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Hydrology and Earth System Sciences Discussions

Interactive comment on "Quantifying uncertainty in the impacts of climate change on river discharge in sub-catchments of the River Yangtze and Yellow Basins, China" *by* H. Xu et al.

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We greatly appreciate the editors and two anonymous reviewers' valuable interactive comments on our manuscript in Hydrology & Earth System Science Discussions. Our response to the comments is given below in sequence.

Anonymous Referee #2:

1. Issues of SWAT model. Huangfuchuan River is located in semi-arid climatic zone, and mechanism of runoff yielding is infiltration excess, but SWAT model is based on saturation excess. No matter how good performance the model does for historical discharge simulation, it's doubtful for the final analysis. Therefore, I suggest author to do this work with another hydrological model which can reflect real runoff yield mechanism.

=> There are two methods to calculate surface runoff in SWAT model. SCS runoff equation is basically an empirical model with long period of studies involving rainfall runoff relationships from small rural watersheds, and the Green-Ampt is time-based physical model linked to infiltration parameters. The perceived advantages of SCS method are described by King, et al., 1999 and Ponce, et al., 1996. The comparison of these two methods on a specific large basin (21.3 km2) using SWAT suggest that no significant advantage was gained by using breakpoint rainfall and sub-daily timesteps when simulating the large basin. SWAT, however, have been used all over the world including the successful application in semi-arid area (Gassman, et al., 2007; Hernandez, et al., 2000; Menking, et al., 2003; Afinowicz, et al., 2005) . Considering the lack of sub-daily rainfall data and infiltration parameters in Huangfuchuan basin, we used SCS curve number method to simulate monthly discharge with an acceptable calibration and validation results.

2. Huangfuchuan river basin has been highly regulated by many soil and water conservation measures since 1970s. Observed discharge can not reflect natural runoff generation. Therefore, author should analyze consistency of observed discharge data series before model calibration and validation. Otherwise, although model performs well for calibration period, it's still hard to get satisfied result for validation period. I suggest author to calibrate and validate hydrological model with naturalized discharge instead.

=> We acknowledge the referee' suggestion about calibration and validation hydrological model with naturalized discharge. As the referee mentioned many soil and water conservation measures were initiated during the 1970s. In addition, natural vegetative cover of grassland and woodland was converted to farmland from the 1950s to 1970s in the River Huangfuchuan catchment. Restoration of artificial grassland and bush land has taken place since the late 1990s. There is, however, limited land-use data and the lack of naturalized discharge to enable modelling of baseline and projected river discharge. Consequently, we do not consider changes in land-use and soil and water conservation measures.

3. Rainfall information plays an important role in discharge simulation. Model performance for Huangfuchuan river basins is just acceptable, but not very good; and model performance for Xiangxi River seems not acceptable. One reason is model itself issue, another reasons should be data issue. In this study, how many raingauges used for each of catchments? If there were not enough rainfall data available, it's hard to get satisfied result.

=> The available daily rain gauges data for both sub-basins comprise a short period (1960-1986). Meteorological data with a long time series exist for only one station located within the sub-basins. Considering the homogenous distribution, long calibration/ validation period, together with consistency both in this study and with other studies in the wider research project that this study is part of, we used CRU gridded meteorological data to drive SWAT model instead of station meteorological data (Figure 1). To date, no absolute criteria for judging model performance have been firmly established in the literature. However, Moriasi et al. (2007) proposed that NSE values should exceed 0.5 in order for model results to be judged as satisfactory for hydrologic and pollutant loss evaluations performed on a monthly time step. Month-to-month sequencing of river discharge in River Xiangxi is poor for the short calibration period (1970-1974) (We have mentioned in P9 line 20). However, the long validation period (1961-1990) and flow duration curve closely match those of observed river discharge (Figure 2). These observations suggest that underlying hydrology is adequately captured by the model.

4. Uncertainty in assessment is not only from climate scenario, but also from hydrolog-

ical model. In the paper, author just analyzes uncertainty induced by climate scenario. Uncertainty induced by hydrological model should also be included in the study.

=> We appreciate the referee's suggestions here and highlight this point, and include more active analysis. In this version of manuscript, to avoid the potential effects of uncertainties caused by the hydrological model, parameters were held constant. The manuscript has been rewritten to highlight the hydrological uncertainty in model parameterization from the autocalibration routines. In the revised manuscript, calibration in section 3.2 provide some indication of hydrological model uncertainty that could measures against that associated with uncertainty in climate projection.

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