# Variability in Circulation and Hydrography in the Denmark Strait

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## Data access

Our datasets and user-friendly post-processing scripts (including the offline lagrangian particle code) are available on `www.sciserver.org`
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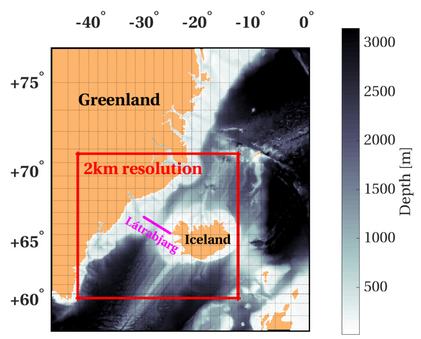
## Abstract

A great portion of the dense and cold Arctic water that reaches the subpolar North Atlantic flows through the Denmark Strait. Thus, the dynamics that occur around the strait are important for the maintenance and variability of the Atlantic Meridional Overturning Circulation. Therefore, we have set up a high-resolution (2 km) realistic model centered on the east Greenland shelf, the Iceland and Irminger Seas to interpret the sparse observations available for this area. Our analysis focuses on the Látrabjarg hydrographic section across the Denmark Strait. Model hydrography and circulation show good agreeent with available observational datasets. We analyze the variability of the Denmark Strait Overflow (DSO) by detecting and characterizing boluses and pulses, which are mesoscale features that increase the mean overflow transport by about 30%.

## Model Configuration



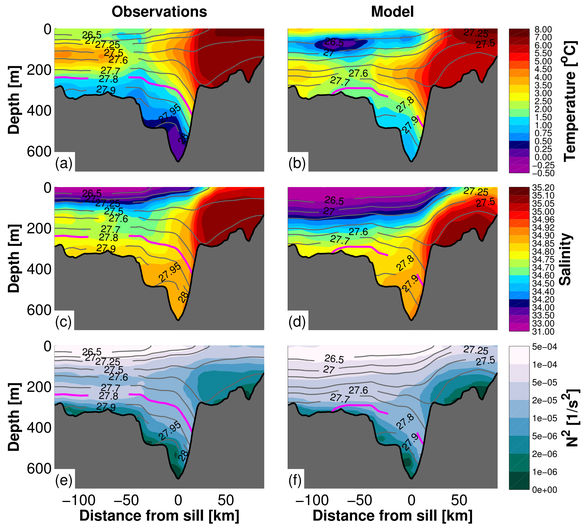

**Regional MITgcm:**

- **HORIZONTAL RESOLUTION**: 2-4 km
- **VERTICAL RESOLUTION**: 1-15 m
- **TIME PERIOD**: Sep. 2007-Sep. 2008 (storing every 6h)

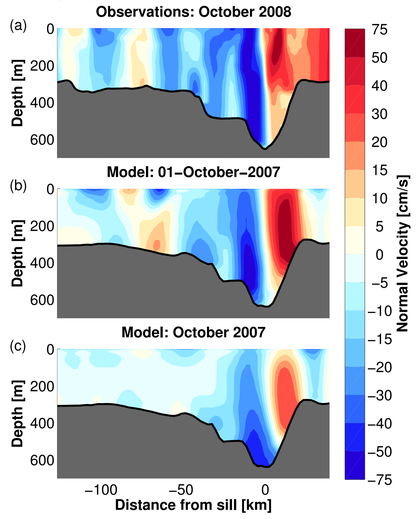
## Comparison with Observations

Model outputs compare well with:

(i) a 20-year hydrographic dataset (Mastropole et al., 2017)




(ii) a velocity survey carried out in October 2008 (Våge et al., 2011)

