Monitoring dry-season vegetation mass at a dust hotspot (Tsogt-Ovoo) in the northern Gobi Desert

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Accurate prediction of dust emission is of significance to prevent its eco-environmental and social-economic damaging effects on not only source regions but also down-wind regions. However, due to insufficient observation data of erodibility factors (especially at source regions) and a lack of understanding of how and to what extent they affect dust emission, the model simulation of dust is not behaving well. As one of the important erodibility components, effects of vegetation on dust emission have been widely investigated. Most previous studies analyzed green vegetation during growing season, while the period for green vegetation is short in the Gobi Desert. Early studies pointed out green vegetation in summer remained as dead leaves till next spring, and suppresses dust emission. However, few studies have dealt with monitoring of dry-season vegetation mass in the northern Gobi Desert. The present study aims to estimate dry-season vegetation mass by using remote sensing data (e.g., MODIS) at Tsogt-Ovoo (TsO), Mongolia.

Soil Tillage Index (STI), which is the ratio of band 6 (1.6 μm) and band 7 (2.1 μm) derived from MODIS Nadir BRDF-Adjusted Reflectance products, is a potential index to estimate dry-season vegetation mass. STI in September 2019 around TsO was tested against field measurement of aboveground biomass (AGB). We found a significant correlation between STI and AGB (R^2=0.49, $p<0.05$). In addition, STI in April was compared with an estimated shear stress (U_s*) scaled by the freestream wind speed (U_h) during the period of 2001-2018. The estimated U_s^*/U_h reflects the aerodynamic roughness and shelter based on albedo. We also found a highly negative relationship between STI and U_s^*/U_h (R^2=0.59, $p<0.01$). Abundant dead leaves result in high values of STI, as well as increase roughness and decrease wind momentum at the soil surface, thus resulting low values of U_s^*/U_h.

The results imply that STI can be applied to monitor dry-season vegetation mass in the Gobi Desert and potentially in large-scale dust simulation models.

Keywords: Soil Tillage Index (STI), MODIS, BRDF, albedo

