

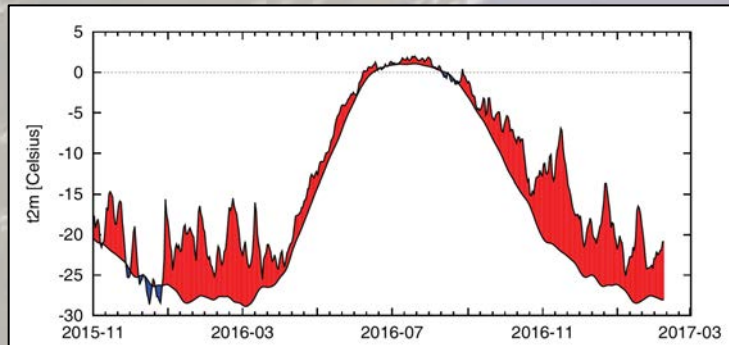
Observed Arctic sea ice loss and Arctic amplification

Richard Bintanja, KNMI/RUG, Netherlands

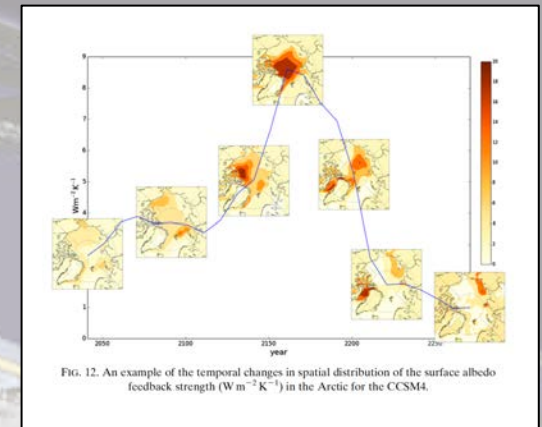


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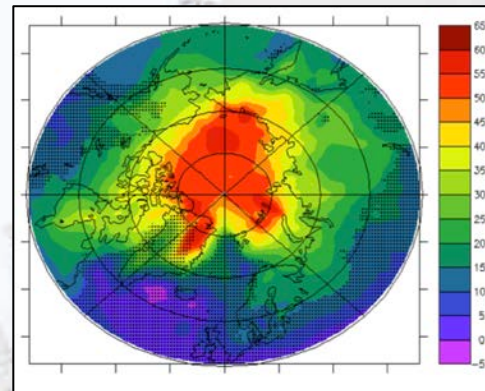
Current trends (warming)



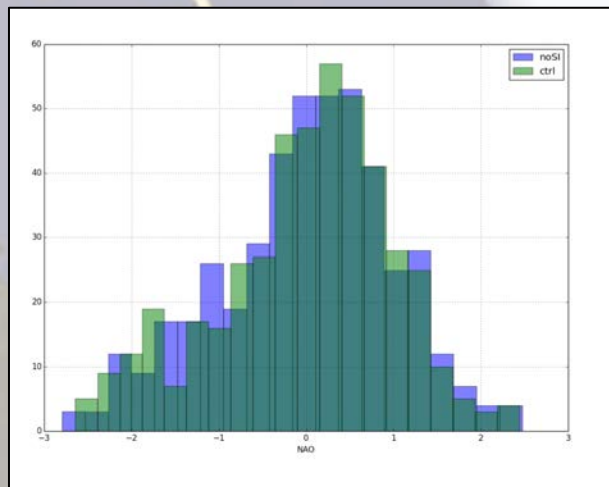
Arctic feedbacks



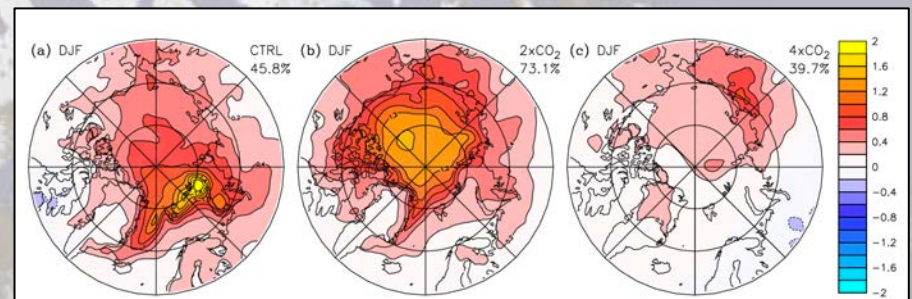
Hydrological cycle



Arctic-midlatitude interactions

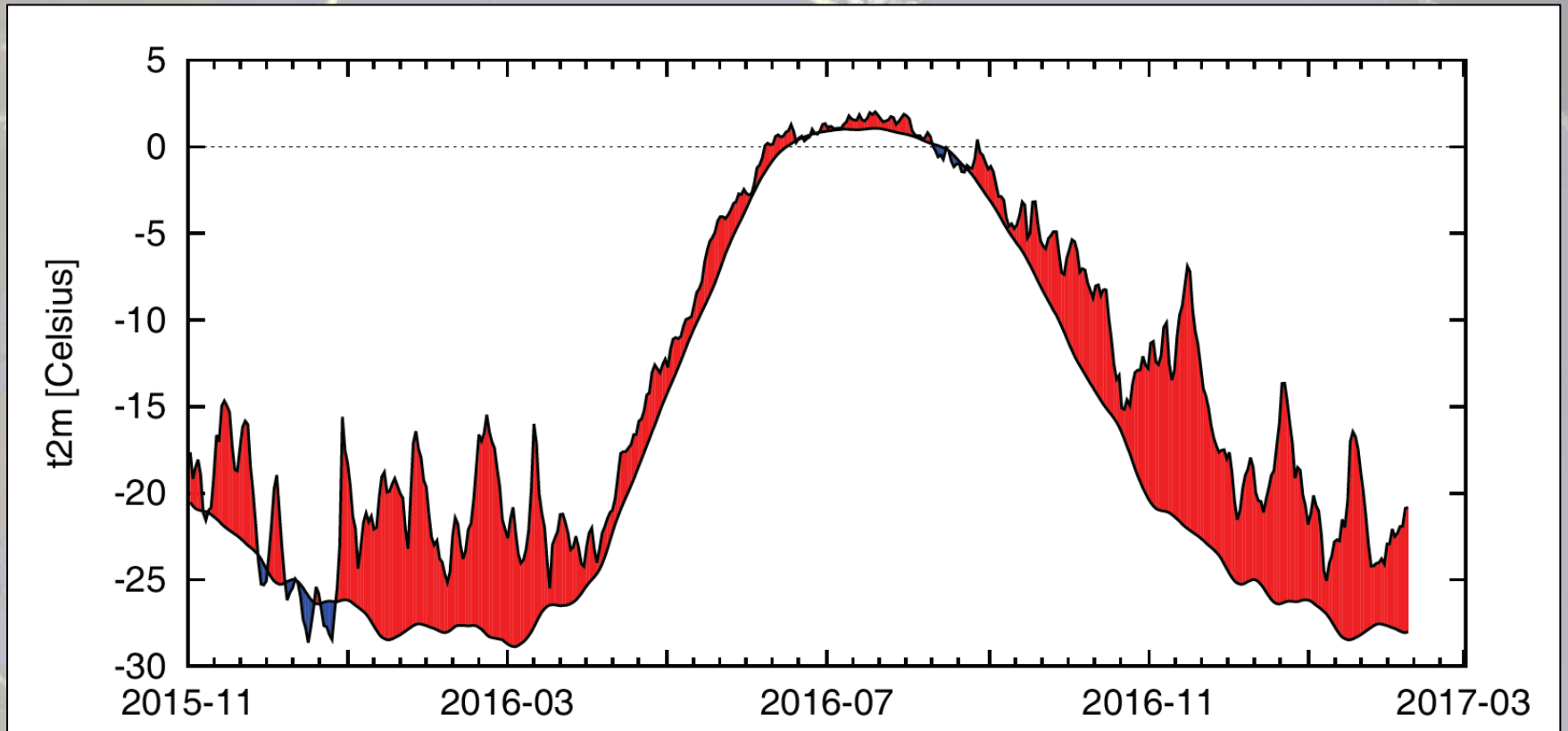


Arctic decadal variability

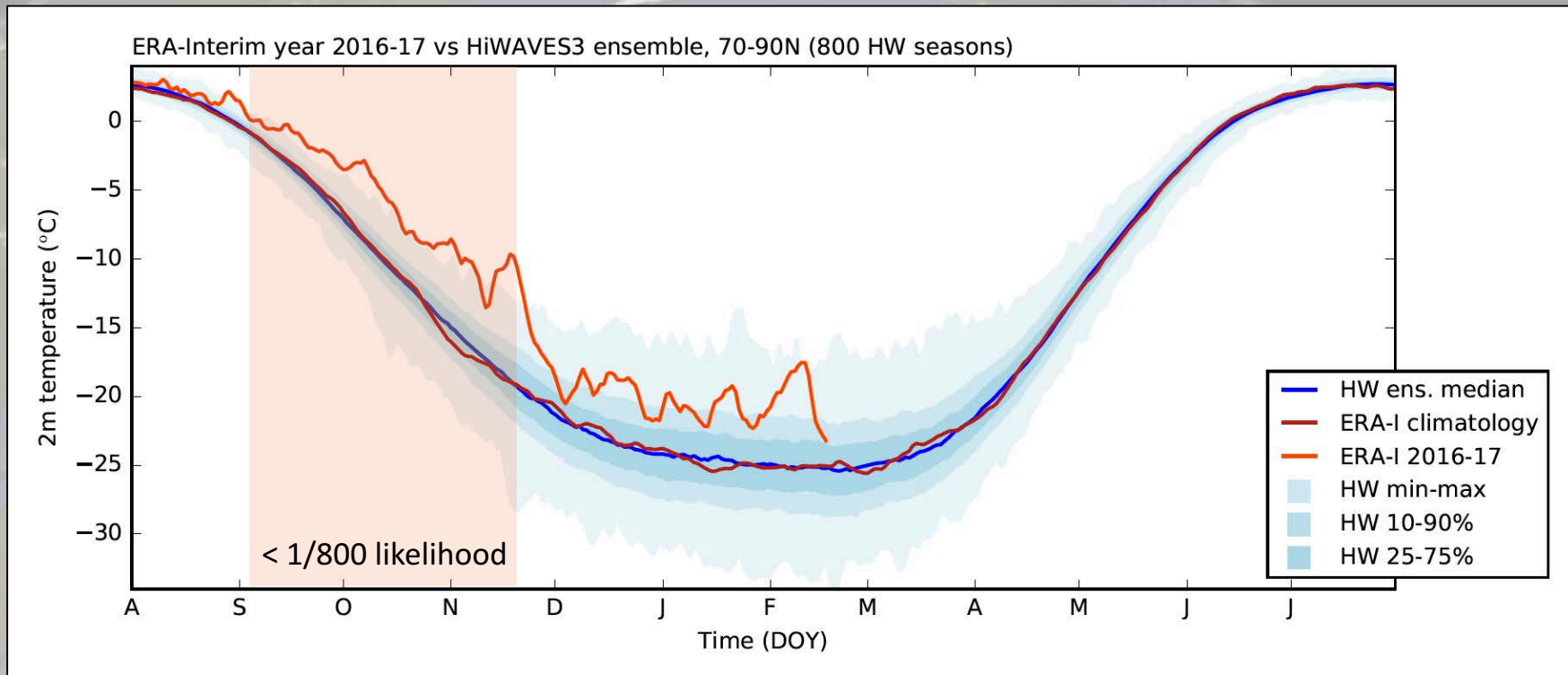


Current trends

T2m 80-90°N ECMWF analyses – ERAint (1981-2010)

