

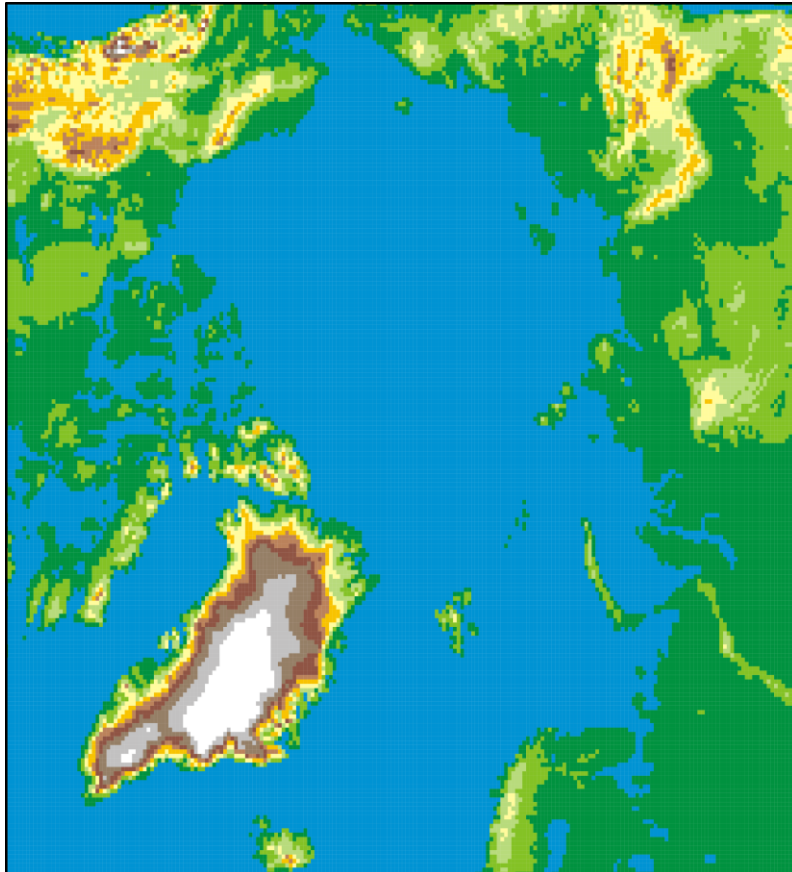
# Using CLM4 in a Regional Climate Model over the Arctic

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# Regional Climate Model HIRHAM5



HIRHAM5 ...

- consists of HIRLAM7 as dynamical core, ECHAM5 physics
- horizontal resolution of  $0.25^\circ$
- 60 vertical levels up to 0.1hPa (~65km)
- covers the pan-Arctic domain north of  $60^\circ\text{N}$
- is run on a rotated grid that allows for approximately equally sized grid cells

# Motivation

## HIRHAM5

- does fairly well in representing climate over the Arctic
- has been used in studies of climate extremes, cyclon paths, cloud cover parametrizations ...

Why use CLM instead of ECHAM's inbuilt landsurface-soil-model?

the inbuilt soil model:

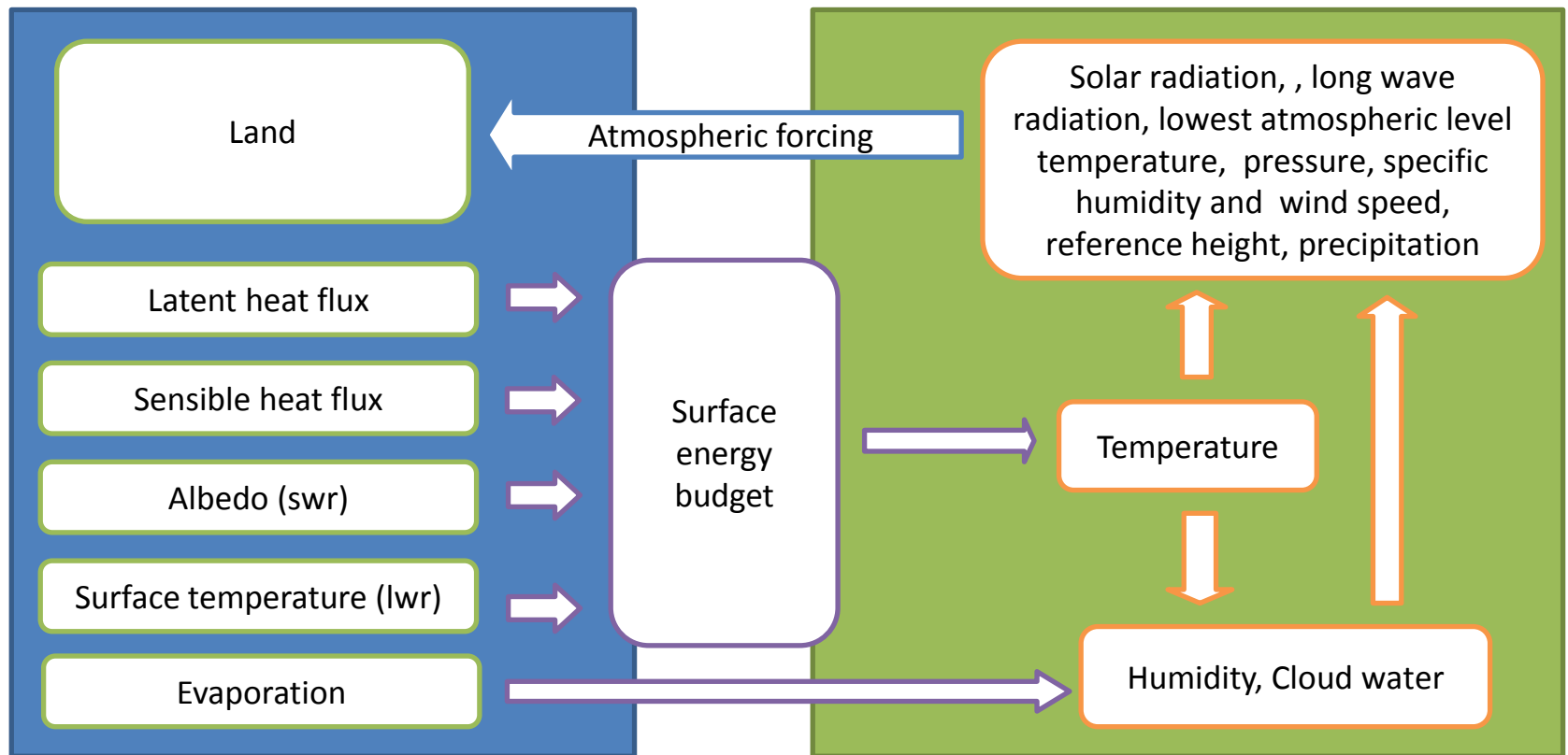
- uses a bucket approach for soil moisture
- it does not account for phase changes in the soil
- it does not distinguish between different pfts ...
- it has severe limitations when you are interested in landsurface – atmosphere interactions!

