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Impacts of climate change on the Huasco salt flat aquifer (North of Chile) – insights from a hydrological and hydrogeological numerical study

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In arid regions, where surface water and precipitation are scarce, groundwater is the main water source that sustains human and natural ecosystems. Therefore, it is very important to investigate the potential impacts of climate change that may threaten the availability of this resource. This study investigates the effect of climate change on the aquifer of the Huasco salt flat basin (Chile). This basin is located in the Andean plateau at an elevation of ∼3800 masl and is an undeveloped basin whose wetlands are part of a groundwater dependent ecosystem.

With this aim, a hydrogeological model is developed and implemented in MODFLOW. Precipitation and temperature forecasts from global atmospheric circulation models are downscaled using the hybrid-delta approach to produce climate change scenarios. Recharge rates are calculated with a rainfall-runoff model under these scenarios and used as input to the hydrogeological model to assess the system's behavior.

Results show that even when evaporation from the water table fluctuates as a response to changes in the recharge rates, the groundwater stored in the aquifer is similar across all climate change scenarios. Nonetheless, when new groundwater withdrawals are added to the model, the groundwater levels are altered, and the system no longer remains in equilibrium. Thus, in undeveloped aquifers of arid zones, such as the Huasco salt flat aquifer, groundwater discharge to the surface will remain constant, buffering the effects of climate change and thus protecting this groundwater dependent ecosystem.

The results obtained in this work suggest that this aquifer must remain a protected area, so groundwater resource development, through activities such as pumping, would not alter the natural conditions of this unique environment.