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# Spatial patterns of summer rainstorms in the mountainous Three Gorges Region and their implications for flash floods modeling

Zhe Li (1), Youcun Qi (2), Xiaogang He (3), and Qiuhong Tang (1)

(1) Key Laboratory of Water Cycle and Related Land Surface Processes, Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China (lizhe@igsnrr.ac.cn), (2) NSSL NOAA Norman, Norman, OK, United States (youcun.qi@noaa.gov), (3) Department of Civil and Environmental Engineering, Princeton University, Princeton, New Jersey, USA (hexg@princeton.edu).

Understanding the space-time variability of rainfall is of critical importance for many applications in hydrology and meteorology, especially for those natural hazards, such as flash floods, that are linked with rainfall extremes. Despite its crucial role in hydrometeorology, accurately monitor and estimate the spatiotemporal patterns of rainfall extremes remains a challenge, particularly over the mountainous areas, due to sampling uncertainties resulting from the scarcity of gauge observations as well as the orographic effects which generate localized hard-to-detect rainstorms. In this study, the spatial patterns of summer rainstorms in the mountainous Three Gorges Region (TGR) of the Yangtze River were quantitatively investigated and characterized for the first time, by synthesizing gauge and newly available high-resolution radar data. A revised version of radar based quantitative precipitation estimation (QPE) algorithm was developed for the TGR, consisting of a series of key procedures which addressed the uncertainties of radar retrievals in a mountainous area (e.g., beam blockage, ground clutter and rainfall type variations). In order to minimize the residual errors, this radar QPE was taken to further assimilate ground gauge information using a geostatistical merging model, and then an innovative approach was proposed and applied to the radar-gauge merged QPE to exploit the spatial patterns of summer rainstorms in the TGR. With rainstorms identification and tracking algorithms, the high-resolution merged QPE data were decomposed into sets of rain cells, and thus the rainstorm patterns could be characterized in terms of the rain cell parameters, namely, location, duration, major (minor) radius, and orientation, which collectively provided quantitative measures of typical scales and trajectories of summer rainstorms in the TGR. For several selected heavy rainfall events of the TGR, the extracted rainstorm spatial patterns were further fed as input into a well-calibrated distributed hydrological model, to discuss the relationship between the flood responses and the spatial patterns of input rainfall in the TGR.