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Oceanic and atmospheric feedbacks associated with bistability of the Atlantic Meridional Overturning Circulation in a coupled climate model

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While simple box models and climate models of intermediate complexity commonly exhibit multiple equilibria of the Atlantic Meridional Overturning Circulation (AMOC), the existence of this phenomenon is less certain in more complex modern atmosphere-ocean general circulation models (AOGCMs). It has been suggested that the presence of a dynamical atmosphere component, with internally-generated atmospheric variability, may allow feedback mechanisms that reduce the stability of the AMOC off-state. This means that although the AMOC can been forced to collapse, coupled feedback mechanisms would allow the circulation to resume once the forcing is removed, preventing the existence of multiple equilibria.

FAMOUS is a lower-resolution version of the HadCM3 coupled AOGCM, which has the benefit of fast integration speed, whilst retaining a physically detailed atmospheric component capable of producing internally-generated temporal variability over periods from days to millennia. An explicit search for AMOC hysteresis shows that FAMOUS does indeed exhibit bistability under certain conditions. We explore the feedbacks that contribute to and oppose the existence bistability in FAMOUS and compare them with the responses of other AOGCMs forced by freshwater perturbations. We also present results that support the notion of an early warning signal for an approaching collapse of the AMOC.