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Uncertainties in changes in potential evaporation: the formulation issue

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Assessing changes in potential evaporation (PE) is crucial in climate change impact studies on water resources. Indeed, PE is still widely used in catchment-scale assessments as input for rainfall-runoff models. Assessing the water balance evolution in a robust way therefore requires to consider and quantify in a comprehensive way the various uncertainties in PE changes.

This work attempts to tackle this issue by looking at transient evolutions of PE for the Durance catchment, located in the southern French Alps. This catchment, under both the Alpine and Mediterranean climate influences, already shows periods with water demand – for drinking water, irrigation, and hydropower – close to total water availability. Estimating the evolution of PE together with the associated uncertainty is therefore of major interest for water managers.

Transient runs from the ENSEMBLES Stream2 GCMs under the A1B emissions scenario (van der Linden et al., 2009) have been previously downscaled over the Durance catchment by three variants of the K-nearest neighbours resampling approach (Lafaysse et al., 2013): an analog method, a weather type method and a regression-based method. 100 transient runs have been generated from each stochastic downscaling method for all 30 combinations of GCM (4 different structures) and GCM runs (from 1 to 6 runs) selected from the ENSEMBLES project.

The specific issue of PE formulation is studied by computing 3000 daily transient evolutions of (1) the reference Penman-Monteith formula calculated from hourly variables derived from the Safran high-resolution reanalysis (Vidal et al., 2010) and (2) the widely used temperature-based formula proposed by Oudin et al. (2005). Results from the 3000 downscaled climate projections show an increase in PE for both formulations, with a substantial dispersion due partly to the GCM structure and run, but mainly to the downscaling method.

Moreover, the most important source of uncertainty in PE changes appears to be the choice of formulation. Additionally, the interactions between the downscaling method and the PE formulation seem to play an important role in the overall dispersion. This work shows that PE changes derived in climate change impact studies on water resources should be taken with great care, by considering not only the standard uncertainties (GCM structure, GCM internal variability, downscaling method, local natural variability), but also their combinations with the choice of the PE formulation.

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