Hydrol. Earth Syst. Sci. Discuss., 11, C4268–C4273, 2014
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Hydrology and Earth System Sciences
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Discussions

Interactive comment on "A framework for assessing hydrological regime sensitivity to climate change in a convective rainfall environment: a case study of two medium-sized eastern Mediterranean catchments, Israel" *by* N. Peleg et al.

Anonymous Referee #1

Received and published: 4 October 2014

Title: A framework for assessing hydrological regime sensitivity to climate change in a convective rainfall environment: a case study of two medium-sized eastern Mediterranean catchments, Israel Article Type: Research Paper Peleg et al. 2014

GENERAL In this study the authors use a suit of hydro-meteorological tools to assess the sensitivity of the hydrological regime of two catchments in a convective rainfall environment (in Israel) with respect to projected climate change. The tools were :(1)

a synoptic classification using the NCEP/NCAR reanalysis data; (2) convective rainfall space–time characterization and empirical distributions per synoptic system using weather radar; (3) selected GCM simulations from CMIP5 were bias corrected, and changes in the occurrence frequency of the synoptic systems were estimated; (4) rainfall ensembles for current and projected climate were generated by the HiReS-WG; and (5) the streamflow in the catchments' outlets was simulated using the Sacramento Soil Moisture Accounting Model (SAC-SMA). The paper is well written and the results are presented clearly. Here are some comments regarding the structure, the references, analytical possible problems, and some minor remarks on the text.

COMMENTS: *The article reflects the use of large analytical effort in several directions, and cites a number of previous papers of the authors. Therefore it is not clear to the average reader what the specific contribution of this article is, or in other words, how is it different from previously published papers by the same authors. I assumed that the new aspect presented in this article is the integration of several tools developed at an earlier stage by the authors. If this assumption is correct, it should be stated clearly in chapter 2. Moreover, it seems logical that the pieces of the framework presented in chapter 2 and chapter 3 should be listed with the adjacent paper developed previously. For example, page 10557 line 20 "Second, a historical record of remotely sensed rainfall estimate is used to derive the relevant rainfall spatiotemporal statistical properties for each synoptic system" should be followed by the reference of Peleg and Morin, 2012 and/or other relevant references. Additional comment on the same issue: There is not much difference between the first to sixth steps in chapter 2, and the methods and models 1-5 in chapter 3. They should be easily combined.

*Page 10556, rows 23 -26: A. Write only the reference. The reader, if interested, can easily find out that (for example) Roberson et al 2004 was written about Northeast Brazil. The same is applied for Page 10563 rows 14-19. B. Samuels et al (2009; see below) did just that (rainfall generator based on synoptic systems analysis) for catchments in northern Israel (closer than Brazil, Greece or Arizona).

*The term “5 min intervals” or “5 min” is mentioned 8 times in the paper. The reader understands it after the second or third time. . . .. . .

*Page 10564, row 15-22 and Figure 5: It is written “initial cumulative rainfall is required in the beginning of the rainy season before measurable streamflow is recorded in the stations”. This is a typical relationship between annual surface flow (ephemeral streams) and the annual rainfall (See Figure 1). It was documented by Arie Ben-Zvi from the Israeli Hydrological Service already in 1992 using the equation: (Tota Runoff/Precipitation) = (Precipitation -270mm)*1.905*10ˆ-2, where the left hand side is given in %. The physical mechanism of this delay is well explained by the Hermon karst model developed by Rimmer and Salingar (2006). Dry summer makes the top soil profile dry, and the water absorption potential of this profile very large (it can be estimated by approximately 250 to 300 mm of rain). This amount, typical to the Mediterranean, is much larger than absorption potential of a typical profile in northern Europe, for example. Similar behavior was given by Samuels et al., (2009) (Figure 1). They revealed that at the Mt. Hermon karst as long as the annual rainfall exceeds 400 mm, the relation (“surface flow”/precipitation) is nearly linear. However if annual rainfall is less than 400 mm (very dry year in terms of this region) minimal additional “surface” flow to the rivers is expected; a stronger reduction in the surface flow component than the reduction in rainfall amounts, and a significant deviation from the linear relations are expected. Similar behavior but for the relations of groundwater recharge/precipitation was clearly observed by Hartmann et al. 2014 (Figure 1) for karst regions in Spain. These previous findings by the following references support the author’s model under nearly similar geographic and/or climatic conditions, and therefore should be cited and added to the references.

Samuels R., A. Rimmer and P. Alpert, 2009. Effect of extreme rainfall events on the water resources of the Jordan River. Journal of Hydrology. 375, Issues 3-4, Pages 513-523.

