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Abrupt shutdown of the Atlantic meridional overturning circulation and rainfall patterns in Mexico

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Model simulations agree that the warming and the resulting freshening of the surface waters will significantly reduce deep water formation in the Labrador Sea during the next decades. A complete collapse of the Atlantic meridional overturning circulation (AMOC) would be associated with a strong cooling of several degrees in the North Atlantic region (Winton 2003). The future response of the AMOC, however, is predictable only within a broad range due to the existence of a critical threshold in the system and the large uncertainty about both the location of this threshold on the freshwater axis and the freshwater forcing (Zickfeld et al., 2007). According to Meehl et al. (2007), the probability of an abrupt slowdown or shutdown of the AMOC triggered by greenhouse gas forcing is low, but it is considered a high-impact event (Wood et al., 2003). An abrupt change in the AMOC could occur so unexpectedly and quickly that natural systems would have difficulty adapting to them (NRC, 2002).

In this work we use coupled ocean-atmosphere models to asses the response of rainfall patterns in Mexico to an abrupt shutdown of the AMOC. First, a cooling pattern, triggered by a freshwater flux perturbation in the North Atlantic, is simulated by an isopycnic ocean model coupled to an atmospheric energy balance model. Then, this anomalous surface temperature pattern is used as a surface boundary condition for a numerical experiment performed using the simplified global atmospheric circulation model PUMA (Portable University Model of the Atmosphere; Fraedrich et al., 1998), which compute the perturbed rainfall patterns in Mexico.