to confirm previous results showing that the northwest corner of the Brazil Basin represents a splitting point for the southward/northward flow of NADW/AABW. The available measurements sample water mass transformation along the two major routes for deep and bottom waters in the tropical to South Atlantic – along the deep western boundary and eastward, parallel to the equator - as well as the hot spots of extensive mixing. We find lower NADW and lighter AABW to form a highly interactive transition layer in the northern Brazil Basin. The AABW north of 5°S is relatively homogeneous with only lighter AABW being able to pass through the Equatorial Channel (EQCH) into the North Atlantic. Spanning a period of 26 years, our data also allow an estimation of long-term temperature trends in abyssal waters. We find a warming of 2.5 $\pm$ 0.7•10-3 °C yr-1 of the waters in the northern Brazil Basin being colder than 0.6 °C throughout the period 1989-2014 and can relate that warming to a thinning of the dense AABW layer. While isopycnal heave is the dominant effect defining the vertical distribution of temperature trends on isobars, we also find temperature changes on isopycnals in the transition layer the lower NADW and AABW layers form. Those temperature changes exhibit decadal variations (warming in the 1990s, cooling in the 2000s) and the contributions to trends on isobars range from $\sim$50% within lighter AABW in the EQCH up to 80% in the transition layer the lower NADW/lighter AABW form in the northern Brazil Basin.