Dominant Characteristics of Surface Climate Change over NW China in 1960-2006

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Abstract

Global warming drives the hydrological cycle on the earth in a complex manner such that recent climate environment in much of NW China has experienced change, causing the increase in precipitation, run off, glacial melting and water level of lakes, as well as the decrease in the number of windy and sandy days and improvement of vegetation. In fact, the contributing factors to evaporation are many enough to make a detailed study for its modification. NW China is a climate change-sensitive zone and also an area of vulnerable ecology for which a comprehensive analysis is undertaken of responses of annual temperature, precipitation, and evaporation to the global warming as well as the possible factors related to evaporation change in order to deepen our understanding of the climate-change pattern and causes over the project region. The characteristics of surface climate change are explored using 1960-2006 datasets of annual temperature, precipitation, evaporation and surface winds taken from 131 stations distributed over northwest China. Results suggest that:

1) Pronounced warming occurs over NW China except small portions of southeastern Qinghai and Xinjiang, achieving the rates ranging over 0.2-0.90C/decade, higher than the national level (0.220C/10 yrs), in conformity with global warming. A sharp shift towards warming of annual mean temperature shift happened in 1994.

2) In association with global warming, bi-hemispheric midlatitude westerlies are being intensified from the 1960s (Qin et al., 2007), leading to rainfall increase (decrease) in parts at tropics (subtropics) and increase at high latitudes (Groisman et al., 1999; Zhai et al., 1999). The 1960-2003 rainfall exhibits a small increase over the project region at higher latitudes that falls into a westerly climate consisting of Xinjiang, western Nei Mongolia, the "panhandle" belt of Gansu and most of the Qinghai tableland while a weakly declining trend happens at lower latitudes in the monsoon climate covering southeastern Qinghai, the east of the Yellow River, Ningxia and Shaanxi, results in entire harmony with those of past studies.

3) Pan evaporation exhibits a greatly decreasing trend from 1974 over the region but the southeastern portion, especially from 1982, with sharp shift in 1976.

4) Analysis of surface wind speed yields that there is a greatly reducing trend from 1976 over the region except eastern Xinjiang and neighborhood of the Helan Mountains, particularly from 1986, with the sharp shift in 1990. The weakening of mean wind is directly related to the annual frequency of dustbowls (Zhou et al., 2002; Zhou et al., 2003), the diminution of potential wind energy resources and lessening of evaporation.

5) The main cause of the decreased evaporation may be the weakening of mean surface winds,

decrease of insolation, reduction of temperature daily range, increase in averaged relative humidity and low cloud value. There may be other factors responsible for the evaporation decrease, a problem that awaits further studies. This table can show the correlation coefficients between pan evaporation and its related factors over NW China.

related factor	sunshine (hrs)	relative humid.	daily temp. range	low cloud value
cor. coef.	0.76	-0.56	0.85	-0.48

NB:These factors are given their yearly mean values. Cor. coef. = correlation coefficient.

Keywords: NW China, climate change, Pan evaporation, surface wind