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Evaluation of Reanalysis, Spatially-interpolated and Remote-sensing derived Precipitation Datasets over Central Asia

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Accurate precipitation data are important for climate and environmental research in the dryland of Central Asia. Although multiple gridded datasets developed with various (spatial-interpolation, climate reanalysis, or remote sensing) methods are available, their accuracy and suitability for this arid and semiarid region, which locates in the center of Eurasia inland and is characterized with complex topography, are still unclear. In this study, a spatially-interpolated dataset developed by the Climate Research Unit (CRU), a satellite-retrieved dataset developed by the Tropical Rainfall Measuring Mission (TRMM) project, and three climate reanalysis datasets, including the Climate Forecast System Reanalysis (CFSR), ERA-Interim, and Modern Era Retrospective-Analysis (MERRA), were evaluated against gauge observations from 399 meteorological stations in Central Asia. Both temporal and spatial patterns were investigated. The results show that (1) TRMM has the highest correlation coefficient (CC = 0.82) and the smallest root mean square error (RMSE = 111.2 mm a^{-1}), followed by CRU (CC=0.71; RMSE=166.1 mm a^{-1}). MERRA performs much better than the other two reanalysis datasets. With correlation coefficient of 0.71,it matches the accuracy of CRU. CFSR performs the worst, having the lowest CC (0.41) and the largest RMSE (529.5 mm a^{-1}) among all datasets. (2) CRU overestimates precipitation in spring and winter while underestimates summer and fall precipitation. TRMM overestimates summer and winter precipitation and underestimates spring and fall precipitation. Reanalysis datasets overestimate precipitation in all seasons. (3) All datasets perform worse in mountain areas than in plain. CRU significantly underestimates the precipitation and has much low correlation with observations in mountain areas than in the plain (mountain vs. plain: absolute difference against observation is -86.5 mm a^{-1} vs. 6.4 mm a^{-1}, CC is 0.49 vs. 0.76). But TRMM maintains high CC (0.74) even in mountain areas. Due to the topography effect, mountain areas in Central Asia have much higher precipitation than plain. Because the number of mountain gauges is only 28% of the plain gauges in Central Asia, and many of the mountain gauges locate in the valley where precipitation is relatively low, spatially-interpolated datasets like CRU tend to underestimate precipitation in Central Asia, especially in the mountain areas. In comparison, remote sensing derived data and climate model derived reanalysis data could capture topography effect and reflect the precipitation difference between plain and mountain areas