

Pathways and watermass transformation of Atlantic Water entering the Nordic Seas through Denmark Strait

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Circulation Nordic Seas



Connection NIIC - NIJ



Våge et al. 2011, 2015 & Pickart et al. 2017:

1000m

- Similar volume transport ~ 1Sv
- Signal disappears northeast of Iceland
 - Hypothesis: connection via local overturning cell in the Iceland Sea

\rightarrow Can we find this connection in ocean models?

Connection NIIC - NIJ



Which path(s) does the NIIC take?

2) How much of the NIIC contributes to the overflow?

3) Where does the watermass transformation take place?

Investigate connection in two ocean models

Similarities

- Ocean component of often-used fully coupled climate models: CESM (for POP) and GFDL-CM2.6 (for MOM)
- 0.1° horizontal resolution \rightarrow 4.5 km
- 50 (MOM) & 42 (POP) layers in the vertical
 → ~5m at surface to ~200m deeper layers
- Forced by Normal Year Forcing (CORE-II)
 → no air-sea feedbacks
 - \rightarrow no interannual atmospheric variability

Differences

Sea-ice:

MOM: coupled sea-ice model

POP: restoring temperature and salinity under sea-ice from climatology



Thermohaline properties at Denmark Strait



Thermohaline properties at Denmark Strait



Release particles in northward flow west of Iceland 80 Each particle tagged with corresponding transport 75 70 65



- Seed daily for 1 year
- 6 years advection time
- Total # of particles MOM: 226407 POP: 284412

over depth

Particles are advected offline in 3D velocity fields using the Connectivity Modeling System

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Lagrangian Particles – separating pathways

Categorize particles based on:

- Through which exit they leave the Nordic Seas
- Which path they take within the Nordic Seas



1) Which path(s) does the NIIC take?







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- Main paths along which transformation takes place differ:
 - Denmark Strait: Short loop in POP
 Long path in MOM
 - Iceland-Shetland: exit is different
 - in MOM most of water leaving here has become dense

3) Where does the watermass transformation take place in MOM?





3) Where does the watermass transformation take place in POP



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- Transformation by mixing with other watermasses and direct cooling by the atmosphere



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- Only part of the NIIC contributes to the overflow
- Transformation by mixing with other watermasses
- Watermass transformation pathways different for MOM and POP

 → influence of sea-ice on hydrography and circulation?

Additional Slides

Temperature & salinity @ 50m



March heat flux and maximum mixed layer depth



Barotropic streamfunction



Kogur transect

