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Hydrology and Earth System Sciences
Discussions

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.

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Dear referee #1, Thanks a lot for your comments and proposals. According to Specific Comments, the replies were as followed.

Specific Comments Certainly, the local water consumption in the catchment is the main driving, now, 18 reservoirs were built in the catchment, whose total storing capacity is 0.214 billion m3 (Li and Li, 2008). It is been insert in line 11, page 7788. Average annual "direct abstraction" increased from 2.2 mm during 1956-1983 to 13.4 mm during 1984-2005, an increase of 11.2 mm (Ma et al., 2010). It has appeared in line 18-20,

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page 7798. For different sub catchments, break points of annual mean flows occurred in different year. The total decrease of inflow should be attributed to land use changes of several sub catchments. Similarly, not all rainfall gauges show no significant trend. However, the goal of this research is whole Miyun reservoir catchment, not every sub catchment and every rainfall gauge. Moreover, it is knotty to reveal change regulation of streamflow between sub catchments and whole Miyun reservoir catchment. Therefore, land use change and hydrometeorological trend were concerned in the whole Miyun reservoir catchment. Daily meteorological data were obtained from the China Administration of Meteorology. Just one meteorological station lies in the catchment. Another six stations lie around the catchment in line 10-11, page 7790. The situation of 7 meteorological stations was as followed. If required, this table may be added to the manuscript.

Table Meteorological stations in the study Station ID* Name Latitude Longitude Altitude(m) 53399 Zhangbei 41°09âĂšN 114°42âĂšE 1393.3 54308 Fengning 41°13âĂšN 116°38âĂšE 661.2 54311 Weichang 41°56âĂšN 117°45âĂšE 842.8 54401 Zhangjiakou 40°47âĂšN 114°53âĂšE 724.2 54405 Huailai 40°24âĂšN 115°30âĂšE 536.8 54423 Chengde 40°59âĂšN 117°57âĂšE 385.9 54511 Beijing 39°48âĂšN 116°28âĂšE 31.3 *Station ID is a unique code by China Meteorological administration.

The Kriging interpolation was employed to estimate the mean value of Ep and P for the whole catchment. In Jan./Feb./Nov./Dec, monthly temperature of every Meteorological station is mean value of daily temperature in this month. However, Ep is the value of accumulated daily value in this month using Hamon method. Though mean daily temperature is below zero, which means that temperature of some days below zero and some days above zero. Ep is above zero in these months. Moreover, Different altitudes of 7 meteorological stations also increased spatial heterogeneity of air temperature. In line 2-6, page 7792, land use was considered as residuals affecting streamflow in addition to climate variations. In AWB model, equal (6, 7) was employed to build the

HESSD

12, C4004–C4011, 2015

model. In this study, land use was acted as dQ (all except climate). Besides, land use change, Water consumption, water abstraction and other anthropogenic activities make hydrological impacts complicated. In order to simple the issue, land use change was assumed as dQother.

Technical Corrections: Page 7786, line 19-23, in here, the forestlands refer to forestland area of Miyun reservoir catchment, not that of some sub catchments. Page 7787, line 12-13, “allocate limited resources” has been deleted according to the opinion. Page 7788, line 2-4, 8,10, the sentence have been changed according to the opinion. Page 7789, line2-4, the sentence has been modified according to the comments. Page 7790. According to the opinions, Ep and spatial interpolation have been detailed as insert in Page 7790, line 12. 7 meteorological stations were selected for Ep analysis (table above). I may put the table into the manuscript if required. Page 7792, section 2.4, the parts about water supply and water diversion has been clarified in “insert part” of page 7788, line 11 and page 7798, line 17-20. Page 7794, line 18, “simulate” has been replaced by “simulated”. Page 7795, “PET” has been replaced by “Ep”. Page 7795, line 20, insert the citation (Xie et al., 2005) Page 7795, line 24. the parts about water supply and water diversion has been clarified in “insert part” of page 7788, line 11. In page 7798, line17-20, Water abstractions increased from 2.2 mm during 1956-1983 to 13.4 mm during 1984-2005. Page 7797 line 19 and line 21, according to the opinions, Eq. (14) and (15) have been replaced by Eq. (16) and (17). Page 7798 line 14, interpolation method has been clarified in “insert part” of section 2.2. Page 7799 line 13, “estimated” has been replaced by “improved”. Page 7799, line 19-24, the sentence has been modified. Page 7800, line 13-16, the sentence has been modified. Page 7800, line 28, “table 2” have been replaced by “table 1”. Page 7801, line 2-6, the sentence has been modified. Page 7801, line 9-10, Mechanism of land use change on streamflow is hard to clarify. Forestland, as one type of land use, is not behalf of land use change. This research regard land use change as a whole to discuss its hydrological effects. Page 7802, line 6 and line9, “global warming” has been replaced by “climate change”. Page 7802, line 7, “ resulting in” has been deleted. Page 7802,

