

Arctic climate system modeling: on the role of systematic errors

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Seasonal to Multi-Decadal
Predictability of Polar Climate
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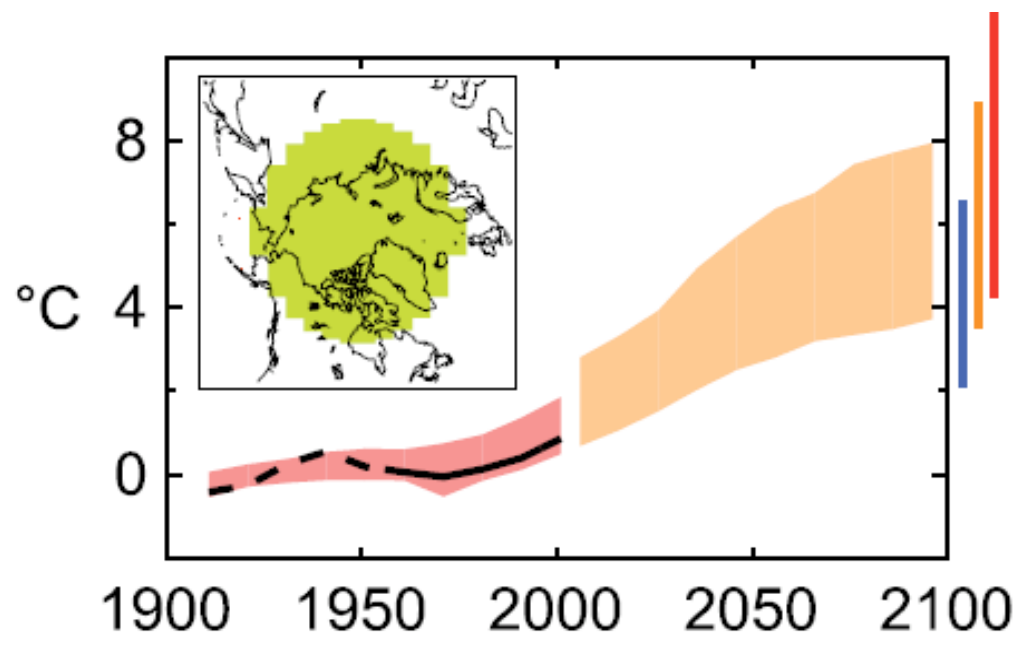
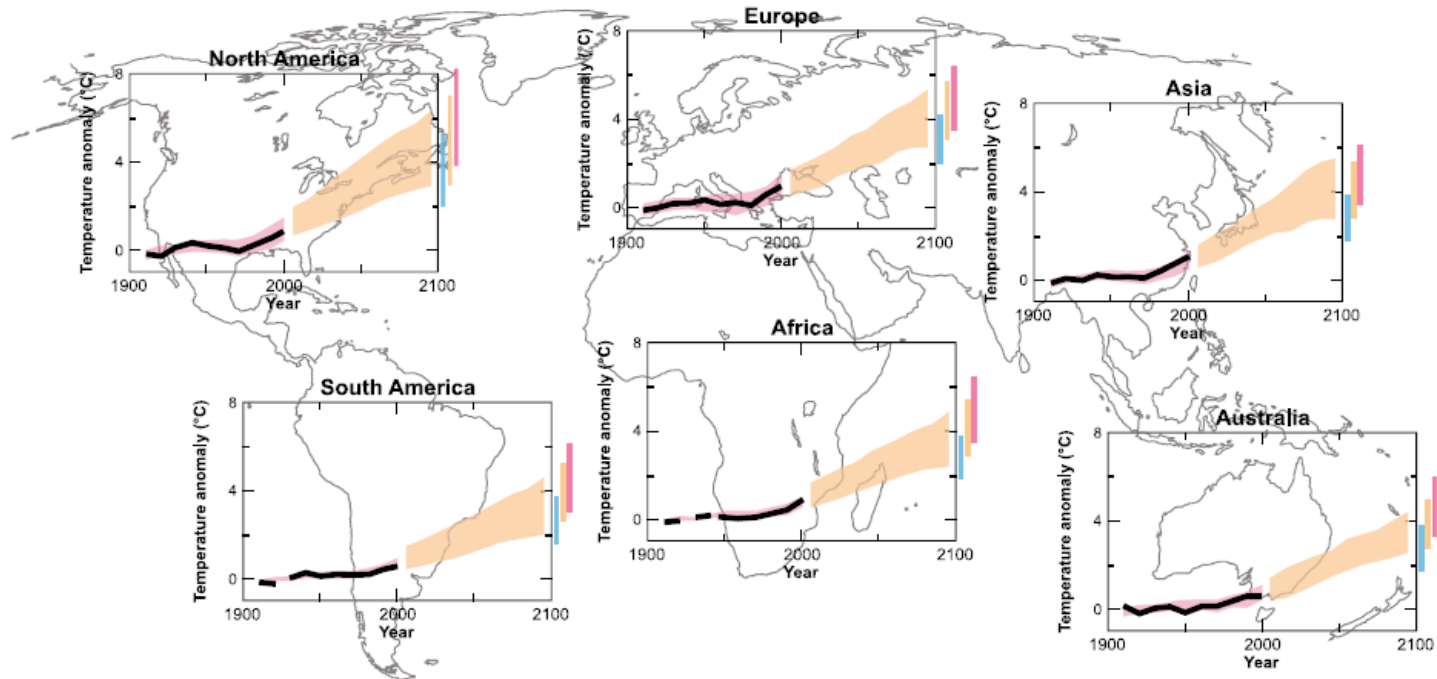
R. Döscher, *SMHI*; H. Drange, *Bjerknes Centre*; T. Jóhannesson, *IMO*;
S. Rysgaard, *Inst. Nat. Res.*

V. Romanovsky, J. Walsh, *UAF*; K. Dethloff, A. Rinke, *AWI*

Overview

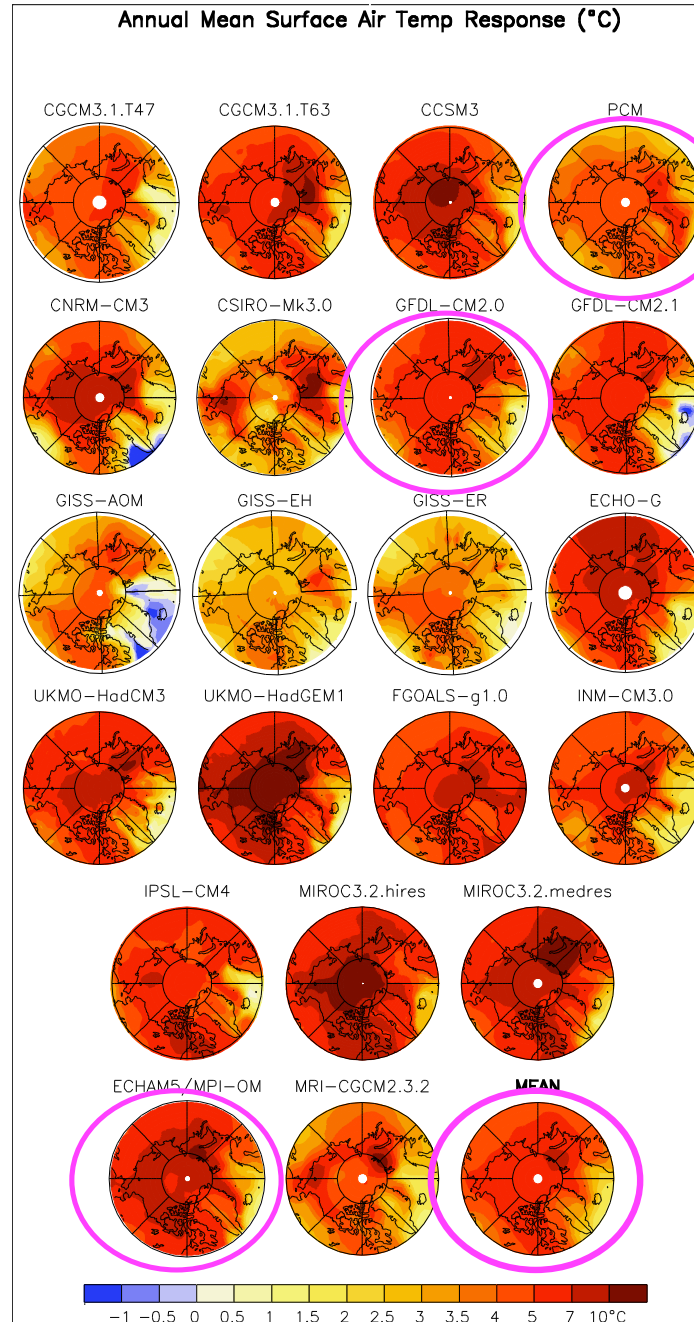
- Some observations from AR4
- Non linearity in 'systematic errors'
- Example(s) of implications
 - Greenland Ice Sheet
 - (Permafrost)
- Conclusions



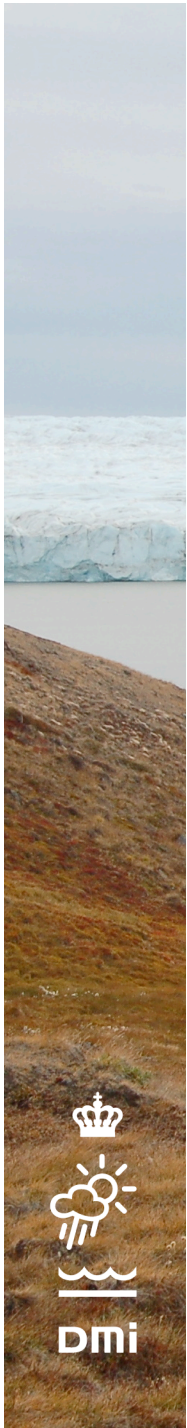


IPCC AR4

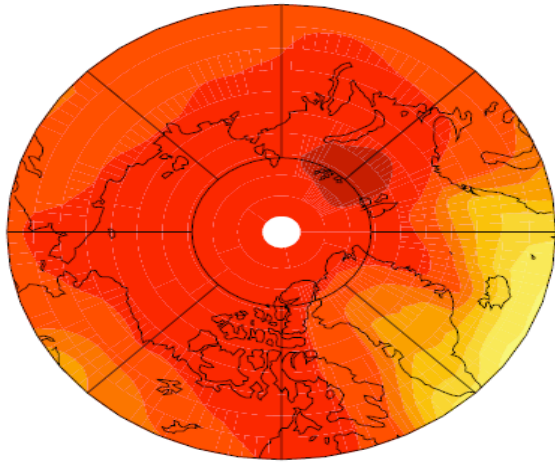
Dmi



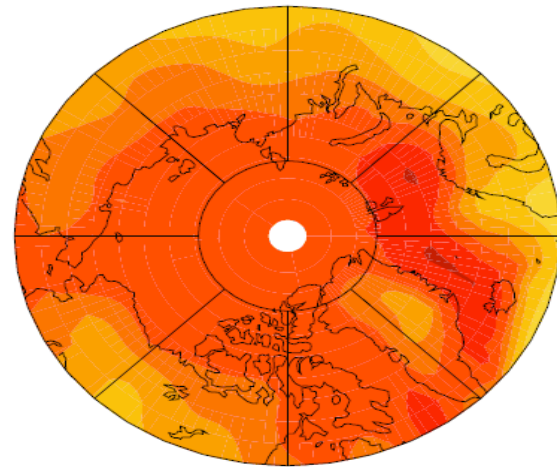
AR4, Ch11 Suppl.



