

Cascading off the West Greenland Shelf: A numerical perspective

Juliana M. Marson^{1*}, Paul G. Myers¹, Brian Petrie², Kumiko Azetsu-Scott², Craig Lee³

Introduction

- Dense water forms on the shelf → slide the slope to intermediate and deep layers

↪ **CASCADING**

- Potential contribution to deep water formation and carbon sequestration

→ East Greenland Shelf cascades: **observed** ✓

→ West Greenland Shelf cascades: ☹️ ?

↪ Covered by sea ice when process has potential to happen → difficult to observe

use numerical simulation

The simulation

- NEMO v3.4 [ocean] + LIM2 [sea ice]
- GLORYS 2 v3 [initial condition]
- CGRF [forcing]
- ANHA4 configuration [0.25° resolution] (Fig. 1)

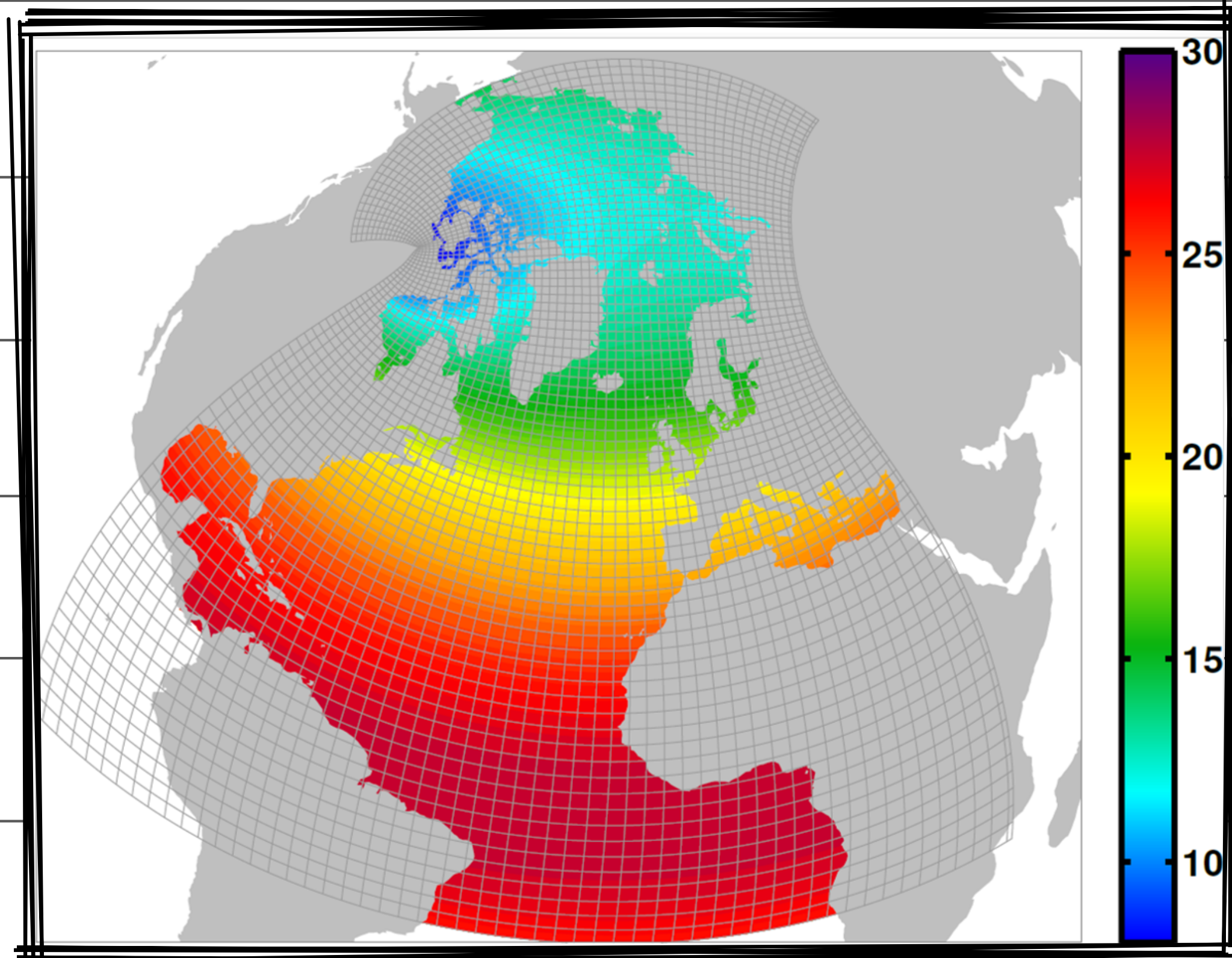


Figure 1: ANHA4 horizontal grid (every ten cells). The colors indicate the resolution in kilometers (<http://knossos.eas.ualberta.ca/xianmin/anha/index.html>)

Results

Dense water occupying whole water column
↪ Formed locally through brine rejection