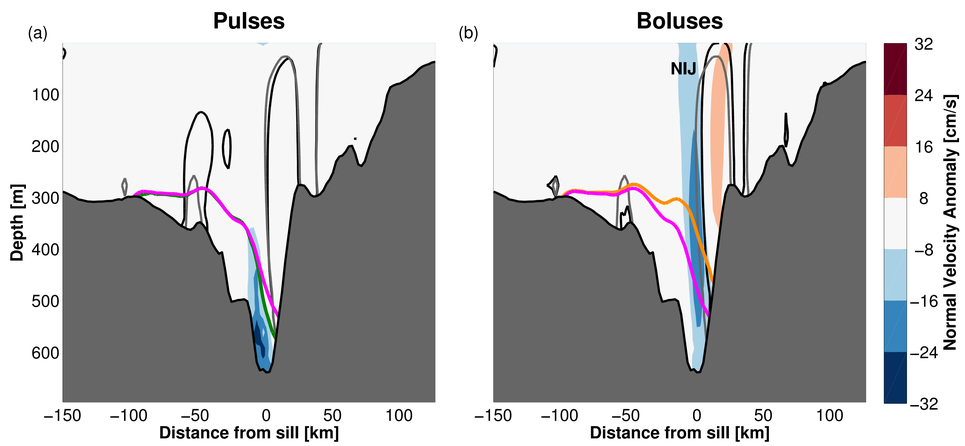



## Boluses and Pulses

Boluses and pulses both increase the southward DSO transport, but the cross-sectional area of the overflow increases during boluses and decreases during pulses. We found that, on average, boluses (pulses) are 57.1 (27.5) hours long, occur every 3.2 (5.5) days, and are more frequent during summer (winter). Temperatures around the overflow interface are colder (warmer) by about 2.5°C (1.5°C) during boluses (pulses).

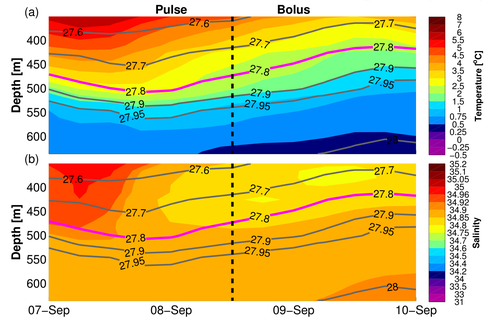
## Circulation in the Denmark Strait

Boluses are associated with a strengthening of the southward North Icelandic Jet (NIJ) in the center of the strait, which pushes the core of the northward flow at the Iceland shelfbreak slightly eastward.

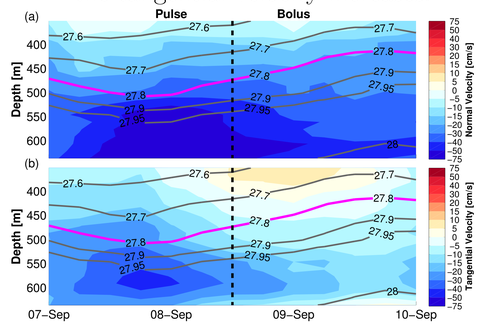



## Time Evolution

As the pulse (bolus) arrives to the Denmark Strait, the overflow interface height deepens (rises).




When the pulse crosses the strait, the magnitude of the tangential velocity increases.




Time evolution figures are obtained by averaging in the area between 15 km east and 15 km west of the sill.

## Conclusions

- Model hydrography and circulation in the Denmark Strait are realistic.
- Boluses and pulses can be detected by looking at hydrographic fields.
- Pulses are associated with a strengthening of the velocity fields within the overflow layer, while the passage of boluses coincides with anomalies in the circulation of the whole water column.

## References

Mastropole, D., Pickart, R. S., Valdimarsson, H., Våge, K., Jochumsen, K., and Girton, J. (2017). On the hydrography of Denmark Strait. *Journal of Geophysical Research: Oceans*.

Våge, K., Pickart, R. S., Spall, M. A., Valdimarsson, H., Jónsson, S., Torres, D. J., Østerhus, S., and Eldevik, T. (2011). Significant role of the North Icelandic Jet in the formation of Denmark Strait overflow water. *Nature Geoscience*, 4(10):723–727.