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Precipitation downscaling and spatial trends in the Pamirs

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In the Tajik Pamirs in an area of 100,000 km^2 only 20 meteorological stations exist which provide precipitation time series for more than 20 years. The access to the recorded data appears to be difficult, especially for recent data. The Pamirs span over altitudes from 2000 m to 7500m a.s.l. with an average altitude between 3500 and 4000m. Only the meteorological stations at the Fedchenko Glacier (4100m) and on the Akbaital Pass (4400m) are located on more or less exposed places. All other stations are located in valleys, between 2000 and 3800m. For precipitation interpolation and analyses, measurements between 3800m and 7000m are missing. In addition, it is difficult to outline orographic effects, because meteorological stations in the western Pamirs (where precipitation is highest) are located down in the valleys, while stations in the eastern Pamirs (where precipitation is lowest) are located on the plateau. As a result, a trend with decreasing rainfall from west to east misleadingly shows up as a reverse altitude effect. We use satellite-based snow cover data as qualitative indicator for precipitation regions which indicate, that a reverse altitude effect does not exist. Remote sensing precipitation datasets are available in spatial resolutions ranging from 8 by 8 km to 0.25 by 0.25 degree, such as the interpolation product APHRODITE. These spatial resolutions are not capable to capture rainfall heterogeneity on a catchment scale in the Pamirs. The altitude drop within a few kilometers is too high, that orographic rainfall could be displayed by the coarse resolutions. Therefore we downscale TRMM and APHRODITE data with the MODIS Cloud Cover product (1km^2) to analyze precipitation trends in a much higher resolution on the catchment scale. We validate our results based on area-normalized discharge time series of paired catchments, located west and east, respectively north and south of the mountain ranges in the southern central Pamirs.