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Estimation of Temperature Lapse Rate Techniques over Uttarakhand Region, Western Himalaya

Priyanka Negi¹, Ajanta Goswami¹, and Girish Chandra Joshi²

¹Department of Earth Sciences, IIT Roorkee, Roorkee, India

²Uttarakhand State Disaster Management Authority, Government of Uttarakhand, Dehradun, India

In this study, the temperature lapse rate (TLR) was estimated for the Uttarakhand region using MODIS-LST (day and night) and the observed air temperature data extracted from the 107 stations. The objective of this study is to estimate the TLR: first directly from MODIS-LST referred as “TLR_DFM” and the second from the observed station data which is referred as “TLR_St.”. The result of our analysis shows that MODIS-LST estimated TLR during the day-time ($-0.54^{\circ}\text{C}/100\text{ m}$) is more accurate than the night-time ($-0.59^{\circ}\text{C}/100\text{ m}$) and shallower during the winter months than summer months. The spatial and temporal changes of TLR from 107 stations varies significantly with steepest summer and shallowest winter ranging from $-0.12^{\circ}\text{C}/100\text{ m}$ to $-1.1^{\circ}\text{C}/100\text{ m}$ of maximum, minimum and mean temperature. The highest TLR occur in June of maximum temperature, while the lowest occur in December of minimum temperature. This observation contradicts with standard temperature lapse rate ($-0.65^{\circ}\text{C}/100\text{ m}$) which is used globally for most of the ecological and hydrological models. Further, for the validation of performance the time series LST data derived from the satellite were correlated with the observed air temperature data for a complete 1 year (2020). Thus, the results found out to be highly correlated, that the TLR for the exact pixel has a great potential than the observed air temperature in extremely sparse region. This study further helps in understanding the results of various land surface process related to climatology, hydrology where the use of standard temperature lapse rate (STLR) is an essential input in the high mountainous region.