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PARALLEL SESSION C : IMPACTS AND APPLICATIONS
C3: REGIONAL SCALE HYDROCLIMATE: FROM OBSERVATIONS TO MODELLING TO APPLICATIONS

A downscaling and bias-correction approach for climate projections of snow conditions in mountain regions using energy balance land surface models

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Projections of future climate change have been increasingly called for lately, as the reality of climate change has been gradually accepted and societies and governments have started to plan upcoming mitigation and adaptation policies. In mountain regions such as the Alps, where a large fraction of the revenue comes from winter tourism (about 20% of the French tourism revenue) and water and hydropower production, particular attention is brought to current and future snow availability. The question of the vulnerability of alpine ecosystems as well as the occurrence of climate-related hazards such as avalanches is also under consideration.

In order to generate projections of snow conditions, however, downscaling global climate models (GCMs) by using regional climate models (RCMs) is not sufficient to capture the fine-scale processes and thresholds at play. In particular, the altitudinal resolution matters, since the phase of precipitation is mainly controlled by the altitude-dependent temperature. Simulations from GCMs and RCMs moreover suffer from biases compared to local observations, due to their rather coarse spatial and altitudinal resolution, and often provide outputs at too coarse time resolution to drive impact models. RCM simulations must therefore be corrected and further downscaled using empirical-statistical downscaling and error correction methods, before they can be used to drive specific models such as energy balance land surface models.

In this study, time series of hourly temperature, precipitation, wind speed, humidity, and short- and longwave radiation were generated over the French Alps for the period 1950-2100, by using a new approach based on quantile mapping. Outputs from the EURO-CORDEX simulations spanning 11 different RCMs forced by different GCMs under 4 representative concentration pathways scenarios over Europe were downscaled at the massif scale and for 300 m elevation bands and statistically corrected against the extensive SAFRAN reanalysis (1958-2015). These corrected fields were then used to force the SURFEX/ISBA-Crocus land surface model over the French Alps. Here we illustrate our method using one GCM/RCM combination from the EURO-CORDEX ensemble, the ARPEGE/ALADIN combination. An extensive evaluation of the downscaling method was carried out using RCM model runs driven by a global reanalysis and some preliminary results in terms of projected meteorological and snow conditions using this GCM/RCM combination are presented.

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