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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Impact of LUCC on Streamflow using the SWAT Model over the Wei River Basin on the Loess Plateau of China" *by* Hong Wang and Fubao Sun

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To: Hydrology and Earth System Sciences (HESS) Subject: Revise the manuscript (#hess-2016-332) The Authors: Wang& Sun The Title: Impact of LUCC on Streamflow Based on the SWAT Model over the Wei River Basin on the Loess Plateau of China Response: The authors appreciate the reviewers for helpful and constructive comments that improved our original manuscript. We have addressed the comments below and have made corrections. The changes being made are marked in red in the manuscript. Response to the detailed comments: 1. Could you add the assessment of model performance for use period (1980-2009) except calibration and validation periods? Thank you for your suggestions. We add a new Fig. 8 to show the time-series graph of calcu-

lated streamflow vs. observed streamflow during 1980-2009 for hydrological stations. We can see the calculated streamflow matched well with the observed values before 1990. The observed values were measured daily based on the actual LUCC, while the calculated streamflow was got based on LUCC of 1980. So Fig. 8 shows the calibrated SWAT model played well in our study area and the changing LUCC can affect streamflow gradually. The streamflow of typical year, the same year with LUCC, is the results of by LUCC and meteorological conditions. To reduce influence of meteorological condition and isolate the impact of the LUCC on streamflow, 30-year average of the streamflow for forest and agricultural land were taken, respectively. For period of 1980-2009, we just used their measured and long-term daily meteorological data in the study area to drive the validated model for the designed hydrological experiments.

Fig.8 The time-series graphs of calculated vs. observed streamflow during 1980-2009 for hydrological stations. 2. Could you provide the water balance (soil moisture, ET, streamflow, baseflow etc.) for each scenario in a Table? And try to analyze how ET change? Thank you for your suggestions. Table 2.1 shows the water balance for different scenarios. The ET values decreased with with increasing of forest area overall. Table 2.1 The water balance for different scenarios S1 S2 S3 S4 S5 ET (mm) 388.98 380.39 373.38 358.87 311.47 Surface runoff (mm) 21.19 21.13 21.43 21.58 21.53 Soil flow (mm) 68.42 69.52 70.63 72.57 77.22 Baseflow (mm) 29.92 36.99 42.37 54.06 94.24 Precipitation (mm) 509.62

3. Part 2.2, the LUCC data were divided into six types which included forest land and shrub land. As we know, similar to forest land, shrub land is also important for water and soil conservation in (semi)arid area. So, could you make a comparison about stream flow change caused by forest and shrub land change? Could you show more data and function about check dams, reservoirs, water channels, and water conservancy projects from 1980 to 2009, even for the calibration and validation periods? I understand this is a virtual experimental (or scenario) study, but the results would provide some implications for land use policy, and therefore need carefully check any-

thing related with hydrology cycle. To my knowledge, there are a lot of check dams for agriculture catchments on loess plateau, which might change hydrology (streamflow) as well. If they are not considered in calibration and validation periods, SWAT model may get wrong parameters for different land use types even if the model results (streamflow) is correct. Thank you for your suggestions. The forest type includes Range-Brush (RNGB), Forest-Mixed (FRST), Forest-Deciduous (FRSD), Pine (PINE) and Forest-Evergreen (FRSE). In Part 2 and 4.1, the forest included all these types, while for the hydrological experiments (part 4.2 and 4.3) the agricultural land was converted to FRST only. The comparison of per unit streamflow between forest and shrub land for 2 LUCC types from 1980 to 2009 is showed in box figure as figure 2.1. The annual average streamflow increased 0.81% in Range-Brush (RNGB) land and the streamflow yield of forest is about 1.18 times of that of RNGB respectively. We also analyzed the streamflow generation of the main types of forest (RNGB, FRST and FRSD) in study area further. Results showed that the streamflow yield of FRST and FRSD were about 1.20 and 1.60 times of that of RNGB respectively.

Figure 2.1 The per unit streamflow generation between forest and shrub land for 2 LUCC types Figure 2.2 showed the development of different soil and water conservation measures (including forestation, terraces, grass and dam land) in the whole and main stream basin of Wei River respectively. According to this figure, we could see the soil and water conservation measures were mainly implemented in the study area after the 1980s in study area. Hence we choose 1960-1969 and 1970-1979 for the model calibration and validation respectively. For period of 1980-2009, we just used their measured and long-term daily meteorological data in the study area to drive the validated model for the designed hydrological experiments. The long-term data could reduce influence caused by meteorological conditions and isolate the impact of the LUCC on streamflow. Figure 1 is the statistical data of government based on natural forest before and artificial planting, which involves all planting area of forestation and does not consider canopy density. The forest of the LUCC data refers to the natural forest and plantation, which canopy density is larger than 30% (Table 3: note âŚą). Data

of Fig. 1 also includes planting land used as agro-fruit, agro-mulberry, agroforestry and replanting land for trees without surviving or deforestation and so on. But land used for agro-fruit, agro-mulberry, agroforestry is classed as Agricultural land (Table 3: note âŚă). There is also screening condition in SWAT model. For hydrological response unit (HRU) analyst, the Dominant Land Use method was used for HRU definition. So the dominant unique combination of land use in the subbasin is used to simulate the HRU.

Figure 2.2 The development of different soil and water conservation measures in the whole and main stream basin of Wei River respectively.

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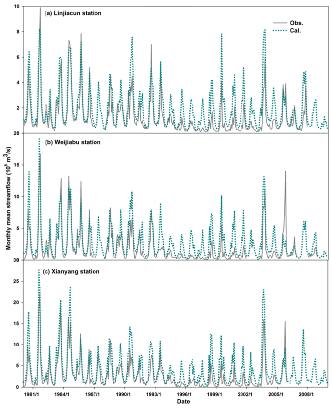

Fig.8 The time-series graphs of calculated vs. observed streamflow during 1980-2009 for hydrological stations.

Table 2.1 The water balance for different scenarios

		S1	S2	S3	S4	S5
ET (mm)		388.98	380.39	373.38	358.87	311.47
Streamflow (mm)	Surface runoff (mm)	21.19	21.13	21.43	21.58	21.53
	Soil flow (mm)	68.42	69.52	70.63	72.57	77.22
	Baseflow (mm)	29.92	36.99	42.37	54.06	94.24
Precipitation (mm)		509.62				

Fig. 1.