Formation and circulation of dense water from two-year moored records in Eggvin Offset, northwestern Iceland Sea

Stefanie Semper

Ilker Fer

Linda Latuta

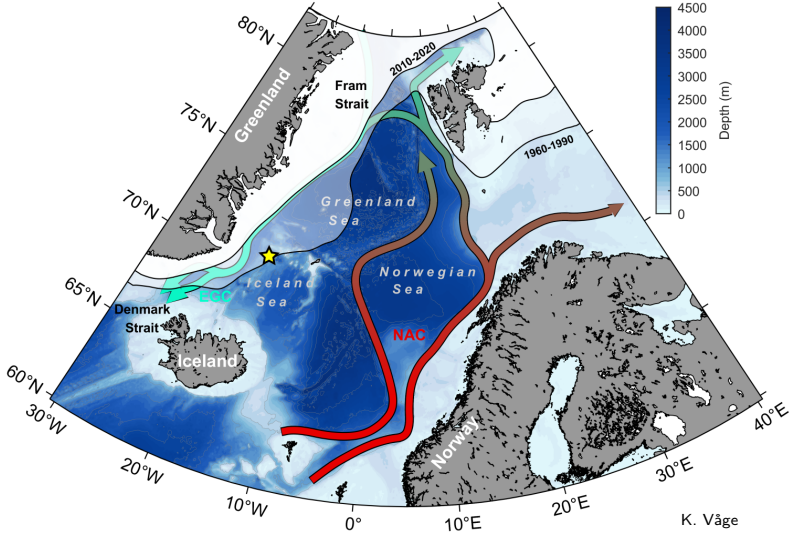
Kjetil Våge

Silje Skjelsvik

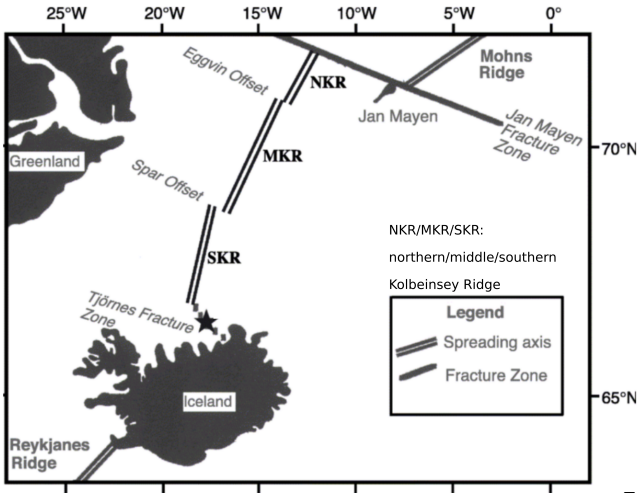
Robert Pickart

wombo.art

Sea-ice retreat opens up new areas for dense-water formation

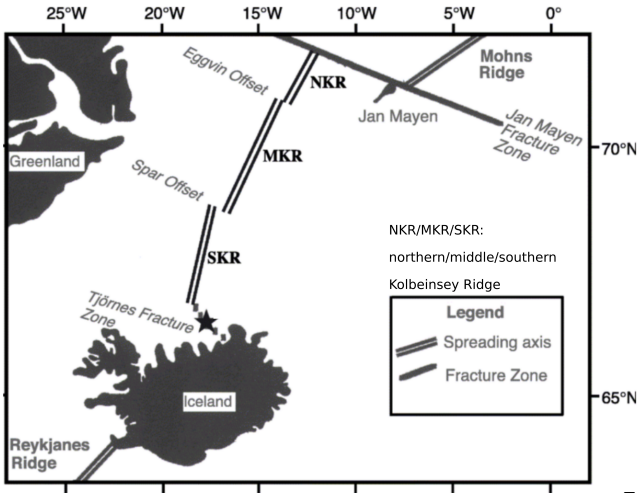


Eggvin Offset – a gap in the mid-Atlantic ridge



T. Barreyre

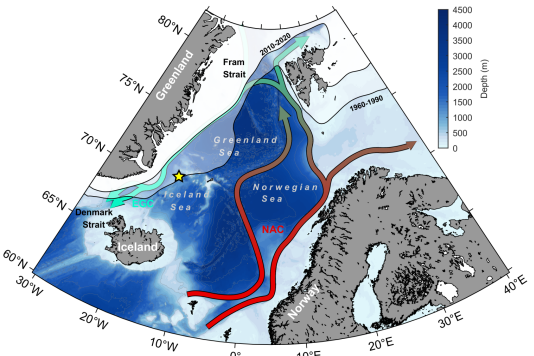
Eggvin Offset – a gap in the mid-Atlantic ridge



T. Barreyre

Outline

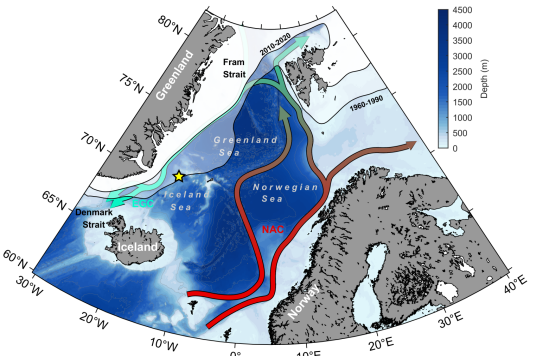
- How dense overflow water is formed in Eggvin Offset?



