Reply to Referee #1

We appreciate the constructive comments and suggestions from Referee #1. We have addressed all the comments in our revised manuscript. The point-by-point responses to the review comments are provided below.

P11295 All examples given in the introduction of studies that show an impact of wind speed on evaporation are based on pan-evaporation. But pan-evaporation is known to be a poor proxy to actual evaporation, especially in dry environments. A word of caution is needed here, and are there any studies on this topic using other reference than pan-evaporation?

Reply: Thanks for the suggestion. Although the impact on actual evaporation is more interesting, most existing studies only focus on the impacts of wind speed change on evaporative demand likely due to the lack of actual evaporation observations. McVicar et al. (2012) did a nice review work in this regard. They mostly reviewed papers using pan-evaporation or reference evapotranspiration as a proxy. Our paper focuses on actual evaporation. Because actual evaporation observation is still unfeasible or unreliable at large scale, we believe that the model investigation would contribute to our understanding. We have noted that evaporative demand is distinct from actual evaporation and have supplied recent publications using reference other than pan-evaporation.

P11296 L16 The model is calibrated against stream flow data at the major basins of China. Please describe in more detail what has been done. What exactly is adapted in the model to arrive at the observed stream flows?

Reply: Thanks for the comments. We have put considerable efforts to adapt the model for hydrological simulation in China. We have collected the streamflows from river gauges at the major basins of China and the model was calibrated and validated against the streamflows. At the gauges where streamflow was largely altered by water management, naturalized streamflow (i.e., streamflow records adjusted for water management effects) was used. The model setting up was fully documented in Zhang et al. (2013a, 2013b). We have provided a brief description with technical details and citations in the revised manuscript.

Zhang, X., Tang Q.: Development of a Long Term Hydrologically-Based Dataset of Land Surface Fluxes and States for China, AGU Fall Meeting, GC11A-0974, 2013a.

Zhang X., Tang Q., Pan M., Tang Y.: A Long-Term Land Surface Hydrologic Fluxes and States Dataset for China, J. Hydrometeor, 2013b. (Under review)

Table 1: The SHJ basin has a particularly large difference between E1 and E2, amounting to 2.6%. According to Figure 3 this basin has the same wind speed trend as basin NW which only show a difference between E1 and E2 of 1.1%. Can the authors explain this discrepancy? This may show that the same wind speed trend applied at different hydrological conditions gives a significant difference in evaporation response. The question then is can we understand this, is the model sufficiently accurate to represent the impact of the wind speed on the hydrological components correct in a quantitative way?

Reply: Thanks for the comments. Please note that the number in Figure 3 gives the relative

difference. The difference in absolute value at basin SHJ is close to those at basins HUAI and SE. It is expected that the influence of wind speed decline on actual evaporation is small in severely water-limited basins such as basin Northwest (NW). In severely water-limited area, actual evaporation is more closely related with water availability and changes in wind speed often have little direct impact on the local water balance (see also the discussion in McVicar et al. (2012)). McVicar et al. (2012) has shown that the response of evaporative demand is quite different under different climatic conditions and wind speed change exerts greater influence on energy-limited catchments than water-limited ones. Our model results generally agree with the findings in McVicar et al. (2012). Thus we think the model can capture the main regional features of the wind speed impact.

McVicar, T. R., Roderick, M. L., Donohue, R. J., and Van Niel, T. G.: Less bluster ahead? Ecohydrological implications of global trends of terrestrial near-surface wind speeds, Ecohydrology, 5, 381-388, 10.1002/eco.1298, 2012.

In the light of the previous remark it is important that all the relevant processes are incorporated well in the model. Describe the parameterization of evaporation in the hydrological model. Radiation is not in the observational data set (P11296, L7). Yet, it is a main driver for evaporation, how is radiation incorporated in the model?

