



Climatic characterization of Baltoro glacier (Karakoram) and northern Pakistan from in-situ stations

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This study discusses the analysis of a set of standard meteorological parameters measured at two high-altitude stations on the Baltoro glacier (Karakoram), which provide a detailed climatic characterization of this area. Temperature and precipitation data from other fourteen in-situ stations in northern Pakistan, located at different altitudes (from 1,250 to 4,710 m), and five gridded precipitation datasets are also analyzed.

The analysis shows that temperature exhibits high spatial coherency across the Upper Indus Basin (UIB) in northern Pakistan and that the temperature lapse rate is consistent with the moist adiabatic lapse rate of the atmosphere. Precipitation is less correlated spatially; the vertical precipitation gradient indicates an increase with elevation until about 3,000 m and then a decrease. This can be attributed to the strong underestimate of solid precipitation by rain gauges in high-altitude regions, mostly caused by the interference of wind with the automatic measurement devices.

The annual cycle of precipitation shows that, in general, stronger precipitation inputs occur in winter than in summer, confirming that northern Pakistan is not under the prevailing influence of the Indian monsoon. Our analysis of the seasonal synoptic-scale circulation by means of back-trajectory ensembles confirms that westerly perturbations play a central role in determining the water input to the northern areas of Pakistan in winter.

Trend analyses on the longest records available confirm that the upper Indus basin has experienced an increasing trend in winter precipitation and summer cooling since the 1960s.