

Estimation of Discharge From Upper Kabul River Basin, Afghanistan Using the Snowmelt Runoff Model

Hafizullah Rasouli^{1,2}, Rijan B. Kayastha¹, Bikas C. Bhattarai¹, Ahuti Shrestha¹, Hedayatullah Arian^{1,3} Richard Armstrong⁴

¹ *Himalayan Cryosphere, Climate and Disaster Research Centre, Department of Environmental Science and Engineering, School of Science, Kathmandu University, Dhulikhel, Nepal*

² *Department of Geology, Faculty of Geosciences, Kabul University, Kabul, Afghanistan*

³ *Department of Hydro-Meteorology, Faculty of Geosciences, Kabul University, Kabul, Afghanistan*

⁴ *National Snow and Ice Data Centre, The University of Colorado, Boulder, USA*

ABSTRACT

In this study, we estimated discharge from Upper Kabul River basin in the Hindu Kush Mountain (Paghman range) in Afghanistan. The Upper Kabul River basin covers an area of 1633.8km² with a maximum elevation of 4522 m and minimum elevation of 1877 m. The Kabul River is one of the main rivers in Afghanistan and sustains a significant flow of water in summer months due to the melting of snow. In this study, daily discharge from Upper Kabul River basin, west of Kabul basin, for 2009 and 2011 is estimated by using Snowmelt Runoff Model (SRM) (Version 1.12, 2009), originally developed by J. Martinec in 1975. Daily precipitation, air temperature, discharge and snow cover data are used in the model as input variables. We calibrated the model for 2009 and validated in 2011. The observed and calculated annual average discharges in 2009 are 5.7m³/s and 5.6m³/s, respectively; and in 2011 are 1.33m³/s and 1.31m³/s, respectively. The model results are in good agreement with the measured daily discharges. With an increase of 1°C in temperature and 10% precipitation, the increase in discharge in winter, summer and annually relative to 2009 discharge are 39%, 18.5% and 17.9%, respectively. Similarly, with an increase of 2°C in temperature and 20% in precipitation, modeled discharge increases by 51.2%, 40.8% and 47.3%, respectively. The results obtained suggest that the SRM can be used efficiently for estimating discharge in the snow fed sub-catchment of the Upper Kabul River basin and other mountain basins in Afghanistan.

Keywords: *Snowmelt, Snowmelt Runoff Model, Upper Kabul River basin, MODIS*