Submitted Abstract

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First Author First Name Last Name	 Simone Schauwecker
Submitting Author First Name Last Name	 Simone Schauwecker
Correspondence	simone.schauwecker@ceaza.cl
Co-Authors **>> E-Mails will be not listed**	Ayala, Álvaro; Cortés, Gonzalo; Goubanova, Katerina; Macdonell, Shelley
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Abstract

Melting snow from high-elevation areas dominates discharge and freshwater supply in semi-arid Chile. The snow cover largely depends on few winter events and consequently there is a large year-to-year variability in the snow water equivalent (SWE). The extraordinarily dry conditions experienced almost continuously since 2010 and increased water consumption in the region have led to a considerable stress of the water system. For an efficient water allocation and water management, it is therefore crucial to know the actual SWE stored in the mountain snowpack. Until now, decisions are based on point measurements of the SWE or snow area estimations from MODIS. A drawback of these estimations are the large uncertainties that hamper an efficient water allocation with important implications for water security of different areas such as hydropower, agriculture and domestic use.

In this project we are developing a new operational SWE Estimation Tool for water resources decision-making in the Coquimbo region (SWEET-Coquimbo). The SWE is estimated using a data assimilation framework that combines meteorological forcing ensembles from reanalysis data, hydrological modelling and satellite observations of the snow-covered area. First, meteorological data are disaggregated to the model grid resolution and a comparison with station data from a relatively dense network of meteorological stations allows evaluating the bias and uncertainty of reanalysis data. This uncertainty is then used to generate ensembles of input variables for the hydrological model. The data assimilation further assigns higher weights to ensemble replicates that generate best predictions compared to satellite observations. These weights are used to calculate ensemble metrics, such as the mean and uncertainty of SWE estimates. Finally, the model outputs are validated with in-situ manual SWE measurements and UAV-based and LiDAR observations of the snow depth.

Along with the operational SWE estimates, retrospective SWE estimates over 1985-present will be used to improve our understanding of the spatial distribution and temporal evolution of the SWE in the region. The results will be published on an open access web platform and available as inputs for downstream applications such as hydrological models and hydrological assessments.