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Investigating mechanisms linking mid-latitude aerosol emission changes to high-latitude climate responses.

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Arctic amplification (AA) is a common occurrence in both general circulation models and observations. Recently, several studies found evidence for causal relationships between AA and mid-latitude climate extremes emphasising the need to understand the driving mechanisms behind AA. Modelling studies using the general circulation model NorESM show that changes in mid-latitude aerosol emissions cause significant temperature responses in the Arctic, amplified compared to the global mean. However, while much work went into analysing feedbacks driving AA, the triggers of remote Arctic climate responses to mid-latitude forcings are unclear.

The aim of this work is to identify the mechanisms triggering AA in response to mid-latitude aerosol changes and the aerosol- and cloud processes contributing to the amplification.

Since aerosol and cloud processes occur on timescales shorter than months, we apply sudden anthropogenic aerosol emissions changes in the mid-latitudes and integrate NorESM1 in its fully coupled set-up with daily output frequency. In order to maximise detectability, we integrate the model for one year only, but initiate a large number of ensemble members (>20 members). A pre-study has shown that one year is enough to achieve significant (student's t-test, 5% significance level) changes in sea ice fraction so that our experiments also capture the initiation of responses in sea ice cover to the initial forcing.
The experiments investigate the sensitivity to emission regions and how atmospheric processes vary if emissions are increased or decreased.

Results from this work will yield critical processes driving Arctic climate response in the modelling framework. This work will further be complemented with a thorough evaluation of NorESM1 with observational data will then serve to assess whether crucial processes are missing in the model thus contributing to model improvement.