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Abstract

Fingerprints of Subpolar AMOC Variability on Decadal Time Scales

R. Kopte*, J. Fischer, J. Karstensen, M. Visbeck, R. Zantopp – Helmholtz Centre for Ocean Research Kiel, Germany (*rkopte@geomar.de)

The outflow from the Labrador Sea off the Canadian shelf at 53°N has been observed continuously since 1997. Here water masses from different source regions (DSOW, NEADW, LSW) combine to form the NADW which represents a major contribution to the AMOC. Earlier analyses of the extensive data set showed a significant warming trend since 1995 of 0.5°C/decade along the western boundary. The temperature signal is not directly correlated to the long-term signal in the flow field which is dominated by short-term waves along the steep topography throughout the basin (Fischer et al., 2014).

However, transport estimates for the different water masses (defined by density, temperature or depth classes) reveal coherent long-term fluctuations on decadal time scales, most pronounced in the LNADW (below 1850m), where a 9-year harmonic fit, with an amplitude of 2.7 Sv and maximum (minimum) outflow in 2003 and 2012 (1998 and 2007), explains 29% of the overall variance, or 70% of the variance for time scales longer than 90 days. We also found that the LSW proper in the depth range 400 – 1850m does not participate in these decadal fluctuations.

On the other hand, the 9-year cycle, with nearly identical amplitude and coherent phase, is also observed in the OLEANDER measurements across the Gulf Stream and in the OVIDE measurements in the Northeastern North Atlantic, and in the Ekman pumping, as determined by the windstress curl over the northwestern corner of the subpolar North Atlantic. Implications for the AMOC variability on these time scales and AMOC observing system requirements to detect long-term trends are discussed.