Structure and variability of the shelf break East Greenland Current

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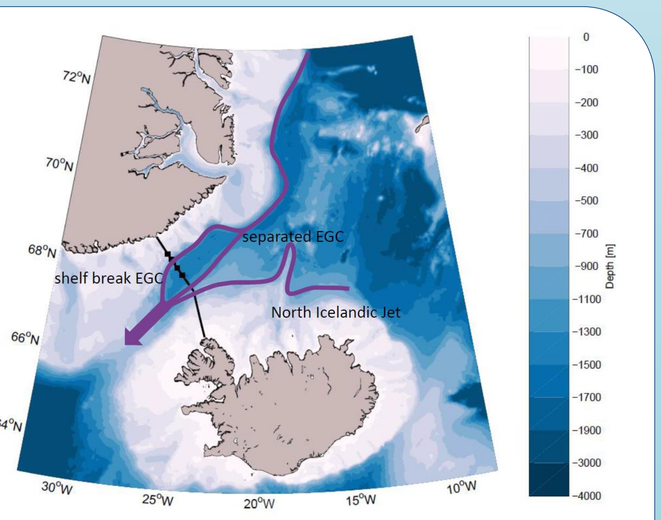
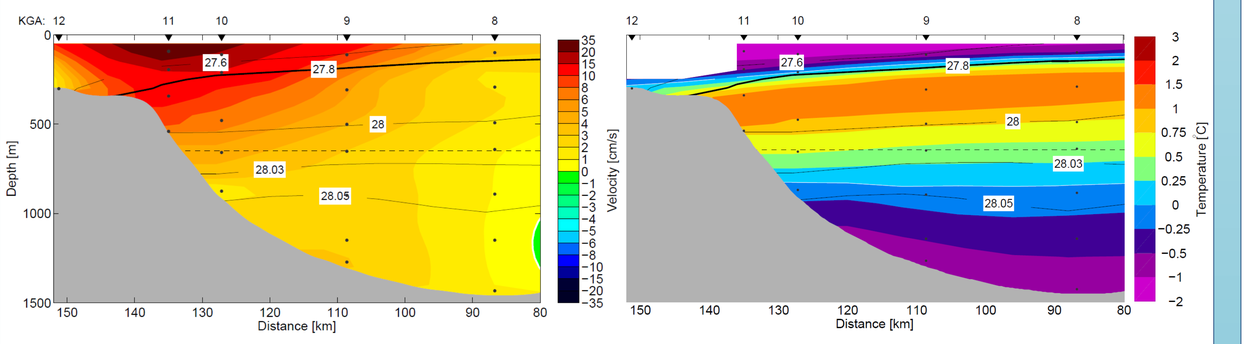
Introduction The East Greenland Current (EGC) is a major pathway by which dense overflow water and Arctic-origin freshwater progresses from the Nordic Seas to the North Atlantic through the Denmark Strait. We use data from a densely instrumented mooring array deployed between Iceland and Greenland north of the Denmark Strait, from summer 2011 to summer 2012, to quantify the temporal and cross-strait variability of the shelf break branch of the current.

Study area: Denmark Strait

Three current branches, monitored by a mooring array over one year, supply dense overflow water through the Denmark Strait. The variability of the shelf break EGC, carrying more than a third of the overflow (Harden et al., in revision), is investigated here.

