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Observations of thermosteric sea level (TSL), equivalent water thickness (EWT) from GRACE, and sea surface height (SSH) are assimilated into a simple model forced by surface heat fluxes to construct a heat budget for the Atlantic for 1993-2010. Heat transport convergence (HTC) anomalies are estimated as a residual of the budget using a Kalman filter. Anomalies of HTC are combined with direct estimates of meridional heat transport (MHT) at 41N from Willis (2010) to estimate MHT anomalies throughout the Atlantic. The monthly MHT anomalies agree well with MHT from the RAPID/MOCHA program at 26.5N (the RAPID line). Our analysis shows that anomalies in MHT comparable to or those observed in 2010-2011 also occurred in 1999-2001. MHT anomalies are highly coherent between 35S and 40N with no obvious temporal lag. Positive anomalies in coherent MHT correspond to increased heat loss in the subtropical gyre highlighting the linkage between air-sea coupling in the North Atlantic subtropical gyre and large-scale ocean circulation. The high level of coherence in MHT, as well as the large contribution of Ekman advection to MHT at 26.5N, suggest forcing by large-scale wind anomalies. We compute estimates of Ekman heat advection from observations for comparison with model HTC and MHT and quantify the contributions of Ekman advection to meridional coherence. Ekman advection anomalies reverse sign across 40N, consistent with a decrease in MHT coherence there.
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