Impact of an abrupt Arctic sea ice reduction on high and mid-latitude climate

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**Thanks to : CERFACS (Rym Msadek, Svenya Chripko, Laurent Terray)
ECMWF (Chris Roberts)**

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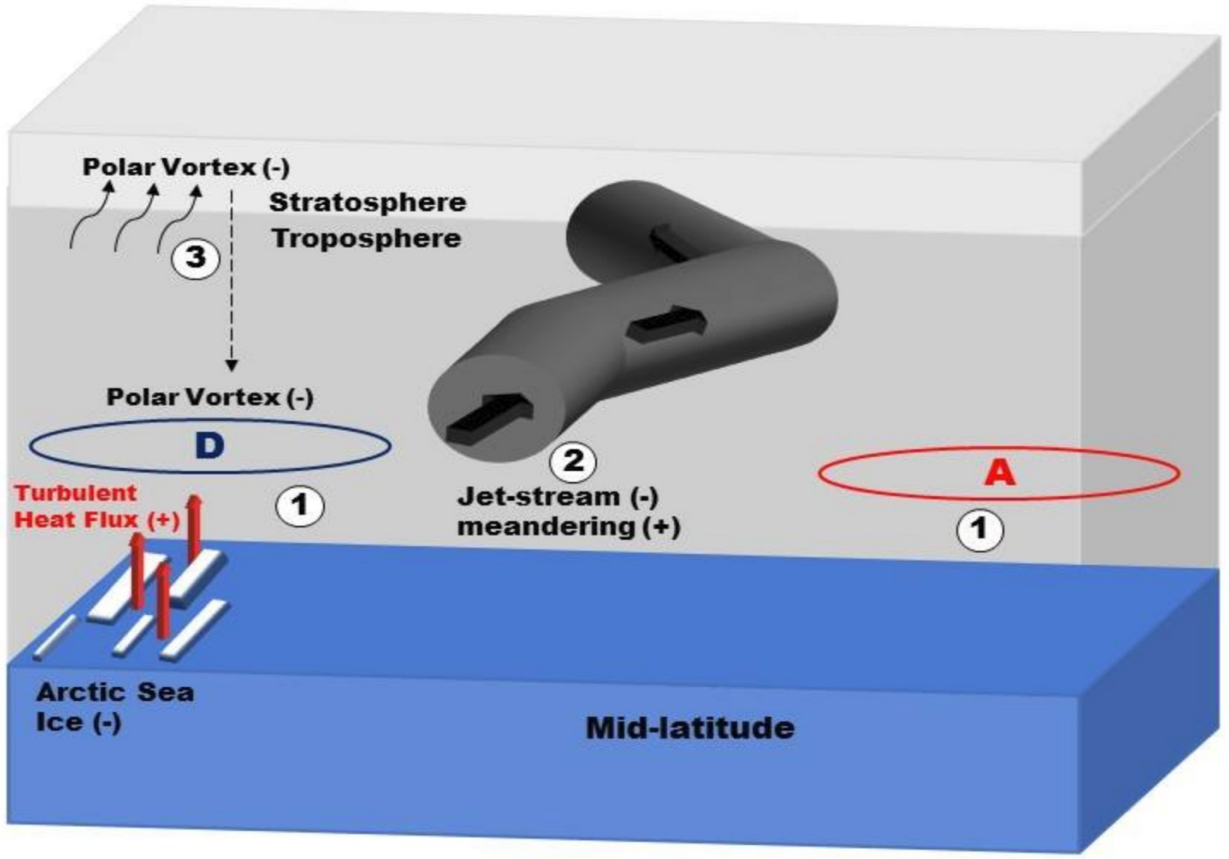
Responses due to Arctic sea ice loss



Inspired by : (Cohen et al, 2014) and (Screen et al, 2018)

Changes in :

1. Storm tracks
2. Behaviour of the polar jet-stream
3. Rossby waves

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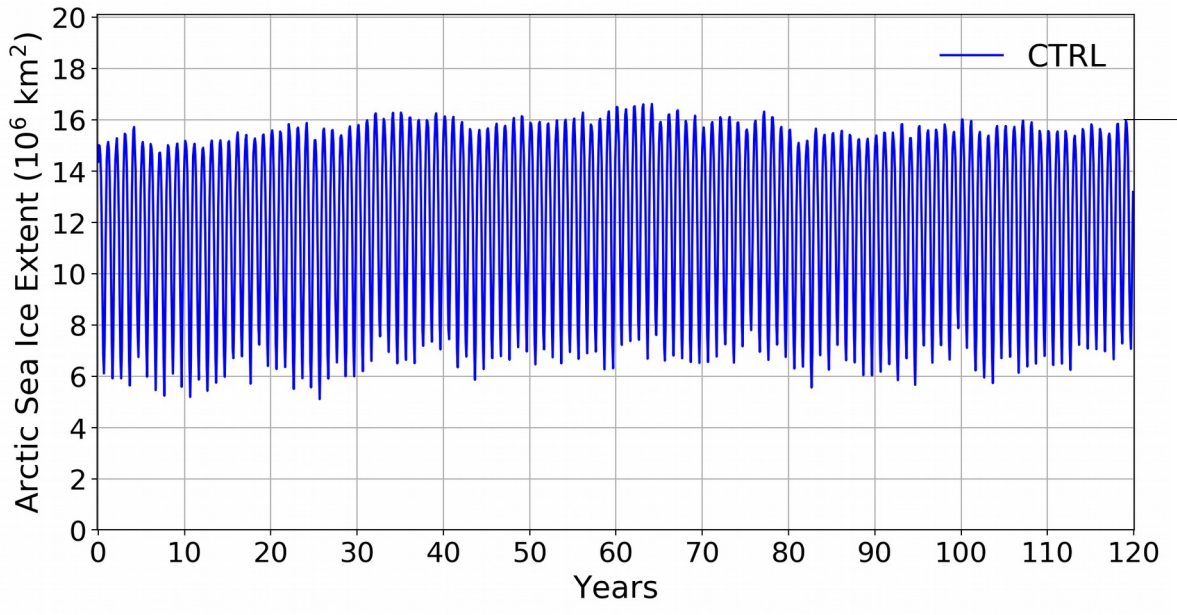
Methods