# Things we want to play with ...

- changing pft distribution (eg shift the treeline to the north)
- run with a dynamic vegetation model
- changing soil composition (eg introducing peatlands to modeled Arctic soils)
- run with Carbon cycling in the soil and Carbon emission from degrading permafrost
- ...
- see how those changes impact on climate and general circulation over the Arctic in a coupled setup
- need a more sophisticated land model: CLM

# HIRHAM5 – CLM4 coupling

- follows the approach suggested by NCAR
- replace NCAR atmospheric model with HIRHAM5



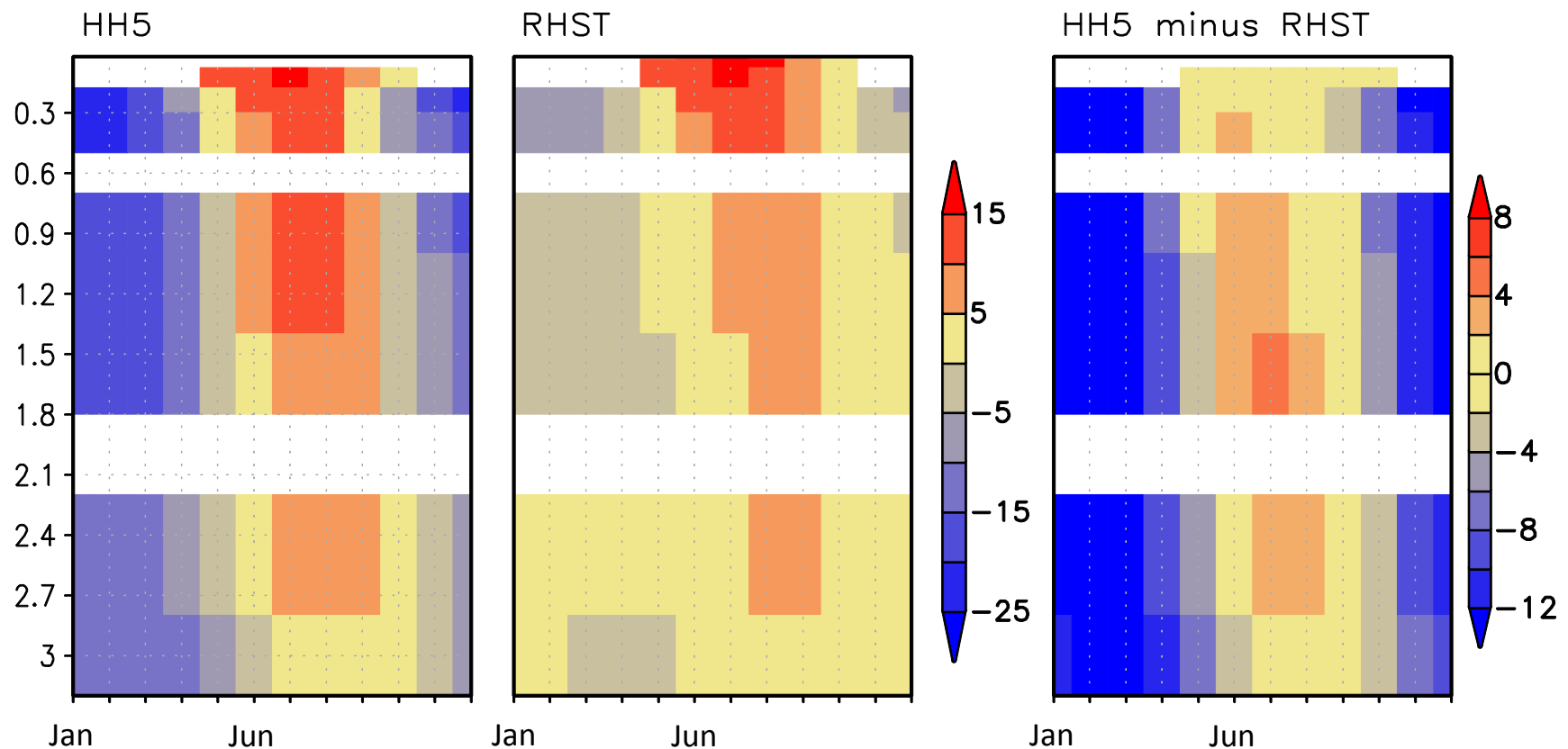
# HIRHAM5 – CLM4 coupling

What impact does the coupling have on modeled climate?

