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The early vs the late 20th century Arctic warming: The role of energy and aerosol fluxes in reanalysis driven datasets

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During the last two decades, the Arctic was put into the scientific focus as one of the most impacted regions worldwide concerning anthropogenic global warming.
However, the warming between 1920 and 1940 proofs the importance of internal variability on yearly and decadal scale. Therefore, it is important to further investigate the role of external and internal forcings on the Arctic climate attribute process and causes leading to changes in the Arctic climate regime (Serreze & Barry 2009).
Although much research effort was spent to understand the links and influences of and on the Arctic climate, there is still a need for further insights concerning this topic. Especially the results and discussion about anthropogenic global warming and Arctic amplification put the Arctic into the public and academic focus (Serreze & Barry 2011). However, the early 20th century Arctic warming, although discovered immediately, was scientifically forgotten until recently (Delworth & Knutson 2000, Bengtsson et al 2004, Grant et al 2009, Bekryaev et al 2010). The comparison of this earlier Arctic warming and the recent warming period grants a chance to deepen knowledge about the drivers of Arctic climate and can be used to evaluate the anthropogenic impact.
The authors use the Twentieth Century Reanalysis (20CR) dataset and a nudged, reanalysis-driven Aerosol Global Circulation Model (A-GCM) to investigate the impact of atmospheric energy and aerosol fluxes into the Arctic during the 20th century.
The 20CR dataset covers the period of 1871 – 2010 with a temporal resolution of 6hr and a spatial resolution of 2° x 2°. For the first time, this dataset (and ist 56 ensemble member) is used to compute the atmospheric energy flux, consisting of sensble heat, latent heat, potential energy and kinetic energy. The values are integrated around 70° N and between 1000 – 100 hPa.
Aerosol fluxes for the same domain but for the years 1957 – 2000 are calculated based on the A-GCM nudged to the ECMWF 40 year Re-analysis (ERA) and correlated to circulation patterns.
Based on these dataset we analyze timeseries and patterns of several variables, with a focus on the temperature changes in the Arctic domain. We show that the 20CR can recreate recent sensible heat fluxes, meaning from the 1950s onward. Before this timeperiod 20CR exhibits a strong positive energy influx between 1920 and 1930, which is difficult to validate, however probably arises due to missrepresentation of local wind maxima, mostly over the Canadian Arctic. The authors highlight the impact of this flaw by investigating snow cover and atmospheric stability over the Arctic. Finally, the two datasets are compared and exemplary extreme events in aerosol fluxes are analysed in terms of warming impact and the related circulation patterns. Possible implications for the future use of 20CR are discussed, together with the impact of our findings for the interpretation of the early 20th warming in todays context.