HIGH-RESOLUTION SIMULATIONS OF HEAVY RAINFALL EVENTS IN ASSOCIATION WITH AN ATMOSPHERIC RIVER

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ABSTRACT

Monsoon systems are major causes of heavy rainfall events in East Asia and occasionally give rise to serious disasters. Most heavy rainfall systems are composed of intense convective clouds. Cloud-resolving models are, therefore, indispensable for studies of their mechanisms and processes, and also for accurate and quantitative predictions of heavy rainfall. Advances in computing now make it feasible to use cloud-resolving models for studies and predictions of heavy rainfalls associated with monsoon systems.

In East Asia, heavy rainfalls occur in association with monsoon systems such as Meiyu, Baiu, Shurin, and Changma. The Meiyu in China and Taiwan, the Baiu in Japan, and the Changma in Korea are quasi-persistent rains or rainy seasons that extend from mid to late spring through early to midsummer. The Shurin (Akisame) is also a similar rainfall or rainy season in Japan and it occurs from late summer through autumn. These systems usually include a quasi-stationary front along a weak baroclinic zone oriented east–west in the lower troposphere, occasionally accompanied by a large moisture flow called an atmospheric river.

To prevent or mitigate such disasters, quantitative precipitation forecasts are indispensable. Mesoscale weather systems that deliver heavy rainfall are usually composed of intense convective clouds such as cumulonimbus clouds. Realistic simulations of these storms and quantitative predictions of their rainfall require high-resolution and non-hydrostatic numerical models. If the models resolve individual convective clouds and predict time change of water substances in clouds, they are called “cloud resolving models”. One of the most important objectives of regional cloud-resolving models is high-resolution simulations of heavy rainfall systems. Because the structure of heavy rainfall systems has a wide range of horizontal scales, a large computational domain and a grid with very high resolution to resolve individual classes of the multiscale structure are necessary to simulate accurately the evolution of the weather systems. The recent rapid development in computing enables us to use cloud-resolving models for realistic simulations and quantitative predictions of heavy rainfall although they are still imperfect and under development.

Keywords: cloud-resolving model, heavy rainfall; atmospheric river