

Review SOIL-2015-84: Calculating the sediment budget of a tropical lake in the Blue Nile basin: Lake Tana

The authors present the calculation of the past sediment budget of Lake Tana, Ethiopia, that is threatened by pollution by sediments and nutrients. The calculation is based on already existing data as well as on discharge and sediment modelling with the PED model. The topic of the paper is of high environmental interest, however the scientific and presentation quality are only moderate to poor.

I recommend *rejection* for the following reasons:

*General comments:*

1. The objectives in the Introduction need to be put clearer. A hypothesis was not formulated.
2. It seems that measured precipitation, discharge and sediment data were not analyzed for consistency sufficiently. Measured data that are proven to be not correct need to be excluded or corrected before further analysis and cannot be used for model calibration and validation. The authors should redo the analyzation of the used data. After that the results might be different from the results presented here.
3. The manuscript needs a major restructuring. Methods and results need to be strictly differentiated.
4. The description of some methods and used data is missing (see Specific comments for details) so that some argumentation cannot be understood.
5. The results should be discussed in more detail and should not be related to errors/anomalies in the measured data.
6. Figures and tables in the supplementary material are either superfluous or could be integrated directly in the manuscript (see Specific comments for details).

*Specific comments:*

*Text:*

- P. 2, l. 8ff: Give the size of the watersheds in brackets.
- P. 3, l. 17ff: The source of the meteorological data needs to be given. How many stations are used? Give the coordinates and names. How long is the measurement period? What is the temporal resolution of the measurements?
- Parts 2.1.1 to 2.1.4: Percentage values should be given either as numbers or as text but should not be intermixed. Instead of references to figure as 1 a reference to table 6 should be given.
- P. 4, l. 2: Why do you call it Lake Tana “sub” basin and not simply basin?
- P. 5, l. 1ff: See comment before: Which stations are used? How long is the measurement period? What is the temporal resolution of the measurements? If there are several stations, why were missing values not estimated by correlations with the surrounding stations? I guess this would better represent the temporal variability of the meteorological data.

- P. 5, l. 6ff: Give the names and coordinates of the gauges. Describe in more detail how the daily discharge was measured at the gauges. Missing data could also be estimated from correlations with the other gauges, if there was any correlation.
- P. 5, l. 10ff: Describe in more detail the sediment load data. How was sediment concentration measured by the MWIE? Line 14: I guess you mean 1994 instead of 1964 (also in Fig. 6)?
- P. 5, l. 29: Change “was designed” in “was adapted/changed”, since the Watem/Sedem model was also originally developed for temperate climate. Why is the Watem/Sedem model mentioned here? You want to explain why you used the PED model.
- P. 6, l.4: The PED is not a “physically based” model! Change this into “conceptual”.
- P. 6, l. 9: Change “Table S1” into “Table 1”, delete “with model performance statistics in the supplementary material”).
- P.6, l. 21: Explain the three areas in more detail: Which land uses or topographic and soil conditions do they represent? What is meant by “degraded” areas?
- P. 7, l. 4: Give a reference for the Thornthwaite-Mather procedure.
- P. 7, l. 14 ff: Write full sentences to explain the equations!
- P. 7, equation 6: Bst instead of Rst
- P. 8, l 9f: The parameter H needs to be explained in more detail. What is given in Fig. S7? How were the values in S7 determined by field observations? Why is transport capacity limited in the time of highest rainfall?
- P. 8, l. 16ff: The procedure described here is not clear. For calibration you cannot simply take values of another day that fit better to the observed ones!
- P. 8, l 26: You write “initial values were changed systematically...”. Please explain in more detail what is meant by systematically here. By which increments were the parameters varied? How many model runs were done?
- P. 8. L. 27ff: Which period was used for calibration of the sediment model? How was “the best fit” determined here?
- P. 9, l. 8ff: This information needs to be given in the Methods section before explaining the calibration procedure.
- P. 9, l. 15/16: “...caused by our inability to estimate amounts of rainfall accurately due to the sparse rain gauge network.” This cannot be understood, since the rain gauge network was not described in the Methods section. The authors need to prove that the rainfall data they used is the best available estimate, otherwise modeled discharge can only be not correct! “There was also an anomaly in the collected data in 1996.” What do the authors want to express by this? If data are known to be not correct, they should not be used!
- P. 9, l. 19/20: What is meant by “initially” and “later on”? Reformulate this to be more precise.
- P. 9, l. 25: Before you explained that missing precipitation data were filled, so this cannot be an argument for better model performance.
- P. 9, l. 27ff: It needs to be explained why parameters in the sub catchments are different. I would expect them to be different, if the hydrologic conditions (e.g. slope, soil, land use) are different in the sub catchment. L. 29: “Despite that” it the wrong argumentation, since you used the best fitting parameters for each sub catchment.
- P. 10, l. 6: The “unlikely reduction” needs to be explained in more detail.
- P. 10. L. 19: You have to be sure that your measured data are correct, otherwise they cannot be used for model calibration and validation. Data that were not measured “correctly” need to be excluded from further analyses.
- P. 10, l. 22: Delete “in our paper”.
- P. 11, l. 9/10: This is not true and needs to be described more differentiated for the different sub catchments, e.g. for Gumara highest runoff is in July whereas highest sediment concentration is in August. Does fig. 6 really show the measured sediment concentrations? From Fig. 4S one can learn that there were only 8 measurements throughout the measurement period (1964.2009 or 1994-2009??). How can monthly means be calculated from these data?

