Origin of Indian Summer Monsoon Biases in CMIP5 Multimodel Ensemble

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Significant biases of climate models lead to considerable uncertainty in climate prediction and future projection. Here it is shown that almost all models participating in the fifth phase of Coupled Model Intercomparison Project (CMIP5) exhibit common weak Indian summer monsoon (ISM). Causes of ISM biases are investigated in the historical climate simulations of 20 CMIP5 models, together with the available Atmospheric Model Intercomparison Project (AMIP) simulations. Results show that the weakened summer monsoon circulation and precipitation over the areas around India are significant in CMIP5 multimodel ensemble, but not existing in AMIP models. Such weakened ISM can be mainly attributed to the antecedent cold sea surface temperature (SST) in the northern Indian Ocean. Furthermore, diagnosis of moisture transport indicates that dynamic processes (atmospheric circulation) are more important than thermodynamic processes (specific humidity) in resulting in the monsoon biases. The systemic cold SST biases in spring time weaken the intensity of southwesterly flow, and subsequently reduce the moisture transport to India. The above results and associated physical processes are also verified through sensitive numerical simulations using the WRF regional model.

9 December 2016

11:30 a.m.

Conference Room, 3/F, Mong Man Wai Building

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