ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

Large ensembles of uncoupled and coupled model experiments on the influence of Arctic sea ice decline on mid-latitude weather and climate

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Question

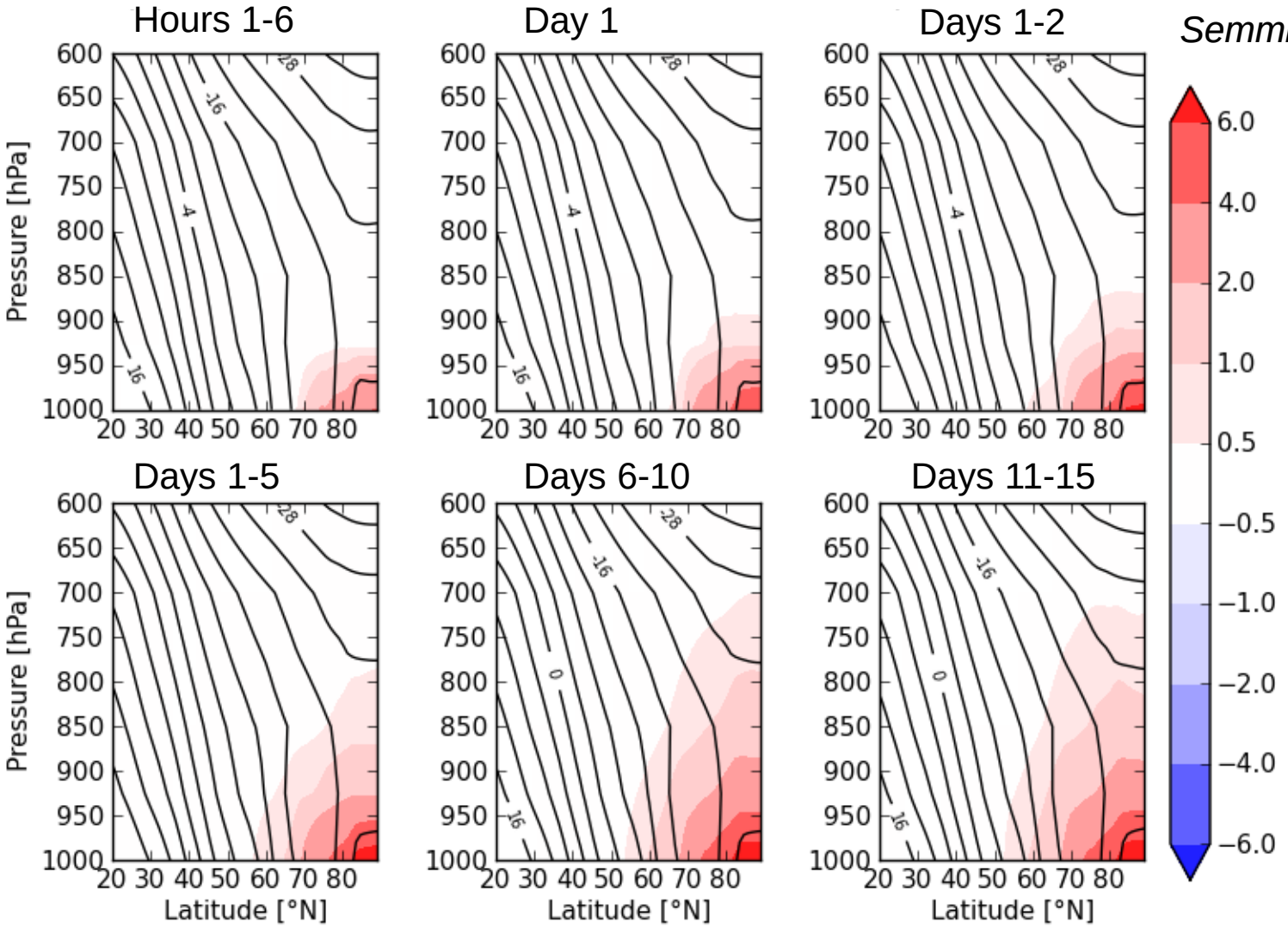
- What happens to the weather and climate of the Northern mid-latitudes if the Arctic sea ice changes faster than anticipated?
- Idealized model studies which *only* consider the influence of the Arctic sea ice and keep the influence of mid-latitudes and tropics as small as possible

