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Space-time analysis of variation of Snow and Ice Cover in Nepal, Himalaya from 2001-2016 using MODIS.

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Abstract

Snow plays an essential role in adding mass to the glacier and snow caps and directly or indirectly contributes to changes in earth water budget. Tools like remote sensing can be used for a large scale spatial analysis of snow cover and depth changes using different satellite images such as Moderate Resolution Imaging Spectroradiometer (MODIS) to understand trend change of snow and ice. This study uses MODIS fractional snow cover data product to analyze snow cover change to have a better understanding of a change in the snow cover from 2001-2016 in Nepal, Himalaya. To understand the possible relationship between snow cover change over Nepalese Himalayas, this paper examined the relationship between the snow cover and two essential climatic parameters, temperature and precipitation variation using person correlation analysis. The spatial distribution and pattern of Snow Cover Days (SCDs) from year to year over the Nepalese mountain region is very similar and relatively stable with very little fluctuation. The areas with greater fractional snow cover are observed more in the mountainous areas with fractional snow cover percentage of 50-75 percent. Considering the DEM, the areas with the fractional snow cover higher than 50 to 60 % are consistent with the elevation zone above 3000 to 4000 m a.s.l. This is convincing as the most of the high mountain is in the northern part of the region. In total 64 % of pixels are characterized by the decrease of snow cover during to 2001 to 2016 for annual changes. In addition to this, seasonal pixels for summer, winter, spring, and autumn had the higher number of pixels with decreasing trend of the snow with values 84%, 62%, 55% and 64 % respectively. Consequently, a significant decrease is observed in the northeastern part of Nepal. The snow cover changes show a significant positive correlation with precipitation for the season of autumn (r=0.8218***), winter (r=0.6800) and for the annual change (r=0.1302). A negative correlation is observed with the interannual seasonal temperatures for the seasons', spring (-0.0308), autumn (-0.3420), and winter (-0.4029). These results suggest that temperature and precipitation both are dominant climatic factors affecting the interannual variation of snow cover in the region.

Keywords: Fractional Snow and Ice cover change, MODIS, Climatic parameter correlation, Nepal Himalaya