Interaction between the North Atlantic Ocean and Greenland Ice Sheet during the present-future deglaciation

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CoupledIceClim

European Research Council

Established by the European Commission

TU Delft

PhD Project

- Goal: Understand ice-ocean interaction in a global warming scenario

PhD Project

How Greenland ice sheet melting fluxes is affecting North Atlantic Ocean circulation in the present-future period?

PhD Project

What is causing the AMOC slowing down?

Freshwater

Warming oceanic waters

PhD Project

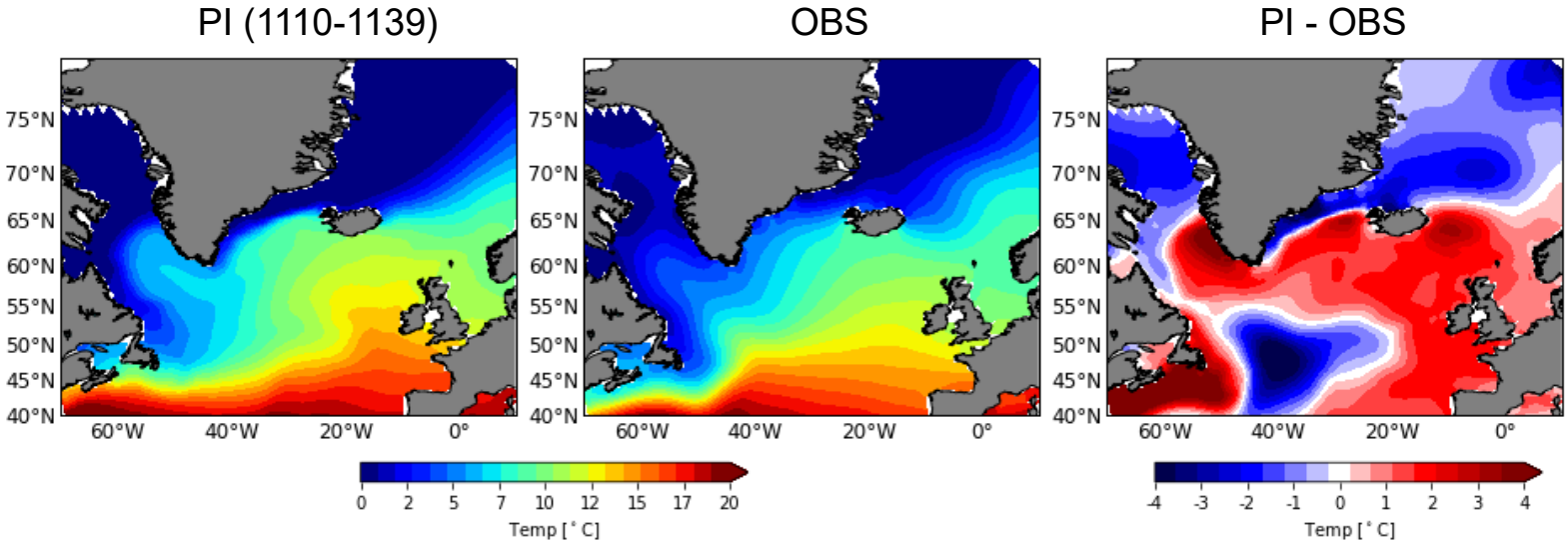
What are the changes caused by a warmer ocean on the atmosphere and Greenland SMB ?

North Atlantic Ocean Circulation in CESM 2.0

North Atlantic Ocean Circulation in CESM 2.0

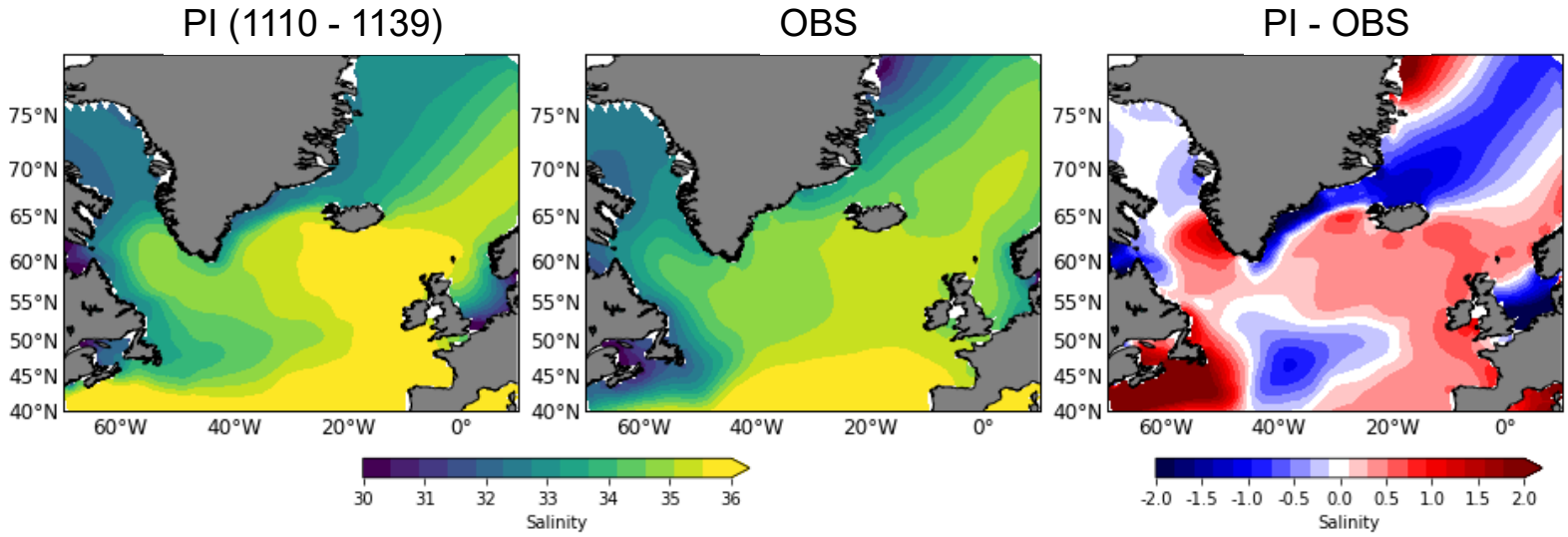
- B run – all components active, except ice sheet
- Pre Industrial (PI) – 1200 yrs
- 1% CO_2 – 150 yrs