- control run over the ERAInterim period with the CLM „standard setup“
- model forced at its lateral and lower boundaries with the ERAInterim data
- so far finished: 1979-1984
- variables analyzed: soil temperature, air temperature, mean sea level pressure

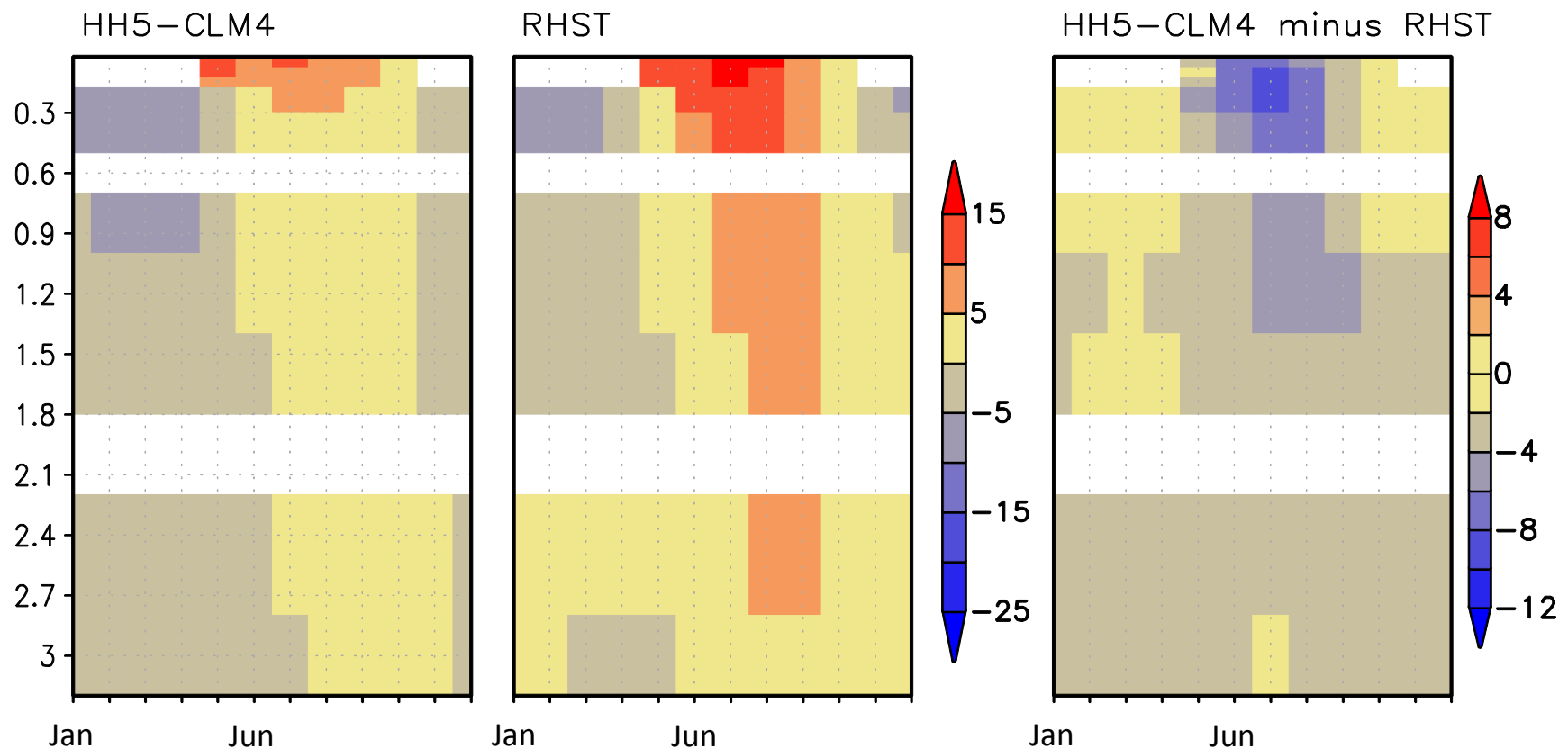
# Direct Improvement: Soil Temperature

- mean over **atmosphere only model run** from Jan 1979 to Dec 1984
- comparison data set: Russian Historical Soil Temperature (70 stations)