K. Våge

Outline

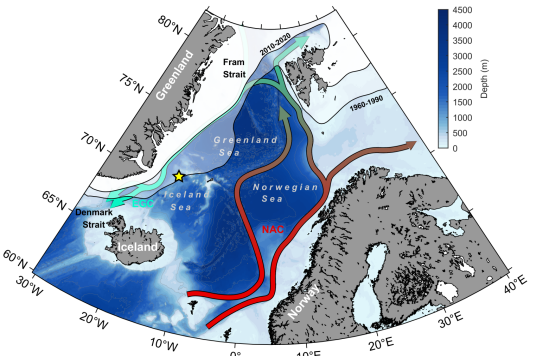
- How dense overflow water is formed in Eggvin Offset?
- What are the processes affecting the mixed-layer evolution?



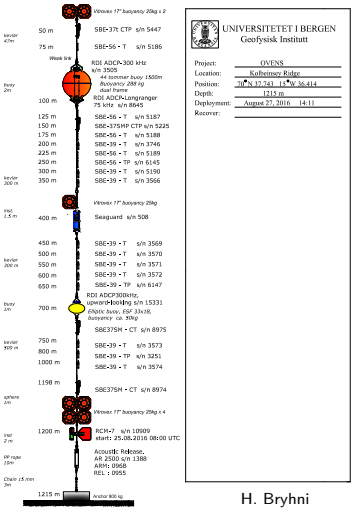
K. Våge

Outline

- How dense overflow water is formed in Eggvin Offset?
- What are the processes affecting the mixed-layer evolution?
- Is Eggvin Offset a major passage for dense-water exchange between the Greenland and Iceland Seas?



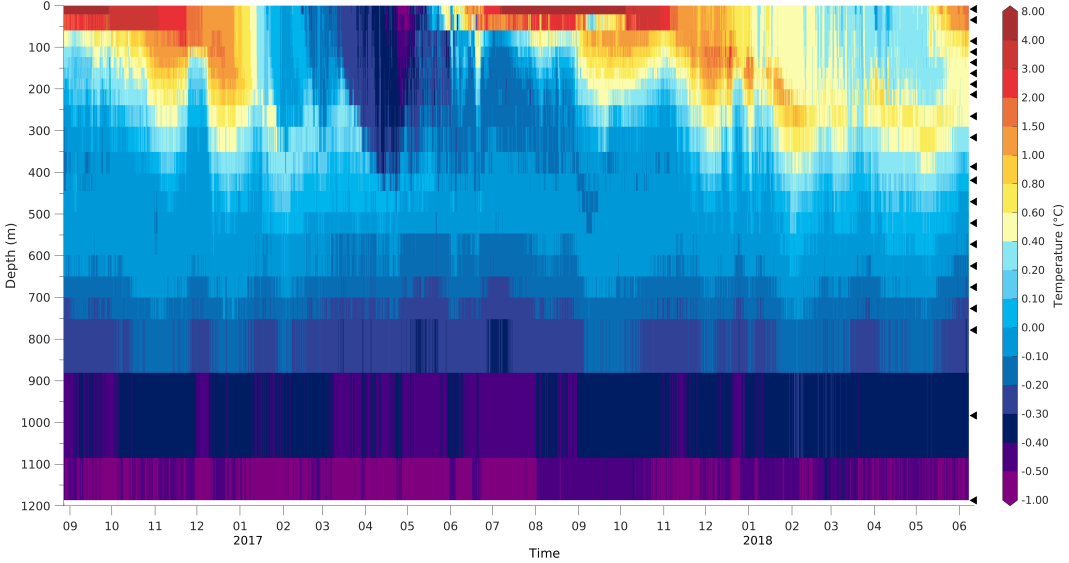
A unique data set from a sparsely sampled region



H. Bryhni

- two-year long record: August 2016 – June 2018
- 25 instruments: 21 x temperature, 4 x salinity, 6 x pressure, 4 x velocity
- 15 min temporal resolution (5 x temperature loggers: 30 s)
- uppermost instrument at 8 m depth

