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The present warming vs. the early 20th century warming in the Arctic: A 400 year perspective

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A prominent climatic event in the Arctic was the 'Early 20th century warming' with its largest amplitude in the Arctic region where temperatures were almost at the same level as presently. The cause for this warming episode is still under debate and explanations range from a combination of external forcings from carbon dioxide and sulphate aerosols and internally generated variability of the thermohaline circulation connected to the 'Atlantic Multidecadal Oscillation' (AMO).

We use a coupled climate model to investigate this. We apply a 'perfect model approach', i.e. we analyse results from two different runs of 400 year length each with the coupled climate model ECHAM4/OPYC3: a forced run with time-varying external forcing from solar variations, volcanoes, greenhouse gases and sulphate aerosols from fossil fuel burning and a control run with the external forcing kept constant.

From the control run we find the signatures in sea surface temperatures and sea ice extent and sea ice thickness arising from internally generated variability of the thermohaline circulation, primarily the AMO. This then allow us by using results from the forced run to quantify the magnitudes of contributions from internally generated variations versus externally forced changes.