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Study on Key Parameters of Radiation Balance in Tibetan Plateau

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As the center of the "third pole", Tibetan Plateau has the largest glaciers except the Arctic and Antarctic and is the birthplace of many rivers in Asia. It is also called the "Asian Water Tower". The radiant energy balance of this region is vital for climate change, water cycle and energy exchange in Asia and the world. Thus, the scientific community is very concerned about the acquisition and accuracy of the parameters of the radiation balance (i.e. surface air temperature (Ta), downward longwave radiation (DLR), and upward longwave radiation (ULR)) in this region. However, the Tibetan Plateau has a very complicated geographical environment and climatic conditions, which makes it more difficult to estimate the key parameters of the radiation balance of the Tibetan Plateau. Thus, how to improve the spatial-temporal resolution and accuracy of the key parameters of radiation balance in this region has become an urgent problem to be solved in the scientific community. In this study, we optimized Ta data and estimated all-weather DLR and ULR data.

We proposed a practical method for Ta downscaling based on the digital elevation model. This method is applied to downscale Ta of the China regional surface meteorological feature dataset (CRSMFD) at 0.1° to 0.01°. The evaluation results show that the daily mean Ta downscaled from the CRSMFD product has a RMSE of 1.13±1.0 K; the instantaneous Ta downscaled from CRSMFD has RMSEs of 1.02 K to 4.0 K at the three experimental stations. Ta after downscaling has better agreement with the ground measured Ta than before downscaling, especially in mountain regions. The 0.01° Ta dataset can better contribute to studies associated with water cycle, and climate change over the Tibetan Plateau.

To estimate the DLR, we tested eight methods for clear-sky condition and six methods for cloudy condition based on ground measured data. Results show that the Dilley and O'Brien (1998) method and the Lhomme et al (2007) are most suitable for Tibetan Plateau. Based on these two methods and meteorological data provided by the China land surface data assimilation system (CLDAS), the hourly all-weather daytime DLR and ULR dataset with a 0.0625° resolution from 2008 to 2016 over the Tibetan Plateau was generated. The evaluation results show that the averaged RMSE of the estimated hourly all-weather DLR was approximately 26.4 W/m2. According to all-weather DLR, land surface temperature (LST), and surface emissivity (εs), we can further obtain ULR. This study can well compensate the drawbacks of the estimation of the DLR and ULR with low temporal resolution through remote sensing data under clear-sky condition.