Nat. Hazards Earth Syst. Sci. Discuss.,
doi:10.5194/nhess-2016-6-AC2, 2016

Natural Hazards and Earth System Sciences
Discussions
Open Access

Interactive comment on "Classification of Karst Springs For Flash Flood-Prone Areas in Western Turkey" *by* M. Demiroglu

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Received and published: 1 April 2016

RESPONSES TO REVIEWER 1:

Prof. Orgun Tutay,

I am deeply thankful for your contribution, time and important guidance. I am happy particularly that I have got very constructive, encouraging and positive comments for which I have prepared a list of "responses to comments" as follows:

The following additions have been made in the light of your comments Page 3, line 8: "Karst structures should be taken into account as a component of the hydrological budget of the watershed to avoid the unexpected, uncalculated additional water coming from neighbouring watersheds (Aksoy 2016). Eris and Wittenberg (2015) showed

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Discussion paper

that water transfer between neighbouring karstic watersheds in Mediterranean Turkey was considerable. Page 3 line 13: Chemical characteristics of the aquifer are functions of residence time and flow conditions in the aquifer (Freeze and Cherry, 1979). Changes in the quantity and quality of the discharge of karst springs are largely caused by recharge parameters in the recharge area such as rainfall and snowmelt (i.e., autogenic recharge) and point infiltration of streams (i.e., allogenic recharge) as well as lithology, hydraulic conductivity, residence time of aquifers that also affect changes. As a matter of fact, Jakucs (1959), Shuster and White (1971), Aydin (2005) and Demiroglu (2008) argued that the reason for the changes observed in the spring discharges was the recharge type or flow type (diffuse or conduit) with high or low storage. High number of studies have been done to define aquifer characteristics using the physico-chemical measurements (Shuster and White, 1971; Raeisi and Karami, 1997; Massei et al., 2007; Raynaud et al., 2015) by considering only one or a few physico-chemical parameters that characterize groundwater with a potential to lead an erroneous interpretation of the hydrodynamics of the karstic catchment draining into the spring (Chicanoa et al., 2001; Massei et al., 2007). In this study, it is proposed to define flood–prone areas by using physico-chemical properties and discharge rates of karst aquifers in addition to evaluating the lithological and structural features."

1. need regional information

Mediterranean region' is removed from the page 2, line 35 and add new examples from the world. "The annual effective infiltration coefficients of the Gradole catchment in Croatia were given between 0.356 and 0.763 (Bonacci, 2001), The infiltration ratio between 0.6 and 0.9 of total precipitation were given for the mountainous karst regions in Switzerland (Malard et al., 2016).

2. This classification should be shown in table. Table 1 revised and aquifer lithology and age added 3. This paragraph should rewrite after forming table Page 3 line 29: Two new paragraphs were added "Representative and organized sampling of springs in Günyüzü basin, Eskişehir, Turkey, indicated that karst groundwater characteristics

