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Evaluation of Mei-yu Heavy-rainfall Forecasts for Taiwan by the CReSS Model: Performance and Impact of Model Resolution

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This study focuses on the quantitative precipitation forecasts (QPFs) of heavy-rainfall events in Taiwan mei-yu season by the Cloud-Resolving Storm Simulator (CReSS), executed every 6 h with a range of 3 days in real time during three mei-yu seasons (2012-2014). Based on evaluation results of 12-h QPFs before 2005, the ensemble model at the time did not have adequate skills at and above middle thresholds (25 and 50 mm) even at shorter range (12-24 or 24-36 h). However, the performance by CReSS evaluated herein (24-h QPFs within days 1-3) shows dramatic improvements. After grouping all rainfall events by the rainfall amount (i.e. event magnitude), we use five widely-used skill scores: the threat score (TS), bias score (BS), probability of detection (POD), false alarm ratio (FAR), and odds ratio (OR), to evaluate the QPFs for each groups individually at 13 different thresholds from trace to extreme (0.05-500 mm per 24 h, including 9 heavy-rainfall thresholds starting at 50 mm) in Taiwan mei-yu season form 2012 to 2014.
The result in this study is that CReSS is more skillful when the rainfall amounts are higher (bigger events), especially at 50-500 mm threshold, consistent with earlier results for typhoon QPFs. Moreover, we compare two different horizontal grid sizes (2.5 and 5.0 km) of the QPFs by CReSS, and show that the 2.5-km CReSS model is more skillful with cloud-resolving capability, especially at heavy-rainfall to extreme thresholds. Overall, the 2.5-km CReSS has reduced under-forecast near the rainfall maxima over these range than its 5-km counterpart, and thus can better predict the location and magnitude of peak amounts in large events.