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Progress in American monsoon research: The Atlantic Multidecadal Oscillation and its climate impacts in IPCC-AR4 models

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The Atlantic Multidecadal Oscillation (AMO) is known as an important SST forcing that project onto a distinctive global precipitation pattern (i.e., in warm phase, dry in most of the United States wet in Sahel) and Atlantic hurricane activity. Due to its significant role in climate, it is important for climate models to properly simulate the AMO and its impact on climate. This is particularly true for the IPCC-AR4 models since the AMO can amplify or diminish the global climate changes induced by the anthropogenic greenhouse effect for the foreseeable future. For instance, it is widely believed that a warm AMO phase and the anthropogenic warming coexisted with comparable amplitude during the past decades. On the other hand if the AMO switches to the cool phase in future decades, then the man-made warming will be offset. Here, we investigate the characteristics of this intrinsic Atlantic variability embedded in the IPCC-AR4 models for the 20th century. As demonstrated in previous studies, the ensemble averaging of IPCC-AR4 model output leads to cancellation of the internal variability between ensemble members consistent with our view that the AMO is an internal mode of climate variability. Therefore, the amplitude, period, spatial pattern and the climate impacts of AMO in each individual model will be analyzed separately with various statistical tools, then averaged in a statistical framework. The performance of each IPCC-AR4 model in reproducing the AMO and its climate impacts should provide a guide stick for evaluating the overall confidence of the future projection by each model.