

# Estimation of discharge of Langtang River basin, Rasuwa District, central Nepal by Positive Degree Day Model

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## Abstract

This paper provides the results of estimation of discharge of Langtang River, Rasuwa district, Nepal using a Positive Degree Day (PDD) Model. Climate warming is often accompanied by changes in the hydrological cycle e.g. changes in rainfall patterns, snow and glacier melting and river discharges. The most widely reported impact of these changes in this region is the retreat of glaciers which has profound future implications for downstream water resources. However, there is severe knowledge gap in the Himalayan region in understanding the impacts of climate change on the hydrological regime. Hence, to address this problem, this study has been performed with an objective to estimate the monthly discharge from a glacierized Langtang River basin and project the future basin discharge with relative contribution of glacier and non-glacier runoff components. The PDD Model estimates snow and ice melt from the debris free areas as well as ice melt under debris layers based on the positive degree-days calculated from monthly mean temperature and precipitation. The model also accounts the potential evapotranspiration, infiltration and base flow for total discharge estimation. The model is calibrated for the period 1995 – 2003 and validated for the period 2004 and 2006 with  $R^2$  0.88 using the observed temperature, precipitation and discharge data. Then the river discharge of the basin is predicted for the period 2010 – 2050 from the Regional Climate Model (RCM) data (1996 – 2050) using WRF model for the RCP4.5 scenario computed at 12 km horizontal resolution. The projected discharge of the basin shows slight positive trend over the period of 2010 – 2050 with highest peak in the year 2019. The average snow and glacier runoff contribution to the total runoff for the period 1995 – 2006 is 49.5% whereas for the period 2010 – 2050 it is estimated to be 45.6 %. During the period 2010 – 2050, relative increase of non-glacier runoff is observed which may be due to increase in temperature and the resulting precipitation in the form of rain. From the sensitivity analysis, it is found that the change in discharge in response to the change in temperature is more which shows that the PDD Model is more sensitive to the temperature. In this study, the PDD Model has well captured the glacio-hydrological dynamics of Langtang River basin and thus the model can be considered as a promising tool to understand the hydrology of glacierized river basins which thereby helps to fill gap in understanding the impacts of climate change on the hydrological regime of Himalayan region.

**Keywords:** Positive degree days, climate change, glacio-hydrological dynamics, future discharge projection