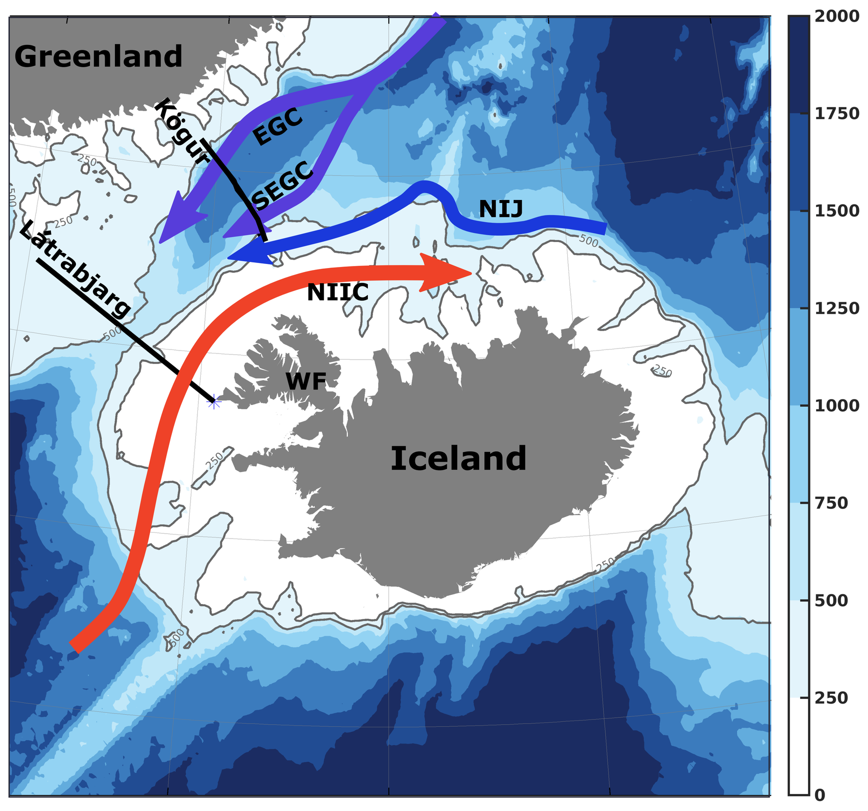
The North Icelandic Jet is fed by transformation of Atlantic Waters on the Icelandic shelf

HE34E-2029

Yarisbel Garcia Quintana*[1], Nathan Grivault[1], Xianmin Hu[1] and Paul G. Myers[1]

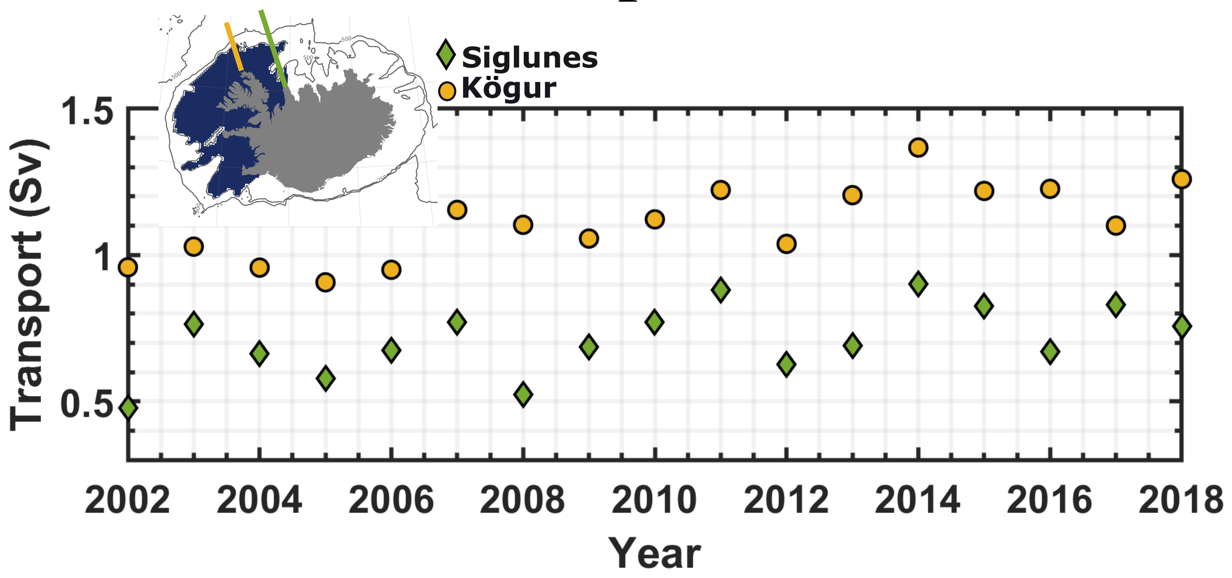
1. Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, Canada.



