



Spatio-temporal snow cover change and hydrological characteristics of the Astore, Gilgit and Hunza river basins (western Himalayas, Hindukush and Karakoram region) - Northern Pakistan

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A large proportion of Pakistan's irrigation water supply is drawn from the Upper Indus River Basin (UIB) situated in the Himalaya-Karakoram-Hindukush (HKH) ranges. More than half of the annual flow in the UIB is contributed by five of its high-altitude snow and glacier-fed sub-basins including the Astore (Western Himalaya – southern part of the UIB), Gilgit (Hindukush – western part of the UIB) and Hunza (Central Karakoram – northern part of the UIB) River basins. Studying the snow cover, its spatio-temporal evolution and the hydrological response of these sub-basins is important so as to better manage water resources. This study compares data from the Astore, Gilgit and Hunza River basins (mean catchment elevation, 4100, 4250 and 4650 m ASL, respectively), obtained using MODIS satellite snow cover images. The hydrological regime of these sub-catchments was analyzed using hydrological and climate data available at different altitudes from the basin areas. The results suggest that the UIB is a region undergoing a stable or slightly increasing trend of snow cover in the southern (Western Himalayas), western (Hindukush) and northern (Central Karakoram) parts. Discharge from the UIB is a combination of snow and glacier melt with rainfall-runoff in the southern part, but snow and glacier melt is dominant in the northern and western parts of the catchment. Despite similar snow cover trends (stable or slightly increasing), different river flow trends (increasing in Astore and Gilgit, decreasing in Hunza) suggest that a sub-catchment level study of the UIB is needed to understand thoroughly its hydrological behavior for better flood forecasting and water resources management and to quantify how the system is being forced by changing climate.