

## ***Interactive comment on “Calibration analysis for water storage variability of the global hydrological model WGHM” by S. Werth and A. Güntner***

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We thank the reviewer for his valuable suggestion and agree with his comment. Section 2.3.3 will be revised in order to make the type of the GRACE data, the filter application and the temporal and spatial resolution of GRACE data more clear.

"p. 4824, l. 15-18: I do not understand this: How could these basins be used in the analysis if their observations do not cover the GRACE period? Doesn't the use of mean values (i.e. the neglect of inter-annual dynamics) seriously compromise the results?"  
> We agree with the reviewer that using monthly mean values of river discharge for some basins without recent discharge data is critical. We cannot evaluate or improve the inter-annual model dynamics in this way. Nevertheless, the focus of the current

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study was mainly to improve WGHM seasonality. Thus, we consider using monthly mean values as a first viable approximation to improve the general model dynamics unless more recent discharge data become available. Nevertheless, we acknowledge the limitations of this approach as one possible reason for poor calibration performance (see, e.g., page 4835, lines 1-4 and conclusions, page 4838, first paragraph).

"Fig. 5: Against which observations were the data compared (especially the TWSV data) to derive the RMSE?" > The RMSE were derived by comparing simulation results of TWSV with water storage data from GRACE and simulated discharge with the discharge measurements. We will clarify this point on page 4828, lines 20-21 in the revised manuscript.

"p. 4829, l. 7: What could be the reason for the decrease in accuracy for Mekong?" > The Mekong basin is difficult for GRACE data analysis due to its long-stretched and thin shape. Here strong leakage effects from surrounding areas may occur in the GRACE data, or satellite errors become too high if one tries to reduce the impact of leakage. The latter is actually shown by Figure 5, where the error bars for the relative RMSE of the calibrated model include the original model version.

"p. 4836: The baseline simulation was done using a specific climate dataset. I miss a brief discussion of the possible influence of the choice of this one (since there is considerable variation among different precipitation data sets in particular). That is, might the present results be strongly different if another climate dataset was used?" > We will include such a brief discussion in the revised paper. Effects on WGHM-TWSV for different climate data sets were analysed by Doell and Fiedler (2007, Adv. Geosci., 11, 63-68).

"The conclusions are way too long, please be concise." > We thank the reviewer for his suggestion and will condense the conclusions in the revised manuscript.

"Table 1: What are the final parameter values for the individual basins? fig. 7 provides standardized values only." > We excluded the final parameter values, because it would

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include an additional huge Table (of same or larger size as Table 3).

Response to technical corrections:

"p. 4815, l. 12-14: This is an incomplete list of global hydrological models with a strong focus on land surface models. Please state that this is a selection, or include others."  
> We agree, we only gave examples of global models and will stress that in the revised paper.

"p. 4821, l. 13: What is the criterion to classify these rivers as "most important?"  
> These rivers are among the largest river basins worldwide in terms of catchment area. Furthermore, large river basins of Europe (Danube) and Australia (Murray) were included in the study to ensure a global representation of the GRACE integration.

"p. 4826, l. 4: Order of figure numbers 2 and 3 is incorrect (3 is mentioned first in the text)." > The figure number order will be re-sorted.

"Table 1: I'd prefer that more intuitive abbreviations were used for the parameters rather than SL-1 etc." > The idea behind the abbreviations is to be able to quickly allocate the parameters to hydrological process groups, which would not be possible for individual parameter names. Also, all parameter abbreviations are described in table 1, which enables a fast access to their meaning. Also, for several conceptual parameters, it may not be possibly to find a more intuitive abbreviation. Therefore, we would not like to change the parameter abbreviations.

"Table 2: Third line: "col. 6" not "col. 7". Table 4, second-last line: delete "compared"."  
>Both will be corrected in the re-submitted manuscript.

"Fig. 1: Are the Köppen classes really needed? Showing the basin numbers would be better." > Köppen-classes are needed for analyses within section 3.4. Climate regions and conditions are allocated to the analysed river basin. Removing this map would reduce overview and transparency of these analyses, since the reader is likely not to have a map of climate region for each basin in mind. In principal, as large river basins

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may cover several climate zones, we decided to use the scale of Koeppen climate zones as an additional way of aggregating and interpreting the simulation results. This enables to differentiate characteristics of water storage variations and their parameterization as a function of environmental conditions. Basin numbers will be included in Fig. 1, to enable a faster access to Tables 3 - 5.

"Fig. 7: Don't use lines for these distinct cases." > The parameter values for distinct cases will be plotted as dots (calibrated model version) and triangles (original model version) instead of lines within the revised manuscript.

"Fig. 8: Much too small, numbers cannot be read. Remove the inset figure of c) (Lena)." > Figure will be improved accordingly.

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