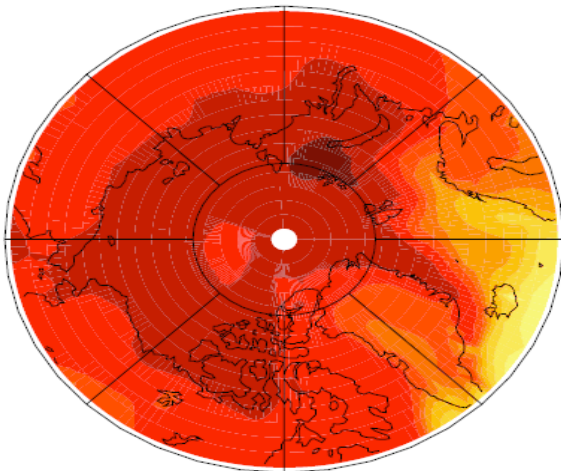
MEAN



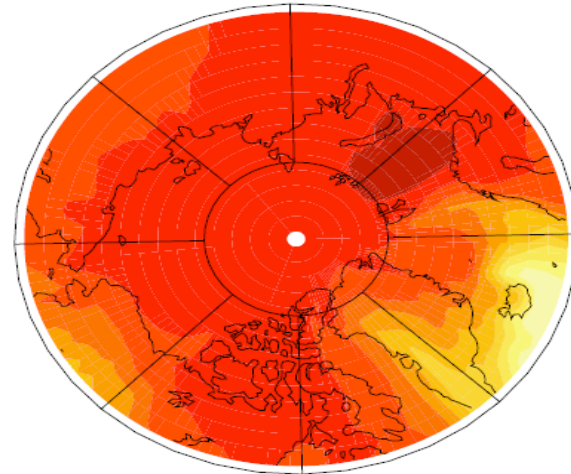
PCM

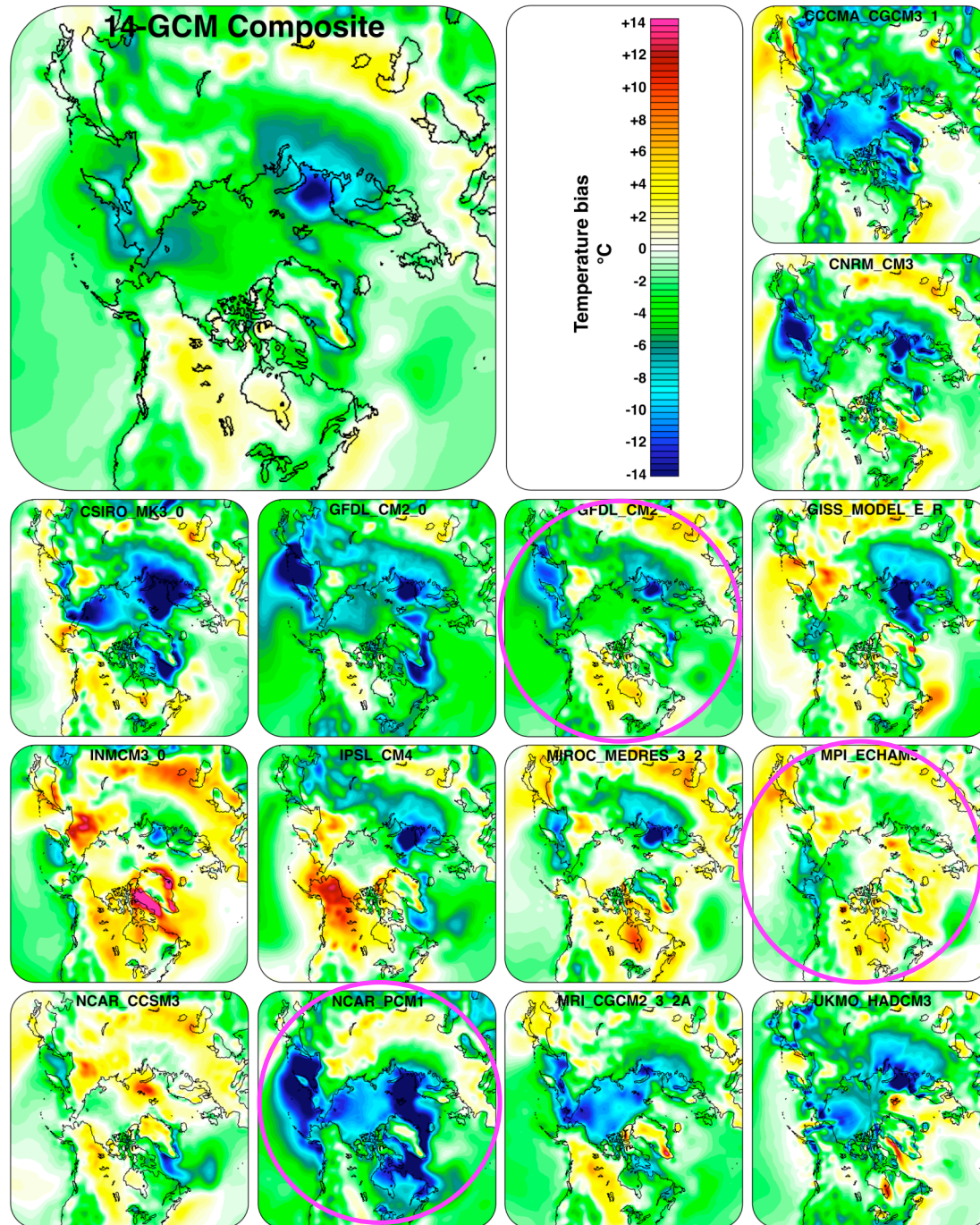


ECHAM5/MPI-OM



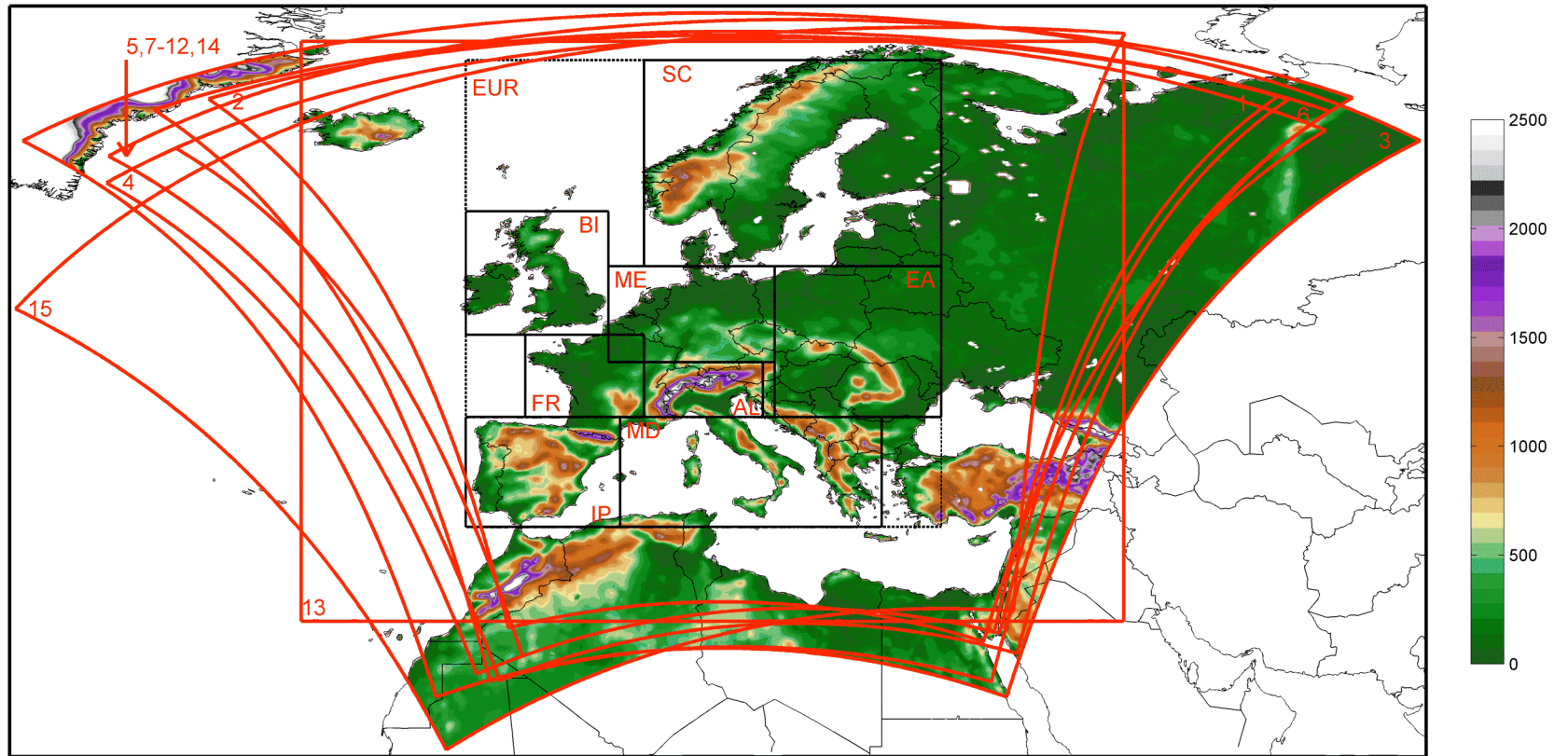
GFDL-CM2.0



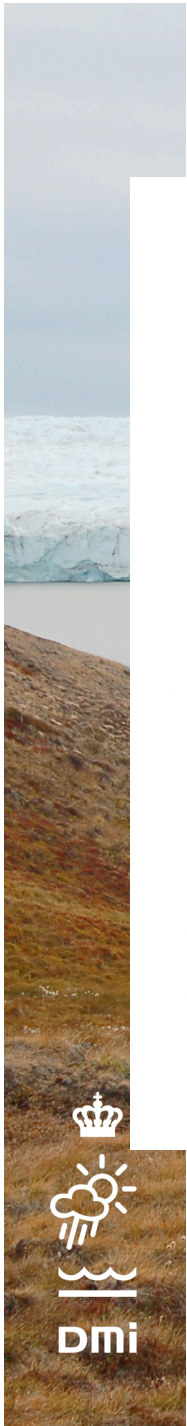


Temperature bias

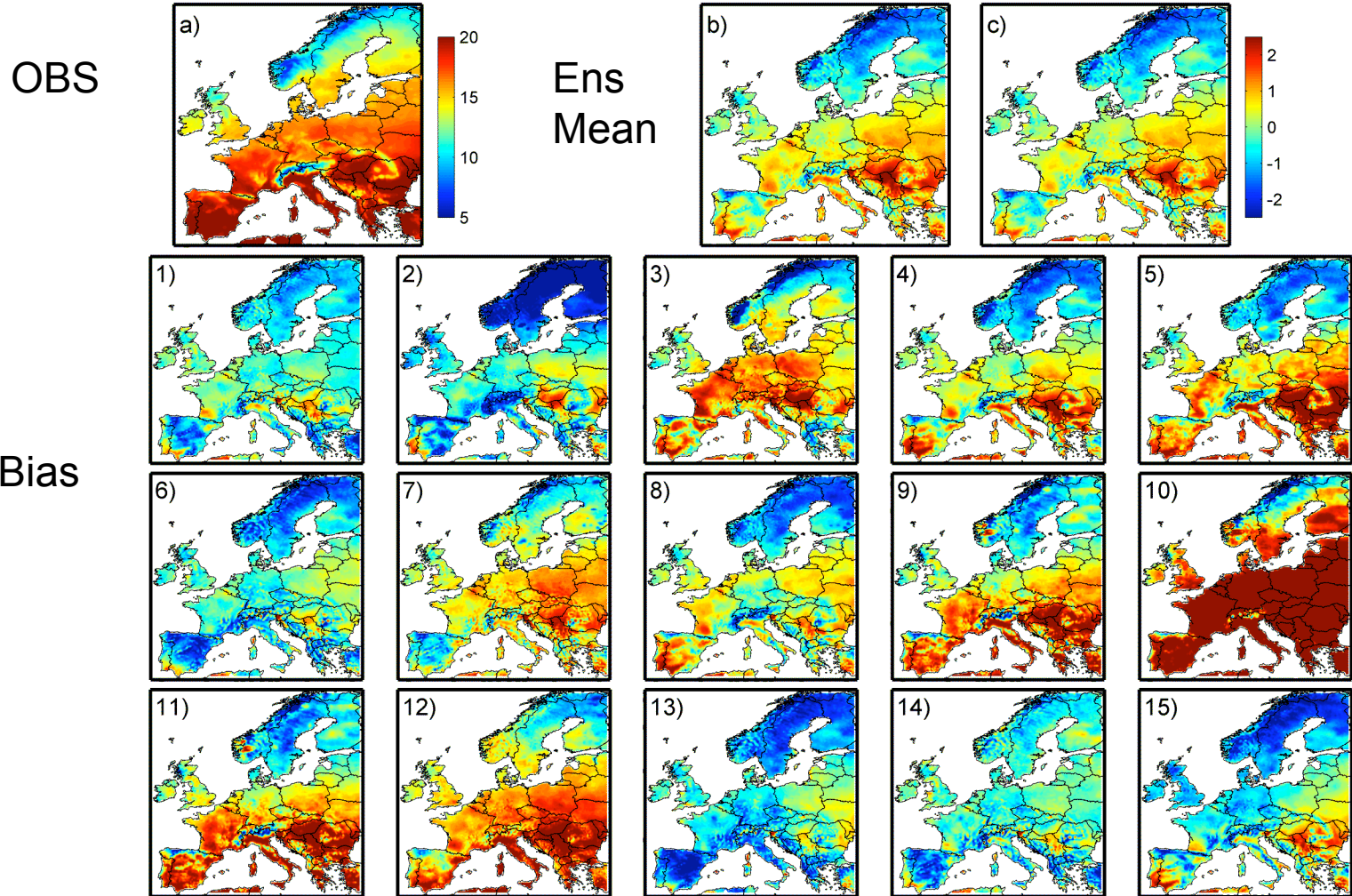
Walsh et al. 2008



Christensen et al. (in press)



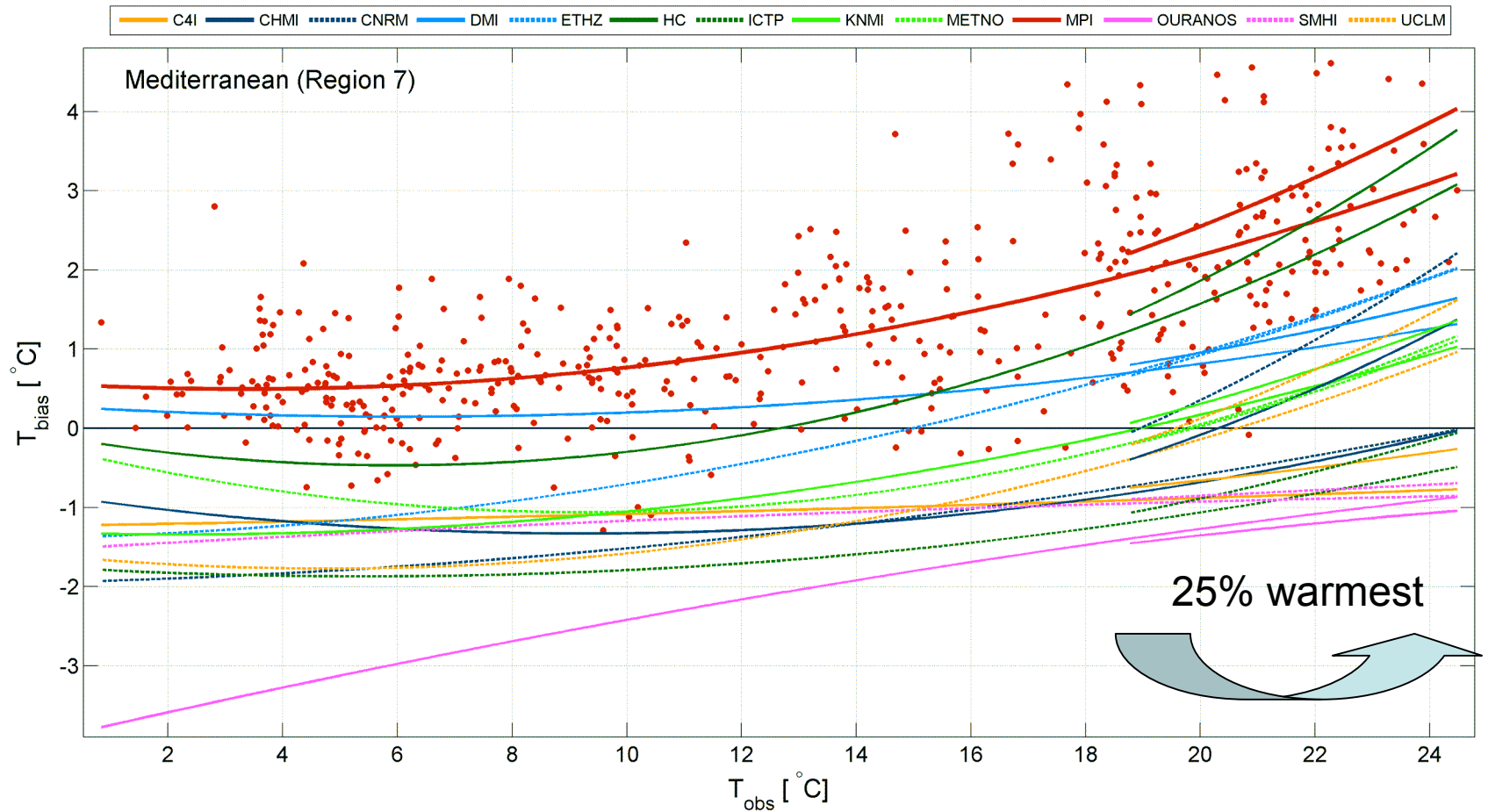
Summer temperatures - ERA40 driven



Christensen et al. (in press)



