Hydrol. Earth Syst. Sci. Discuss., 12, C4418–C4423, 2015
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Hydrology and Earth System Sciences
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Discussions

Interactive comment on "Reviving the "Ganges Water Machine": where and how much?" *by* L. Muthuwatta et al.

Anonymous Referee #3

Received and published: 26 October 2015

This manuscript presents a modeling analysis of the water flows in the Ganges River Basin. The model considered in this study is the SWAT model and it is used to assess to potential efficiency of subsurface storage of runoff occurring during monsoon floods. The manuscript is adequately written from a grammatical point of view; however, it lacks several components and/or sections relevant for a complete study publishable in HESS. The topic addressed in this study is important and more work on the sustainability of the Ganges water resource system is needed. The main message of the work (e.g., the potential for artificial subsurface recharge in seasonally dry regions) is one that deserves to be heard by the water management authorities. That said, the current study presents little novel science and the work that is put forward lacks completeness and rigor. As such, it is recommended that this manuscript be rejected

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for publication. The approach, once expanded, could have a better fit in a regional and/or water resources management focused journal but it is unlikely that this study would find a home in HESS without considerable effort. In the following, the motivation for this recommendation is outlined as general comments followed by minor/editorial comments.

1) Model-model comparisons

The main focus of the study is modeling. The model calibration is glanced over with little reference or information. Apparently, there has been no calibration or validation of this model carried out. With that, it is impossible to say how good the model is performing. There are numerous methodological permutations for SWAT and without state how these were selected and calibrated, it is not possible to consider the validity of the results. This is a cardinal sin for a modeling study. Lack of observation data can be a common shortcoming to modeling, but there must be some contingency to address this within the analysis framework.

In addition, there is an excessive amount of model-model comparison to add richness to the results. For example, the entirety of Figure 5 with its linear relationships among inflows and outflows is not entirely surprising given a model-model comparison. How real is this? That is the crux of the issue here. Why trust this modeling result to represent anything real? The process representation potential within SWAT opens the door for multiple types of modeling scenarios but not all of these would be valid in this region.

2) Potential to implement subsurface storage

The modeling results address the supply of water available within the sub-basins and information from previous work by Amarasinghe et al. (2015) regarding the subsurface storage potential (more or less). No consideration on the capacity to pump water into or the space required to actually recharge the aquifer is presented. What rates of pumping would be required and could the structure of the aquifer take that? Given that, it would

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be nice to see (at least a rudimentary) estimation of the cost associated with such an undertaking. If the recharge is through nature zones, how would the change in land used impact (feedback) on the modeling itself? What are the capable recharge zones to get high flows quickly into the ground?

On top of that, little is given regarding the downstream impacts of reallocation of the upstream runoff. Taking water from the streams could have profound implications to the countries downstream. This impact could be acute (during the high flow season) and more subsequent (impacts on the low flows via diversion of recharging waters). While the emphasis on flood mitigation is important, why exclude other flow impacts since these waters are important to both upstream and downstream people?

3) Results put forward

In general, the results presented are basic and not considering the full potential of the modeling. There are numerous flow metrics that could have been considered in addition to the 75% dependable flows. Why not present a better cross section of the potential flows that are considered in the generation of excess runoff. Also, why focus only on the flows themselves? One central advantage of a modeling approach to these issues would be to compare the amounts of water (or at relative changes) in storages within the subsurface. Taking that one step further, what not show the impacts of subsurface storage on the hydrological response of the system? It would be a reasonable thing to account for the potential feedback of recharging the groundwater on the hydrological response of the catchments.

Also, it is interesting that the only results presented are maps of absolute volumes of water. One would anticipate relative percentages of water contribution. Also, why not show hydrographs for the basins? At the very least for the key sub-basins be considered for repurposing of flows. Finally, it seems appropriate to demonstrate more the implications on flows via the implementation of subsurface storage scenarios. What impacts on the timing of flows would be created and how would this further feedback

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onto upstream and downstream resources? One imagines that there are various manners by which to implement the recharge needed to increase subsurface storage. It is surprising that these various scenarios of recharge practice are not explicitly considered since this is the true strength of a modeling approach. This is especially relevant in the face of land use and climatic changes (although care is needed in extrapolating a model beyond calibrated ranges).

4) Structure

The results section contains much text that is not truly results. These are either methods text or findings from previous studies. These are not the results of this work. More significantly, the manuscript provides no discussion of the results and findings. How does this work relate to management or understanding of the region? This is a large oversight that prevents this study from being considered as a standalone contribution to the scientific literature.

Minor/Editorial Comments

P9742L6: Should be 'increasing' and 'mitigating'

P9742L8: 'sub-basin-wise' is awkward. Just use 'sub-basin'

P9744L1: What about the potentials for remobilization of chemicals and/or increase interactions with pollutants? Are these possible issues that limit the feasibility of increase subsurface storage as a viable choice?

P9744L2: 'Popular belief' may not be the same as the views of the scientific community that reads HESS. How appropriate is this line of logic to a scientific paper? Cover a review of the relevant science on these management issues.

P9745L17: The main issue here is knowing the actual processes that take place in the real-world system. How sure are you that your SWAT model setup actually captures the processes and true hydrological responses within the sub-basins?

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P9745L21: Verb tense shift.

L9745L24: It is more correct that HRUs allow for a modeling efficiency whereby hydrological similarity of responses can be leveraged.

P9745L25: How are things routed? Are HRUs allowed to interact and flow into each other or is everything dumped to a stream and the routed out of the system? How sure are you that the dynamics of the stream systems are being represented? Even more so, once you start changing flow conditions via artificial recharge, how does this feedback into the flow routing?

Eq1: In my printout, the summation sign is dropped. Double check PDF formatting. Also, the double f's are printed strange everywhere.

P9746L2: Why this threshold?

P9746L21: Was the impact of treating the entire of Nepal as one region explored? Does it influence the timing of the modeled flows?

P9746L25: Not an adequate amount of information regarding calibration, choices of model setup and validation procedures given here. More information is needed since this is a standalone study. Further, it would be good to demonstrate clearly how this work pushes beyond previous work.

P9747L9: Seems like there should be a reference for the statement regarding the adequacy of the dependable flow metric.

P9749L15: Why not compare the MODIS product with you modeled results? That sounds more interesting.

P9750L5: Why are we surprised by this linear relationship given a model-model comparison? It seems to follow naturally based on the limited model setup insight provided. Did the authors anticipate non-linearity here? My guess is that the scatter around the line actually derives from uncertainty in parameter and process representation of the

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SWAT setup. That alone could provide a more fruitful exploration

P9751L14: This study as it is presented does not discuss this or any other implications.

Figure 2: Consider a black-white relevant color scale.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 9741, 2015.