

## Temperature index based snowmelt runoff modelling for the Satluj River basin in the western Himalayas

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**Abstract:** The Satluj River is one of the main rivers in the western Himalayas. Snowmelt runoff substantially contributes to the streamflow of the river in the spring and summer months. The unavailability of observed meteorological data (precipitation, surface temperature) spread across the Satluj basin is a major problem for modelling snowmelt runoff there. Researchers have used station observations available at certain points in the basin for modelling snowmelt and rainfall runoff in Satluj and have obtained mixed results. For this study, a new meteorological dataset was prepared by merging gridded precipitation from India Meteorological Department (IMD) and Aphrodite as well as station observations of Bhakra Beas Management Board (BBMB) in the basin. Maximum and minimum temperatures from the Climate Forecast System Reanalysis were also used for the entire basin. The Soil and Water Assessment Tool (SWAT) hydrology model was run using the new dataset to simulate runoff in the Satluj River and to evaluate the streamflow characteristics. Sensitivity experiments were carried out using temperature and precipitation lapse rates, routing methods (travel time vs Muskingum) and degree day factors to identify best suitable parameters for simulations. Three sets of calibration (1982-1992) and validation (1993-2003) simulations were carried out to estimate the performance of the SWAT model in simulating runoff in the Satluj basin. The experiment with precipitation data prepared using IMD, Aphrodite and BBMB stations provided the best performance with a Nash Sutcliffe efficiency (NS) of 0.60 and  $R^2 = 0.70$ , which is a major improvement on the use of Aphrodite data only (NS = 0.13 and  $R^2 = 0.51$ ). However, the model underestimates the streamflow in all seasons in all the simulations. It was found that the model is able to simulate the extreme streamflow cases in Satluj with reasonable skill.