Coupled Model

Resolution

Simulations



Constant forcing of 1950

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Methods

Coupled Model

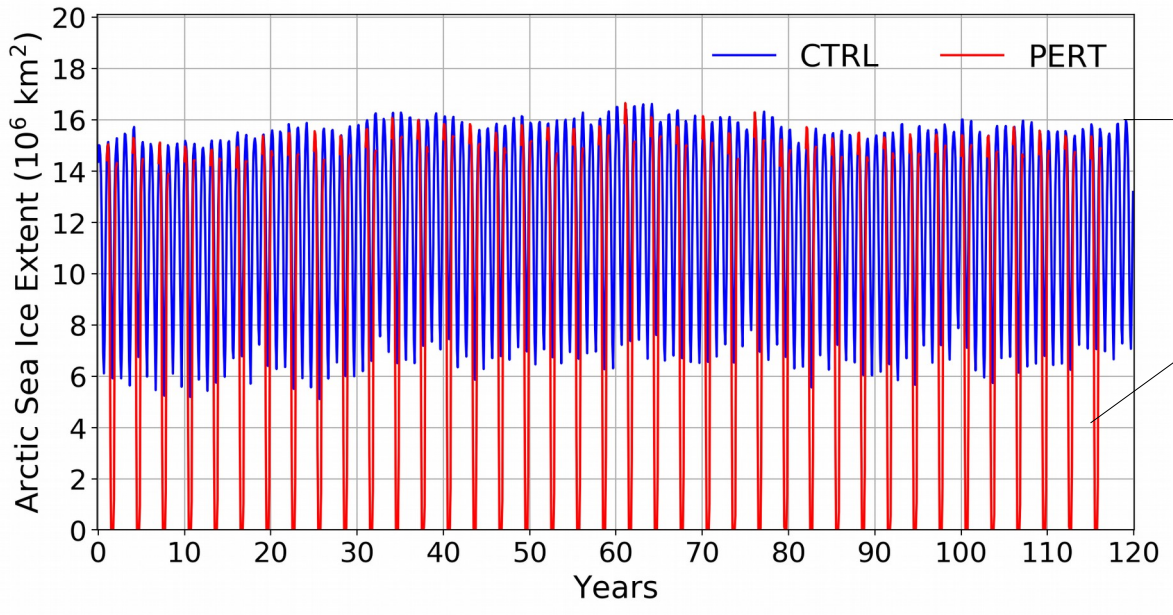
ECMWF-IFS

CNRM-CM6

Resolution

LR **HR** **LR** **HR**

Simulations



Constant forcing of 1950

=

But ice albedo = ocean albedo

Sea ice loss

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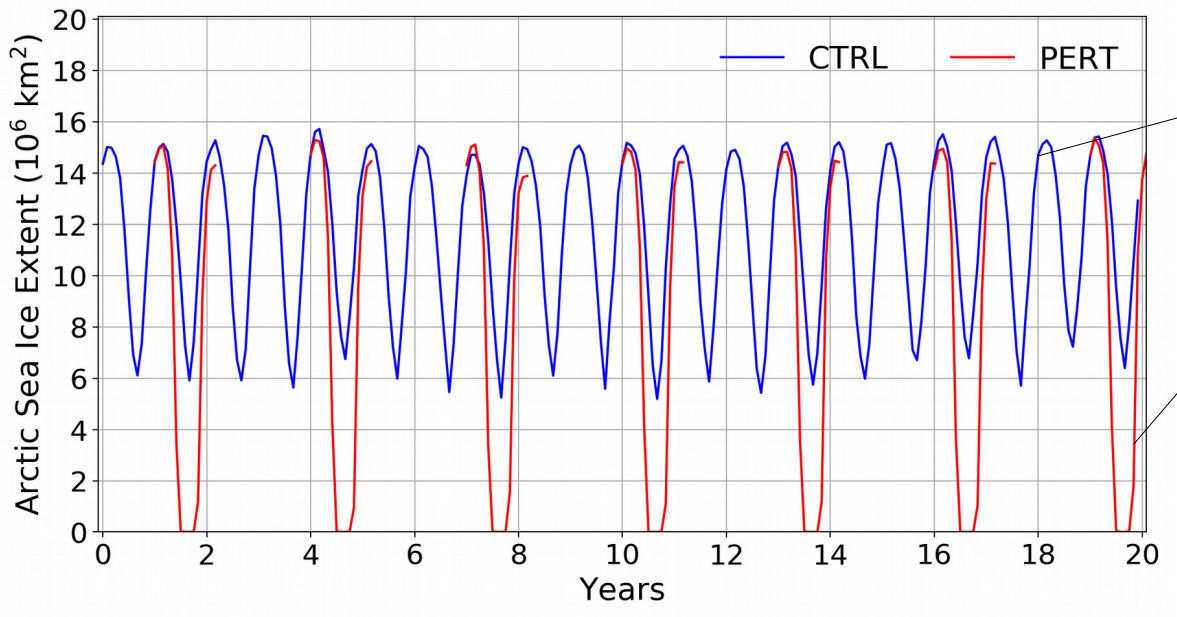
Methods

Coupled Model

Resolution

Simulations



Constant forcing of 1950

II

But ice albedo = ocean albedo

Sea ice loss

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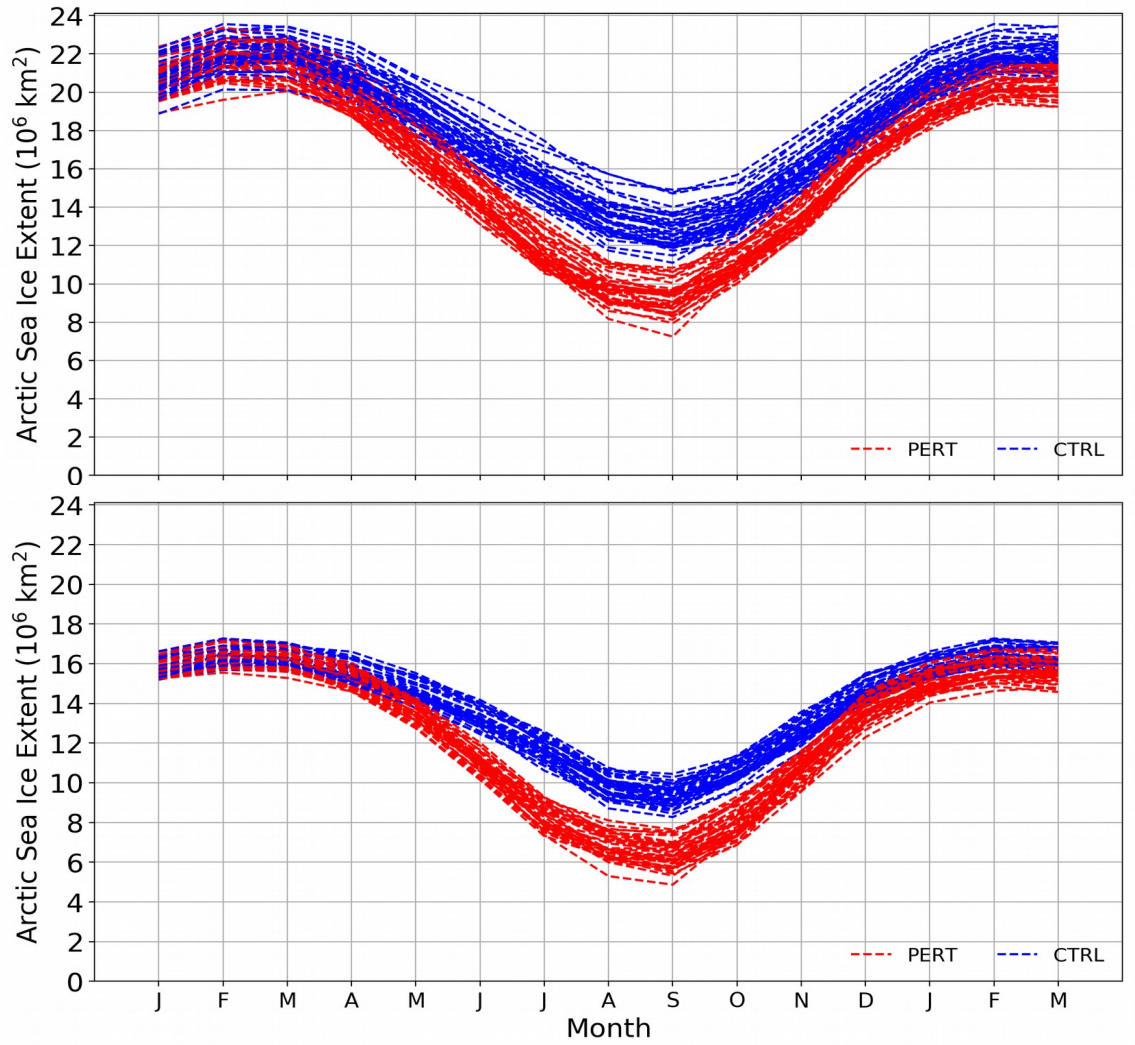
Arctic Sea Ice Extent

