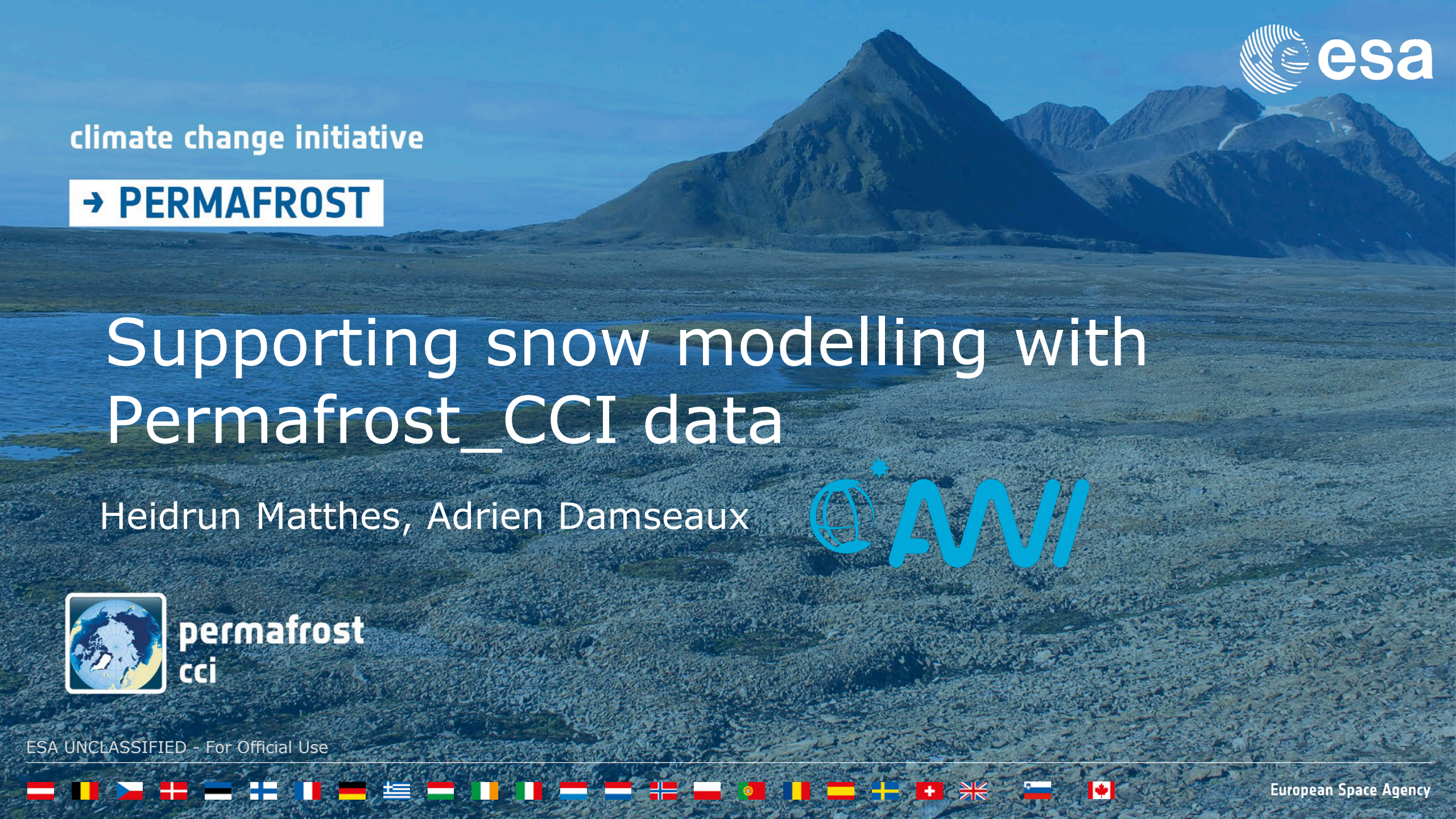