Temperature evolution reveals two different winters



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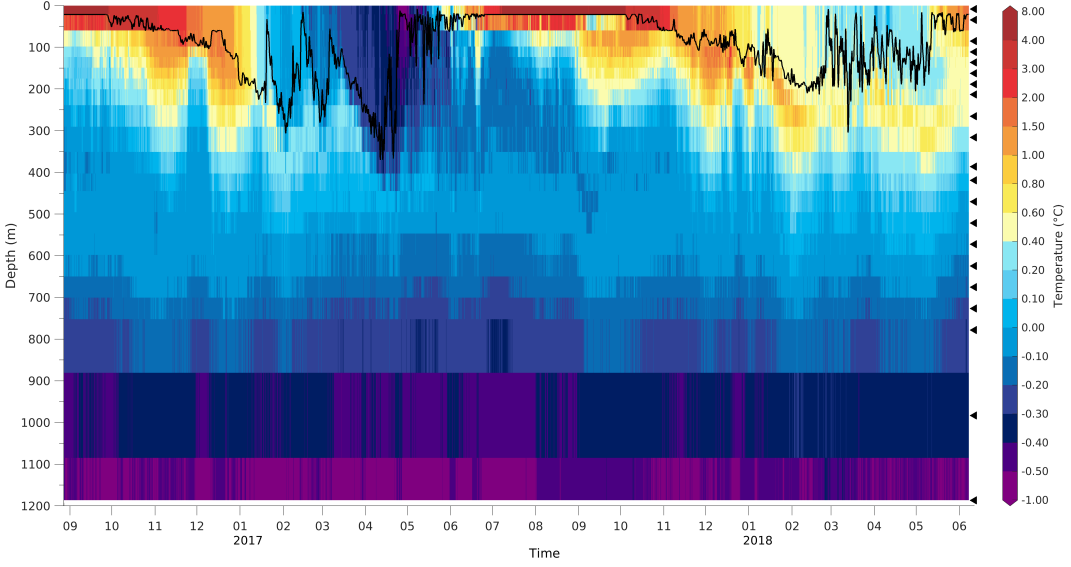
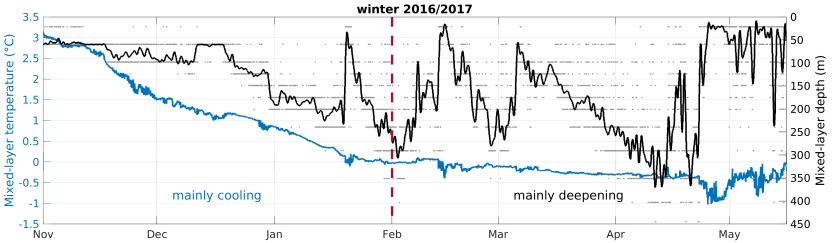


Two stages of mixed-layer evolution: i) cooling, ii) deepening



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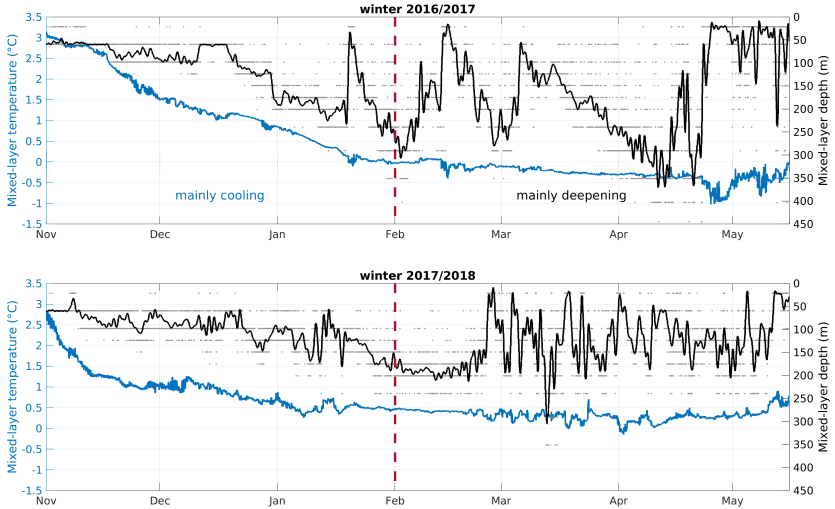
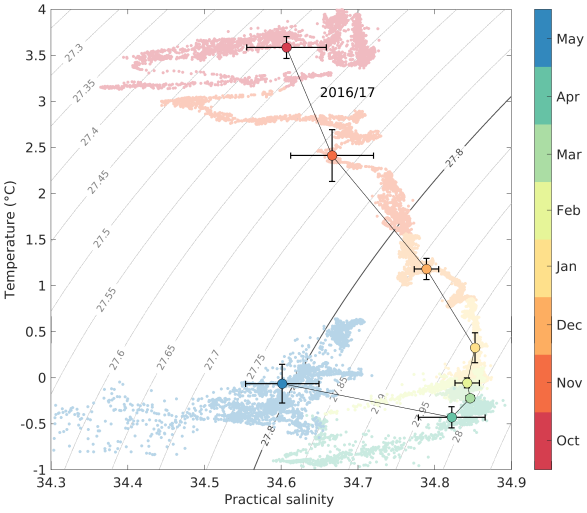


