

Interactive comment on “Impacts of land use change and climate variations on annual inflow into Miyun Reservoir, Beijing, China” by J. K. Zheng et al.

Anonymous Referee #1

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General Comments

The authors attempted to quantitatively distinguish the impacts of the changes of land use or climate variables on the water yield as inflow into Miyun reservoir in the past decades. Two statistical approaches for detecting the abrupt change in streamflow data and three types of model were employed for analyzing the contributions to the decline of annual mean discharges. The manuscript is well structured and designed. The purpose of the research is of interest to the hydrologists. However, there are some issues should be clarified before it can be published in HESS.

C3636

Specific Comments

The local water consumption in the catchment could be one of the main driving forces for the decline of the streamflow, the authors should present more information about the water abstraction at upstream. At least the construction of the hydraulic works for water abstraction or diversion should be briefly introduced.

Did all annual mean flows in the tributaries decreased in the past decades with the same break change at 1984? Did all the precipitation observed at 39 rainfall gauges show no significant trend? I can see the decrease of forestland with the increase of cropland in 2000's at YZSK/DG/XH/XB/ZJF counties while the land uses in DY/SDY counties are opposite in Figure 8. The authors should detect the changes in hydro-meteorological variables in the sub catchments to better address the spatial characteristics and discuss the effects. The total decrease of inflow can be attributed to land use changes in several sub catchment.

All the climate variables used in this research were collected from the measurements at the local hydro/meteorological stations except for potential evapotranspiration, which is crucial for your analysis and simulation. But I only see one meteorological station lies in the catchment in Figure 1, how could you estimate the mean annual E_p for the whole catchment? The E_p in Equation (9) indicates that the zero potential evapotranspiration were input into the model when the temperature below zero in winter. That is inconsistent with the E_p in Figure 3. The average temperatures in Jan/Feb/Nov/Dec are below zero (Figure 3), which implies zero E_p in winter for AWB model. Did you use the same mean annual E_p for the other two models?

It is debatable while interpreting the model results in table 1. The AWB model can detect the influence of land use on the streamflow through quantitative analysis, while the CEM focus on the effect of climate change in this study. I would use the term dQ_{land} and dQ_{other} (include climate) for results from AWB, dQ_{other} (include land use) and $dQ_{climate}$ for the results from CEM. The results of AWB imply that the land use change

C3637

accounts for 49% of decline of the water yield, while less than 51% can be attributed to climate in 2000's. It is clear that water consumption has been increased in the past decades; hence the climate variables may have less effect on the streamflow compared with that of land use. The coefficients used in the rainfall-runoff model were estimated with the rainfall and discharge data in reference period. The P and standard deviation in the rainfall-runoff model (Equation 16) represent the climate variation, while the coefficients in the model describe catchment properties including the land use status in the reference period. Since the coefficients remains the same during the simulation, the term in table1 for results from rainfall runoff model should be dQ_{other} (no land use) and $dQ_{climate}$. But the $dQ_{climate}$ could be overestimated with the variation of monthly rainfall in different periods. The contrary conclusion may be draw that the land use contributes more than that of climate on the decline of the streamflow according to the results of AWB and CEM model.

Technical Corrections:

Page 7786, line 19-23, the forestlands in some sub catchments decreased in 2000's from Figure 8.

Page 7787, line 12-13, there are more natural resources in such developing arid region that should be concerned. I suggest the authors focus on the scientific purpose, delete the "allocate limited resources".

Page 7788, line 2-4, should be passive tense.

Page 7788, line 8, should be "mean annual inflow".

Page 7788, line 10, better use "in 2000's" instead of "today".

Page 7789, line 2-4, such exclusive sentence is not encouraged, the "vegetation change" should be "land use change".

Page 7790, section 2.2, as the one of the three main variables used in the research, the estimation of E_p should be introduced, perhaps some of the contents in section 2.4.1

C3638

and 4.2 can be moved to here. The spatial interpolation for the areal P and E_p from the 37 rainfall gauges and the 7 meteorological stations should be detailed. How many meteorological stations were selected for data analysis? I can only see one within the catchment in Figure 1.

Page 7792, section 2.4, the flow regime could be altered by construction of hydraulic engineering for water supply and water diversion, at least the change of water supply or the water abstraction to the local society should be introduced.

Page 7794, line 18, "simulate" should be "simulated"

Page 7795, line 17, the abbreviation of PET should be explained when first appears in the manuscript.

Page 7795, line 20, needs citation.

Page 7795, line 24, where are the two water abstractions? Are they all at the main river?

Page 7797, line 19, should be Eq. (16)?

Page 7797, line 21, should be Eq. (17)?

Page 7798, line 14, the interpolation method should be clarified.

Page 7799, line 13, "estimated" should be "improved"

Page 7799, line 19-24, weird sentence.

Page 7800, line 13-16, weird sentence.

Page 7800, line 28, where is table 2?

Page 7801, line 2-6, weird sentence.

Page 7801, line 9-10, based on the analysis results, the impact of increasing forestlands from 71.9% in 1998 to 73.8% in 2008 accounts for 36% to 58% of decline in

C3639

water yield in table 1. Thus, the positive effects of land use were neglected in discussion section, which should be properly addressed.

Page 7802, line 6, the temperature data were not discussed in this paper. The "global warming" should be replaced by "climate change".

Page 7802, line 7, delete "resulting in"

Page 7802, line 9, the "global warming" should be replaced by "climate change".

Page 7802, line 11-15, how to consider the climate change in designing management strategies? The groundwater withdrawal had not been mentioned in manuscript, did you mean increase the groundwater abstraction instead of directly diverting the water from surface water for irrigation?

Figure 1, I can only see 3 meteorological stations in the map, can you add one map to indicate the location of 7 meteorological stations at the regional scale?

Figure 2, the E_p in Jan/Feb/Nov/Dec are larger than zero in the figure when the temperature in the below table are negative. If you insist on these values in winter, please address them as "estimated potential evapotranspiration" in caption.

Figure 3, the six categories were used in the text, why do you only use four?

Figure 9, the dashed line can't be seen, the "measured evapotranspiration" in caption should be deleted.

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