ECMWF-LR

ECMWF-HR



CTRL

Constant forcing of 1950

PERT

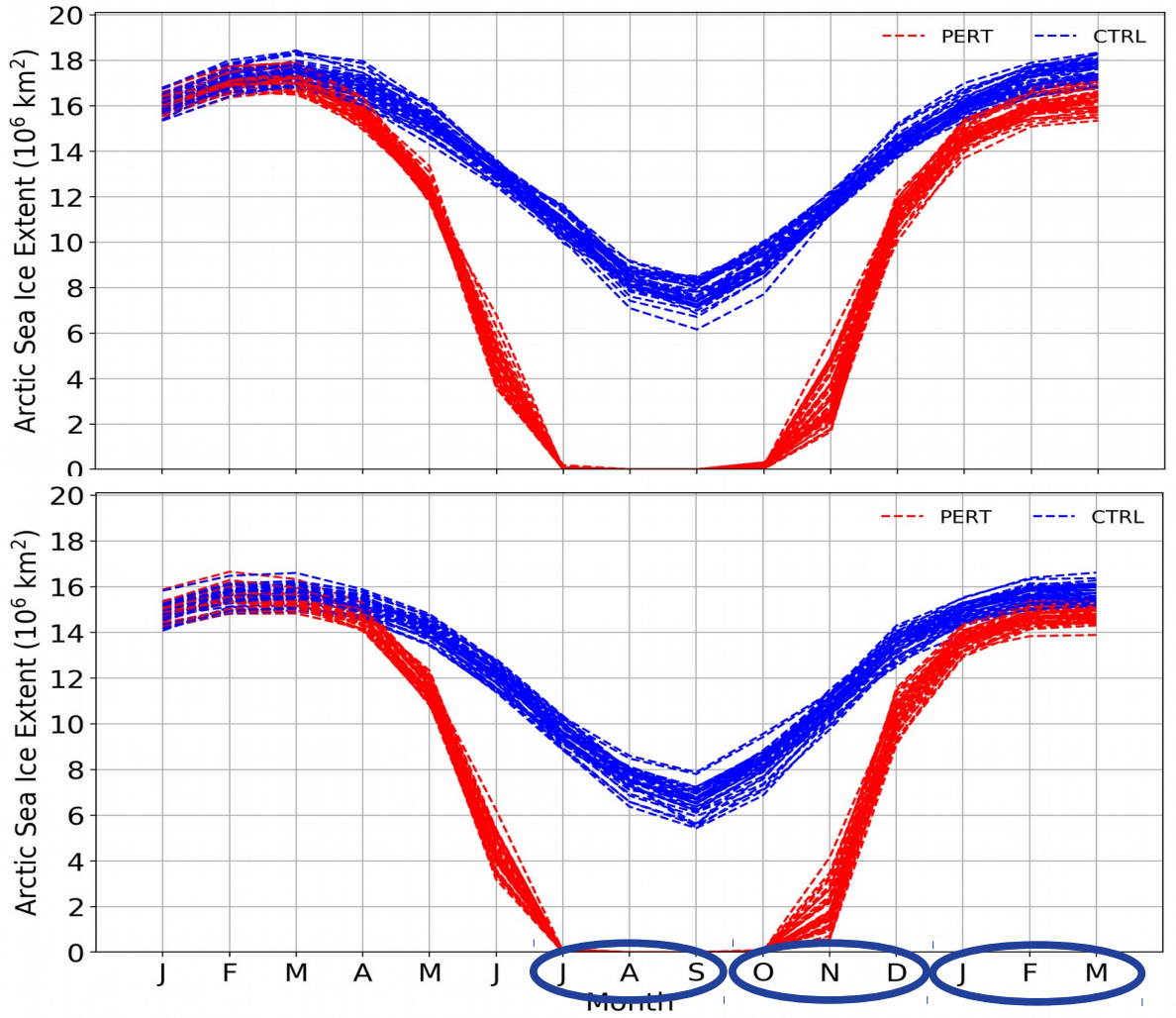
Ice albedo = ocean albedo

40 members

Arctic Sea Ice Extent

CNRM-LR

CNRM-HR



CTRL

Constant forcing of 1950

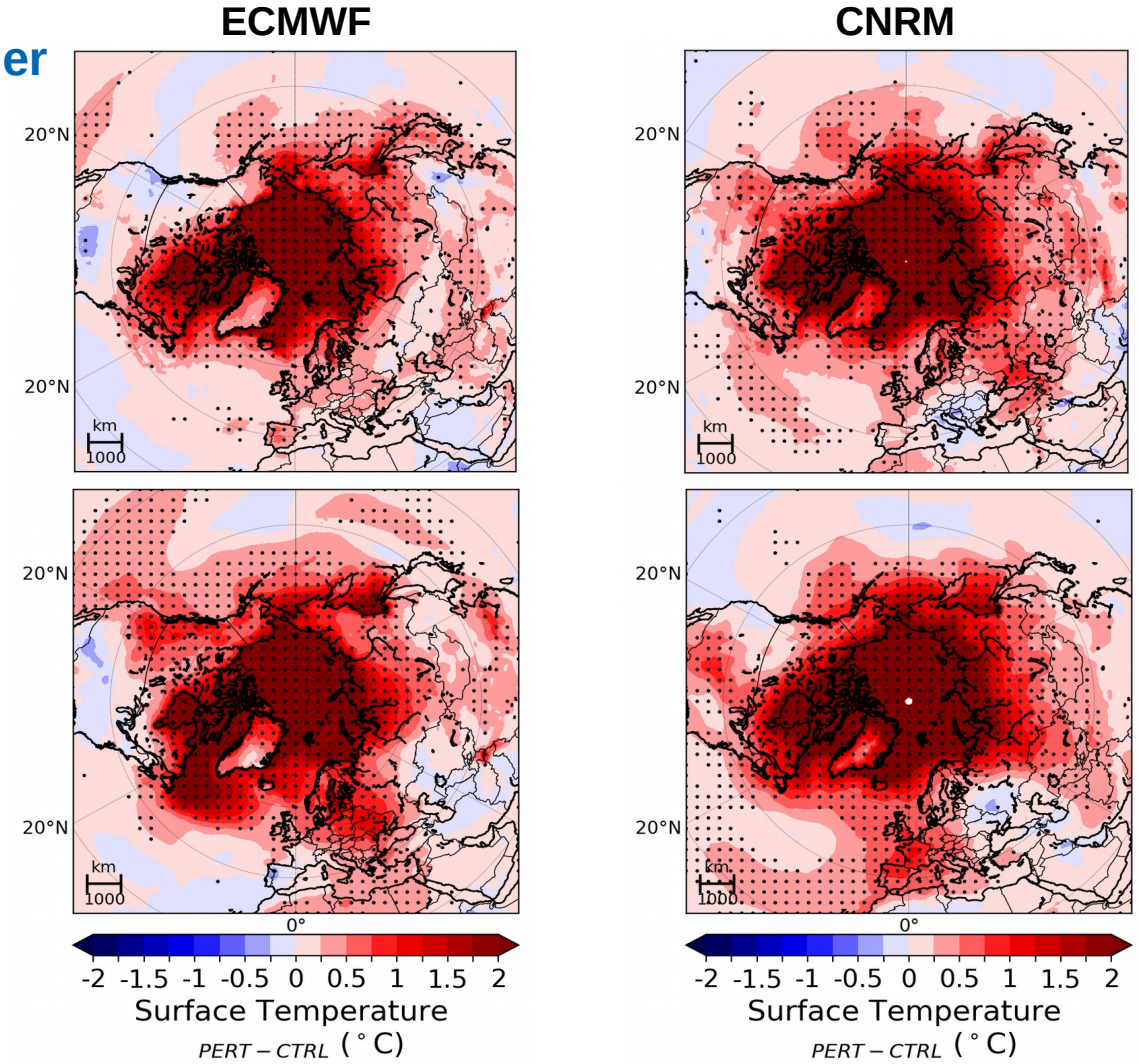
PERT

Ice albedo = ocean albedo

40 members

Surface Temperature

Summer (JAS)



- **Arctic Warming**
- **Extent of warming in CNRM > ECMWF**
  - **More SI extent loss (PERT-CTRL)**
- **Extent of warming in LR > HR**
  - **More SI volume loss (absolute) in LR**

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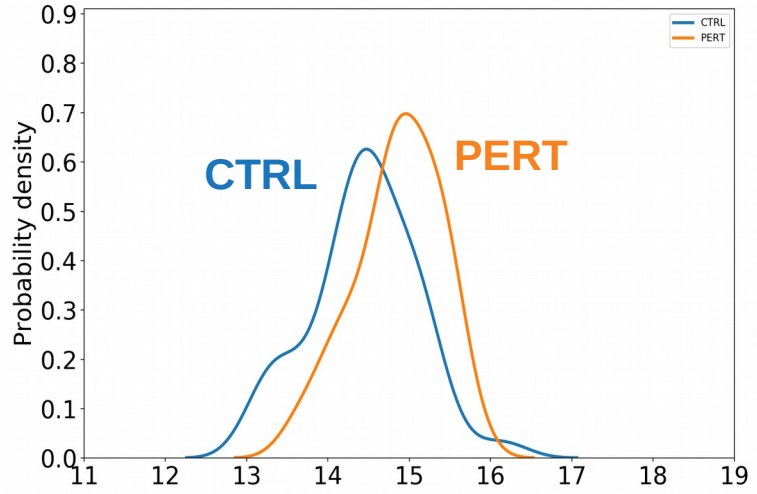
Surface Temperature (Europe)

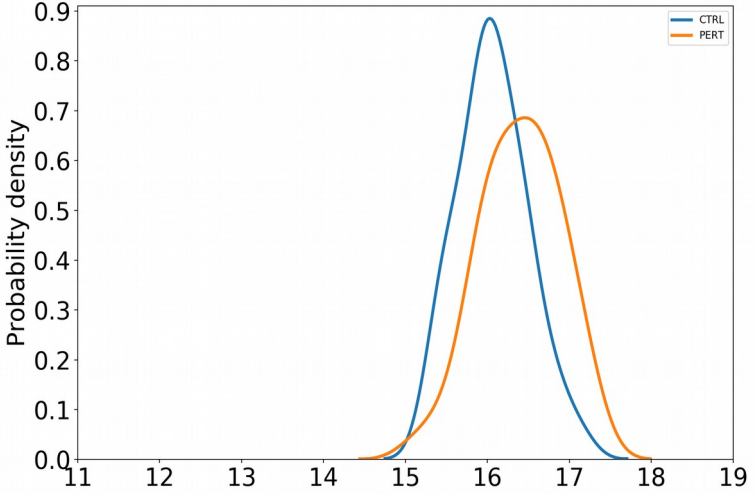
Summer (JAS)