Surface Temperature



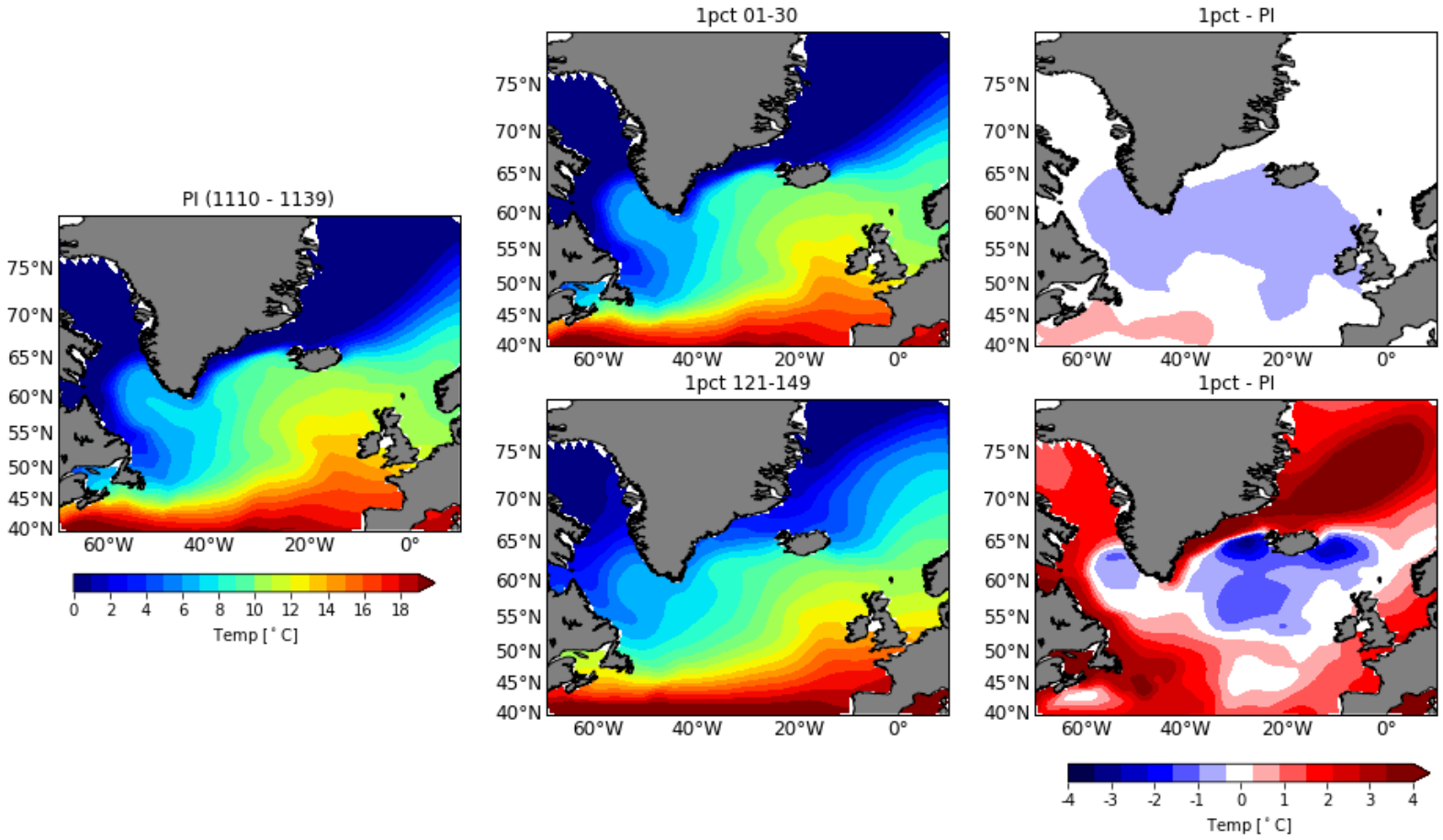
- OBS → Polar Hydrographic Climatology 2 (PHC2)
- Warmer North Atlantic Ocean and Labrador Sea
- Cold Blob – it can be seen in CESM 1.0 (20th simulation)