I. Motivation

- The North Icelandic Jet (NIJ) is the densest component of the AMOC.
- NIJ source is still unknown.
- Uncertainty on how the NIJ will be impacted by climate change

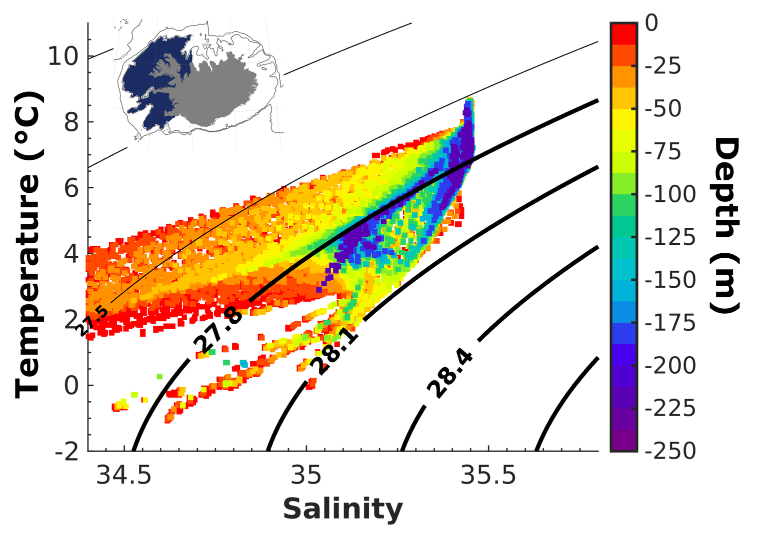
II. Model transport evaluation

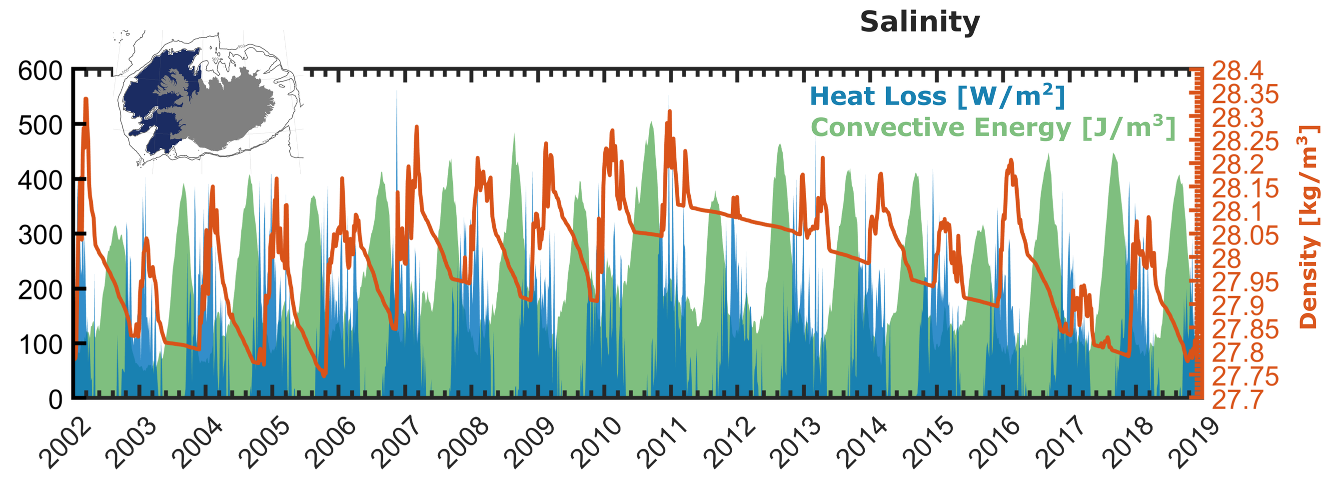


Model transport along the hydrographic sections Siglunes and Kögur (between the coast and the 750 m isobath) is in agreement with the observed transport (Våge et al., 2011, Harden et al., 2016, Semper et al., 2019)