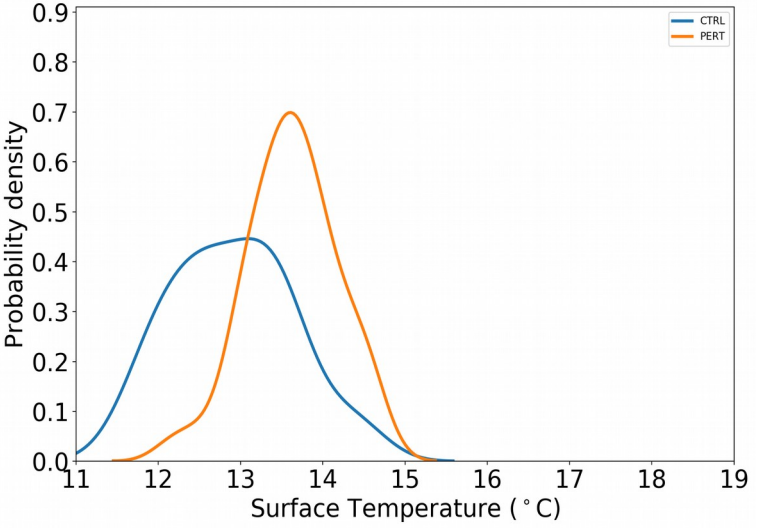
ECMWF | **CNRM**

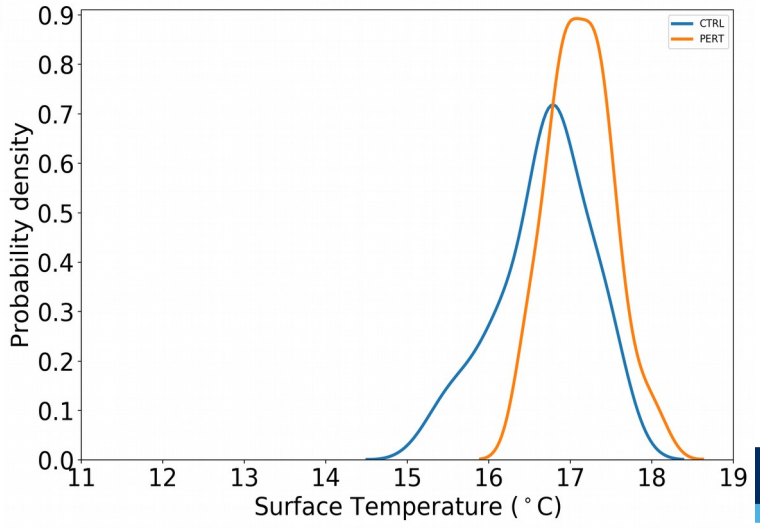
HR

LR

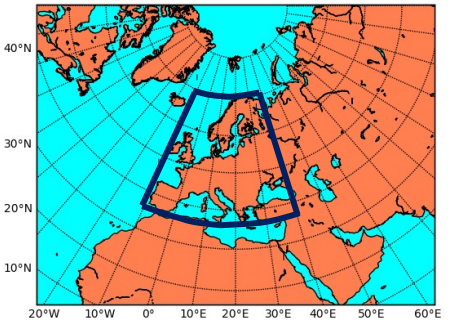








Europe



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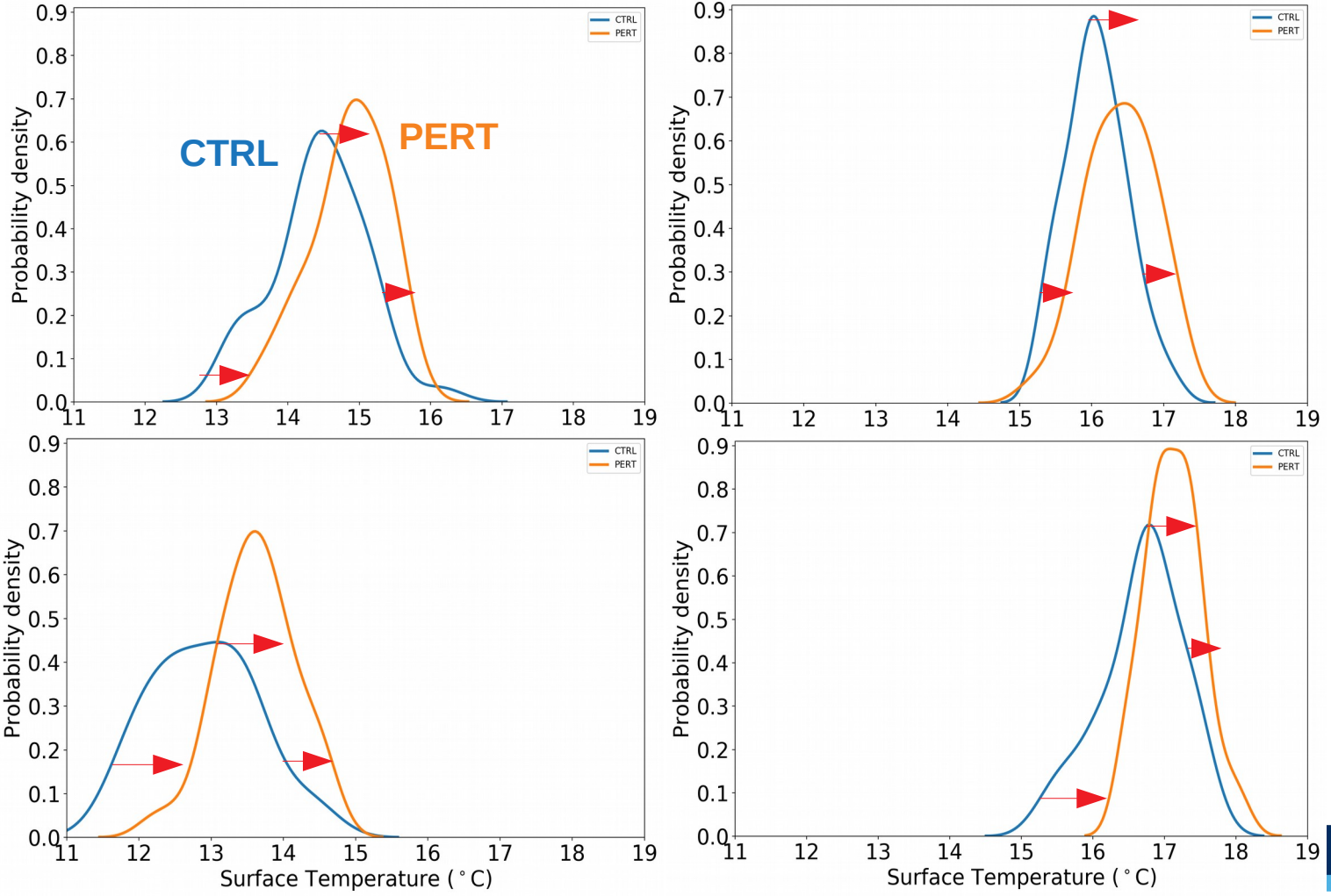
