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Aeolian mass flux profiles above different sands surfaces versus sand surface with pebble coverages of different density

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The vertical distribution of aeolian mass flux has been studied mainly on sand surfaces and much less often on gravel surfaces, particularly under natural conditions. We present data of measurements made in three beach settings differed in petrographic composition of the beach sand (quartz, bioclastic, and bioclastic-basaltic sand) and density of pebble coverage (5-70%). We aimed to show the differences in mass flux profiles induced by surface properties resulting from sediment composition. All measurements were made on a dry sand bed under conditions of maximum sand transport rate, i.e. during alongshore wind when the fetch distance was not limited. Sand transport rate was measured by means of passive sand trap, 0.5 m in high and divided into 40 chambers. The obtained dataset contains results of 241 measurements of mass flux made on bare sand surfaces and 127 on sand surfaces covered with discoidal pebbles (with short axis of less than 1 cm). The results showed that (i) regardless of the surface type, all vertical mass flux profiles were well fitted by an exponential decay function, but the regression coefficients differed greatly between those for sand surfaces and surfaces with pebble covers of different densities, (ii) changes in these coefficients with wind speed were much more pronounced in the case of sand surfaces than on surfaces with pebbles, (iii) the exponential model underpredicted mass flux in the near-bed region in the case of sandy surfaces, whereas in the case of pebble surfaces, the departures from the model were insignificant, and (iv) a pebble cover with a low density between 5% and 10% strongly affected the concentration of sand in the vertical profile. All mass flux profiles showed that as wind speed increased, the proportion of sand transported in the near-bed region decreased and the proportion of sand transported at higher elevations increased. For each surface type, the height at which the constant proportion of sand was transported may be defined irrespective of wind speed. This height was equal to 3-4 cm in the case of sand surfaces and changed from 6 cm to 11 cm as the density of pebble coverage increased from 5-10% to 50-70%. We also showed that the average roughness length parameter Z_0 was very similar for sandy surfaces irrespective of sand composition (0.0010-0.0011 m) and only two times greater (0.0022-0.0024 m) on sand surfaces covered with pebbles. We observed neither a decrease in this parameter with increasing wind speed nor relationship between Z_0 and pebble coverage density. Contrary to many measurements made on the desert surfaces covered with 3D gravels we did not record mass flux distributions with a peak at a height of few centimetres above the surface that could be described by a Gaussian peak function. We think that the discoidal and more streamlined shape of pebbles (acting more as 2D roughness elements), and their relatively well sorting are responsible for that fact.

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