Reply: Thanks for the comments. The Variable Infiltration Capacity (VIC) model has been used in many hydrological applications worldwide and in China. It represents a parameterization that has about the necessary degree of sophistication for the representation of the land surface hydrological processes. We have provided a brief description of the parameterization of evaporation in VIC with citation to the VIC primary references (Liang et al. 1994; Gao et al. 2010b; Tang et al. 2012). We agree that radiation is a main driver for evaporation. Radiation used in VIC model was derived from daily precipitation, mean temperature and temperature range with an empirical approach (Kimball et al., 1997; Thornton and Running 1999). The estimated radiations were compared with a China radiation product (Yang et al., 2010; Chen et al., 2011). The evaluation of the radiation estimates and other model performance was documented in Zhang et al. (2013). Because wind speed does not affect radiation estimation in VIC, radiation estimation may have little effect on assessing the impacts of wind speed decline.

Kimball, J. S., Running, S. W., and Nemani, R.: An improved method for estimating surface humidity from daily minimum temperature, Agric. For. Meteorol., 85, 87-98, 1997.

Thornton, P. E., and Running, S. W.: An improved algorithm for estimating incident daily solar radiation from measurements of temperature, humidity, and precipitation, Agric. For. Meteorol., 93, 211-228, 1999.

Chen, Y., Yang, K., He, J., Qin, J., Shi, J., Du, J., and He, Q.: Improving land surface temperature modeling for dry land of China, J Geophys Res: Atmos, 116, D20104, 10.1029/2011JD015921, 2011.

Liang, X., Lettenmaier, D. P., Wood, E. F., and Burges, S. J.: A simple hydrologically based model of land surface water and energy fluxes for general circulation models, J. Geophys. Res., 99, 14415-14428, 10.1029/94jd00483, 1994.

Gao, H., Tang, Q., Shi, X., Zhu, C., Bohn, T. J., Su, F., Sheffield, J., Pan, M., Lettenmaier, D. P., and Wood, E. F.: Water budget record from Variable Infiltration Capacity (VIC) model, available at: http://www.hydro.washington.edu/SurfaceWaterGroup/Publications/Water_Cycle_MEaSUREs_ATBD_VICmodel_submit.doc (last access: 28 August 2013),in: Algorithm Theoretical Basis Document for Terrestrial Water Cycle Data

Records, 2010

Tang, Q., Vivoni, E. R., Muñoz-Arriola, F., and Lettenmaier, D. P.: Predictability of Evapotranspiration Patterns Using Remotely Sensed Vegetation Dynamics during the North American Monsoon, J. Hydrometeor, 13, 103-121, 10.1175/jhm-d-11-032.1, 2012.

Yang, K., He, J., Tang, W., Qin, J., and Cheng, C. C. K.: On downward shortwave and longwave radiations over high altitude regions: Observation and modeling in the Tibetan Plateau, Agric. For. Meteorol., 150, 38-46, http://dx.doi.org/10.1016/j.agrformet.2009.08.004, 2010.

Zhang X., Tang Q., Pan M., Tang Y.: A Long-Term Land Surface Hydrologic Fluxes and States Dataset for China, J. Hydrometeor, 2003. (Under review)

Observed wind speed decrease is in general partly attributed to a change of exposure of the meteorological stations in developing urban areas. Such a trend will have no relation to a change in evaporation due to changing wind speed. Could the authors reflect on this?

Reply: Thanks for the comments. Previous studies have investigated the possible effects of urbanization on the observed wind speed change and generally concluded that urbanization has only minor influence (see Figure 2 in Xu et al. 2006 and Figure 8 in Jiang et al. 2010). We do not intend to attribute the wind speed decline in this manuscript. Rather we focus on the hydrological effects of wind speed decline.

Table 1: Although trends in individual components are often not significant, it could well be that trends in the difference between EXP1 and EXP2 are significant.

Reply: Thanks for the comments. The trends in individual components are often insignificant because of the large natural variability. The trend in the difference between EXP1 and EXP2 (Figure 3), i.e. the effect of wind speed change, could be significant because wind speed has decreased significantly (see also Figure 2).

Minor points:

P11294 L19 expect -> except

Reply: Thanks for the correction. It has been corrected.

P11296 L14 Maurer et al. (2006) is not in the reference list

Reply: Thanks for the correction. The reference should be Maurer et al. (2002) and it has been added in the revision.

P11296 L16 unclear word: naturalized

Reply: Naturalized streamflow is the streamflow records adjusted for water management effects. It has been widely used in hydrological study. We have clarified it in the revision.