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First data on atmospheric chloride mass balance components in the Andean páramo in central Ecuador: implications to project climate scenarios of net aquifer recharge and potential groundwater chemical baseline

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1. PROBLEMATIC

Screening of the impact of projected climate scenarios on groundwater quantity (net aquifer recharge, R) and quality (potential chemical baseline, CR) is a challenge in Earth and Life Sciences because alterations due to global driving forces are being detected in aquifers, surface-water courses, and dependent ecosystems. However, the evaluation of steady R and CR is a complex task submitted to different kinds of uncertainty, without a clearly defined methodology, which is currently solved by adopting non-global techniques of questionable validity when using to project future scenarios. As a step, new global methods must be programmed for future scenarios of R and CR by using the information about climate change projections and the expected variance of time-series variables.

2. MAIN QUESTIONS

Research widens the tracer techniques applicability, essentially the atmospheric chloride mass balance (CMB), for R and CR as an alternative to the most widely used physical and hydrodynamic techniques for R purposes, and the semi-quantitative, quality-reference thresholds for CR objectives. The CMB method is proposed because: (1) does not include actual evapotranspiration (E) in formulae, thus reducing the overall uncertainty in R from precipitation (P), and (2) allows the joint evaluation of R and CR by combining the atmospheric chloride bulk deposition (AP=P CP) and E; note that CR is a potential estimate of chloride content below the soil root zone expected to be less than actual chloride content in groundwater (CR*). The Cl/Br ratio was used to identify the atmospheric origin of chloride in groundwater and runoff.

3. OBJECTIVE

Research aims projections of future scenarios of R and CR on regional and local scales. For this, the purpose of partial goals 1 and 2 will initially be to program new global CMB solutions for R and CR, respectively based on experimental data from the balance variables. Two experimental areas in the páramos highlands in central Ecuador have been be selected as pilot areas to achieve the objective.

5. OUTCOMES

The research objective contributes solutions to the sustainability and efficient use of natural water resources in Ecuador though the implementation of low- technology research.

6. ACKNOWLEDGMENTS

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4. STUDY AREA AND RESULTS

The páramo, a tropical alpine highland in the 3000-4100 m elevation in the Andean region from Venezuela to Peru, is a main recharge area contributing to regional rivers and aquifers. In the Andean páramo in central Ecuador, the Pita river basin and the Tingo catchment, both including Neogene and Quaternary lava-flow and pyroclastic aquifers, were selected for sampling monthly P, CP, and (CR*) from local aquifers having low water-rock interaction. In both cases, per 100 m in elevation, P increases by 60 mm and CP decreases by 0.2 mg L^{-1}. Average AP is 1.65 and 2.11 g m^{-2} $year^{-1}$ in the Pita and Tingo areas, respectively. As deduced from the 0.2 E-to-P ratio, average CR around 5 mg L^{-1} and 8 mg L^{-1} agrees with CR* data reported in both areas. Long P, U, E, CP, and CU time series are being compiled for modelling future scenarios of R and CR. Additionally, CR and CR* times series are being compiled to calibrate CR.