Quantifying threshold friction velocities for PM10 emission over an altitude gradient: a field study employing the PI-SWERL

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Aeolian processes can be held responsible for shaping a large variety of landscapes around the globe, from low lying sea shores to desert areas at high altitudes. It can be assumed that threshold friction velocities, at which wind erosion occurs, change with increasing altitude due to a decrease in air density. However, this altitude effect on wind erosion is not yet well understood and is, therefore, not incorporated in physically based wind erosion modeling. To enlarge our understanding on this matter, we employed the Portable In-Situ Wind Erosion Lab (PI-SWERL) at four different locations with increasing altitude in Switzerland to measure the effect of decreasing air density on the threshold friction velocity and PM10 emissions. This new device was used because of its logistic advantages, i. e. small size and weight, over traditional portable wind tunnels. The results of a previously accomplished cross-comparison between the PI-SWERL and the Portable Wind and Rainfall Simulator (PWRS) of the University of Basel indicated that the different instruments are comparable. In the current research, a significant positive linear relationship between the threshold friction velocity for PM10 emission and air density was found . Furthermore, the vertical PM10 emission flux decreased with decreasing air density. These findings show on the one hand that the PI-SWERL is able to capture the relationship between air density and dust emission accurately. On the other hand, they also show that the effect of altitude on wind erosion needs to be taken into account when investigating wind erosion in different altitudes.

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