An evaluation of the temperature and salinity structure of the North Atlantic circulation based on an eddy-resolving simulation

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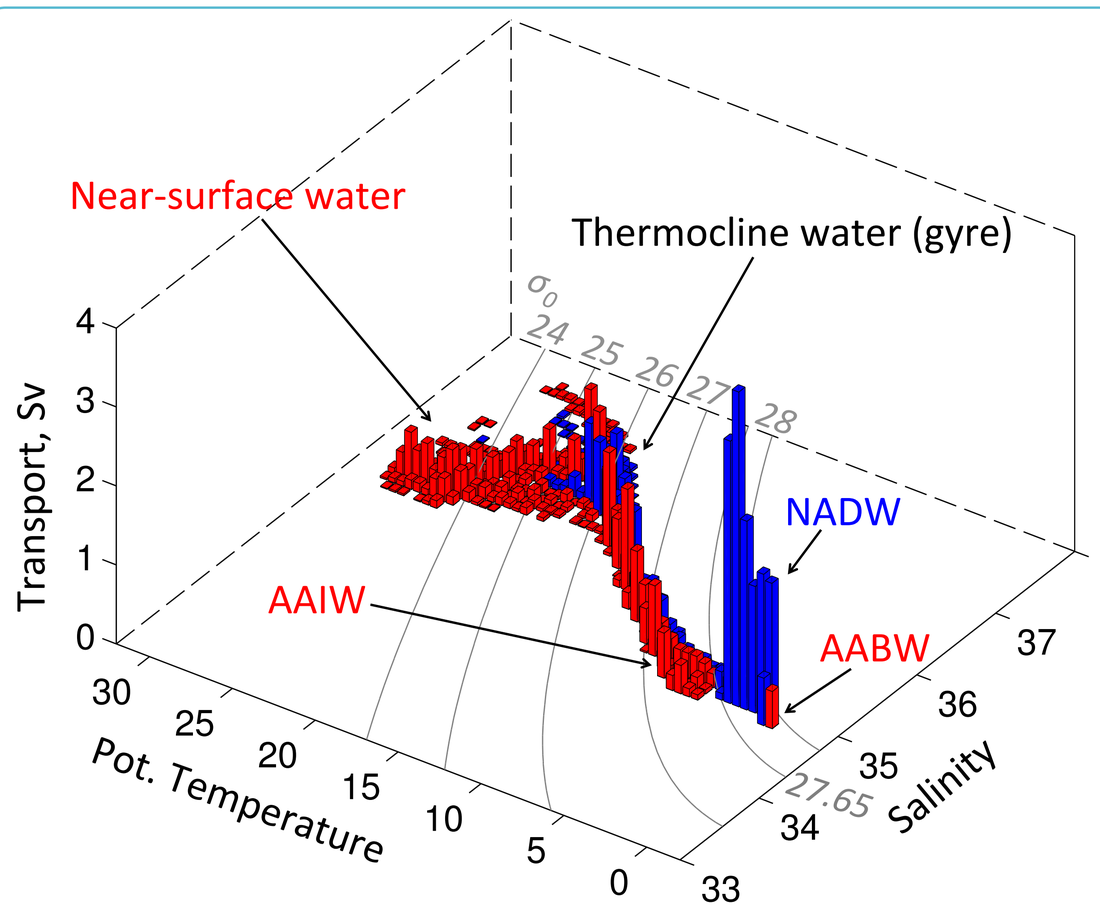
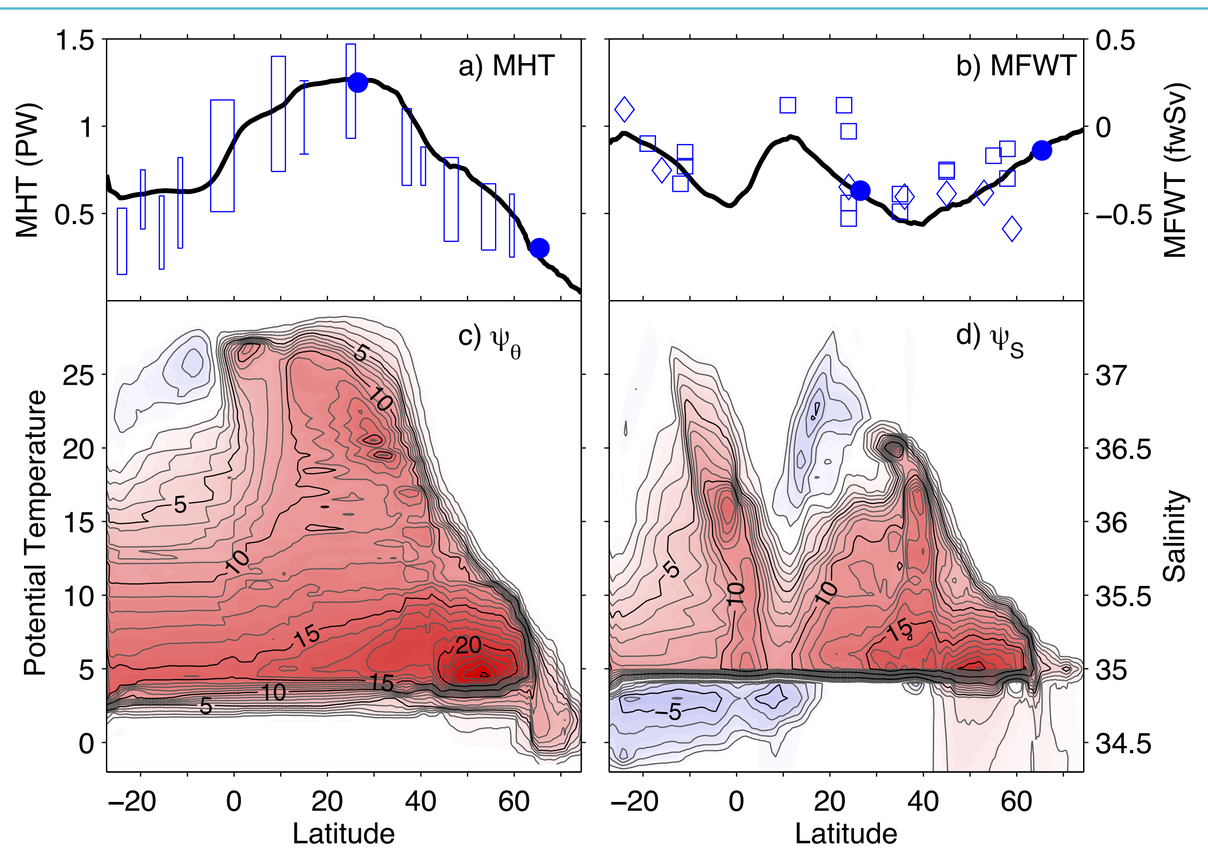
[Abstract] *Results from an eddy-resolving simulation are used to demonstrate a diagnostic approach for depicting the structure of the North Atlantic circulation and to assess the relative importance of the overturning circulation versus lateral gyre in heat and freshwater transports of the subtropical and subpolar North Atlantic. We found*