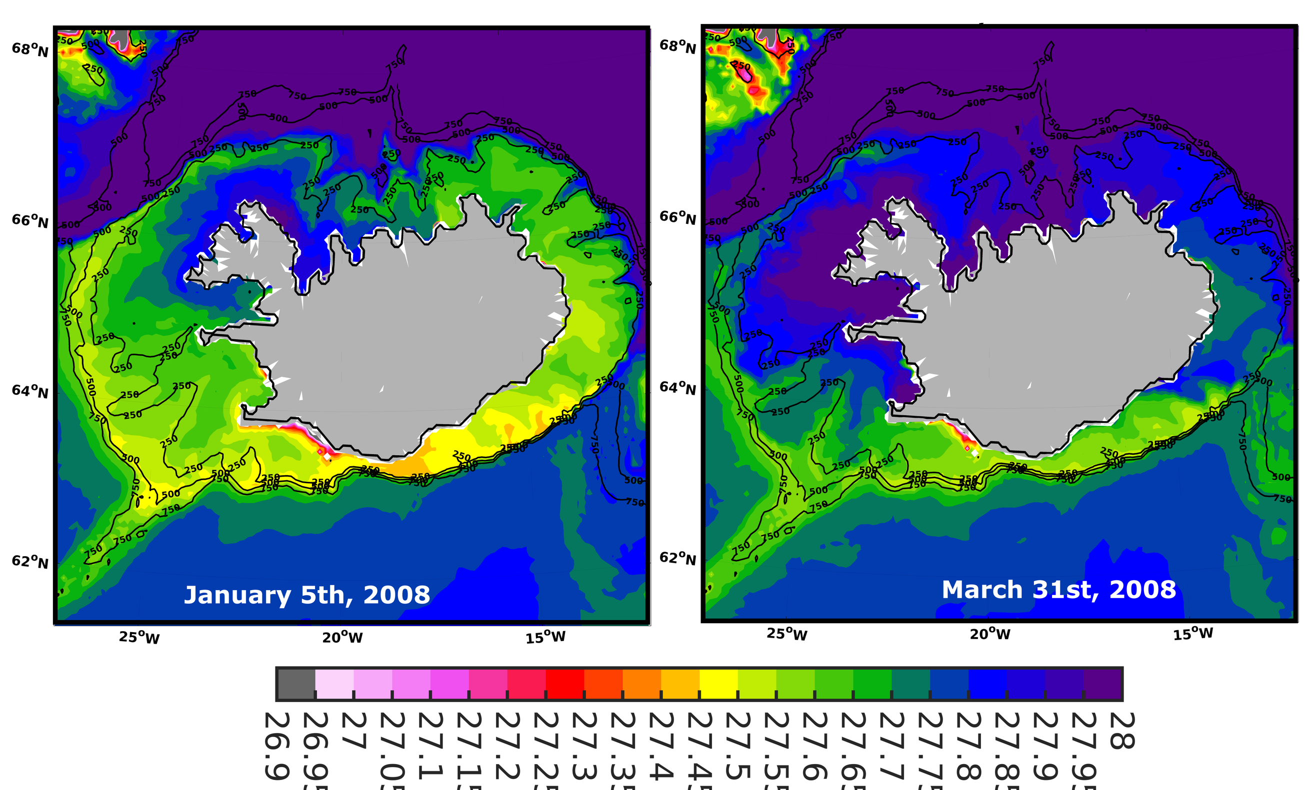
III. Atlantic inflow transforms

- Strong heat loss cools shelf waters enough to make them denser than underlying waters, triggering their sinking
- Densified waters reach the shelf bottom

