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

Question

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

Experiments

- Atmosphere-only relaxation experiments (14 days)
- 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)

Conclusions

- Reduced sea ice increases temperature mainly in Arctic boundary layer
- Strongest pathway from Arctic to Northern mid-latitudes: Barents Sea / Kara Sea area -> Siberia
- Reduced westerly flow especially over Eurasian sector along with some cooling
- Less synoptic activity but stronger Eady growth rate in the Arctic (vertical stability increase not as relevant as vertical wind shear decrease)
- Southward atmospheric storm track shift
- Encouraging: results consistent between different methods and different time scales
- In long coupled simulations southward atmospheric storm track shift reflected in the ocean. Generally more active ocean circulation in Arctic and sub-Artic.

References:

- Jung et al., 2014, GRL
- Semmler et al., 2016b
- Campos et al., 2017, in prep.