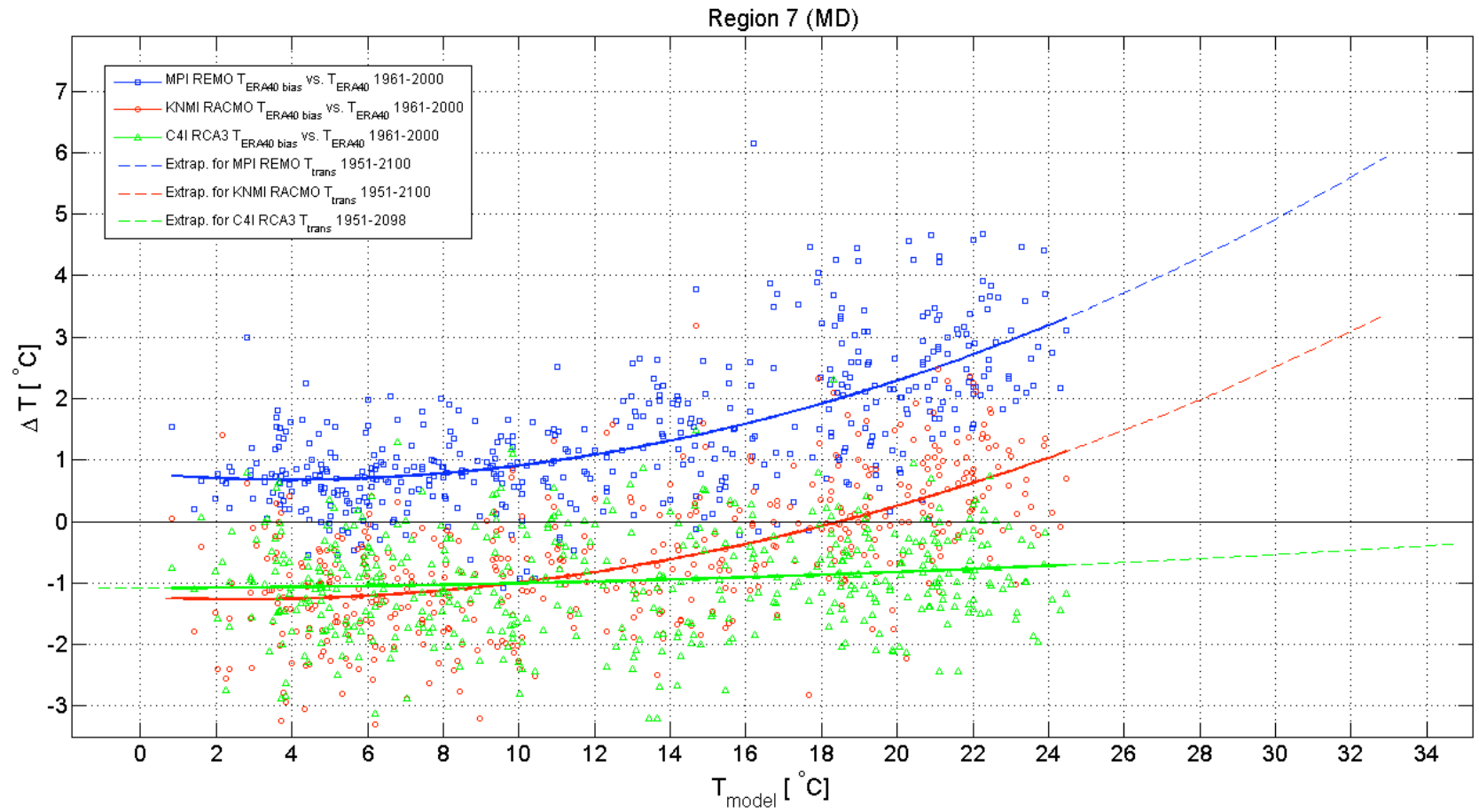
Model bias vs. observations



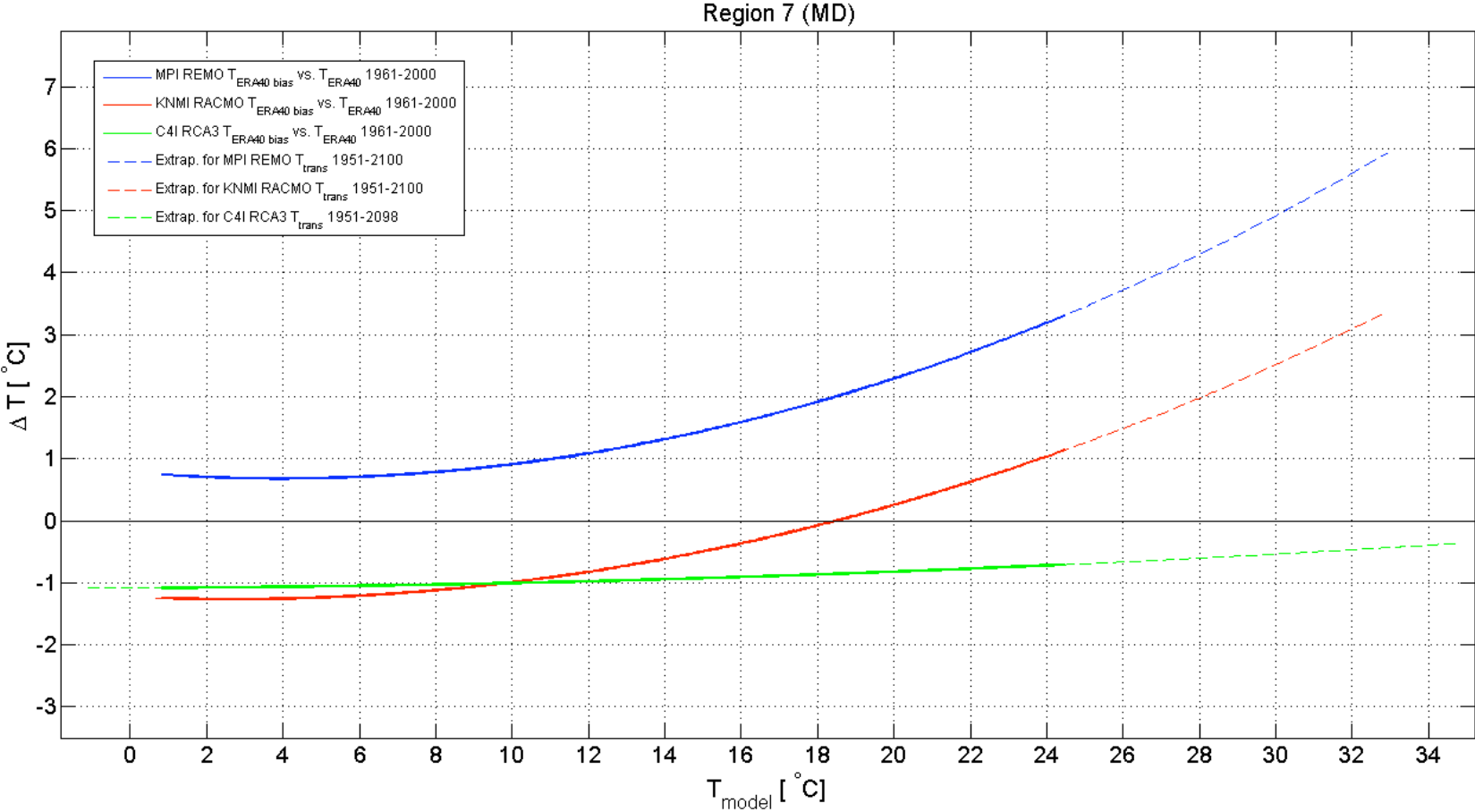
(Christensen *et al.* 2008)



