Poleward Shift in Ventilation of the North Atlantic Subtropical Underwater (STUW)

Problem: The subtropical high pressure of the descending branch of the Hadley circulation is located between 20° and 40° of both north and south latitudes. Within the zone, a pool of sea surface salinity maximum (SSS-max) exists in responding to the excess of evaporation over precipitation. This study is to report that the sea-surface salinity maximum (SSS-max) in the North Atlantic has poleward expanded in recent decades, and that the expansion is a main driver of the decadal changes in subtropical underwater (STUW) —a high-saline water mass in the upper 50–300 m.

Key Findings: The STUW ventilation zone (marked by the location of the 36.7 isohaline) has been displaced northward by 1.2 ± 0.36° latitude for the 34-year (1979-2012) period (Fig.1). As a result of the redistribution of the SSS-max water, the ventilation zone has shifted northward and expanded westward into the Sargasso Sea (Fig.2). The ventilation rate of STUW has increased, which is attributed to the increased lateral induction of the sloping mixed layer (Fig.3). STUW has become broader, deeper, and saltier, and the changes are most pronounced on the northern and western edges of the high-saline core (Fig.4).

Significance: This study shows that the increase of SSS-max in the North Atlantic is due to the poleward expansion of the SSS-max center in association with the widening of the tropics, which is different from the “dry-gets-drier and wet-gets-wetter” paradigm. The expansion has shifted the ventilation zone poleward, leading to an increased production of the STUW. The change in STUW could have profound impacts on both the equatorial thermocline and the North Atlantic Deep Water, as the STUW propagates into the tropical and subpolar regions via interior pathways.


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