Surface Salinity



- Saltier North Atlantic Ocean
- Fresher Blob – it can be seen in CESM 1.0 (20th simulation)

1% CO_2 - Surface Temperature

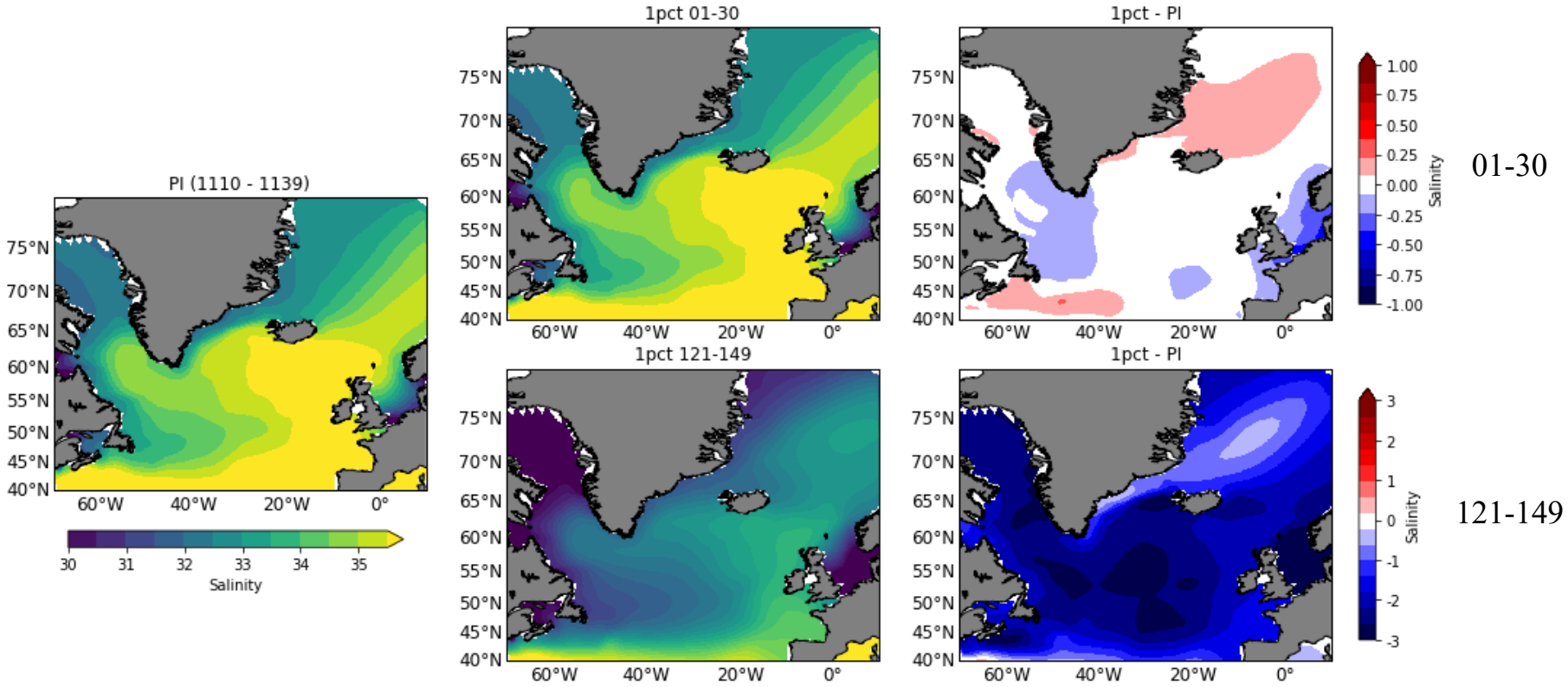


01-30

121-149

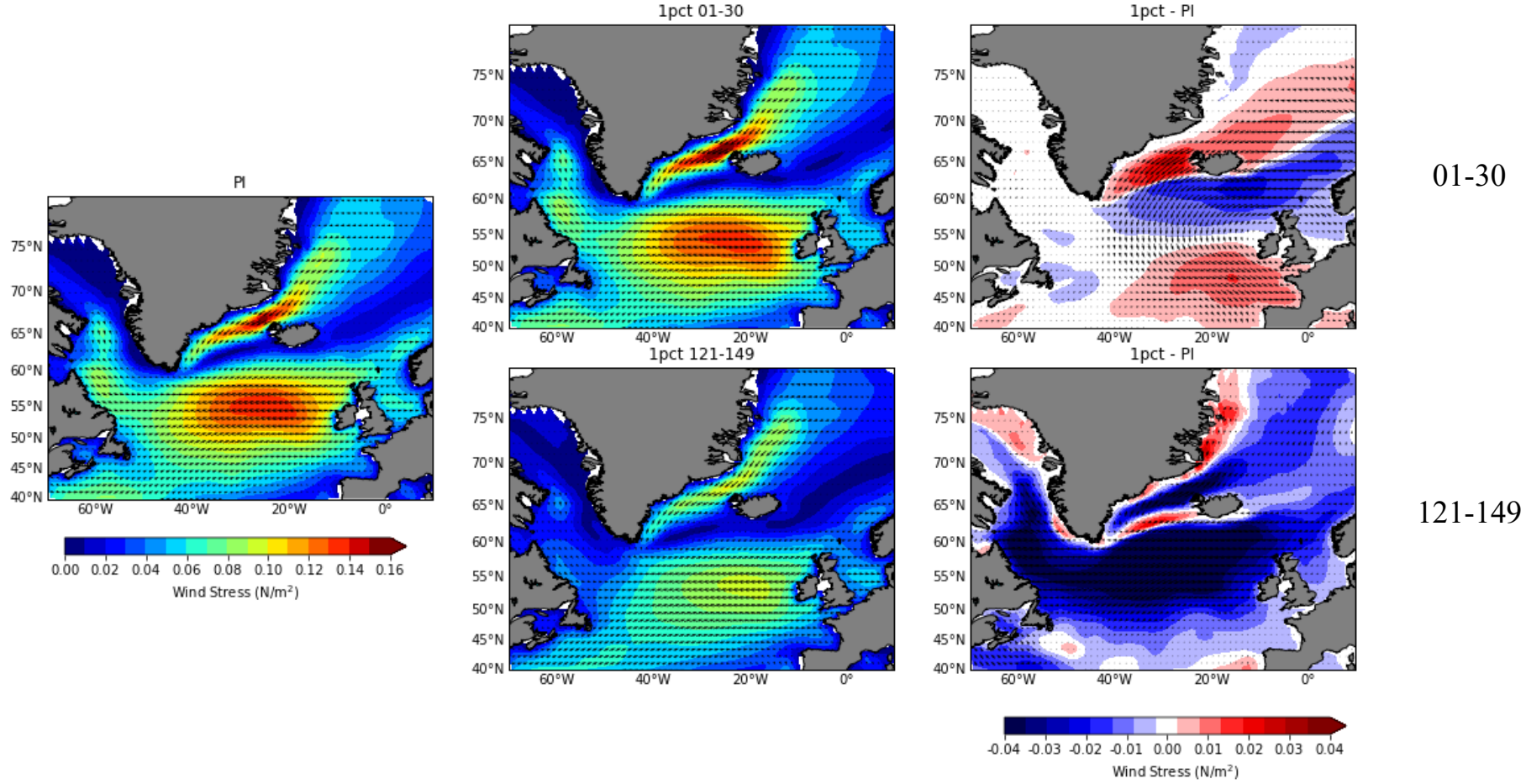
- 1pct 01-30 very similar to the PI
- Cold waters around Iceland and Labrador Sea

1% CO_2 - Surface Salinity



- 1pct 01-30 very similar to the PI
- Fresher waters around Iceland and Labrador Sea