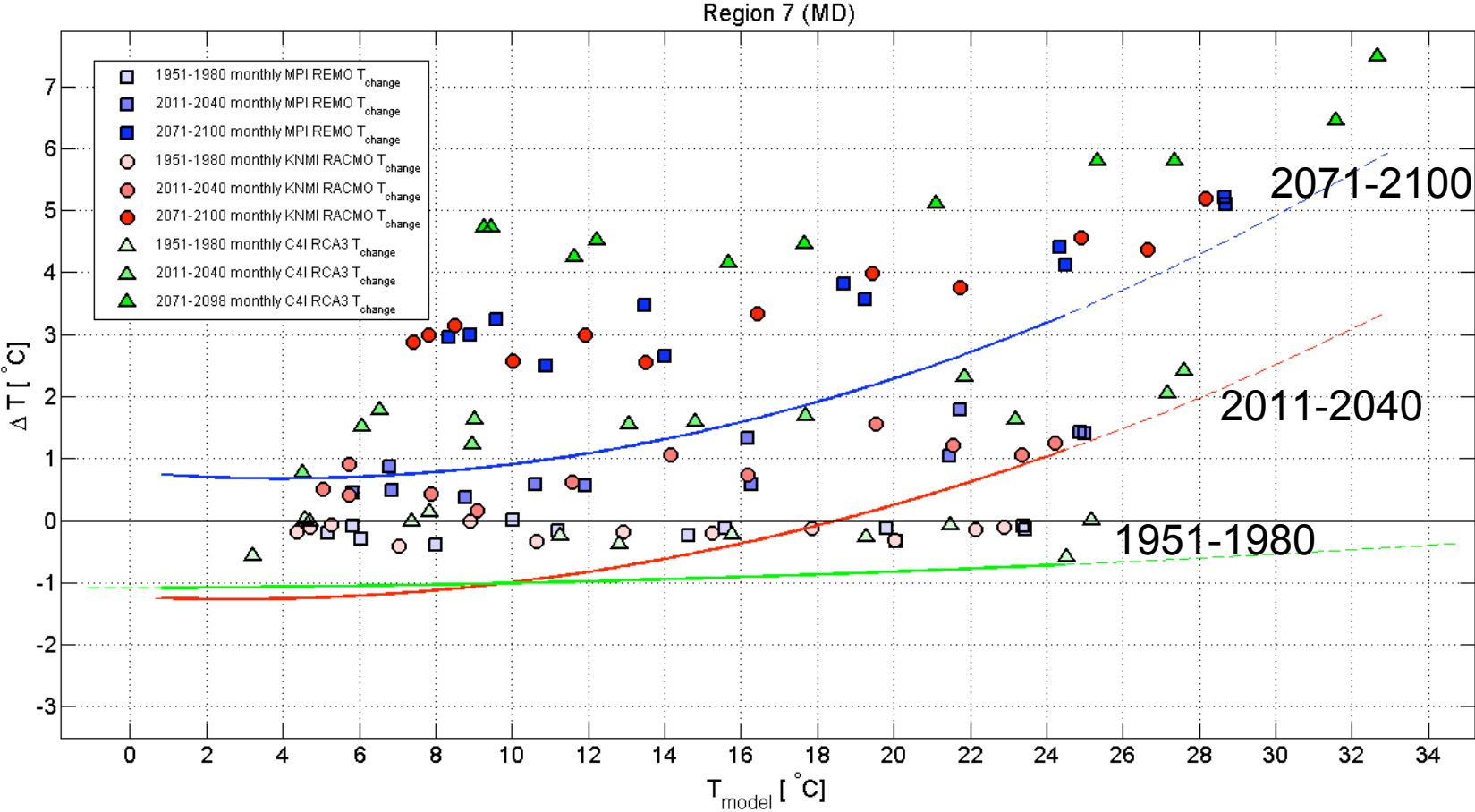
Model bias vs. model values



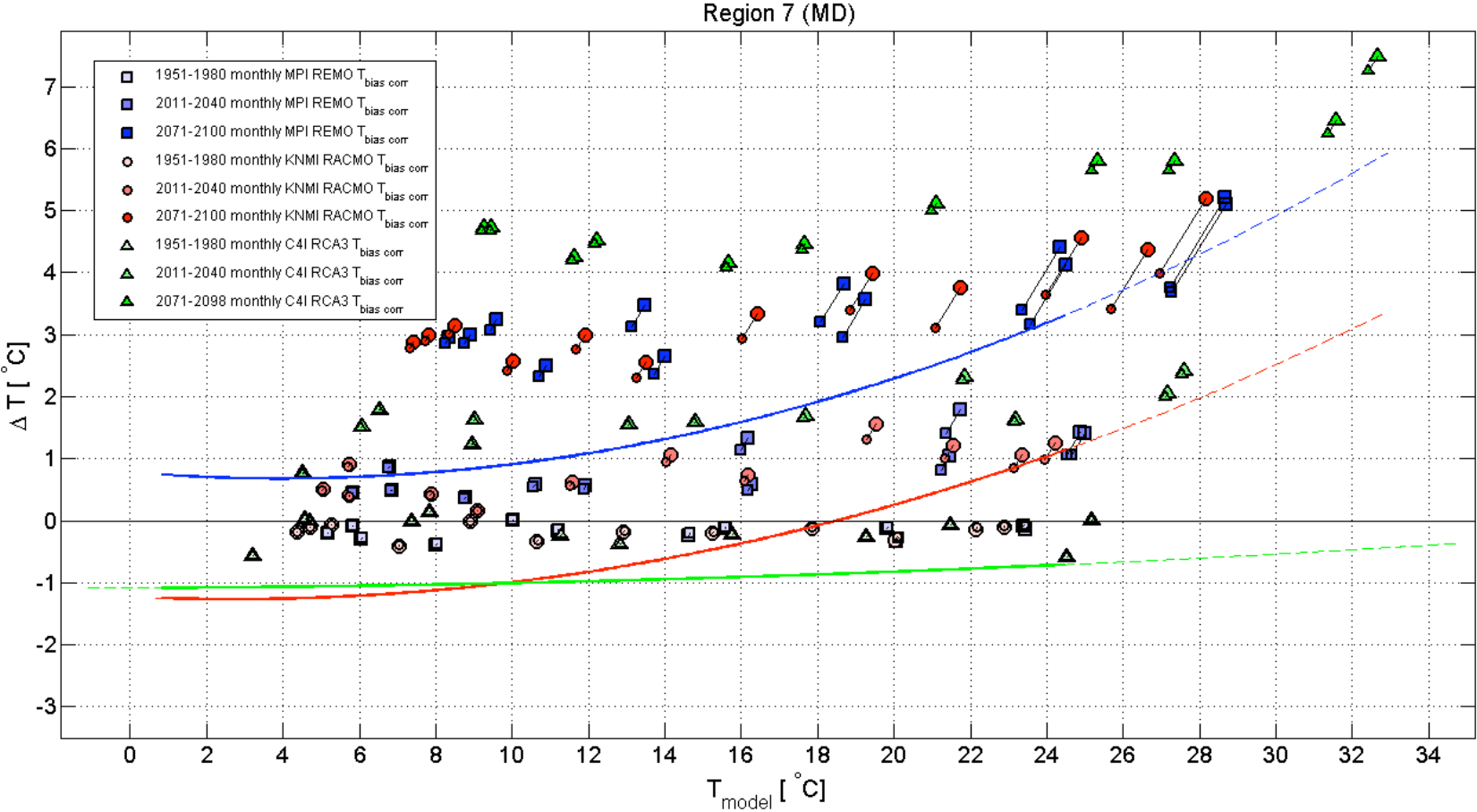
Assessing climate change



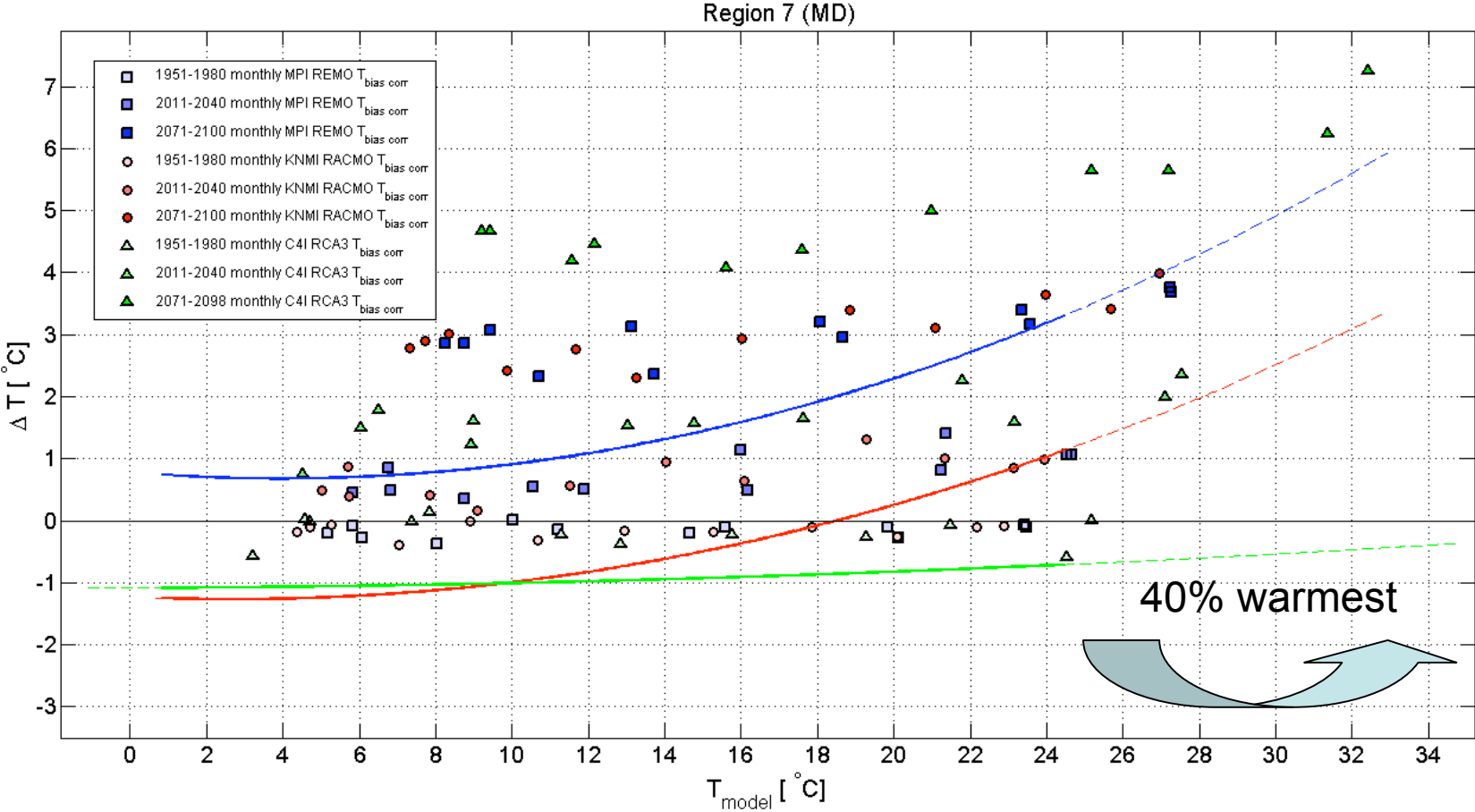
Assessing climate change



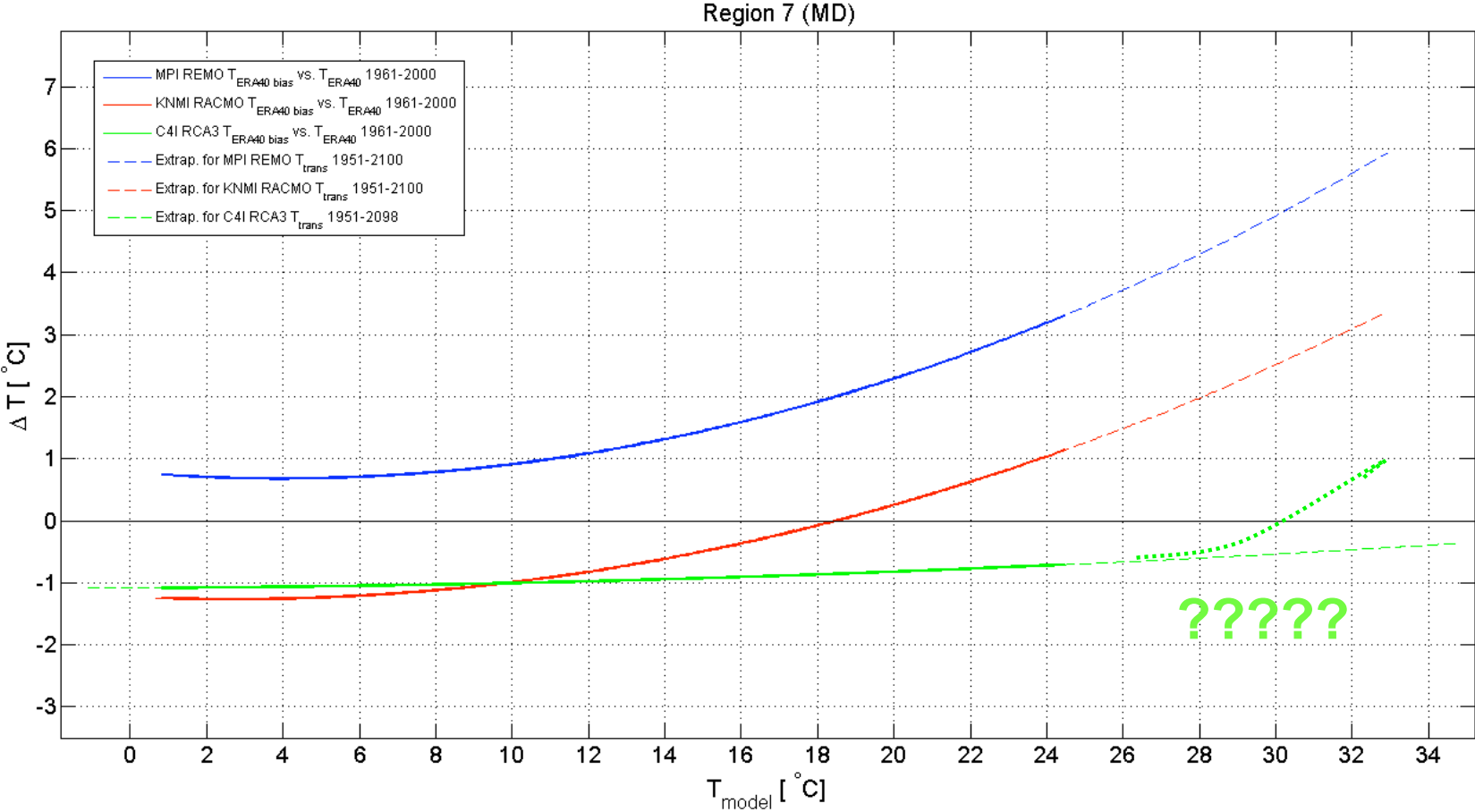
Assessing climate change



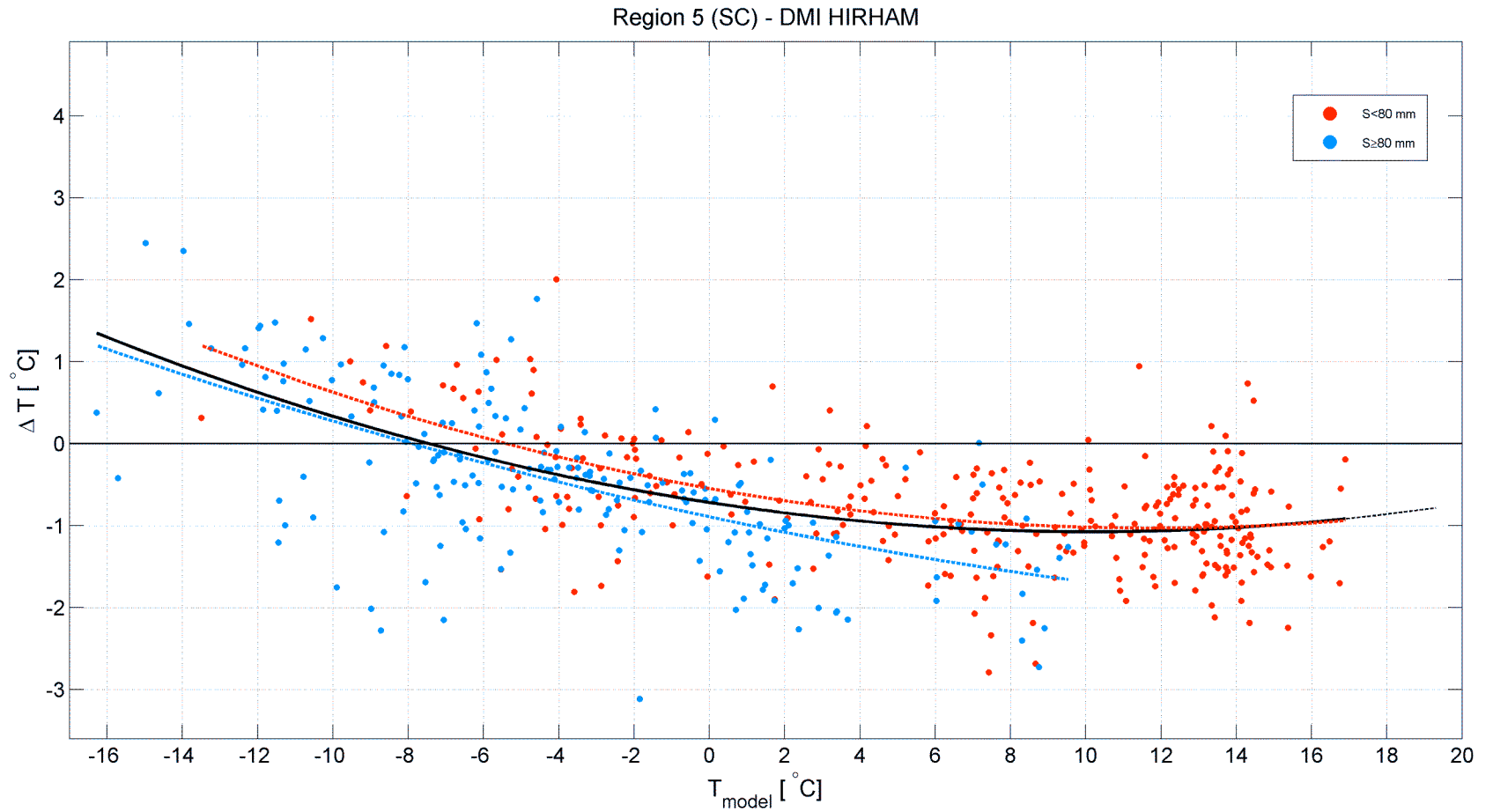
Assessing climate change



Assessing climate change