Experiments

- Atmosphere-only relaxation experiments (14 days) ➤ poster session, P100
- Idealized atmosphere-only experiments with reduced sea ice thickness (15 days, some 90 days)
- Idealized coupled experiments with initially reduced sea ice thickness (1 year)
- Idealized coupled experiments with modified albedo, lead closing parameter, longwave radiation (150 years) ➤ poster session, P102

Atmosphere-only idealized exp.

Winter temperature profile response

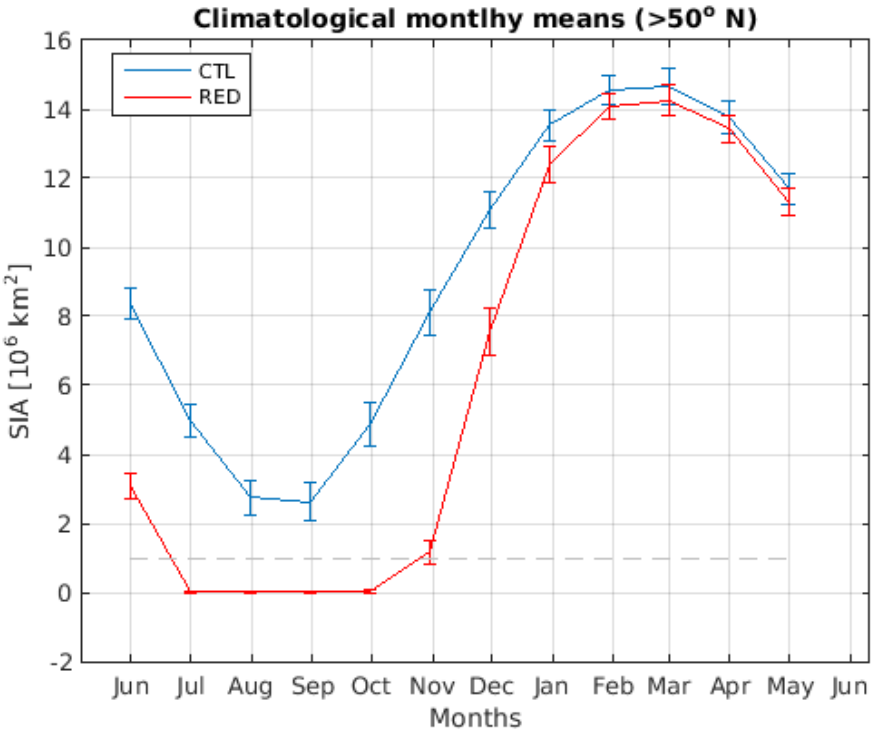


Semmler et al. (2016a)

