Effects of non-photosynthetic vegetation cover on dust occurrence in the Gobi region

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In arid and semi-arid regions, aeolian dust has severe environmental and socioeconomic consequences due to its local and regional impacts on air pollution and the health of humans and livestock. Aeolian dust, resulting from wind erosion, is dependent on erosivity (i.e., wind) and erodibility (i.e., land surface conditions). As one of the most important erodibility factors, vegetation cover affects threshold friction velocity for dust occurrence. However, most previous studies focused on the effects of green vegetation on wind erosion, while more attention should be paid to non-photosynthetic vegetation. Recently, estimations of the non-photosynthetic vegetation cover using remote sensing data have been succeeded in parts of arid and semi-arid regions, such as Sahel and the Gobi Desert. Those estimations provide a way to evaluate the effects of dry vegetation on dust occurrence, which remain lots of uncertainties.
We investigated the frequency of spring dust occurrence (March and April) in the Gobi region from 2001 to 2021 using synoptic surface meteorological data. We used three definitions of threshold wind speeds: a constant value of 6.5 m s^{-1}; $u_{t5\%}$ that can be identified as threshold wind speeds at close to the most favorable land surface condition for dust occurrence; and $u_{t(STI)}$ that can be obtained from the non-photosynthetic vegetation cover estimated from MODIS STI (Soil Tillage Index). The performance of threat scores based on the three defined threshold wind speeds were compared to discuss the effect of non-photosynthetic vegetation cover on dust occurrence in March and April.
We found that the major dust sources over the last two decades were the Gobi Desert in the southern Mongolia and the grasslands in the eastern Mongolia. Generally, the frequency of dust occurrence was greater in April than that in March. In April, values of the threat scores derived from $u_{t(STI)}$ increased over the whole study region, especially for the grasslands in Inner Mongolia. This suggests changes in non-photosynthetic cover greatly contributes to the inter-annual variations in dust occurrence. However, the increased threat scores were found at limited numbers of synoptic observatories in March. This suggests non-photosynthetic vegetation cover is not the only key factor to determine variations in dust occurrence in March. Other erodibility factors such as soil temperature and moisture should be taken into consideration, which are subjects in need of further study.

Keywords: dust occurrence, threshold wind speed, non-photosynthetic vegetation, MODIS STI

