ICEBERG MODELLING: IMPROVING PATHWAYS AND SOURCES OF FRESHWATER TO THE NORTH ATLANTIC

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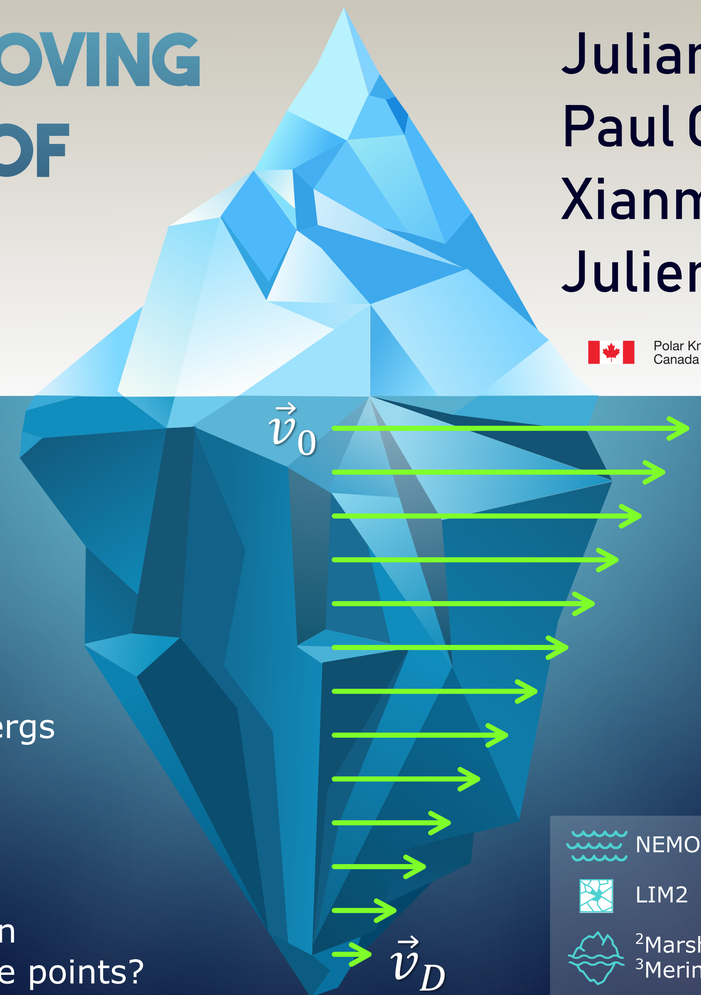
Around half of Greenland's annual mass loss is attributed to solid ice discharge. Yet, most ocean models ignore the representation of icebergs.



1. WHAT DO WE WANT TO KNOW?

- Does using ocean 3D fields to move and melt icebergs make a difference in their pathways?
- How is iceberg melt spatially distributed?
- Does iceberg melt impact the ocean differently than introducing its meltwater as liquid from their source points?

KEY POINTS

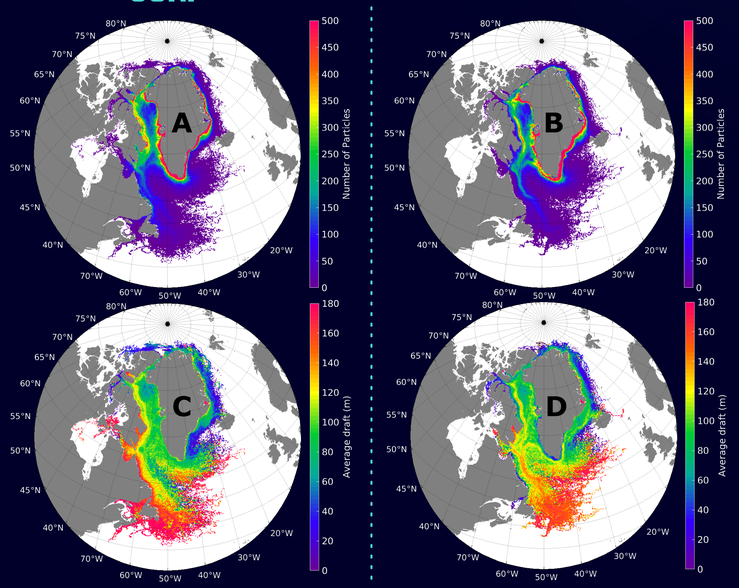
- When taking 3D ocean fields into account, icebergs move preferentially along the shelf break.
- Mean iceberg melt has the same order of magnitude as the mean net freshwater flux north of Baffin Bay and the Labrador Sea.
- Icebergs tend to distribute freshwater over larger areas when compared to all-liquid freshwater input; most changes in temperature and salinity are, however, within one standard deviation of the control run's interannual variability.