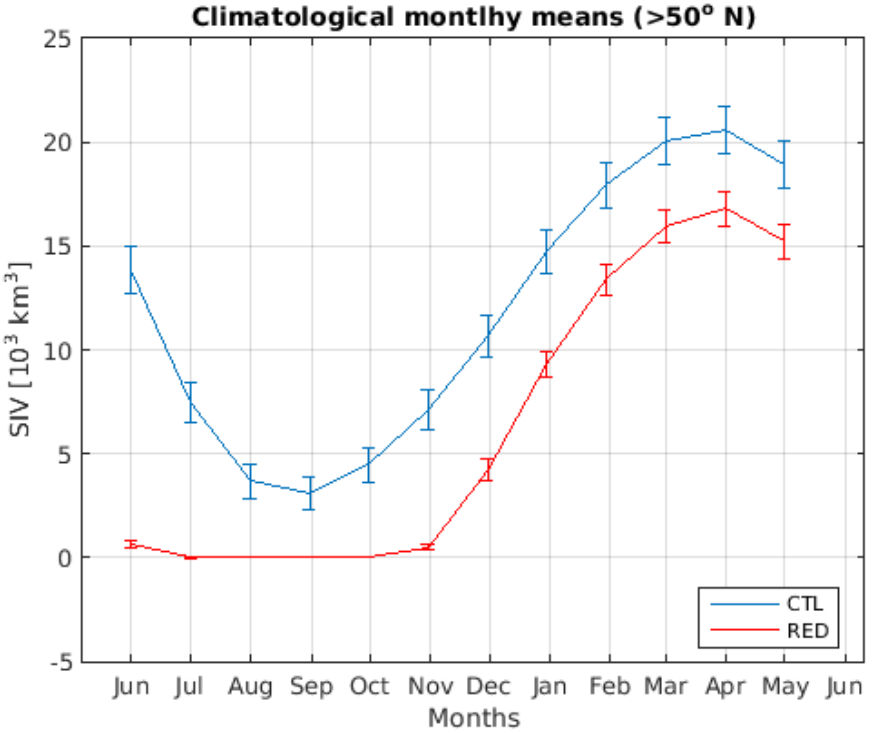
Mainly boundary layer affected

Short coupled experiments

Sea ice area



Sea ice volume



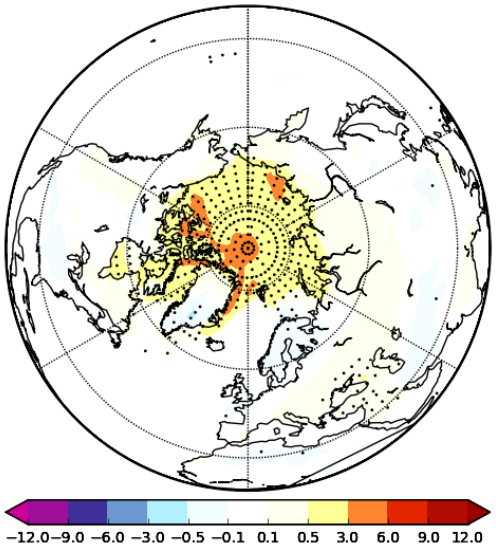
Semmler et al. (2016b)

Short coupled experiments

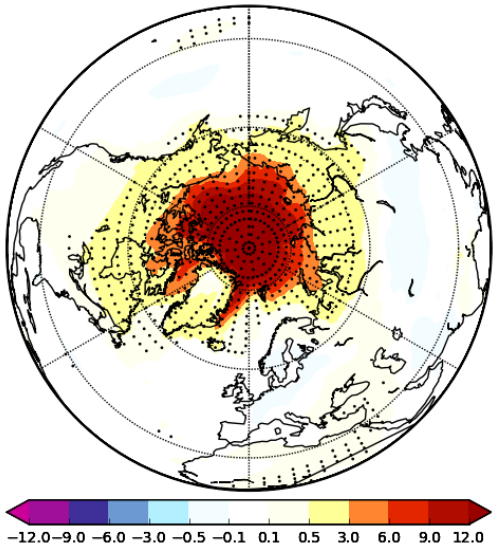
Surface air temperature response (K)

Strongest response in autumn (15K),
peak in November (19K) over the Central Arctic.

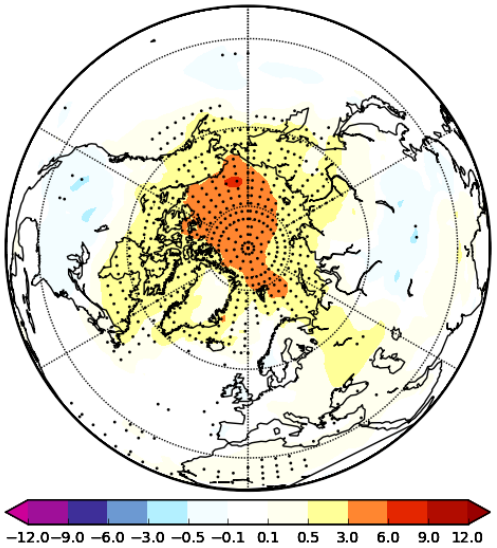
Summer (JAS)



Autumn (OND)



Winter (JFM)



