

Monthly precipitations for South Siberia derived from bias-corrected reanalysis

Nadezhda Voropay^{1,2}, *Anna Ryazanova¹, Egor Dyukarev^{1,3}

1. Institute of Monitoring of Climatic and Ecological Systems of the Siberian Branch of the Russian Academy of Sciences, 2. V B Sochava Institute of Geography of the Siberian Branch of the Russian Academy of Sciences, 3. Yugra State University

The accuracy of global hydrometeorological data is important for regional and global climate studies. We compared the ERA5 reanalysis monthly precipitation data of the European Centre for Medium-range Weather Forecasts over South Siberia against observed precipitation data records from 132 ground weather stations for 1979–2015. The ERA5 reanalysis provides detailed fields reasonably reproducing features of mesoscale precipitation structures related to topography and synoptic-scale patterns. The linear correlation coefficients between reanalysis and weather station data are high but mean values are biased. The mean absolute error varies from -23 mm to 90 mm. A bias correction procedure was suggested to improve the precipitation data quality and reduce mean values error. The linear scaling coefficient for each month and weather station were calculated and extrapolated to the study area using the ordinary kriging method.

Finally, the maps of the Bias-Corrected Precipitation data for South Siberia (CPSS) were created and annual sums of precipitation were calculated. Multiply validation of bias correction was performed on the control test sets. The CPSS data fit the observation data very well. The mean error does not exceed 7 mm, the mean absolute error maximal value is 44 mm, and the mean relative error is less than 23%. The maximal biases are typical for mountain areas.

After bias correction for all months, in most cases, there is a decrease in monthly precipitation compared to the original ERA5 dataset. The precipitation decreases slightly in the winter months and significantly (by 10–13 mm) in the summer. The standard deviation also decreases for all months, but the changes are more pronounced in summer. The correction procedure almost eliminated the average error, the rest of the statistical characteristics also showed an improvement in the data quality.

The suggested approach of bias correction and downscaling is based on a combination of the physical-based high-resolution precipitation data field obtained in ERA5 reanalysis and spatially-irregular statistical correction using high-quality ground observation data. Taking into account the assessment of the scaling efficiency, the described approach can be recommended for correcting the monthly precipitation in territories with continental and sharply continental climates at territories with similar physical and geographical conditions.

Accordingly, this work forms part of a long-term effort to produce high-quality precipitation datasets across this region. High-resolution bias-corrected gridded precipitation data sets provide important information regarding precipitation conditions over different regions, especially for regions with very sparse meteorological stations. The dataset obtained could be useful for large-scale hydrological streamflow simulations, for studies of long-term precipitation variations at a higher scale, and analysis of droughts and water-logging events. The data is available for download from Zenodo in Network Common Data Form (NetCDF) format (<https://zenodo.org/record/4472614>).

The study was carried out with the financial support of the RFBR in the framework of scientific project 18-45-700015.

Keywords: precipitations, reanalysis, South Siberia, bias correction, downscaling