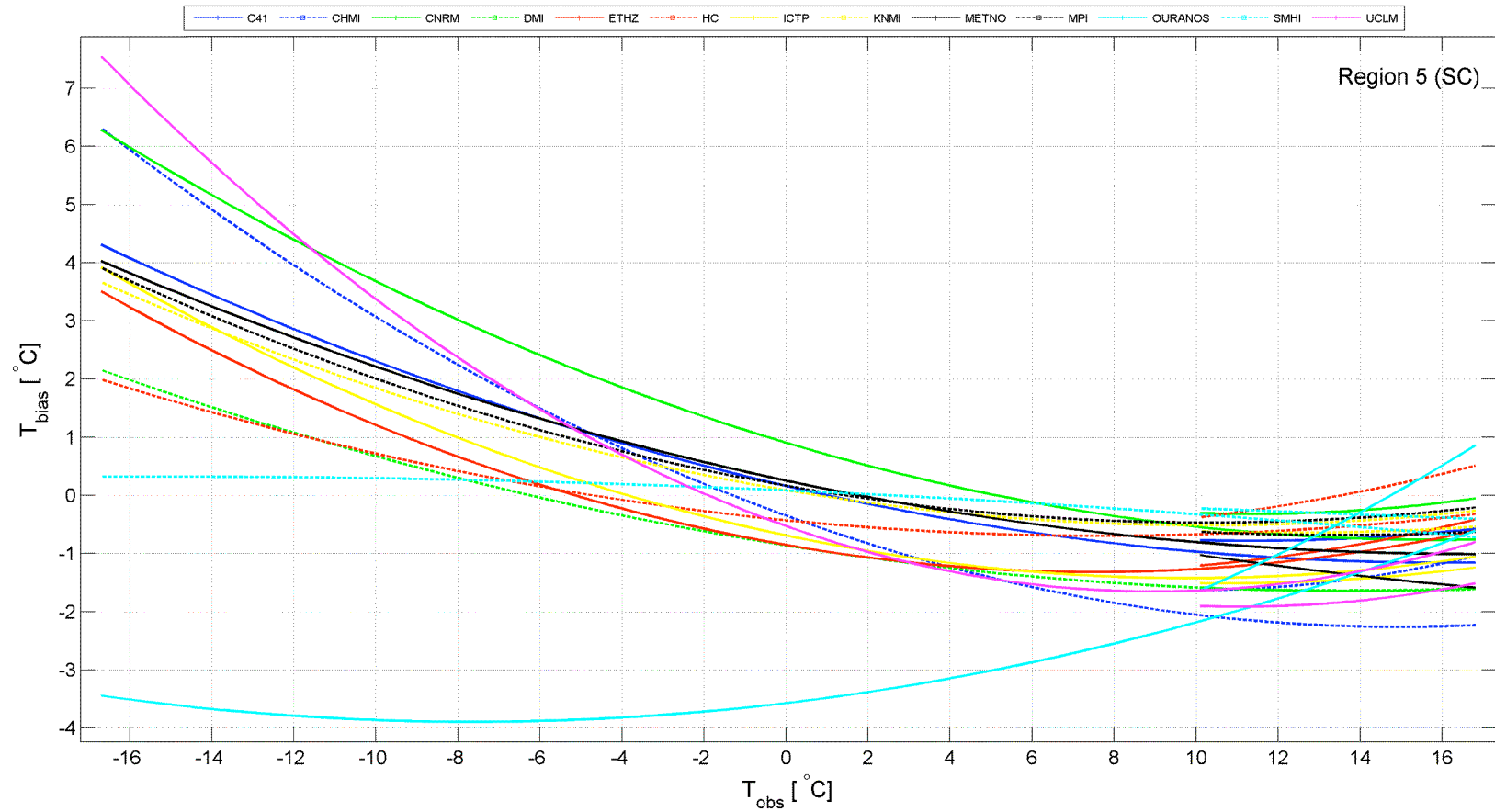
Model bias vs. observations



Boberg et al. (2011)



Model bias vs. observations



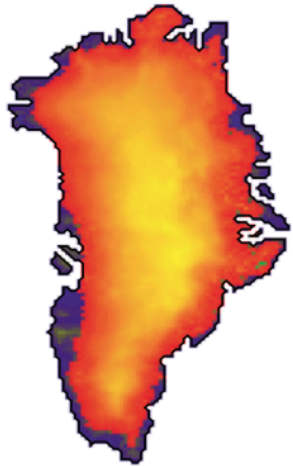
Boberg et al. (2011)



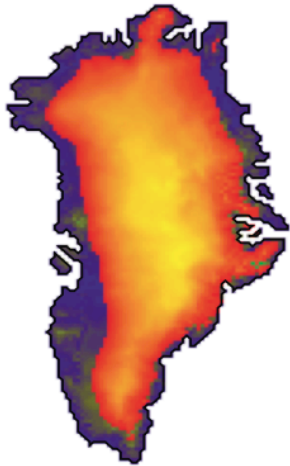
Ice Sheet



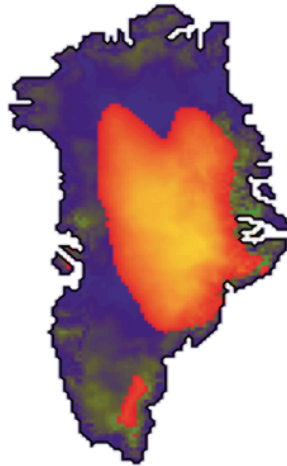
Year 0
Volume 100%



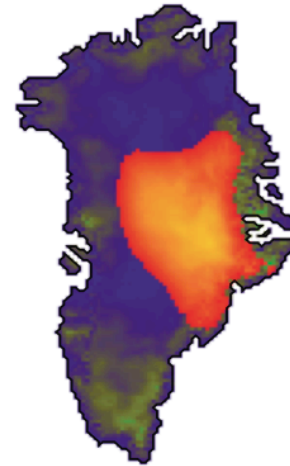
Year 270
Volume 80%



