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Conditions for the emergence and growth of aeolian sand structures

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One of the important characteristics of the wind process of dust removal is a critical or threshold wind velocity [1]. Saltating flow grows with increasing of the effective roughness [2] that affecting shear stress and friction velocity [3]. The drag coefficient increases depending on the density of the coating by particles of the surface [4]. The location of particles in the aeolian structure, their size and relative position determine their resistance to wind influence. Aeolian structures change the structure of flows and the balance of mass transfer of particles deposited and rising from the surface [5]. The surface microstructures and ripples significantly affect of sand removal.
The flow of particles with a size of 100 μm on the surface has been considered using the OPEN FOAM with LES model. The calculation area has sizes of 5x5x2 mm. For the velocity at the upper boundary, 2.8 m/s select in accordance with the experimental data [6]. It should be noted that with a relative increase in the distance between pairs of particles and a change in the level of the upper surface, the pressure difference between the base and top of the particle increases by 10-30 percents. Depending on the distance between the particles, the buoyant force acting from the side of the air flow, the critical velocity, and the departure velocity of the particle also change. When the distances between the surfaces of the particles are close to its size, the buoyant force is greater than the adhesion and gravity forces. As a result, areas with different probability for the sand removal by wind, due to which, in particular, the occurrence of aeolian ripples occurs.
The average critical velocity increases when moving up the windward slope of the dune [7, 8]. This phenomenon is possibly associated with the influence of ripples on the air flow. The flow around of the micro-ripples with a height of 0.1-1 mm was considered for air flow velocity of 2-4 m/s at a height of 1-2 cm. The addition of supplementary elements of heterogeneity at the apex near the rough surface of the streamlined aeolian structure leads to a displacement of the separation point of the ascending flows. Also we have a change in the length of the recirculation zone and the time intervals of the strengthening of the wind at the apex, which was observed in [6].
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