Formation of denser water during winter 2016/2017



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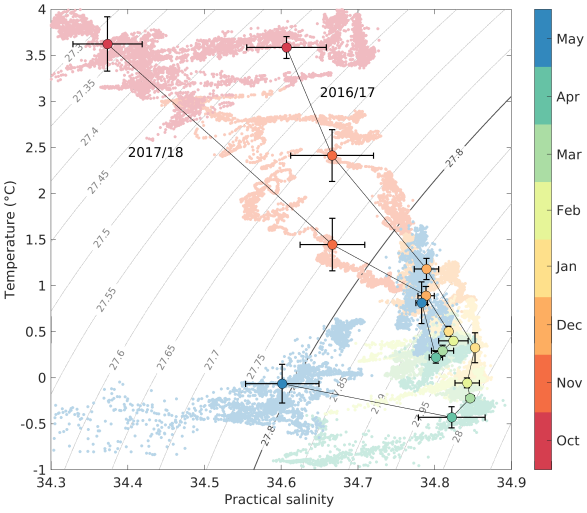

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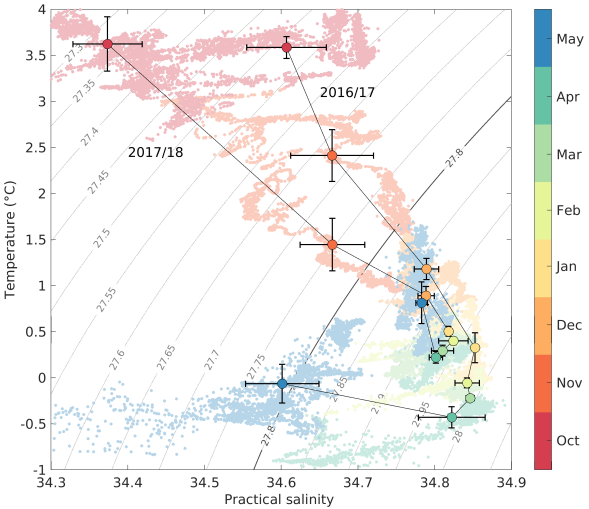
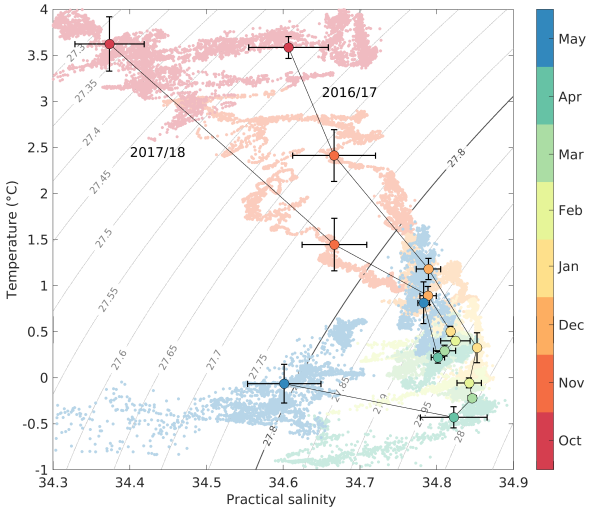


- maximum densities:
  σ_θ =28.03 kg m^{-3} (winter 2016/17)
  σ_θ =27.97 kg m^{-3} (winter 2017/18)

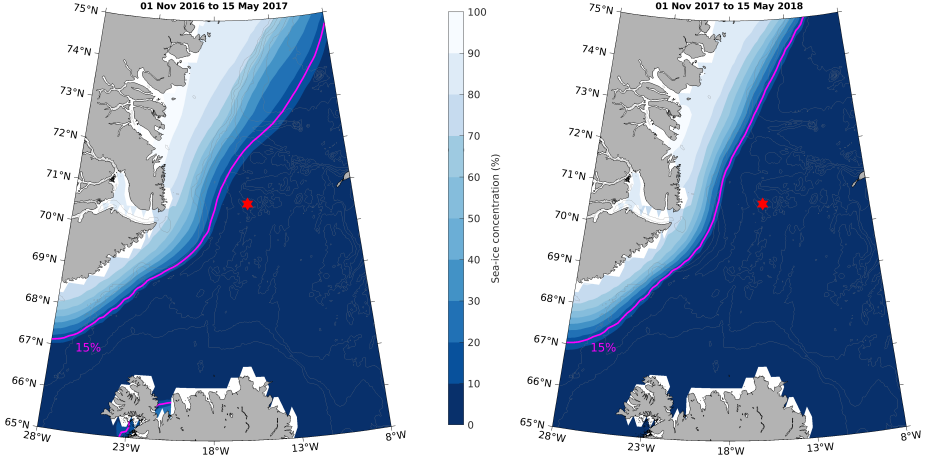
Formation of denser water during winter 2016/2017