Surface Temperature (Europe)

Summer (JAS)

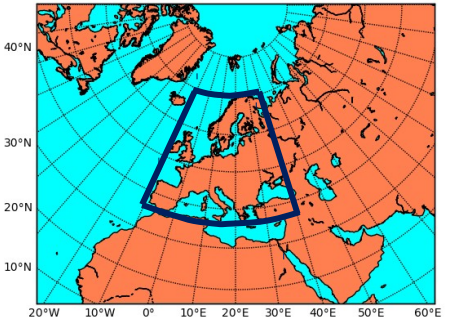
ECMWF | **CNRM**

HR

LR



Europe



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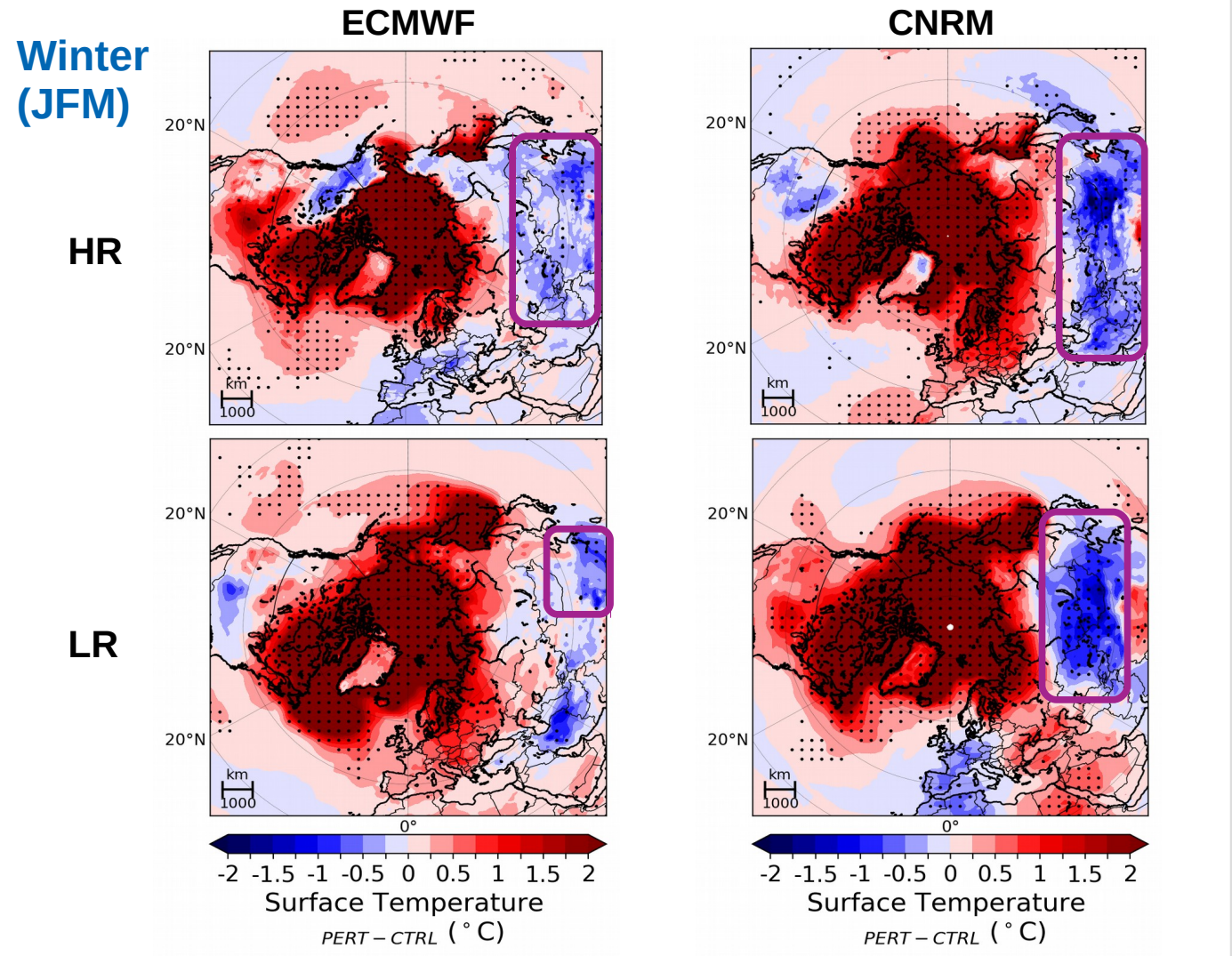
Surface Temperature (Eurasia)