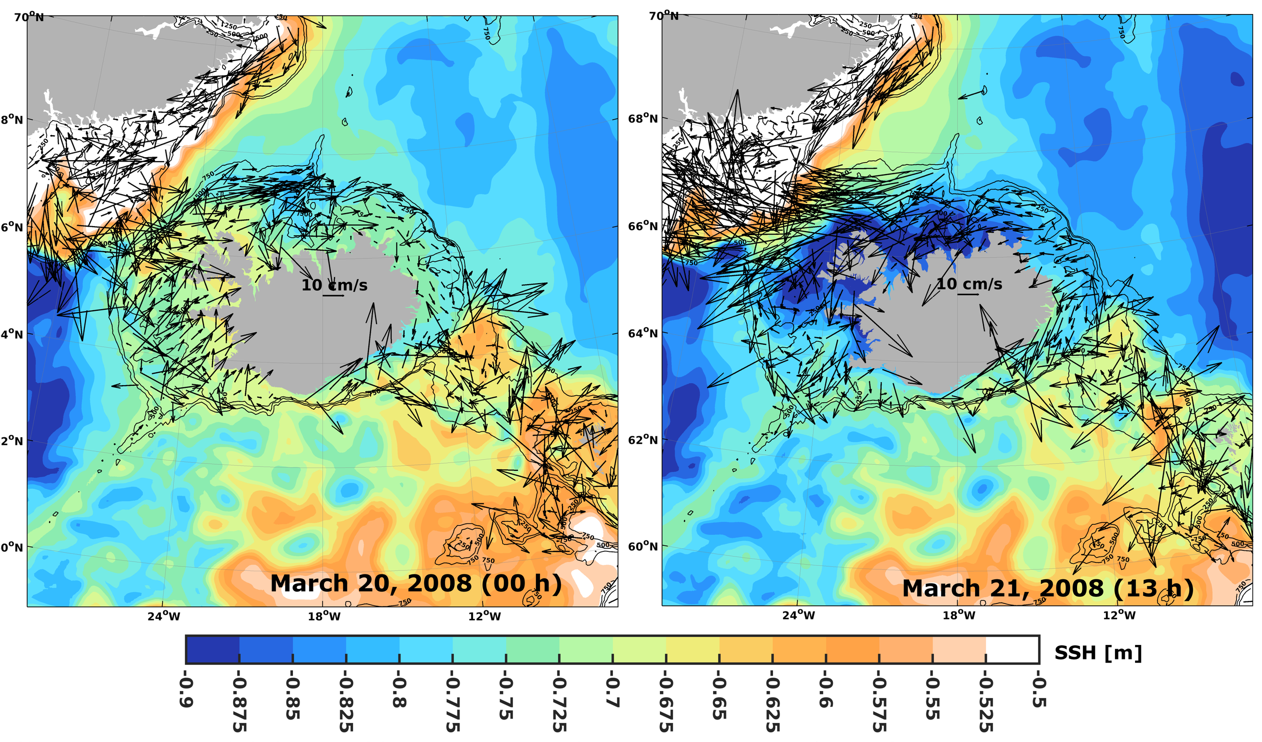




IV. A dense plume forms

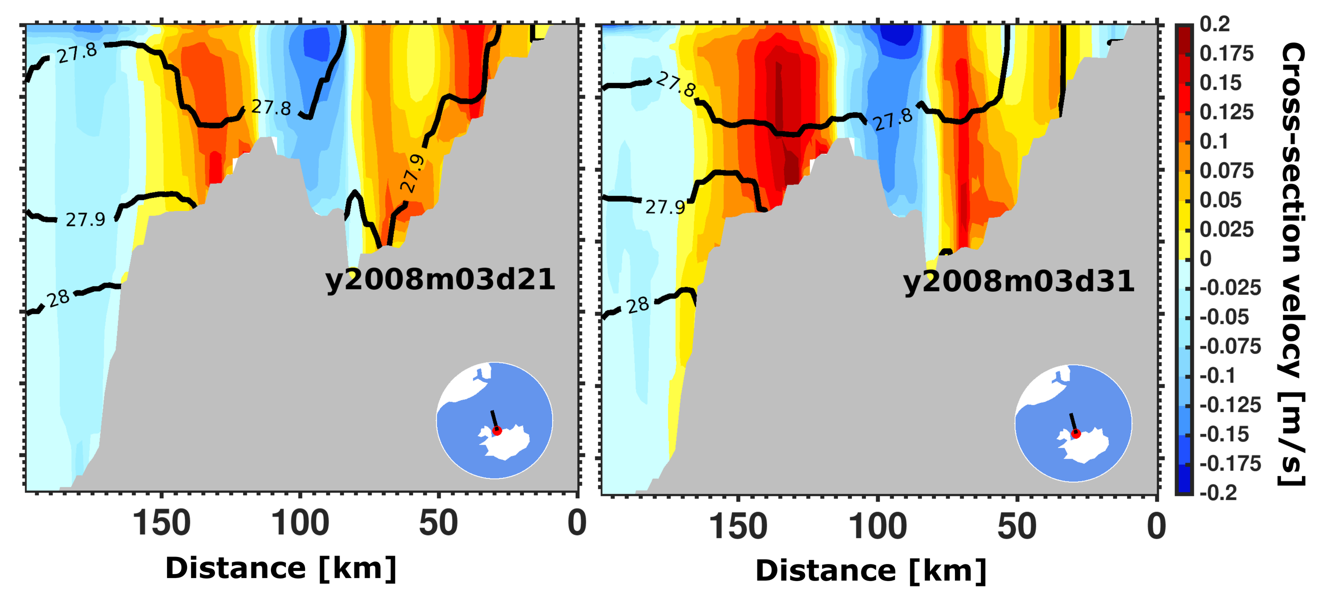


V. A SSH depression is generated



