Temporal dynamics of soil water balance components in a karst range in southeastern Spain: estimation of potential recharge

Yolanda Cantón[1], Luis Villagarcía[2], María José Moro[3], Penelope Serrano-Ortíz[4,5], Ana Were[6], Francisco Javier Alcalá[7], Andrew S. Kowalski[4,8], Alberto Solé-Benet[7], Roberto Lázaro[7] & Francisco Domingo[7,9]

[1]*Departamento de Edafología y Química Agrícola, Universidad de Almería, Carretera de Sacramento s/n, La Cañada de San Urbano, E-04120 Almería, Spain*
ycanton@ual.es

[2]*Departamento de Sistemas Físicos y Químicos, Universidad Pablo de Olavide, Carretera de Utrera Km1, E-41013 Sevilla, Spain*

[3]*Departamento de Ecología, Universidad de Alicante, Apdo 99, Alicante, Spain*

[4]*Centro Andaluz de Medio Ambiente (CEAMA), Av. del Mediterráneo s/n, E-18006 Granada, Spain*

[5]*Department of Biology, University of Antwerp, Universiteitsplein 1, B-2610 Wilrijk, Belgium*

[6]*Department of Hydrology and Geo-environmental Sciences, Vrije Universiteit Amsterdam, De Boelelaan 1085, 1081 HV Amsterdam, The Netherlands*

[7]*Estación Experimental de Zonas Aridas, Carretera de Sacramento s/n, La Cañada de San Urbano, E-04120 Almería, Spain*

[8]*Departamento de Física Aplicada, Universidad de Granada, c/Fuente Nueva s/n, E-18071 Granada, Spain*

[9]*Departamento de Biología Vegetal y Ecología, Universidad de Almería, Carretera de Sacramento s/n, La Cañada de San Urbano, E-04120 Almería, Spain*

Received 23 August 2009; accepted 10 March 2010; open for discussion until 1 January 2011

Citation Cantón, Y., Villagarcía, L., Moro, M. J., Serrano-Ortíz, P., Were, A., Alcalá, F. J., Kowalski, A. S., Solé-Benet, A., Lázaro, R. & Domingo, F. (2010) Temporal dynamics of soil water balance components in a karst range in southeastern Spain: estimation of potential recharge. *Hydrol. Sci. J.* **55**(5), 737–753.

Abstract This paper analyses the temporal dynamics of soil water balance components in a representative recharge area of the Sierra de Gádor (Almeria, southeastern Spain) in two hydrological years. Two approaches are used to estimate daily potential recharge (PR): Approach 1 based on deriving PR from the water balance as the difference between measurements of rainfall (P) and actual evapotranspiration (E) obtained by eddy covariance; and Approach 2 with PR obtained from the dynamic pattern of the soil moisture (θ) recorded at two depths in the site's thin soil (average 0.35 m thickess). For the hydrological year 2003/04, which was slightly drier than the 30-year average, E accounted for 64% of rainfall and occurred mainly in late spring and early summer. The PR estimated by Approach 1 was 181 ± 18 mm year^{-1} (36% of rainfall), suggesting an effective groundwater recharge in the study area. In the unusually dry hydrological year 2004/05, E was about 215 mm year^{-1}, close to the annual rainfall input, and allowing very little (8 ± 12 mm year^{-1}) PR according to Approach 1. Estimation of PR based on Approach 2 resulted in PR rates lower than those found by Approach 1, because Approach 2 does not take into account the recharge that occurs through preferential flow pathways (cracks, joints and fissures) which were not monitored with the θ probes. Moreover, using Approach 2, the PR estimates differed widely depending on the time scale considered: with daily mean θ data, PR estimation was lower, especially in late spring, while θ data at 30 min resolution yielded a more reliable prediction of the fraction of total PR resulting from the downward movement of soil water by gravity.

Key words potential recharge; evapotranspiration; soil moisture; soil water balance; Mediterranean; Sierra de Gádor

Dynamique temporelle des composantes du bilan hydrique du sol dans une chaine karstique du sud-est de l'Espagne: estimation de la recharge potentielle

Résumé Ce travail analyse la dynamique temporelle des composantes du bilan hydrique du sol dans une zone de recharge représentative de la Sierra de Gador (Almeria, SE de l'Espagne) pendant deux années hydrologiques. Deux approches ont été utilisées pour estimer la recharge potentielle journalière (RP): dans l'approche 1, RP est calculée à partir de la différence entre les mesures de pluie (P) et d'évapotranspiration réelle (E) obtenues par la méthode de la covariance turbulente; dans l'approche 2, RP est obtenue à partir de l'humidité du sol (θ) mesurée à deux profondeurs dans les sols peu profonds du site (épaisseur moyenne de 0.35 m). Pendant l'année hydrologique

ISSN 0262-6667 print/ISSN 2150-3435 online

doi: 10.1080/02626667.2010.490530
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