1% CO_2 – Wind Stress



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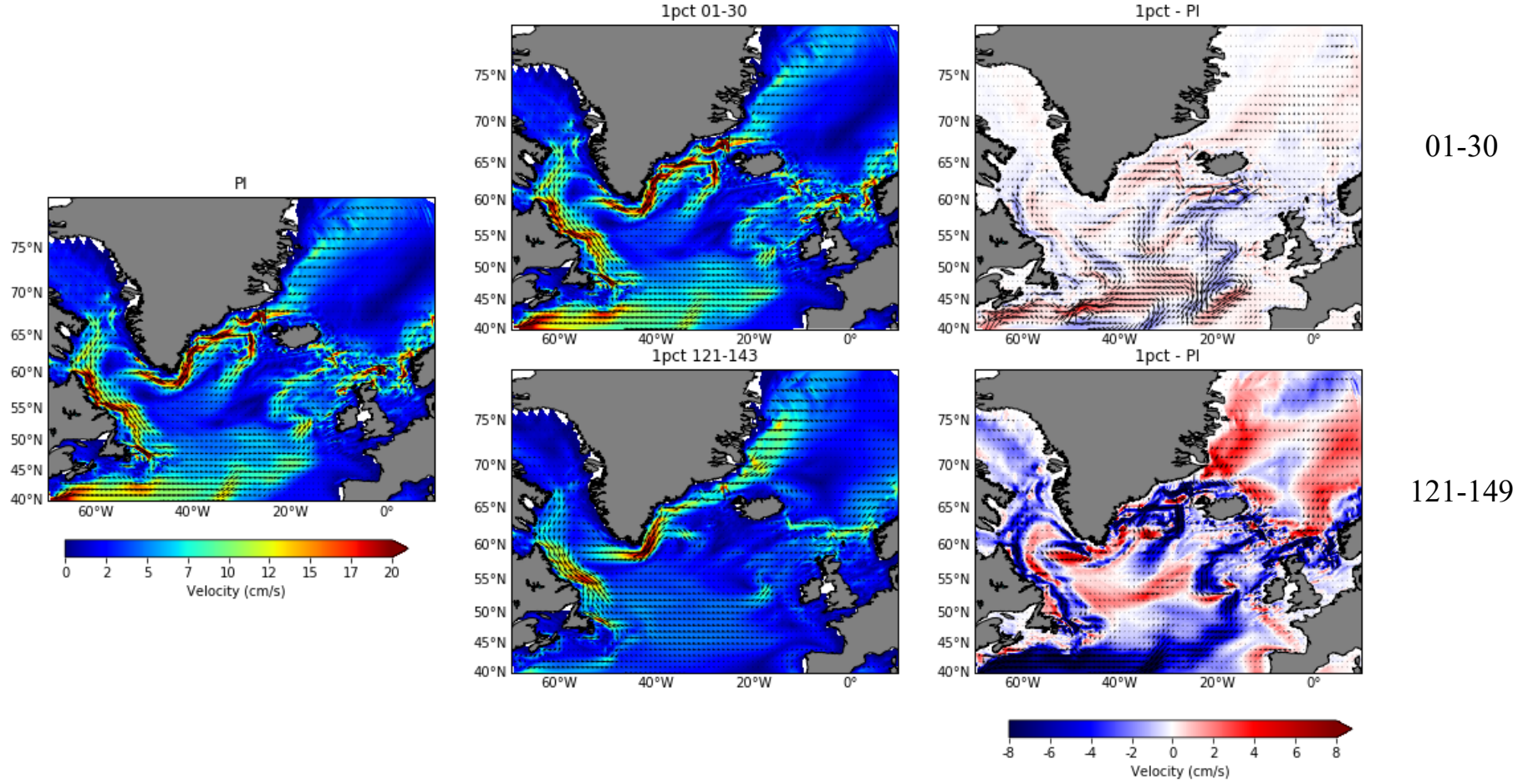
- Could affect the surface circulation

1% CO_2 - Surface Velocity



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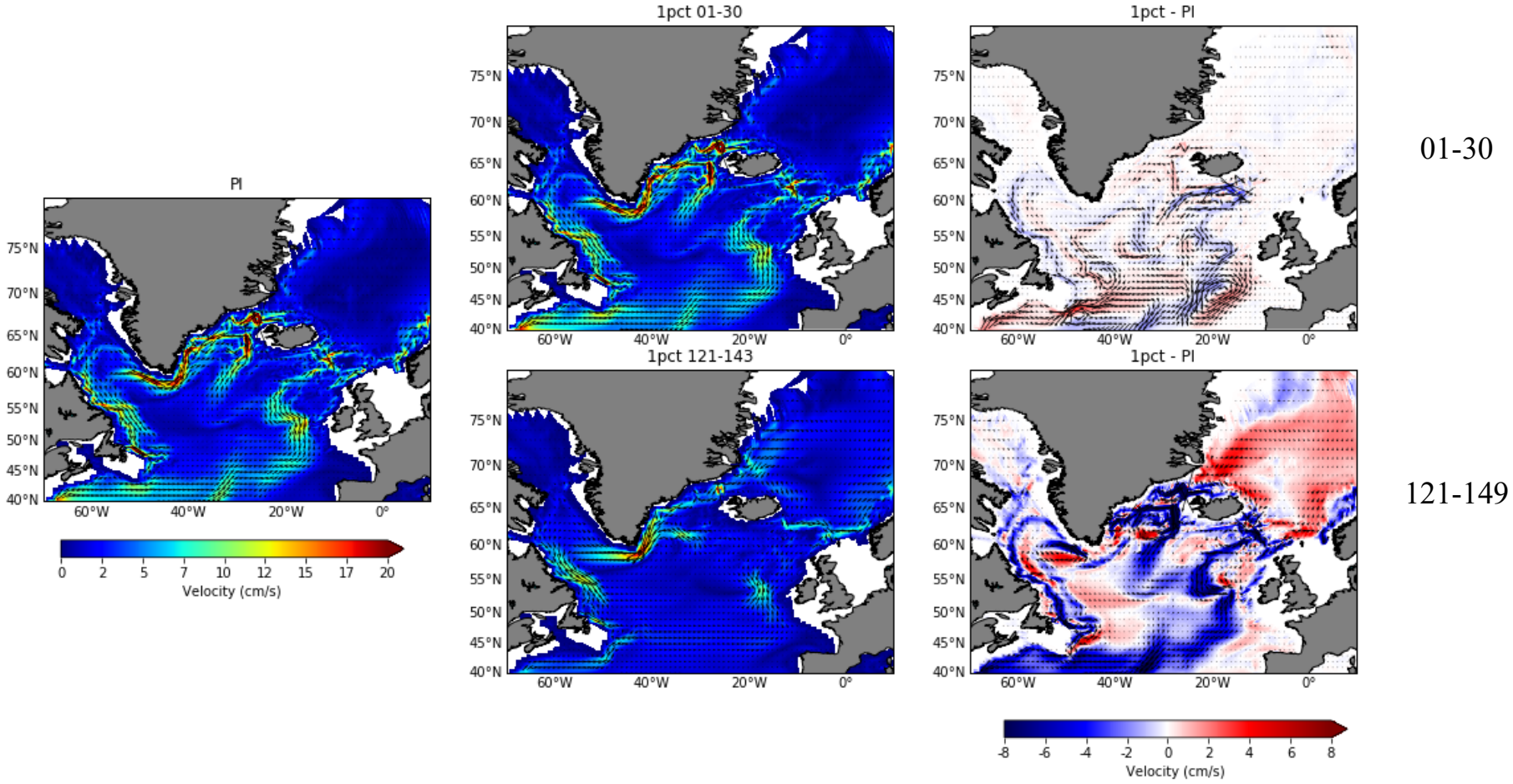
121-149