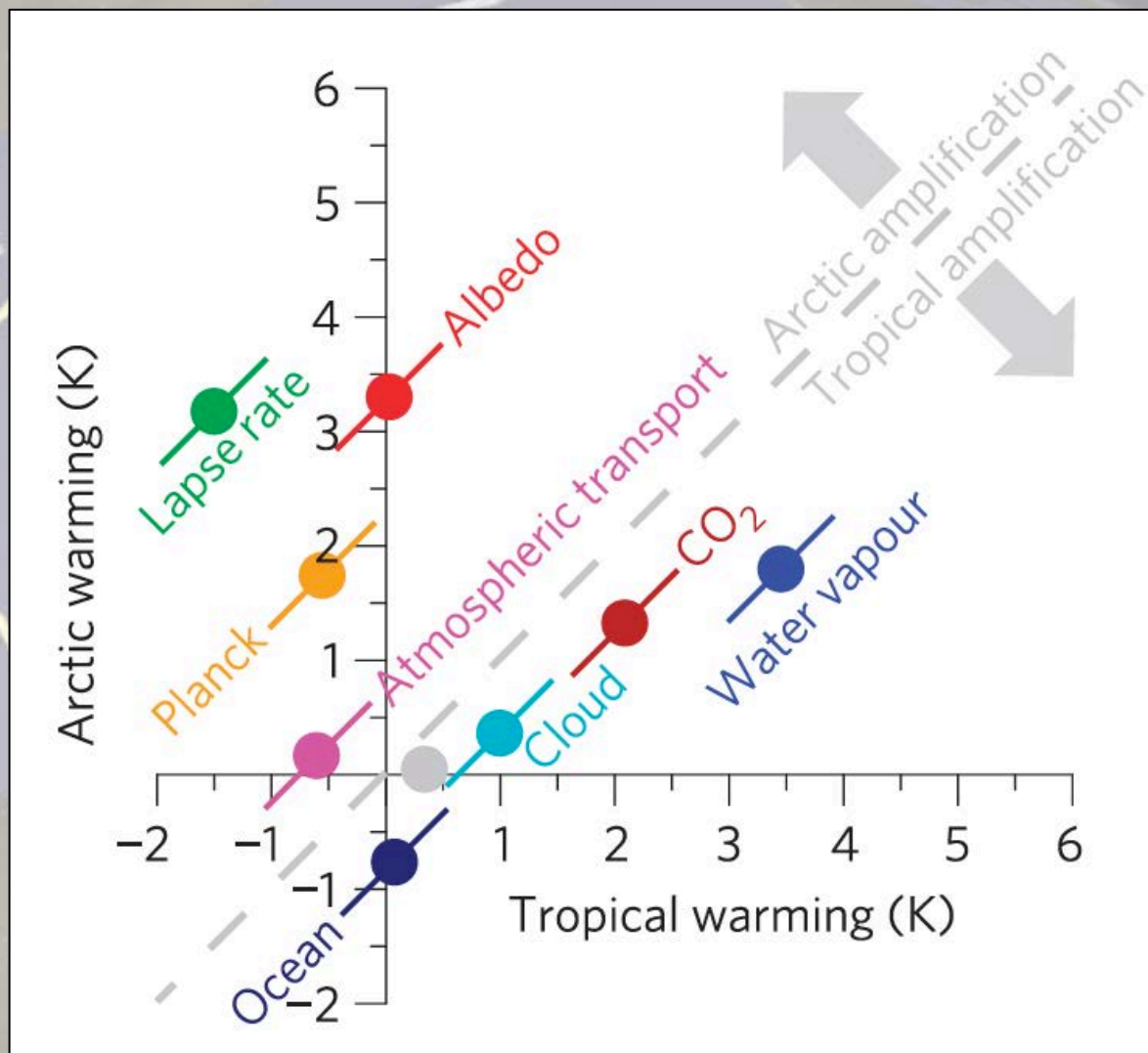


van Oldenborgh et al., 2017



Compared to present-day, 800 years EC-Earth

Arctic feedbacks

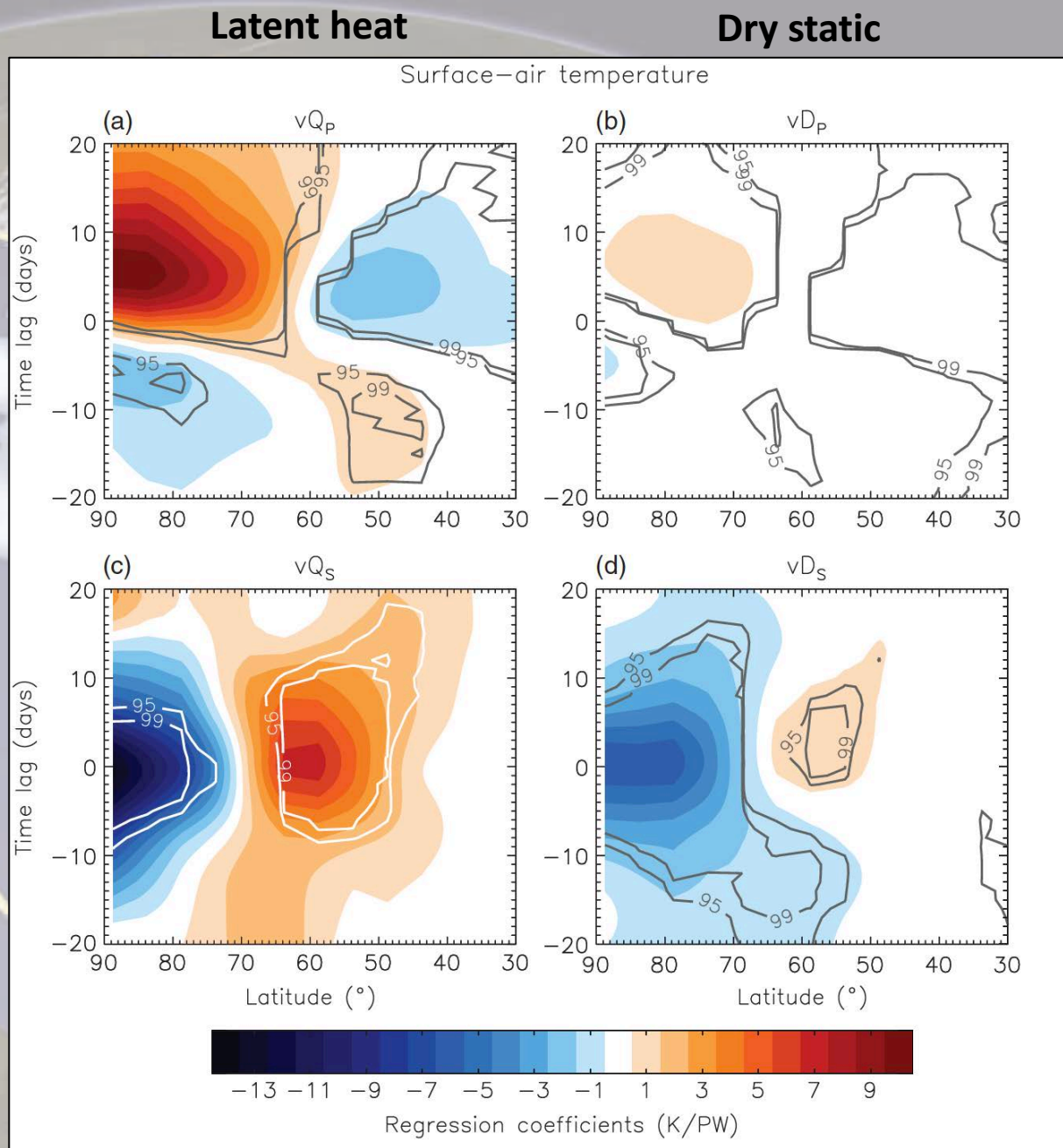


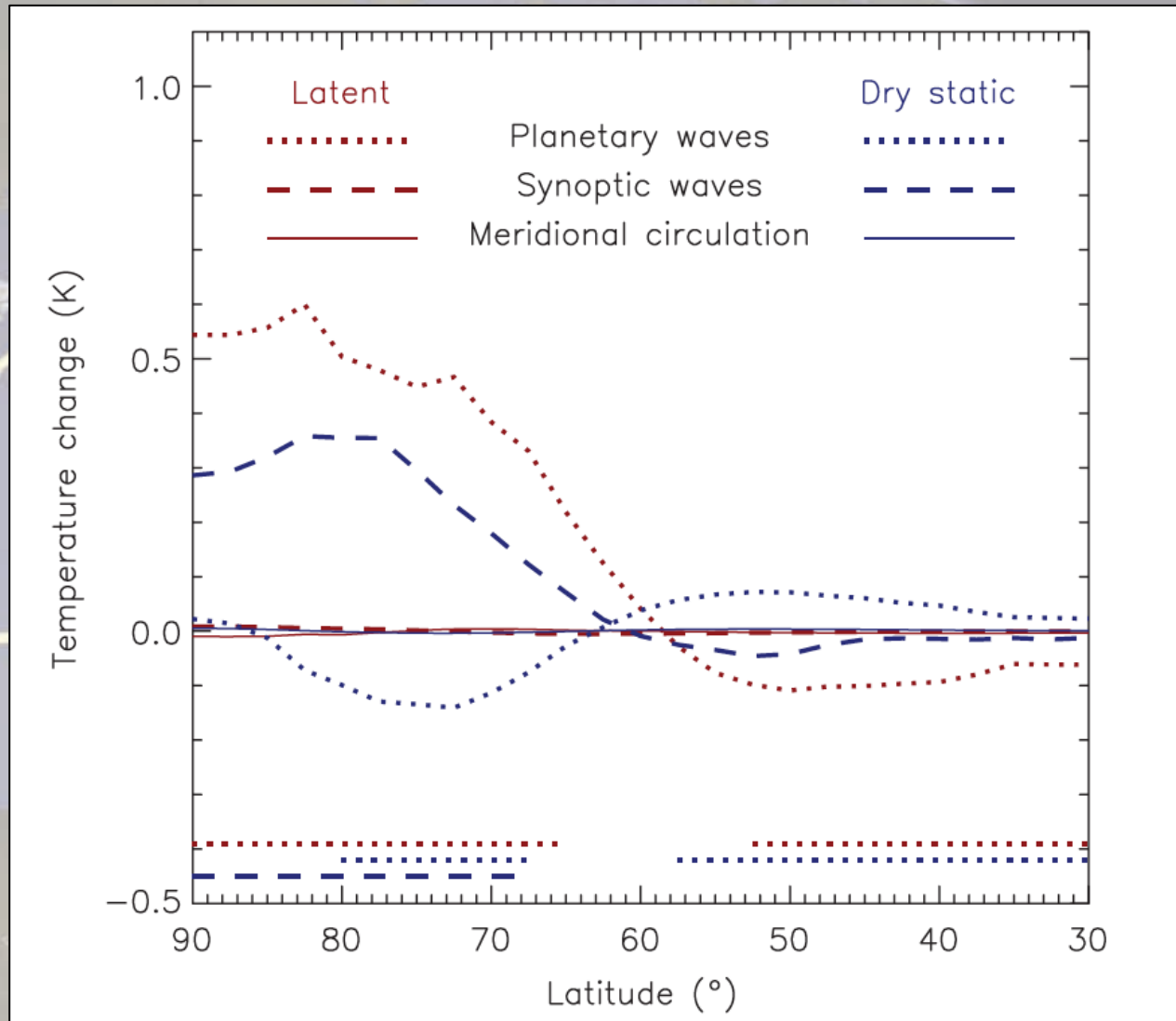
Pithan and Mauritsen, 2014

Atmospheric