- **Arctic Warming**
- **Some cooling events at mid-latitudes in winter**

Eastern Eurasia cooling

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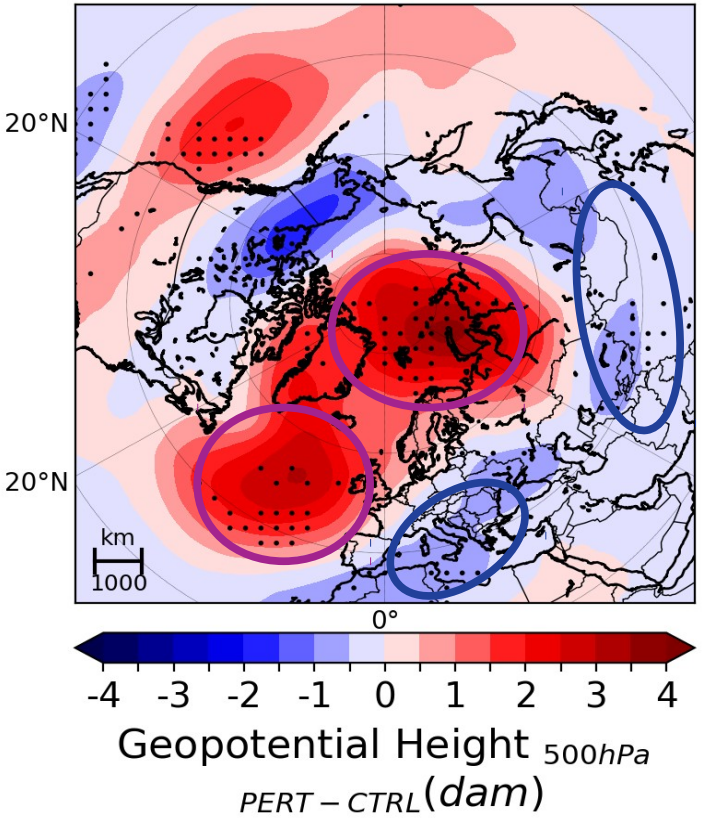
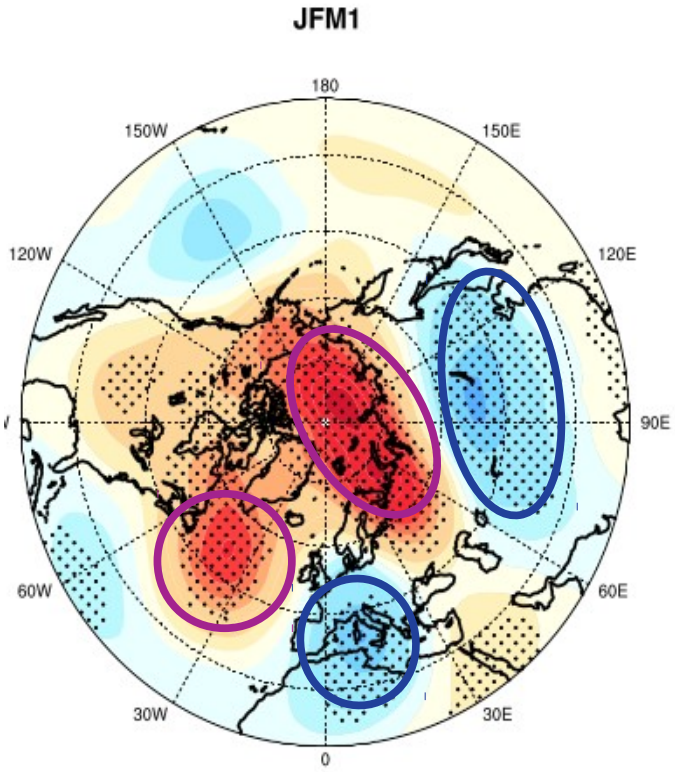
Geopotential Height

Winter (JFM)

