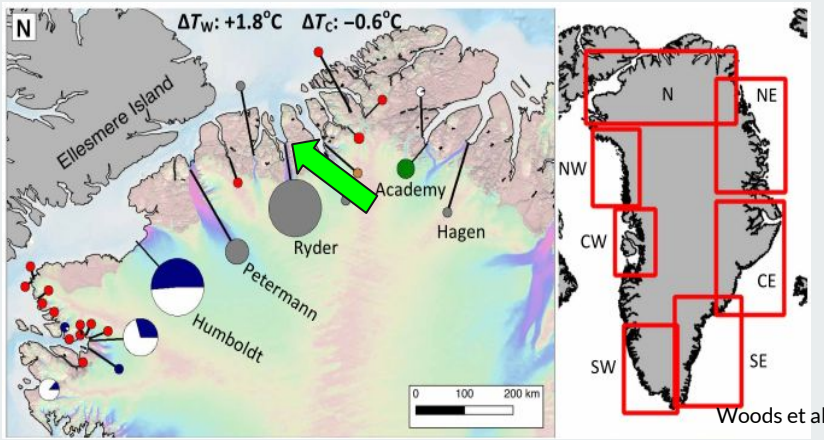
Idealized high resolution modelling of plume dynamics and basal melting at Ryder Glacier

An initial assessment of basal melt at Ryder Glacier



Woods et al, 2021

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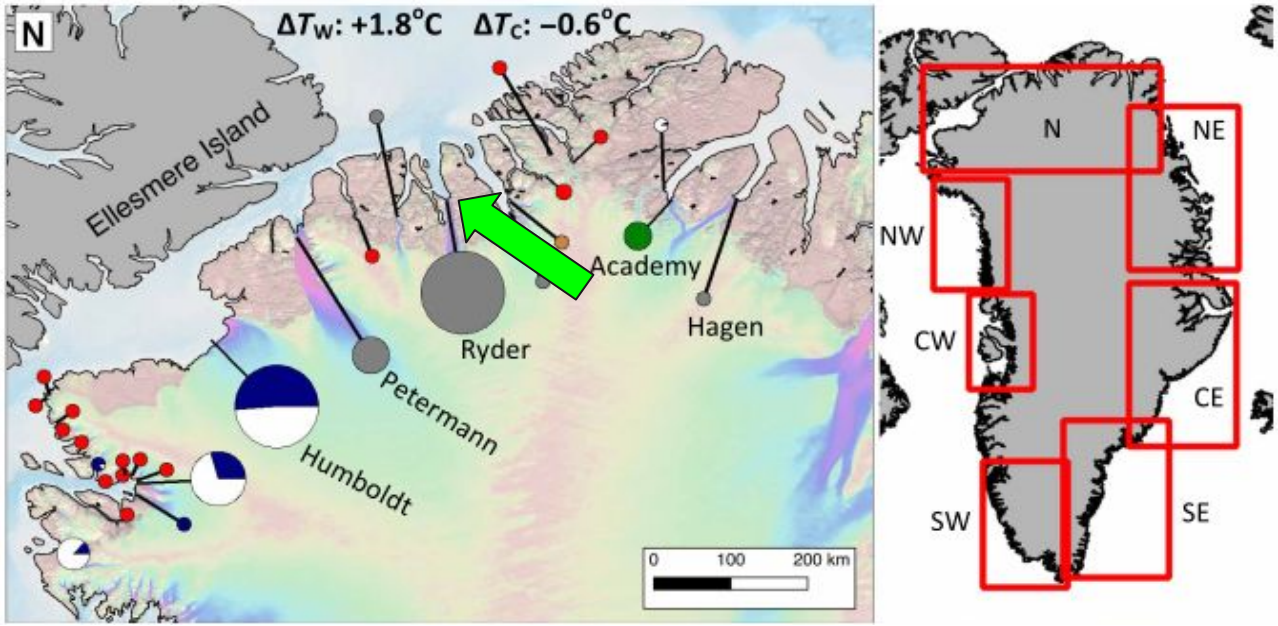
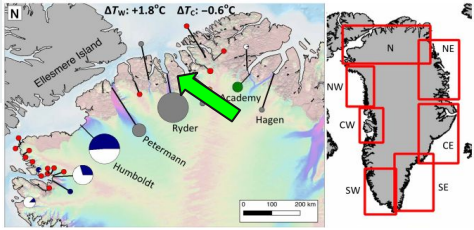
Outline