# Direct Improvement: Soil Temperature

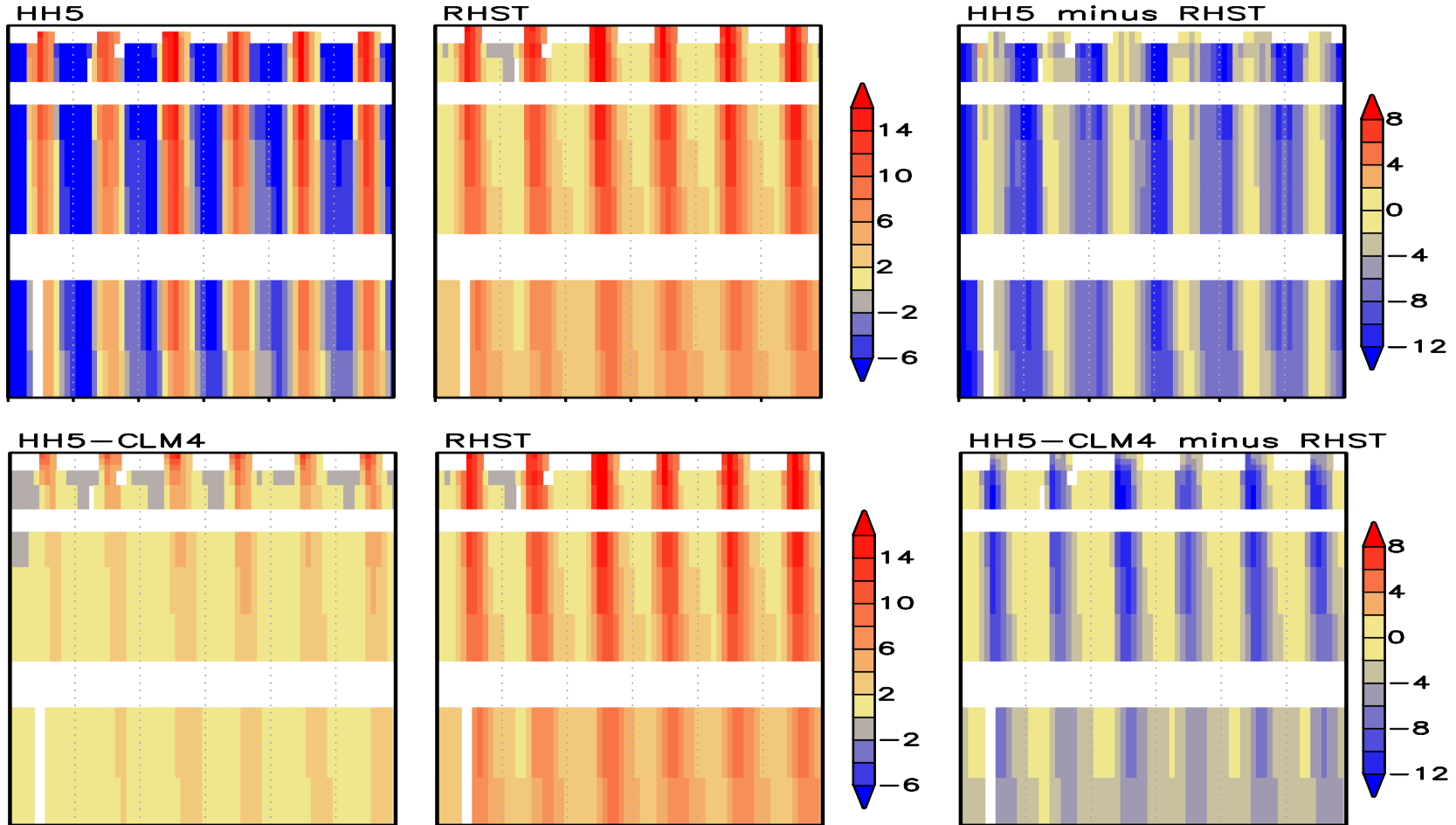
- mean over **coupled model run** from Jan 1979 to Dec 1984
- comparison data set: Russian Historical Soil Temperature (70 stations)