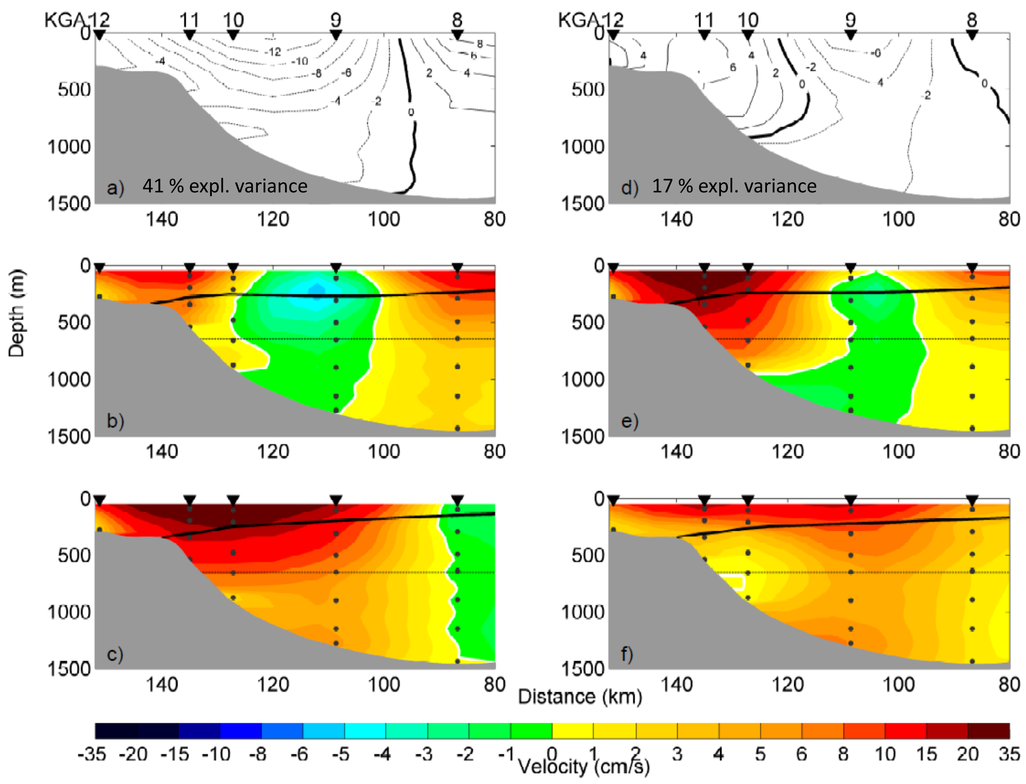




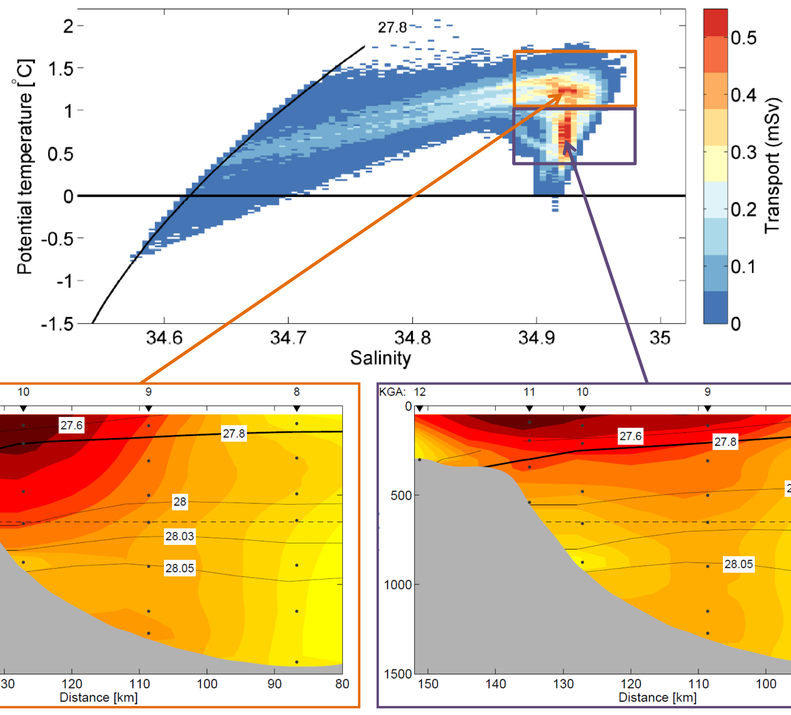
Mean along-stream velocity and temperature of the shelf break EGC. The black lines are density contours and the thick black line is the 27.8 kg/m^3 isopycnal, taken to be the lower density limit of the overflow water. The dashed line at 650 m marks the depth of the Denmark Strait sill. Positive velocities are towards the Denmark Strait. The numbers on top indicate mooring locations.

