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Simulation of the Persistent Snow Storm in January 2008 over Southern China with a Regional Air-Sea Coupled Model

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We studied the impact of the Madden-Julian oscillation (MJO) on a persistent snow storm, using a regional air-sea coupled model (RegCM3-POM) and its atmospheric component in twin experiments. The performance of RegCM3-POM is evaluated through simulating the persistent snow storm over southern China in January 2008. Compared with the stand-alone RegCM3, the coupled model has a better performance in reproducing the temporal evolution, the spatial pattern and intensity of the precipitation episodes. The power spectral analysis indicates that the coupled model successfully captured the dominant period between 30-60 days in the precipitation field, leading to a notable improvement in simulating the magnitude of intraseasonal precipitation variation, and further enhancement of the intensity of the simulated precipitation during the snow storm. These improvements are mainly due to the well simulated low-frequency oscillation center and its eastward propagation characteristics in each MJO phase by RegCM3-POM, which improved the simulations of MJO-related low-frequency vertical motions and water vapor transports that can directly influence the precipitation event, and further improved the simulated MJO-precipitation relationship during the snow storm. Examination of the phase relationships between convection and sea-surface temperature (SST) indicates that RegCM3-POM exhibits a near-quadrature relation between the simulated convection and SST anomalies, which is consistent with the observations. However, such a near-quadrature relation is not so significant if stand-alone RegCM3 is used. This difference indicates the inherent coupled feedback process between the atmosphere and ocean in RegCM3-POM plays a crucial role in reproducing the characteristics of the MJO that accompanied the snow storm.