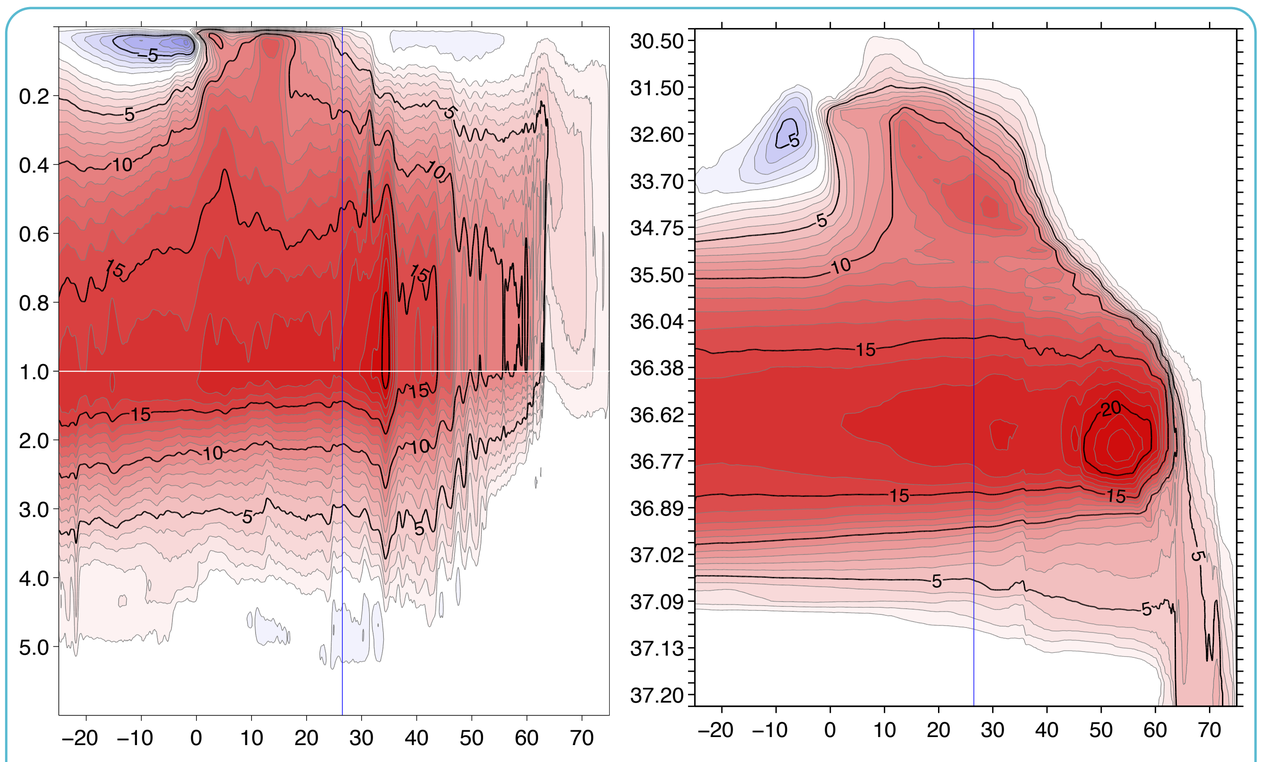
- The trans-basin meridional volume transports on θ-S plane provide a useful summary of the complex circulation in that they retain the water mass structure of the circulation when zonally integrated and connect directly to the heat transport, fresh-water transport, and water mass transformations (diapycnally and isopycnally).
- The wind-driven subtropical gyre, which features a large isopycnic recirculation and a small shallow diapycnal overturning, contributes about zero heat transport, even less than 10% obtained from the classical vertical vs. horizontal decomposition. It however contributes 1/3 freshwater transport, in the opposite direction to that by the meridional overturning circulation.
- Heat and freshwater transports in the subpolar North Atlantic are dominated by the diapycnal overturning circulation, or the transformation of warm salty upper layer water into North Atlantic deep water. This picture differs greatly from that the gyre contributing 2/3 heat and freshwater transports based on the vertical versus horizontal decomposition.