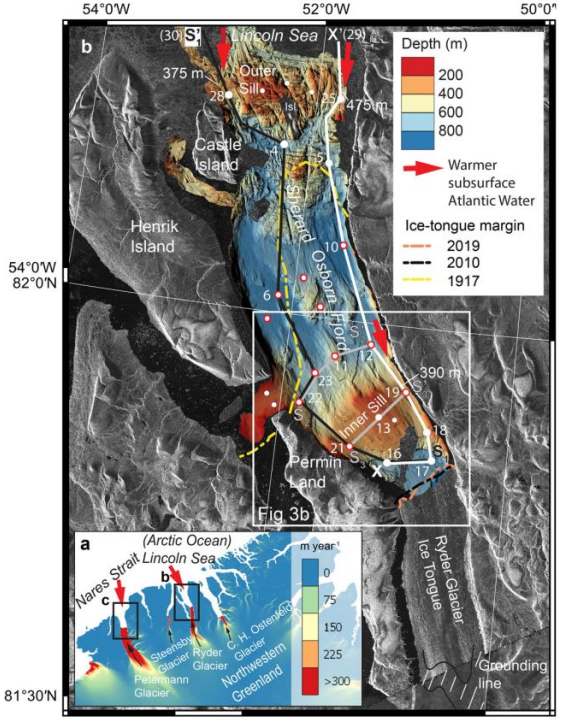
1. The role of Greenlands marine terminating glaciers and ice shelves
2. The real case of Ryder Glacier
3. The Model Setup
4. The modelled case of Ryder Glacier
    a. Plume Characteristics
    b. Sensitivities to AW Temperature
5. Summary and Conclusion
6. Outlook

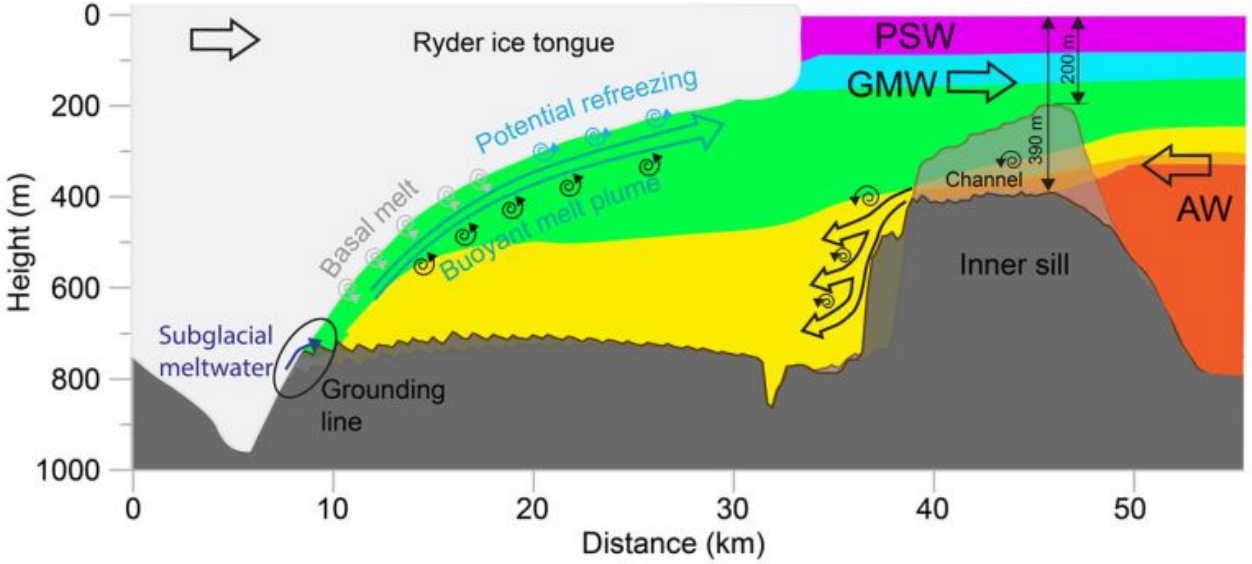
The Greenland Ice sheet and marine terminating glaciers