Objectives

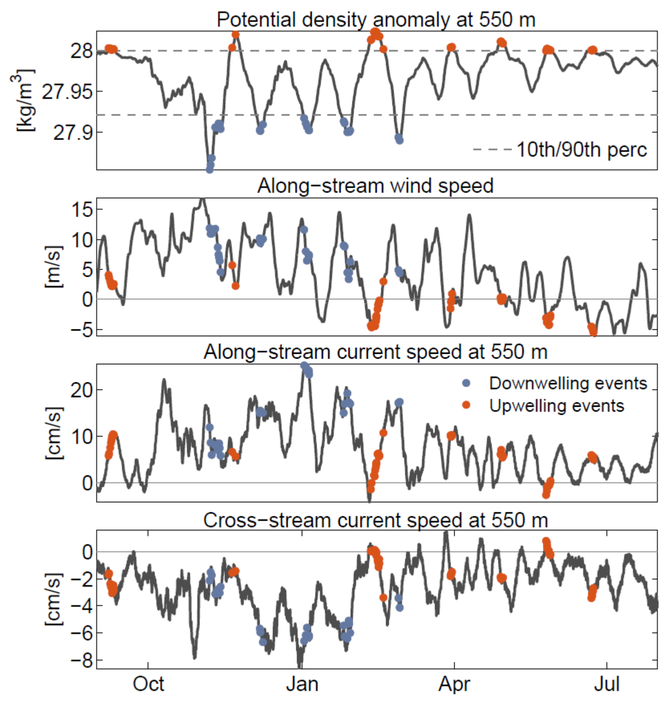
I. **Investigate temporal and spatial variability of the shelf break EGC.**
II. **Identify origin of overflow water masses in the shelf break EGC.**
III. **Relate cross-stream flow to atmospheric forcing.**

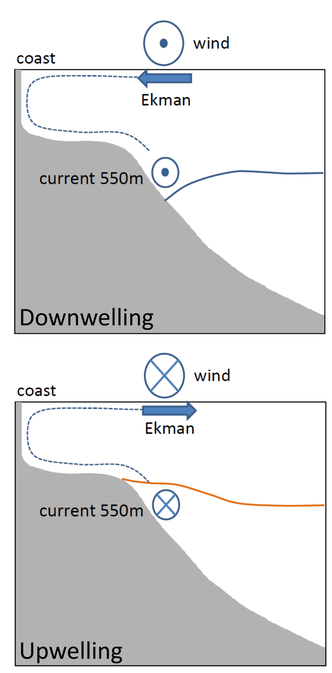


I. **Dominant modes of variability** shown by empirical orthogonal functions of the along-stream velocity field where a) is a pulsing mode, and d) is a meandering mode. b) and c) show the mean velocity field plus and minus one standard deviation of the first modal amplitude, respectively. e) and f) show the same as b) and c), but for the second mode.



II. **Atlantic-origin overflow water**. Warm and saline Atlantic Water is modified in the boundary current system around the perimeter of the Nordic Seas and exits via the EGC as an intermediate water mass with T>0°C (Mauritzen, 1996). The transport TS-plot (top) of the overflow water in the shelf break EGC revealed a warm and cold mode of the Atlantic-origin water, associated with a strong and narrow current (left) and a weaker and wider current (right), respectively.





III. **Coastal downwelling and upwelling events** were detected after a few days of persistent along-stream wind. There was a lag of approximately 3 days from the peak of the wind event to the peak of the up- or downwelling. The cross-stream velocities are consistent with Ekman transport in the surface layer as indicated in the schematics on the right.

Conclusions

- **The shelf break EGC pulsed and meandered relative to its mean state.**
- **The overflow water was of Atlantic origin. Different temperatures of the overflow water were associated with distinct velocity states of the current.**
- **Coastal up- and downwelling took place throughout the year. This could be important in terms of freshwater exchange between the shelf and the interior.**

References:

Harden, B. E., Pickart, R. S., Valdimarsson, H., Våge, K., deSteur, L., Richards, C., Bahr, F., Torres, D., Børve, E., Jónsson, S., Macrander, A., Østerhus, S., Håvik, L., Hattermann, T., 2016. Upstream Sources of the Denmark Strait Overflow: Observations from a High-Resolution Mooring Array. *In revision, Deep Sea Research Part I.*

Mauritzen C. 1996. Production of dense overflow waters feeding the North Atlantic across the Greenland-Scotland Ridge. Part 1. Evidence for a revised circulation scheme. *Deep Sea Research I.*43: 769-806

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