A half-century of change? Analyzing precipitation and streamflow trends across the Khangai Mountain region of Mongolia

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Abstract. In the semi-arid rangelands of Mongolia, precipitation amount and timing directly influence vegetation availability for livestock and flow of water in rivers used by both pastoralists and their livestock. Herders of the Khangai Mountain region of Mongolia have observed change in the hydroclimate and condition of pasturelands over their lifetimes. Records from local precipitation stations and streamflow gages are affected by uncertainty in measurement, particularly in terms of missing data, complicating efforts to study trends in the data. Additionally, the summer-dominated precipitation regime exhibits great variability on seasonal and interannual timescales and from local to regional spatial scales with only a half-century of data available for analysis. The non-parametric Mann-Kendall and Thiel-Sen trend analysis approaches designed to handle missing data and outliers are tested here, along with more traditional linear regression approaches using complete and incomplete summer-dominated precipitation research datasets from the southwestern US to highlight potential application issues. The methods are then used with the incomplete Mongolian datasets and with versions that have been filled through a multidisciplinary approach uncommon in the hydrological literature to test the significance and rate of change of these hydroclimatic variables. The results of the new analyses are interpreted in light of existing coarser spatial trend analyses and information gathered from herders.