- maximum densities:
  $\sigma_\theta = 28.03\,\mathrm{kg\,m^{-3}}$ (winter 2016/17)
  $\sigma_\theta = 27.97\,\mathrm{kg\,m^{-3}}$ (winter 2017/18)
- similar mixed-layer densities as in the central Iceland Sea several decades ago

  $\rightarrow$ shifting locus of dense-water formation

Closer sea-ice edge in winter 2016/2017



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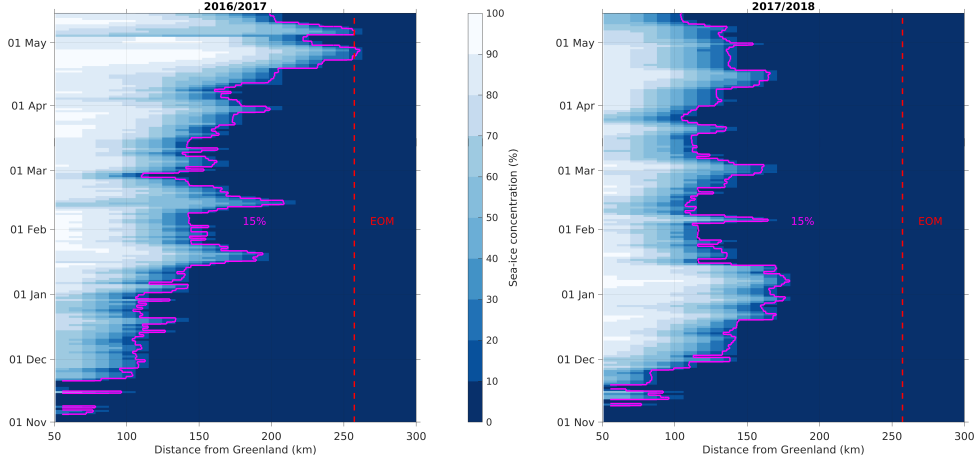
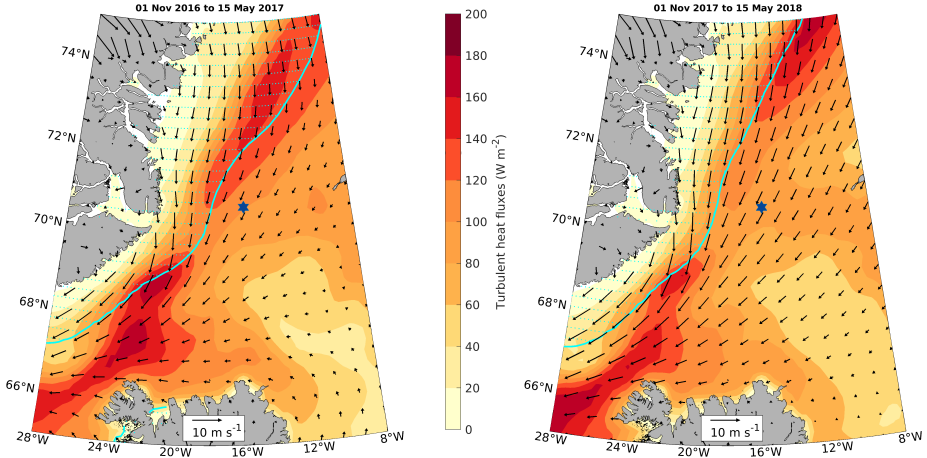


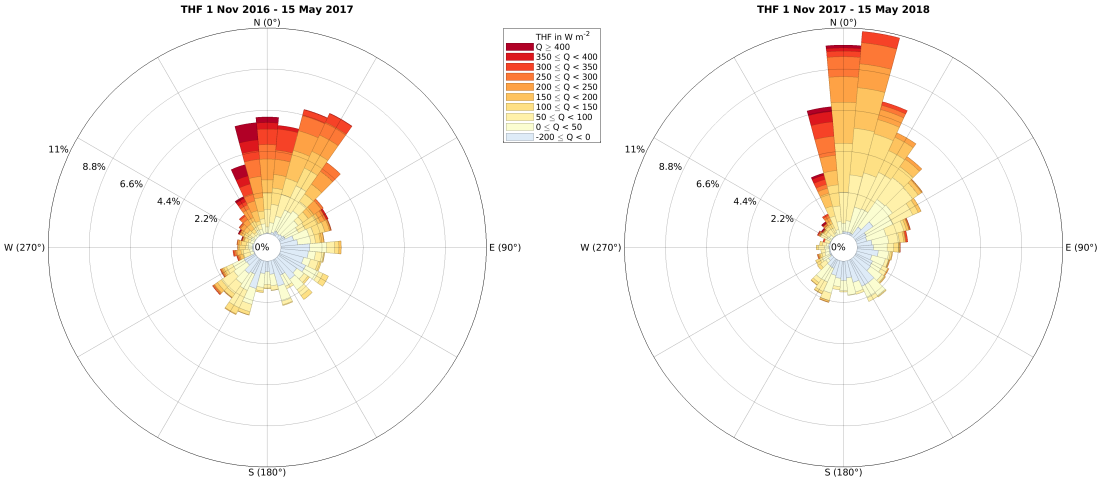
- mean distance ice edge–mooring: 99 km (winter 2016/17); 126 km (winter 2017/18)

