Hydrology and Earth System Sciences Discussions

Hydrol. Earth Syst. Sci. Discuss., author comment AC1
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Reply on RC1

Christoph Neukum et al.

Author comment on "Modelling groundwater recharge, actual evaporation and transpiration in semi-arid sites of the Lake Chad Basin: The role of soil and vegetation on groundwater recharge" by Christoph Neukum et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-390-AC1, 2021

In the attached file, replies on RC1 comments have been written in blue to differentiate from comments from the reviewer

The authors should stress on the novelty of this paper. In my understanding, they try to provide an affordable low-cost approach in a data-poor region to assess groundwater recharge. Nevertheless, the description of Materials and Methods is poorly described, unclear and some parts are "gray". Precipitation and ET are given at monthly scale. The authors then declare that they set up Hydrus-1D at monthly scale (line 185). As far as I know, time units in Hydrus-1D are seconds, minutes, hours, days and years. The authors are invited to give more detailed information on the Hydrus-1D version. Did the authors use year fractions? In any case, running Hydrus-1D at monthly scale provides only a gross water balance simulation.

The section Data and Methods has been rewritten to provide more clarification on the data used. A new section Modelling methodology has been added to explain more in detail the methods applied in the modelling activities.

We used Hydrus-1D with a daily time-step. Because data are given at monthly, they were considered invariable over the month. By doing this, variability of input data is missed. However, results show that the method is still valid for evaluation of mean recharge

The manuscript is potentially interesting for the readers, however it needs substantial revisions before publication in light of the following comments:

1) I invite the authors to thoroughly revise Materials and Methods by adding a methodological sub-section in which they describe step-by-step the proposed approach. Maybe they can add a flowchart, a schematic overview to clarify all steps.

A section Modelling methodology has been added as proposed.

2) Session 2.5 is very unclear. I suggest to substantially revise this part. The authors declare that they have monthly P and ET from 1970 to 2019 (line 123). Then in line 192 they set up a burn-in period of 80 years to relax the impact of unknown initial conditions on model simulations. How can this be possible? In Fig. 6 I see simulations of groundwater recharge from 2005 up to 2019. I do not understand the impact of the 7

scenarios on model results.

The section has been rewritten. The modelling periods are thoroughly described. We modelled for a period of time long enough to allow for the exchange of at least 1-time the water volume of the column. Because percolation velocity depends on soil properties, the modelling periods were different depending on the location.

Data on Ke, Kcb and vegetation root are given as ranges. To investigate the model sensitivity to these ranges, scenarios were created.

3) In sub-Session 2.5.2 the authors use the bulk density in Rosetta in Hydrus-1D. How can you sample a known soil volume from the auger? Please clarify it in sub-session 2.3. It is recommended to add the Richards equation, the van Genuchten (1980) equation for soil water retention function and hydraulic conductivity function by declaring all soil hydraulic parameters (θr,s, n, α and Ks)

Bulk density was not measured in the field. Values were obtained by multiplying the gravimetric water contents by typical bulk densities from Global Gridded Surfaces of Selected Soil Characteristics database (Global Soil Data Task Group, 2000) for each soil type (lines 171-174).

Richards and van Genuchten equations have been added (sections 3.2.1 and 3.2.2).

4) The description of scenarios and model calibration in section 2.5.5 and 2.5.6 is unclear at all. I

Scenarios are described in section 3.2.5 (lines 300-305)