- Main currents well represented
- Maximum velocities in Labrador Sea → displaced
- In general, the surface current speed weakens

1% CO_2 - Surface Velocity – 200m



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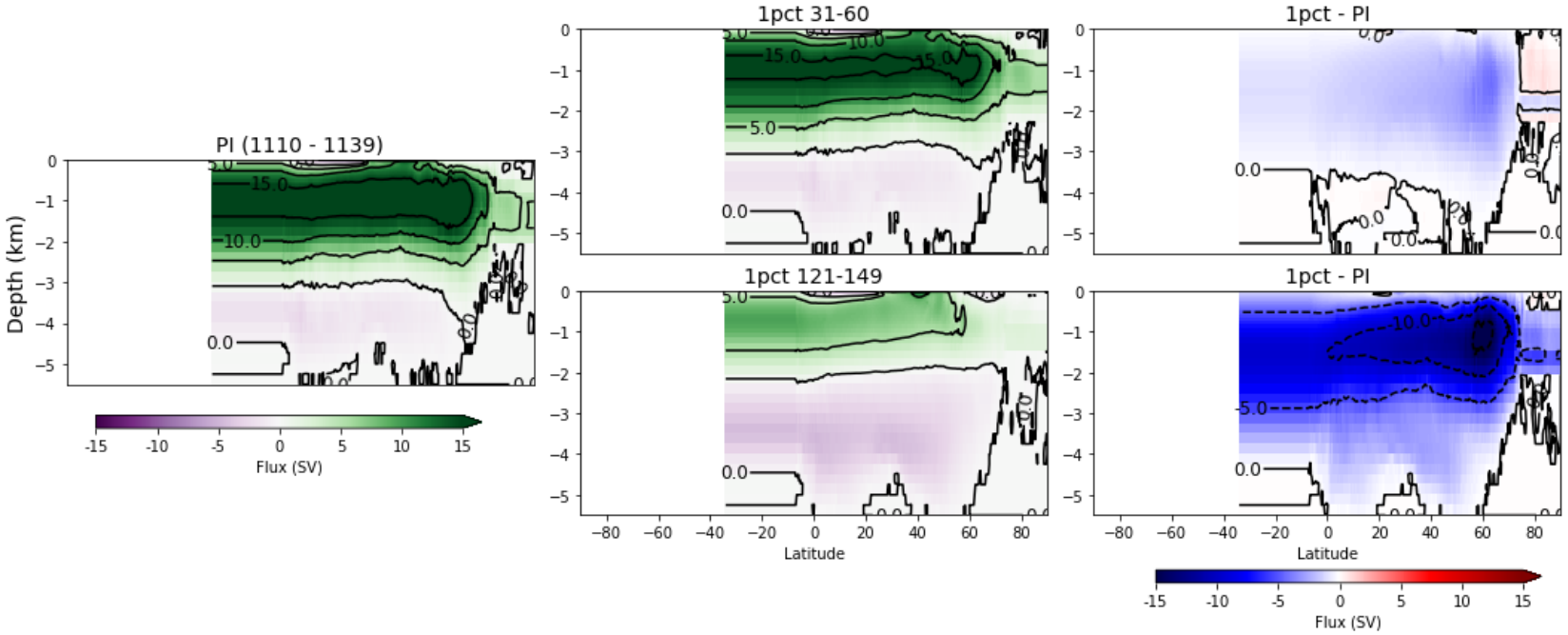
- Current speed weakens → subsurface water spreading
- Convection site in the Labrador Sea might change (?)