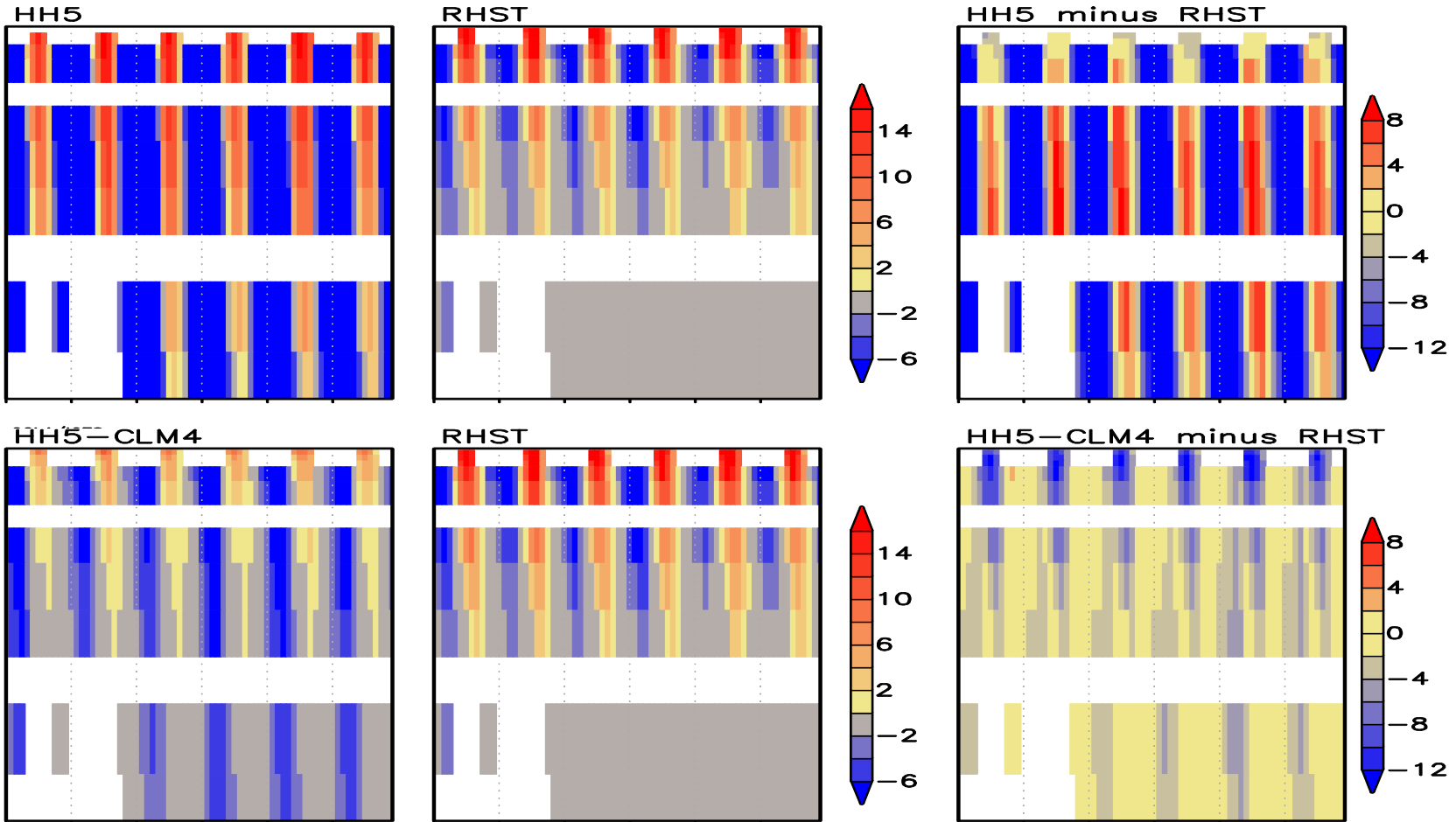
# Direct Improvement: Soil Temperature

56.20°E, 62.70°N



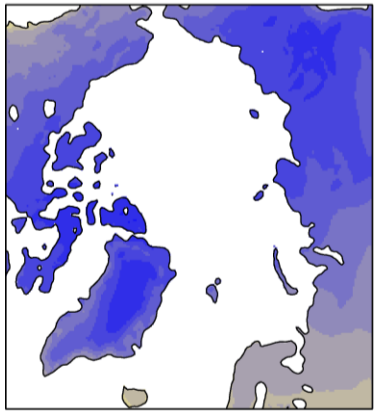
# Direct Improvement: Soil Temperature

134.50°E, 60.40°N

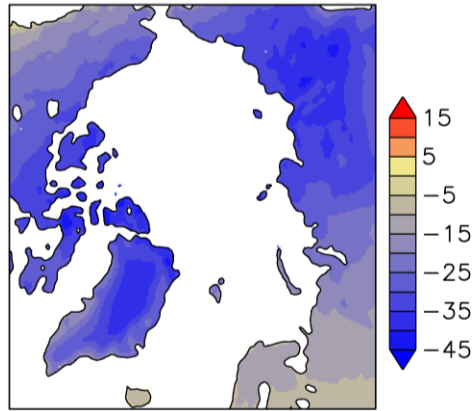


# Impact on 2m air temperature

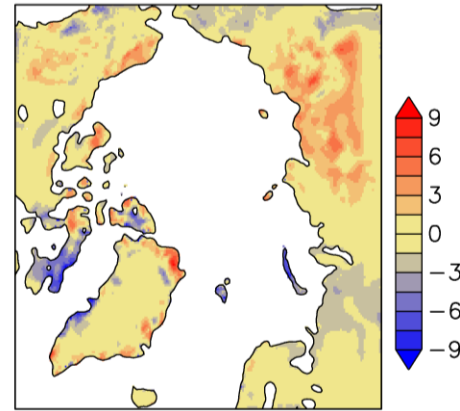
atmosphere only



ERAInterim

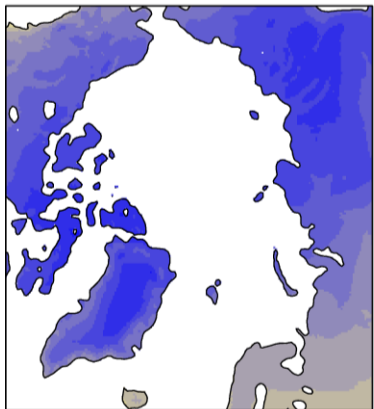


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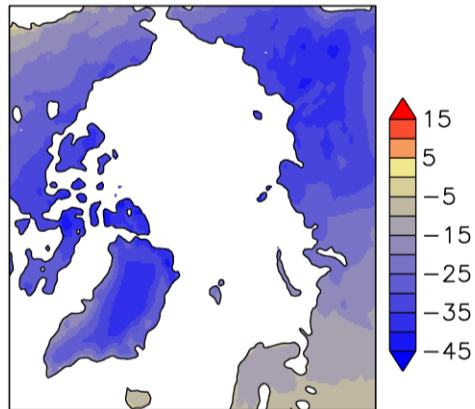


