EGU24-7382, updated on 20 May 2024
https://doi.org/10.5194/egusphere-egu24-7382
EGU General Assembly 2024

A secular decline in daily maximum wind speed over the Tibetan Plateau from 1973-2020 and its possible causes

Yaoyao Ma[1,2,3], Gangfeng Zhang[1,2,3], Yiwen Wang[1,2,3], and Heng Ma[4]

[1]State Key Laboratory of Earth Surface Processes and Resource Ecology, Beijing Normal University, Beijing,China
[2]State Key Laboratory of Earth Surface Processes and Resource Ecology, Beijing Normal University□Beijing,China
[3]Engineering Center of Desertification and Blown-Sand Control of Ministry of Education, Faculty of Geographical Science, Beijing Normal University,Beijing,China
[4]National institute of natural hazards,Beijing, China

The observed decline and reversal in average near-surface wind speeds over recent decades have been widely reported and confirmed globally and regionally (especially in mid-latitude areas). The trends in extreme wind speeds do not completely synchronize with average wind speeds, and the variability of extreme wind speeds and their driving mechanisms are still unclear, especially for the high mountainous regions, such as the Tibetan Plateau. This study utilizes a homogenized dataset of daily maximum wind speeds from 1973 to 2020 in the Tibetan Plateau to investigate the variability of daily maximum wind speed and uncover the physical processes through which atmospheric circulation influences it. The results indicate that: (1) the daily maximum wind speed in the Tibetan Plateau has significantly decreased in most areas from 1973 to 2020, with the largest decreasing trends in magnitude observed in the spring(-0.57 m $s^{-1}dec^{-1}$,p<0.05), summer (-0.46 m $s^{-1}dec^{-1}$, p<0.05), winter (-0.41 m $s^{-1}dec^{-1}$,p<0.05), and autumn (-0.37 m $s^{-1}dec^{-1}$, p<0.05). The frequency of daily maximum wind speed exceeding 95% quantile shows a similar pattern. (2) Large-scale atmospheric circulation plays a key role in influencing the changes in daily maximum wind speed, with the westerly and monsoon patterns explaining 35%~57% of daily maximum wind speed variations. (3) The physical processes associated with atmospheric circulation changes such as geostrophic wind(0 to -0.4 m s^{-1} dec^{-1}), anticyclone activity(0 to -0.2 K dec^{-1}), vertical wind shear(0 to -0.1 m s^{-1} dec^{-1}), and Tibetan Plateau low vortex(-0.69 to 0.26 dec^{-1}) across the Tibetan Plateau region, partly explain the decreasing trends in magnitude and frequency of daily maximum wind speed. Our study provides some new insights for the management of sand and dust storms as well as the utilization of wind energy resources in the Tibetan Plateau.

Keywords: Tibetan Plateau, daily maximum wind speed, trend, atmospheric circulation, physical processes