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The Drought Interest Group: What cause the weakening and earlier ending of the North American Monsoon in recent decades?

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We show that the causes of the dry regimes of the North American Monsoon System (NAMS) during the periods 1948-1959 and 1990-2009 are different although they occurred during the positive phase of the Atlantic Multi-decadal Oscillation (AMO). The first dry NAMS regime is mainly caused by circulation changes associated with the positive phase of the AMO. The more recent dry NAMS regime is mainly due to both an anomalous westward expansion of the North Atlantic Subtropical High (NASH) and a northward displacement of the subtropical jet stream over the United States (US). The former enhances the low-level flow from the Gulf of Mexico to the Great Plains and weakens moisture transport to Mexico and the southwestern US. The latter reduces the equatorward incursions of the extratropical synoptic disturbances into the NAMS region, a dynamic condition important for producing large-scale monsoon rainfall. Furthermore, anomalous changes in the upper-troposphere circulation associated with the expansion of the NASH and the western Pacific warm pool contribute to the northward shift of the subtropical jets over the US. The westward expansion of the NASH is not correlated to any decadal variability modes we tested, in agreement with the results from a previous study which suggests that the westward expansion of the NASH observed in recent decades is forced by an increase in anthropogenic forcing.