Semmler et al. (2016b)

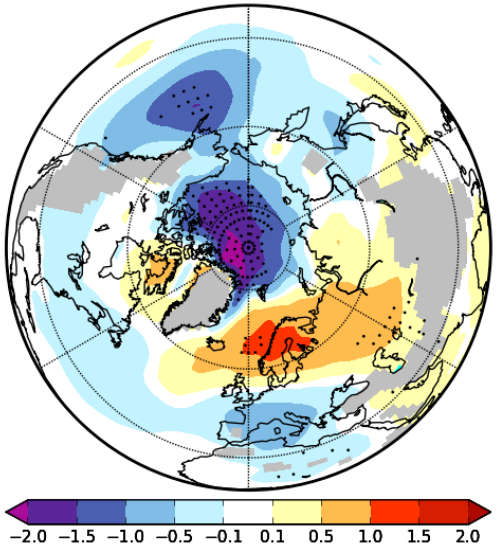
Short coupled experiments

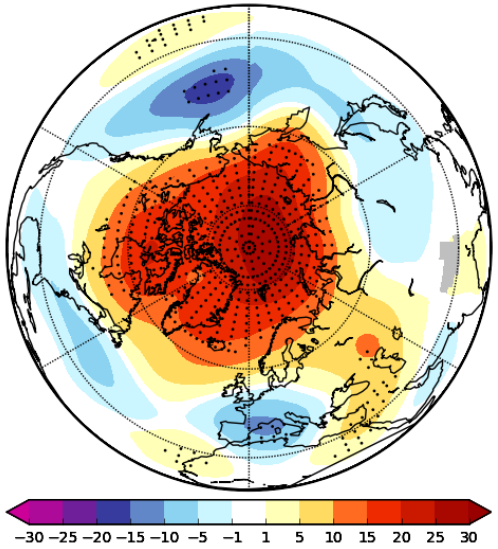
MSLP response (hPa)

Z500 response (m)

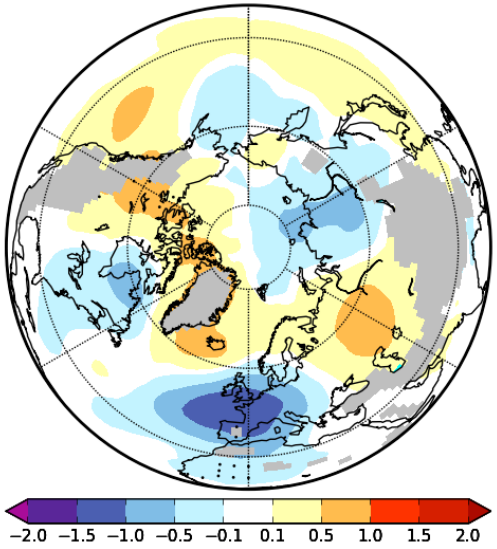
Baroclinic response in autumn, barotropic in winter.

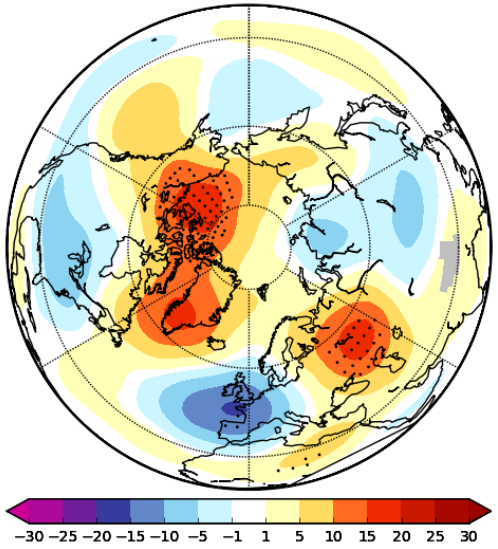
Autumn (OND)





Winter (JFM)