transport
feedback

Planetary

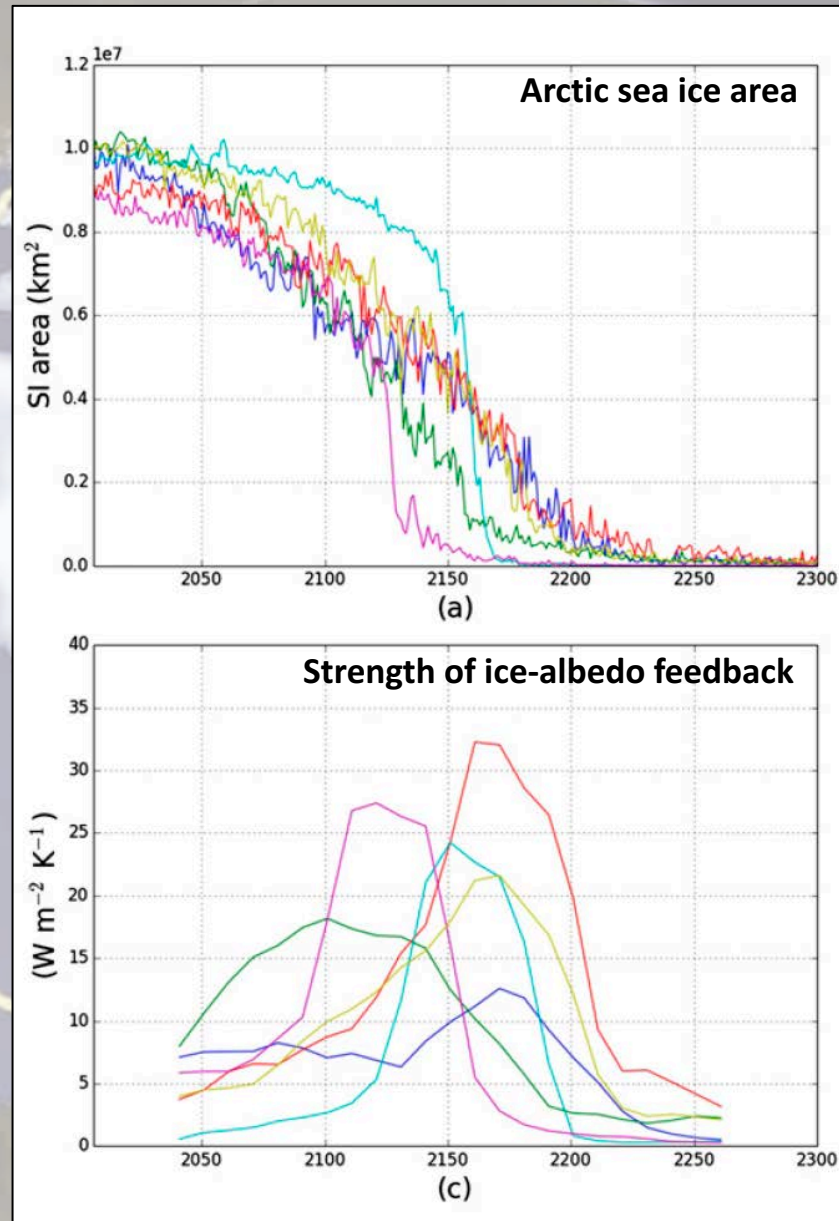
Synoptic





Graversen and Burtu, 2016

Time-dependency of Arctic feedbacks



Andry et al., 2016

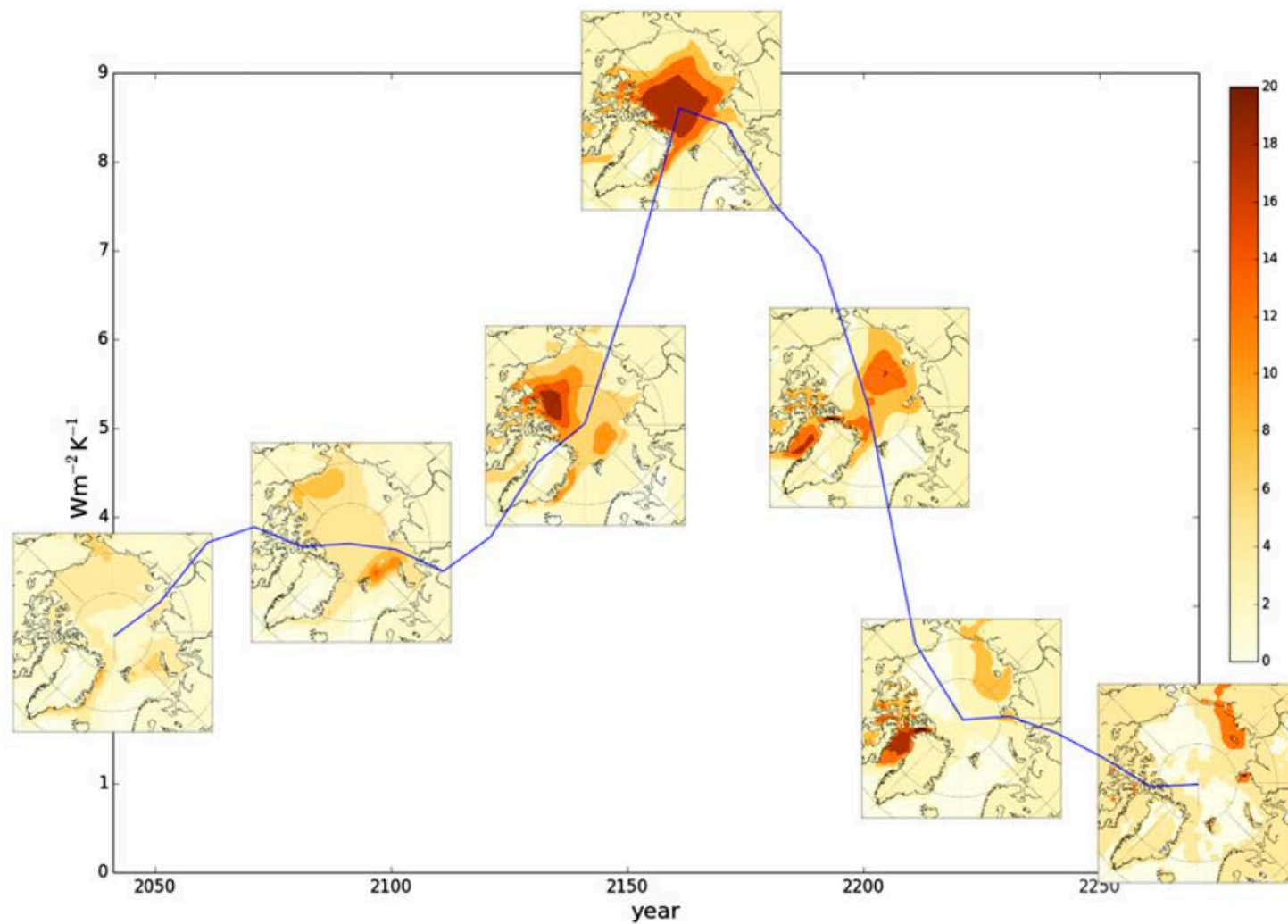
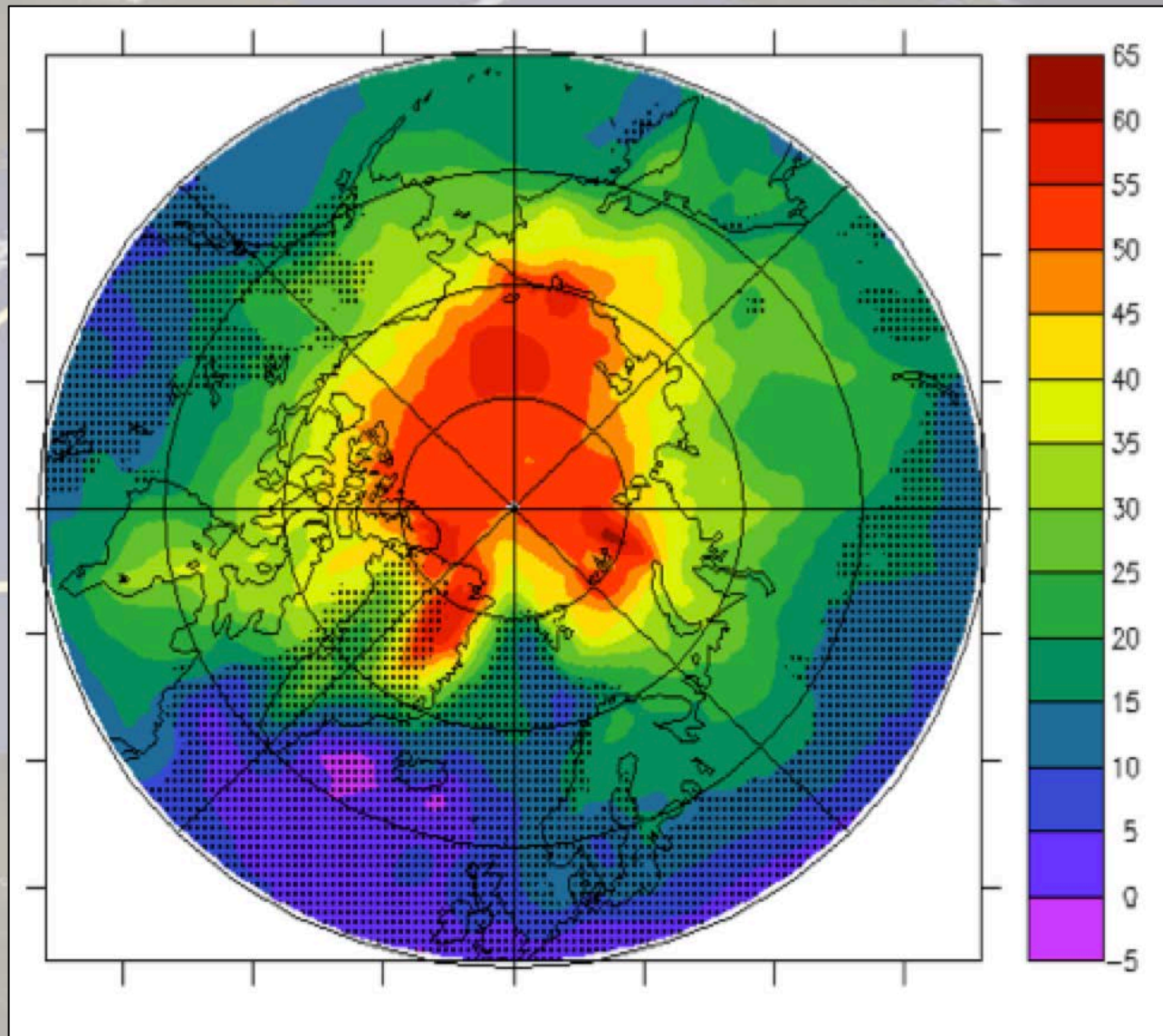


