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Climate storylines for AMOC tipping in response to increasing greenhouse gases

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Many generations of climate general circulation models (GCMs) have suggested that a radical reorganisation (tipping) of the Atlantic Meridional Overturning Circulation is unlikely in the 21st Century in response to the greenhouse gas emissions pathways considered by the Intergovernmental Panel on Climate Change (IPCC). Yet some studies suggest that GCMs as a class may represent an AMOC that is biased towards excessive stability. If this is the case then simply looking at AMOC response in the ensemble of current GCMs may give a misleading picture of the possible future pathways of the AMOC.

In this study we use a simple coupled climate model, including both the thermal and water cycle responses to greenhouse gas increase, to explore beyond the range of the current ensemble of 'best estimate' GCMs. What would the climate system need to look like in order for AMOC tipping to be a plausible outcome? We find that tipping behaviour would require key parameters controlling the response of the hydrological cycle to surface warming to be towards the edge of plausible ranges.

While AMOC tipping remains a 'High Impact, Low Likelihood' outcome, our results extend current knowledge by showing how AMOC tipping could occur in response to greenhouse gas forcing (as opposed to the common idealisation of 'water hosing' experiments). The results also show how monitoring key parameters of the climate system may over time allow the possibility of tipping to be more confidently assessed.