OBTAINING RELEVANT ATMOSPHERIC CONTEXTS FOR DUNE STUDIES. T. I. Michaels[1], [1]Southwest Research Institute, 1050 Walnut St Suite 300, Boulder, CO 80302, tmichael@boulder.swri.edu.

Introduction: Dunes are known to exist on every solar system body that possesses a robust surface and a thicker atmosphere (surface pressure > 100 Pa; Venus, Earth, Mars, and Titan). From an idealized (simplified) perspective, dunes and related depositional aeolian features are a natural consequence of the interactions between atmospheric fluid dynamics and the physics of granular materials, given a simple driving wind and dry homogeneous particles. Wind-driven particle saltation is the primary mechanism by which such idealized dunes change over time. Substantial progress in the understanding of the evolution of idealized dunes and dune fields has been made in recent years through computer modeling efforts (e.g., [1] and [2]).

However, many (perhaps even most) real dunes experience significant departures from idealized conditions. Such non-idealistic conditions include, but are by no means limited to, precipitation (rain, snow, dust, etcetera), biology (on Earth), atmospheric stability, phase changes of volatile components, and the intricacies of realistic time-dependent wind fields (see [3]). Real dunes are the expression of a complex integration of all relevant environmental factors in time and space. Thus these additional real-world processes can substantially alter the dune morphologies and time evolution that would otherwise exist, and potentially even produce dunes that can be easily misinterpreted when using only the idealized dune framework as a guide.

It is of course currently impractical to include all such variables in dune simulations or theory. However, this does not mean that such conditions should be neglected by those trying to interpret what the dunes record about their formative environment. This document will reflect on what can perhaps be done to mitigate one of these factors, the relatively common neglect of the local atmospheric context.

Dunes' Atmospheric Context: The most primitive form of atmospheric measurements that are in some way relevant to dunes are observations that have a resolution much coarser than the dunes being studied. An example would be global-scale imagery of a dust storm (indicative of some wind event) near the dunes. It is best to think of such observations only as potential proxies for the general type of condition that might be affecting the dunes near the time of the observation. This type of observation is generally only useful when other measurements are not available (such as is most often the case at Mars, Titan, and Venus).

One might think of using the atmospheric conditions recorded at the nearest pre-existing location (even if it is tens of kilometers distant; on Earth this might be a town or forest service station). This method would provide substantially better interpretive guidance than nothing at all, particularly with respect to temporal changes. However, in many locales this would not provide an accurate gauge of the conditions (particularly the winds) relevant to the dunes being studied, due for example to topographic effects and the tendency of deep convective precipitation (e.g., thunderstorms) to be spatially patchy.

One might also deploy (even for a limited time) one or more meteorological stations on or near the dune study site (in addition to obtaining data from surrounding pre-existing weather stations). This strategy enables perhaps the best atmospheric context information for dune interpretation that is practical while in the field. Even so, smaller-scale atmospheric variations are likely near a dune or dunefield, due to variations in surface characteristics (rocks, vegetation, ponds, etcetera) or topography (even that of the dune(s)).

The fact remains that measurements, while invaluable as "ground truth", cannot practically provide a comprehensive, time-varying three-dimensional (or even 2D) atmospheric context over a dune, a dune field, sediment transport pathways, a valley or crater that contains the dune(s), etc. However, for Earth and Mars (currently), higher-resolution atmospheric models can provide such information. Although not perfect by any means, the output from such models can be compared with any *in situ* weather data collected in order to characterize potential biases.

References:

[1] Ortiz P. and Smolarkiewicz P. K. (2009) *Phys. Rev. E, 79*, 041307. [2] Diniega S. et al. (2009) *Geomorphology*, doi:10.1016/j.geomorph.2009.02.010, *in press.* [3] Michaels T. I. (2008) *Planetary Dunes Workshop*, Abstract #7039.