Hartmann A, M. Mudarra, B. Andreo, A. Marín, T. Wagener, J. Lange, 2014. Mod-

elling spatio-temporal impacts of hydro-climatic extremes on groundwater recharge at a Mediterranean karst aquifer. WRR in press.

Rimmer, A., Y. Salingar, 2006. Modelling precipitation-streamflow processes in karst basin: The case of the Jordan River sources, Israel. Journal of Hydrology, 331(3), 524-542.âĂŔ

*Page 10565, row 1-7 and Figure 4: The idea expressed in the sentence “A streamflow event begins when a corresponding rain event begins and ends either when a new rain event begins or after 720 h” and the example in Fig. 4 are not in line with the basic assumptions of linear hydrology systems or with the integral equation for linear systems (the convolution integral), expressed for example by Dooge & O’Kane (2003) or Singh (1988). While the time of the beginning of the streamflow event is the time of beginning of rain, the abrupt cut of the streamflow event is a non-physical interpretation of rainfall-runoff relationship. Instead the authors should use slightly less simplistic formulation, more suitable to classical rainfall-runoff relations by using an exponential decay function (“linear reservoir”) of the type Q(t)=Qoexp(-alfa*t) that start when the previous rain event ended with Q(t=0)=Qo, and decay to nearly zero with time, controlled by the recession constant alfa, which is usually typical to the basin. With this method Figure 4 will look as Figure 2 below, and would likely improve the rˆ2 results of Figure 3c and 3d in the paper.

Dooge, J. C., & O’Kane, P. 2003. Deterministic Methods in Systems Hydrology: IHE Delft Lecture Note Series. CRC Press.âĂŔ Singh, V. P. (1988). Hydrologic systems. v. 1. Rainfall-runoff modeling.âĂŔ

*Page 10571, row 13: Three (not two) studies assessing climate change impact on the hydrological regime of the east Mediterranean are there: Samuels et al, 2009 (see above); Samuels et al, 2010; and Rimmer et al, 2011.

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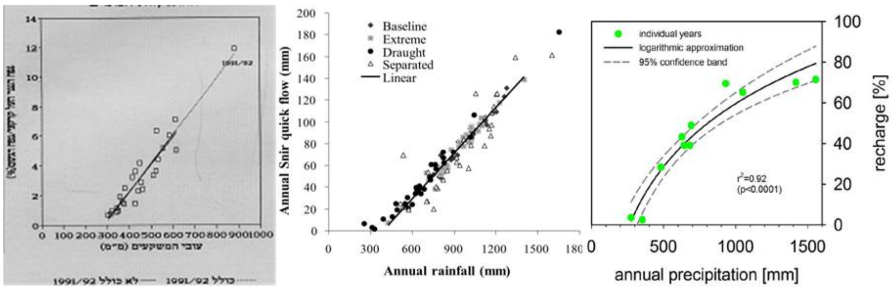

Figure 1: left: Runoff % as a function of the annual rainfall in the Israeli west drainage areas (Dr. Arie Ben-Zvi booklet, Israeli Hydrological Service, 1992, in Heberew); Center: Runoff (mm) as a function of the annual rainfall for the Snir tributary at the Hermon Basin (Samuels et al., 2009). Right: The relations of groundwater recharge/precipitation observed by Hartmann et al, 2014 for karst regions in Spain. All cases clearly indicate that surface water flow processes and significant groundwater enrichment begin only after the seasonal rainfall has come through the line of the 300 to 400 millimeters.

Fig. 1. Figures 1

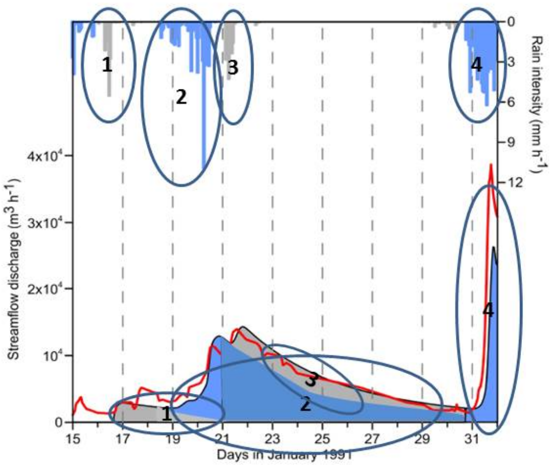

Figure 2: Schematic presentation of Figure 4 from the ms after the application of the proposed exponential decay function of the type $Q(t)=Q_0\exp(-\alpha t)$ that start when the previous rain event ended with $Q(t=0)=Q_0$, and decay to nearly zero with time, controlled by the recession constant α, which is usually typical to the basin.

Fig. 2. Figure 2