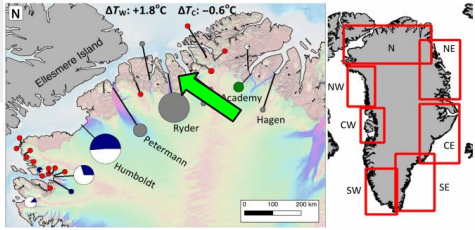


Ryder Glacier/ Sherard Osborn fjord





both from Jakobsson et al, 2020



MITgcm configuration

Domain size: 30 km (+ 2 km sponge) x 1 km

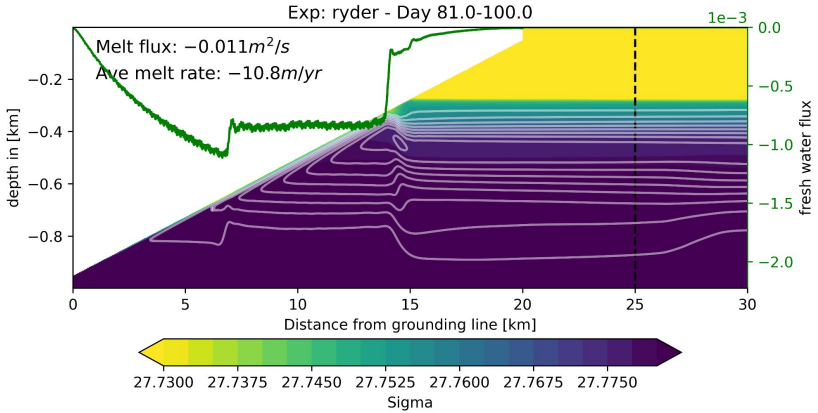
Resolution: 10 m x 3.33 m

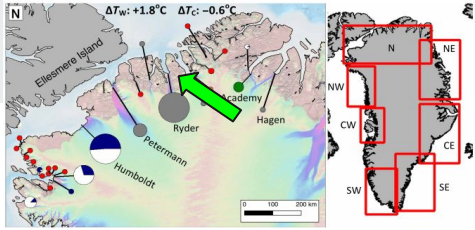
time: 100 days

time-step: 5-10 seconds

melt parametrization of static ice

non-hydrostatic





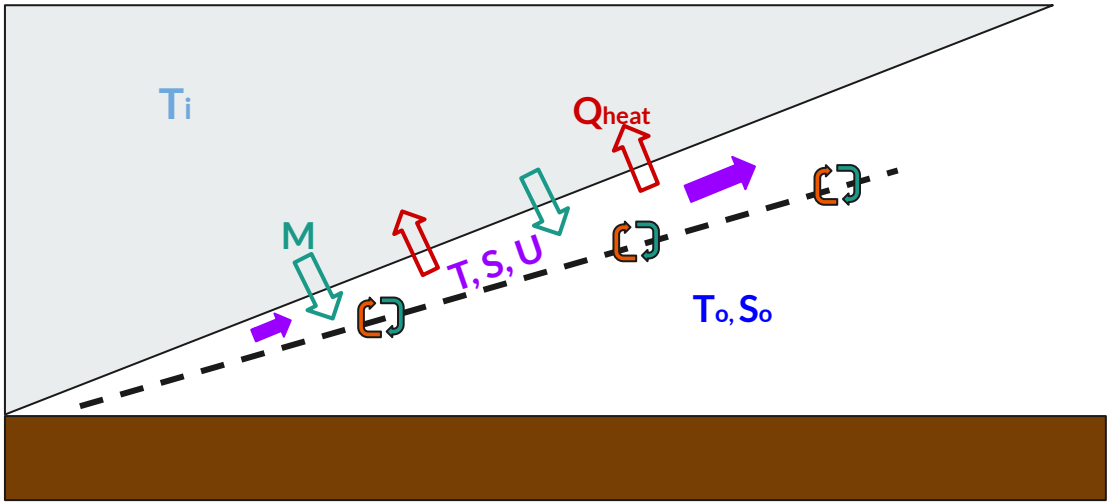
MITgcm configuration

Melt parametrization

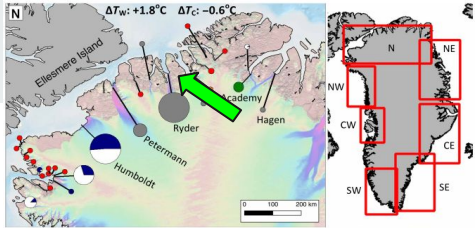
$Q_{heat} \propto U\,(T - T_{freeze})$

$M \propto Q_{heat}$ / (Latent heat)

