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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Estimating groundwater recharge from groundwater levels using non-linear transfer function noise models and comparison to lysimeter data" *by* Raoul Collenteur et al.

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Dear Rafael Schäffer,

We thank the Reviewer for his review and constructive comments on the manuscript. In this short response we outline how we plan to address the most important issues that were raised in the review. A full response to the Reviewer will be provided at a later stage, awaiting the review from a second Reviewer and the Editors' decision.

Scientific significance

The major concern from the Reviewer is the scientific significance of this work and we

regret that this is not clear in the current manuscript. To address this important issue, we plan to add more explicit statements about this throughout the manuscript, in particular, as also suggested by the Reviewer, the Abstract, Introduction, and Conclusions. The main scientific contributions of this study are:

1. This study shows that non-linear TFN models can be successfully used to obtain estimates of groundwater recharge at different time scales, in areas where limited data is available: only groundwater levels, precipitation and evaporation are used.

2. For the first time, internal fluxes (e.g., recharge, evaporation) computed with the TFN model were compared to high resolution lysimeter measurements.

3. The use of non-linear TFN models improves the simulation of groundwater levels under drought conditions. This model should be preferred over the linear model, which is probably still the most-used model in practice.

4. The use of an ARMA(1,1) model can improve the capability of the noise model to reduce the residuals to white noise, and eventually pass diagnostic checks that allow for uncertainty quantification.

We will also highlight the significance of quantifying recharge for real world problems such as the adequate management of groundwater resources. The overarching research question is whether recharge can be estimated accurately from measured time series of groundwater levels, precipitation and potential evaporation. In this paper, a new method is developed to demonstrate that this is possible. Performance of the new method is assessed through comparison of the estimated recharge with recharge measurements of a lysimeter.

Description of the study site

We will add a figure with the geographic location of the research site and add more detailed information about the local conditions.

Technical Corrections

We agree with the suggested technical corrections from the Reviewer and will update the manuscript accordingly. We will make sure the use of units and numbers is consistent.

Improve discussion and conclusions

We plan to restructure parts of the Discussion and Conclusions according to the suggestions of the Reviewer to clarify these sections. Where applicable, we will add explicit statements on why certain findings are important and what their impact is. In particular, we will reconsider paragraph 5.4. The purpose of this paragraph was to clarify that (similar) non-linear models should be preferred over the linear model if one wants to estimate groundwater recharge or predict groundwater levels under drought conditions, because the hydrological processes are better represented. However, this comparison to the linear model is not clear from the paragraph and will be changed accordingly. We will also consider using this paragraph for highlighting the other aspects of the study that are relevant for a broader readership.

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