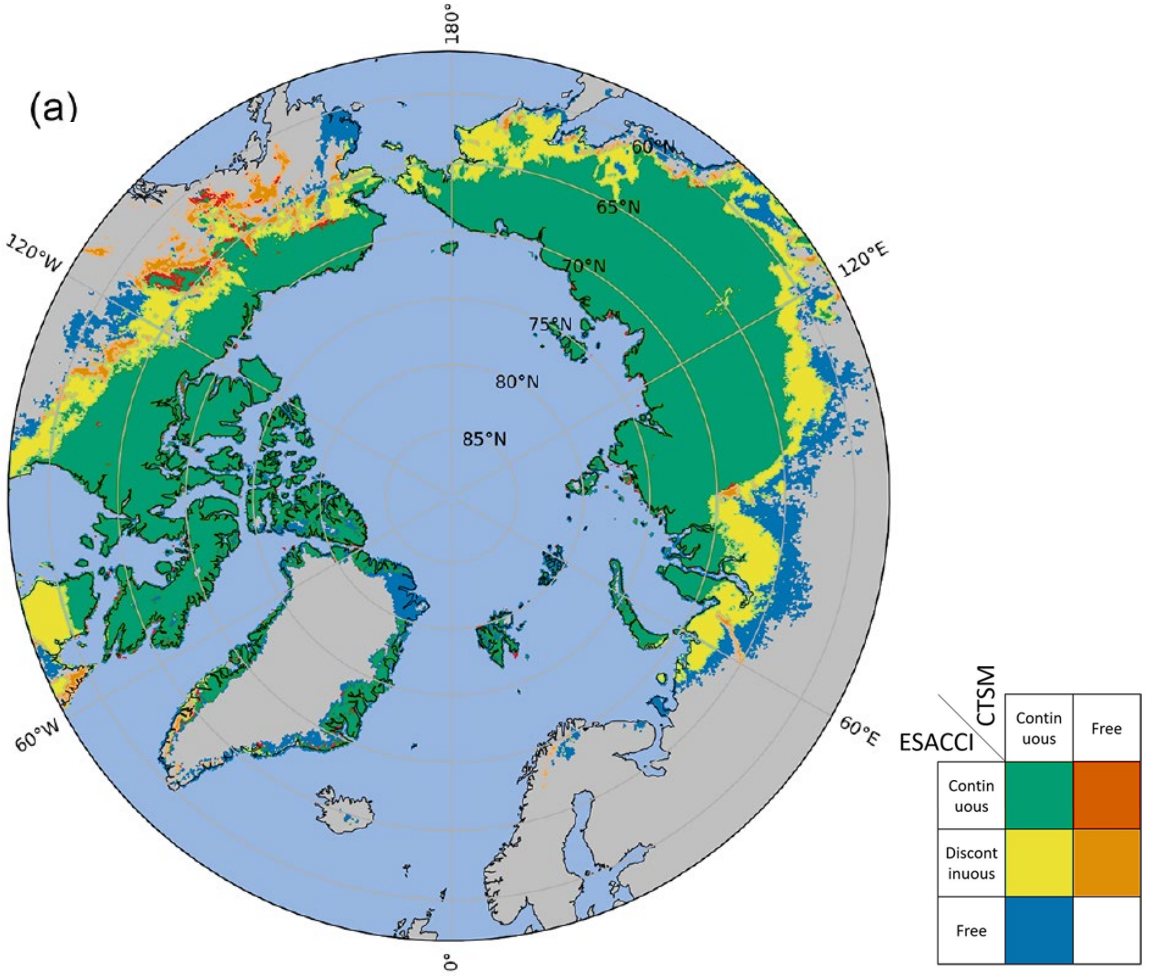