Higher turbulent heat fluxes in winter 2016/2017



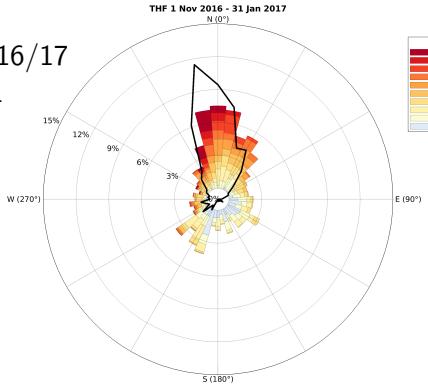
- mean turbulent heat flux: 104 W m^{-2} (winter 2016/17); 88 W m^{-2} (winter 2017/18)

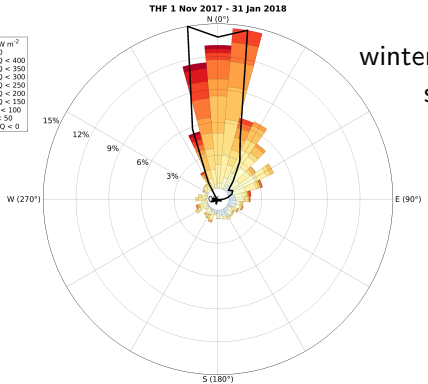
Northerly winds associated with high heat fluxes



Looking beyond the mean

winter 2016/17
stage 1





winter 2017/18
stage 1

Looking beyond the mean

winter 2016/17
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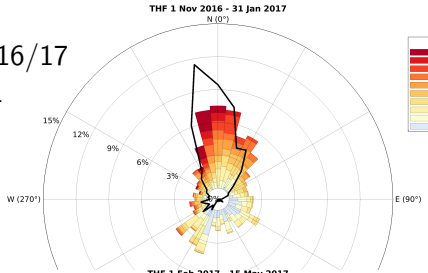
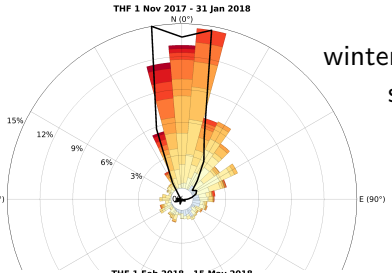
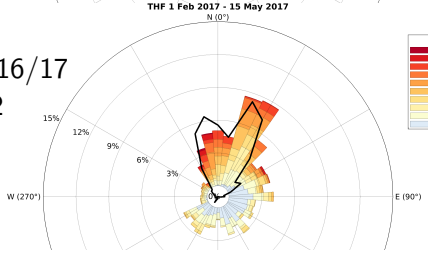


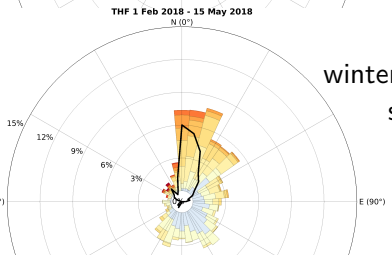
winter 2017/18
stage 1



winter 2016/17
stage 2

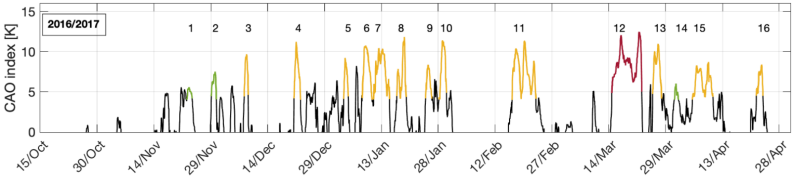


winter 2017/18
stage 2



Period of the IGP cruise (06 Feb 2018 – 22 Mar 2018)

Varying distribution of cold-air outbreak (CAO) forcing



Moderate Strong Very strong

CAO contribution to wintertime heat loss:

