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R^3GeM: New hydrological model for the simulation of rain-runoff events in wet areas.

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This work presents and evaluates a new hydrological model, R^3GeM, for the simulation of rain-runoff events in wet areas. This hydrological model divides the precipitation into different components: surface runoff due to saturation, subsurface runoff and losses, and carries out the circulation of the surface and subsurface runoff. For the estimation of the part of the rain which is turned into surface runoff due to saturation, the saturated area of the watershed is used. The model calculates the storage at each moment in terms of the precipitation and the existing subsurface runoff and obtains the saturated area of the basin from that storage. The relation between the storage and the saturated area is established from the distribution of the topographic indices of the watershed, in the same way as was done in the TOPMODEL model.

The circulation of the surface runoff is carried out by employing the unit hydrograph technique, to be specific, the geomorphological unit hydrograph of deposits. This unit hydrograph proposed by López et al. relates the geomorphology of the watershed to the shape of the unit hydrograph, thus obtaining a unit hydrograph with a single parameter. To obtain the subsurface runoff, the watershed is considered as a linear draining deposit with respect to storage.

The R^3GeM consists of 5 parameters in all and has been applied to a total of 52 events in two watersheds in the province of Gipuzkoa (north of Spain): Aixola of 4.70 km^2 with 1600 mm mean annual rainfall, and Oiartzun of 56.07 km^2 with 1650-2100 mm of mean annual rainfall. These watersheds belong to the Hydrometeorological Network of the County Council of Gipuzkoa, and their rain and flow data are recorded every 10 minutes.

First, the model optimizing the parameters was applied and these were compared with the data observed using the Nash and Sutcliffe coefficient of efficiency. The model gave a result of a mean efficiency of 0.93 in the events in both watersheds.

For the evaluation of the model, firstly an analysis of the parameters was made in order to observe the influence of each one. Next, the model was calibrated for the Aixola watershed by two procedures. In the first one, a constant value was given to all the parameters, and in the second, one of the model's parameters was modified as a function of the actual characteristics of the event. Finally, the calibrations were validated in the Aixola watershed itself.