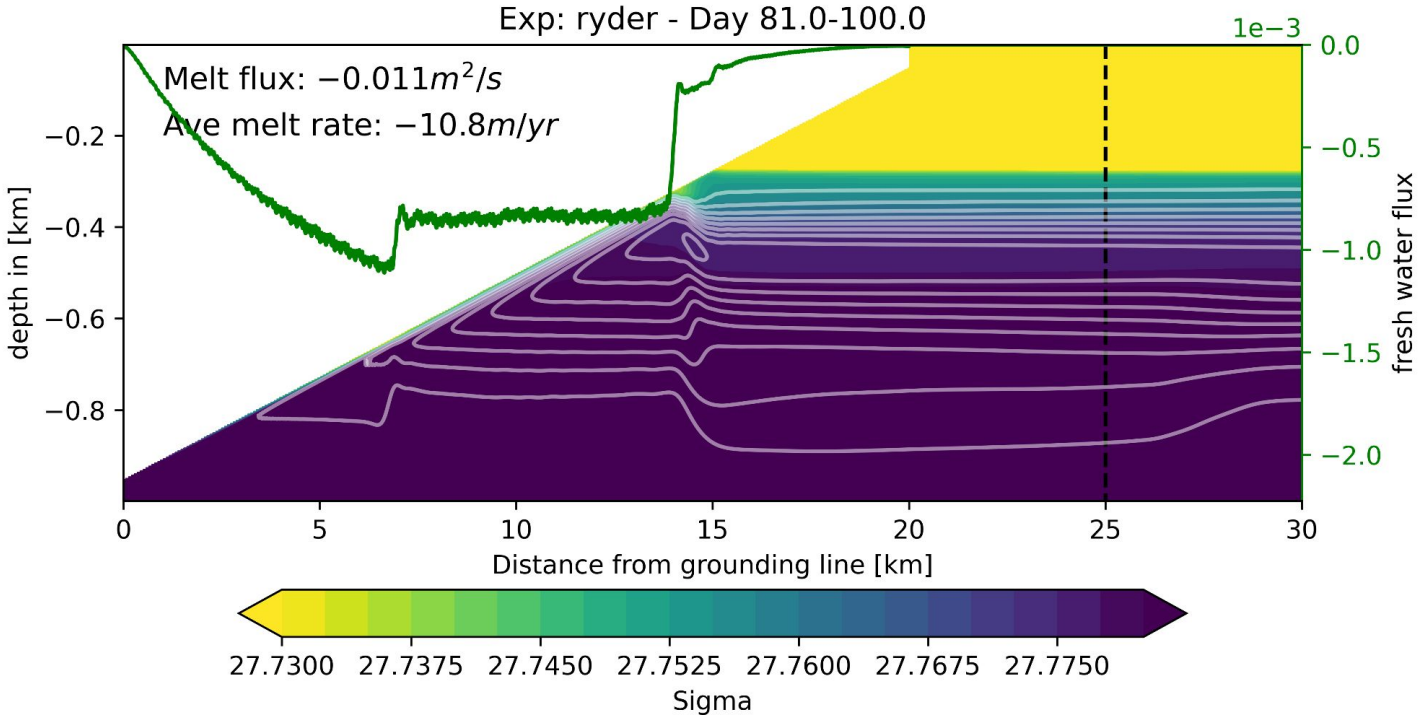
➡ Tendencies for **T** and **S**



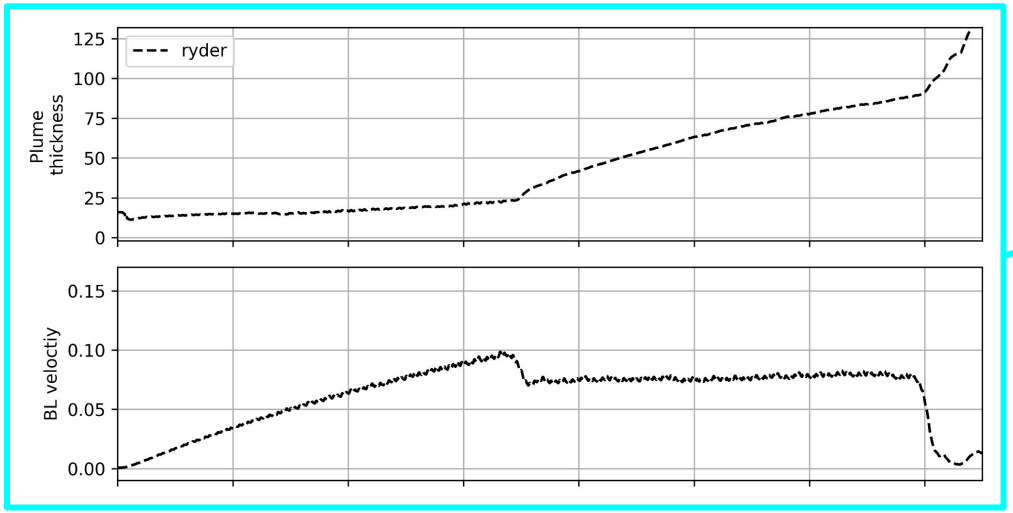
Plume, Ambient Ocean, Ice, Melt, Heat Flux

