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Increasing the Atlantic subtropical jet cools the circum-North Atlantic Region

Gerard van der Schrier (1), Sybren Drijfhout (1), Wilco Hazeleger (1), Ludovic Noulin (2), and Geert-Jan van Oldenborgh (1)

(1) Royal Netherlands Meteorological Institute, KS/KA, De Bilt, Netherlands (schrier@knmi.nl), (2) Ecole d'Ingenieurs en Modelisation Methematique, Talence, France

Part of a scenario for abrupt climate change over the North Atlantic sector in a General Circulation Model of intermediate complexity is modelled. Central to this scenario is the hypothesis that a substantial strengthening of the Atlantic subtropical jet will lead to a reorganization of the mid-latitude atmospheric circulation in which the Atlantic subtropical and eddy-driven jets coincide. The subtropical jet over the North Atlantic sector is increased by calculating optimal model tendency perturbations, using a recently developed technique. Strengthening of the subtropical jet is achieved by model tendency perturbations which (1) sharpen the meridional gradient in stream-function or (2) force a strong and persistently negative North Atlantic Oscillation pattern in the upper troposphere. Both approaches lead to similar forcing patterns. It is found that when the subtropical jet is sufficiently strong, the eddy-driven jet is indeed drawn to the northern rim of the subtropical jet. This reduces atmospheric meridional heat transport over the North Atlantic. In the model, a positive feedback is observed; the southern sea ice-edge extends further south and snowcover over Europe is more persistent. All factors combined result in an overall cooling of the circum-North Atlantic region.