Statistical and Hydrological Evaluation of Multiple Satellite Precipitation Products in the Yellow River Source Region of China

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In recent years, satellite precipitation products had been widely used in runoff simulation, especially in the ungauged basin. However, the accuracy of different satellite data on real precipitation process varies greatly in different regions. The applicability of satellite precipitation products in a particular watershed needs to be scientifically demonstrated. In this study, the Yellow River Source Region was chosen as the research area, and precipitation data of 11 rainfall stations as the benchmark. Tropical Rainfall Measurement Mission (TRMM) Multisatellite Precipitation Analysis (TMPA) 3B42V7, Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks-Climate Data Record (PERSIANN-CDR), Global Precipitation Measurement (GPM) Integrated Multi-SatellitE Retrievals for GPM (IMERG) final run and Global Satellite Mapping of Precipitation (GSMaP) gauge products were evaluated in the accuracy as well as their runoff simulation capability under Variable Infiltration Capacity (VIC) hydrological model during 1998 to 2016 in daily temporal scale. Results show that these four satellite precipitation products can reflect the consistent spatial distribution of precipitation with rainfall stations in the Yellow River Source Region. In the long term (1998 to 2016) precision analysis, TRMM performs better than PRESIANN-CDR. In the short term (2014 to 2016) precision analysis, GSMaP shows a high precipitation assessment capability. Comparing the precipitation data of the rainfall gauge with the satellite precipitation data of its grid, it is found that 3B42V7 is generally underestimated for precipitation in the whole basin. PERSIAN-CDR and GSMaP overestimate the precipitation in the southeast and underestimate in the northwest. The runoff simulation capability of 3B42V7 and PERSIAN-CDR has been improved in recent years. GSMAP has demonstrated excellent runoff simulation ability in the Yellow River Source Region. Because of the overestimation of precipitation by PERSIANN-CDR, the simulated runoff process is much higher than the observed runoff. As a substitute for TRMM, IMERG has superior runoff simulation ability in the Yellow River Source Region.