

***Interactive comment on* “Influence of feedbacks from simulated crop growth on integrated regional hydrologic simulations under climate scenarios”**

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Anonymous Referee #1

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General comments

The paper aims to investigate the influence of eco-hydrological feedbacks from crop growth on hydrologic simulations under climate change scenarios. The Author uses the regional hydrologic modelling framework SIMGRO, which provides the opportunity to integrate the sub-model WOFOST for crop growth simulations. The link between SIMGRO and WOFOST was set up either statically (without eco-hydrological feedbacks) or dynamically (feedbacks enabled) to show how eco-hydrological feedbacks influence hydrologic predictions, which is critical under a change in future climate. The

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simulation runs and results are based on a real study site in The Netherlands assuming an agricultural land use of either grassland or arable land (potatoes) under two possible climate scenarios provided from the literature. The Author concludes that the influence of eco-hydrological feedbacks on the regional water balance is most crucial for arable land use, leading to less periods of crop water stress when using a dynamic linkage.

The paper addresses a relevant scientific question within the scope of HESS and reaches substantial conclusions. The manuscript is concise; however, at this stage major revision is required to present the article in a clear and well-structured way. It is very challenging to read the paper as a standalone publication because often the required context to understand stated arguments is not provided. Instead the Author refers to publications, which are partly too bulky to be read as a prerequisite to understand the manuscript. As a consequence it is very challenging to provide a comprehensive review of the methodology and the conclusions referred from the results. More detailed information is provided below.

Specific comments

Title

Suggestion: Influence of ecohydrological feedbacks from simulated crop growth on regional hydrologic simulations under climate change scenarios.

Abstract

The last sentence is very weak since it discourages the reader to go ahead with the rest of the paper.

Introduction

The Introduction does not provide sufficient background information to allow the reader to understand and evaluate results of this study without needing to refer to previous publications on the topic. Moreover, it does not provide a rationale of the study. A red thread or 'story' throughout the manuscript is missing. It took me awhile and a lot of

cross-reading with other paragraphs within the manuscript and previous publications to understand the purpose of the study, and the nature and scope of the problem investigated. As a consequence it is very hard to judge on the validity of the assumptions and methods used.

From my perspective the scientific problem under study seems to be that a change in climate (e.g. temperature, precipitation) influences eco-hydrological feedbacks through processes like evapotranspiration, root water uptake, germination, or growth rates of plant parts such as roots and leaves. Neglecting those feedbacks when modelling the regional water balance under climate change may lead to unreliable hydrologic predictions such as ground water recharge. Therefore, it is critical that sub-model(s) of crop growth, are able to simulate the dynamic behaviour of vegetation under changed climatic conditions. This is what I picked up from the context of the manuscript by browsing through all paragraphs. No matter if I am wrong or right, the purpose and rationale of the study must be stated much clearer, e.g. at the end of the Introduction. I also suggest including a short discussion of the differences between using a static or dynamic crop model.

P 10153, L 7-15: What are consequences of neglecting eco-hydrological feedbacks in the context of crop modelling? What did previous studies conclude?

P 10153, L 16-21: What was the purpose of coupling the SWAP model and Theseus model to WOFOST? Did the stated references neglect the ecohydrological feedbacks because they focused on a different scientific question or did they address the same question but ignored the feedbacks anyway? What are the consequences for regional groundwater simulations when neglecting the feedback loop?

P 10153, L 25-26: Are there any examples of systems that require a feedback loop via groundwater?

P 10154, L 4-6: What is the simple recharge module type? One more sentence would be helpful. What are the consequences of diminishing water table dynamics in the

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context of this study (crop growth dynamics)?

Methods and materials

In general, this section would be better readable and understandable if the Author could provide more transition sentences between each method that motivate the use of methods (e.g. their merits) and guide the reader throughout the section. Often only one sentence would be sufficient to enhance the section considerably.

P 10155, L 2: I would suggest using a clearer sub-title such as “The regional hydrologic modelling system SIMGRO” or simply “The SIMGRO model”

P 10155, L 3-19: What is SIMGRO? Is it a conceptual modelling framework consisting of a range of sub-models to integrate ecosystem compartments such as vegetation, unsaturated soil and groundwater? I understand that describing SIMGRO in detail is far beyond the scope of this paper but the reader needs more guidance through the modelling framework to understand the concept and principles underlying the model and the linkage between the sub-models. This should be provided in a condensed way and objective-oriented, i.e. in the context of the purpose of this study. Lines 10-19 could be integrated into Fig. 1. Moreover, Fig. 1 would benefit from highlighting the sub-parts of SIMGRO, which are relevant for this study.

P 10156, L 14-15: “potential rate” = potential evapo(transpi)ration rate? What exactly is it that is conceptually questionable (literature references)?

P 10157, L 17-19: One more sentence would be helpful to understand how the reduction from potential to actual soil evaporation is calculated, without the need of cross-reading the reference.

P10158, L 4-9: If there is a crucial reason to mention what method is NOT USED, instead of mentioning only the methods USED in this study? If yes, it should be discussed in more detail. Moreover, more information is required to understand the discussion of preferring one method (Makkink (reference?)) over another (Penman-

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Monteith (reference?)) instead of calling the reader to cross-read. Further, could a reference be provided that refers to the commonly known “crop factor”?

P 10158, L 25-26: 1-T_{rel} is not only appropriate for comparing the results of different modelling approaches, intuitively it also makes more sense that higher values of water stress indeed indicate higher crop water stress.

P 10159, L 2-11: Can the WOFOST parameters for grassland and arable land be provided as a table? What does the method of Van Wijk et al. include? The decision of using day 111 as sowing date appears arbitrary, is there a particular reason?

P 10162, L 14-15: Why is the temperature sensitivity of root water uptake not considered in this study?

P 10163, L 13-26: Better fits to section 2.1

P 10164, L 7-9: How has the climate change been simulated? Has a stochastic weather/climate generator been used? If yes, how many stochastically identical time series of weather conditions have been applied to address the stochastic variability of the climate?

P 10164, L 12-14: Can a reference be provided to underpin that the selected climate scenarios have the biggest impact on vegetation development and ecohydrological feedbacks affecting the hydrosystem?

Results

In general, more effort is required to guide the reader through the figures: Why is a figure plotted? What does a figure show? A rash discussion should be avoided. Figures only should be described instead.

P 10165, L 2-16: Better fits to Methods and Materials

Discussion

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The start of the discussion is very weak. The discussion needs to hit the reader in the face with the biggest discovery. What is the most exciting discovery? Section 4.1 only states the caveats of the study.

Section 4.2: The first half of this paragraph better fits to the Introduction and is certainly missing there. It is unclear why figures from Wegehenkel are discussed instead of figures produced in this study. The second half of this paragraph appears much more like a discussion of the own results but still requires more detailed re-work. This has been done partly in the Result section.

Conclusions

What are the conclusions regarding the significance of the work? What are implications for regional hydrologic model simulations? When can static crop models be applied, when dynamic models?

Technical comments

P 10157, L 9: “nett” = net?

P 10162, L 4: “nett” = net?

P 10162, L 21: “CO2-assimilation”

P 10164, L 3: “nett” = net?

Table 1: Arranging the land use categories by decreasing order of values for area would be more intuitive.

Fig. 7: “nett” = net?

Fig. 8: It is difficult to distinguish between the dashed lines.

Fig. 9: I suggest subtitles and labelling of sub-figures. Can sub-figures “up-right” and “low-left” be neglected because they are integrated into sub-figure “low-right”?

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