2. MODEL AND SIMULATIONS

NEMO 3.4 (1/4°)
LIM2
[2]Marsh et al. (2015)
[3]Merino et al. (2016)
CGRF (2002-2016)
IC & OBC: GLORYS 2v3

SURF[2] $\vec{v}_{ocean} = \vec{v}_0$
VERT[3] $\vec{v}_{ocean} = \frac{1}{D}\int_D^0 \vec{v}_z \, dz$
HEAT Includes iceberg latent heat flux (implemented by Met Office)
CTL No icebergs; solid discharge (54%) converted to liquid

3. ICEBERG DISTRIBUTION



[1]Marson et al. (2018)

Figure 1: *Number of particles found at each grid point between 2002-2015 (A and B), and their average draft (C and D).*

4. FRESHWATER FLUX

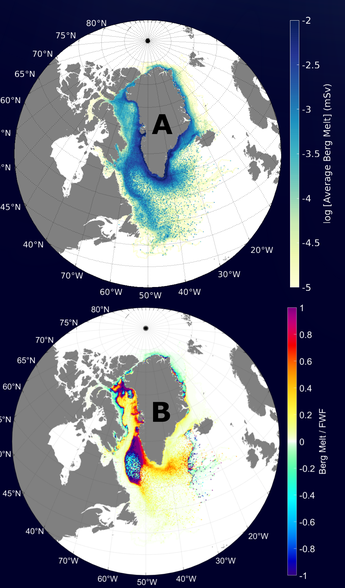


Figure 2: *Average (2010-2016) meltwater flux from icebergs in HEAT (across the surface) in logarithmic scale (A). In (B), this melt flux is compared with the net freshwater flux at the surface.*

5. IMPACTS

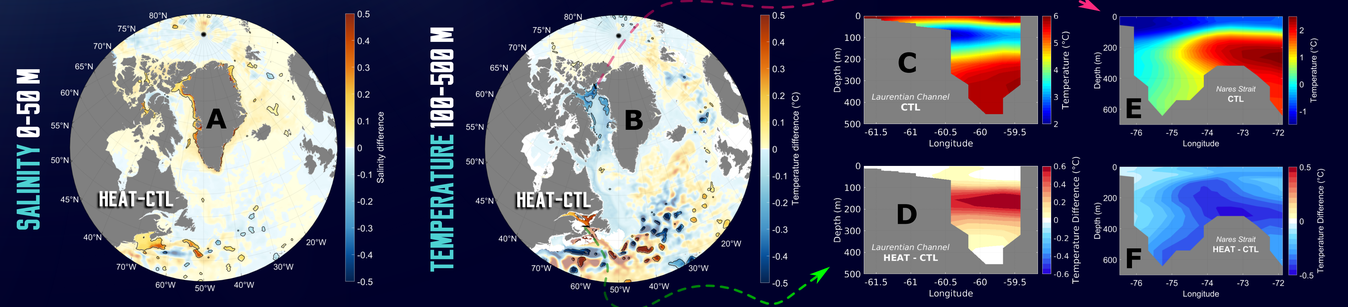


Figure 3: *Difference between HEAT and CTL simulations in 0-50 m averaged salinity (A) and 100-500 m averaged temperature (B) between 2010-2016. The faded areas indicate where the differences fall within one standard deviation of the CTL interannual variability. Panels (C) and (E) show the average temperature (2010-2016) in CTL along the Laurentian Channel and Nares Strait sections, respectively, while (D) and (F) show the temperature difference between HEAT and CTL at those sections.*

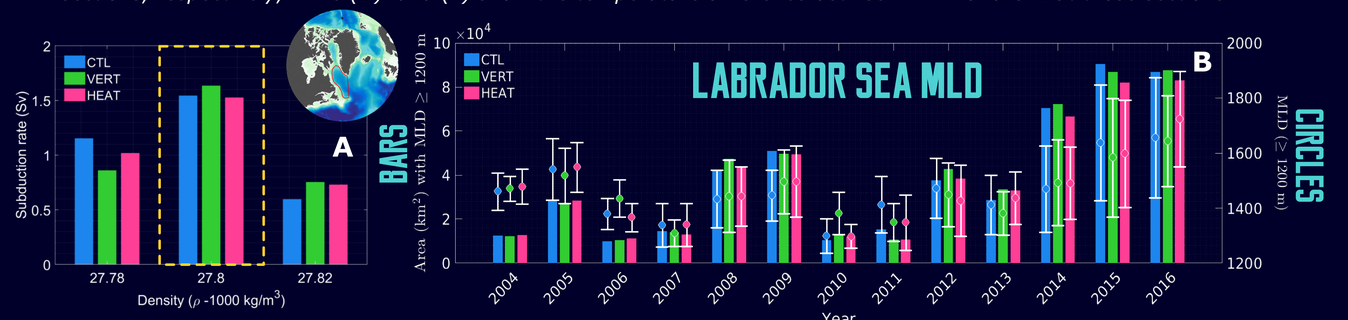


Figure 4: *Panel (A) shows the three main density bins within which subduction occurs in the Labrador Sea, indicated in the small map. For each density, the bars indicate the average subduction rate (2010-2016) for the corresponding simulation. In (B), the bars show the annual average area where the mixed layer depth (MLD) is deeper than 1200 m in the Labrador Sea and circles indicate the average MLD inside this area.*

[1] Marson et al. (2018). Using vertically integrated ocean fields to characterize Greenland icebergs' distribution and lifetime. Geophys. Res. Lett., 45, 4208–4217.
[2] Marsh et al. (2015). NEMO-ICB (v1.0): Interactive icebergs in the NEMO ocean model globally configured at eddy-permitting resolution. Geosci. Model Dev., 8(5), 1547–1562.
[3] Merino et al. (2016). Antarctic icebergs melt over the Southern Ocean: Climatology and impact on sea ice. Ocean Modelling, 104, 99–110.

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