**NUMERICAL MODELING OF TITAN AEOLIAN SEDIMENT TRANSPORT: PRELIMINARY THRESHOLD WIND SPEED AND TRAJECTORY RESULTS.** D.M. Burr[1,2], J.F. Aliaga-Caro[3], B.R. White[3], J.R. Marshall[2], R. Greeley[4], and N.T. Bridges[5], [1]Earth and Planetary Sciences Department and Planetary Geosciences Institute, University of Tennessee, Knoxville TN 37996-1410 (dburr1@utk.edu) [2]Carl Sagan Center, SETI Institute, [3]University of California, Davis, [4]Arizona State University, [5]Jet Propulsion Laboratory

**Introduction:** Extensive aeolian dunes covering ~20% of Titan's surface [1,2] present a scientific opportunity to learn more about the current and past wind regime, aeolian sediment transport rate, and contribution of aeolian processes to resurfacing on Titan. In addition, laboratory work into the wind and sediment conditions inferred by the dunes provide an opportunity in comparative planetology to investigate aeolian sediment transport processes under a dense atmosphere and low gravity, for which little data are available [3].

For these reasons, we are refurbishing the Venus Wind Tunnel at the NASA Ames Planetary Laboratory for Titan analog experiments. The first planned experiments will provide data for numerical modeling of the threshold friction velocity on Titan. Knowledge of the threshold friction speed in turn will enable estimates of the wind speed required to have formed the dunes.

Presentation of the refurbishment effort was described previously [4]. Completion of the refurbishment and wind tunnel operation is expected before the summer of 2009. (The PAL is an 'National Facility Instrument' available to the planetary science community.) Here we present initial numerical calculations of threshold friction wind speed and saltation parameters, to be updated using experimental wind tunnel data as input.

**Model parameters:**

*Particle density.* On Earth, aeolian dune sediments are comprised of crustal (i.e., silicate) material. Titan dunes show a spectroscopy signature of organics, the lack of which in the interdune areas indicates that the organics are associated with dune sediments and not with atmospheric deposition [5]. It is possible either that the sediments are entirely organic (with a density range of 0.4 – 1.5 g/cm$^3$ [see discusion in 6]) or that they are composed of an organic coatings on water ice grains. For our initial modeling, we assumed a median value for sediment density of 1 g/cm$^3$.

*Environmental conditions.* The surface environmental conditions were derived from the Huygens Atmospheric Structure Instrument (HASI) surface data [7], namely, pressure of 146.645 kPa, temperature of 93.5 $^0$K, and atmospheric density of 5.34 kg/m$^3$.

**Model results:**

*Threshold wind speeds.* Threshold wind speeds were calculated for different particle diameters. Calculations show a minimum threshold friction wind speed of 0.035 m/s for a particle diameter of 236 microns. For comparison, previous modeling results gave a similar threshold friction speed but a smaller minimum particle diameter of 180 microns [3, Fig. 3.17]. The particle density used in this previous modeling was 1.9 g/cm$^3$ (the average density of the satellite), and we attribute the difference in minimum particle diameter to this difference in input parameters. For diameters ranging from 100 to 1000 microns, threshold speeds range from ~0.035 m/s to ~0.06 m/s. These correspond to threshold free stream wind velocities of ~1 to ~1.5 m/s respectively.

*Saltation path length.* Calculations of saltation path length, along with particle flux, can be used to model aeolian features. Our preliminary calculations show a significant dependence of sediment path length on particle size. At the threshold free stream wind speed for each particle size, the sediment path length attained decreases dramatically from ~22 cm to 12 cm for particle diameters of 100 to ~400 microns respectively (Fig. 1). Above ~400 microns to 1000 microns, the sediment path length retains a near-constant value fluctuating between ~12 and ~13 cm.

*Wavelength of Titan dunes.* The wavelength of aeolian features can be determined from sediment path length and by the flux of material available. Each path length is associated with two different particle diameters. This duality results from the fact that threshold frition wind speeds increase both at large and small particle sizes due to increased weight and interparticle effects, respectively [8]. Thus, for a constant free stream velocity of 1.5 m/s, particle path lengths rise to a maximum value, which in this modeling equals ~34 cm, and then decrease to ~12 cm with increasing particle diameter. Particles of diameters of 100 microns and ~600 microns each reached the same maximum path length (Fig. 2).

**Future work:** These calculations of saltation path length and height allow us to develop grain trajectory models, and thus investigate other questions pertaining to Titan dunes: 1) should we expect production of microdunes, such as developed in Venus analog experiments [cf. 9]? if so, how would these effect the dune appearance in Radar images? 2) should Titan experience the same kinds of ballistically-drive aeolian processes as Venus, e.g., choking [10], reptation, creep? 3) what is the total flux expected for a given wind distribution on Titan and how much might this contribute to resurfacing? 4) is the constant of proportionality for the expression of mass transport rate of aeolian sediment [11] the same on Titan as on Mars and Earth? if not, what is it?

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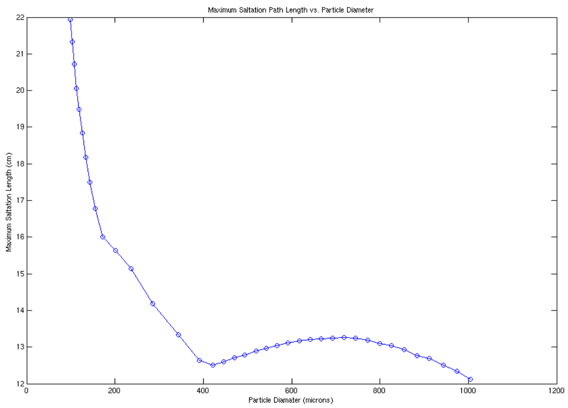


Fig.1: Maximum saltation path length (centimeters) vs. particle diameter ( microns).

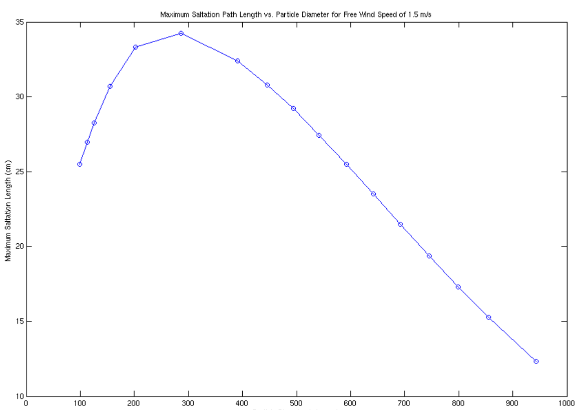


Fig 2: Maximum saltation length (centimeters) vs. particle diameter (microns)