Formation and circulation of dense water from a two-year moored record in the northwestern Iceland Sea

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Water mass transformation in the Nordic Seas is crucial for the climate
Two main formation mechanisms of overflow water

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→ East Greenland Current
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interior basins:
→ North Icelandic Jet
→ Iceland–Faroe Slope Jet
High heat loss near the sea-ice edge facilitates open-ocean convection
Sea-ice retreat opens up new areas for dense-water formation
A mooring in the now ice-free northwestern Iceland Sea
Eggvin Offset – a gap in the mid-Atlantic ridge
Outline

- How dense overflow water is formed in Eggvin Offset?
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- 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

- 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

- Maximum densities:
  - $\sigma = 28.03 \text{ kg m}^{-3}$ (winter 2016/17)
  - $\sigma = 27.97 \text{ kg m}^{-3}$ (winter 2017/18)
- Similar mixed-layer densities as in the central Iceland Sea several decades ago → shifting locus of dense-water formation
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→ shifting locus of dense-water formation
Closer sea-ice edge in winter 2016/2017

- 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: $104 \text{ W m}^{-2}$ (winter 2016/17); $88 \text{ W m}^{-2}$ (winter 2017/18)
Varying distribution of cold-air outbreak (CAO) forcing

CAO contribution to wintertime heat loss:

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CAO contribution to wintertime heat loss:

- 2016/2017: 54%
- 2017/2018: 38%

L. Latuta
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Expected geostrophic flow through Eggvin Offset

S. Skjelsvik
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Little transport into the Iceland Sea through Eggvin Offset
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Argo demonstrates a connection to the north Iceland slope
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Climatology of turbulent heat fluxes and sea-ice concentration
Seasonality of turbulent heat fluxes (winter 2002/03 – winter 2020/21)
Bathymetry of the southern slope of Eggvin Offset

S. Skjelsvik
Closer sea-ice edge in winter 2016/2017

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Northerly winds associated with high heat fluxes
Looking beyond the mean

winter 2016/17 stage I

winter 2017/18 stage I

winter 2016/17 stage II

winter 2017/18 stage II