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Hydrology and Earth System Sciences Discussions

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

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If adequately presented and defended, this paper has the potential to makea substantial contribution to the literature in this area. Whilst there are some questions requiring further explanation, if these are adequately explained, the paper mayindicatethat if an appropriate conceptual basis for hydrologic and sediment yield processes is adopted, then the obvious complexity of catchments, at whatever scale, does not prevent an efficient description of dynamic responses given adequate conventionally- measureable or observable relevant data.

The main general reservations on the paper relate to hydrologic modelling, and are as follows:

1. Evidently the per cent fractional area of the three defined types of land surface is obtained in the process of calibration of modelled versus measured data. The-outcome would be much more convincing if the percentages were estimated independently of the calibration process.On p. 2128 it is said that a daily water balance is kept for the defined regions. How can this be done when the percentages of the different regions in the Anjenicatchment do not add up to 100%? Was rain allowed to fall on the missing area or not?

2. The nature of the sub-surface modelling cannot be adequately understood without pursuing the references given. On p.2128 reference is made to a "first order basin reservoir", a "linear interflow reservoir", and a "first order groundwater reservoir". All these various "reservoirs" require some explanation and justification in this paper, however well they may be defined in references given.

3. If some justification can be given of the hydrologic modelling can be given, then at least a critical comparison should be given of how the modelled areas A_1, A_2, and A_3 relate to observations on the ground (for Anjeni),and, if possible,from the air or satellite for the Blue Nile catchment.

Specific questions and comments are as follows:

1. Page 2129, line 6. Sediment yield is expressed in t day^{-1} ha^{-1}, so presumable "t" stands for tons. But in Eqn. (3) "t" is is introduced as an undefined subscript, where its meaning would appear to refer to a day index.

Thus there are two undefined, but apparently contradictory uses of the symbol "t". Is $Q_{Tt}$the value of Q_T for day t?

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1. The following comments and questions all relate to Table (2):

   (a) It is most surprising that the value of $t_{1/2}$ is twice as high for the relatively small Anjenibasin (@ 70 days) than for thr great Blue Nile basin (@30 days). Is this difference feasible? In the text there is no mention of as value of $t_{1/2}$for the Blue Nile.

   (b) S_{max} in A_1. Table 2 shows this as 200mm, but in the text it is given as 70mm. Which is correct?

   (c) BS_{max} for Anjeni is shown as 20mm in Table 2, but is given as 100mm on p. 2135, line 27.

   (d) τin Table 2 apparently should be τ^*.

   (e) P.2136, line 28. The suggestion that area fractions are similar for Anjeni and Blue Nile catchments is not correct for saturated areas which are shown as 2% and 29% respectively.

   (f) Conceptually the sum of the % areas of the Anjeni catchment which are saturated, degraded or are hill slope should add up to 100%, as for the Blue Nile. Evidently the discrepancy between the sum of percentages (66%) and 100% arises from the calibration process described. The explanation for this apparent discrepancy given in the text (p.2135, lines 16-18) is that it arises from the possibility that the steamflow as measured at exit from the Anjeni catchment did not capture all the base flow and interflow which may have exited the catchment at depths below the stream. Was this possibility supported by any investigation (eg. was soil depth at exit considerably greater stream depth?).

Also was (Q_{BF} + Q_{IF}) taken to be equal to the measured streamflow, or, if not, how was it evaluated?

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1. It is a strong assumption that sediment concentration leaving the degraded are was at the transport limit. However, even if this was an over-estimate, from the structure of the equations employed such a discrepancy would be accommodated in the calibrated parameter "a". Even an approximate comparison of the calibrated value of "a"with an estimate of that theoretically expected could throw light on the likely validity of this assumption, though the validity of this comparison would depend on the reality of the area estimates.

Technical correction.

P.2130, line 14. The Eqn. number should be (3), not (4).

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 2121, 2012.