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# The Role of Air-Sea Interaction in the Climatological Evolution and ENSO-Related Variability of the Summer Monsoon over South China Sea and Western Pacific

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ABSTRACT

The processes contributing to the summertime northeastward march of the climatological maritime monsoon over the South China Sea (SCS) and subtropical western North Pacific (WNP) are examined using the output from a 200-year integration of a coupled atmosphere-ocean general circulation model (GCM). Increased cloud cover and surface wind speed during monsoon onset over SCS in May-June reduce the incoming shortwave flux and enhance the upward latent heat flux at the ocean surface, thereby cooling the local sea surface temperature (SST). The resulting east-west gradient in the SST pattern, with lower temperature in SCS and higher temperature in WNP, is conducive to eastward migration of the monsoon precipitation over this region. Upon arrival of the precipitation center at WNP in July-August, the local circulation changes lead to weakening of the Meiyu-Baiu rainband near 30°N. The subsequent increases in the local shortwave flux and SST impart a northward tendency to the evolution of the WNP monsoon. Many of these model inferences are supported by a parallel analysis of various observational datasets.

The modulation of the above climatological scenario by El Niño-Southern Oscillation (ENSO) events is investigated by diagnosing the output from the coupled GCM, and from experiments based on the atmospheric component of this GCM with SST forcings being prescribed separately in the SCS/WNP and equatorial Pacific domains. During the May-June period after the peak phase of ENSO, the simulated monsoon onset over SCS occurs later (earlier) than normal in El Niño (La Niña) events. These changes are primarily remote responses to the anomalous SST forcing in the equatorial Pacific. The above-normal precipitation in SCS in the ensuing July-August period of the warm events is mainly forced by the local warm SST anomaly, which is linked to ENSO forcing in the tropical Pacific through an 'atmospheric bridge'. In the July-August period of cold events, the equatorial SST anomaly retains its strength and moves still closer to SCS/WNP. This forcing cooperates with the cold SST anomaly in SCS, and brings about dry conditions in SCS/WNP. The ENSO-related changes in SCS/WNP are associated with above-normal (below-normal) Meiyu-Baiu activity during warm (cold) events.