

Effects of freeze-thaw and land-surface processes on dust occurrence in the Mongolian desert steppe

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Dust storms not only cause serious environmental problems, but also influence social and economic activities. They depend on the relationships between erosivity (wind speed) and erodibility (e.g., soil moisture, freeze-thaw cycle, and vegetation). However, in the Mongolian desert steppe (MDS), these relationships have not fully been investigated, particularly the effect of freeze-thaw cycles on dust events. Here, we investigated the impacts of freeze-thaw and land surface processes on dust occurrence at Tsogt-Ovoo in the MDS during 2012–2017. This study uses the saltation number and dust concentration measurements, and modelled land-surface variables by an ecosystem (DAYCENT) model, which was validated with field measurements. Results showed that interannual variations in wind speed and dust concentration were not significantly different within springs (April–June) of 2012–2017. However, large interannual variability of saltation events observed at the same time. Saltation events were high in springs of 2012 and 2015 because small threshold wind speed that was related to dry soil and less vegetation, which were, in turn, the result of less precipitation in the preceding summer. Additionally, saltation events tended to occur after near-surface soil temperature rose above the freezing point. This freeze-thaw process likely plays an important role in increasing the susceptibility of soil to erosion.

Keywords: Mongolian desert steppe, freeze-thaw cycles, land-surface processes, dust occurrence, DAYCENT model