

Interactive comment on “Indicators of Necessary Storages for Flood and Drought Management: Towards Global Maps” by Kuniyoshi Takeuchi and Muhammad Masood

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RESPONSE TO THE REVIEWER #5'S COMMENTS

We are grateful to Reviewer #5 for the helpful and insightful comments. The provided comments have contributed substantially to improving the manuscript. Accordingly, we have made significant efforts to revise the manuscript with the details being explained as follows.

Point #1

COMMENT: My major review comment on the current manuscript, however, is that the central theme of this manuscript is ambiguous. In the manuscript, I see at least the

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following five topics are presented in a mixed manner.

1) Authors promote the application of various traditional analysis approaches, in particular FDC and DDC here, with a large dataset in modern days to obtain practical implications. 2) FDC and DDC curves have been used previously for a dam operation at a single site, while the authors in this manuscript extend the method to spatially distributed data. 3) Authors claim the use of FDC and DDC enabled to characterize necessary storages in the Ganges-Brahmaputra-Meghna (GBM) basin. 4) Authors claim most of recent climate change impact assessment studies simply evaluate the increase or decrease of hydrologic variables. On the other hand, the presented approach with FDC-DDC can provides different perspective to interpret climate change projections suitable for practical water resource management. 5) Finally the authors attempt to present the projected climate change impact in the GBM basin.

I believe all the above issues are equally important. Meanwhile with such a many topics, I found difficulty in understanding the main message by the authors. For example, the introduction mainly reviews the original concept of FDC-DDC with some other similar approaches but not necessary arguing the point of 1). The method section solely reviews the FDC and DDC methods with some extensions to the spatially application i.e. point 2). The result sections including the conclusions focus mostly on 3) - 5), whose issues are not well explained in the introduction.

RESPONSE: Thanks for the comments. We consider 1) and 2) are the core of the paper and 3) is an application case study in GBM. We follow your suggestion omitting climate change part 4) and 5). The use of FDC-DDC 1) for necessary storage calculation is indispensable in this paper as without its practical easiness of calculation of necessary storages at many grid points and production of an areal map would be very difficult. Its introduction is vital as it is not well known while its comparison with other methods was partially done by Takeuchi (1980) and is out of the scope of this paper.

Point #2

COMMENT: Personally I believe this paper can improve the readability if the authors express their own points on the 1) and 2) in result, discussion and conclusion sections. Just revisiting traditional approach cannot be accepted in a scientific paper, but this is not the case with demonstrating further extensions.

RESPONSE: Thanks for the comments. As the 2) spatial distribution of necessary storages is the main theme of the paper it is discussed in all sections, while the 1) FDC-DDC is only the way of calculating necessary storages discussed in section 2 only. But as you suggest, its methodological needs for this application will be discussed in result, discussion and conclusion sections.

Point #3

COMMENT: Please add some more explanations on the practical use of the quantified necessary storages for river basin managers. Especially for such a large river basins, the meaning of smoothing discharge at a particular river section should be carefully discussed. For example, smoothing river discharge at an upstream point with smaller storage and at a downstream point with large storage have different impacts for both flood (at the downstream of the reservoirs) and drought. Hence I wonder for the effective use of the information, it requires some additional information such as the impact of smoothing to the downstream areas etc. for practical applications. This comment does not request for additional analysis but requesting for how the spatially distributed necessary storage information can be used in practices.

RESPONSE: Thanks for the comments. You raise the most important question. Frankly we do not have the satisfactory answers yet. But we will discuss as much as possible on the potential use of necessary storage information to water managers. One may be an implication of spatial differences of necessary storages in months in relation to potential benefit of water transfer. Another would be that area with smaller storages may indicate relative advantage for agricultural use. Also, your point of impact to downstream is a question of changes of necessary storages along river lines that may indicate the

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advantageous site of dam construction in hydrological sense.

Point #4

COMMENT: P2 L24-26 The part of "its scale is different from that of elementary hydrological processes in a small catchment" is unclear. The similar sentences appear also in 4.2.2 describing Representative Elementary Area (REA), but the current manuscript is still unclear how the scale issue dealt in this study is related to REA.

RESPONSE: Thanks for the comments. Our understanding of REA is the smallest area over which a measurement can be made that will yield a value representative of the whole. In various hydrological phenomena, they are about 1km² but in storage domain, it seems in much higher order. This will be mentioned in discussion.

Point #5

COMMENT: P5 L2 AOEB -> ADEB

RESPONSE: Thanks for your comments. Accordingly, we have revised it.

Point #6

COMMENT: P9 L1 What is the relationship between "WATCH Forcing Data set (WFD)" and previously described datasets including CRU and APHRODITE in 3.2.2.1 in the presented simulation.

RESPONSE: Thanks for your comments. We apologies for the confusion with this paragraph. We have removed it from Section 3.2.2.1. It was mistakenly left from the original draft (which mentioned about the other application of the BTOPMC model).

Point #7

COMMENT: P12 4.2.1 Please explain the motivation of this discussion at the beginning of this subsection or in the introduction, otherwise this part sounds a bit too sudden and not well connected to the other part.

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RESPONSE: Thanks for your comments. Yes, it is. This introduction will be moved to theory section 2 in relation to definition of necessary storages.

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