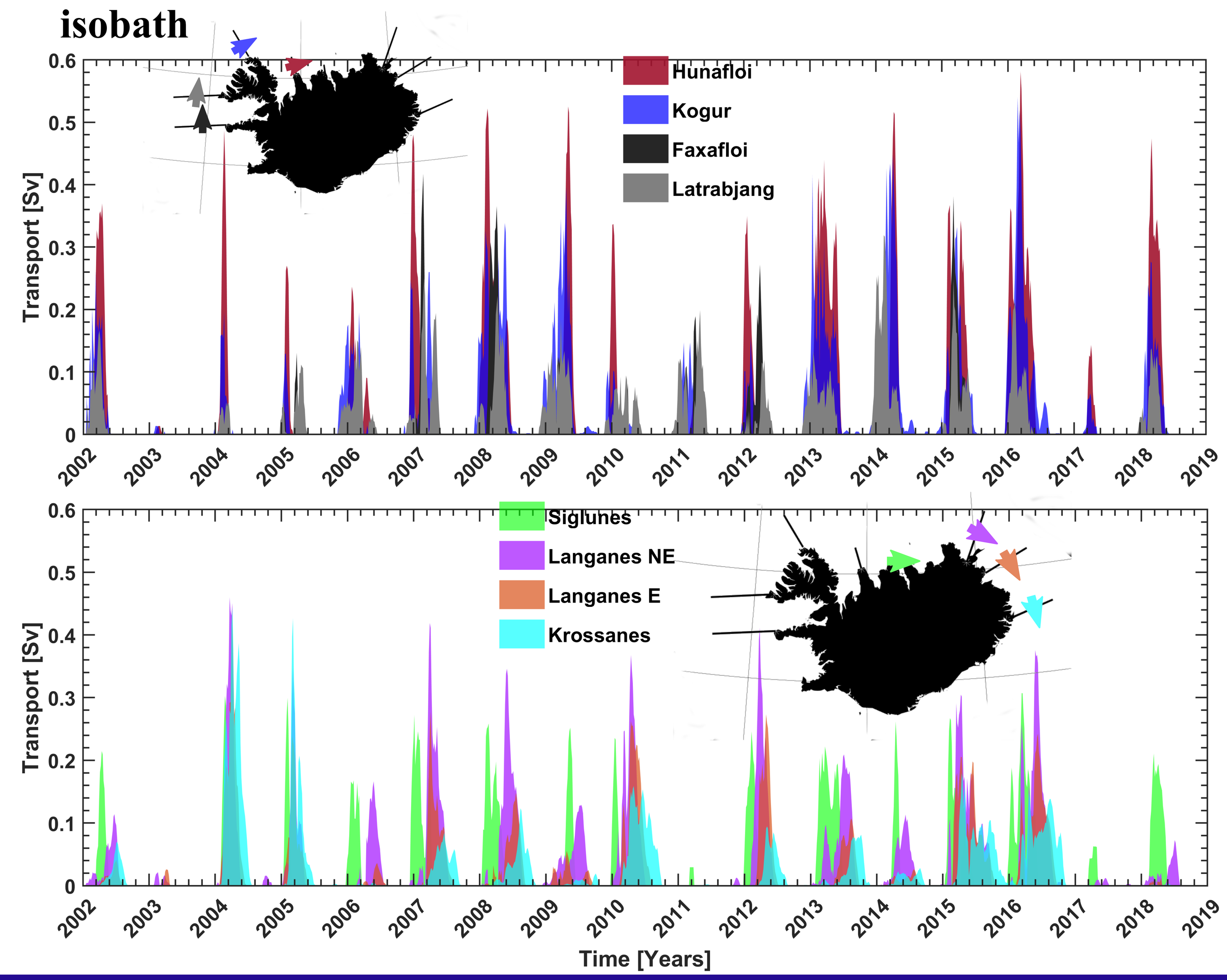
- Spall et al (2017) offers a physical explanation for the dense plume formation and evolution and the large-scale circulation response

