

Why AMOCs are Too Stable in Current CGCMs?

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Past climate records show strong evidence of abrupt climate changes that could be associated with the instability of the AMOC in response to melting water changes. Yet, in almost all of the current CGCMs, AMOCs are stable in response to a freshwater perturbation. Based on a series of sensitivity experiments in the NCAR-CCSM3, we propose that the over-stable AMOC in the current CGCMs are mainly caused by the tropical bias of a double ITCZ over the tropical Atlantic. This tropical bias produces too fresh upper ocean water in the tropical South Atlantic, a reduced AMOC export of freshwater, and eventually a net convergence of freshwater transport associated with AMOC in the Atlantic basin. The freshwater convergence changes the stability of the AMOC from bi-stable to mono-stable through the Stommel-Rahmstorf salinity-AMOC positive feedback mechanism. Our finding has important implications to our further development of CGCMs and their applications to the study of the AMOC.