Twice Wind Onsets of Monsoon over the Western North Pacific and Their Simulations in AMIP Models

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The evolutions of wind directions are investigated and described by the absolute angles between two prevailing low-level wind vectors , it indicates the wind directions over the western North Pacific (WNP, 10°-22.5°N, 125°-145°E) undergoes two abrupt changes from winter to summer. Here we name the phenomena as twice wind onsets. The first wind onset occurs near mid-May in 15°N, and the second wind onset happens with the wind direction shifting to southwesterly in mid-July and ends in late September. And the variations of OLR and rainfall in the northern 5 latitudes neighboring region show similar pattern as that of the twice wind onsets. Based on the dates of the twice wind onsets of monsoon, four stable states of wind direction have been separated as four phases to examine corresponding circulation and rainfall feature over Eastern Asia. The western Pacific subtropical high (WPSH) retreat eastward in Phase 2 (pentad 29 to 37) which differ from Phase 1 (pentad 1 to 24). With the intense cross-equator flows from Southern Hemisphere reaching the WNP, the eastward retreat of WPSH consequently trigger the first wind onset. And the ridge of WPSH suddenly jump to 30°N resulting in the second wind onset. Meanwhile, the propagation of the second wind onset is consistent with the migration of the WNP monsoon trough well.

Seven AGCMs of AMIP from IPCC AR4 are validated against observations mentioned above. The results show that there are still notable shortcomings for models to simulate the WNP summer monsoon, especially the twice onsets. There is no significant improvement for the simulation of multi-models ensemble mean. Only MPI-ECHAM5 captures part of the similar pattern. And the poor simulation of the migration of WPSH ridge and monsoon trough may be important factors for the shortcomings. Moreover, none of the models reproduce corresponding rainfall pattern over the WNP.