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Interactive comment on "The Nexus Solutions Tool (NEST): An open platform for optimizing multi-scale energy-water-land system transformations" *by* Adriano Vinca et al.

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Thank you for your review of our paper. We are glad that you find the research valuable. In this comment we report the reviewer's comments under <> brackets, followed by our replies. Attached is the updated version or the manuscript, where also some text has been re-shuffled and new figures and tables have been added.

< There is a brief presentation of hydrological model calibration and performance in section 2.3, but beyond this it is not very clear to me what the outcomes of the model are sensitive to and to what extend uncertainties is various parameters and components might impact upon the outcomes. The model is very complex and has many

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parameters, but what is it sensitive to in this test case. I would assume many of the components have a minor effect on the outcomes. The computation time was not clear to me, apologies if I have missed this, thus it's difficult to know what a realistic expectation for the authors is in this regard however at the very least this issue requires more discussion. >

Thank you for the comments and for expressing the need of more uncertainty assessment. We added a section on sensitivity to major scenario assumptions, both for the outcomes of CWaTM and MESSAGEix. We decided not to include parametric sensitivity as our tests show lower uncertainty compared to SSP and RCP scenarios, and the number of parameters involved is very high. Future publication focusing on more precise sectorial questions will also explore the related parametric uncertainty.

< How the model was parameterised is also not very clear to me. The combination of tables 1 and 2 do not seem to represent all the data layers required by the model and they don't clearly (to me) map onto model parameters or distinct elements of the system. Perhaps this would be too long for the main text, but could it be a supplement? I'm not criticising the research as such but I don't feel I adequately understand the model data requirements from the text. >

Most of the update in this review expands the data section, in the main text and in the appendix. We expanded the summary table on data (Table1) to cover each single data source. We also included in the appendixes several tables on demand assumptions, historical conditions, costs and other technology parameters. An additional csv file will be attached to the SI, including data on solar and wind variable capacity factor.

< The limitations section is primarily a list of things that could be added to the model in future versions, in my opinion it's not sufficiently critical of the current model as implemented and the outputs. The text chooses to focus on several things that could be added without much evidence of how sensitive model results might be to these. There should be a discussion around the data sets needed, how well these can de-

fine model parameters and what implications these might have on the reliability of the conclusions.>

We made minor changes to the limitation sections, excluding not possible improvements that are not evident from what shown in the paper and adding some reference to results. We have not included discussion on the quality of the datasets used for the Indus case study as we would like to present the framework as applicable to other scopes and flexible in terms of data sources.

< Specific points: Figure 6: What simulations does this plot? Is it the mean of calibrated simulations by CWatM for the four climate models? Why not present the range and performance stats for each simulation? Section 2.3: Multiple climate models are used, but what about uncertainties in the other component? Why have an ensemble for this and then a deterministic set of parameters for the hydrological model? >

Yes, the plot shows the mean of calibrated simulations. It is a quite standard figure often shown in (https://www.geosci-model-dev-discuss.net/gmd-2019-214/). For sure including all climate model outputs would be interesting but also less clear to visualize. Concerning sensitivity, as mentioned in the first answer, we show the variability for different climate models.

< P24: "However, it brings greater computational challenges associated with using classical mathematical programming methods" perhaps I missed it but what is the computational burden of the model and how does resolution affect this? >

We added the following paragraph in the 'Model setup' section:

"CWaTM is run with fixed spatial and temporal resolution as mentioned in previous sections. Therefore, performances are not affected by the final scale of the optimization model. Running times are in the order of few hours on personal computers. The MESSAGEix component is instead scale sensitive, increasing the number of BCU or the temporal resolution increases the matrix of the LP optimization significantly. In the

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configuration described here, the cplex solver in the GAMS model reduces the system of equations to a LP matrix of approximately 1 million x 1 million elements and solves in less than 30 minutes on personal computers. For each policy scenario described in the following sections, CWaTM is only run once for each SSP and RCP combination, while additional policies are only implemented and run in the optimization model."

Please also note the supplement to this comment:
https://www.geosci-model-dev-discuss.net/gmd-2019-134/gmd-2019-134-AC3-supplement.pdf

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