1% CO_2 - AMOC



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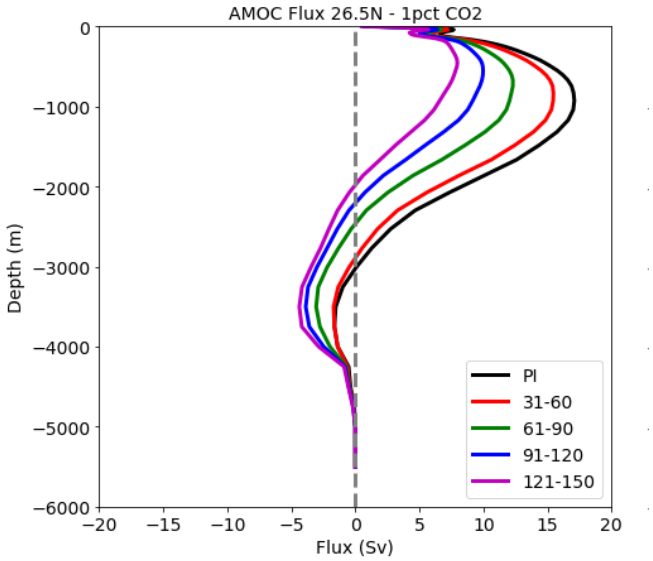
Upper Limit AMOC

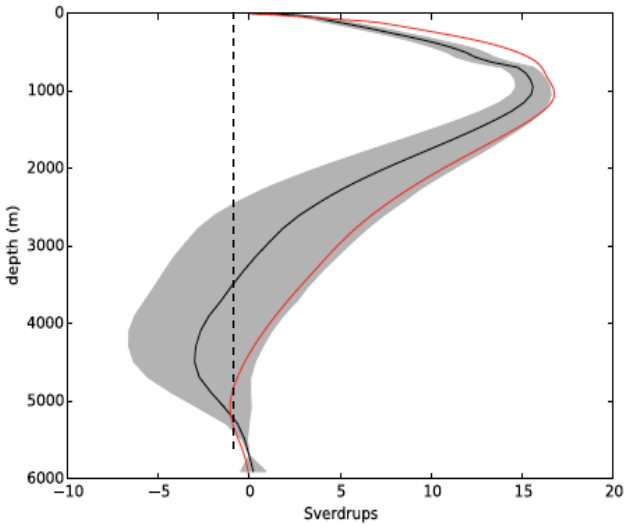
- Weakens
- Shallower

AMOC Flux 26.5ºN



1% CO2

RAPID (**red line**)