54 %

L. Latuta

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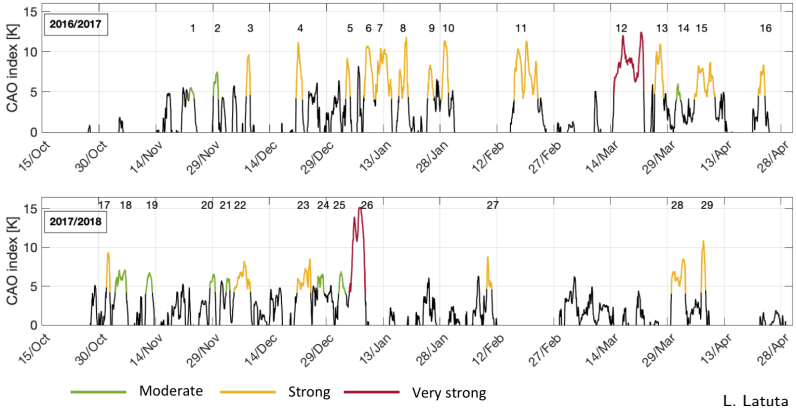


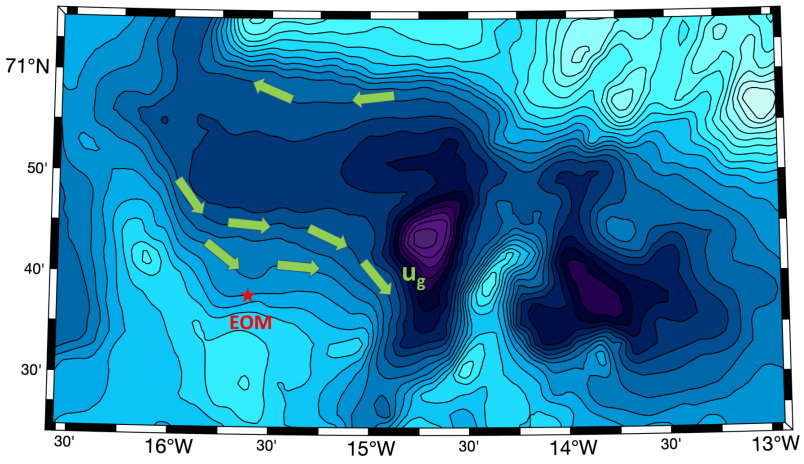
L. Latuta

CAO contribution to wintertime heat loss:

54 %

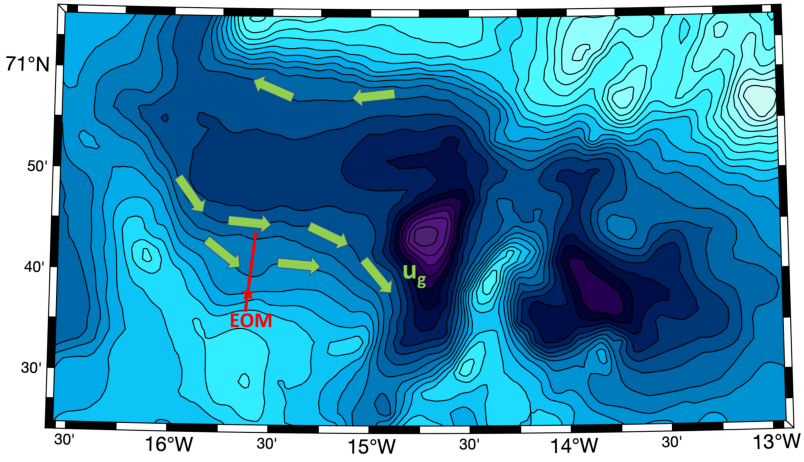
38 %

Expected geostrophic flow through Eggvin Offset



S. Skjelsvik

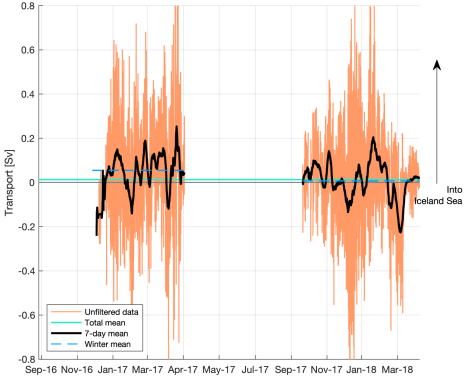
Expected geostrophic flow through Eggvin Offset



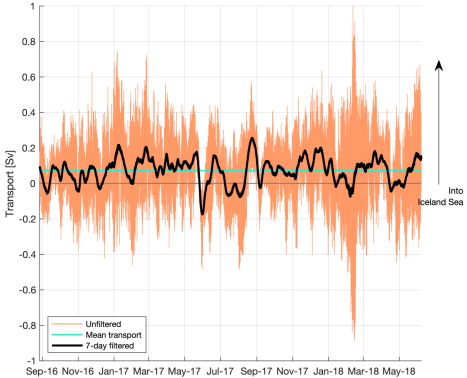
S. Skjelsvik

Little transport through Eggvin Offset

mixed layer ($\sigma_\theta > 27.8\,\mathrm{kg\,m^{-3}}$):
$\approx 13\,\mathrm{mSv}$

