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Climate change impact on hydroclimate regimes and extremes over Andean basins in the central-southern Chile

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We have assessed the impact of projected increases in temperature and decreased precipitation on variability and potential changes in hydroclimate regimes and extremes over Andean basins in the central-southern Chile (∼30-40S). The altitude of the southern Andes in the study area has an average altitude of 5000 m in the north that decreases to 3000 m at the southern edge. Climatically the region has a Mediterranean–like climate with mainly winter precipitation that gradually increases southwards, from around 300 mm/yr to 1000 mm/yr. The region is home to most of the population in Chile (∼10 mil. inhabitants), it has fertile and productive agriculture land, as well as hydro-electrical power plants. During the 20th Century the region has experienced a decreasing precipitation trend imbedded in important interannual and decadal scale variability.
We have used gridded observed daily precipitation and temperatures to drive and validate the VIC macro-scale model over the region of interest at 0.25 x 0.25 degree resolution. Historical (1960-2005) and projected (RCP8.5, 2006-2099) daily precipitation and temperatures from 28 CMIP5 models are adjusted via a transfer function based on the gridded observed daily precipitation and temperature data. Adjusted time series are then used to drive the VIC model in order to present climate change projections. The hydrological model simulations foresee that drying is robust in the models and total annual runoff will decrease in the future (40-45% by the end of the century). Center timing of runoff tends to shift to earlier days (3-5 weeks by the end of the century). In some areas over the Andes winter runoff is projected to increase due to upward movement of zero isotherm. Moreover, reductions in the amount of snowpack and accelerated snowmelt lead to more pronounced increase in winter evapotranspiration over the same areas. The simulated 12-months Standardized Runoff Index (SRI) clearly shows severe persistent hydrological droughts without (or a few) wet spell interruptions by the end of the century. On the other hand, probability density function of annual maximum runoff over high elevations (>1000 m) and higher interannual variability of 3-months SRI indicate a possible increase in the probability of flood events.