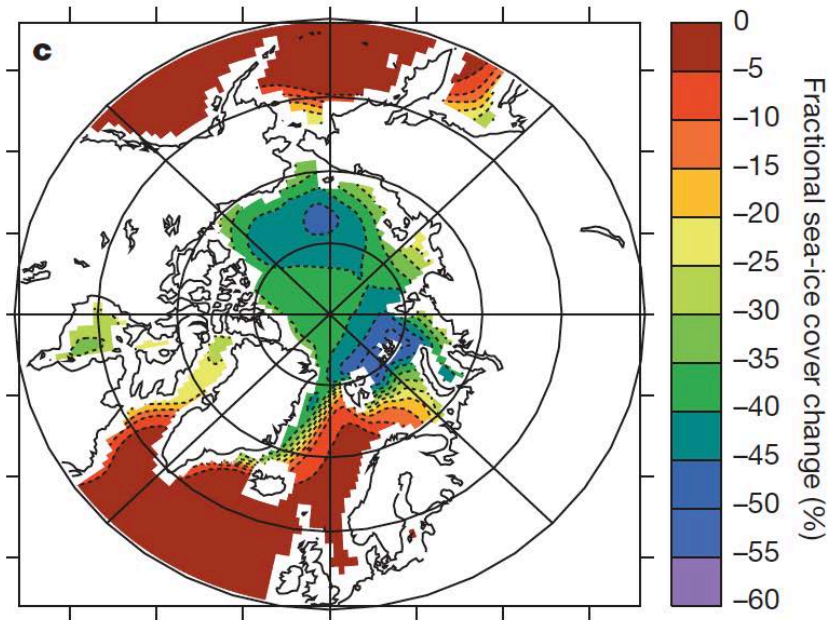
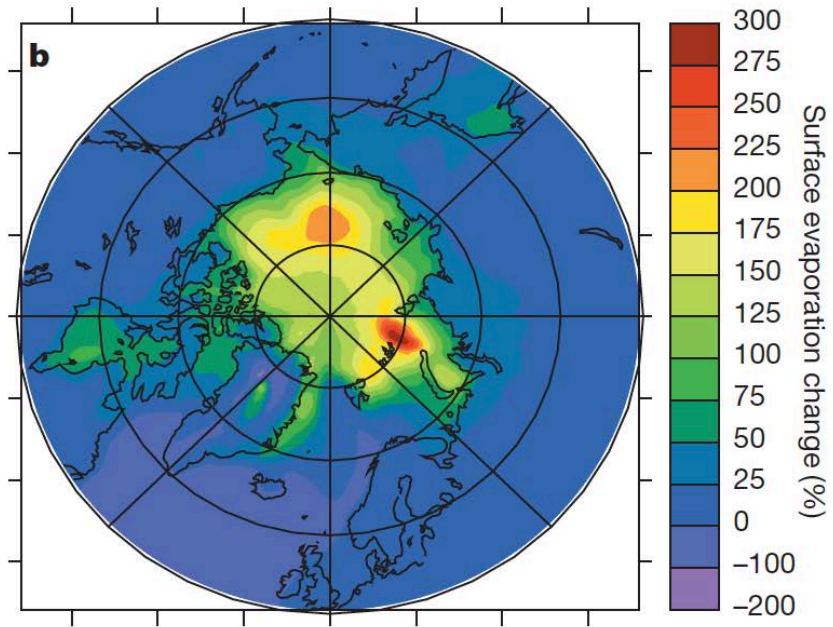
FIG. 12. An example of the temporal changes in spatial distribution of the surface albedo feedback strength ($\text{W m}^{-2} \text{K}^{-1}$) in the Arctic for the CCSM4.

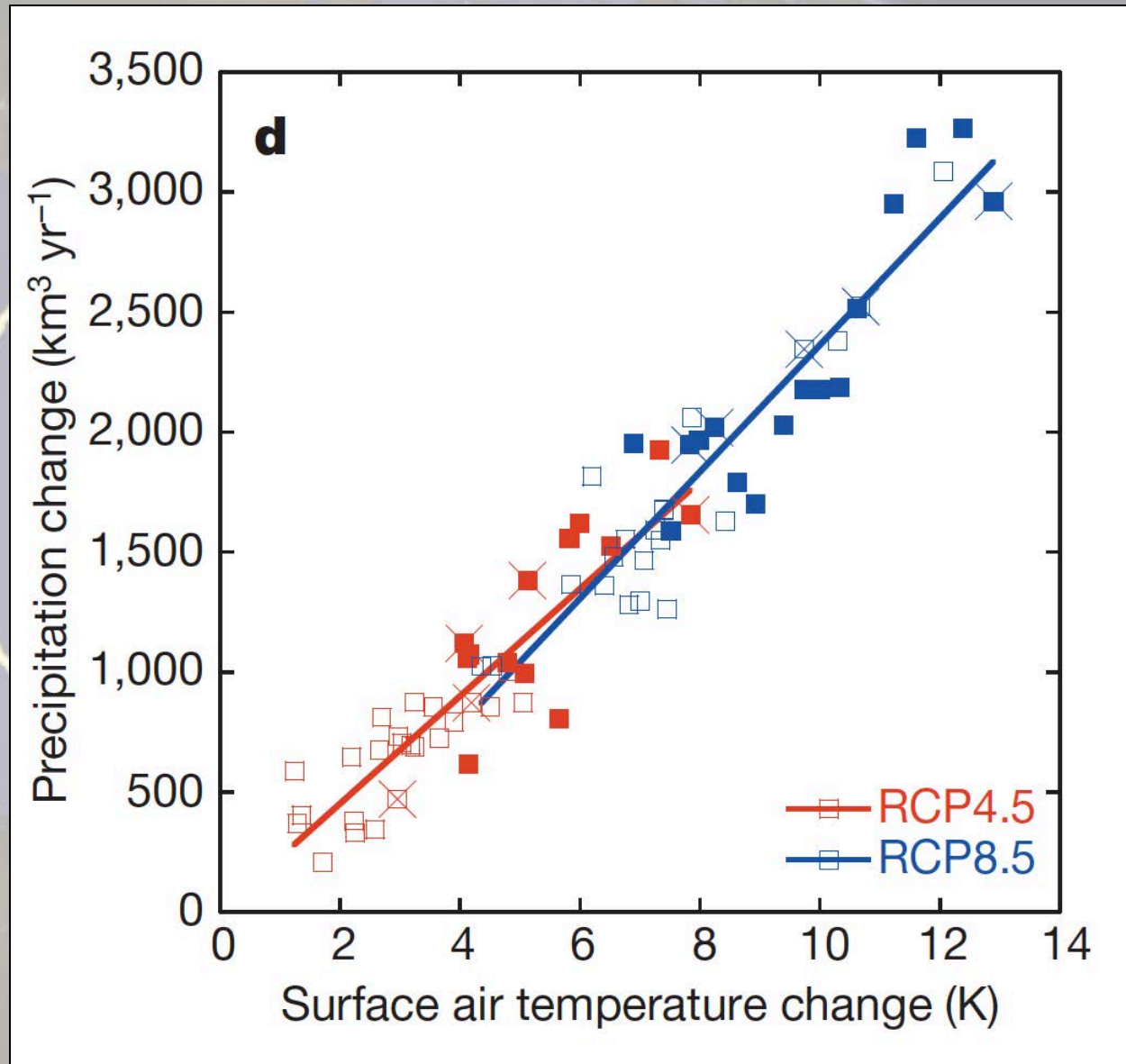
Hydrological cycle

Precipitation change (%) for RCP85 (21st century)