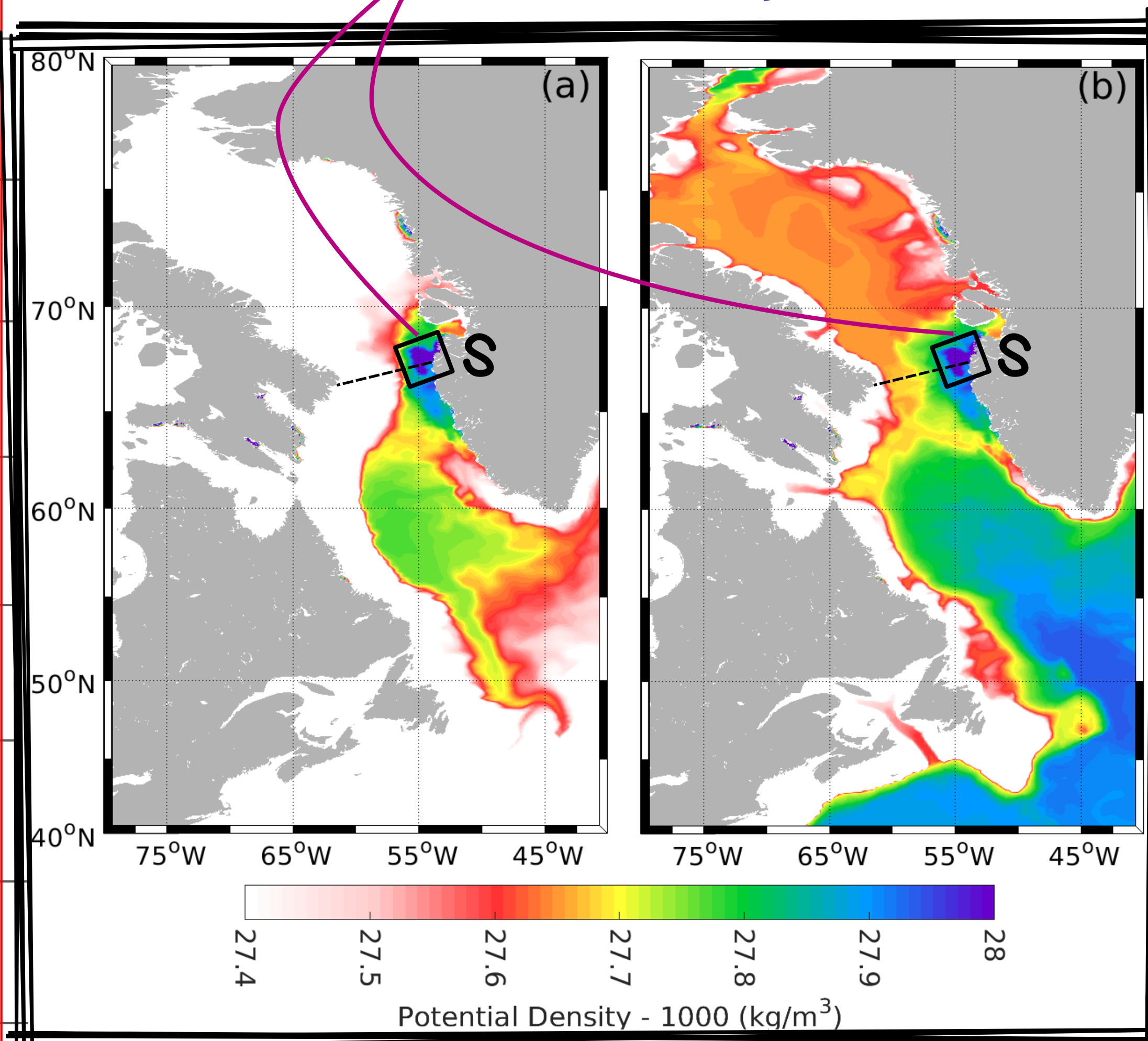


Figure 2: (a) Surface and (b) bottom density in April 2004 from NEMO simulation. Area S is used to calculate the averages presented in Figure 3. The dashed line indicates the location of the section depicted in Figure 4.