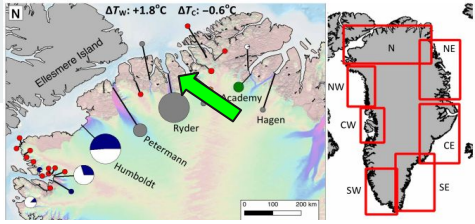


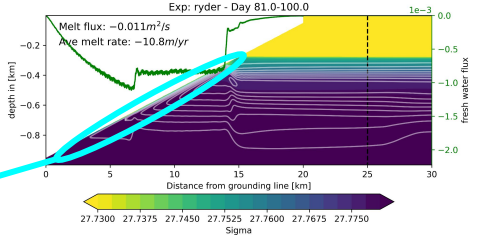
Ryder Glacier Model



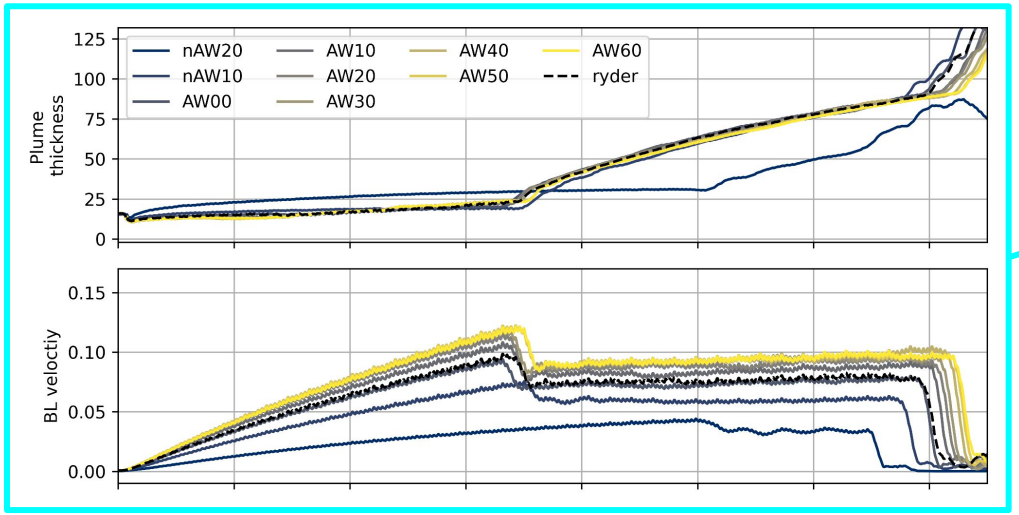
Ryder Glacier Model

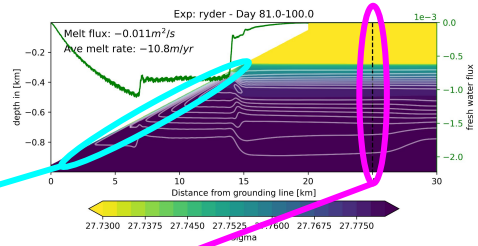


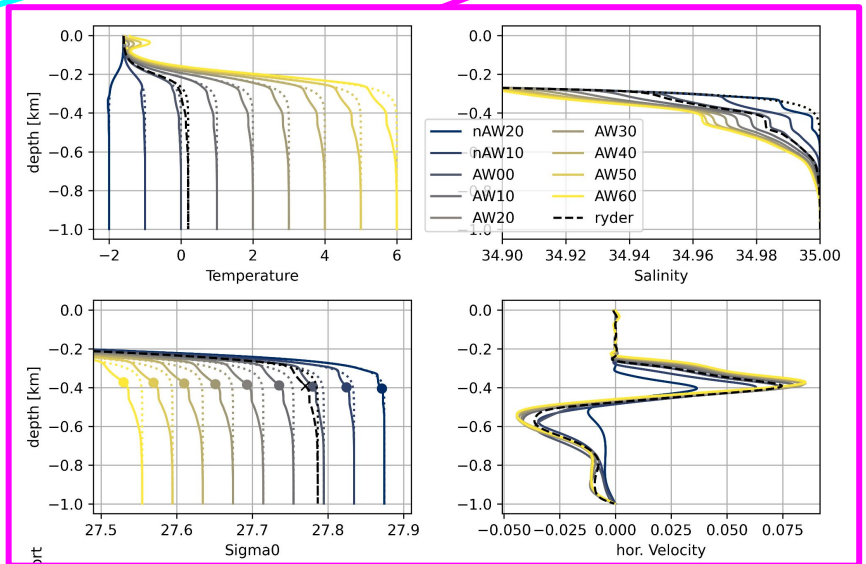