ECMWF-IFS-HR



CNRM-CM6-1-LR



Svenya Chripko

- **Negative anomaly over Siberia**
- **Positive height anomaly over BAKA**

Can induce vertically propagating planetary-scale waves

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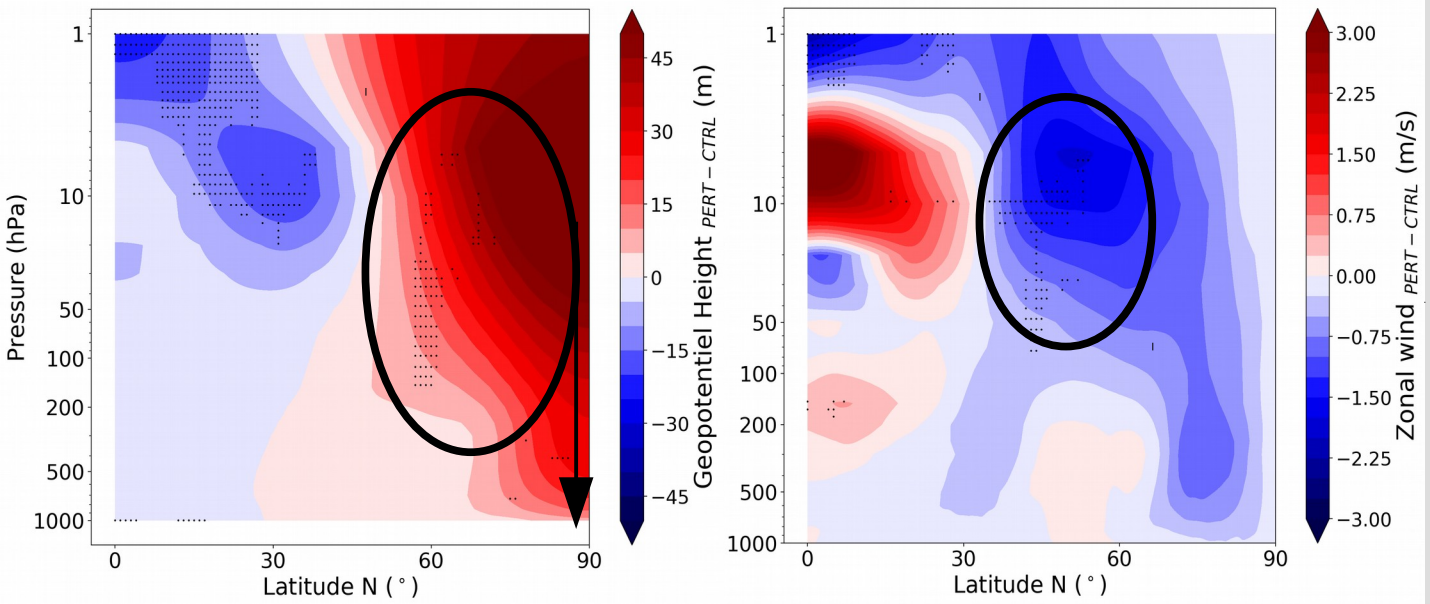
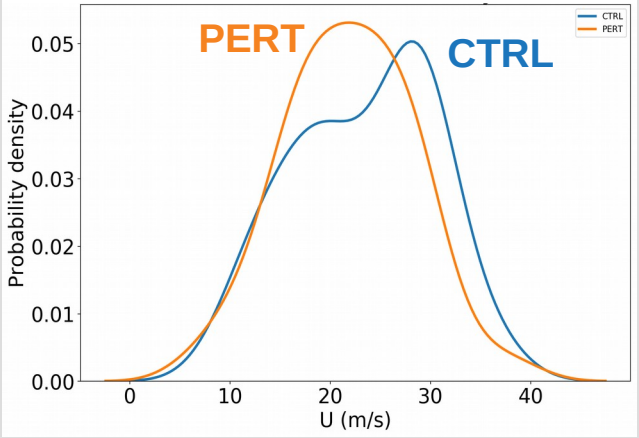
Stratospheric response related to Eurasian cooling

Winter (JFM)

ECMWF-IFS-HR



PDF of 10hPa zonal winds at 60°N



Weakening stratospheric polar vortex (// Kim et al, 2014)

Eastern Eurasia cooling

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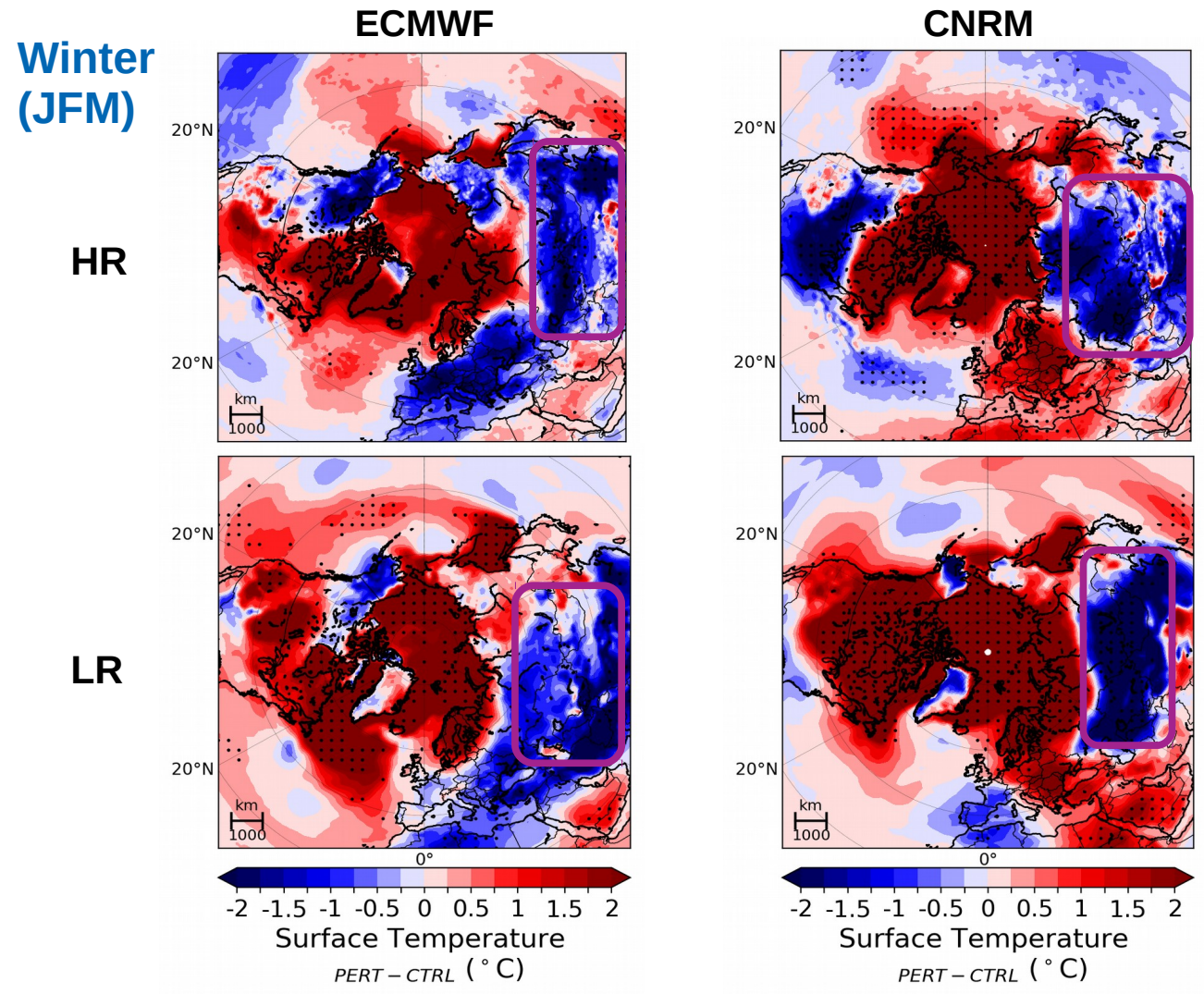
Surface Temperature (Eurasia)



- **Only the 5 members where the AMO is the lowest in the CTRL run**
- **Eastern Eurasia cooling in winter is amplified**
- **This is non-linear in HR for the 40 members**