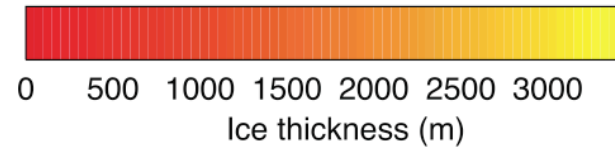
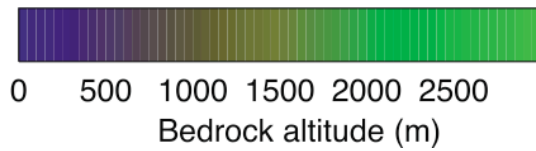
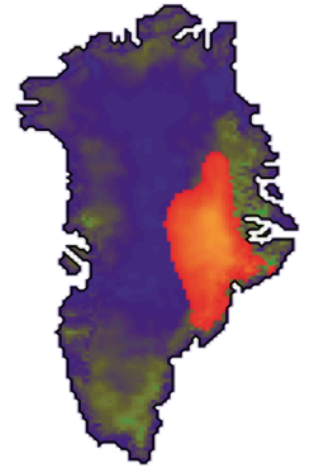
Year 710
Volume 60%



Year 1130
Volume 40%



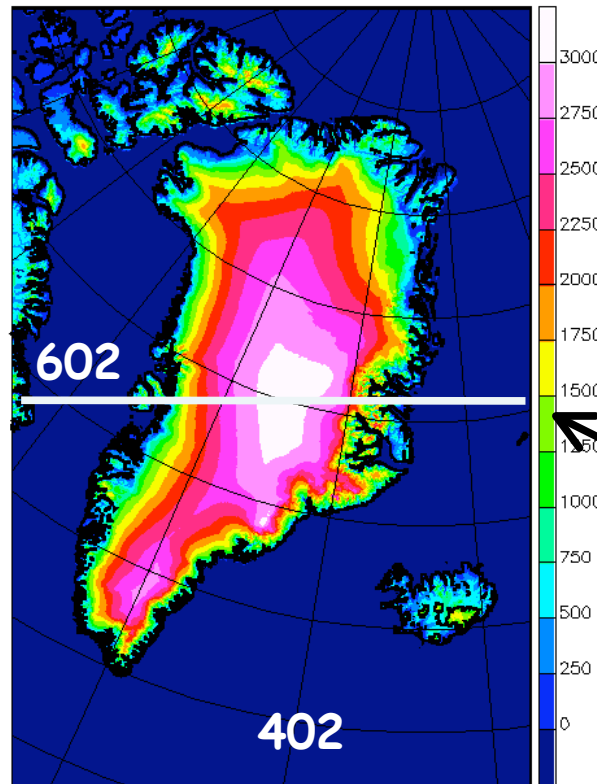
Year 1760
Volume 20%



IPCC, 2007

Resolution matters

0.05 deg or 5.5 km

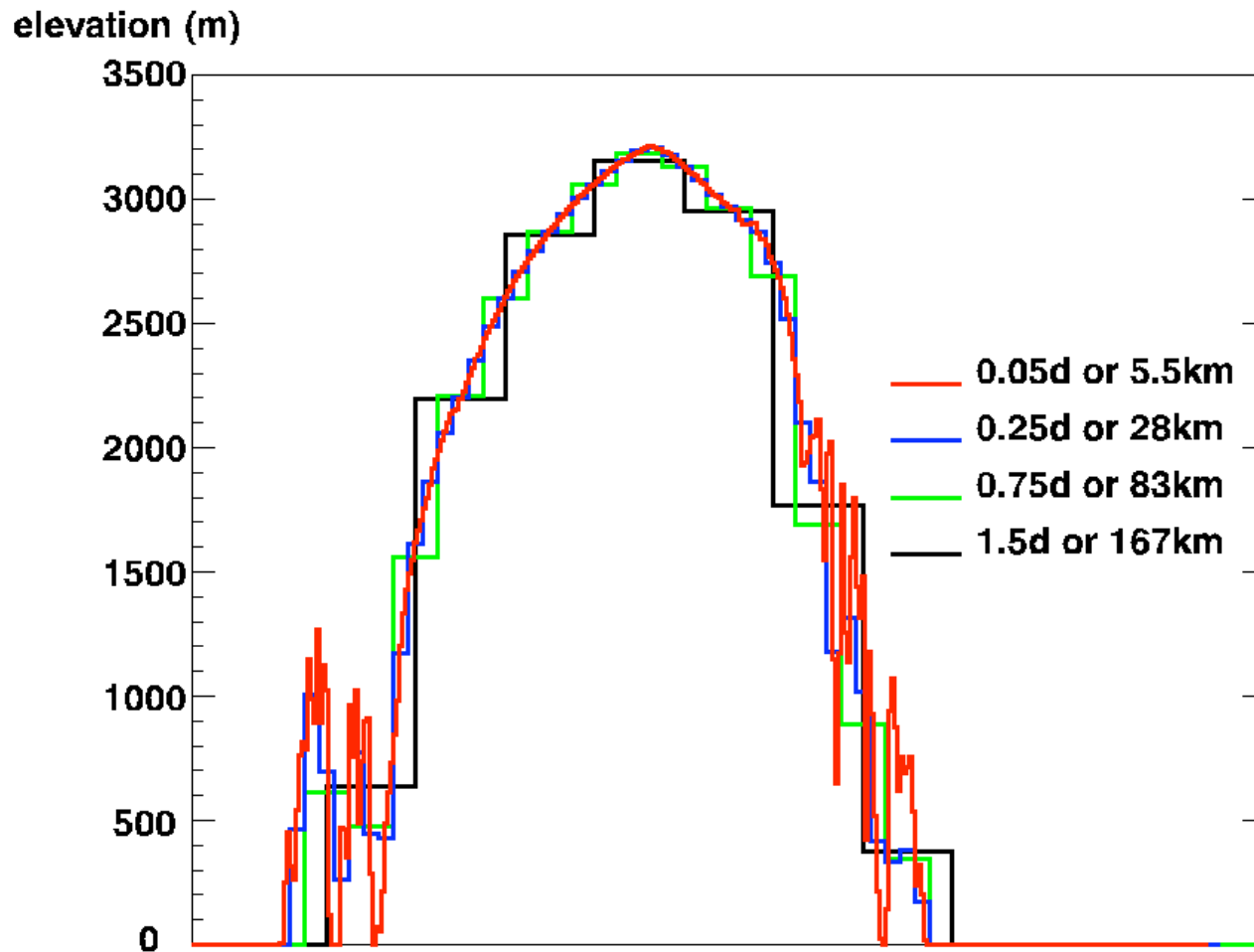


If we plot a cross section of the topography...

