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Wind tunnel measurements of the dynamic saltation threshold

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Saltation transport is an important driver of planetary surface evolution and dust aerosol emission. It is therefore essential to understand the minimal value u_t of the wind friction velocity u_* above which saltation can be sustained. Many decades ago, Bagnold and Chepil measured u_t by visual means for various sand beds, for which, however, they did not report the particle size distribution. More recently, values of u_t are only reported very rarely and usually obtained indirectly from extrapolating paired measurements of u_* and the transport rate Q to vanishing Q. In my presentation, I will demonstrate for two well-established laboratory data sets that this method is unreliable because it is very sensitive to the fitting method (e.g., least-squares versus weighted least-squares) and the transport law used for the extrapolation. Furthermore, I will report on measurements of u_t that we carried out in a wind tunnel for four well-sorted and two poorly sorted sands using a visual method and a recent indirect method that exploits a regime shift in the behavior of the surface roughness when crossing u_t. We find that both methods yield similar thresholds and that well-sorted sands (but not poorly sorted sands) exhibit significantly smaller thresholds than what has been reported before. For example, for the typical size $d_{50} \simeq 250$ μm, we measure the surprisingly low value $u_t = 0.13 \pm 0.01$ m/s. When nondimensionalizing u_t using the 90^{th} percentile particle diameter d_{90}, well-sorted, poorly sorted, and recent field measurements of u_t are consistent with each other, which may partially resolve recently noted discrepancies between theoretical predictions and field measurements.