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Variability of Subpolar Mode Water in the Subpolar North Atlantic

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Subpolar Mode Water (SPMW) represents a variety of near-surface waters that occupy a large volume in the upper 1000 m of the Subpolar North Atlantic (SPNA) water column. Originating in the eastern and north-eastern SPNA through late winter water mass formation, SPMW acts as a precursor to forming the North Atlantic Deep Water, an important ingredient of the Atlantic Meridional Overturning Circulation (AMOC). This study addresses spatial and temporal changes in the SPMW layer thickness and volume. We relate these changes to variability in the water mass formation estimated both through a thermodynamic approach (focusing on the direct effect of air-sea interactions) and through a kinematic approach, the latter involving the estimation of volume transport from the mixed layer to the interior of the ocean due to subduction and to the entrainment/detrainment of the mixed layer itself. We use two observation-based gridded 3D products from the Copernicus Marine Environmental Monitoring Service (CMEMS), i.e., the ARMOR3D and the OMEGA3D datasets. The first one provides 3D temperature and salinity fields and is available on a weekly 0.25° regular grid from 1993 to the present. The second one provides observation-based quasi-geostrophic vertical and horizontal velocity fields with the same temporal and spatial resolution as ARMOR3D but for the period 1993 to 2018. This is the first time that thermodynamic and kinematic approaches are applied to observation-based data in the North Atlantic. Our results show that formation of SPMW is characterized by large interannual variability in terms of volume and spatial distribution. Most importantly, the differences in the kinematic and thermodynamic estimates of SPMW yearly formation rates suggest a substantial role of diapycnal mixing in diluting the waters formed by air-sea fluxes towards the range of SPMW densities.

Topic

Value of AMOC observing –what have we learned?

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