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TITLE: Interannual to decadal oxygen variability in the mid-depth water masses of the eastern North Atlantic

AUTHOR: ['Ilaria Stendardo', 'Dagmar Kieke', 'Monika Rhein', 'Nicolas Gruber', 'Reiner Steinfeldt']

ABSTRACT:

The detection of multi-decadal trends in the oceanic oxygen content and its possible attribution to global warming is protracted by the presence of a substantial amount of interannual to decadal variability, which hitherto is poorly known and characterized. Here we address this gap by studying interannual to decadal changes of the oxygen concentration in the Subpolar Mode Water (SPMW), the Intermediate Water (IW) and the Mediterranean Outflow Water (MOW) in the eastern North Atlantic. We use data from a hydrographic section located in the eastern North Atlantic at about 48°N repeated 12 times over a period of 19 years from 1993 through 2011, with a nearly annual resolution up to 2005. Despite a substantial amount of year-to-year variability, we observe a long-term decrease in the oxygen concentration of all three water masses, with the largest changes occurring from 1993 to 2002. During that time period, the trends were mainly caused by a contraction of the subpolar gyre associated with a northwestward shift of the Subpolar Front (SPF) in the eastern North Atlantic. This caused SPMW to be ventilated at lighter densities and its original density range being invaded by subtropical waters with substantially lower oxygen concentrations. The contraction of the subpolar gyre reduced also the penetration of IW of subpolar origin into the region in favor of an increased northward transport of IW of subtropical origin, which is also lower in oxygen. The long-term oxygen changes in the MOW were mainly affected by the interplay between circulation and solubility changes. Besides the long-term signals, mesoscale variability leaves a substantial imprint as well, affecting the water column over at least the upper 1000 m and laterally by more than 400 km. Mesoscale eddies induced changes in the oxygen concentration of a magnitude that can substantially alias analyses of long-term changes based on repeat hydrographic data that are being collected at intervals of typically 10 years.

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