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Master Thesis Abstract

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Hydrological analysis of a glaciated catchment in the Cordillera Blanca (Peru)

Glaciers are important freshwater reserves for different sectors throughout the world. They display seasonal melt behaviour depending on different meteorological factors. In order to understand this behaviour and impact on water resources, measurements can be made and models can be developed. Here, the highly glaciated mountainous Artesón catchment in the Cordillera Blanca (Peru) is studied. The catchment area (9.2 km^2) and contributing glaciers (68% to 52% glaciated from 2001 to 2016) are identified using remote sensing data. Meteorological and hydrological data collected at different stations in the catchment are analysed, to identify the drivers of melt and runoff, suggested to be monthly average temperature and monthly total precipitation. Weather Research & Forecasting model outputs (surface fluxes and temperature) are compared to measurements at the study site, presenting bias but good monthly correlations. An initial full energy balance could be derived, displaying the seasonality of melt and sublimation, and a first estimation of monthly melt shows a good correlation with the observed runoff. The conceptual semi-lumped GSM-SOCONT model is applied to this catchment, and modified to simulate total catchment runoff. The best Nash-Sutcliffe and log-Nash-Sutcliffe values were obtained using a seasonally variable sinusoidal degree-day factor (DDF) for melt and the maximum or average daytime air temperatures. A Glacier Area Change Routine (GACR) based on the Δh-parameterization was used to predict the glacier area at the end of each simulation, using the total melt volume simulated. The glacier melt volume obtained from a sinusoidal DDF with the average daytime temperature yielded the best agreement between the area predicted by the GACR and the area delineated using remote sensing data.

Keywords: glacier melt, ice, tropical glacier, glacier delineation, glacier thickness, GSM-SOCONT, energy balance, degree-day factor.