- P 12, l 13ff: The method of calculating the sediment budget of Lake Tana needs to be explained in the Methods section and not in the Results section.
- P. 13, l. 29/30: All available measurements need to be explained in the Methods section.
- P. 14, l 5 and l 26: It needs to be explained or references should be given about what degradation means in the study area.
- P. 15, l. 1-3: This cannot be understood.

*Figures and tables:*

- Fig. 1: In general, the figure looks good! However, please additionally include the gauging stations as a point layer and also the outlet to the Blue Nile. Topography in the background would also be helpful for readers who don't know the area, but might make the figure hard to read. Please color the lake in blue. Eliminate the heading within the map ("Lake Tana Sub Basin"). In the figure caption please mention the method used for river network and watershed delineation (it looks like it was done in SWAT?). Or even describe this in the Methods section because the size of the watersheds is an important parameter in calculating the sediment budget.
- Fig. 2-5: For each of the figures there are no references to figures c and d within the text. Figures c and d should be deleted since the information on the coefficient of correlation is also given in table 3. In this table also the slope and intercept as well as the significance if  $R^2$  should be given. However, the regression lines seem to be forced to go through the point of origin which is not appropriate. Please recalculate the regression lines without forcing them through zero. The number of values n needs to be given for each sub catchment. Is it really necessary to show the hydrographs of each sub catchment?
- Fig. 6: How can monthly values be calculated from only a view measurements throughout the measurement period?
- Fig. 7 and figures S4 – S6: The figures can be deleted since the information is also given in table 5. In this table also the slope and intercept as well as the significance if  $R^2$  should be given. However, the regression lines seem to be forced to go through the point of origin which is not appropriate. Please recalculate the regression lines without forcing them through zero. The number of values n needs to be given for each sub catchment.
- Fig. S1: Can be deleted, information is given in table 6.
- Fig. S2 and S3: These figures are not very helpful since the differences within the sub catchments are not used for discussion. Instead of land use the proportions of degraded land might be more helpful.
- Fig. S7: This figure can be deleted. The used values can be explained in one sentence within the manuscript.
- Table 1: All abbreviations need to be explained in the heading or footnote. Footnote 3 does not occur within the table. For the study of Easton et al 2010 no validation values are given, hence the study cannot be used for model comparison. The calibration values should always be good; otherwise the calibration would not be good.
- Table 2: Change the heading in "Calibrated PED parameters for calculating discharge and sediment concentration..."

- Table 3: All abbreviations need to be explained in the heading or footnote. RVE and Pbias are not mentioned in the methods section. The number of values n needs to be given for each sub catchment. For Gilgel Abay  $R^2$  and NSE of the calibration data set are exactly the same. Is this correct? I guess the monthly values are monthly sums, then the unit is mm/month. This needs to be included in the heading.
- Table 4: Change the heading in “Calibrated sediment concentration parameters ...”.
- Table 5: All abbreviations need to be explained in the heading or footnote. What is the “error”? It is not mentioned in the methods section. The number of values n needs to be given for each sub catchment.
- Table 6: Change the heading in “Distribution of slope classes in ...”.
- Table S1: This table could be included directly in the manuscript, if this is the only figure or table left in the supplementary material.