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Wind erosion in the alpine zone – a case study at Latschuelfurgga (Davos, Switzerland)

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Protection against wind erosive processes ranks among the most important challenges in natural hazard mitigation, worldwide. Today, it is generally accepted that the (re-)establishment of a protective vegetation cover is the most promising and efficient measure in restoring degraded land in the long term. Sustainable protection against wind erosion requires adequate information about suitable plant species regarding ecological aspects as well as with respect to their proper contribution to wind erosion control. The latter, however, is widely lacking. Within a broader conceptual framework, wind tunnel studies have been performed using naturally grown vegetation covers. The use of live plants aimed at simulating the behaviour of natural canopies as accurately as possible compared to previous studies using artificial objects. The goals of the presented field study are to record reliable data on windblown erosion rates under natural alpine conditions on the one hand and, on the other hand, to interrelate the findings with the results of the wind tunnel experiments with live plants.

The wind erosion test field was established at 2409 m a.s.l. on a small saddle like pass in an alpine meadow and includes two east-west orientated test tracks of the dimension 2x10 m^2. One track is left as is, representing the naturally alpine vegetated soil (15-20% plant cover). The other track is equipped with a plastic covering sheet, mimicking desertified soil (0% plant cover) and serving as control plot as well as providing a direct link to the wind tunnel experiments. Blue and red quartz sand (grain size: 0.2-0.6 mm) was spread on the vegetated and sheet-covered track, respectively, to visualise and measure the effect of vegetation on wind erosion control. During summer and fall 2010 field experiments were performed of which experiment no. 4 is presented here as a case study as well as compared with and discussed in relation to a wind tunnel run with medium-density configuration (16% plant cover).

The measuring equipment consists of three climate stations recording wind direction and wind speed at 50, 100, and 200 cm, air temperature and humidity, incoming and reflected short- and long wave radiation, as well as precipitation. Leeward of the two test tracks, panels and ground-plates were installed equipped with sticky foils to trap and quantify vertical and horizontal particle transport.

Compared to the desertified soil (0% plant cover) it was found that only small amounts of sand from the vegetated plot (15-20% plant cover) were transported, even during heavy wind events. Overall the ratio varied from 1:50 to 1:175 depending on the position of the panels and ground plates. Qualitatively similar findings, however quantitatively less pronounced, resulted from the wind tunnel experiments (ratio = 1:15). The difference between the field study and the wind tunnel results is quite remarkable and implies that the sheltering effect of vegetation under natural conditions is 3 to 12 times higher than found for the medium-density experiment in the wind tunnel (16% plant cover).

However, this conclusion needs careful reflection. After all, the two studies differ in several aspects of their set-up. Correspondingly, the data are speculatively discussed, particularly with respect to meteorological parameters (wind speed, turbulence intensity, humidity, temperature), ecological aspects, and hydrological processes.