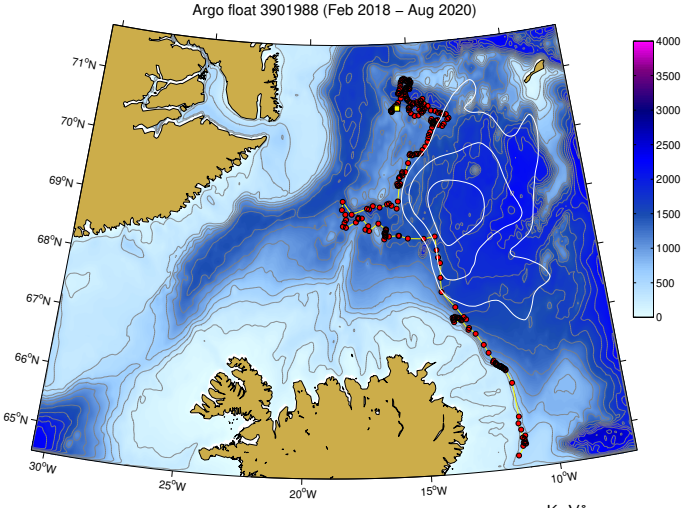


dense-water layer ($\sigma_\theta \approx 28.05\,\mathrm{kg\,m^{-3}}$):
$\approx 72\,\mathrm{mSv}$



S. Skjelsvik

Argo demonstrates a connection to the north Iceland slope

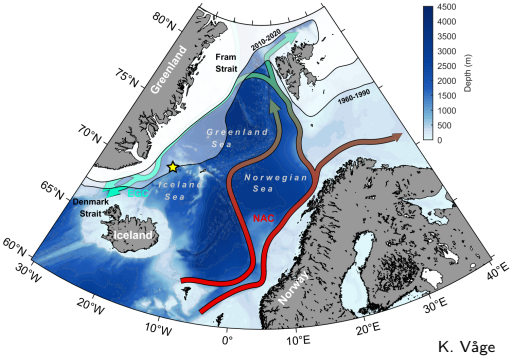


K. Våge

https://argo.ucsd.edu/argo-yellow-01/

Summary

- **Dense-water formation transitions**
  from the central to the western Iceland Sea
  due to retreating sea ice.



K. Våge

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- **Dense-water formation transitions** from the central to the western Iceland Sea due to retreating sea ice.
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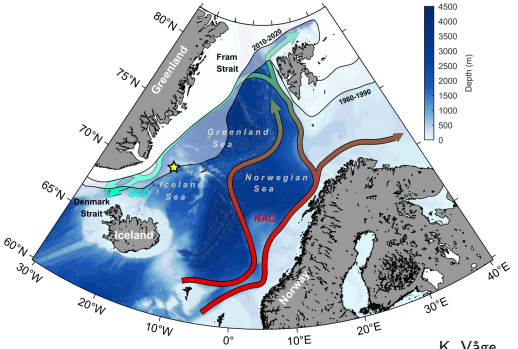

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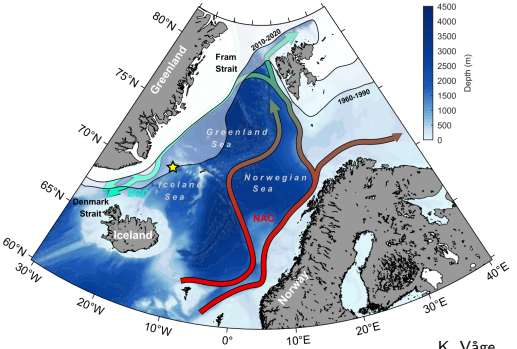

K. Våge

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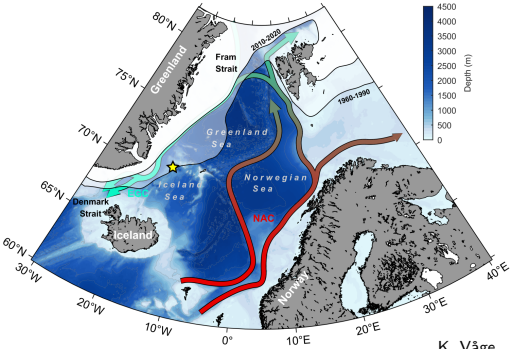

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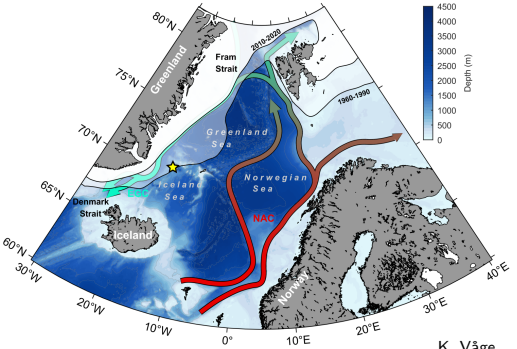
Thank you!



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