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Hydrology and Earth System Sciences Discussions

Interactive comment on "Analysis of soil and vegetation patterns in semi-arid Mediterranean landscapes by way of a conceptual water balance model" *by* I. Portoghese et al.

I. Portoghese et al.

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We are grateful to the reviewer for his comments to our manuscript. His comments have been useful in order to improve the quality of the revised paper. Nevertheless we believe it is helpful to better explain, in this reply, some of our reasoning and results that could have been misleading with respect to the main objectives of the work. In the following the Referee#1's comments are discussed one by one.

General comments

RC: The authors use a variation of a classical single bucket monthly water balance model (probably first used by Thorntwaite and Mather, 1955) to investigate the water

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balance of four types of crops frequent in a subhumid-semiarid Mediterranean climate area. In a second part of the paper, the authors claim that the results of the model are in agreement with the distribution of the water holding capacity for three of the crops investigated in the area, providing evidence for the validation of both the model results and the hypothesis that the present vegetation patterns, in such a deeply manmanaged landscape, are the result of the adaptation of crops to the natural soil-climate conditions.

AC: It is worth stating what are the research questions that inspired our work and the investigation approach, as reported in the following points:

1) A primary motivation for this study is the development and implementation of a simple water balance model for regional applications in semi-arid Mediterranean landscapes, suitable to investigate the impact of climate change on regional water budget, and identify critical climatic and landscape controls over large spatial domains.

2) The testing hypothesis is that the analysis and detection of CSV interactions may provide a priori information which can be easily exploited, in large-scale water balance studies helping to reduce parameter uncertainties that arise in absence of accurate soil databases.

3) As a validation of such kind of reasoning, we provide evidence that the landscape feature (vegetation, soils, topography etc.) prevalent in the study region being the outcome of an evolutionary adaptation to the multi-scale climate variability, could be considered as keys to understanding the underlying water balance regimes at regional scale.

RC: In general the paper is verbose, providing more results and discussions than the reasonable for the simple model and data.

AC: We recognize that the paper could be shortened. Nevertheless, the referee's comment is a little un-specific. Therefore, parts of the paper were re-written and some

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model output representations (figures 3 and 5) have been removed in the revised manuscript.

Specific comments

RC: None of the claimed results is supported by any statistical test.

AC: We believe this point is not much pertinent to the paper results. In fact we mostly adopted basic statistics to describe the average hydrological behaviour and its dispersion at the annual and monthly timescale. No inference on the stochastic behaviour of the involved quantities is actually invoked except for the pdf of the soil water holding capacity that is assumed to be Gamma-distributed according the referenced literature.

RC: There are many simplifications in the course of the paper: the root depths of crops (e.g. grape plants are known to be able to extend their roots as deep as 30 m), and citrus trees are commonly irrigated in semiarid areas. Common well known agricultural concepts like the crop yield factor (quotient between the relative crop yield and the relative evapotranspiration), which varies between 1.15 for wheat and 0.2 for olives are not taken into account.

AC: To estimate the broad-scale elements of the water cycle (e.g. Milly, 1994), simplifications (e.g. grape plants are known to be able to extend their roots as deep as 30 m and citrus trees are commonly irrigated in semiarid areas) are necessary in model applications (e.g. Yates, 1997; Arnell, 1999: Oki et al., 2001; Doll et al., 2003) and particularly they are here introduced because we want to focus on (quite commonly experienced) conditions of absence of accurate soil databases (see point 2 here-above). In fact, conceptual and physically based models almost always face with data scarcity. Our assumptions on root depth ranges are taken from the reference literature and refer to the equivalent soil depth containing most part of below ground biomass. Deep-growing roots are considered as a response to anomalous environmental conditions (shallow soils over fractured rocks). In this sense, the lower AWC values in the experimental soil samples in Fig. 10 can be justified. Referring to the citrus trees, we confirm

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that this should not be considered among the typical naturally adapted vegetation as it is not suitable for rain-fed farming. As a proof of that, in the considered soil samples, less than 0.5% corresponds to citrus plantations in the study region.

RC: Finally, the conclusions are not clearly supported by the results and reasoning, whereas the more relevant are really obvious or unoriginal: on the one hand, it may be assumed that, beyond the subsidies, farmers need to adapt their crops to the capability of their soils and climate (or they irrigate them), and, on the other, there are other published papers that really demonstrate the adequacy of the monthly bucket water balance model.

AC: It obviously appears that we didn't convey properly the motivation of the paper. Our aim was not to provide instructions for farmer's practice neither we aim to assess the hydrologic performance of such a simple model that has been widely performed in the hydrologic literature. We firstly observe that, despite human efforts and technologies, the water balance of the observed ecosystems, also for cultivated species, results to be mainly controlled by natural factors that are not merely climatic but are strongly affected by climate-soil-vegetation interactions. This is not obvious and it is not un-useful. It is particularly useful since our goal is the reduction of uncertainty of water balance model at regional scale in conditions of absence or scarcity of soil-related information. In such a case the respect of eco-hydrological principles may provide useful and non-conventional information which is today mostly not exploited in hydrology.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 4, 3909, 2007.

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