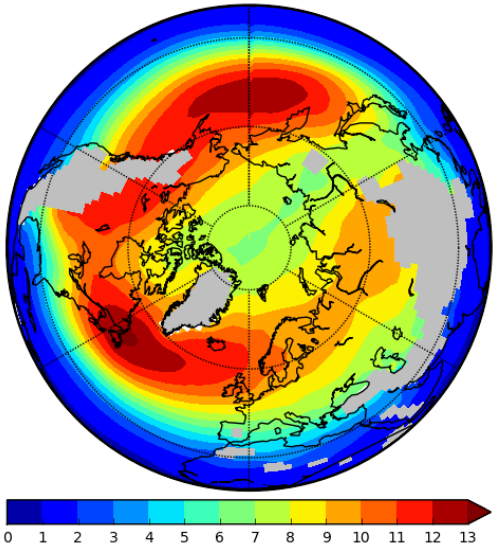
Semmler et al. (2016b)

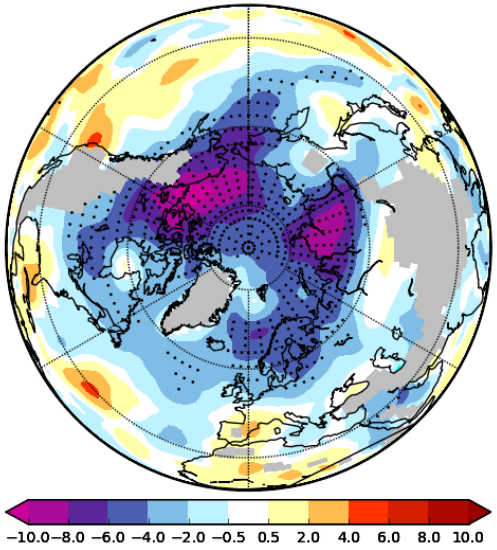
Short coupled experiments

CTL

CTL-RED

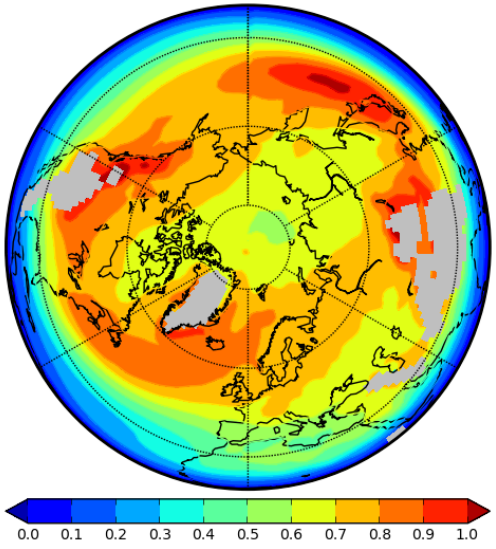
Synoptic activity OND (m)

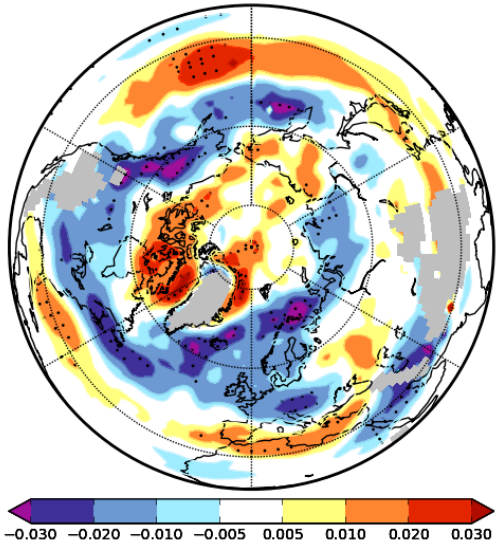




Less synoptic activity but stronger Eady growth rate in Arctic

Eady growth rate between 850 and 500 hPa OND (1/d)





Semmler et al. (2016b)

Conclusions

- Reduced sea ice increases temperature mainly in Arctic boundary layer
- Reduced westerly flow especially over Eurasian sector along with some cooling
- Less synoptic activity but stronger Eady growth rate in the Arctic (vertical stability decrease not as relevant as vertical wind shear decrease)
- Southward atmospheric storm track shift
- Encouraging: results consistent between different methods and different time scales