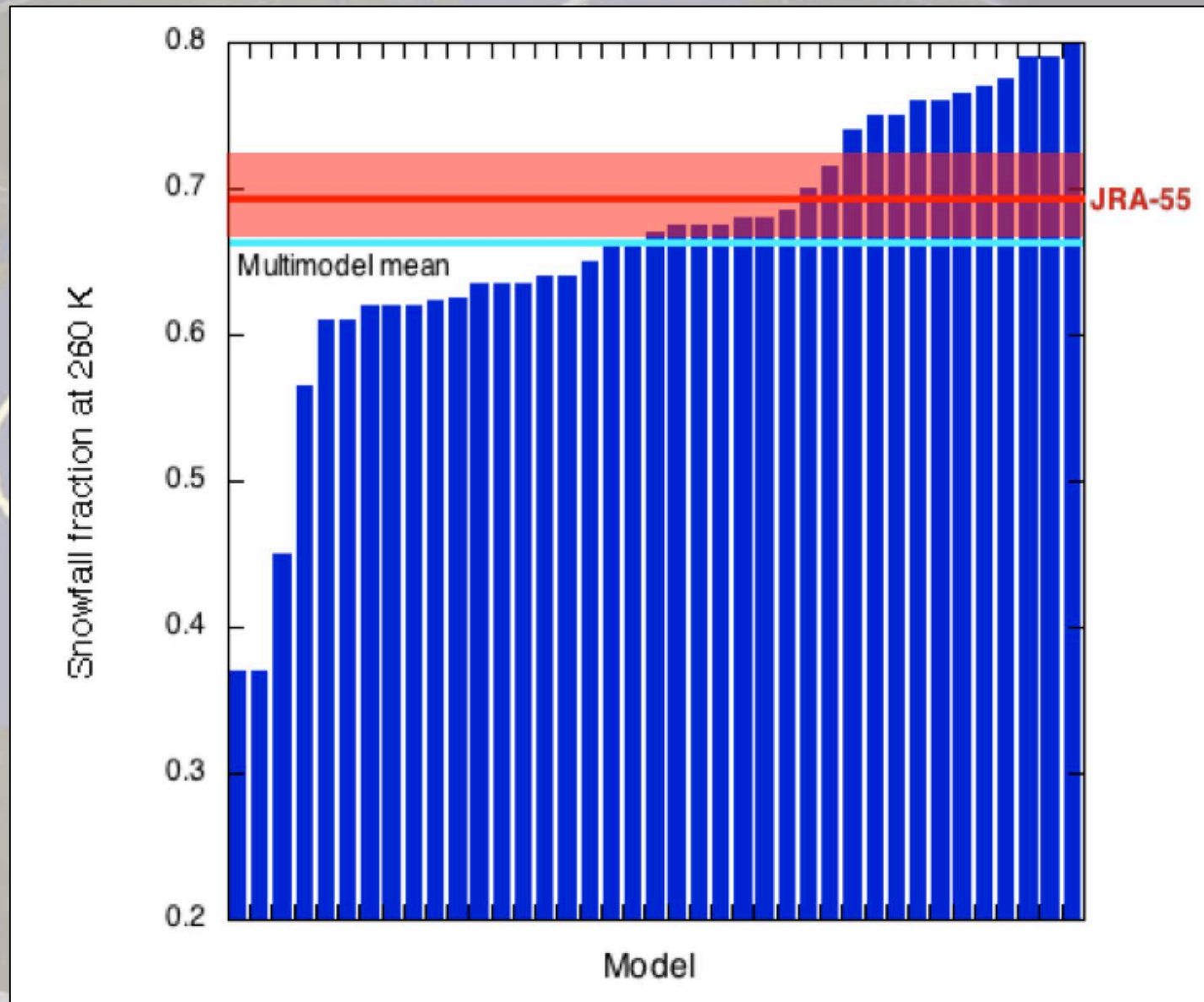


Bintanja and Andry, 2017

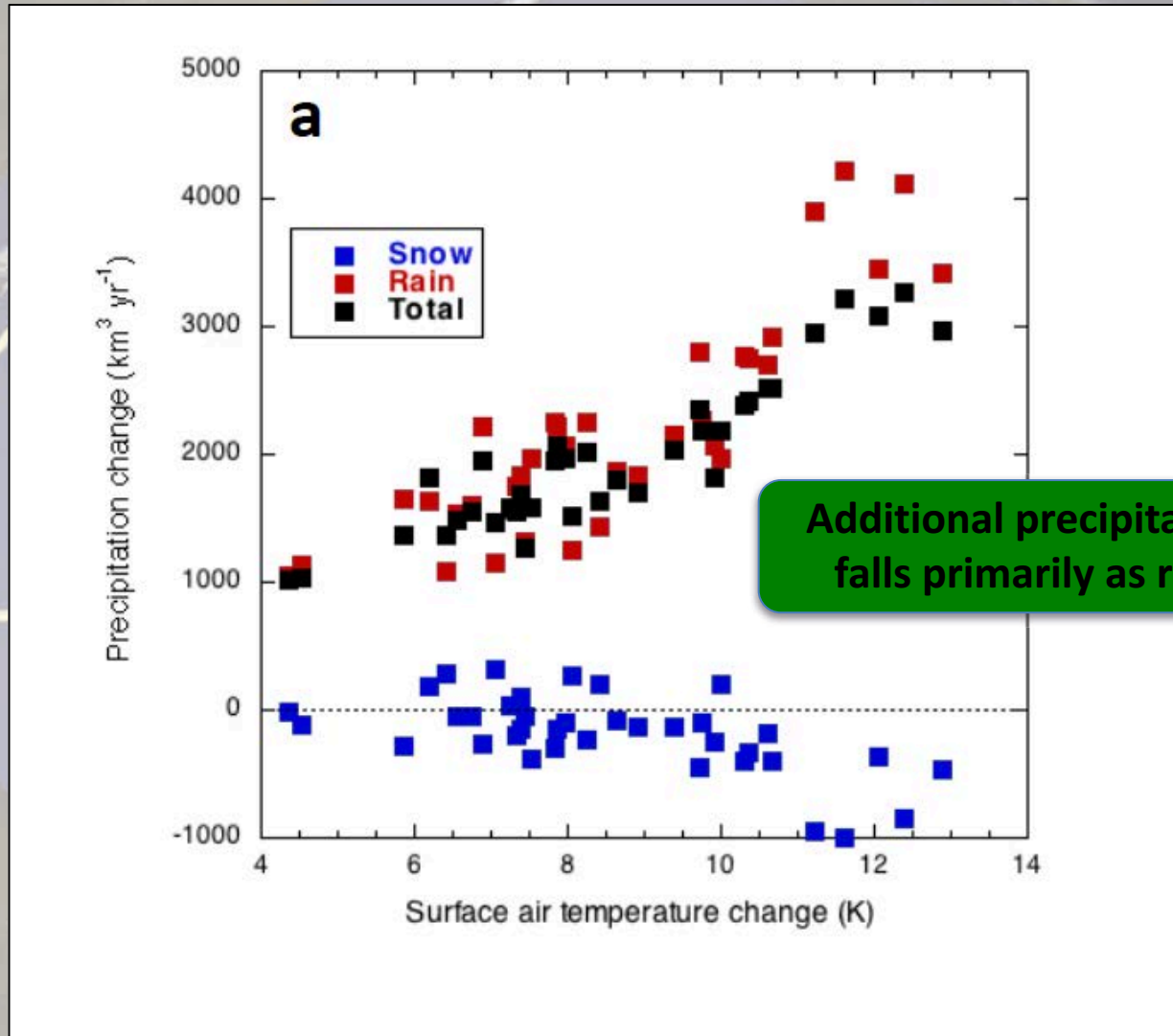




Snowfall or rainfall?

