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Characterization of hydrological responses to rainfall and volumetric coefficients on the event scale in rural catchments of the Iberian Peninsula

Encarnación Taguas (1), Estela Nadal-Romero (2), José L Ayuso (1), Javier Casalí (3), Patricio Cid (4), Jorge Dafonte (5), Antonio C Duarte (6), Rafael Giménez (3), Juan V Giráldez (1), Helena Gómez-Macpherson (7), José A Gómez (7), J Carlos González-Hidalgo (2), Ana Lucía (8), Luciano Mateos (7), M Luz Rodríguez-Blanco (9), Susanne Schnabel (10), M. Pilar Serrano-Muela (11), Noemí Lana-Renault (12), M. Mercedes Taboada-Castro (9), M.Teresa Taboada-Castro (9), and the Ane Zabaleta Team

(1) University of Córdoba, Agronomist and Forest Engineering School, Rural Engineering, Cordoba, Spain (evtaguas@uco.es, ir1aymuj@uco.es, ag1gicej@uco.es)), (2) Department of Geography, Environment Sciences Institute (IUCA), University of Zaragoza, Zaragoza, Spain (estelanr@unizar.es, jcgh@unizar.es), (3) Universidad Pública de Navarra, Departamento de Proyectos e Ingeniería Rural, Campus de Arrosadia s/n, 31006 Pamplona (jcs@unavarra.es, rafael.gimenez@unavarra.es), (4) Department of Plant Science, Pennsylvania State University, USA (patriciocid@outlook.com), (5) Department of Agroforestry Engineering, University of Santiago de Compostela, Lugo, Spain (jorge.dafonte@usc.es), (6) Escola Superior Agrária de Castelo Branco, Castelo Branco Portugal, (acduarte@ipcb.pt), (7) Instituto de Agricultura Sostenible—CSIC, Córdoba, Spain (ag1mainl@uco.es, hgomez@cica.es, joseagomez@ias.csic.es), (8) Faculty of Science and Technology, Free University of Bolzano, Italy (a.lucia.vela@gmail.com), (9) Facultad de Ciencias and Centro de Investigaciones Científicas Avanzadas (CICA), University of A Coruña, Campus de A Coruña, 15071 A Coruña, Spain (m.rodriguezb@udc.es, merche@mail2.udc.es, teresat@udc.es), (10) GeoEnvironmental Research Group, Universidad de Extremadura, Spain (schnabel@unex.es),, (11) Instituto Pirenaico de Ecología- CSIC, Zaragoza, Spain (piliserranomuela@gmail.com), (12) DCH, Physical Geography, University of La Rioja, 26004, Logroño, Spain (noemi-solange.lana-renault@unirioja.es), (13) University of the Basque Country 48940, Leioa, Basque Country (Spain) (ane.zabaleta@ehu.es)

Analysis of storm rainfall-runoff data is essential to improve our understanding of catchment hydrology and to validate models supporting hydrological planning. In a context of climate change, statistical and process-based models are helpful to explore different scenarios which might be represented by simple parameters such as volumetric runoff coefficient.

In this work, rainfall-runoff event datasets collected at 17 rural catchments in the Iberian Peninsula were studied. The objectives were: i) to describe hydrological patterns/variability of the relation rainfall-runoff; ii) to explore different methodologies to quantify representative volumetric runoff coefficients.

Firstly, the criteria used to define an event were examined in order to standardize the analysis. Linear regression adjustments and statistics of the rainfall-runoff relations were examined to identify possible common patterns. In addition, a principal component analysis was applied to evaluate the variability among catchments based on their physical attributes. Secondly, runoff coefficients at event temporal scale were calculated following different methods. Median, mean, Hawkins′ graphic method (Hawkins, 1993), reference values for engineering project of Prevert (TRAGSA, 1994) and the ratio of cumulated runoff and cumulated precipitation of the event that generated runoff (Rcum) were compared. Finally, the relations between the most representative volumetric runoff coefficients with the physical features of the catchments were explored using multiple linear regressions.

The mean volumetric runoff coefficient in the studied catchments was 0.18, whereas the median was 0.15, both with variation coefficients greater than 100%. In 6 catchments, rainfall-runoff linear adjustments presented coefficient of determination greater than 0.60 ($p < 0.001$) while in 5, it was lesser than 0.40. The slope of the linear adjustments for agricultural catchments located in areas with the lowest annual precipitation were between 0.15 and 0.34, whereas for the catchments located in humid areas with rangeland and forest as main land-use, higher slope variability was found. This tendency was also observed on the results of the principal components analysis, which allowed grouping agricultural catchments by variation ranges of runoff coefficients.

Finally, volumetric runoff coefficients obtained by Hawkins′ method and Rcum minimized the root mean square error. Both coefficients were well correlated, however, Rcum is easier to calculate because no graphical interpretation is needed. Rcum was also well reproduced by a multiple linear regression depending on the

catchment annual precipitation, drainage area and mean slope. Because slope gradient indirectly represents land uses, being agricultural areas usually located in flatter areas, runoff travel times and rainfall regime were enough to discriminate hydrological response differences in the catchments.

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