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West African drying triggered by glacial slowdowns of the Atlantic meridional overturning circulation

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Paleoclimatic records from the last glacial unambiguously show substantial drying of West Africa (including the Sahel and the Guinea coast region) during millennial-scale slowdowns of the Atlantic meridional overturning circulation (so-called "Heinrich events"). Many state-of-the-art global climate models are not capable of reproducing this drying in "water hosing experiments" in which the meridional overturning is substantially reduced by meltwater input to the North Atlantic. Here, we present new hosing experiments with the Community Climate System Model in which significant West African drying (e.g. 50% decrease in Sahel runoff) is simulated in response to a shutdown of Atlantic meridional overturning. These hosing experiments were carried out under both present-day and glacial boundary conditions.

In our contribution, we briefly overview the paleoclimatic evidence for millennial-scale West African dry events during the last glacial. Based on the analysis of our hosing experiments, a mechanism is described which explains the drying of West Africa in response to a slowing of the Atlantic meridional overturning circulation. This mechanism involves a strengthening of the northeasterly Harmattan winds and intensification and southward expansion (by about 3 degrees latitude) of the mid-tropospheric African Easterly Jet. Finally, we speculate on reasons why other climate models do not reproduce the West African drying correctly.

From the results of our study, it seems likely that future rainfall in West Africa – especially in the Sahel – will strongly depend on the behaviour of the Atlantic meridional overturning circulation under global warming conditions.