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On the density compensation of the North Atlantic waters over the past fifty years

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Analyses of oceanic temperature and salinity fields, via an examination of repeat cross-sections and historical hydrographic databases, have consistently revealed significant changes in the ocean's temperature and salinity fields over the past fifty years. While an understanding of these property changes is important for an assessment of the ocean's role as a heat and freshwater reservoir, it is the degree to which these changes are density compensated that sheds light on whether there are any dynamical consequences for the observed temperature and salinity changes. Our study focuses on an assessment of the temporal changes in the density field of the North Atlantic, a basin chosen for its unparalleled data density and its active thermohaline circulation. Specifically, we assess the spatial pattern of density changes over the past fifty years in this basin and quantify the contribution from temperature and salinity changes. A strong degree of compensation is found such that the density changes are smaller than what one would expect from an examination of the temperature or salinity fields in isolation. The cause of the compensation is discussed, as are the implications of the calculated density changes.