esa
climate change initiative
→ PERMAFROST
Supporting snow modelling with Permafrost_CCI data
Heidrun Matthes, Adrien Damseaux
AWI
permafrost cci
ESA UNCLASSIFIED - For Official Use
European Space Agency

Motivation

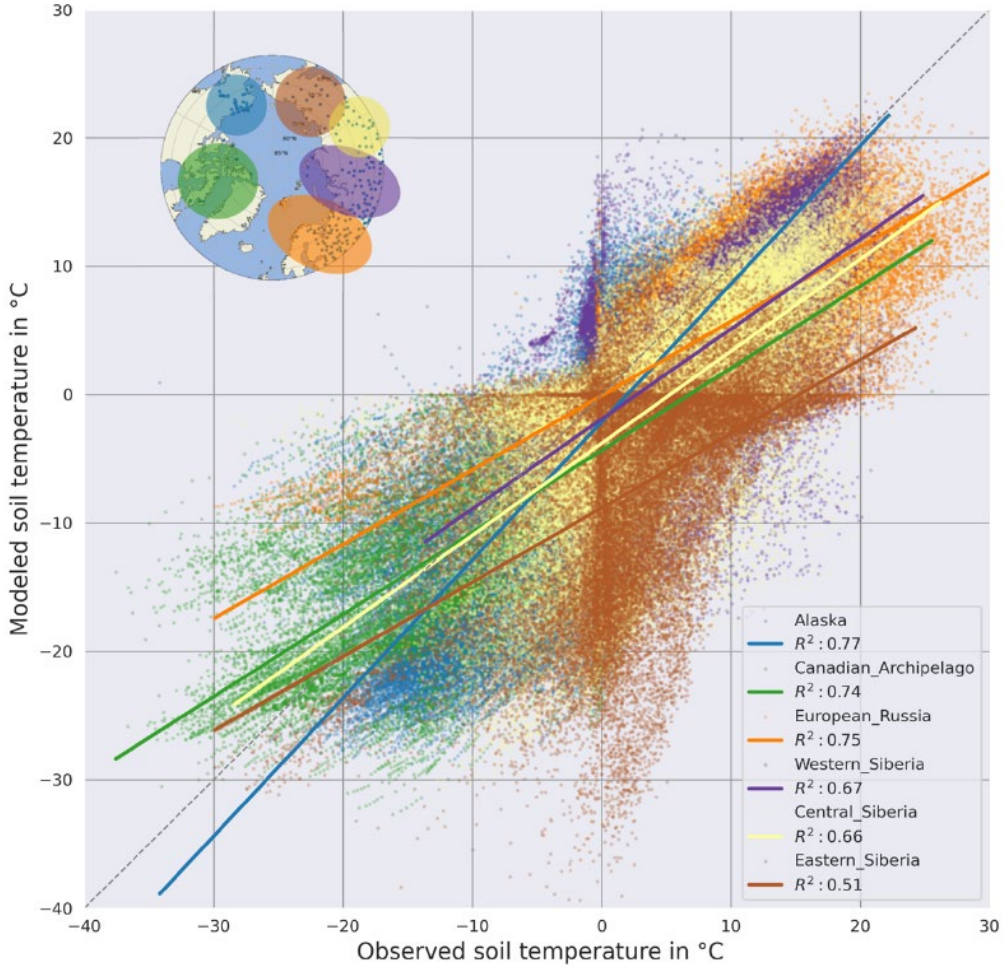
- heat transfer between atmosphere and soil in the snow season is determined by snow pack structure and snow thermal conductivity
- in our land surface model CLM5, snow thermal conductivity is parameterized as a function of snow density
- we run the model on a pan-Arctic domain with a ~12km horizontal resolution, for evaluation purposes forced with ERA5 from 1980-2020
- we are interested in the representation of permafrost in the model
- we use in situ station data for evaluation of soil temperatures (295 stations around the Arctic)