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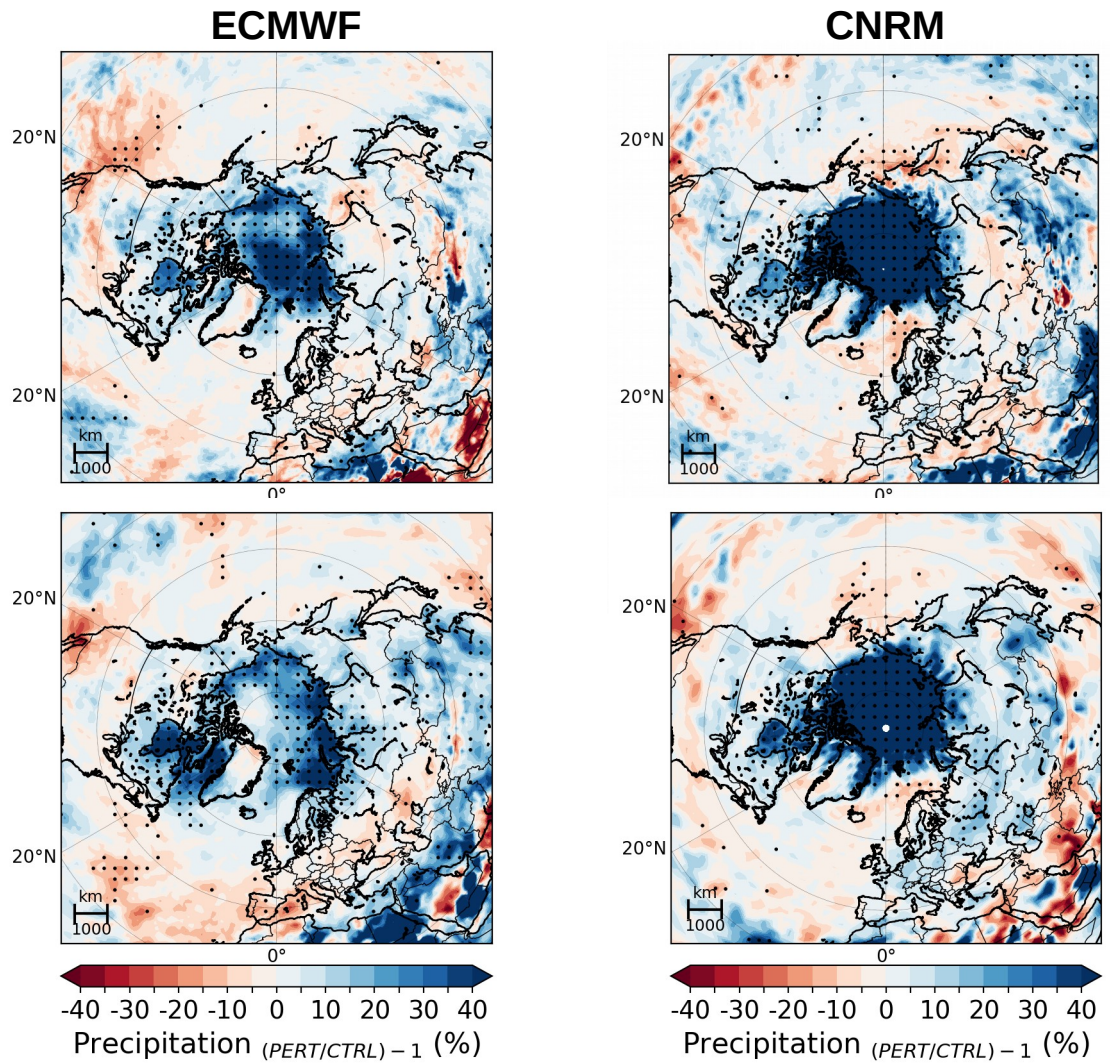
Precipitation (Liq + Sol)

Fall (OND)



- **Increase over Arctic**
  - **Mainly in fall**
    - **Heat and moisure from ocean to atmosphere**
  - **Mainly in CNRM**
    - **SI loss more important**

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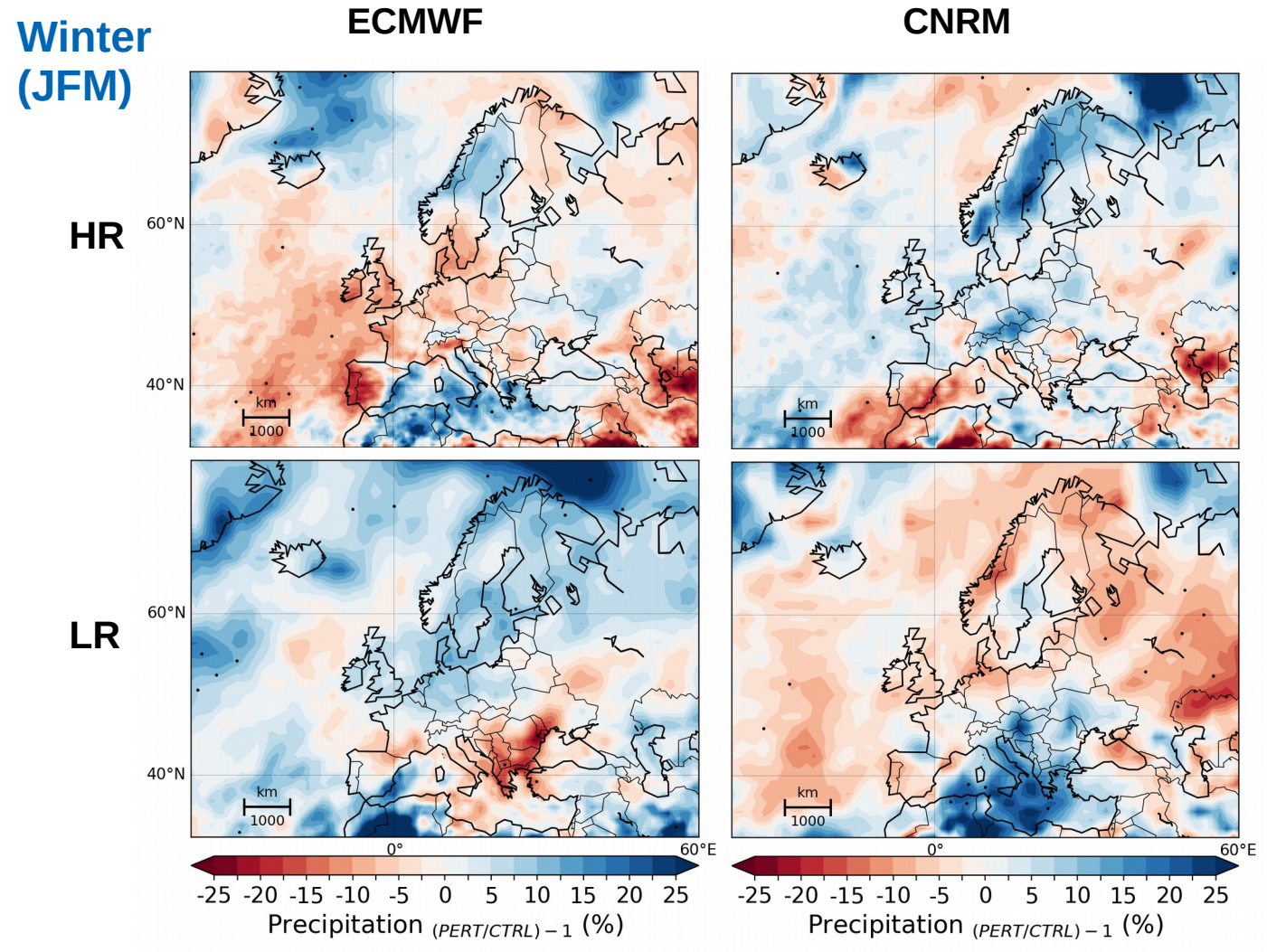
Precipitation (Liq + Sol) in Europe



- **In Europe**
  - **Less intense and less significant responses**
  - **Divergent responses between models and resolutions**

Internal variability is important

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Summary

- Arctic warming all seasons
- Eastern Eurasia cooling in winter (caused by stratospheric polar vortex weakening ?)
- Eastern Eurasia cooling amplified during AMO (AMV) –
- No robust precipitations responses over Europe

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Thank you for your attention
Any questions ?
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