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Hydrology and Earth System Sciences
Discussions



# *Interactive comment on* "Modeling the Changes in Water Balance Components of Highly Irrigated Western Part of Bangladesh" *by* A. T. M. Sakiur Rahman et al.

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We are very much grateful to you for your valuable comments on our study "Modeling the Changes in Water Balance Components of Highly Irrigated Western Part of Bangladesh".

Overall comments: This manuscript describes the application of discrete wavelet transformation (DWT) and different forms of Mann-Kendal test to study changes in water balance components (WBCs). The authors also develop a "wavelet autoregressive moving average (ARIMA) model" to forecast WBCs. The contribution of the manuscript seems to be detecting trends and identifying periodicities in WBCs along with fore-



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casting them after removing the noise from the time series. The manuscript is statistical than hydrological and I would say that hydrological concepts are insufficiently addressed and not fully developed. Moreover, there are some theoretical inaccuracies and confusing statements (especially in hydrologic side) that undermine the quality of this manuscript. Overall, the authors address an interesting subject; but in the current form, there are concerns and shortcomings that warrant major revisions.

Replay to overall comments: You are concerned about the hydrological theory. We think there are no inaccuracies in hydrological theory in our manuscript. We have explained the matter in the theoretical issues section; please go through the replies to this section.

Theoretical issues: Comment 1: There is confusion in the paper about the concept of "Water Balance" and its "Components". Water Balance Components (WBC) and some other parameters are frequently used in awkward and confusing sentences. As an example, potential evapotranspiration (PET), which is named as one of the WBCs in line 91 is called "the key parameter to estimate water balance components ..." in line 119. I strongly recommend that the authors provide the Water Balance Equation, briefly introduce Water Balance Components, and define which components they consider in their study, clearly. They may explain these concepts at the beginning of the "Methods" section (section 2.3). They may also mention the reason(s) for selecting each WBC. Comment 2: Following the previous comment, both Potential Evapotranspiration (PET) and Actual Evapotranspiration (AET) are considered, surprisingly, as components of water balance equation (for example in lines 91, 265, 325) without any explanation on their application and role in the equation. However, the application of these parameters in Water Balance Equation is different and they cannot be considered both at the same time. I would also suggest the authors revise their manuscript to ensure that no confusing sentence remains on this subject.

Reply to comments 1 and 2: You are concerned about the water balance components (WBCs)and the input parameters of WBCs. We think we have appropriately presented





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the WBCs and the input parameters of WBCs in our manuscript. There are a lot of articles on water balance/ WBCs, however, please go through the following few sentences for your clarifications about the water balance components and input parameters of water balance components. McCabe and Wolock (2013) studied on "Temporal and spatial variability of the global water balance". Please go through the first sentence of the abstract. You will find that precipitation, actual evapotranspiration (AET), runoff, and potential evapotranspiration (PET) are water balance components. Therefore, we hope that you will understand PET is one of the WBCs. It is also one of the important input parameters of WBCs to calculate other WBCs like AET, surplus/ runoff and so on. For your clarification, please go through the study conducted by Xu and Singh (1998). This is a review article on water balance models. We have given here only two examples for your clarification about the hydrological theory. We hope that you will find a lot of articles on water balance/ WBCs and there are some citations on water balance study in our manuscript too. We will add water balance component equations in our final manuscript. However, we will not add the PET equation as it is a well-established method. Moreover, PET has been calculated by Penman-Monteith (Allen et al., 1998) method and there is a citation in the manuscript.

Comment 3: In line 145, the authors stated that "When rainfall is greater than PET the soil always remains full of water and:", which is an inaccurate statement. I understand the authors try to explain the concept of surplus; however, surplus occurs when the soil becomes saturated and infiltration is hardly possible.

Reply 3: Thank you very much to find out this mistake. We will incorporate this correction in our final manuscript.

Title and Abstract Comment 4: The authors should perhaps reframe the title to better reflect their work. The present title implies that the study is mainly concentrated on the interaction between changes in water balance components and intensive irrigation in Western Bangladesh.





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Reply 4: We will not reframe the title. WBCs such as PET, AET, Surplus and deficit are related to the crop water requirements, irrigation requirement, irrigation scheduling and so on. Therefore, we will not reframe our title. Comment 5: I would recommend that the authors name water balance components that they consider in this study in the abstract. They may provide then a summary of the methodology and results in a more organized way.

Reply 5: We have mentioned the names of the WBCs which are considered in our study. Please go through the abstract, you will find these. We do not think it is necessary to add descriptions of water balance calculation process in the abstract section. Moreover, there is a methodology section.

Comment 6: I was wondering whether the authors apply ARIMA or ARMA models in their study. In case of having ARIMA, which stands for "Autoregressive Integrated Moving Average" they should revise the statement in line 17.

Reply 6: Thank you very much to find out this mistake. We have used ARIMA model. We will incorporate this correction to our final manuscript.

Comment 7: Line 34: The statement ": : : findings of study can be used to improve water resources management : : :" is too generic. Please clarify in what respect this study can improve water resources management in the highly irrigated area.

Reply 7: There is a lot of information on WBCs, trends and periodicity in WBCs and a new developed methodology for the forecasting WBCs. We hope that water resources manager will get a lot of information from our study. Please also go to the reply 4 for your understanding how WBCs are related to the water management.

The Structure: Comment 8: In general, the paper has no flow and each section seems to be a separate part without proper connection to the other sections. I think the authors should improve the structure and flow of their manuscript.

Reply 8: Thank you very much for your suggestions. Our final manuscript will be a

better organized one.

