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Assessing impacts of future potential climate change scenarios on snow cover area by using cellular automata models and Montecarlo simulations

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Climate change will modify the availability of snow resources in the future. Thus developing methodologies to assess impacts of potential future climate change scenarios on snow variables is a key subject. In this work we combine several previous developed methodologies (downscaling climate change scenarios to local scale, cellular automata models, and stochastic weather generators) to assess impacts of future climate change scenarios and its uncertainty on snow cover area through a Montecarlo simulation. The cellular automata model uses climatic indices (precipitation and temperature) as driving variables to estimate snow cover area. Future scenarios of these variables can be generated using bias correction and delta change approaches and different regional climate models. The stochastic weather generators allow us to produce multiple series of precipitation and temperature based on the statistical characteristics of the future local scenarios generated. These multiple series can be used as inputs of the cellular automata model in order to assess the future snow cover area and its uncertainty. The main advantages of the proposed methodology are its applicability in cases with limited information and in mountain ranges scales. The methodology has been applied to the Sierra Nevada mountain range in southern Spain. This area has a Mediterranean climate very sensitive to climate change. Using the future precipitation and temperature scenarios generated considering the Representative Concentration Pathways 8.5 (RCP8.5) for the period 2071–2100, we obtain a significant reduction in snow cover area, with mean values of 59.0% for the local scenarios generated with a delta change approach, and 61.7% for those one generated with the bias correction approach.

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