

Application of the Snowmelt Runoff Model in the Salang River Basin, Afghanistan Using MODIS Satellite Data

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ABSTRACT

This study is carried out on the Salang River basin, which is located at the northern part of the Kabul River basin, and in the south facing slope of the Hindu Kush Mountains. The basin drains through the Salang River, which is one of the tributaries of the Panjshir River. The basin covers an area of 485.9km² with a minimum elevation of 1653 m a. s. l. and a maximum elevation of 4770 m a. s. l. The Salang River sustains a substantial flow of water in summer months due to the melting of snow. In this study, we estimate daily discharge of Salang River from 2009 to 2011 using the Snowmelt Runoff Model (SRM, Version 1.12, 2009), originally developed by J. Martinec in 1975. The model uses daily observed precipitation, air temperature and snow cover data as input variables from which discharge is computed. The model is calibrated for the year 2009 and validated for 2010 and 2011. The observed and calculated annual average discharges for the calibration year 2009 are 11.57m³s⁻¹ and 10.73m³s⁻¹, respectively. Similarly, the observed and calculated annual average discharges for the validation year 2010 are 11.55m³s⁻¹ and 10.07m³s⁻¹, respectively and for 2011, the discharges are 9.05 m³ s⁻¹ and 9.6m³s⁻¹, respectively. The model is also tested by changing temperature and precipitation for the year 2009. With an increase of 1°C in temperature and 10% in precipitation, the increases in discharge for winter, summer and annually are 21.8%, 13.5% and 14.8%, respectively. With an increase of 2°C in temperature and 20% in precipitation, the increases are 48.5%, 43.3% and 44.1%, respectively. The results obtained suggest that the SRM can be used as a promising tool to estimate the river discharge of the snow fed mountainous river basins of Afghanistan and to study the impact of climate change on river flow pattern of such basins.

Keywords: Snowmelt Runoff Model (SRM), Salang River basin, snowmelt, river discharge