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Comparison and validation of the Pyrenean hydrological cycle simulated by different modeling approaches using in-situ and remote sensing data.

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In the Mediterranean, mountainous areas are an important source of water resources. Not only do mountains generate most of runoff, but they also store water in soils, as groundwater in aquifers and as snowpack which melts in spring where it can be diverted and used for agriculture. However, climate change and local anthropic processes are changing the behaviour of the Mediterranean mountainous basins, which is adding uncertainty to water management in an area where water management is already difficult. This is the case of the Pyrenees range between France, Spain and Andorra.

Hydrological modelling is a valuable tool in order to quantify the continental water cycle and, hence, the water resources as green and blue water. It helps understanding the underlying processes, simulating variables that are difficult or impossible to observe (e.g. soil moisture, snowpack, or land evaporation), and performing experiments impossible to conduct in the real-world (e.g.: fix the land use in order to assess the impacts of climate change only). However, all that valuable contributions are subjected to model uncertainty, an issue that should not be neglected and carefully assessed.

The PIRAGUA project aims at assessing the water resources of the Pyrenees in the past and in the future. To this aim, different models are being deployed and compared with past dataset in a first step (period September 1979 to August 2014). At the scale of the whole Pyrenees, we use the physical-based and semi-distributed hydrological model SWAT and the fully distributed, physically-based, hydrological chain SASER (based on the SURFEX LSM). Furthermore, potential groundwater recharge is also evaluated using a simple water balance approach (RECHARGE). In some selected

river basins, including karst systems, the GIS-BALAN hydrogeological model has also been applied. The agreement and disagreement of the models with the observations (when available), and between them, will allow a the detection and quantification of the main sources of uncertainty.

In this study, we have first validated the simulated streamflow at a selection of non-influenced gauging stations. Not only have we used the usual scores (i.e. KGE), but we have also validated the model temporal trends, comparing them to the observed ones. This will allow attributing (assess the link with climate change) trend changes in influenced stations, where models simulate the natural flow and observations also include human processes. KGE comparisons shown that the models are able to correctly simulate daily streamflow on most natural sub-basins. Then, the main fluxes (evaporation, drainage and runoff) and stocks (soil moisture and snowpack) of the models have been compared at the sub-basin scale, showing the rate of agreement between them. Finally, some variables have been compared to remote sensing products (evaporation, soil moisture and snow cover), in order to expand the validation to other relevant variables.