**DJF**

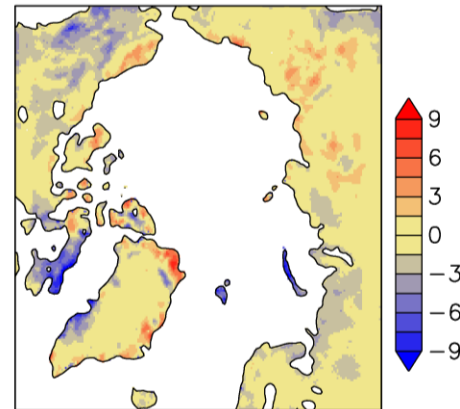
coupled



ERAInterim

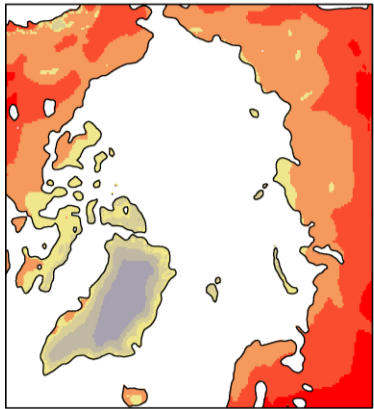


coupled – ERAInterim

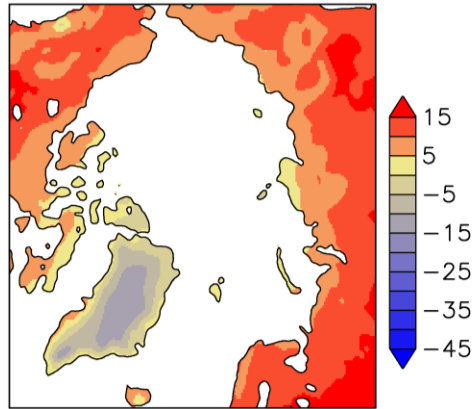


# Impact on 2m air temperature

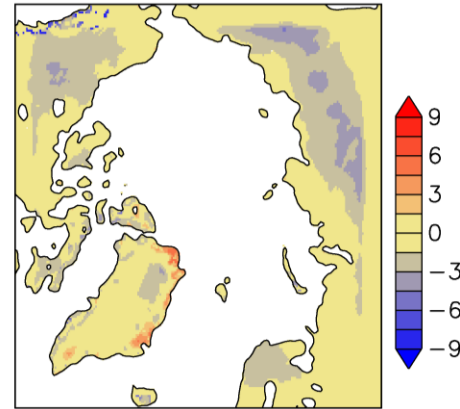
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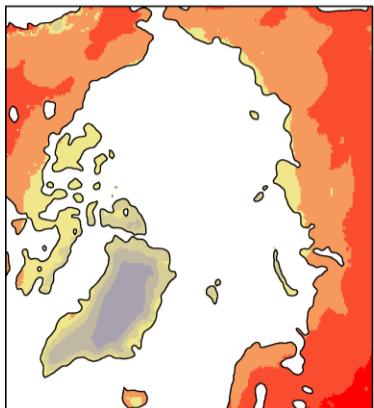
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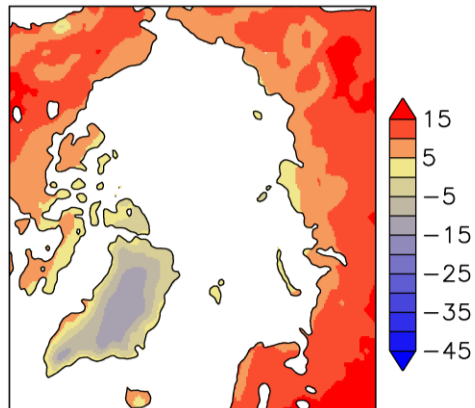
atmosphere only –  
ERAInterim



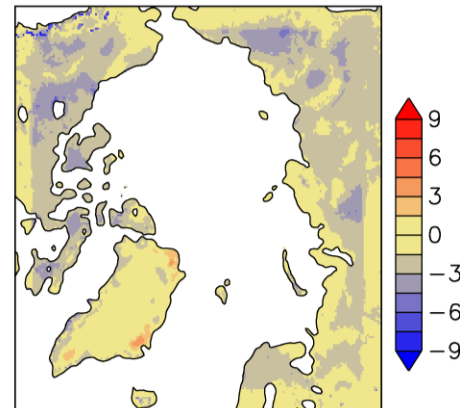
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ERAInterim



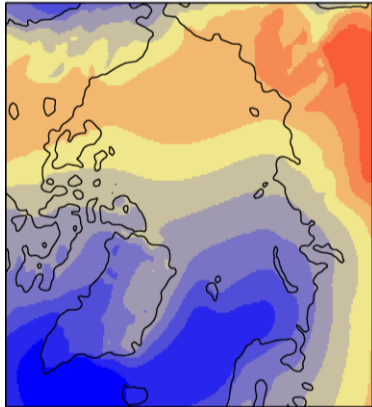
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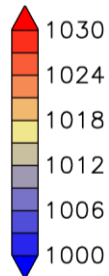
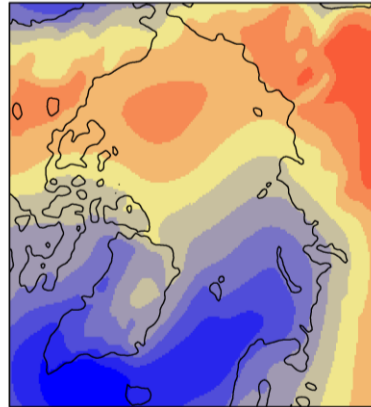
JJA

