Estimation of Hydraulic Properties of Wetland Soils in a Precipitation Gradient in North Patagonia

Fiorella Laco Mazzone[1,2]; Pablo Garcia Martinez[1,3]; Graciela Calabrese[1,2]

[1] Universidad Nacional de Río Negro, San Carlos de Bariloche, Río Negro, Argentina.

[2] IRNAD (UNRN-CONICET), San Carlos de Bariloche, Río Negro, Argentina.

[3] CONICET, Centro Atómico Bariloche (CNEA), San Carlos de Bariloche, Río Negro, Argentina.

Corresponding Author: flacomazzone@unrn.edu.ar

Andean wetlands are important biodiversity reservoirs that offer many ecosystem services. Previous studies in the Northern Patagonian Andes indicate that the precipitation regime plays a key role on wetlands structure and ecohydrology, suggesting that any change in precipitation regime may significantly affect these ecosystems. However, knowledge of many aspects of the hydrological baseline in this region, including the typical hydraulic properties of wetland soils, are still lacking. Such knowledge would be valuable, for instance, to identify most vulnerable areas under land use change or to assess the impact of climate change.

In this study, we estimated the typical hydraulic properties for hydric soils of wetlands placed along a precipitation gradient produced by the rain shadow effect created by the Andes Mountains. This estimation was performed indirectly, by numerically solving the Richards equation, and looking for the appropriate set of hydraulic parameters that produced results in agreement with the hydrological regimes observed in five representative wetlands along the precipitation gradient. The selected wetlands are at similar elevations and latitudes and have a flat landscape.

A large number of simulations were carried out using previously validated atmospheric fluxes (precipitation - evapotranspiration). The Mualem-van Genuchten (M-vG) model was adopted to describe the soil water retention curve (SWRC) and the unsaturated hydraulic conductivity (UHC). The parameter α within the adopted model is the inverse of the air entry pressure head and was used to estimate the saturated conductivity K_S. The numerical simulations were conducted using the code HYDRUS-1D.

We found that horizontal displacements of the SWRC along the pressure head axis play a dominant role in establishing the hydrological regime. The horizontal position of the SWRC is mainly controlled by α. Taking advantage of this fact, we used α as the main calibration parameter to obtain simulations that reproduced the observed water table levels at the five considered wetlands. As a result, we identified a range of adequate values for the hydraulic parameters of the M-vG model consistent with the hydrological regimes observed along the precipitation gradient, when the current atmospheric forcing is imposed. Possible reduction of the parameter uncertainties by the inclusion of additional information, such as the surface saturation period, are discussed. Using the obtained hydrological baseline, it is possible to assess the potential effects on the water levels under climate change scenarios involving different precipitation regimes and mean temperatures.