THE TITAN WIND TUNNEL: A NEW RESOURCE IN THE PLANETARY AEOLIAN LABORATORY.
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Introduction: Although pre-Cassini calculations predicted little sediment transport by wind on Titan [1,2], the Cassini-Huygens mission discovered extensive aeolian dunes covering ~20% of Titan's surface [3,4]. Because the dunes can provide information on multiple Titan processes (including atmosphere-surface interaction, sediment transport rates, and resurfacing mechanisms), they present a tremendous scientific opportunity. In order to exploit this opportunity, the Venus Wind Tunnel (VWT) at NASA's the Planetary Aeolian Laboratory (PAL) is being refurbished through the Planetary Geology and Geophysics (PGG) program to enable analog Titan work. This abstract describes this refurbishment process and publicizes this new experimental opportunity for the planetary aeolian community. The PAL is an 'Regional Facility Instrument.' Thus, the refurbished wind tunnel would be available to all investigators supported through the PGG program.

Facility and wind tunnel background: First developed in the 1970s, the PAL currently houses both a Mars Wind Tunnel (MARSWIT) [5] and a Venus Wind Tunnel (VWT) [6]. The VWT was used during the 1980s to determine the conditions necessary for the formation of dunes on Venus, which were suggested by wind speed and other measurements from the Venera and Pioneer-Venus spacecraft [6]. The tunnel is a closed-circuit, atmospheric boundary-layer tunnel measuring 6 x 3.2 m (Figure 1). The two-phase (gas-sediment) flow is generated by a fan in the tunnel and passes through a settling chamber before entering the test section. The test section of the tunnel is 20 cm in diameter and 122 cm long. It is mounted on a wheeled-track assembly and connected with quick-couple clamps for easy access between experiments. Four glass ports, each 7 cm in diameter, enable observation and imaging of particle motion during experiments. A diffuser downstream of the test section houses a replaceable screen to trap particles before they encounter the fan. The diffuser section also provides 20 connectors for various instruments used in the tunnel.

Titan analog operating conditions: Titan's atmosphere is ~95% N_2, and surface conditions are ~94K and 1.44 bars of pressure [7]. This produces a density of 5 kg/m^3 and a kinematic viscosity (m^2/s) of approximately 1.2x10^{-6}. At Earth's much higher ambient temperature, terrestrial air requires a pressure of 12 bar or 175 psi to achieve the same kinematic viscosity. Thus, the wind tunnel is being refurbished to achieve this pressure.

Refurbishment: Numerous items are being addressed during the on-going reburishment to permit operations with air as a working fluid at a pressure of 12 bars. These include: 1) removing previous supply pipes and reconfiguring the air supply connection; 2) rebuilding the wind tunnel, including replacing the blower drive motor and controller, replacing the optical windows, and assessing for leaks; 3) replacing the current pressure gages and anemometers; and 4) testing and documenting the refurbished facility, including an operational readiness review and an integrated systems test.

Results: The result of this work will be a facility available to the community for operation at Titan analog pressures. The first use of the tunnel will be experiments to provide input into numerical modeling in order to constrain the threshold friction wind speeds for aeolian particles on Titan. Those experiments and modeling work by this team will contribute to determining the minimum wind speeds implied by the observed aeolian dunes [3,4].

Venus analog conditions required a pressure of 30 bars [6], almost 3 times greater than required for Titan analog work. This on-going refurbishment will not provide the capability for achieving that pressure due to the rating of the gas supply lines into the tunnel. However, this deficiency could be amended in future updates to the facility, e.g., for experimental work analyzing Venus Express data.

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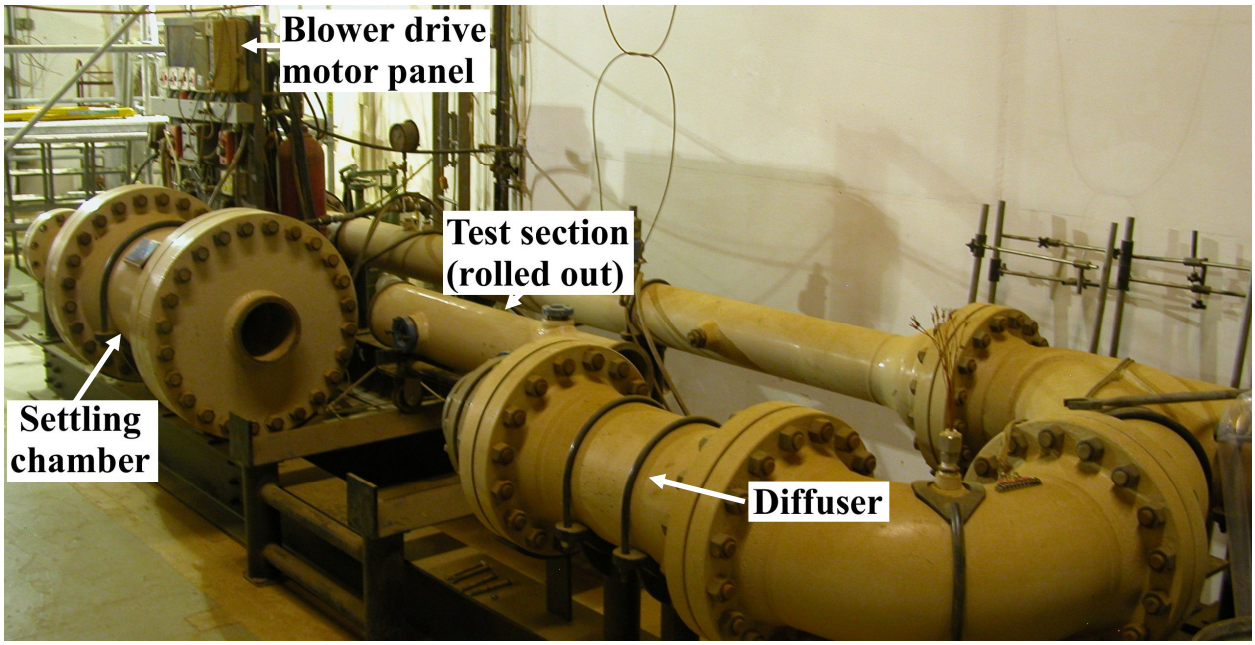

Figure 1: Photograph of the Venus Wind Tunnel (VWT) at the NASA Ames Research Center Planetary Aeolian Laboratory (PAL). The fan is just off the image to the middle right. The gas supply lines are behind and to the right of the drive motor panel.