# Impact on mean sea level pressure

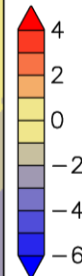
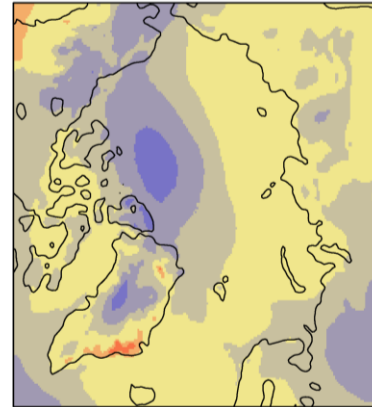
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ERAInterim

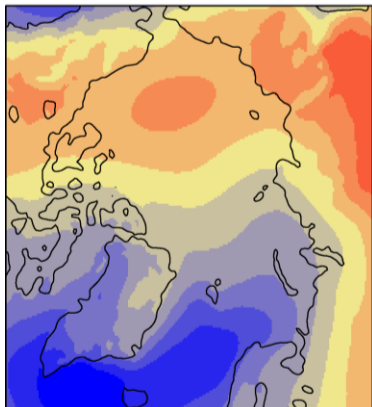


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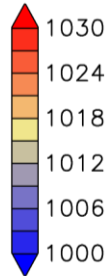
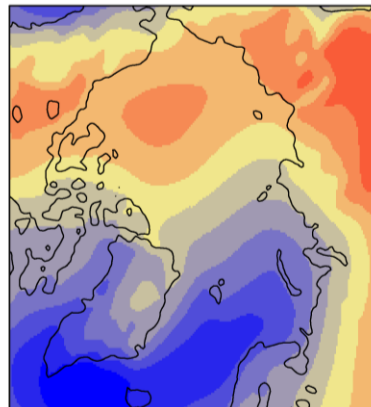


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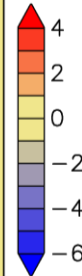
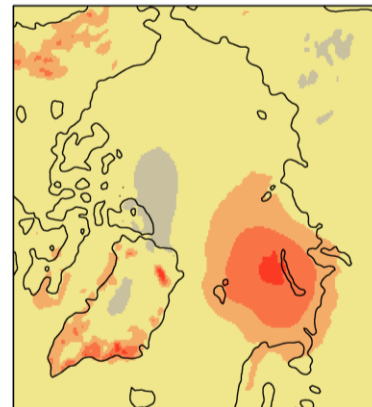
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ERAInterim

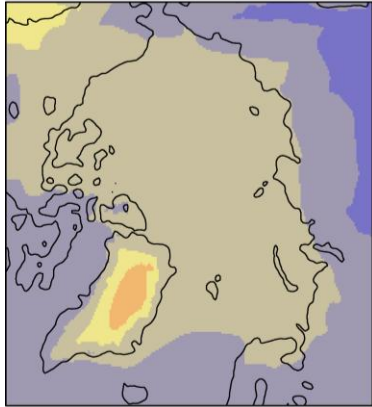


coupled – ERAInterim

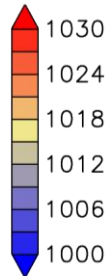
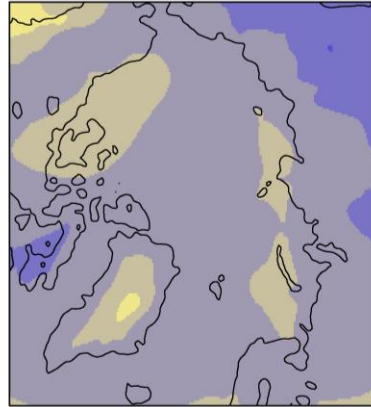


# Impact on mean sea level pressure

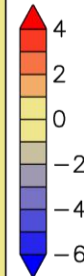
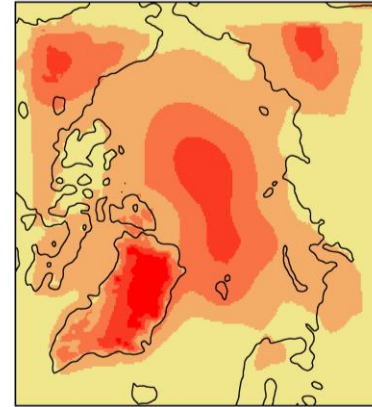
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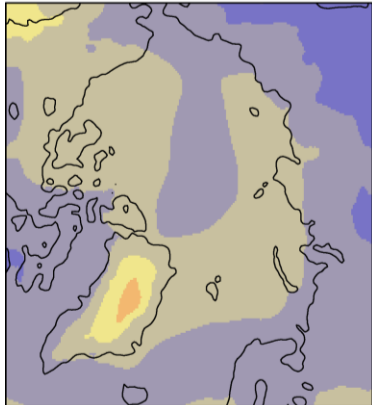


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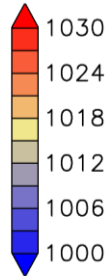
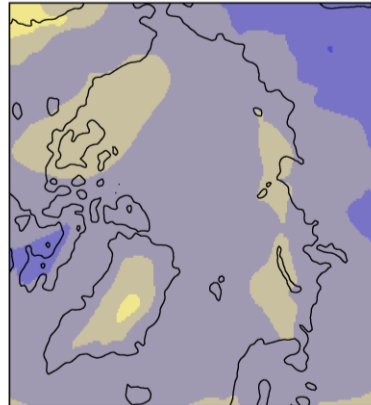


