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Temperature and precipitation trends on the southern slopes of Mt Everest during the last twenty years (1994-2013)

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The current uncertainties on Himalayan glacier shrinkage is mainly attributed to lack of meteorological measurements. The need for a fine scale investigation is particularly evident in the south slope of Mt Everest as it is one of the heavily glaciated parts of the Himalaya. To fill this knowledge gap the "Pyramid" station (5050 m) was created by Ev-K2-CNR Committee since the 1990. This meteorological observatory is located at the highest elevation at which weather data have ever been gathered in the region and thus the collected time series represents a valuable dataset to investigate the climate change in southern central Himalaya. However the remoteness and the harsh conditions of the region has determined over the years complications of operating of the automated weather stations (AWS) which do not have allowed to make long-term measurement coming from a unique station.
In this context, we propose here a monthly temperature and precipitation reconstruction of the last twenty years (1994-2013) (and associated uncertainty) using quantile mapping and expectation maximization techniques using all the available in situ measurements. We observed an increase of $+0.53\pm0.12$°C which is comparable to that of the Northern Hemisphere. However, the trend is significant at 90%. In addition, the increasing trend is concentrated in the winter months. The implications of these findings are significant. The melting of glaciers is ascribed to the temperature increase during the summer, while we observe a stationary trend during the warmer months. Consequently, the role of precipitation and solar radiation becomes central in the climate change impact studies of the region. As regards to the precipitation trend, we observe a substantial decrease (about -16.2 $\pm$1.1 mm y-1 of precipitation, $p<0.001$) both for winter and summer months. Our results agree with the findings from other research groups that refer to a weakening of the monsoon from the '70s.
These results are compared to the time series of other 25 AWSs located at lower elevations (Nepali Department of Hydrology and Meteorology –DHM-) and one located on the north slope of Mt Everest (Chinese Academy of Science –CAS-). Afterwards, we evaluate the agreement of these meteorological land stations with reanalysis and gridded data in order to investigate the possible spatial extension of our observations. In general, this study has as its ultimate goal to use all our available figures in order to expand and streamline the current knowledge on climate drivers in southern central Himalaya and allow thus interpreting the observed impacts on cryoshere of the region.