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How common are aeolian processes on planetary bodies with very thin atmospheres?

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Observations from the Voyager 2, New Horizons, and Rosetta missions indicate that aeolian surface features, such as ripples and dunes, do not only occur on the surfaces of Earth, Mars, and Titan, but seemingly also on the surfaces of planetary bodies with extremely thin atmospheres, such as Triton, Pluto, and the comet 67P/Churyumov-Gerasimenko. This is highly intriguing since the saltation-threshold wind shear velocities predicted for these bodies from standard saltation-threshold models are so large that wind erosion actually should not occur. Here, guided by coupled DEM/RANS numerical simulations of sediment transport in Newtonian fluid using the numerical model by Duran et al. (POF 24, 103306, 2012), we propose an analytical model based entirely on physical princinples that predicts the minimal fluid speeds required to sustain sediment transport in Newtonian fluid. The analytical model is consistent with measurements of the transport threshold in water and Earth's air and with a recent observational estimate of the threshold on Mars. When applied to Triton and Pluto, it predicts threshold wind shear velocities (u_t) of about 1-3m/s, which is comparable to wind shear occurring during storms on Earth and Mars, for particles with diameters (d) within the range $d \in [200, 3000]\mu$m. The minimal values ($\approx$ 1m/s) are thereby predicted for surprisingly large particles with $d \approx 2000\mu$m. When applied to 67P/Churyumov-Gerasimenko, the analytical model predicts threshold wind shear velocities that are fairly extreme (e.g., $u_t = 45$m/s for $d = 1$cm), but nonetheless consistent with wind shear velocities estimated to occur on this comet. From our results, we conclude that surface-shaping wind erosion and thus the occurrence of aeolian surface features might be much more common on low-air-density planetary bodies than previously thought.