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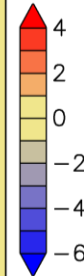
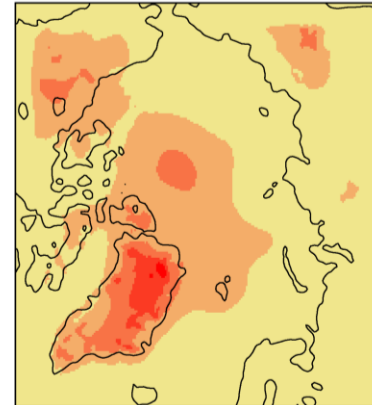
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ERAInterim



coupled – ERAInterim



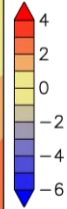
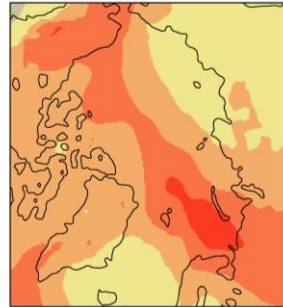
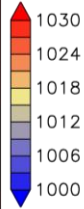
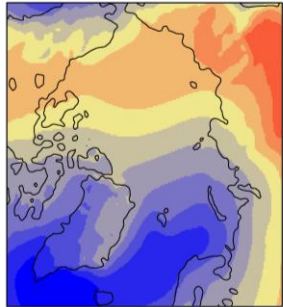
# Impact throughout the atmosphere

DJF  
atmosphere only

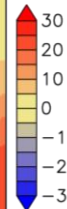
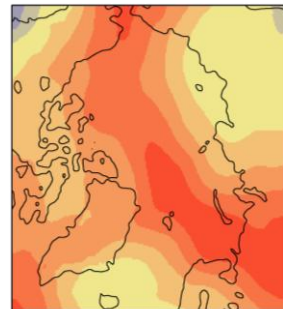
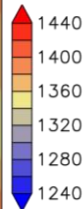
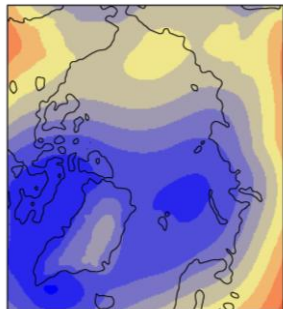
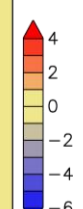
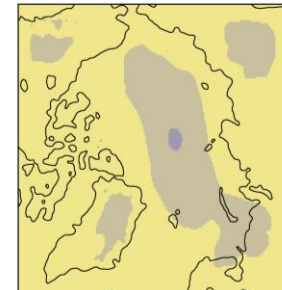
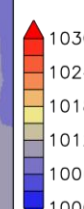
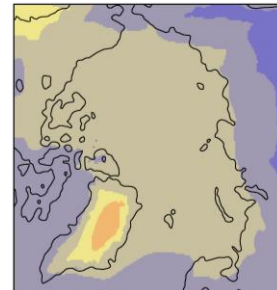
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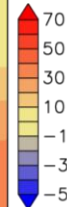
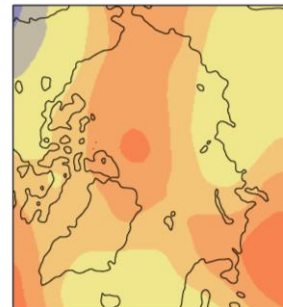
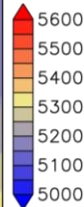
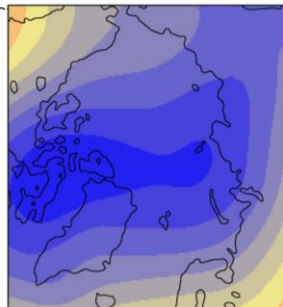
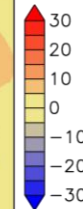
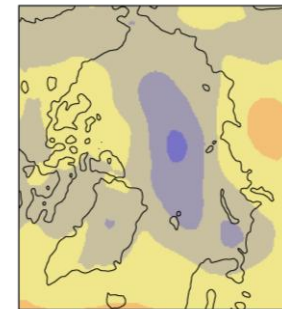
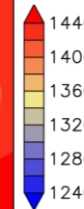
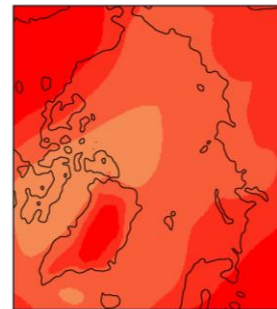
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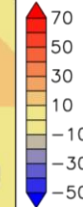
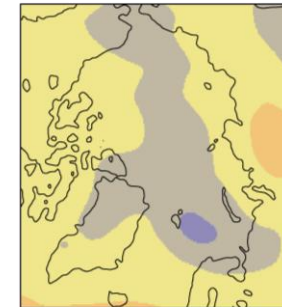
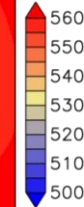
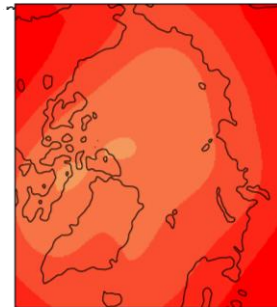
mslp



850hPa



500hPa



# Outlook and Conclusions

coupling HIRHAM5 and CLM4:

- improves modeled soil temperature
- improves modeled air temperature and mean sea level pressure
- has impacts throughout the atmospheric column and on general circulation

after the control run is finished:

- experiment with vegetation distribution
- experiment with new soil properties/pfts
- ...

or directly move on to CLM4.5?