42



Cross section



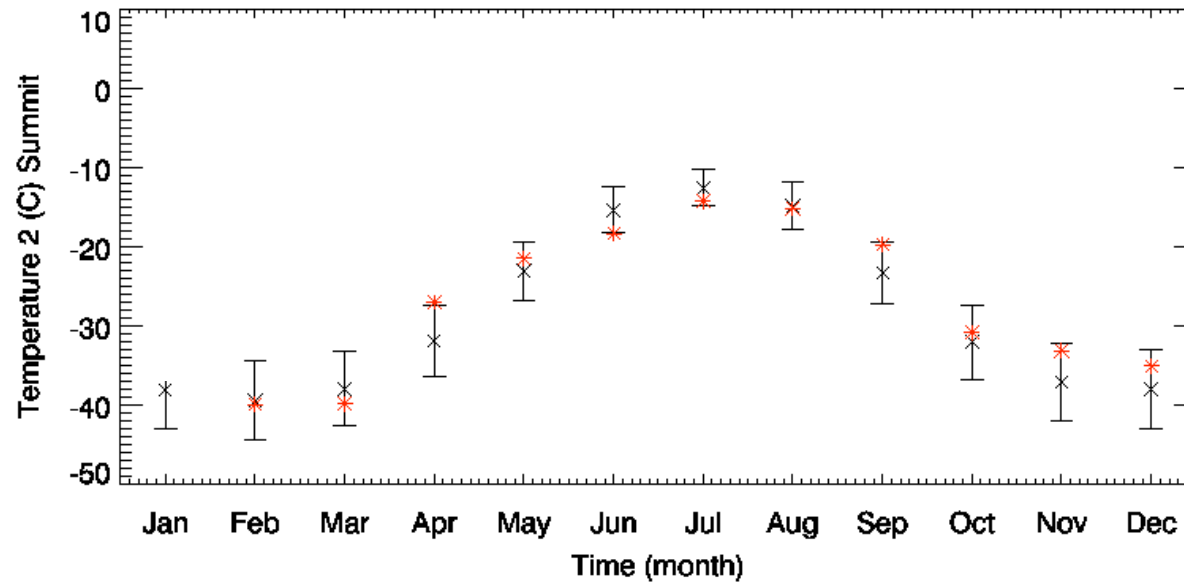
Courtesy Lucas-Picher



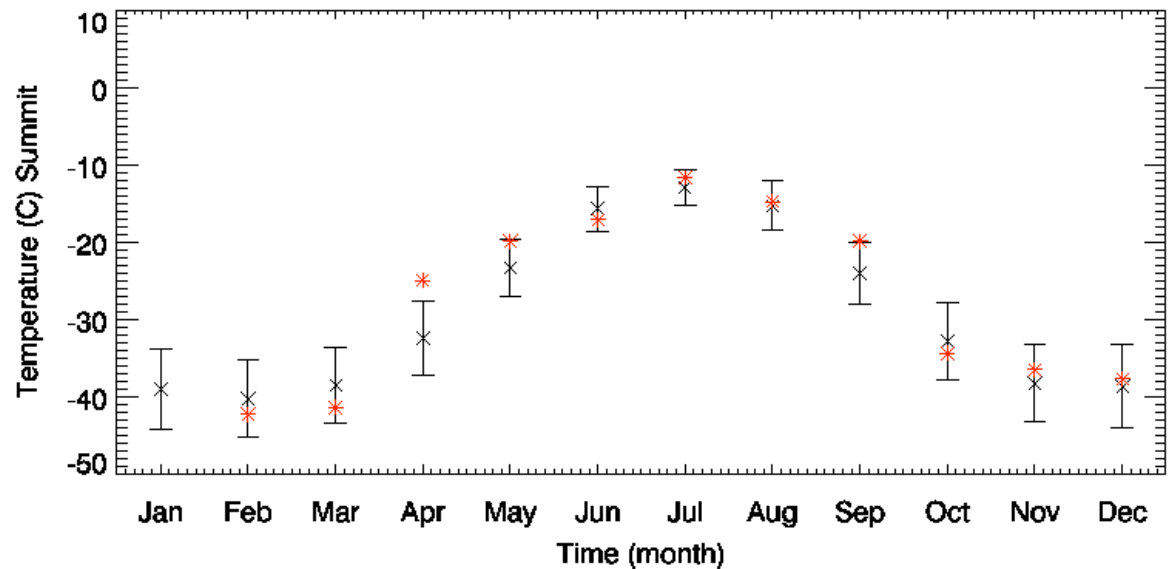
Dmi

Mean 2m Temp: Summit

Without snow model



With snow model



Black crosses are GC-NET monthly means

Errorbars show standard deviation

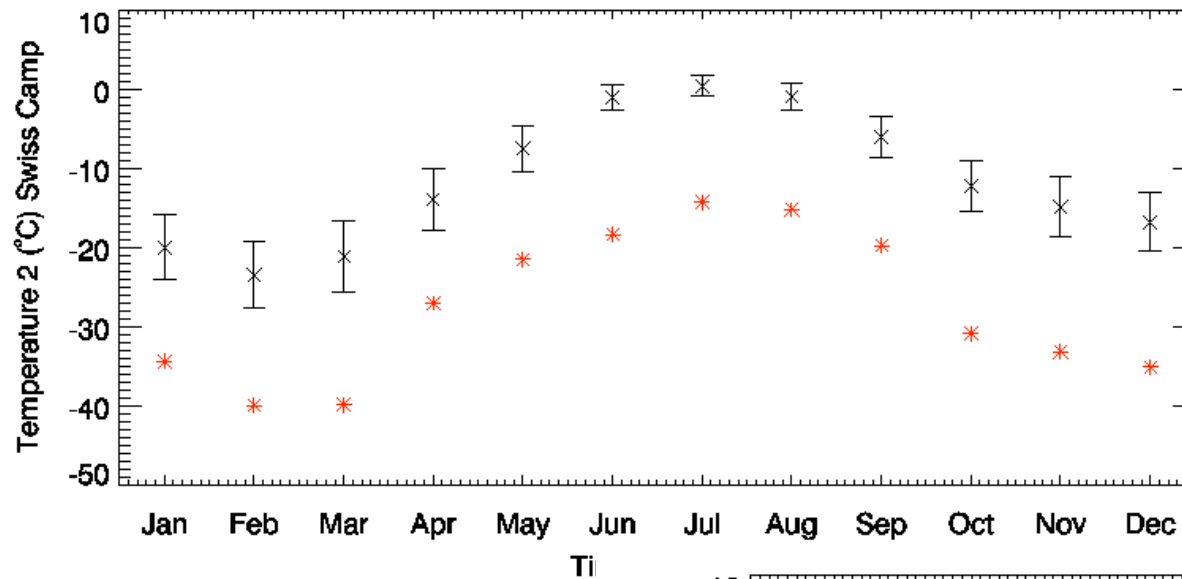
Red crosses show modelled monthly means



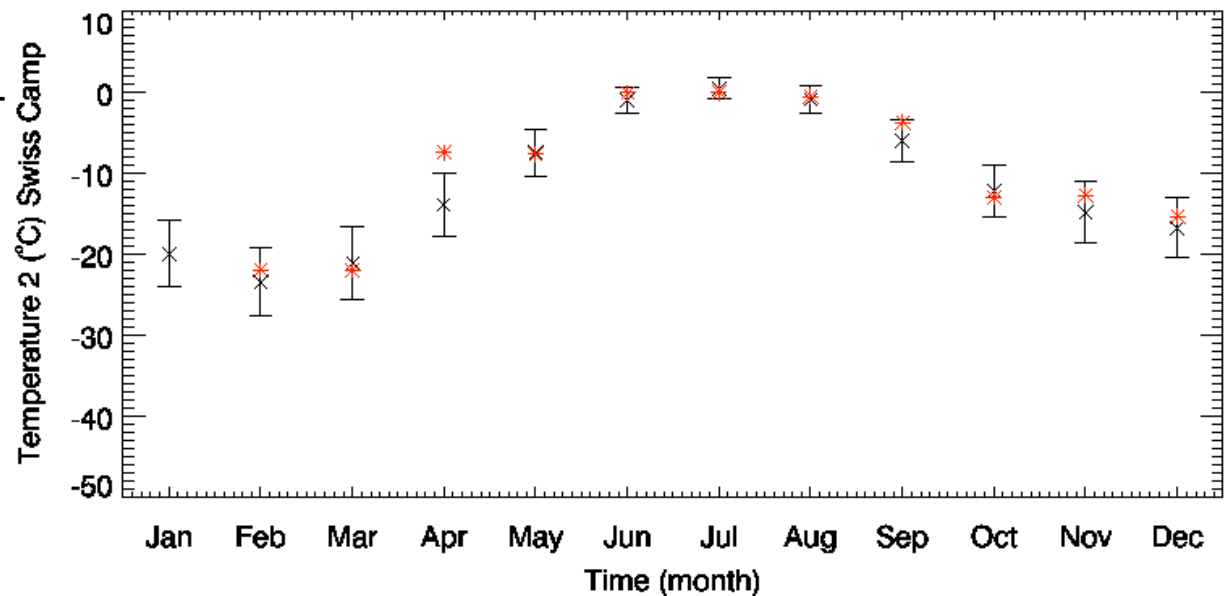
DMI

Mean 2m Temp: Swiss Camp

Without snow model



With snow model



Black crosses are GC-NET monthly means

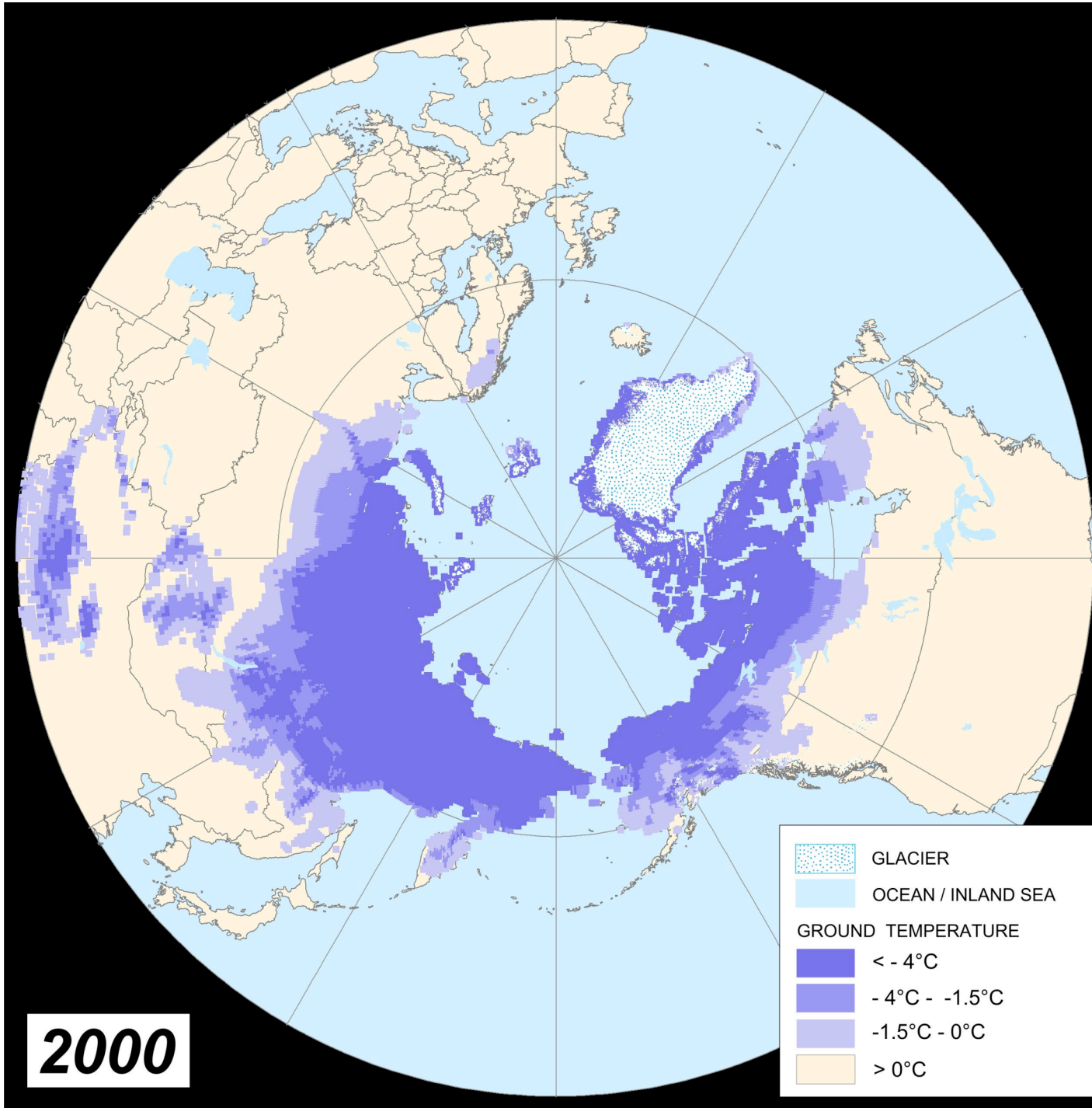
Errorbars show standard deviation

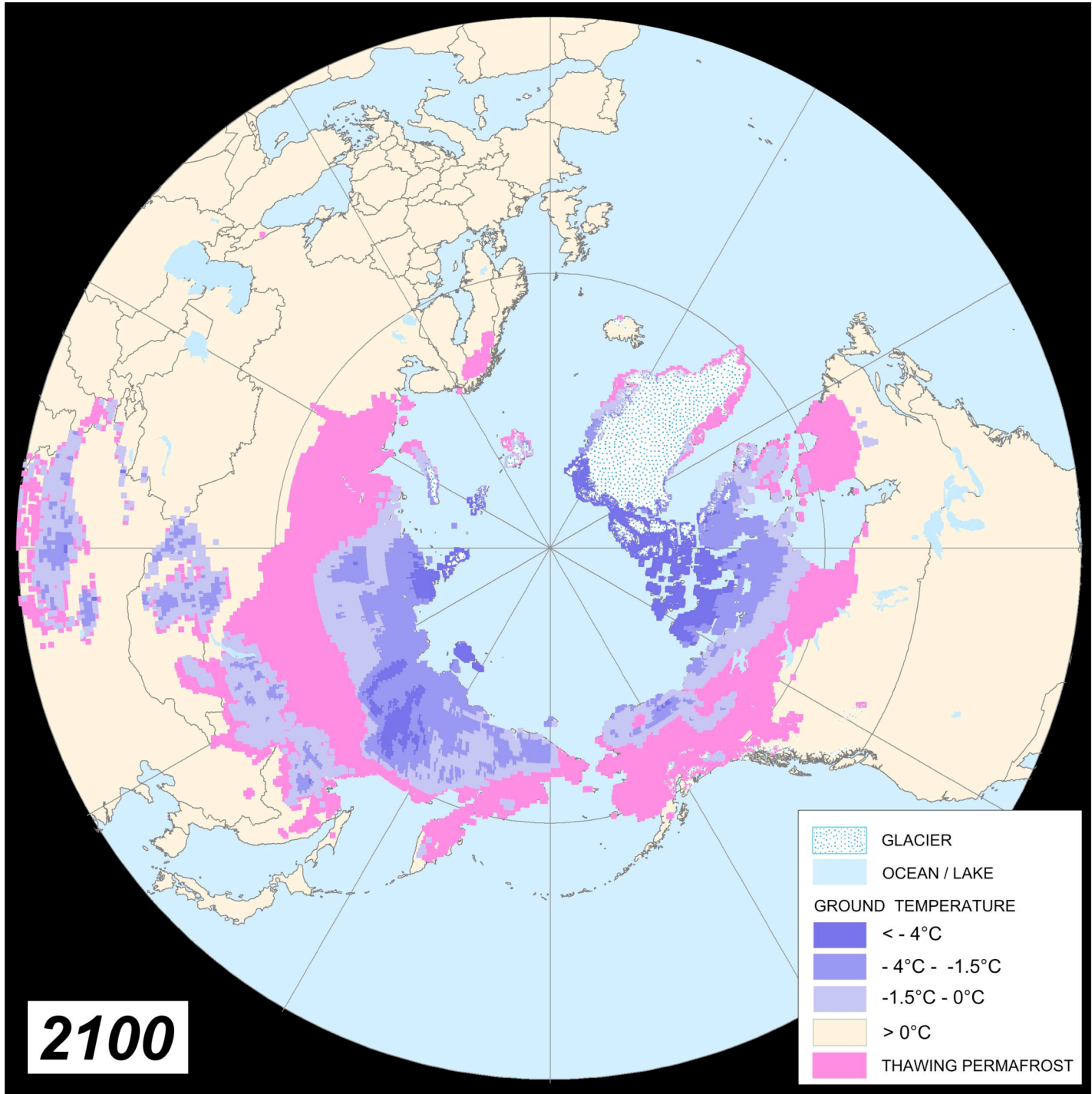
Red crosses show modelled monthly means



