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Statistical downscaling in Chile: Selection of large-scale predictors and climate change projections

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General Circulation Models (GCMs) allow to analyze alternative pathways of possible changes in the climate system under different emissions scenarios. However, their spatial resolution is too coarse to produce useful and usable climate information for the impacts, adaptation and vulnerability communities. This is especially relevant for regions with complex orography and coast lines, such as Chile. Downscaling techniques attempt to bridge the gap between the global and regional-to-local scales. In particular, statistical downscaling methods build empirical relationships between large-scale predictors (e.g. sea level pressure, geopotential height and humidity at different vertical levels) and local predictands (e.g. temperature, precipitation).

In the present work, statistical downscaling is used for the first time in Chile to produce climate change projections of daily maximum and minimum temperature in 130 locations and precipitation in more than 400. For this purpose, we use the analog method, which consists of identifying the most similar or analog day based on similarities on the large-scale patterns from a pool of historical records. The method is firstly applied to reanalysis data (perfect prognosis approach) in a cross-validation framework using different sets of potential predictors. Secondly, the best-performing set of predictor variables is used to downscale GCM data in order to obtain climate projections for temperature and precipitation. Our results show that minimum and maximum temperature are projected to increase in the entire Chilean territory in all seasons. The largest increase of maximum temperature is found in boreal spring, which amounts to 1-1.5°C under RCP2.6 and 6-7°C under RCP8.5 for the end of the 21st century (2081-2100). Minimum temperature is projected to increase of up to 1°C for RCP2.6 and 1-2°C under RCP8.5 in all seasons. Precipitation changes present higher spatial variability. At the end of the 21st century, a decrease of boreal summer mean precipitation up to 20% is projected under RCP2.6 in large parts of Chile, which amounts to a reduction of 40-60% under RCP8.5.