Response to Reviewer 2 by Qin et al.

Dear Reviewer,

First of all, we appreciate your interest in this study and your insightful suggestion to make our conclusions more convincing. Accordingly, we provide following response point to point.

(1) In this manuscript, the authors present an analysis of daily meteorological data for 6 weather stations in (the near surroundings of) the Qinhuai river basin in China. They derive evaporation data using the Penman-Monteith model and look for annual and seasonal trends. Subsequently, they analyze relations with various meteorological variables to identify their potential contributions to changes in evaporation values. One of the motivations for this study is that few such studies have been done for the humid region of southern China. This at the same time is an important limitation of the work: it's not clear what new insights are derived from analysis of data from only 6 weather stations within a limited geographical scope. In its present form and given the limited scope, I consider the manuscript unsuitable for publication in HESS.

Response:

The Qinhuai River Basin used for this case study has a subtropical climate typical of the lower Yangtze River Delta region (210,700 km^2) in China. Working at a watershed scale, we had the opportunity to look at all aspects of the hydrometeorological changes. We have further clarified this motivation using one watershed to derive information for a bigger region.

This study focuses on climatic control on ETo over QRB, and results can provide information for the similar areas in the Yangtze River Delta. Using data from the 6 weather stations that cover the entire study basin, we indeed found an interesting new trend in ETo. Based on the results of previous studies, we initially thought that ETo in QRB would increase in the past 50 years as a result of the increasing temperature. However, we eventually found that ETo in QRB showed a significant decreasing trend in 1961-1987, then significantly increased in 1988-2012. Decreasing solar radiation, wind speed, VPD and increased RH were the main reasons for the decreasing ETo in 1961-1987. Since 1988, atmospheric demand (increased VPD and decreased RH), instead of air temperature alone, is the major control on the increased ETo. Thus, we conclude that accurately predicting current and future ETo and hydrological change under a changing climate must consider changes in VPD (i.e., air humidity and temperature) in the study region. Water resource management in the study basin must consider the increasing trend of ETo to meet the associated increasing water demand for irrigation agriculture and domestic water uses.

(2) Dataset description: add information on instrumentation of the meteorological stations: what variables are measured, at what resolution, what sensors are used, what is the mean distance between stations, report data control procedures and data gaps

Response:

The daily data from six weather stations were provided by the China Meteorological Data Sharing Service System and Jiangsu Weather Bureau. All the observations of meteorological variables follow the standards edited by World Meteorological Organization (WMO). The measurement of temperature, relative humidity, surface wind speed and sunshine duration can be found in section 2, 4, 5 and 8 of the book "World Meteorological Organization Guide to Meteorological Instruments and Methods of Observation, 2006". According to section 20.4 in the book "The Criterion of Surface Meteorological Observation, 2004, China Meteorological Administration.", the mean daily climatic variables such as relative humidity, temperature, wind speed were computed by averaging the observations at 02 am, 08 am, 02 pm, 08 pm. For your kind suggestion, more detailed introduction to the instrumentation can be found in this book. I have displayed the linear distances between each station in Table 1 and add this table in Supplementary Material. Except for the data in Jiangning station which was available before 2007, the data in other five stations offered by China Meteorological Data Sharing Service System and Jiangsu Weather Bureau was almost complete (missing daily data < 1%). These data were processed and interpolated according to section 23 in this book "The Criterion of Surface Meteorological Observation, 2004, China Meteorological Administration".

Table 1 The linear distances between each station (km)

Stations	Liuhe	Pukou	Nanjing	Jiangning	Lishui	Jurong
Liuhe	-	42	35	44	81	56
Pukou	42	-	19	27	61	56
Nanjing	35	19	-	12	49	37
Jiangning	44	27	12	-	39	29
Lishui	81	61	49	39	-	32
Jurong	56	56	37	29	32	-

(3) Equation (1): equal sign seems to be missing

Response: Modified.

(4) On p12, l 199 it is stated that "spatially average wind speeds" were derived. Wind speeds are typically highly variable in space, so they cannot be simply interpolated across 10-20km distances. This needs more explanation or rather, stick to analysis of the individual data series per station.

Response:

Thank you for this valuable suggestion. I am sorry for the incorrect expression "spatially average wind speed". In this study, we evaluated the impacts of changes in climatic variables to ETo trends by using the station data, not the interpolated spatial data. We separately computed the recalculated ETo by using the detrended wind speed from each station. Due to space limitations, we evaluated the impacts of wind speed over QRB by comparing averaged recalculated ETo with detrended Wind speed and the original averaged ETo.

(5) Reporting both relative humidity and water vapor deficit seems superfluous, since 1 directly depends on the other –

Response:

Thank you for your suggestion. We would like to retain these two variables because they have different definitions and meanings to ecosystems and climate system. Relative humidity (%) represents the degree of moisture content of atmosphere and commonly used to analyze the impacts of air humidity to ETo trends. Vapor pressure deficit, determined as the difference between saturated vapor pressure and actual vapor pressure, is directly related to atmospheric demand for water (Novick et al, 2016). We have added the reasons for selecting these variables in the last paragraph in section 2.2.

(6) Conclusion: explain better what this study contributes to the general body of knowledge. Most of what is currently in the conclusions section are interpretations of the findings towards practical application. Consider moving this to the discussions section.

Response:

Based on the Reviewer's suggestion, we added new findings in section 5 line 410: (1) The environment is getting drier over the Qinhuai River Basin in the humid southern China. It is unknown how this change may affect crops that are used to grow in a humid climate. (2) Atmospheric demand, instead of air temperature alone, is a major control on ETo. Predicting hydrological change under a changing climate must consider both air humidity and air temperature. (3) This study has important implications for watershed management in these paddy field-dominated regions, and similar humid regions, where actual water loss is mainly controlled by atmospheric demand.

We have modified the conclusion as follows:

This long-term study (1961−2012) shows that ETo over Qinhuai River Basin has

changed significantly over the past 52 years: a decreasing trend during 1961−1987 and then an increasing trend during 1988−2012. Prior to 1987, decreased WS, R_s, VPD and increased relative humidity were responsible for the negative trends of ETo. The positive trends of ETo during 1988−2012 were mainly caused by effects of decreased relative humidity and increased VPD. The decreased absolute humidity and increased air temperature also contributed to the increased ETo to a lesser degree.

Generally speaking, our new findings in this study showed that the environment is getting drier over the Qinhuai River Basin in the humid southern China. It is unknown how this change may affect crops that are used to a humid climate Secondly, atmospheric demand, instead of air temperature alone, is a major control on ETo. Predicting hydrological change under a changing climate must consider both air humidity and air temperature. Our study also has important implications for watershed management in these paddy field-dominated regions, and similar humid regions, where actual water loss is mainly controlled by atmospheric demand.

Future water management must also consider the recent shifts of climatic control on the hydrological cycles. Because atmospheric demand (VPD) is a major control on potential water loss over the study region, predicting hydrological change under a changing climate must consider both air humidity and air temperature. Climate predictions from General Circulation Models (GCMs) must be assessed for their accuracy to simulate VPD in addition to air temperature and precipitation. In addition, potential ET algorithms that are often embedded in watershed hydrological models must include VPD as a major input variable to fully account for atmospheric water demand and actual ET.