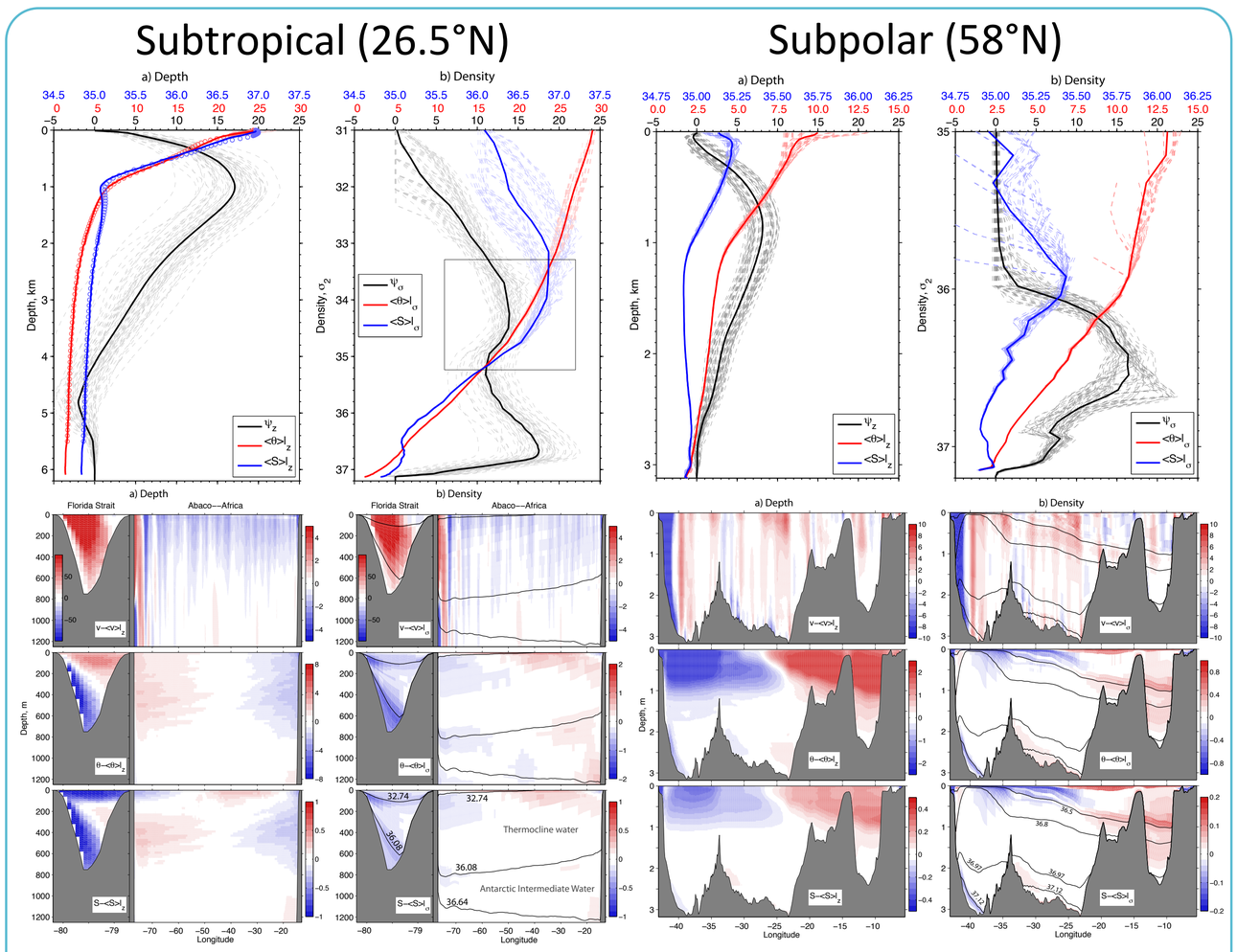
1. Volume transport at 26.5°N projected on θ-S plane



2. Latitudinal distributions of meridional heat/freshwater transports (MHT/MFWT), and the corresponding streamfunctions ψ_θ and ψ_S



3. Streamfunction on depth (z) and density (σ_2) coordinates



4. Overturning versus gyre decomposition in the subtropical and subpolar North Atlantic along depth (z) and density (σ_2)

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