Comment 9: I believe that the “Introduction” should be significantly revised. For instance, the literature review on periodicity and using wavelet transformation is only limited to few sentences. The authors can elaborate more on what the previous researchers have done and how this study differs from previous attempts.

Reply 9: We think we have to emphasize on time series analysis instead of the periodicity only. Our main objective was to develop a methodology for forecasting the WBCs. Moreover, there are some citations related to the topics in introduction and methodology sections.

Comment 10: In section 2.2, “Data”, I would suggest that authors provide the time duration they used in this study.

Reply 10: Thank you very much for the suggestion. Though there is no information on time duration in the data section, we have mentioned it in the first sentence of results of analysis section. We will also add time duration in the data section.

Comment 11: Headings are awkward and in some cases poorly selected. For example, in lines 265 and 325, (sections 3.2.1, and 3.2.2) it would be better to replace “PET” with “Potential Evapotranspiration” and “AET” with “Actual Evapotranspiration” respectively.

Reply 11: We will replace these headings in the final manuscript.

Comment 12: In section 2.3, “Methods”, I would suggest that the authors provide a general overview of their methods and then explain each section in detail rather than starting the section immediately with a sub-heading.

Reply 12: We will add a general overview of the methodology. Please go through the reply 7 of referee #2.

Comment 13: Section 3, which seems to provide results of the study, is poorly structured. Sentences are awkward and poorly written, which makes it difficult for readers





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to follow.

Reply 13: We will do the necessary language corrections.

Comment 14: I was wondering why the authors consider the section “Model Selection and Forecasting Ability” as a sub-heading of Results section (line 352). The methodology of the modeling and considerations regarding model selection should be discussed in the “Methods” section.

Reply 14: We think the heading of this sub-section is right. Please also go through reply 15.

Comment 15: Following the above-mentioned comment, section 3.3 (lines 352-416) contains the model selection, methodology, results, and some discussions. The section is too long and without proper flow. I suggest the authors break this section into methodology, results, and discussion to help readers better follow their work.

Reply 15: Thank you very much for your valuable suggestion. Though there are some descriptions linked to methodology, we think we do not need to rewrite this section as our manuscript is methodological in nature. Therefore, it is necessary to link this section with the methodology.

Comment 16: The authors use passive voice and active sentences alternatively in the manuscript. They may re-write these complicated parts. For example lines 293-294.

Reply 16: As we have mentioned earlier, we will do the necessary language corrections.

Comment 17: In the “Summary and Conclusion”, the authors mostly repeat some parts of the manuscript. I would expect to read a more conclusive summary and conclusion. For example, in Lines 447-449, (as mentioned earlier in comments on the Abstract) the authors stated that results of this study “can be incorporated to water resources management plans : : :”; but they didn’t explain how this incorporation would take place. I suggest that authors add some explanations to the manuscript to clarify in

what respect their work will affect water resources management in the highly irrigated lands.

Reply 17: We will make the necessary corrections, please go also through the reply 7. Moreover, it is not only conclusion section. Please look at the heading of this section, it is Summary and Conclusion.

Comment 18: Lines 43-44: confusing and awkward statement: “Two important climatic variables like rainfall and PET that derives from the climatic variables are the main inputs in the water balance modeling”. Please re-write the sentence.

Reply 18: You may understand this is a technically correct sentence after going through our replies. Comment 19: Lines 74-77: Please re-write the statement.

Reply 19: We will check these sentences before final submission. Comment 20: Lines 81-82: “: : : most of studies were limited to detect trends or forecasting of rainfall and temperature and few studies on PET and water balance.” References are required.

Reply 20: At first, we have discussed about the relevant studies in Bangladesh. Therefore, it is not a separate sentence. There are some references in the manuscript. Please go through the manuscript carefully.

Comment 21: In section 2.1, it is stated that rice, the main crop cultivated in Bangladesh is mainly rain-fed or irrigated by groundwater resources (lines 104-106). Unfortunately, the authors have not clearly explained the relation between their study and irrigated area or even irrigation water demand in the study area. They may define how their work will affect the “Highly Irrigated Western Part of Bangladesh”.

Reply 21: Please go to reply 7.

Comment 22: Lines 144-147, as acknowledged earlier, the statement needs theoretical revision. However, references are required for the definitions of surplus and deficit.

Reply 22: We will check these sentences.





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Reply 23: For the statement in lines 147-151, on the AET and its “calculation”, references are required.

Reply 23: There is a reference in line 137.

Comment 24: Lines 398-400, awkward sentence. Please re-write this sentence.

Comment 25: In general, the writing can be significantly improved. . ...

Reply to 24 & 25: As we have mentioned earlier, we will do the necessary language corrections. Thank you very much for your suggestions.

References Allen, R. G., Pereira, L. S., Raes, D. and Smith, M. Crop evapotranspiration: guidelines for computing crop water requirements. FAO Irrigation and Drainage Paper, No. 56, Rome, Italy, p.328, 1998.

McCabe, G.J. and Wolock, D.M. Temporal and spatial variability of the global water balance, 120, 375, Climatic Change, https://doi.org/10.1007/s10584-013-0798-0, 2013.

Xu, C.Y. and Singh, V.P. A Review on Monthly Water Balance Models for Water Resources Investigations, Water Resources Management 12, 20, https://doi.org/10.1023/A:1007916816469, 1998.

Please also note the supplement to this comment:
https://www.hydrol-earth-syst-sci-discuss.net/hess-2017-523/hess-2017-523-AC2-supplement.pdf

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