# ESTIMATION OF DISCHARGE FROM GILGIT RIVER BASIN, KARAKORAM PAKISTAN USING A GLACIO-HYDROLOGICAL MODEL

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## ABSTRACT

The Hindu Kush, Karakorum and Himalayan (HKH) mountain ranges contain some of the largest glaciers, extensive perennial snow and ice covered areas of the world outside the Polar Regions and nourishes large Asian river basins with significant amounts of snow and glacier melt. In scarcity of hydro-meteorological and cryospheric data in these mountainous regions, the temperature index model or degree day model often serves as a powerful tool in ice and snow melt computations on a catchment scale. This study uses modified positive-degree day model (MPDDM) to estimate daily discharge of Gilgit River basin (drainage area: 13,471 km2) geographically, extends from 35.80°N, 72.53°E to 36.91°N, 74.70°E, a sub-catchment of upper Indus basin in the high Karakorum region. The modified positive-degree model is based on the relation that the melting of snow or ice during any particular period is proportional to the positive degree-days linked by the positive-degree day factor involving a simplification of complex process that are more properly described by the energy balance of the glacier surface and overlaying atmospheric boundary layer. The degree-day factors used in the current study are taken from the field studies carried out by the Pakistan Meteorological Department to Hinarchi Glacier, Bagrot Valley, Gilgit in 2008. The degree-Day factor was measured for different type of glaciated ice and snow, which includes debris covered ice, firn, bare ice cliffs and snow bestowed by summer snowfalls. These values ranges from 1-6 mm/°C/d. The degree-day factors estimated in the Karakorum region by different authors for snow and ice ranges from 1-14 mm/°C/d and debris cover ice ranges from 1.13 – 7.73 mm/°C/d. The model is calibrated from 2001 to 2005 and the validation period of the model is from 2006 to 2010. The observed and simulated average discharges for the calibration years are 307.07 m3/s and 298.79 m3/s and for validation years are 316.59 m3/s and 302.92 m3/s, respectively. The Nash – Sutcliffe model efficiency coefficient values and volume differences are 83 % and ~2.7 % in the calibration years and 74% and ~4.3%, respectively in the validation years. Similarly, the relative contribution of snow and ice melt in the total discharge in the calibration and validation years are 24 % and 22%, respectively. The results obtained from the MPPDM showed that this model is good enough to estimate daily discharge from glacierized river basins. It can also be used in climate sensitivity studies and other hydrological and ice dynamic modelling. It is also helpful in the prediction of future discharge.

**KEYWORDS:** Modified Positive degree day model, climate sensitivity, prediction of future discharge