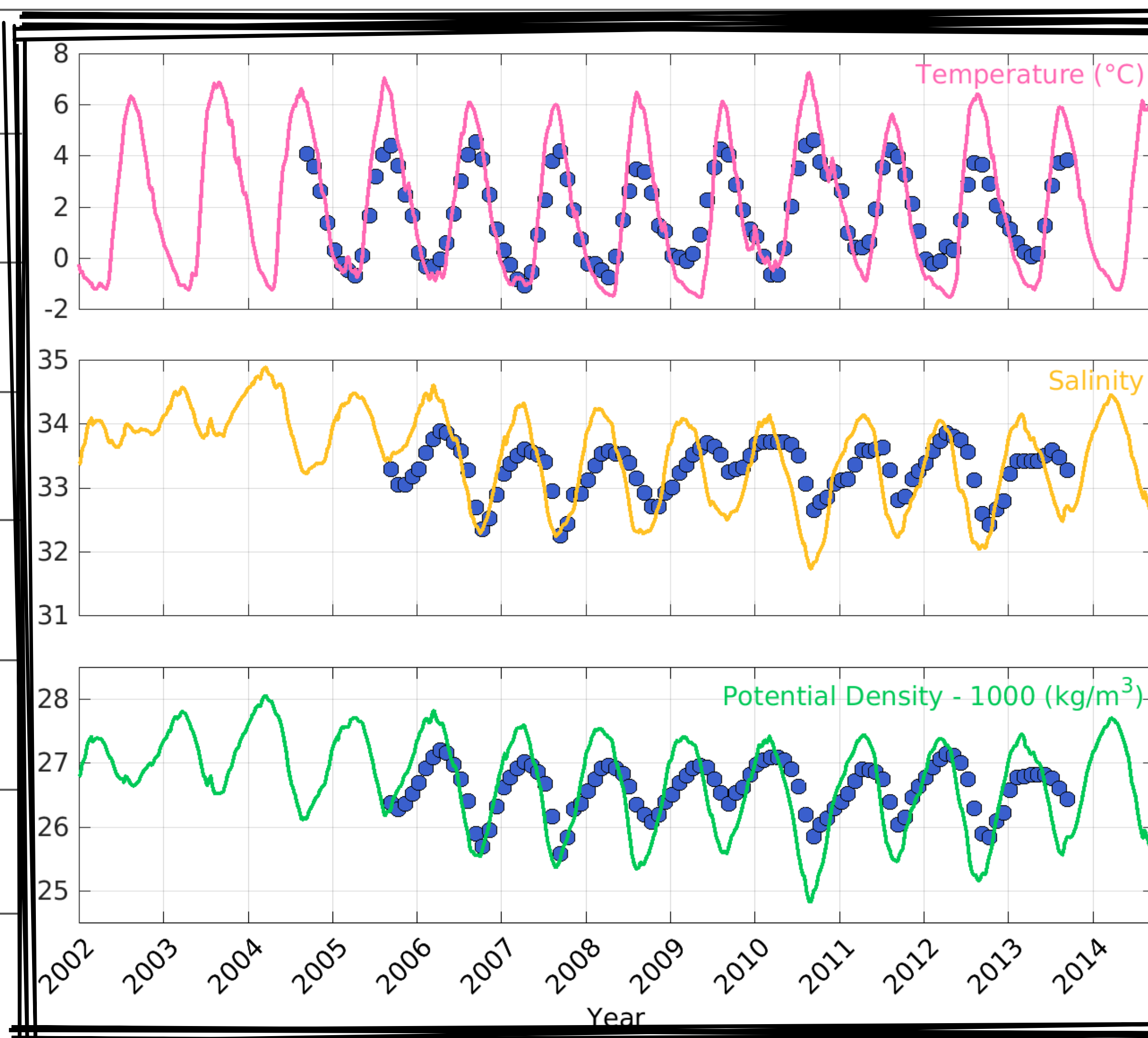


Figure 3: Evolution of (a) temperature, (b) salinity, and (c) potential density. Solid lines indicate averages from NEMO simulation inside area S, white blue circles indicate observations made by five moorings placed inside the same area (data from Curry et al., 2014)^a.

- Waters on eastern Davis Strait shelf get dense seasonally (up to 28 kg/m³)
- Before 2007, even the minimum density is larger than 26 kg/m³

