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Wind-induced dust-PM emission coefficient for dirt and unpaved roads

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Dust emission from soil surface to the atmosphere is a common phenomenon in intensive land uses such as agriculture, mining, quarries, and unpaved roads. In the Environment Impact Assessment (EIA) of mine planning, Emission coefficients published in the AP-42 document of the United States Environmental Protection Agency (EPA) are in use for to predict emissions of particular matter (PM) from different sources. The AP-42 document includes an equation for PM emission from unpaved road in relation to transport of vehicles on the road. However, roads are subjected also to wind-induced dust emission. This study examines both processes in controlled generic soil. The soil was 'manufactured' by modification of two main variables in the AP-42 equation; clay-silt contents (<63 micrometer) (2%, 10%, 25%, 40%, 55%, 70%, 85%) and water content (5%, 10%, 20%), which has resulted in different soil compositions. Experiments of wind-induced dust emission were performed in a boundary layer wind tunnel. The dust-PM emission from the different soil compositions was tested at various wind velocities ranging from 4 to 9.5 m/s. The measured atmospheric PM10 concentration during the experiments allows calculating the dust emission flux (μg m-2 s) from each soil composition. The results show that PM10 fluxes is strongly depends on the clay-silt content and wind velocity. The fluxes obtained by the wind-induced emission under moderate wind of 7 m/s (25.2 km/h) were significantly lower than the calculated coefficients by the AP-42. However, strong correlation was found between the dust fluxes (wind and vehicles) for all soil compositions. This may enable to suggest emission coefficients of materials not mentioned in the AP-42 document, such as clay soil or phosphate rock, and validate it by simple wind tunnel experiments. The results of this study have implications for air pollution studies, in which empirical emission coefficients can be assimilated in numerical models of atmospheric dust dispersion.