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Snow-Hydrological modeling using remote sensing data in Vilcanota basin, Peru

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Water resources availability in the southern Andes of Peru is being affected by glacier and snow retreat. This problem is already perceived in the Vilcanota river basin, where hydro-climatological information is scarce. In this particular mountain context, any water plan represents a great challenge. To cope with these limitations, we propose to assess the space-time consistency of 10 satellite-based precipitation products (CMORPH-CRT v.1, CMORPH-BLD v.1, CHIRP v.2, CHIRPS v.2, GSMaP v.6, GSMaP correction, MSWEP v.2.1, PERSIANN, PERSIANN-CDR, TRMM 3B42) with 25 rain gauge stations in order to select the best product that represents the variability in the Vilcanota basin. For this purpose, through a direct evaluation of sensitivity analysis via the GR4J parsimonious hydrological model over the basin. GSMap v.6, TRMM 3B42 and CHIRPS were selected to represent rainfall spatial variability according with different statistical criteria, such as correlation coefficient (CC), standard deviation (SD), percentage of bias (%B) and centered mean square error (CRMSE). To facilitate the interpretation of statistical results, Taylor's diagram was used to represent the CC statistics, normalized values of SD and CRMSE.

A distributed degree-day model was chosen to analyse the sensitivity of snow cover simulations and hydrological contribution. The GR4J rainfall-runoff model was calibrated (using global optimization) and applied to simulate the daily discharge and compared with the Distributed Hydrology and Vegetation Model with Glacier Dynamics (DHSVM-GDM) over the 2001-2018 period. Furthermore, the simulated streamflow was evaluated through comparisons with observations at the hydrological stations using Nash-Sutcliffe efficiency and Kling Gupta Efficiency (KGE). The results show that the snow-runoff have increased in recent years, so new water management and planning strategies should be developed in the basin. This research is part of the multidisciplinary collaboration between British and Peruvian scientists (Newton Fund, Newton-Paulet) through RAHU project.