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Influence of snow pack and soil water dynamics on river flows in un-glaciarized Himalayan catchments.

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In the Central Himalayas, it is generally accepted that 80 % of the annual precipitation occurs during the monsoon months (June – September). However, surveys with local populations show that surface water is available throughout the year. The main question then is to identify the origin of these surface flows. One hypothesis proposes that they are provided by glacial melt during the dry season. However, on the one hand, this historically "permanent" supply is also observed in catchments with little or no glacial contribution, and on the other hand, annual volumes cannot be totally explained by the glacial mass balances currently monitored.

Therefore, a better understanding of the hydrological processes is needed for quantifying the influence of the inter-seasonal surface (snow) and sub-surface storage on surface flows outside of the monsoon season. One solution consists in the application of modelling tools. However, simulations for Himalayan catchments are limited due to a lack of knowledge regarding their hydrological behaviour. The main source of uncertainty in poorly monitored environments is the scarcity of observations, which can be used for model calibration and evaluation. In this study, physically-based modelling with the ISBA Soil-Vegetation-Atmosphere transfer scheme is applied to small catchments whose physical characteristics are well studied, therefore this approach could constitute an interesting way for understanding hydrological systems.

For that purpose, two small slope catchments selected in the Dudh Koshi River basin (Eastern Nepal), which represent high and mid-mountain environments, are studied in order to evaluate the spatial variability of the studied processes. They are equipped with 6 stations for air temperature and precipitation observations. A distributed approach allows a better representation of the spatial variation of hydro-climatic processes. Moreover, the descriptions of surfaces currently available at global scales are enhanced, based on field observations and points of measurements of soil properties. A reduced number of internal parameters of the model can then be calibrated through a multi-objective optimization step. Both hourly measured flows and remote sensing data for snow cover can be used as criteria for validation. In this presentation, we estimate from modelling results the contribution of snow melt and sub surface flows to the river discharges during the seasons with low precipitation.

Key words : Himalayas, physical modelling, inter-seasonal storage, soil water, snow melt.