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Hydrology and Earth System Sciences
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Discussions



# *Interactive comment on* "Spatial and temporal variability of groundwater recharge in a sandstone aquifer in a semi-arid region" *by* Ferdinando Manna et al.

**Anonymous Referee #1**

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A review of: Spatial and temporal variability of groundwater recharge in a sandstone aquifer in a semi-arid region, by Manna et al. submitted to HESS

Summary and Recommendation

In this study, a high-resolution surface-unsaturated_zone-aquifer flow model was fit to a km2 scale hilly drainage basin near Los Angeles, to investigate spatial and temporal variability of groundwater recharge. The main result is that, although the long-term spatial average recharge under the catchment is 16 mm/yr, under the small alluvial valley after heavy rain, focused temporal recharge rate may reach 1000 mm/yr. Although this



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Discussion paper

type of variability in recharge is not totally new for this setting, the work is worthy for its rare and intensive modelling effort and comparison with local estimates (e.g. chloride mass balance). Nevertheless, substantial changes need to be made in the manuscript before it can be published in HESS.

Major comments

1) Structure: There is no Methods section and no Discussion in the paper. The authors avoiding the classic titles of sections in a scientific paper is deep in the content, many methods are not clear (S. comments 7-10, 13 below), and there is no discussion of the results with the wide literature on recharge. Methods and Discussion sections should be included and taken more seriously (it could be Results and Discussion but a discussion should be done).

2) Concerning the discussion above: I would say that the recharge characteristics described in the manuscript is similar to what many stidies term: Mountain Front Recharge (MFR). Aquifers under alluvial valleys in mountainous regions are recharged from the edge of the valley (mountain front) or maybe altogether in subsurface recharge of rain percolating in the mountain block (can explain fresh groundwater above saline unsaturated zone). Discuss your findings in light of MFR literature.

3) Figures graphics. Although digital era, some of us do print and read from paper some of their work (manuscripts for review, especially). The manuscript include figures with axis-titles that are extremely small (unreadable). Check figures graphics on a printed version with a reader older than 50.

Specific comments

1) L25 The Abstract is a standalone entity, it should not contain references.

2) L49 and throughout the manuscript – put a space after the semicolon.

3) L62 I would change “transient” to fast changing. The literature is full of examples of changing recharge due to change in land-use that were shown via chloride mass

balance and similar methods.

4) L64-L70. In many semiarid regions surface run-off is ~1% of precipitation way within the modeling error, hence sub-surface unsaturated - saturated zone flow models (and in some cases even only unsaturated zone models) are a very reasonable choice for studying recharge and contamination. This type of studies are quite common in the literature of the last decade (e.g. Levi et al., 2017 HESS; Turkeltaub et al., 2015 WRR). Therefore, the elaboration on 2006 review, is outdated and not very convincing, I suggest to discard.

5) L88. Potential evaporation – give the numbers.

6) L 93 chemical contamination – say what contamination (in 2-3 words, nitrate, industrial organic compounds).

7) L140 – How is infiltration capacity modeled? is it constant at field capacity or starts significantly higher after a dry period?

8) L143-146 – Not clear is the root zone and the deeper unsaturated zone modeled as a continuous domain with Richards Equation with root water uptake sink at the root zone. Or is the root-zone modeled as bimodal: above FC –deep drainage, below no deep drainage? "...It is mainly vertical" is it a 1D model in this zone, or of higher dimension.

9) L153-154, as far as I understand if there is a constant head as a bottom boundary condition the water table will not change and recharge or discharge will be reflected only by flux out or into the model domain. Was the model fitted to transient head in wells? or only to a steady-state approximation? If so, say it explicitly in Figure 6 captions.

10) L187 – "physical properties" there is only Ks in the table (not enough to model unsaturated zone flow, parameters of hydraulic functions? What type of functions? – not clear

11) L 242, MIKESHE, MIKE SHE or MIKE-SHE choose 1 and be consistent.

12) L 265, I would change "centuries" to decades in this sentence.

13) L 270-277 when and how these analysis of samples 24 years old were done? Is it new data, if not, reference? If yes a sentence on the analytical methods.

14) L305-307, I assume these are spatially average recharge rates, if right say it explicitly, if not describe.

15) L 449- 452, typical Mountain Front Recharge (major comment 2).

16) L 468 see Kurtzman et al., 2016 HESS, for discussion on by-pass preferential flow recharge of fresh water to aquifers under saline unsaturated zone.

17) Table 3 – rainfall at bottom line is cumulative not mean

18) Figure 1. Confusing map. In physical (topographic) maps green is for low lands and brown for high land. Switch the color scale to fit to the customary color scale.

19) Figure 3 enlarge text

20) Figure 7 enlarge text. m-1 shouldn't be used for per month (its per meter in the SI system).

21) Figure all graphics and writing are too small. Panel C is missing.

Please also note the supplement to this comment:
https://www.hydrol-earth-syst-sci-discuss.net/hess-2018-531/hess-2018-531-RC1-supplement.pdf

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