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Denmark Strait exchanges: structure and variability

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The water exchange across the Greenland-Scotland Ridge plays an eminent role in the dynamics of the Atlantic Meridional Overturning Circulation. The dense overflow waters are one of the main sources for the formation of North Atlantic Deep Water (NADW); the densest NADW component is composed of Denmark Strait overflow water. The overflow water fills the deep layer in Denmark Strait, below approx. 200 m depth to the bottom at 630 m, and sinks to greater depths when reaching the basins of the North Atlantic, thereby entraining surrounding water.
The near surface waters in Denmark Strait have two sources: the fresh and cold East Greenland Current, which continues from Fram Strait into the Irminger Sea, and the salty and warm Irminger Current, which brings Atlantic water into the Nordic Seas. The horizontal front between these shallow water masses migrates prevalently, resulting in a vertical displacement of the isopycnals in Denmark Strait. Either water mass may dominate the upper water column in the Strait. The mean total volume transport along the strait is about 6 Sv, of which 5 Sv are directed to the south and 1 Sv to the north.

The transports in the overflow have been monitored on the sill of Denmark Strait with up to three current profiling moorings since more than ten years (with some gaps due to instrument failures and mooring losses), as well as near-bottom temperatures. While no long term trend is evident in the data, variability is high on short timescales. Also, during recoveries and deployments hydrographic measurements were collected, as well as ship borne current measurements. We present an analysis of the observed hydrographic variability (from 2001 to 2010), which is evident in satellite measurements of sea surface height anomalies (obtained from e.g. AVISO) as well. The variability is compared to the fluctuations found in the overflow, which is to first order a hydraulically controlled flow: In the mean and at longer time scales the baroclinicity of the flow is simply linked to the height of the dense water reservoir in the north. In addition, there exists a strong barotropic wind-driven component in the circulation that is characterized by variability extending to much shorter time scales.
Therefore, variability in the near surface layers is likely to give an imprint on the overflow variability as well.