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# Accuracy assessment of gridded precipitation datasets in the Upper Indus Basin

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Accurate precipitation data are vital for hydro-climatic modelling and water resources assessments. Based on mass balance calculations and Turc-Budyko analysis, this study investigates the accuracy of thirteen widely used precipitation gridded datasets for sub-basins in the Upper Indus Basin (UIB) in the Himalayas-Karakoram-Hindukush (HKH) region. These datasets are: 1) Global Precipitation Climatology Project (GPCP), 2) Climate Prediction Centre (CPC) Merged Analysis of Precipitation (CMAP), 3) National Centers for Environmental Prediction (NCEP) / National Center for Atmospheric Research (NCAR), 4) Global Precipitation Climatology Centre (GPCC), 5) Climatic Research Unit (CRU), 6) Asian Precipitation Highly Resolved Observational Data Integration Towards Evaluation of Water Resources (APHRODITE), 7) Tropical Rainfall Measuring Mission (TRMM), 8) European Reanalysis (ERA) interim, 9) PRINCETON, 10) European Reanalysis-40 (ERA-40), 11) Willmott and Matsuura, 12) WATCH Forcing Data based on ERA interim (WFDEI), and 13) the Japanese 55-year Reanalysis (JRA-55) data. Precipitation accuracy and consistency was assessed by physical mass balance involving sum of annual measured flow, estimated actual evapotranspiration (average of 4 datasets), estimated glacier mass balance melt contribution (average of 4 datasets), and ground water recharge (average of 3 datasets), during 1999-2010. Mass balance assessment was complemented by Turc-Budyko non-dimensional analysis, where annual precipitation, measured flow and potential evapotranspiration (average of 5 datasets) data were used for the same period. Both analyses suggest that all tested precipitation datasets significantly under-estimate precipitation in the Karakoram sub-basins, except JRA-55 data. For the Hindukush and Himalayan sub-basins most datasets under-estimate precipitation except all Reanalysis datasets. The analysis indicates that for this large region with complicated terrain features and stark spatial precipitation gradients the reanalysis datasets have better consistency with flow measurements than datasets derived from records of only sparsely distributed climate stations in the HKH. Given the importance of the HKH region as the water tower of South Asia, our findings also suggest a revisit and scrutiny of hydro-climatic studies in the study region as to biases caused by the under-estimated gridded precipitation datasets.