HESSD

12, C4004–C4011, 2015

line 11-15, climate change in the future should be considered in designing watershed management strategies. For example, according to IPCC, the trends of precipitation and air temperature are required in designing water resource supply and allocation. “groundwater withdrawal” was replaced by "drinking water management". Figure 1, as the table above, latitude and longitude of 7 meteorological stations were described. Figure 2 (should be Figure 3), the reason lie in the paragraph under the table of this document. Figure 3 (should be Figure 4), four categories were used in the Figure. Reasons as followed. First, others including water area, residential area, and bare area, account for very small proportion of total area. Second, the manuscript focus on Ep. Others including water area, residential area, and bare area account for very small proportion of Total Ep. Figure 9, “the dashed line” have been replaced by “the thin line”. “the solid line” have been replaced by “the bold line”. “measured evapotranspiration” have been deleted.

References Li, Z., and Li, X.: Trend and causation analysis of runoff variation in the upper reach of Chaobaihe River Basin in northern China during 1961-2005, Journal of Beijing Forestry University, 30, 82-87, 2008.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/12/C4004/2015/hessd-12-C4004-2015-supplement.pdf

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 7785, 2015.

Table Meteorological stations in the study

Station ID*	Station name	Latitude	Longitude	Altitude(m)
53399	Zhangbei	41°09′N	114°42′E	1393.3
54308	Fengning	41°13′N	116°38′E	661.2
54311	Weichang	41°56′N	117°45′E	842.8
54401	Zhangjiakou	40°47′N	114°53′E	724.2
54405	Huailai	40°24′N	115°30′E	536.8
54423	Chengde	40°59′N	117°57′E	385.9
54511	Beijing	39°48′N	116°28′E	31.3

*Station ID is a unique code assigned to each station by China Meteorological Administration.

Fig. 1. Table Meteorological stations in the study

HESSD

12, C4004–C4011, 2015

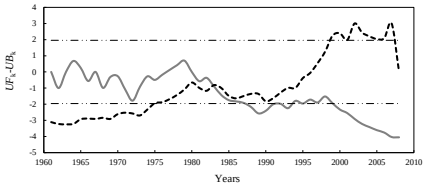


Figure 5. The Sequential Mann-Kendall test for annual streamflow in Miyun reservoir catchment with forward-trend UK_k (solid line), and backward-trend UB_k (dotted line). Dashed bold horizontal lines represent critical values at the 95% confidence.

Fig. 2. Figure 5.

HESSD

12, C4004–C4011, 2015

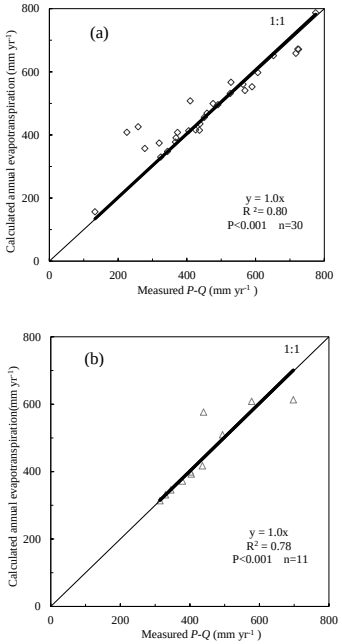
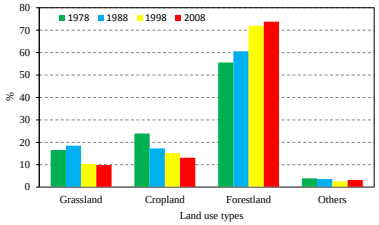


Figure 8. Scatter plots of calculated evapotranspiration using equation (7 & 8) against $E_a = P\text{-}Q$ during calibration phase (a) and validation period (b). The thin line is the 1:1 line and the bold line is the line of best-fit provided by the equation.

Fig. 3. Figure 8.



Land use types	1978	1988	1998	2008
grassland	16.54096	18.48505	10.37711	9.830949
cropland	23.94668	17.28869	15.16255	13.13394
forestland	55.61118	60.59168	71.93108	73.79064
others	3.90117	3.63459	2.529259	3.244473

Figure 9. Land use composition of Miyun reservoir catchment (14653 km^2) in 1978, 1988, 1998, and 2008.

Fig. 4. Figure 9.

HESSD
12, C4004–C4011, 2015