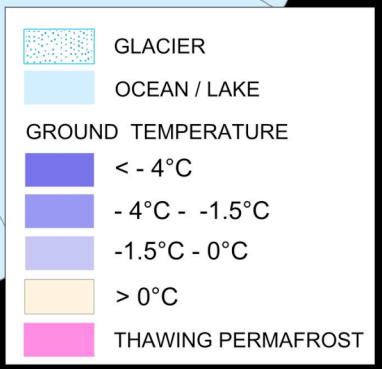
Permafrost

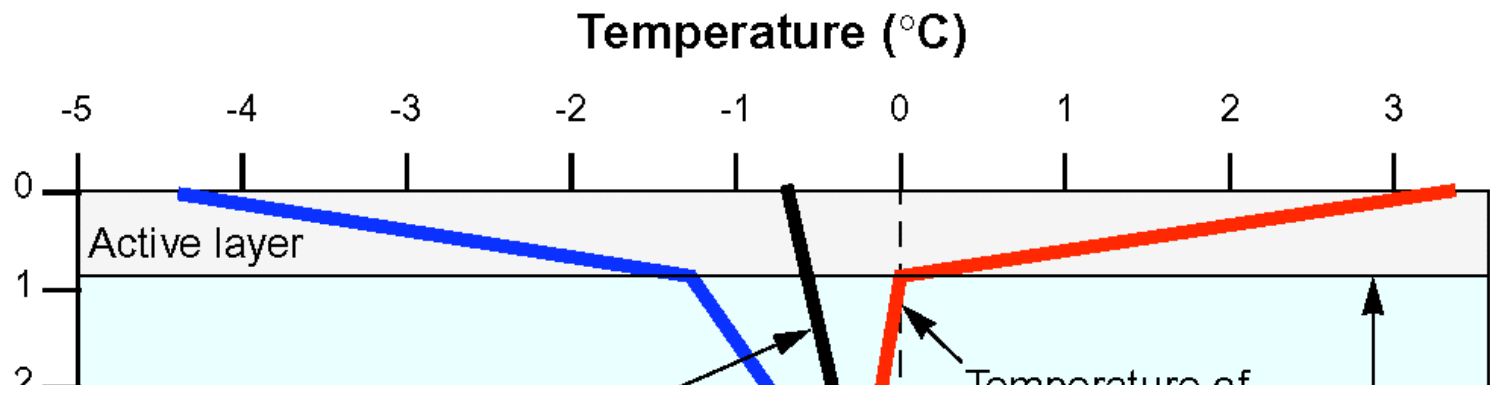




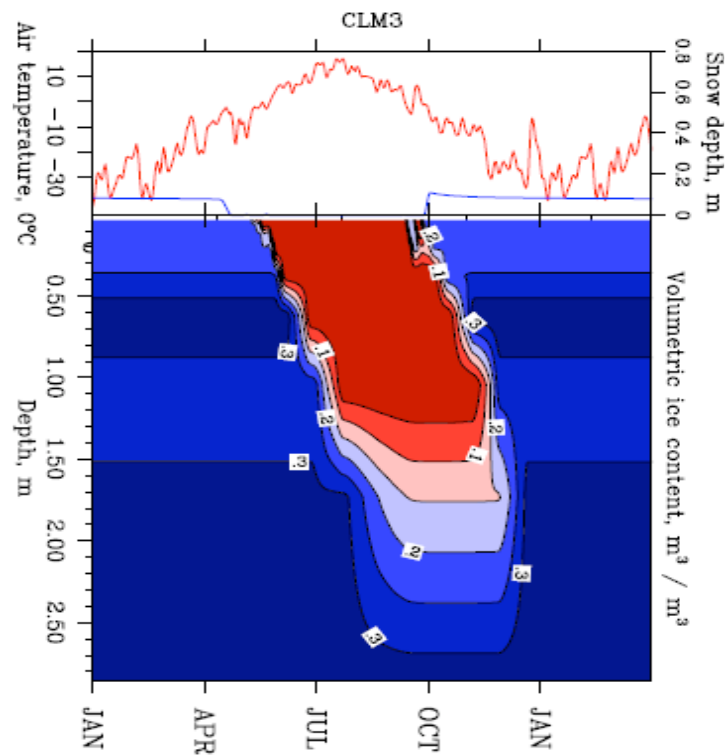


2100





Formulation of soil processes



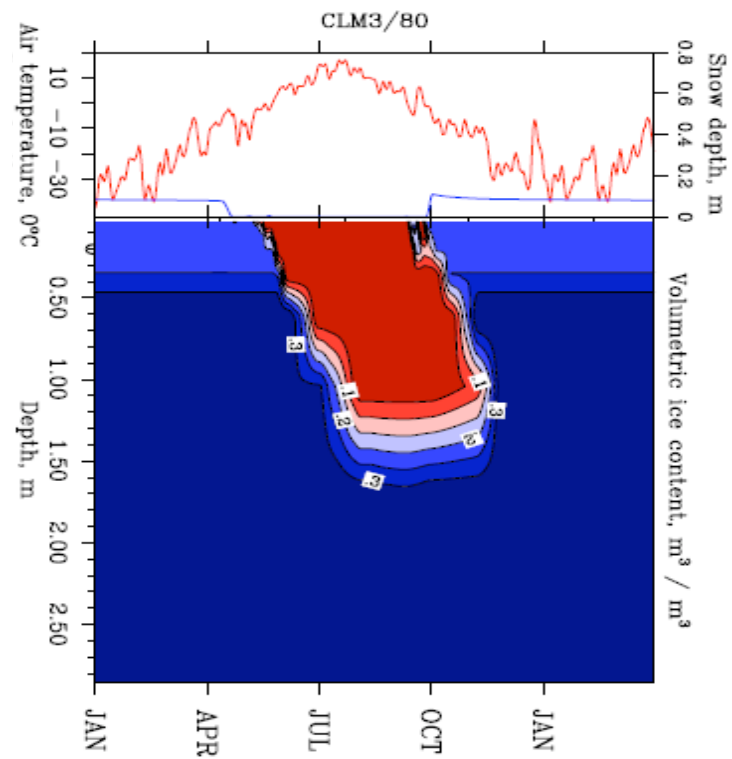
Deadhorse

Bottom at 3.43m

Nicolsky et al. 2007



Formulation of soil processes



Deadhorse

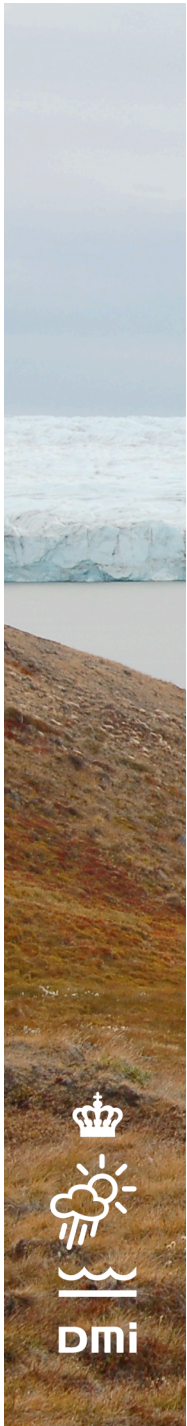
Bottom at 80m

Nicolsky et al. 2007



Conclusion

- Models project an enhanced warming in the Arctic due to anthropogenic greenhouse gas emissions, but with a large spread (uncertainty)
- To narrow uncertainties there is a need to refine our model description of
 - The regional Arctic Earth System





Thank you!