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Bjerknes' hypothesis on the coldness during AD 1790-1820 revisited

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The aim of this talk is to re-examine and quantify a hypothesis first put forward by J. Bjerknes concerning the anomalous coldness during the AD 1790-1820 period in western Europe. Central to Bjerknes' hypothesis is an anomalous interaction between ocean and atmosphere studied here using an ocean-atmosphere coupled climate model of intermediate complexity. A reconstruction of the sea-level pressure pattern over the North Atlantic sector averaged over the period 1790-1820 is assimilated in this model, using a recently developed technique which has not been applied to paleoclimatic modelling before. This technique ensures that *averaged* over the simulation the reconstructed pattern is retrieved whilst leaving atmospheric and climatic variability to develop freely.

In accordance with Bjerknes' hypothesis, the model results show anomalous southward advection of polar waters into the northeastern North Atlantic in the winter season, lowering the sea-surface temperatures (SSTs) there with 0.3°C to 1.0°C. This SST anomaly is persistent into the summer season.

A decrease in western European winter surface air temperatures is found which can be related almost completely to advection of cold polar air. The decrease in summer surface air temperatures is related to a combination of low SSTs and anomalous atmospheric circulation. The modelled winter and summer temperatures in Europe compare favourably with reconstructed temperatures. Enhanced baroclinicity at the Atlantic seaboard and over Baffin Island is observed along with more variability in the position of the North Atlantic storm tracks. The zone of peak winter storm frequency is drawn to the European mid-latitudes.