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The impact of the Atlantic ocean variability on Indian summer monsoon rainfall

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Prominent multidecadal fluctuations of India summer monsoon rainfall have been observed during the 20th century. Understanding the mechanisms will have enormous social and economic implications. With statistical analyses we show that there is an in-phase relationship between the multidecadal variability of Indian summer monsoon rainfall and the Atlantic Multidecadal Oscillation (AMO). We further show that the multidecadal variability in the Atlantic Ocean could cause the observed multidecadal variations of Indian summer rainfall during the 20th century, using the GFDL CM2.1 climate model simulations. The in-phase relationship between Indian rainfall and the AMO is consistent with our water-hosing experiments showing that the Indian monsoon rainfall is significantly reduced when the Atlantic thermohaline circulation (THC) is substantially weakened. The modeling results support paleo records off the western boundary of the Arabian Sea, which indicate a weakening of the southerly Indian summer monsoon winds and coastal upwelling when the Greenland was in cooling conditions during the millennial timescale abrupt climate change events. The modeling results suggest that the remote forcing of the Atlantic THC variations is very important, and the link between the Atlantic ocean and Indian monsoon rainfall is mainly through the meridional shifts of the intertropical convergence zone (ITCZ).