Spatiotemporal Distribution of Snow in the High Mountain Asia and its Impact on Runoff

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ABSTRACT

The melting of snow and glaciers in the High Mountain Asia (HMA) provides the water needs of approximately 1.3 billion people in the region. Increasing temperatures have large effects on the hydrologic cycle, influencing snowmelt, snowpack, streamflow, and water runoff, which can impact many aspects of water security. Most mountain regions, however, remain ungauged without in-situ measurement of precipitation or snowpack due to the complex terrain, and thus it is difficult to understand the regional water balance and assess how it might change in the future. In this study, we focus on characterizing the spatiotemporal patterns of snowpack states and fluxes over the last 30+ years (1980 – present) and assessing the relationship between snowmelt and runoff. Three different land surface models (i.e., Noah 3.3, Noah-MP 3.6, and Catchment F2.5) in the NASA Land Information System (LIS) is used to characterize the spatiotemporal pattern of snow. Combining information from satellite observations and the Modern-Era Retrospective analysis for Research and Applications, Version 2 (MERRA-2) is used to provide an effective way to develop spatially and temporally continuous estimates of changes. We evaluate our model estimates against satellite-derived data (e.g., MODIS snow cover fraction and GRACE total water storage anomaly) and reanalysis products (e.g., CMC and ERA-interim) using the NASA-developed Land Verification Toolkit. Using the model estimates, we examine spatiotemporal patterns of the snowmelt across HMA.

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