VI. Enhanced velocities along the shelfbreak



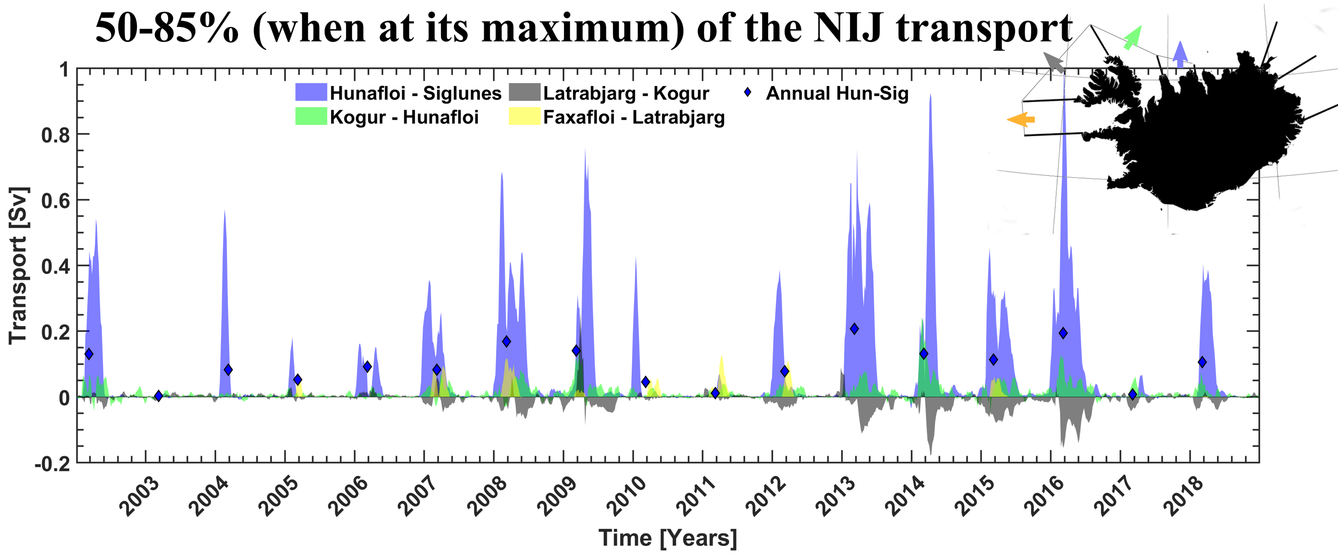
VII. Transport of dense overflow water increases as the plume travels on the shelf

- Hydrographic sections are cross-shelf oriented, from coast to 250 m isobath

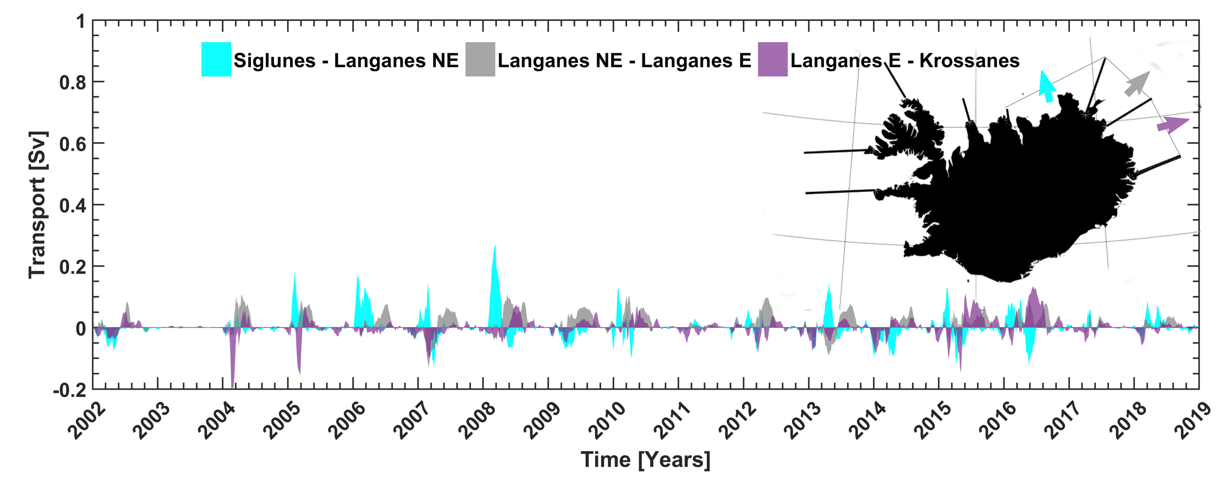


VIII. The bulk of the plume cascades north of Iceland

- Dense waters cascading (down slope cross-isobath transport) between the northern sections feed directly in to the NIJ
- During years of strong cascading events the dense plume feeds 50-85% (when at its maximum) of the NIJ transport