Sensitivity - AW Temp







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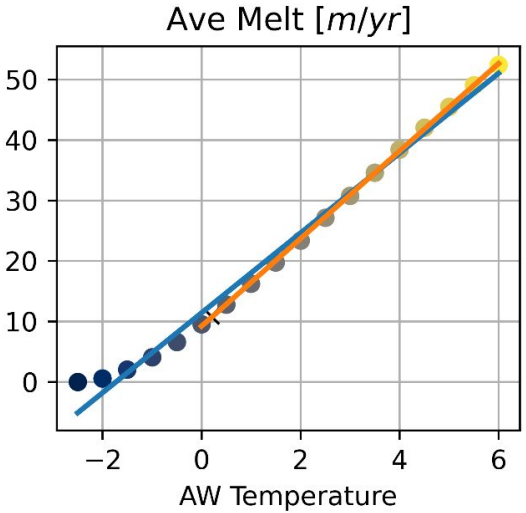
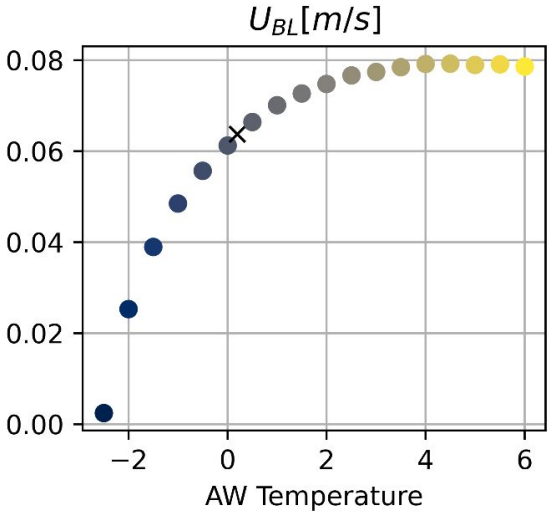
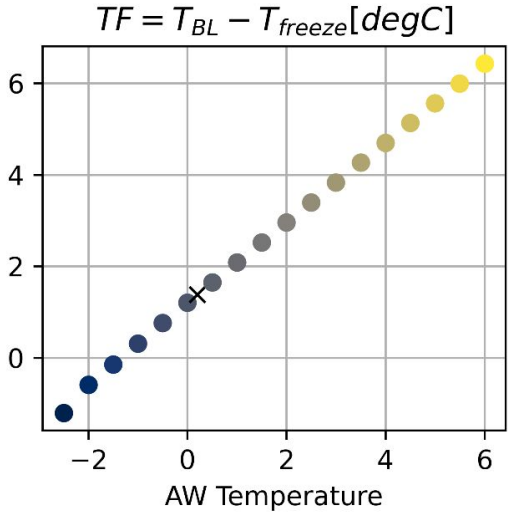
Sensitivity to AW Temperature