can be defined and used for the classification of karst aquifers regarding their contribution in generating flash flood (Demiroglu, 2008). In this manner, data related to study area as listed in Table 1 were compiled from previous studies" Page 2 line 38: "The hydrogeological characteristics (topography, physical boundary and storage capacity of aquifer) were defined first. Measurements in wet and dry seasons and discharge rates were then compared in order to support and explain aquifer characteristics." 4. The age data should be given here if it is possible. It was given in table 1. 5. This principle can support by literature such as Shuster and White 1971, Chicanoa et al, 2001 Page 3, line 13 The below paragraph has been added to the text "Chemical characteristics of the aquifer are functions of residence time and flow conditions in the aquifer (Freeze and Cherry, 1979). Changes in the quantity and quality of the discharge of karst springs are largely caused by recharge parameters in the recharge area such as rainfall and snowmelt (i.e., autogenic recharge) and point infiltration of streams (i.e., allogenic recharge) as well as lithology, hydraulic conductivity, residence time of aquifers that also affect changes. As a matter of fact, Jakucs (1959), Shuster and White (1971), Aydin (2005) and Demiroglu (2008) argued that the reason for the changes observed in the spring discharges was the recharge type or flow type (diffuse or conduit) with high or low storage. High number of studies have been done to define aquifer characteristics using the physico-chemical measurements (Shuster and White, 1971; Raeisi and Karami, 1997; Massei et al., 2007; Raynaud et al., 2015) by considering only one or a few physico-chemical parameters that characterize groundwater with a potential to lead an erroneous interpretation of the hydrodynamics of the karstic catchment draining into the spring (Chicanoa et al., 2001; Massei et al., 2007). In this study, it is proposed to define flood–prone areas by using physico-chemical properties and discharge rates of karst aquifers in addition to evaluating the lithological and structural features." 6. in It is corrected 7. no need more repetition Page 4 line 11: this part "which is composed of Jurassic Bilecik limestone", was removed to ovoid from repetition 8. which analyses? Major anion – cation analysis but just Ca and Coefficient variation of Ca was given. 9. This part should be moved to discussion This part could not be moved to discussion to avoid not being understood 10. This explanation should be given in a table Main aquifer lithology and discharge lithology were given in the table 1 11. is this sentence complete? Page 5, line23: “Most of this kind of springs discharge from the Mesozoic age marine limestones.” was added. 12. this should be written as Plio Quaternary. Page 4 line 33: The " Plioquaternery " was replaced with " Plio Quaternary " 13. This spring number should be given Why are sütcüler springs important. This part needs additional explanations Page 5 line 30: “A historical spring, Sagalassos (S18) in the Lake district discharges from the deeply fractured allochthonous Cretaceous-aged limestones. It is a good example with a high response capability to heavy precipitation taking place in the ancient city.” Page 5 line 16: “Another example in the Lake District is Sütcüler small springs. There are no regular yield and water chemistry measurements on these springs” 14. Äřf so what are we supposed to understand Electrical conductivity (EC) diferences in between Jurassic limestone aquifer and Paleozoic marble aquifer tried to explained 15. Does this data include the dry and wet season? “This data includes the dry season. Page6, line 31: This paragraph was corrected as follows; EC measurements show that variations in physicochemical data depend not only on circulation depth and residence time but also on lithology. For example; springs S3 and S8 have nearly the same temperature and DO (26,7-30 oC / 4,36-4,81 mg/l) which represent approximately the same circulation depth and residence time. However, the EC value differences (398, 778 μS/cm) stem from lithology. Spring S3 recharges, circulates and discharges from Paleozoic marbles, whereas, spring S8 recharges and circulates in marbles, then circulates and discharges from Neogene limestones and sediments. In this respect, the chemical signature of karst aquifer mainly depends on lithology, residence time and hydrologic conditions. “

16. S8 looks in both (shallow and deep) this needs clarification

“It contains both. Page 7, line 4: It is seen that springs S3, S4, S5, S6, S7, S8, and S10 of the second group display nearly constant temperature, low variations in chemical composition and low variations for the measurements both in dry and wet seasons but springs S7, S8, and S10 display high discharge coefficients of variation when the data are analysed (Table 3). As an example, S8 (the SubasÄś spring) has three discharge points. Hydrograph of SubaşÄś springs S8 (Fig. 4) reflects a correlation between monthly cumulative precipitation and discharge unlike the montly precipitation which does not replace such a correlation. Annual precipitation could influence the discharge of the following hydrological year (Fiorillo 2009, 2015b). This reterdation time in aquifers controlled by diffusive infiltration is longer than that in the point infiltration controlled aquifers. However, it is observed in Fig. 4 that the SubaşÄś spring discharge (64 l/s) in March 2002 suddenly rised to 173 l/s in April after a heavy precipitation of 88,3 mm in April. The total precipitation in April has been recorded as 88,3 mm more than twice compared to the average (43,98 mm) of total precipitation in April calculated for the long term from 1925 to 2005. This is shows that the vadose zone (developed fossil karstic structures) is activated after heavy rains and carries the surge to surface water and to deep aquifer. Therefore, spring S8 (SubaşÄś) is classified as having high response capability to heavy precipitation. "

Please also note the supplement to this comment:
http://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2016-6/nhess-2016-6-AC2-supplement.pdf

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