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Usefulness of rainfall estimated by remote sensing in hydrologic modeling applied to river basin Júcar in Spain

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In this study the usefulness of precipitation estimated by remote sensing was assessed through a rainfall-runoff hydrological model. Rainfall estimated by the algorithm PERSIANN was used from satellite measurements, with a daily temporal resolution and spatial resolution of 0.25° for the period from March 1, 2000 to October 31, 2009 in Júcar River Basin (Spain) with an area of 21434 km2.

The hydrological model used is the TETIS, which is a distributed hydrological simulation model with physically based parameters, representing the basin as a mesh of interconnected cells in topographic settings. For each cell, the model performs a water balance following a conceptualization of such tanks. For this work, the spatial scale used in the modeling corresponds to a cell size of 500 meters and the time scale is daily.

Rainfall estimated by the algorithm PERSIANN is available to the user through a friendly interface HY-DIS call that allows collect data in a selected region for a cumulative period interval, with information from the March 1, 2000, in ASCII format interpreted in the TETIS model as virtual stations are located at the centroid of each grid cell rain.

As the rain is a key variable in the hydrological balance, the study characterizes the rainfall. Distributed rainfall, yearly, monthly and daily was obtained from three interpolation techniques and the aggregate rain was obtained as an output of the TETIS model. Júcar rainfall has important spatial differences, summer having the highest values which are concentrated in the lower and middle of the basin, this caused by Mesoscale Convective Systems typical of the Mediterranean. Whereas in winter, the highest values are concentrated in the upper part of the basin caused by the mountains of the Iberian system. The study obtained a low-level Pearson correlation of annual, monthly and daily rainfall between local and satellite information, yielding even negative values on an annual basis. In general, there are lower values with satellite rainfall, which is influenced by the number of days without rain (zeros). Obtaining a probability of success of rain of 0.54 to 0.60.

The first calibration was performed manually to adjust the base flow, then adjusting the volume error is more sensitive to initial conditions of humidity in the static tank, aquifer and river bed to finally perform the automatic calibration objective function the Nash-Sutcliffe index, which is more sensitive to peak flows. Thus, this reduces the computation time in the optimization process automatically. In general, the calibration and validation with local rainfall in the model TETIS obtained excellent results with Nash-Sutcliffe index of 0.874 (calibration), 0.81 (temporal validation) and from 0.62 to 0.75 (space-time validation). Unlike the calibration and validation with global satellite rainfall did not generate satisfactory results, being the best performance with the Pajaroncillo calibration with values of 0,384, -8.66% and 4.647m3/s of the Nash-Sutcliffe index, error volume and mean squared error, respectively. This may be due to the relationship assumed by the satellite data between the temperature at the top of cloud and rain intensity are not appropriate for this Mediterranean region is characterized by high intensity rainfall and short duration of origin convective. Furthermore, although satellite observations are able to provide temporary space distribution of rainfall, the measurements tend to show a systematic bias because they are dependent on indirect estimates of cloud properties or liquid content clouds.

Following the study, estimated rainfall by remote sensing will be combined with the best available rainfall data. With the advancement of science, new satellite sensors and technologies will improve the detection and its utility in hydrologic modeling.