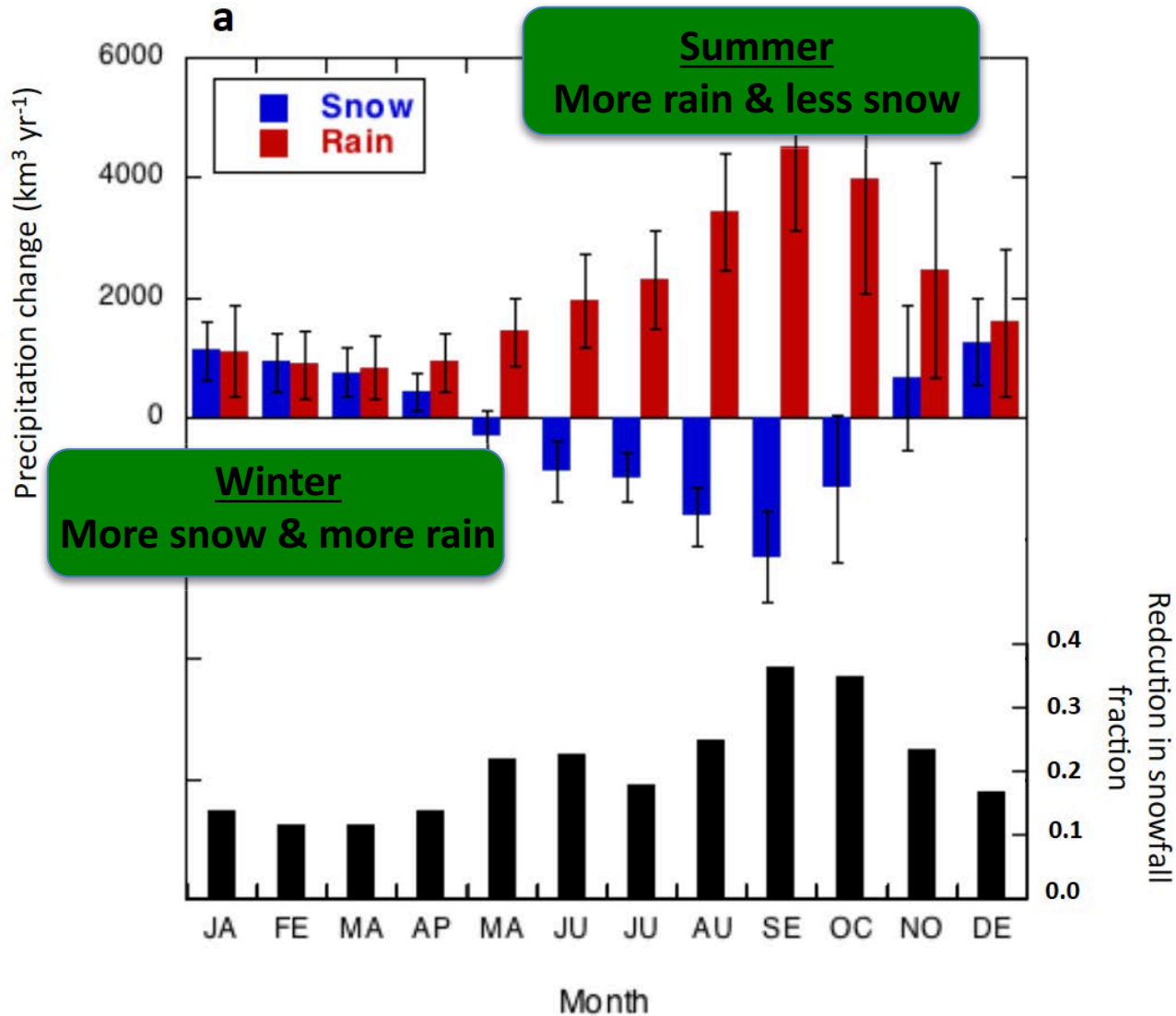


Changes in Arctic mean rainfall/snowfall, RCP8.5

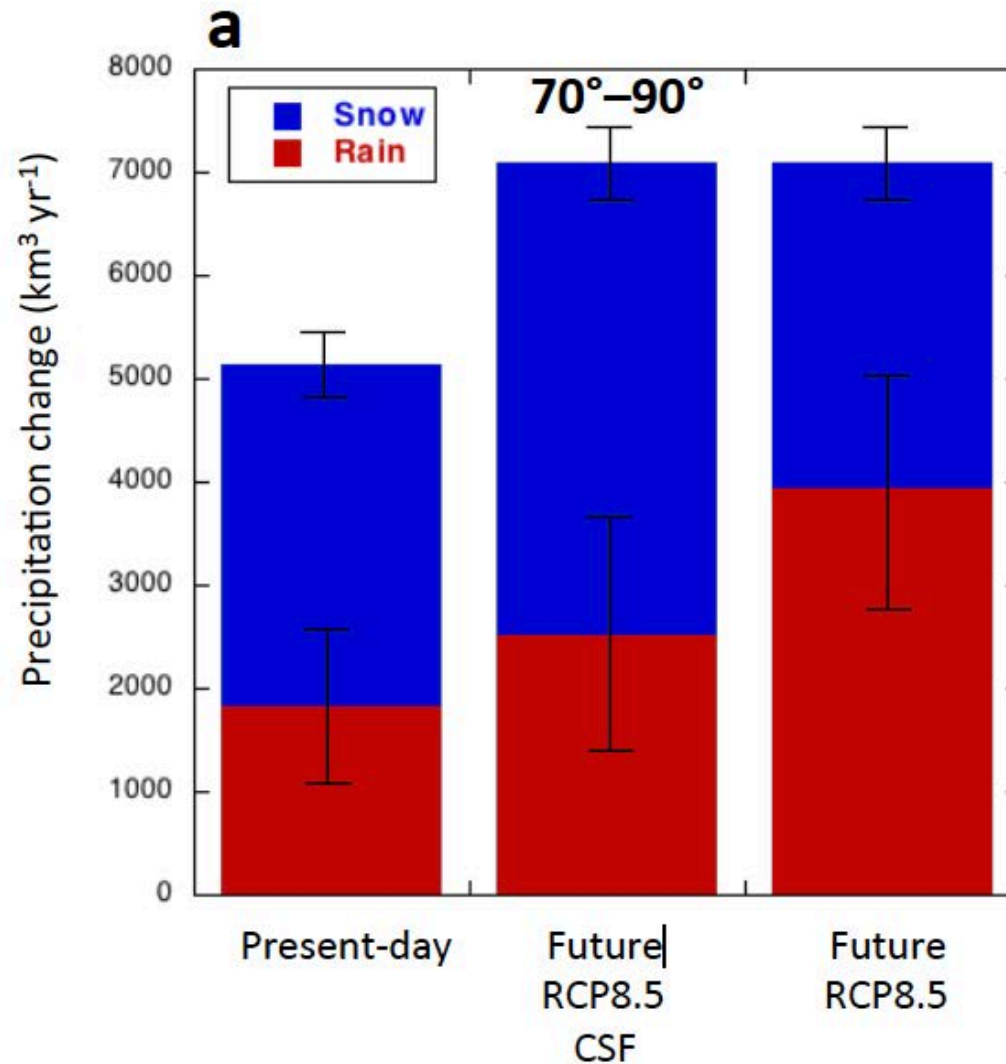


Bintanja and Andry, 2017

Changes in Arctic rainfall/snowfall, RCP8.5



Changes in Arctic rain/snow, RCP8.5

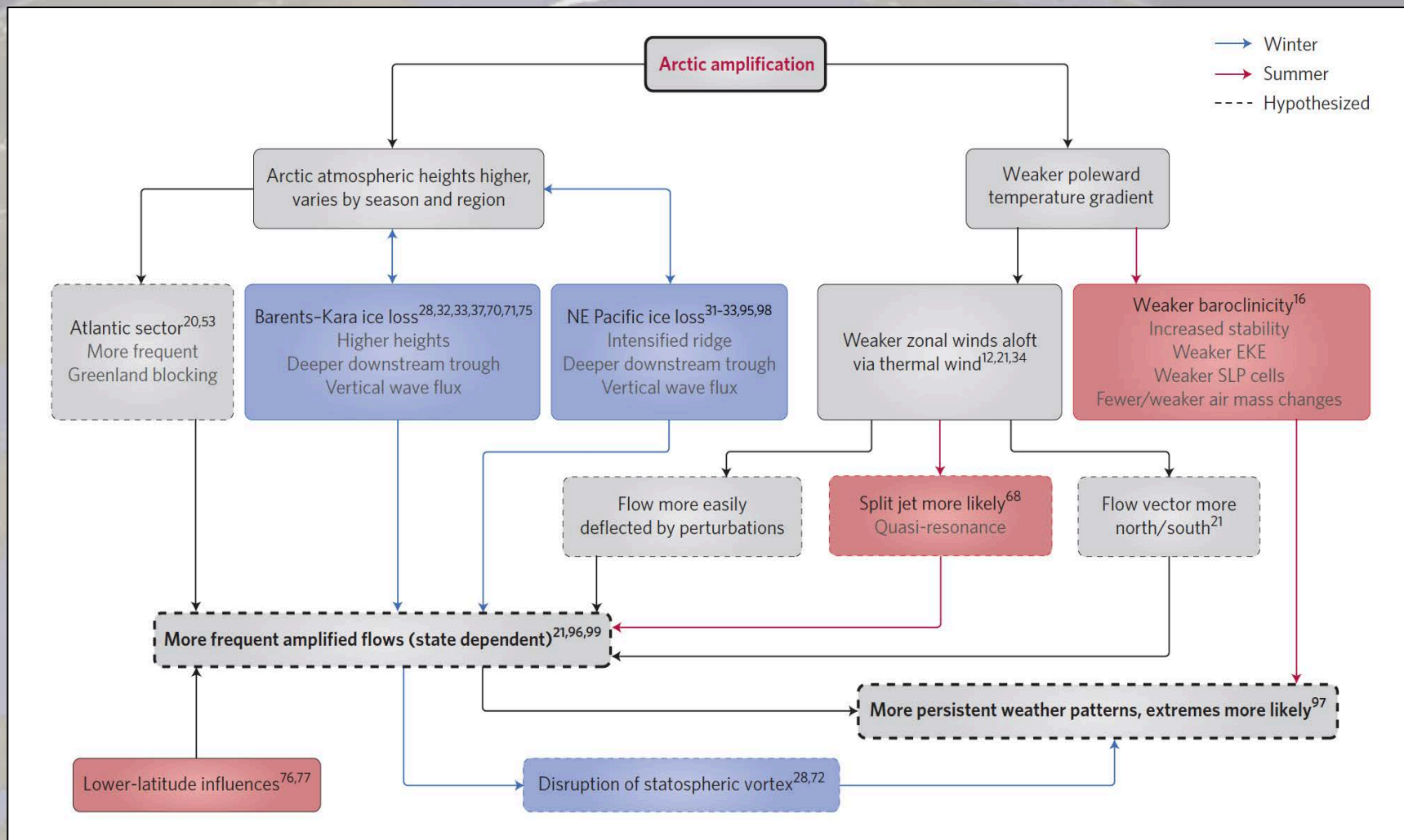


This will affect

- Surface albedo
- Snowmelt
- Sea ice retreat
- Run-off
- Marine ecology
- Terrestrial ecology
- Permafrost thawing

**Rain will dominate
future Arctic precipitation**

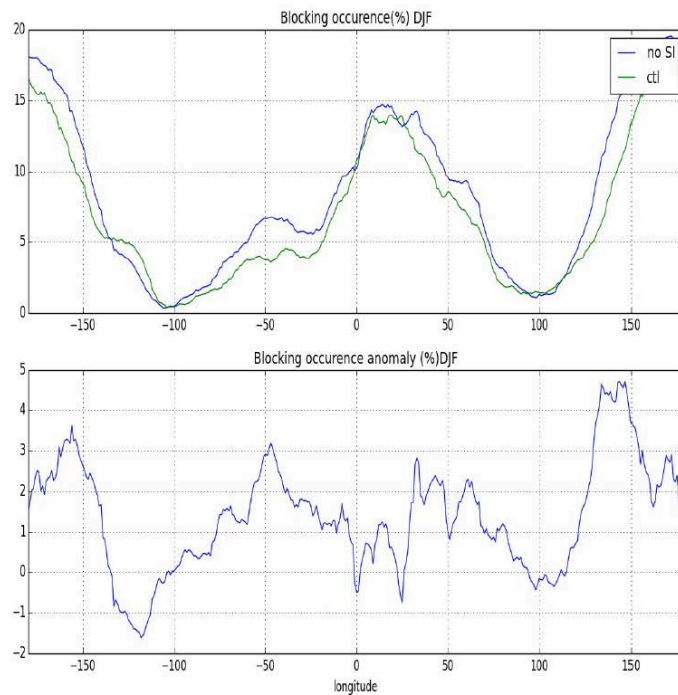
Effects of Arctic changes on midlatitude weather