Performance of Standard Model Simulation

permafrost extent



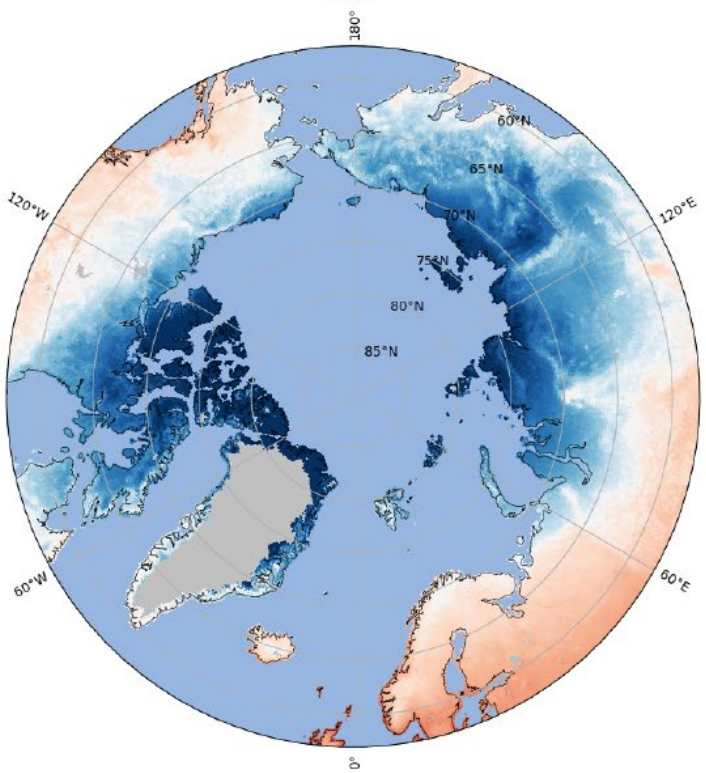
soil temperature



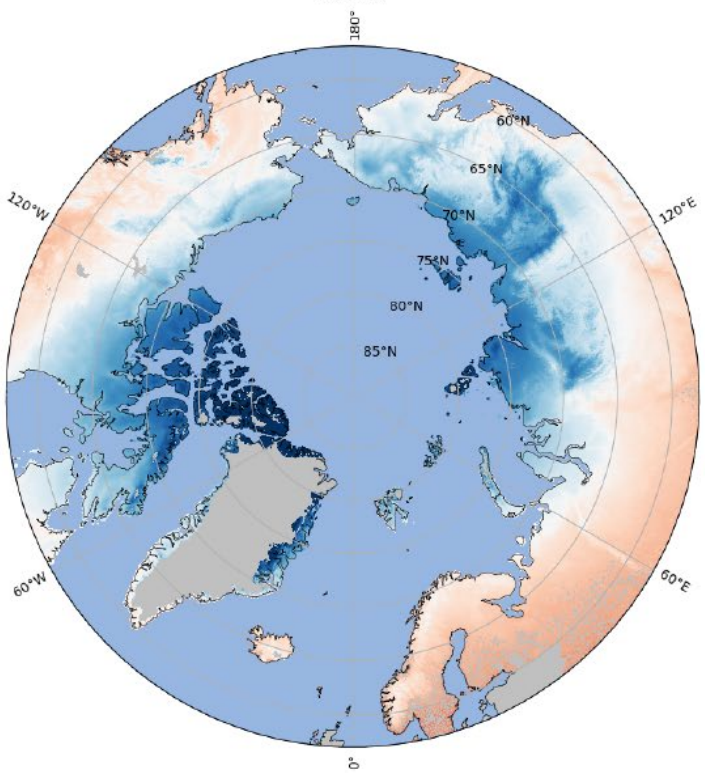
Performance of Standard Model Simulation

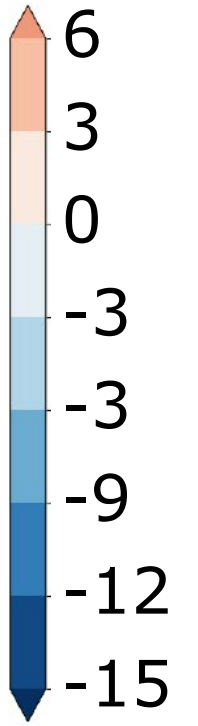
mean annual ground temperature (1m)

