Experimental investigation on turbulence burst over different roughness in the wind tunnel

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Particle liftoff and the initiation of saltation is a process controlling wind erosion that is imperfectly understood. Burst start-up theory is important for sand particles' liftoff. Current theoretical and experimental studies of turbulence burst mostly consider flat sand surface or smooth flat bed. However, sand dunes and sand ripples are basic forms of desert landscape, and the slope gradient has great influence on the frequency of burst. In this paper flow velocity on 4 different sand surfaces, including smooth flat bed, flat sand bed, sand ripples and slope bed, is measured using one-dimensional hot wire detector. Based on Mu-level method, the results indicate that the velocity on flow direction over flat and sand ripples surface can be expressed as logarithmic function, which viscous sub-layer, transition layer, logarithmic layer and drafting layer are clearly told. On the slope sand surface, the velocity in flow direction are steadily increasing in the height of 0.5~16 cm, increasing dramatically in the height of 17cm and trending to invariant. On the flat sand surface, the distribution of turbulence intensity and Reynolds normal stress are gradually decreasing along the height of boundary layer. The turbulence intensity over slope sand surface is staying invariant in the height of 0.5~10cm, and decreasing dramatically in the height of 10cm. The burst frequency occurring on different roughness is mainly near the wall, and gradually decreasing with the increase of height. Compared to other surfaces, the burst frequency is 30%~50% higher on the sand ripples surface, which maybe indicates that different surfaces have an influence on the turbulence burst. The burst frequency over smooth flat bed is the lowest among 4 different roughness. This work is helpful in understanding the turbulence burst over different surfaces, and also provides a reference for the study of how the sand particle eject in the first place.