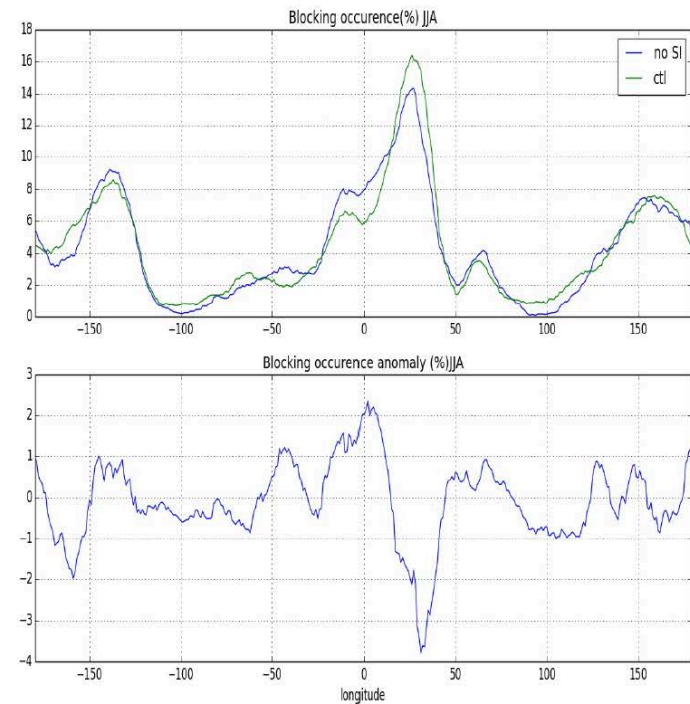
Overland et al., 2016

Artificial total sea ice removal, SST warming – effects on midlatitude dynamics

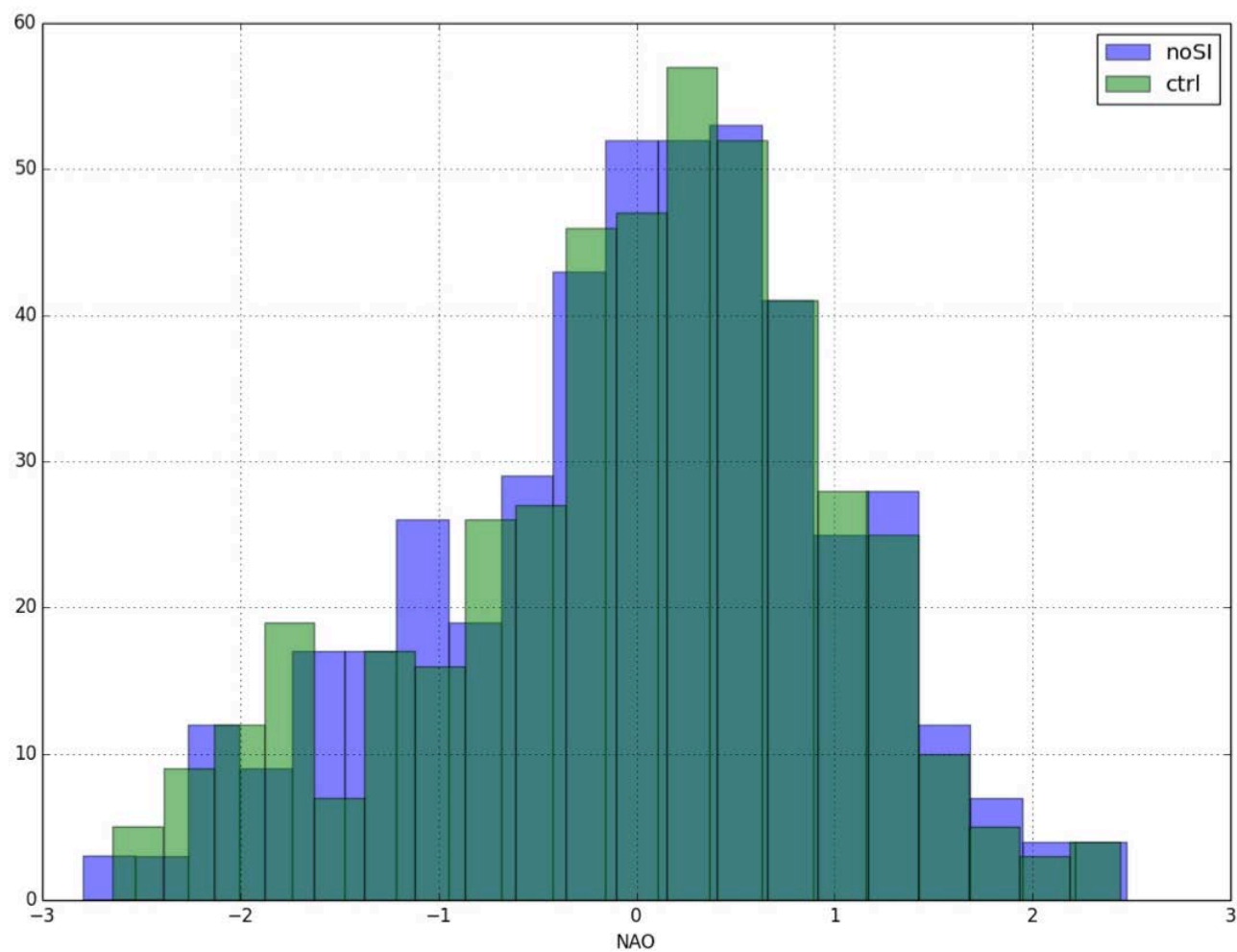
Winter blocking



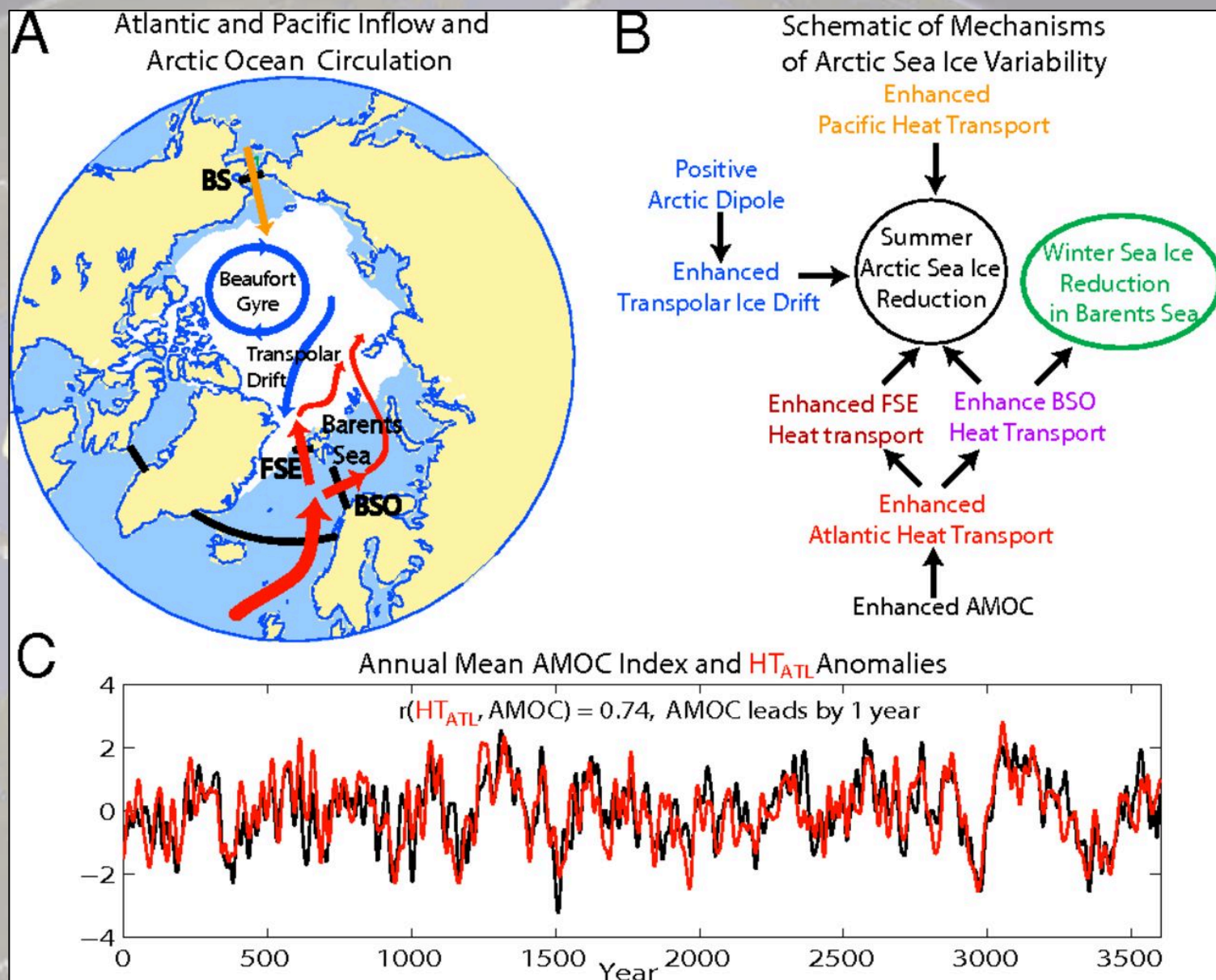
Summer blocking



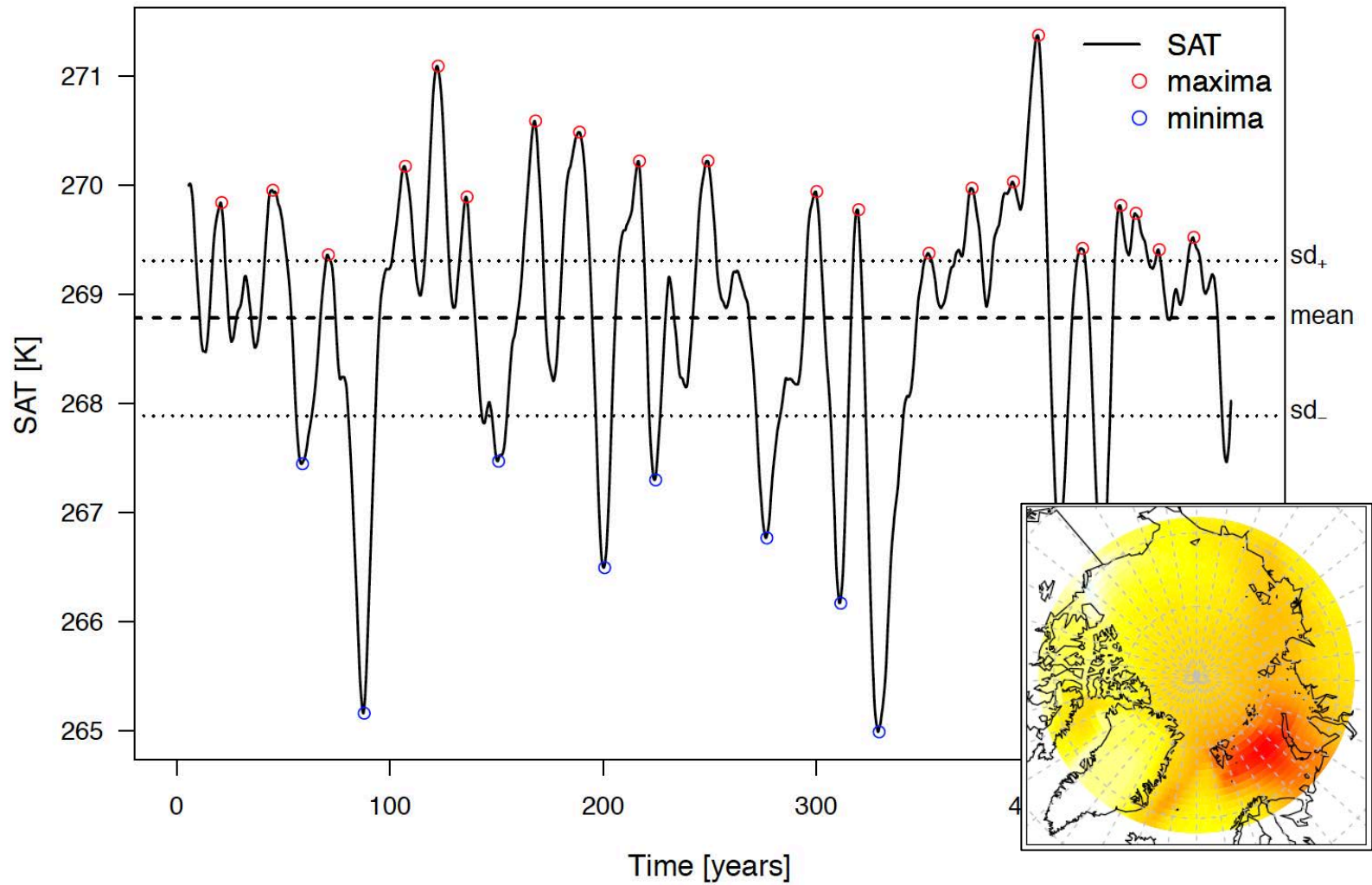
Artificial sea ice removal, SST warming – effect on NAO