↪ Build up of dense waters on the shelf

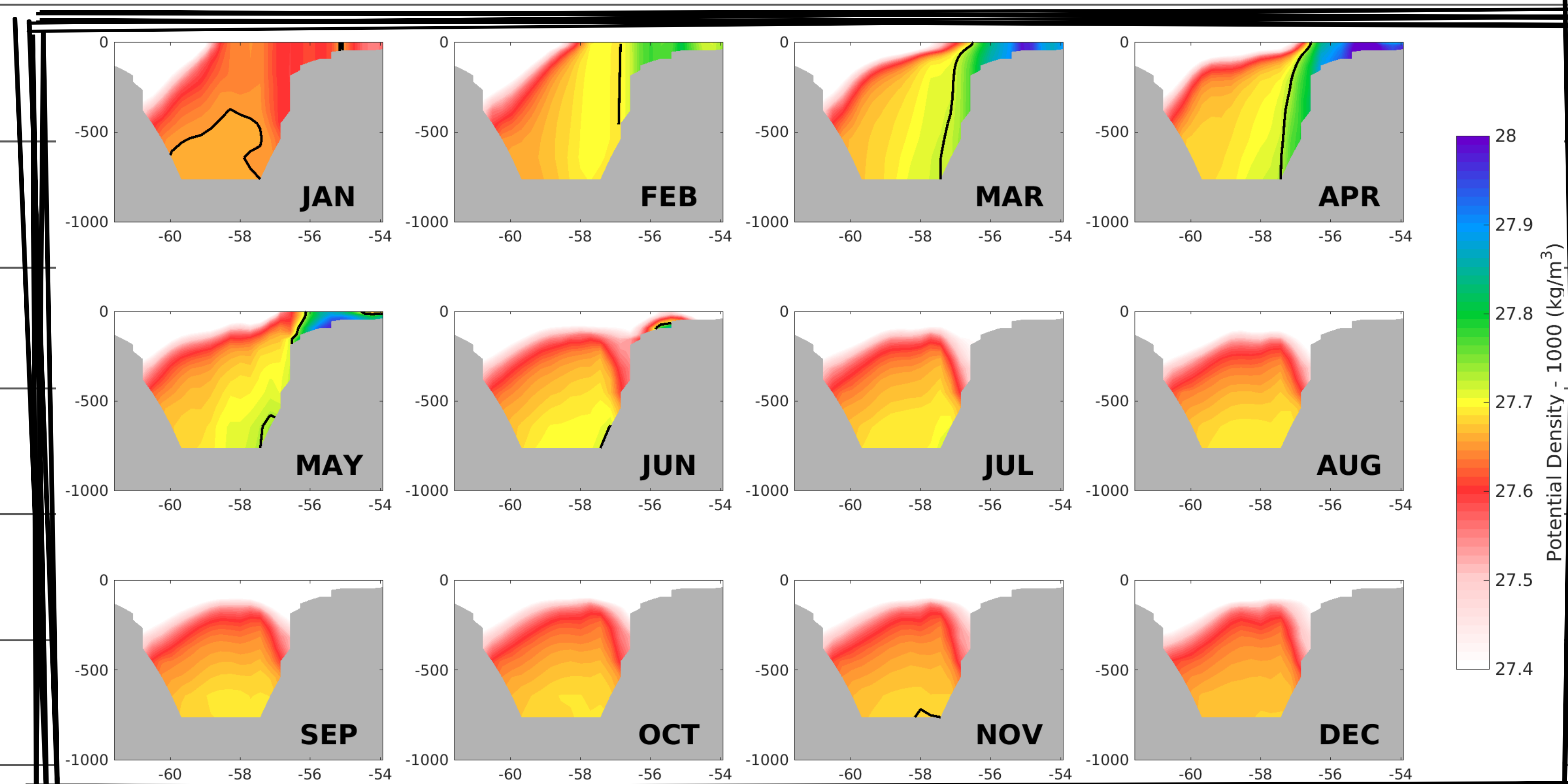


Figure 4: Cross-section at Davis Strait (indicated by dashed line in Fig. 2) showing the monthly mean distribution of density. The black line indicates the isopycnal passing by the bottom of the slope.

Plume of dense water slides down the slope between February and June - and goes to deep Baffin Bay

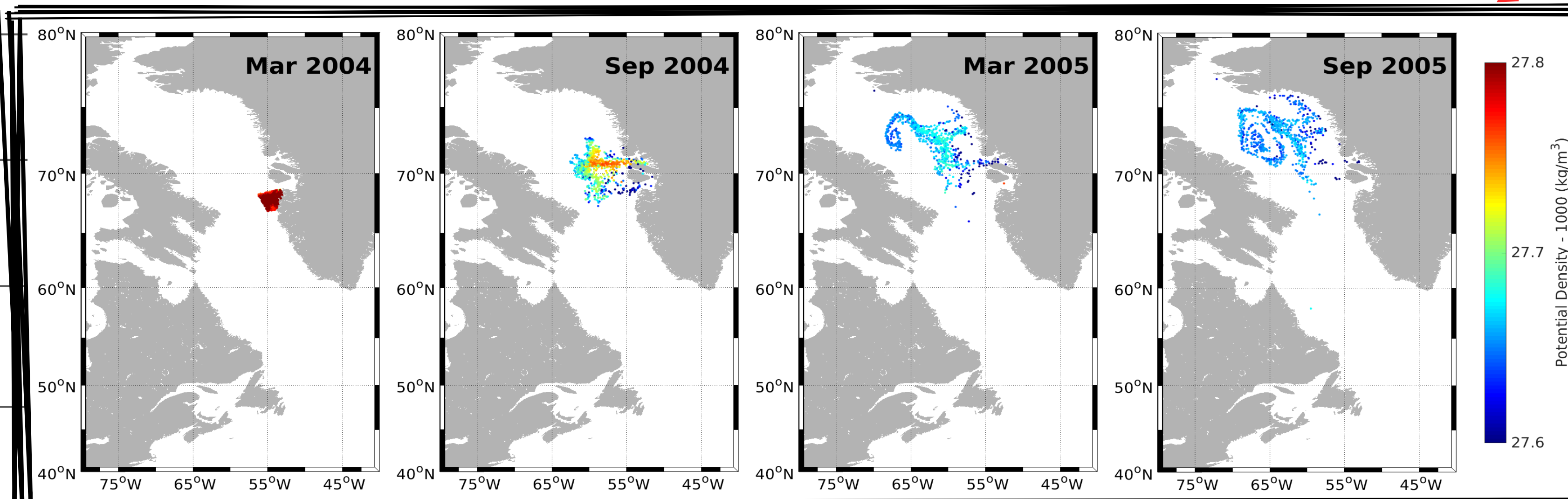


Figure 5: Position and density of particles released in area S that reached 500 m or deeper during 18 months of NEMO simulation. Computed using the offline tool ARIANE.

Main Conclusion

Cascading has potential to happen on the west side of Greenland, near Davis Strait. The thermohaline properties in this area - and their interannual variability - are well reproduced by the simulation, giving strength to our claim. The dense water formed may contribute to the formation of Baffin Bay Deep Water.

^a Curry, B., Lee, C. M., Petrie, B., Moritz, R. E., and Kwok, R. (2014). Multiyear Volume, Liquid Freshwater, and Sea Ice Transports through Davis Strait, 2004–10*. *Journal of Physical Oceanography*, 44(4):1244–1266.