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Basin-wide integrated volume transports in an eddy-filled ocean

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Western boundary regions coincide with the fastest ocean currents, and are associated with elevated levels of eddy kinetic energy and dynamic height variations. Based on moored density measurements along 26.5°N in the Atlantic we show that the amplitude of dynamic height variability peaks between 500 and 100 km east of the Abaco shelf (Bahamas) with values between 9.1 and 11.0 dyn. cm rms. The amplitude then rapidly decays westward to 5.9 and 3.9 dyn. cm rms at 40 and 16 km east of the shelf, respectively. Sea surface height variability observed by satellite altimetry shows a similar decline toward the shelf. Consequently, the meridional upper mid-ocean transport (i.e., transport shallower than 1000 m integrated between Morocco and Abaco) displays variations of 3.0 Sv rms, whereas the integral between Morocco and a station 500 km, or 40 km, east of Abaco yields 10.7 Sv rms, or 6.0 Sv rms, respectively. A numerical model simulation is presented, suggesting that boundary-trapped waves may account for the observed decline in variability in the coastal zone as they provide a mechanism for fast equatorward export of transport anomalies associated with eddies impinging on the western boundary. A linear theory is then put forward that successfully describes the reduction of thermocline thickness variations on the boundary compared to open-ocean conditions. The results suggest that the impact of eddy-boundary-impingement on the upper mid-ocean transport measurements made at 26.5°N is too small to mask possible decadal trends in the Atlantic meridional overturning circulation.