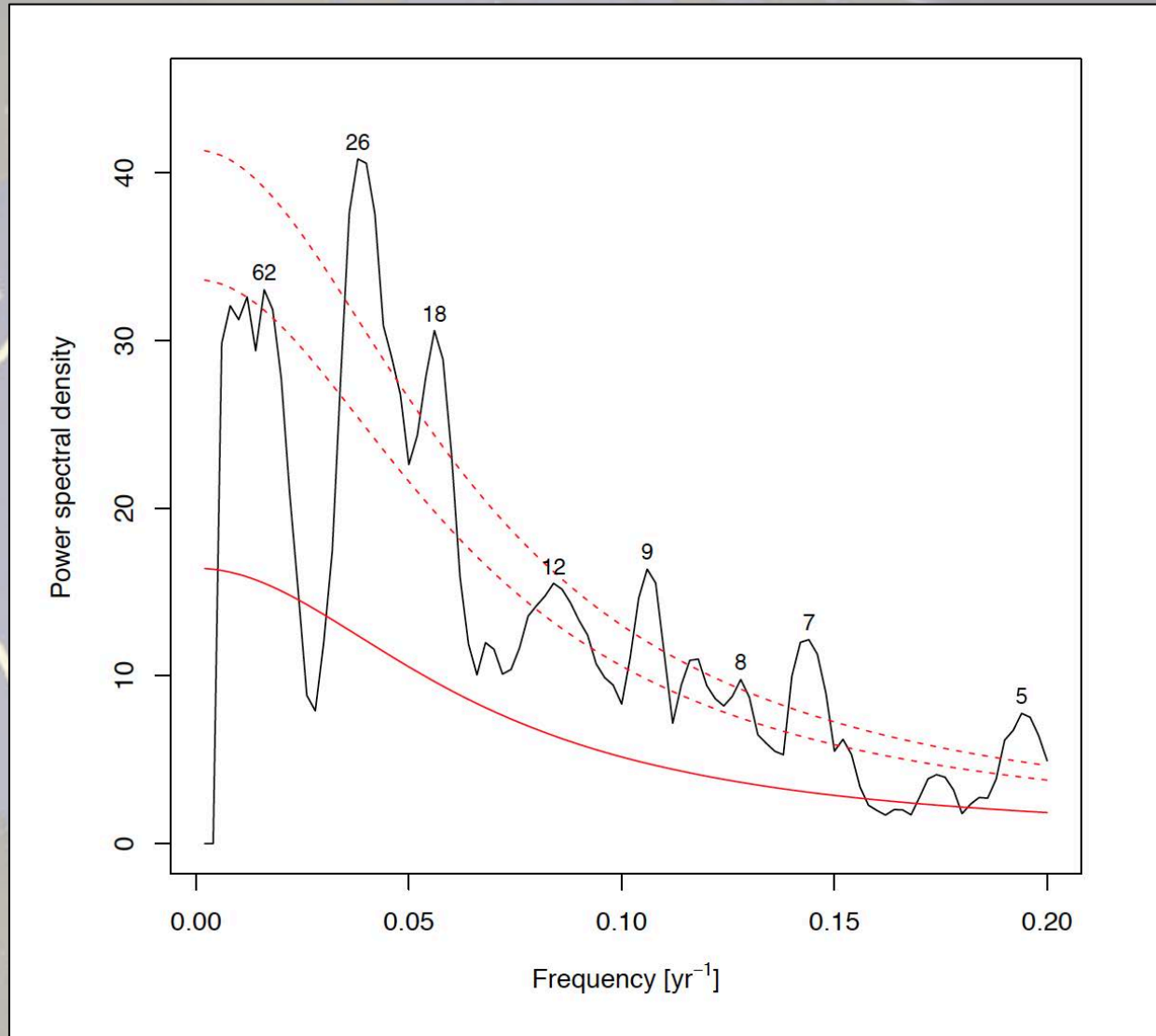
Arctic decadal variability (ADV)



500 year EC-Earth constant present-day forcing

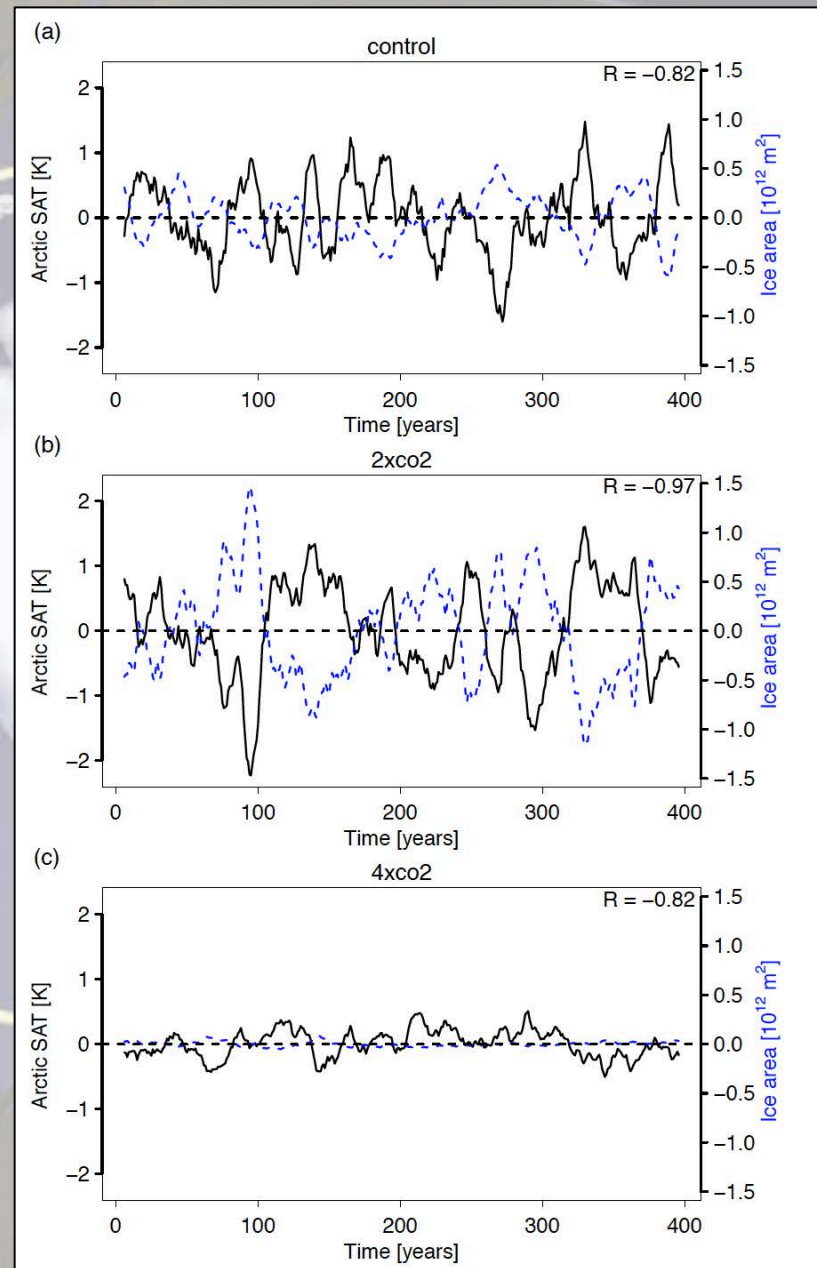


500 year EC-Earth constant present-day forcing



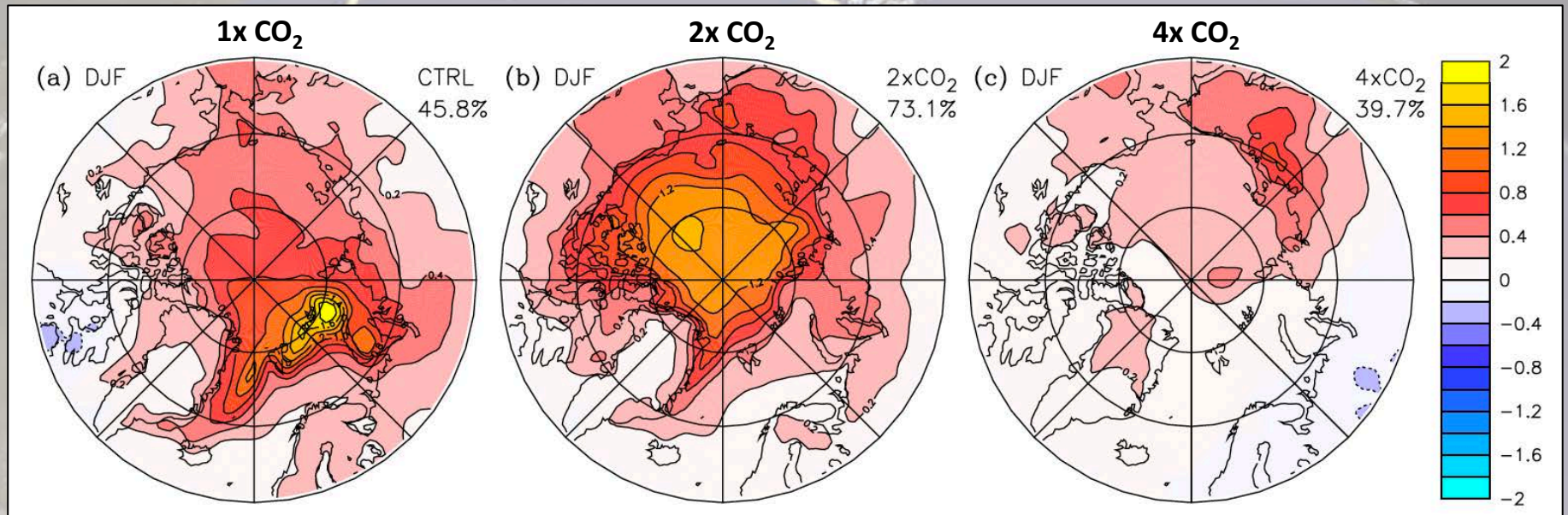
van der Linden et al., 2017

ADV in a warming world



van der Linden et al., 2017

ADV in a warming world – linked to sea ice cover



van der Linden et al., 2017

Thank you

Richard Bintanja (bintanja@knmi.nl)



Royal Netherlands
Meteorological Institute
Ministry of Infrastructure and the
Environment



university of
 groningen