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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Calibration and validation of SWAT model and estimation of water balance components of Shaya mountainous watershed, Southeastern Ethiopia" *by* A. A. Shawul et al.

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Authors response and comment

To: Interactive comment made by Anonymous Referee #2

First of all, we would like to acknowledge Anonymous Referee #2 and Anonymous Referee #1 for providing detail and sensible comments, and questions on our research article. All the editorial corrections are practical and the comments are entirely ac-

cepted for editorial modifications.

Detailed comments # Replies to the comment by the Authors 1, 2, 3,4 These are necessary editorial correction that will be included. 5 All weather stations delivered precipitation and maximum and minimum temperature while solar radiation, wind speed and relative humidity were obtained from Robe and Agarfa weather stations with varying recording periods. Daily solar radiation was calculated from the daily sunshine hour data using the Angstorm-Prescott equation, which is simple empirical formula that relates short-wave radiation with other physical factors, such as extraterrestrial radiation, optical air mass, and turbidity, water vapor content of the air, amount and type of cloud cover. The Penman-Montheith method which utilizes the temperature, solar radiation, relative humidity and wind speed data records was employed for estimation of PET for this specific study. Meteorological stations were also geo-referenced using latitude, longitude, and elevation data. StreamïňĆow gauge station is located at the outlet of the watershed which was used to calibrate SWAT model. 6 and 7 Correction will be made. 8 The threshold level set for multiple HRU is a function of the project goal and the detail desired by the modeler (Neitsch et al., 2005). For this specific study a 5% threshold value for land use, 20% for soil and 20% for slope were used. The land use threshold level used was to eliminate minor land uses in each sub-basin. Land uses that cover a percentage (or area) of the sub-basin area less than the threshold level were eliminated. After the elimination process, the area of the remaining land uses was reapportioned so that 100% of the land area in the sub-basin is modeled. The same was true for soil classes and slope ranges distribution in all sub-basins. The last step in the HRU analysis was the HRU definition. The HRU distribution in this study was determined by assigning multiple HRU to each sub-basin. 9 The model was run for a period of eight years January 1, 1992 to December 31, 1999. However, the first three years of the recording period (1992 to1994) were used for stabilization of model runs (warm up period). The calibration was performed for a period of five years (January 1, 1995 to December 31, 1999). 10 The estimation of model parameters at monthly and annual scale has been done based on aggregate daily simulations. 11 and 12 These are

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sensible comments and correction will be made. 13 In fact, calibrating complex models like SWAT on remote and data scarce areas might be cumbersome. For this particular study calibration and validation were undertaken on monthly time step by aggregating daily simulations. 14 The word base is used to represent the baseline time period used for simulation of streamflow using calibrated hydrologic parameters. 15 The total water yield mathematically expressed as surface runoff (Sur_Q) plus lateral soil flow contribution to streamflow (Lat_Q) plus ground water contribution to streamflow (Gw_Q) minus water lost from tributary channels in the HRU via transmission through the bed (Tloss). Total water yield (outflow) at the outlet of watershed is one of the major water balance components of the watershed like actual evapotranspiration, precipitation and soil water content. 16 The calibrated SWAT model may be taken as a potential tool for simulation the water balance components of neighboring watershed which behave similar hydro-meteorological characteristics with Shaya watershed. 17 Mountains are key water towers but under stress due to global change (climate change, land use/cover change). Land use/cover dynamics constitute an important factor especially in fragile mountain areas like Bale Mountains driven by many factors e.g. increasing population, infrastructural developments and expansion of agriculture into marginal lands. Future studies should consider effect of climate change and land use/cover change on the runoff and soil erosion within Shaya watershed and implement strategies for best management practices.

Authors response and comment

To: Interactive comment made by Anonymous Referee #1

Most of the specific comments have already indicated in the document such as the analysis of how well the model captures hydrological processes of the watershed is well indicated on Fig. 4 and Fig. 5. The efficiency of SWAT model was evaluated with three statistical criteria namely regression coeïňČcient (r2) Nash and SutcliïňĂe simulation eïňČciency (ENS) and percent diïňĂerence (D) as indicated in the paper. The study watershed area is also indicated in description of the study area section and

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the HRU used for calibration is the whole HRUs, calibration is performed at the outlet of the watershed Fig 1. Base ïňĆow separation was undertaken on the bases of daily discharge data. The other comments like elevation of weather stations, the rating curve will be included within short period of time.

Table: Meteorological stations used for this study

Stations Altitude (m) Daily data recording periods Rainfall Temperature Sunshine Wind Speed Humidity Robe 2464 1984-2010 1984-2008 2000-2008 1985-2008 2000-2008 Agarfa 2360 1988-1997 1988-1997 - 1983-1997 1983-1985 Dinsho 3072 1981-2007 1981-2008 - - - Goba 2545 1998-2007 1974-1984 - - -

The typical quality of temporal data was checked by cross correlation between the stations, double mass curve and test of homogeneity using Rainbow software. Correlation coefficient which approaches to one implies a good agreement or consistency of record on the monthly series of the gauging stations. Homogeneity test at 95% significance level was performed for average annual values of precipitation and maximum and minimum temperature data of all the precipitation and temperature gauges containing synthetic data records.

The hydrological data of the measurement station was tested for the period of model implementation, summarizes the acceptance / rejection of homogeneity test at 95% significance level of average annual flow records. Average annual observed flow series of the station passed the homogeneity test for range and maximum of cumulative deviation.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 13955, 2013.