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Analysis of snow-glacial historical and projected flows in Olivares river basin. Comparison between DHSVM and WEAP models

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In the Andes Mountains, in central Chile, glaciers are a key element to both environment and economy, since they contribute highly to stream flow during the summer season. Many studies have been performed in order to understand the actual contribution of glacialer-based streamflow and the expected response of glaciers to climatological alterations such as climate change. This work studies and analyses the historical and future stream flow on the Olivares river basin, located close to Chile's capital city, Santiago, under scenario RCP8.5.
For this, we use two hydrological models with different topology, to have more consistency in the results, and analysing the differences because of the conceptualization of the processes and its spatial scale. DHSVM is a distributed, physically based model, while WEAP is a semi-distributed model that represents some processes conceptually and others physically based. Both models are calibrated considering streamflow and snow cover data from the period 2001-2012 at a daily scale. Additionally, comparisons between the modelled glaciealr area variations and LANDSAT images are performed to strengthen the calibration process. Climate change projections are obtained from five Global Circulation Models (GCM) under RCP8.5 scenario. Changes in glaciaerl area, glacial volume and glacial streamflow contribution to basin discharge are analysed, comparing two future time lapses, near-future period (2015-2044) and far-future (2045-2074), to a baseline period (1985-2004).
The basin has an area of 543 km2, with elevations ranging from 1,528 to 6,024 m.a.s.l. and an important glacialer presence. According to the National Glacier Cadastre developed by Chile Water Authority (DGA) in 2012, there are 80 uncovered glaciers within the basin, the most important being Juncal Sur, Olivares Alfa, Beta and Gamma. Glaciaerl area represented 17% of the basin in 19865, while they made up only to 11% in 2015.The glaciers are located at altitudes ranging from 3,500 to 6,000 m.a.s.l., most on the vicinity of 4,500 m.a.s.l.
Analysing variations in meteorological information between baseline, for the near and far future periods we obtain an increase of 1.3°C and 2.9°C respectively. Analogously, a decrease of 33.6 mm and 93.2 mm for the annual precipitation is projected for the same corresponding periods.
Results from both models show that most of the glacial area will have melted away by the end of the far-future period, with only 1.2 km2 and 6.8 km2 remaining, according to DHSVM and WEAP models respectively. Also for the far future period, total streamflow decreases respect to base line period between 15 and 46%, while glacier streamflow decreases between 53 and 85% in far future, depending of the GCM and hydrological model used.