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TITLE: Variability of the meridional overturning circulation at the Greenland?Portugal OVIDE section from 1993 to 2010

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ABSTRACT:

The meridional overturning circulation (MOC) in the North Atlantic transports heat from the subtropics to high latitudes and hence plays an important role in the Earth?s climate. A region crucial for the MOC is the northern North Atlantic and the adjacent Nordic Seas, where waters transported northward in the MOC upper limb progressively cool, gain density and eventually sink. Here we discuss the variability of the gyre circulation, the MOC and heat flux as quantified from a joint analysis of hydrographic and velocity data from six repeats of the Greenland to Portugal OVIDE section (1997?2010), satellite altimetry and Argo float measurements. For each repeat of the OVIDE section, the full-depth absolute circulation and transports were assessed using an inverse model constrained by ship-mounted Acoustic Doppler Current Profiler data and by an overall mass balance. The obtained circulation patterns revealed remarkable transport changes in the whole water column and evidenced large variations (up to 50% of the lowest value) in the magnitude of the MOC computed in density coordinates (MOC?). The extent and time scales of the MOC? variability in 1993?2010 were then evaluated using a monthly MOC? index built upon altimetry and Argo. The MOC? index, validated by the good agreement with the estimates from repeat hydrographic surveys, shows a large variability of the MOC? at OVIDE on monthly to decadal time scales. The intra-annual variability is dominated by the seasonal component with peak-to-peak amplitude of 4.3 Sv (1 Sv = 106 m3 s?1). On longer time scales, the MOC? index varies from less than 15 Sv to about 25 Sv. It averages to 18.1 ± 1.4 Sv and shows an overall decline of 2.5 ± 1.4 Sv (95% confidence interval) between 1993 and 2010. The heat flux estimates from repeat hydrographic surveys, which vary between 0.29 and 0.70 ± 0.05 PW, indicate that the heat flux across the OVIDE section is linearly related to the MOC? intensity (0.054 PW/Sv).

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