Title

Climate change impacts on renewable groundwater resources in the andosol-dominated Andean highlands, Ecuador

Abstract

Climate change, coupled with adaptive human actions, will affect water resource access and availability for environmental requirements. Hydrological modelling is an effective strategy for forecasting climate and human impacts on water resources. Modelling tools are advised for sparse-data mountainous basins intended to supply densely populated urban areas in the future. In this context, the SWAT model is used to evaluate the impact of climate change on renewable groundwater resources in the Pita River basin (PRB), a representative area of the andosol-dominated páramo ecosystem in the Andean highlands projected to meet future water demand in the metropolitan district of Quito (MDQ), Ecuador. Based on data availability, a SWAT model is configured for the PRB over the period 2006–2015 and five regional climate models (RCMs) based on two Representative Concentration Pathway (RCP) emission scenarios (4.5 and 8.5) for the mid- (2040–2069) and long-term (2070–2099) future horizons are implemented. Hydrological modelling demonstrates increases in average temperature and precipitation of + 2 °C and + 3 % in the mid-term and + 4.5 °C and + 20 % in the long term, respectively. All the RCMs indicate less aquifer recharge in the mid-term. However, this pattern is softened, and even reversed, in several scenarios in the long term. Seasonal differences in streamflow and aquifer recharge in the baseline scenario are predicted to increase to + 23 %. The natural hydrological regime determined by thick porous allophane-rich andosols over virtually full moderate-permeability volcanic and volcano-sedimentary aquifers induces high streamflow and low aquifer recharge rates. Future hydrological regime could place the highly sensitive soil–vegetation dynamics of the páramo ecosystem at risk of degradation, with negative

consequences for habitat preservation, in general, and stream water provision, in particular. Hence, groundwater is the safest option for water provision in the future.

Authors

Senent-Aparicio J.; Peñafiel L.; Alcalá F.J.; Jimeno-Sáez P.; Pérez-Sánchez J.

Author full names

Senent-Aparicio, Javier (56692838000); Peñafiel, Lilia (56305873100); Alcalá, Francisco Javier (6603128699); Jimeno-Sáez, Patricia (57194269805); Pérez-Sánchez, Julio (56692422200)

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Affiliations

Department of Civil Engineering, Catholic University of San Antonio, Campus de los Jerónimos s/n, Murcia, Guadalupe, 30107, Spain; Departamento de Desertificación y Geo-Ecología, Estación Experimental de Zonas Áridas (EEZA–CSIC), Almería, 04120, Spain; Instituto de Ciencias Químicas Aplicadas, Facultad de Ingeniería, Universidad

Autónoma de Chile, Santiago, 7500138, Chile; Department of Civil Engineering, Universidad de Las Palmas de Gran Canaria, Campus de Tafira, Las Palmas de Gran Canaria, 35017, Spain

Authors with affiliations

Senent-Aparicio J., Department of Civil Engineering, Catholic University of San Antonio, Campus de los Jerónimos s/n, Murcia, Guadalupe, 30107, Spain; Peñafiel L., Department of Civil Engineering, Catholic University of San Antonio, Campus de los Jerónimos s/n, Murcia, Guadalupe, 30107, Spain; Alcalá F.J., Departamento de Desertificación y Geo-Ecología, Estación Experimental de Zonas Áridas (EEZA–CSIC), Almería, 04120, Spain, Instituto de Ciencias Químicas Aplicadas, Facultad de Ingeniería, Universidad Autónoma de Chile, Santiago, 7500138, Chile; Jimeno-Sáez P., Department of Civil Engineering, Catholic University of San Antonio, Campus de los Jerónimos s/n, Murcia, Guadalupe, 30107, Spain; Pérez-Sánchez J., Department of Civil Engineering, Universidad de Las Palmas de Gran Canaria, Campus de Tafira, Las Palmas de Gran Canaria, 35017, Spain

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Correspondence Address

J. Senent-Aparicio; Department of Civil Engineering, Catholic University of San Antonio, Guadalupe, Campus de los Jerónimos s/n, Murcia, 30107, Spain; email: %20jsenent@ucam.edu

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