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Transport estimates and variability of the Denmark Strait Overflow, 1996-2016

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The major export route of dense water flow from the Nordic Seas into the North Atlantic occurs in the deep channel in Denmark Strait. Downstream, the volume of this water is about doubled by entrainment and forms the prominent bottom layer of the Deep Western Boundary Current in the Subpolar North Atlantic. The dense water outflow through Denmark Strait has been monitored with moored instruments (typically two) since 1996, using Acoustic Doppler Current Profilers (ADCPs) anchored close to the bottom in floatation bodies. Volume transport calculations in Denmark Strait have been based so far on these ADCPs anchored in the deeper part of the channel, which were regressed to the total transport of dense water through the Strait in a model. The resulting transport has been used in many publications.

Here, we present a new calculation method to estimate the volume transport of the Denmark Strait Overflow, based on results from an extended five mooring array deployed in 2014/15. At the same time, a correction is proposed for a bias detected on some ADCPs (the 'Workhorse Long Ranger' devices working at 75 kHz frequency), which led to earlier underestimation of the flow in the deep plume core. However, the new array included measurements at shallower positions on the Greenland shelf, where the net transports were found to be small. Using the new method, the mean dense overflow transport is estimated to be -3.07±0.56 Sv, without a significant trend.

Besides variations on the eddy scale, an analysis of the fluctuations in the velocity field using empirical orthogonal functions (EOF) reveals three dominant modes of variability: the first mode is roughly barotropic and corresponds to pulsations of the plume, the second mode represents the laterally shifting component of the plume core position, and the third mode indicates the impact of the vertical extension, i.e. the varying overflow thickness. Furthermore, a similar approach is applied to the volume transport time series, where dominant modes of variability are identified from a singular spectrum analysis (SSA). The results from the SSA analysis are used to fill the gaps in the observational time series, thus providing continuous overflow transports for the period 1996-2016. Finally, Denmark Strait overflow transports are compared to Faroe Bank Channel overflow transports with a focus on co-variability.