# ADAPTATION AND CALIBRATION OF A CONCEPTUAL SNOW AND GLACIER MELT RUNOFF MODEL FOR OPERATIONAL PURPOSES IN THE NEPAL HIMALAYA

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For the development of the hydropower potential of Nepal in the context of a distributed power generation scheme, the assessment of the water available for safe energy production is essential for site selection, design, and economic operation of the planned and implemented hydropower schemes. Runoff from the snow and glacier fields of the high Himalayas is hereby the primary source of river runoff in the dry season (Grabs et al. this issue).

To simulate and predict snow and glaciermelt runoff, an existing conceptual snow and glaciermelt runoff model operation with daily time-steps has been adapted from Alpine to Himalayan conditions (Lang et al. 1992, Braun et al. 1993, Hottelet et al. 1993). A schematic description of its individual model components is shown in Fig. 1. The paper demonstrates some of the major differences between Alpine and Himalayan runoff simulation and prediction and the adjustment of the parameters in the model for its operational use in Nepal.

Amongst the differences between Alpine and Himalayan conditions are the different treatment of evaporation in the adapted model and the necessary model changes to reproduce the sensitivity of debris-covered glaciers in Nepal versus the mostly blank ice glaciers in the Alps with respect to changes in temperature and runoff generation. The paper discusses methods to adjust the model parameters to different basins, namely the Langtang, Imja, and Modi *Khola*, where the model has been successfully applied (Fig. 1). The threshold temperature between liquid and solid precipitation is discussed together with different temperature gradients experienced during the dry and the monsoon season.

In this regard, it is also necessary to use information from ungauged basins as input in the model to allow runoff simulation under different terrain and environmental conditions; a task which is important but for which the first concepts for Nepal are just emerging.

The model has been further adapted to cope with data losses and allow the necessary correction of precipitation data to represent the basin conditions as a generalisation of the gauge measurements. In the simulation phase, the quality of the model results is checked against precision discharge measurements using fluorescence-tracer techniques (Spreafico and Grabs 1993). The paper also discusses the steps necessary to shift from the simulation mode to the prediction mode.

The model runs on a stand-alone PC-basis where the data is transferred from the database of the Snow and Glacier Hydrology Project (SGHP). The development of the model to a user-friendly tool has required extensive work which is briefly reported in the paper.

While the simulation mode is sufficient for site selection and design of hydropower schemes, the prediction mode requires enhanced near-real time data transmission and improved areal information about the snow coverage for the economic operation of the hydropower scheme and the prediction of general electrical energy.

The paper discusses the operational aspects of the model and use of the model's results for the operation of a run-of-the-river hydropower scheme.

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Figure 1. Schematic overview of the HBV3-ETH snow and glacier melt runoff model

Figure 2. Simulation of discharge of the Modi *Khola* (1987/88), Langtang *Khola* (1989/90) and Imja *Khola* (1989/90) basins

Figure 1. Schematic overview of the HBV3-ETH snow and glacier melt runoff model

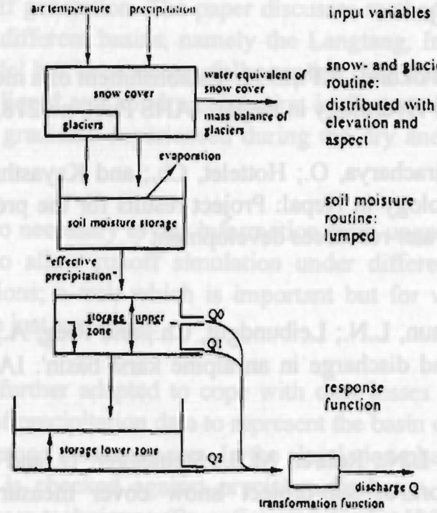


Figure 2. simulation of discharge of the Modi *Khola* (1987/88), Langtang *Khola* (1989/90) and Imja *Khola* (1989/90) basins