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Effect of Atlantic Meridional Overturning Circulation on Tropical Atlantic Variability: A regional coupled model study

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A simplified coupled ocean-atmosphere model, where an atmospheric general circulation model is fully coupled to a 2-1/2-layer reduce gravity ocean model over the tropical Atlantic sector, is presented in the context of studying the role of the Atlantic Meridional Overturning Circulation (AMOC) in tropical Atlantic variability. Extensive experiments are carried out to examine the relative importance of oceanic versus atmospheric processes in linking the AMOC changes to the tropics. It is found that the oceanic processes are a primary factor contributing the warming at and south of the equator and the precipitation increase over the Gulf of Guinea, while atmospheric processes are responsible for the surface cooling of the tropical north Atlantic and southward displacement of ITCZ. Model results show that equatorial warming lags the AMOC change by about 8 years.This delayed response may give rise to certain predictability of equatorial SST in response to AMOC changes at decadal time scales. A systematic investigation of the coupled system response to changes in AMOC strength indicates that the SST over the cold tongue region responds nonlinearly to AMOC changes. The sensitivity of the SST response increases rapidly when AMOC strength decrease below a threshold value. Such nonlinear behavior is also found in precipitation response over the Gulf of Guinea. These results suggest that complex and competing atmosphere-ocean processes are involved in tropical Atlantic variability response to AMOC changes and the nature of the response can vary from one region to another.