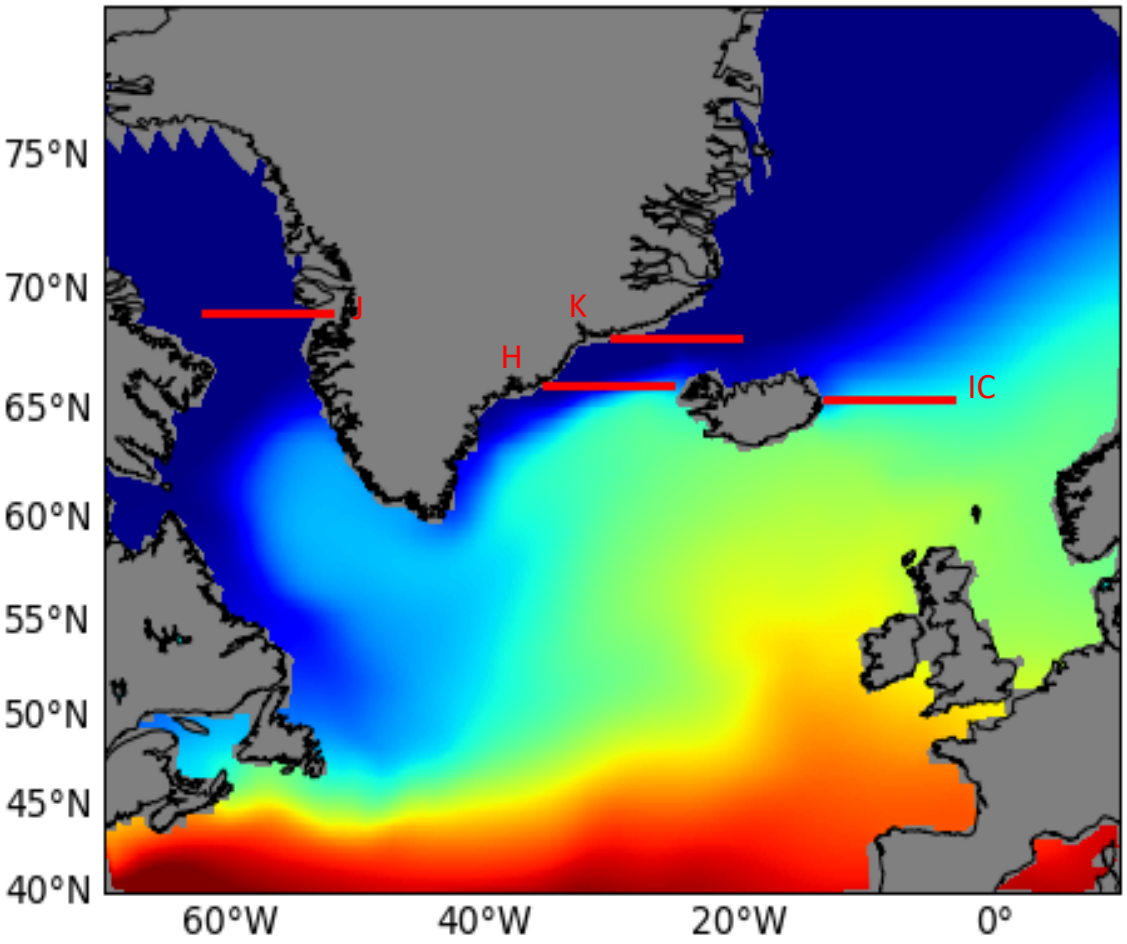
Smeed et al., 2017

Upper Limit AMOC well represented

Next (ongoing) steps

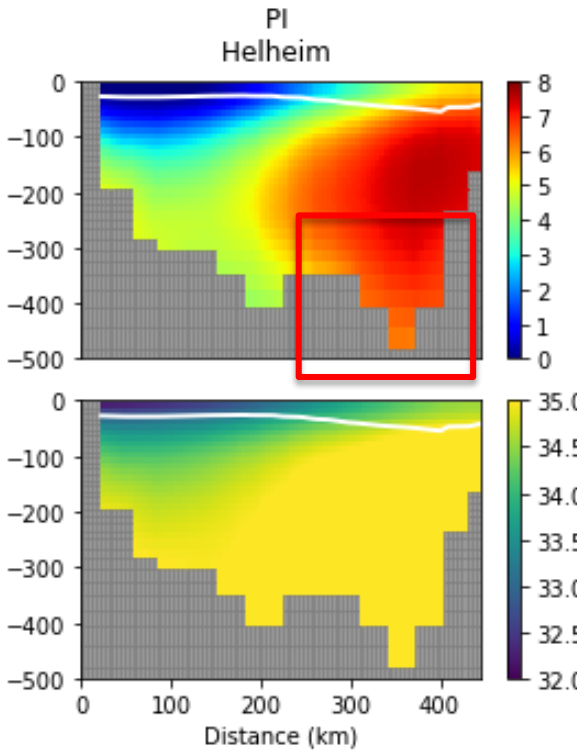
- Look the changes in vertical sections
- Identification of the water masses

Transects



K – Kangerlussuaq
H – Helheim
IC – Iceland
J – Jakobshavn

Pre Industrial



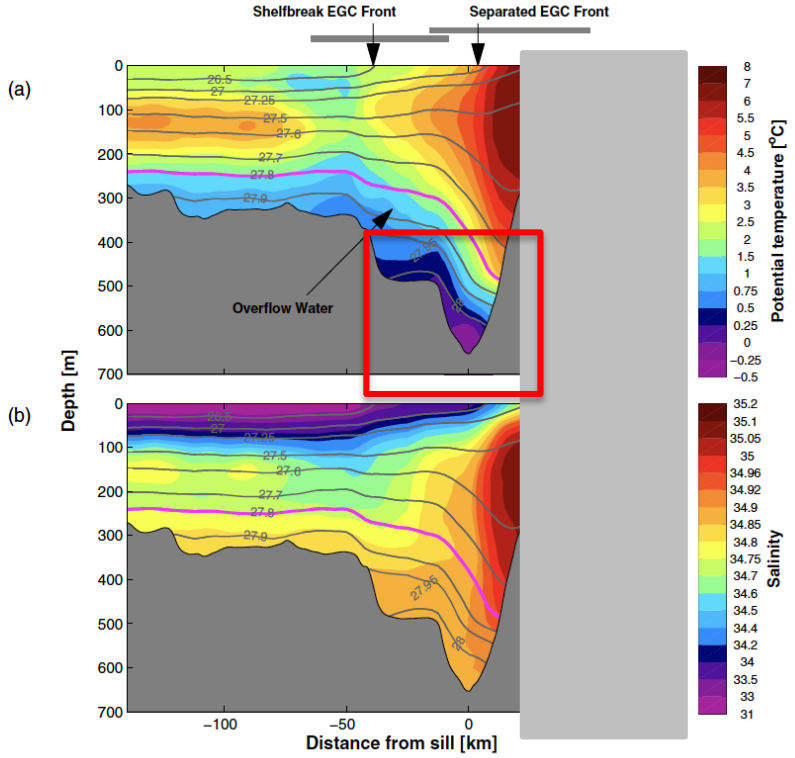


Figure 5. Mean vertical sections of (a) potential temperature (°C, color) and (b) salinity (color), overlain by potential density (kg/m^3, contours). The mean is comprised of data collected between 1990 and 2012. The 27.8 kg/m^3 isopycnal, which indicates the top of the overflow layer, is highlighted in magenta. The mean locations of the shelfbreak and separated EGC fronts are indicated by arrows at the top of the plot, and the corresponding ranges are indicated by horizontal gray bars.

CESM

Mastrapole et al., 2017

Conclusion

- In general, CESM ocean component is really good.
- Some limitations we have to keep in mind.

Thank You!

Questions?

(Photo: Dirk Van As): http://sciencenordic.com/predicting-next-big-flood-greenland