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Projected effects of climate change on the hydrology and water resources at the 2040's horizon in the Rheraya watershed (Marrakech, Morocco)

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The Tensift-El Haouz watershed (20500 km^2), located in Central Morocco (around Marrakech city) is composed of two parts: (i) the Haouz plain in the north has a semi-arid climate characterized by low rainfall (∼250 mm/year) and a high evaporative demand (∼1400 mm/year) represent an area of exploitation and consumption of water resources. (ii) The High-Atlas mountains culminating at 4165 m in the South, with precipitations ranging from 300 to 700 mm/year are the major source of water in this region. The water resources in the area experienced a decrease resulting from the strong increase of water consumption due to both urban and agricultural development and successive periods of drought.
The present study aims at modeling and analyzing the climate change effects on the runoff in the Rheraya Wadi, taking into account the snow component. For this purpose, we combined the GR4J conceptual rainfall-runoff model with the CemaNeige snow module for the period 1989-2009. After calibration using historical time series of climatic and runoff data, we used the Med-Cordex climate projections for the period 2020-2040 to simulate the future evolution of precipitations, snow cover area (SCA) and runoff according to the Representative Concentration Pathway scenarios (RCP); RCP 4.5 (stabilization of emissions) and RCP 8.5 (trend scenario).
The results show a decrease in rainfall, snow cover area and runoff for both RCP 4.5 and RCP 8.5 scenarios at the 2040's horizon when compared to the 1989–2009 baseline. The annual rainfall decreases by -18.4% for the RCP 4.5 scenario and -19.6% for the RCP 8.5 scenario. The SCA decreases by -38% and -48% for RCP 4.5 and RCP 8.5, respectively. Finally, the average annual runoff decrease by -9% for RCP 4.5 and -28% for RCP 8.5 scenarios. The results of the precipitations are in agreement with those obtained by Marchane (2015) on the Rheraya watershed.