CLM5

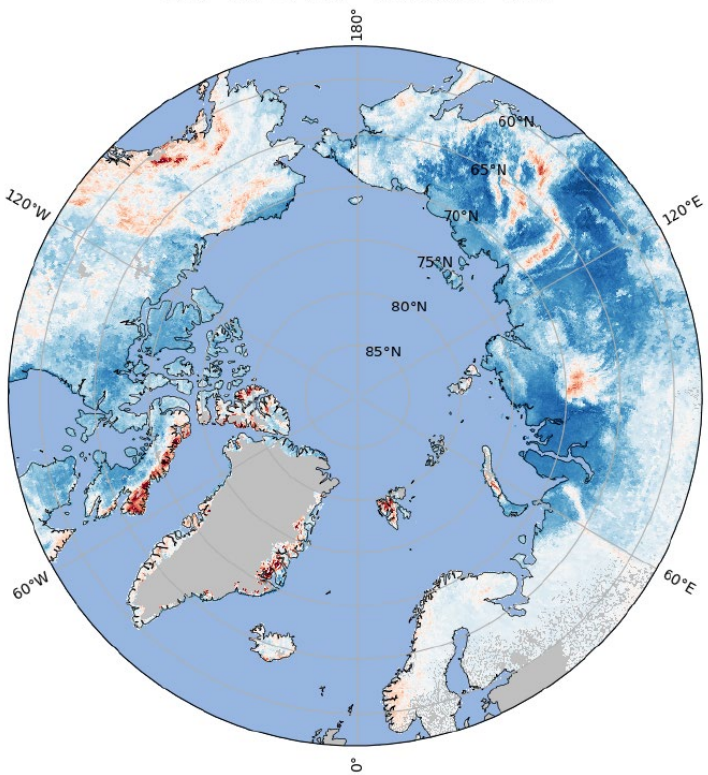


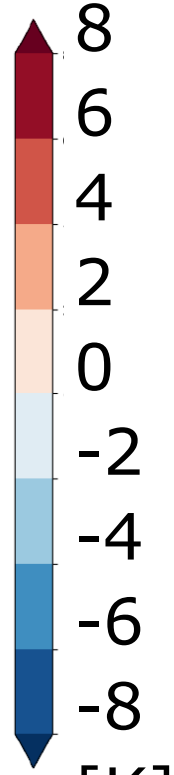
ESA-CCI





CLM5 minus ESA-CCI

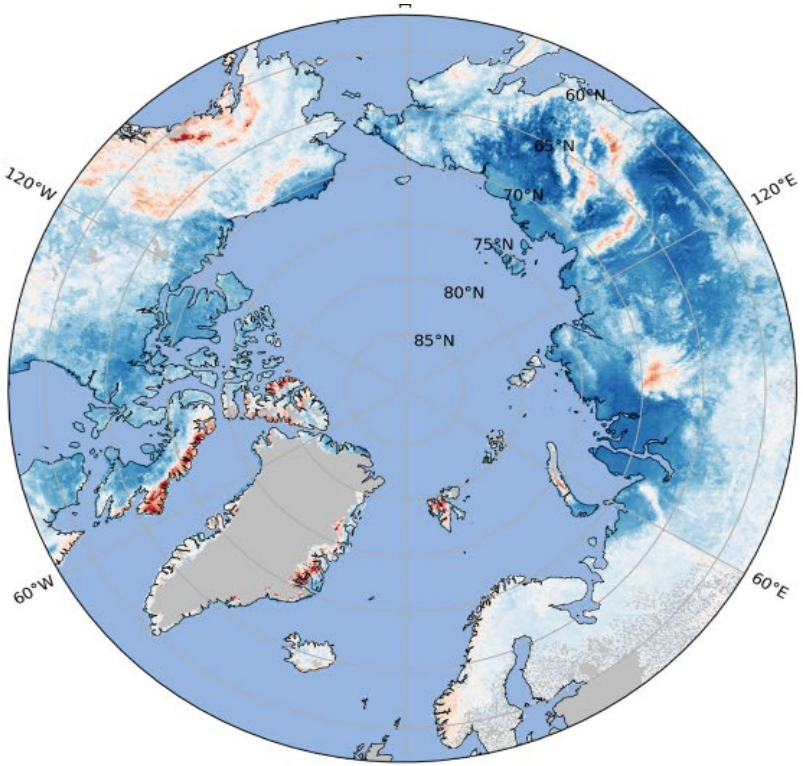




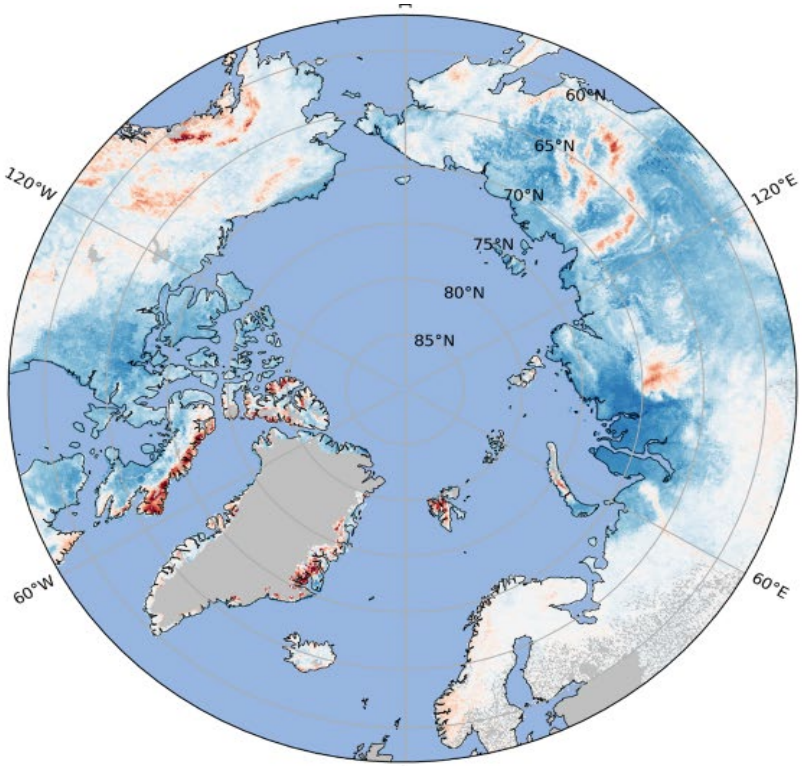
Change of snow thermal conductivity: Jordan vs Sturm

