

## ***Interactive comment on “Water balance modelling in a semi-arid environment with limited in-situ data: remote sensing coupled with satellite gravimetry, Lake Manyara, East African Rift, Tanzania” by D. Deus et al.***

### **Anonymous Referee #1**

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#### General comments:

The paper focuses on modeling water balances in data limited basin using alternative remote sensing information which is becoming more and more important for hydrological modeling in data scarce regions. Satellite gravimetry GRACE data and altimetry data are used to verify obtained lake water balance results. MODIS Land Surface Temperature (LST) data and TRMM rainfall data are used as model input. The paper presents use of remote sensing data for hydrological modeling purposes in data

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limited regions and with this it falls within the scope of HESS. The paper is well organized. However, there are improvements to be carried out before it can be accepted for publication. There are following issues I missed in the paper.

1. In the rainfall data description section, authors describe the quality of TRMM and GPCP datasets compared to in-situ information. However, it is not clear whether GPCP is also used as model input or only for validation purpose? The authors should make it clear that in-situ (and GPCP) data is used for validation only in this study and are not model input, if this is the case.

2. As it is explained in the paper, MODIS LST product is used as model input. This means that evapotranspiration is also calculated using LST data. However, the Penman-Montheith method for ET estimation uses air temperature as an input. This is why the authors should clarify how LST was integrated into the model. Was it directly used constituting air temperature information, which is actually not correct?

3. In the structure of paper I would suggest to combine sections 4 and 5 (approaches and model setup) and name them as Methodology section. Model setup is also a methodology used in this study.

4. Presentation of modeling results is not clear enough (especially fig. 12). In my opinion, the authors should give more attention for clear representation of modeling results with better visualization options.

Specific comments:

1. Page 8743, line 3-4: From my past readings I have always read that TRMM shows reduced quality in mountain areas. Would it be possible to check TRMM quality using individual stations (four rain gauges) at different elevations?

2. Page 8744 lines 9-15: You need to state whether you used in-situ air temperature or in-situ LST for comparison with MODIS LST. State also from which station LST / air temperature data was used for comparison.

3. Page 8744 lines 9-15: Clarify how the comparison was done. Was the monthly mean MODIS LST compared against monthly mean in-situ LST / air temperature?
4. Page 8744 lines 9-10: What is the combination of V4 and V4.1 product? Authors state earlier that V4 is from 2000 to 2006 and V4.1 is from 2006 to 2010. This is why clarification for combining these two datasets is necessary which were explained to have different time series.
5. Page 8744 lines 9-15: You used Pearson's correlation for rainfall evaluation and used coefficient of determination for MODIS LST evaluation. It is better to use the same measure everywhere, unless you explain why you use other measure than previous one.
6. Page 8744 lines 25-28: Is it important to mention all land use classes?
7. Page 8745 lines 6-7: Reformulate sentence.
8. Page 8745 lines 4-9: Useless information. Only mentioning SRTM in data section would be enough.
9. Page 8746 lines 5-6: There are four rain gauges shown in the map but authors say about five rain gauges. Remove "about" since it must be clear weather you have 4 stations as shown in the map or 5 stations as stated in the text. Change one of them, four or five in both, text and map.
10. Page 8748 line 6: I would suggest to use Methodology instead of Approaches as section title
11. Page 8751 line 16: What do you mean by "hydrological target"?
12. Page 8752 lines 25-28: In my opinion there is no need to explain goodness of fit since it should be familiar to any who wants to understand this paper.
13. Page 8753 lines 1-3: I would remove eq. 9 since it is common and well known coefficient.

14. Page 8753 lines 16-18: No need to explain what model validation is.
15. Page 8761 line 1: Please use same decimal numbers for area description. The sentence about Lake Manyara basin covering 18763 km<sup>2</sup> and 465.96 km<sup>2</sup> is little confusing. It is better to say about 466 km<sup>2</sup> than 465.96 km<sup>2</sup>.
16. Fig. 12: More explanation for this figure is necessary. Especially, actual ET figure shows questionable illustration of its spatial distribution. The authors should explain why it suddenly changes in some parts.
17. Fig. 7 can also be explained in words and in my opinion there is no need to illustrate it as a figure since you do not show legends anyway.
18. In my opinion, description of Land cover and topography can be explained in the beginning of data section and should not be explained as an additional sub-section. Moreover, slope and aspect as named in sub-section title are not described at all.
19. I wonder whether it would make more sense to use other methodology for ET estimation in data scarce region. Penman-Monteith methodology requires more input data and there are other methods which require less input data (e.g. Hargreaves-Samani). Computing ET using Hargreaves method and comparing it against observed ET data and choosing better method would increase the quality of paper. Another reason for this is that there is only one meteorological station which is located outside the basin. Extrapolating all climatic parameters from this station into whole study area is less accurate than transferring only temperature data which can also be extrapolated using simple lapse rate methodology.

#### Technical corrections:

1. Lines 11-13: Reformulate sentence or use “;” after comparable trends.
2. Page 8740, line 9: add “to” before “test”
3. Page 8740, line 6: You say remote sensing and GRACE data. Is GRACE data not

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remote sensing product?

4. Page 8740, line 20: do you mean area instead of depth?
5. Caption of Fig. 3: comma after median.
6. Page 8742, line 24: Give extensions for SSM/I and VIS/IR
7. Page 8743, line 11: I would suggest using another synonym for “amalgamate”.
8. Page 8744 lines 15-17: MODIS over / underestimates LST and not in-situ temperature values.
9. Page 8745 lines 12: its aerospace centre? Does DLR belong to NASA?
10. Page 8745 line 25: is instead of are
11. Fig. 12: Map legends are too small and not readable. Enlarging necessary.
12. Page 8761 line 22: Remove one “the”
13. Page 8761 line 23: intense instead of intesense.
14. Page 8762 line 5: remove “with”

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