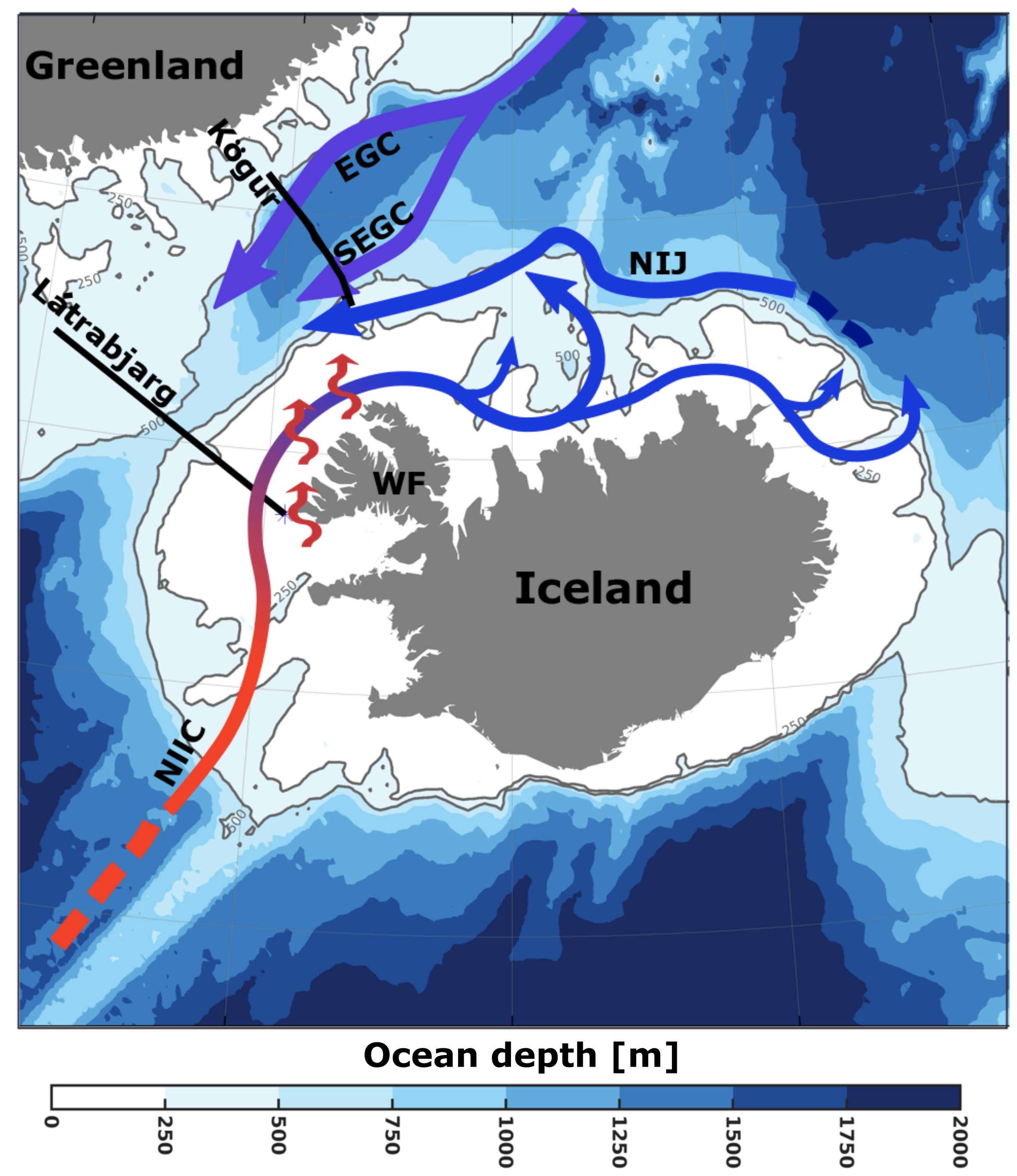


IX. A small percentage of plume cascades northeast of Iceland

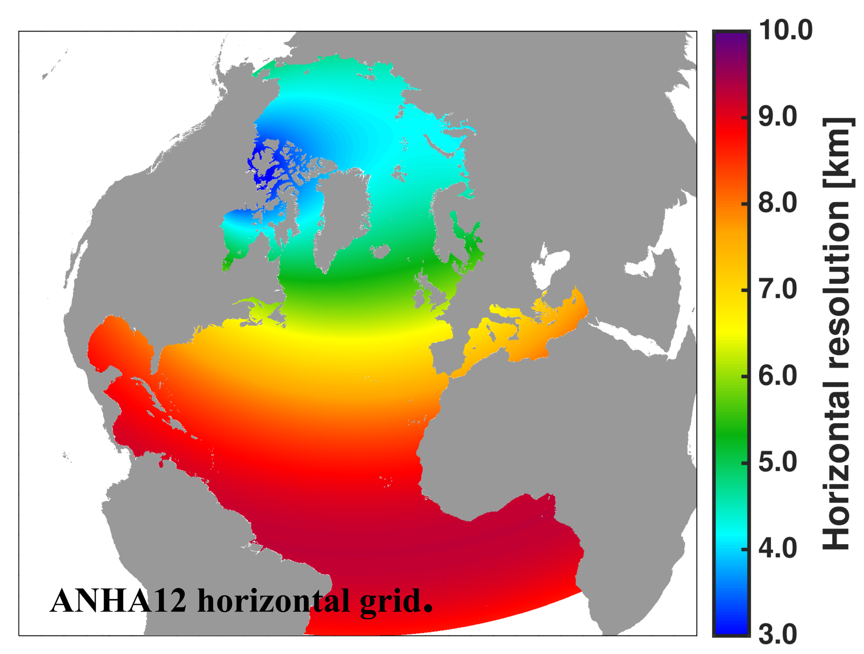


X. Conclusions

- The bulk of the dense plume cascades north of Iceland funnelled through deep glacially-eroded cross-shelf troughs
- Transport strength and variability are closely linked to the total oceanic heat loss west of Icelanad along Denmark Strait.
- On an annual basis, on years of strong cascading event the dense plume feeds up to 20% of the observed NIJ transport



XI. Methods



ANHA12:
Arctic and
Northern
Hemispheric
Atlantic

- * NEMO v3.4 [ocean] +LIM2 [sea ice]
- * GLORYS 2v3 [initial conditions]
- * CGRF [atmospheric forcing]
- * Horizontal resolution: 1/12°
- * River runoff: Dai et al. (2009)
- * Greenland melt: Bamber et al. (2012)
- * No restoring

References

Bamber, J., den Broeke, M., Ettema, J., Lenaerts, J., and Rignot, E. (2012). Recent large increases in freshwater fluxes from Greenland into the North Atlantic. Geophysical Research Letters, 39(19).

Dai, A., Qian, T., Trenberth, K. E., and Milliman, J. D. (2009). Changes in continental freshwater discharge from 1948 to 2004. Journal of Climate, 22(10):2773–2792

Semper S., Våge, K., Pickart, R.S., Valdimarsson, H., Torres, D.J. and Jónsson S. (2019). The emergence of the North Icelandic Jet and its evolution from northeast to Denmark Strait. Journal of Physical Oceanography, 49(10): 2499-2521

Harden, B.E., Pickart, R.S., Valdimarsson, H., Våge, K., de Steur, L., Richards, C., Bahr, C., Torres, D., Børve, E., Jónsson S., Macrander, A., Østerhus, S., Håvik, L., and Hattermann, T. (2019). Up-stream sources of the Denmark Strait Overflow: Observations from a high-resolution mooring array. Deep Sea Research Part I, 112:94-112

Spall, M.A., Pedlosky J., and Cenedese C. (2017). Circulation induced by isolated dense water formation over closed tophography contours. Jpurnal of Physical Oceanography, 74(9):2251-2265

Våge, K., Pickart, R.S., Spall, M.A., Valdimarsson, H., Steingrimur J., Torres D.J. and Eldevic T. (2011). Significant role of the North Icelandic Jet in the formation of Denmark Strait overflow water. Nature Geoscience,

Acknowledgments

compute canada | calcul canada
NSERC CRSNG
Earth & Atmospheric Sciences

*yarisbel@ualberta.ca