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Calibration of Convective-scale Hourly Precipitation Based on the Frequency-Matching Method

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Calibration of convective-scale hourly precipitation based on the frequency-matching method was carried on using CMPASS observation and CMA-MESO 3km forecast data. The character of hourly precipitation bias was studied.The effect of frequency-matching method (FMM) on the bias correction of CMA-MESO 3km hourly precipitation forecasts was analyzed. In the bias characteristic analysis, the differences in precipitation intensity in different regions of the country and the differences in precipitation in different months were considered. The whole country was divided into 7 sub-regions for monthly analysis. In the bias correction based on the frequency-matching method, the daily variations of precipitation bias and the impact of increasing and decreasing precipitation values on the corrected precipitation scores were analyzed. The results show that CMA-MESO 3km forecasts have a wet bias in light rainfall in the cold season, while a dry bias dominates in moderate to heavy rainfall. In the warm season, except for the Tibet region, the hourly precipitation forecast bias of CMA-MESO 3km shows significant daily variations, with more precipitation in the afternoon and less at night and in the morning, especially for heavy rainfall. Therefore, whether to consider the daily variations of precipitation bias in the use of FMM correction mainly reflects in the summer, especially at night and in the morning. Considering the daily variations of precipitation bias is beneficial to improving the forecast skills (TS scores) for nighttime and morning in the summer. Further analysis shows that the positive contribution of FMM correction to forecast scores mainly comes from the increase in frequency adjustment, especially for heavy rainfall. However, for light rainfall with wet bias, FMM often results in negative contribution. Therefore, FMM has a significant improvement effect on heavy rainfall in winter and nighttime rainfall in summer. The reason for this result is that the hit rate of CMA-MESO hourly precipitation forecast is low, and the false alarm rate is generally high, especially for heavy rainfall. In this case, the increased precipitation significantly increases the hit rate, while the false alarm rate increases to a lesser extent, thereby improving the precipitation scores.