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Is there a see-saw over an ice-free Arctic Ocean?

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The “see-saw“ in winter temperatures between western Greenland and the Canadian Arctic on one side and northern Europe on the other has been described by Loewe already in 1937, but actually this behaviour was at least known since the Danish colonization of Greenland in the early 18th century. The see-saw is associated with pressure anomalies not only near the region of interest, but as remote as the Mediterranean and the North Pacific. Recent research has pointed out the role of sea ice in maintaining the see-saw in either its warm or its cold phase over extended periods, which strongly affects European winter temperatures.

What would happen to the seesaw if Arctic sea ice were to disappear suddenly? In the framework of the FP7-funded project ice2ice, we try to answer this and related questions. We have conducted a very long global simulation with a global climate model interactively coupled to a Greenland ice sheet component, covering the period 1850-3250 at a horizontal resolution of approximately 125 km. Up to 2005, the forcing is from observed greenhouse gas concentrations, and from 2006 onward it follows the extended RCP8.5 scenario, in which greenhouse gas concentrations continue to increase and eventually level out around 2250. With such a strong forcing, all Arctic sea ice has completely disappeared by roughly the same time, and the surface mass balance of the Greenland Ice Sheet becomes strongly negative.

We investigate how the see-saw behaves in such an ice-free world and which implications circulation changes have in the Arctic and over Europe. To further elucidate the role of sea ice distribution on the atmospheric flow and the role of surface fluxes in maintaining the Greenland-European see-saw, we intend at a later time to expand our analysis to include a contrasting simulation with both western Greenland and northern Europe covered by ice during the Last Glacier Maximum.