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Analysis of reference evapotranspiration change in the Huaihe River Basin

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Evapotranspiration is one of the most important components of the hydrological cycle. The calculation of reference or potential evapotranspiration (ETref) is a key step to estimate the actual evapotranspiration by using the Penman, Budyko and Bouchet hypotheses. Therefore investigation of the spatial and temporal variations of ETref plays a vital role in hydrological studies.

In this study reference evapotranspiration is calculated using the Penman-Monteith method for 26 meteorological stations during 1960-2008 in the Huaihe River Basin in China. Its spatial distributions and temporal variations are analyzed. To determine the major driving forces of the changing patterns of ETref, sensitivity analyses are carried out for maximum and minimum temperatures, solar radiation, relative humidity and wind speed at 2 m height by employing a non-dimensional relative sensitivity coefficient, and the variations of the five climatic variables during 1960-2008 are also conducted. The contributions of climatic variables to reference evapotranspiration change is then estimated quantitatively. The results show that:

(1) In general, ETref is most sensitive to relative humidity, followed by maximum temperature, solar radiation and wind speed and it is not sensitive to minimum temperature. The sensitivity of ETref to the same climatic variables showed differences among regions. As an example, ETref is more sensitive to solar radiation in the northern part of the basin.

(2) For the whole basin wind speed, maximum and minimum temperatures have a significant increasing trend over the past 49 years, while solar radiation have a significant decreasing trend. The magnitude of the slope of the same climatic variables shows differences among regions. As an example, the magnitude of the negative slope of solar radiation in the northern part of the catchment is larger than in the southern part.

(3) The annual reference evapotranspiration in the northern part of the catchment is larger than in the southern part which is mainly due to the relative high solar radiation and low relative humidity in the northern part.

(3) There exists a decreasing trend in ETref in the basin, which is more significant in the northern part than the southern part of the basin. The main contributing climatic variables for the strong decreasing trend in ETref in the north part are solar radiation and wind speed which both have the same decreasing trend, while a combined effect of solar radiation, wind speed and relative humidity contributes to the slight decreasing trend in ETref in the southern part.