$$\text{Melt} \propto U_{BL}\,(T_{BL} - T_{freeze})$$







dM/dT = 6.6 m/yr/K
dM/dT = 7.2 m/yr/K

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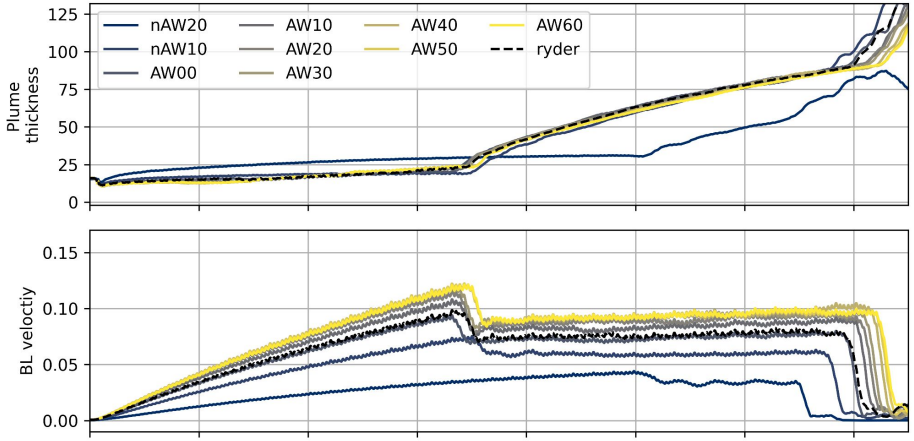
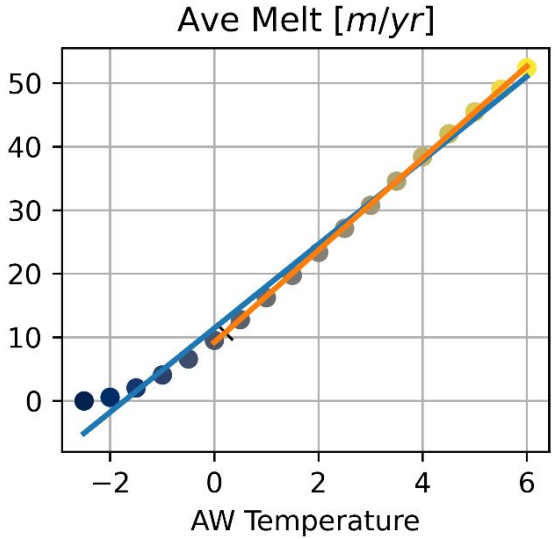
Summary

Two plume regimes:

1. acceleration with constant thickness
2. thickening with constant speed





Melt dependency on AW depends on T_AW:

1. non linear for colder ambient water (Antarctic)
2. linear for warmer ambient water (Greenland)

dM/dT = 7.2 m/yr/K

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Sensitivity - SGD