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Study Employed a Computer Model and Satellite Remote Sensing to Evaluate the Temporal and Spatial Distribution of Snow in the Western Hindu Kush Region of Afghanistan

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Abstract : Millions of people reside downstream of river basins that heavily rely on snowmelt originating from the Hindu Kush (HK) region. Snowmelt plays a critical role as a primary water source in these areas. This study aimed to evaluate snowfall and snowmelt characteristics in the HK region across altitudes ranging from 2019m to 4533m. To achieve this, the study employed a combination of remote sensing techniques and the Snow Model (SM) to analyze the spatial and temporal distribution of Snow Water Equivalent (SWE). By integrating the simulated Snow-cover Area (SCA) with data from the Moderate Resolution Imaging Spectroradiometer (MODIS), the study optimized the Precipitation Gradient (PG), snowfall assessment, and the degree-day factor (DDF) for snowmelt distribution. Ground observed data from various elevations were used to calculate a temperature lapse rate of -7.0 (°C km-1). Consequently, the DDF value was determined as 3 (mm °C-1 d-1) for altitudes below 3000m and 3 to 4 (mm °C-1 d-1) for higher altitudes above 3000m. Moreover, the distribution of precipitation varies with elevation, with the PG being 0.001 (m-1) at lower elevations below 4000m and 0 (m-1) at higher elevations above 4000m. This study successfully utilized the SM to assess SCA and SWE by incorporating the two optimized parameters. The analysis of simulated SCA and MODIS data yielded coefficient determinations of R2, resulting in values of 0.95 and 0.97 for the years 2014-2015, 2015-2016, and 2016-2017, respectively. These results demonstrate that the SM is a valuable tool for managing water resources in mountainous watersheds such as the HK, where data scarcity poses a challenge."

Keywords : improved MODIS, experiment, snow water equivalent, snowmelt
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