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Hydrology and Earth System Sciences Discussions

Interactive comment on "An efficient semi-distributed hillslope sediment model: the Anjeni in the sub humid Ethiopian Highlands" *by* S. A. Tilahun et al.

Anonymous Referee #1

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General comments The prediction of sediment transport remains a very difficult one, especially for regions such as Ethiopia which lack comprehensive spatial databases limiting the use of more detailed models developed in the US and/or Europe. This paper presents a simple approach to model daily sediment yield values from a limited number of input parameters. Although the statistical results are promising, there are several methodological and analytical shortcomings in this paper that need to be addressed first. These are given below.

Specific comments

First of all it is not made clear why daily sediment concentrations were calculated although one has a more detailed dataset available. I presume this was done because also the discharge model is run on a daily basis but this is not stated explicitly. The model implicitly uses a transport capacity limited approach to model sediment transport. Are there any (field-based) arguments for this ? Is it not possible that some (steeper) slope segments in the degraded area could potentially transport more sediment than what is made available by erosion processes on more gently sloping land further upslope ?

The three regions are now treated more or less as a black box: average values for the coefficient "a" are calibrated irrespective of the variability in slope, slope length, rougness, .. within each region. This implies that the calibrated parameters will only be valid for this watershed under current land use conditions. It will not be possible to use this calibrated model for other watersheds as these will have a different setting (slope distribution, soil typology, . . .). Hence, what is the value of this model approach when it can not be extrapolated ? the model can also not be treated as a semi-distributed model such as the title suggests given the fact that the three regions are black boxes.

The hydrological model is also overparameterized: with nine calibration parameters it is not so difficult to get a good model fit. But this does not mean that the current combination of the nine calibration values is meaningful. Other combinations could also give good predictions. However, this kind of information is not provided. What is the range of model efficiency values for a range of parameter values ?

The model assumes that the nine calibration parameters, and thus also the fraction of the three regions, are constant for the watershed through time. But is this realistic ? What about the variable source area concept ? Is this not valid for this catchment ? Does the area with saturation excess overland flow not vary through time, over the years, during the rainy season, etc, and thus also the area with erosion ? How sensitive is the model when the calibration parameters change ? How sensitive is the model for changes (or errors) in input values ? This is as important as obtaining a good validation

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result. Plots like figure 4 and 5 always give a false impression of the goodness of the model predictions. Off course, the predicted runoff will increase when the observed runoff increases: this is quite logic as there will only be runoff after rainfall. Likewise, if there is no runoff, there will be no sediment transport/concentration. It would therefore be better to plot the observed versus the predicted values of daily Q and C in one graph to see how far the predictions plot from the 1:1 line. Also, it is better to use the Relative RMSE or RRMSE instead of the RMSE which is independent on the intensity of the variable.

The quality of Figure 1 is insufficient, especially the DEM (only three odd-chosen colors).

Finally, a lot of typographical/grammatical errors were made throughout the manuscript and these need to be corrected prior to resubmission.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 2207, 2011.