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Observed Transport Variability of the Atlantic Subtropical Cells and Their Connection to Tropical Sea Surface Temperature Variability

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The shallow meridional overturning cells of the Atlantic Ocean, the subtropical cells (STCs), consist of poleward Ekman transport at the surface, subduction in the subtropics, equatorward flow at thermocline level and upwelling along the equator and at the eastern boundary. In this study, we provide the first observational estimate of transport variability associated with the horizontal branches of the Atlantic STCs in both hemispheres based on Argo float data and supplemented by reanalysis products.

Thermocline layer transport convergence and surface layer transport divergence between 10°N and 10°S are dominated by seasonal variability. Meridional thermocline layer transport anomalies at the western boundary and in the interior basin are anti-correlated and partially compensate each other at all resolved time scales. It is suggested that the seesaw-like relation is forced by the large-scale off-equatorial wind stress changes through low-baroclinic-mode Rossby wave adjustment. We further show that anomalies of the thermocline layer interior transport convergence modulate sea surface temperature (SST) variability in the upwelling regions along the equator and at the eastern boundary at time scales longer than 5 years. Phases of weaker (stronger) interior transport are associated with phases of higher (lower) equatorial SST. At these time scales, STC transport variability is forced by off-equatorial wind stress changes, especially by those in the southern hemisphere. At shorter time scales, equatorial SST anomalies are, instead, mainly forced by local changes of zonal wind stress.