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Drivers of the water mass transformations that set the overturning circulation in the subpolar North Atlantic

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The OSNAP (Overturning in the Subpolar North Atlantic Program) array at ~60°N has provided new and unprecedented insight into the strength and variability of the meridional overturning circulation in the subpolar North Atlantic. OSNAP has identified the region of the subpolar North Atlantic east of Greenland as a key region for the water mass transformation and densification that sets the strength and variability of the overturning circulation. Here, we will investigate the drivers of this water mass transformation and their roles in driving the overturning circulation at OSNAP. Using a water mass analysis on both model-based and observational-based datasets, we isolate diathermal (across surfaces of constant temperature) and diahaline (across surfaces of constant salinity) transformations due to air-sea buoyancy fluxes, and mixing. We show that the time-mean overturning strength is set by both the air-sea buoyancy fluxes and the strength of subsurface mixing. This balance is apparent on a seasonal timescale, where we resolve large seasonal fluctuations in the both the air-sea buoyancy fluxes and mixing. The residual of this seasonal cycle then corresponds to the mean overturning strength. On interannual timescales, mixing becomes the dominant driver of variability in the overturning circulation. To determine the location of these water mass transformations and the dynamical processes responsible for the mixing-driven variability, our water mass analysis is projected onto geographical coordinates.