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Local climate assessments in data scarce mountain areas; for example Kullu district, Himachal Pradesh, India

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High-mountain regions like the Himalayas and their adjacent downstream areas are often highly affected by climate change, climate variability and/or related extremes. As a result of cascading effects of rising air temperatures, melting glaciers, thawing permafrost – as well as anthropogenic water usage or changes in forest and agro-biodiversity – potential impacts on people's livelihood has broadened and increased. However, climate impacts assessments on physical and societal systems are often limited due to the scarcity of reliable long-term observations, particularly in remote high-mountain regions, which additionally also hampers robustness of future projections. Since livelihoods in remote high-mountain regions are particularly vulnerable to climate related impacts, and have typically only low adaptive capacities, studies assessing climate variability pattern of the past and for the future (climate baselines) are a fundamental requirement for sound impact assessments, and as such for preparing and planning adequate adaptation measures.
Within the Indian Himalayas Climate Adaptation Programme (IHCAP) an integrated vulnerability and hazard and risk assessment is being conducted for the Kullu district in Himachal Pradesh, India, for the sake of supporting adaptation planning there. Related to these studies, the present work aims to provide an approach and according results for climatological baseline generation for regions without respective observations available or accessible.
Here, we use observational gridded data sets (CRU, Delaware) and Reanalyses (ERA-20C, JRA-55, NCEP CFSR, ERA-i, NCEP/NCAR-R1) to provide spatially and temporally continuous data. For the grid boxes covering the area of interest, the time series for temperature are analysed and possible trends and variations are assessed for the time window 1981-2010, as well as the entire time line of the respective gridded dataset. The analyses reveal that the mean annual air temperatures over all levels and datasets have generally increased within the time window of 1981 to 2010. Seasonal analysis clearly reveal the positive linear trends for spring (MAM) temperatures over Kullu. Contrary are the summer (JJA) temperatures, where the linear trends are stagnant or even decreasing.
As gridded datasets are prone to inhomogeneities, an 'ensemble' of observational and Reanalyses datasets are analysed and possible uncertainties have to be discussed. In conclusion it is important to state that global observational datasets and Reanalysis are not a surrogate for ground and upper air in-situ measurements and allow only a very coarse estimation of air temperature and precipitation trends. Nevertheless, it often remains the only option for local studies.