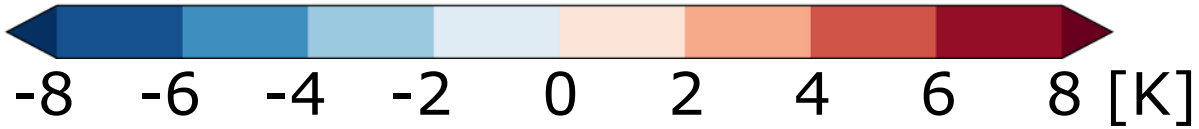
mean annual ground temperature (1m)

CLM5jordan - ESA-CCI

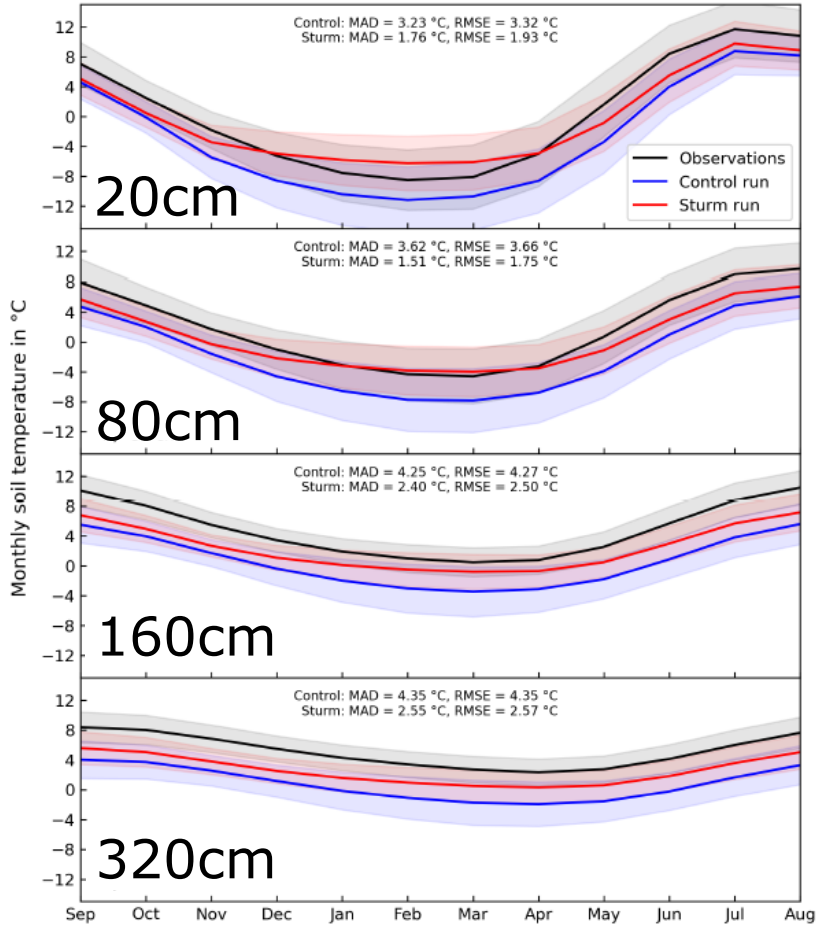


CLM5sturm - ESA-CCI



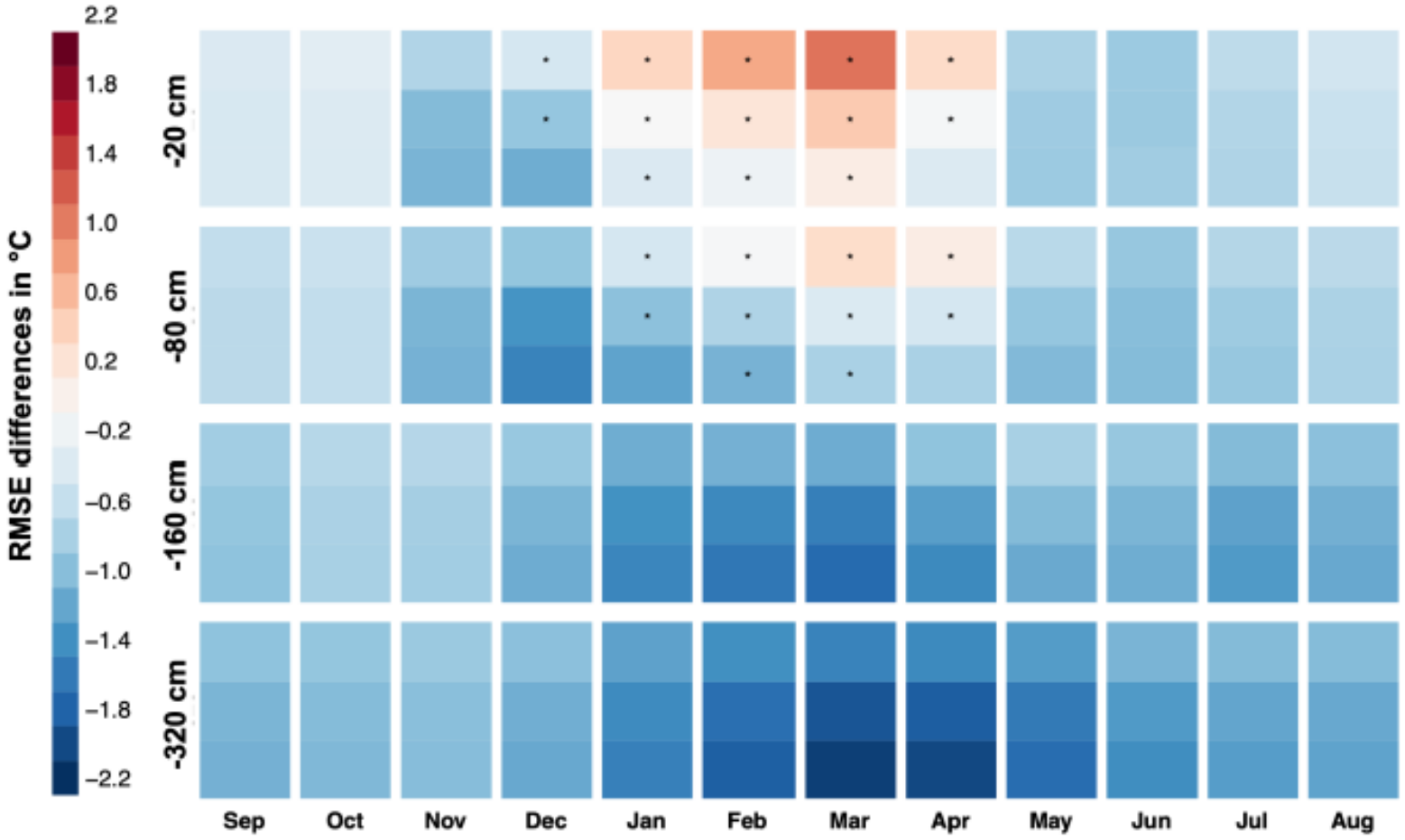


seasonal cycle



Change of snow thermal conductivity: Jordan vs Sturm

– can we asses if this is an effect of error compensation?



- Sturm parameterization regularly yields lower RMSE values compared to Jordan (blue cells)
- as snow density is reduced, the relative benefit of Sturm over Jordan diminishes, but does not disappear

scaling factor
0.7
0.9
1

Damseaux et al., 2025, https://doi.org/10.5194/tc-19-1539-2025