Abstract Title: Use of Radar Backscatter to infer Aerodynamic Roughness

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Use of Radar Backscatter to Infer Aerodynamic Roughness

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ABSTRACT

Aeolian transport of small particles depends on wind flow and is an important quantity to measure for several economic-related reasons. If some estimate of wind regime could be made from remotely-txmscd data, important geological and ecological problems on Earth and other planets could be addressed,

The effect of roughness on the wind field is parameterized in terms of the aerodynamic roughness z_0, a scaling length that, for a given surface, measures the height at which the wind speed should becomes zero due to the effect of surface topography. Since in fact the wind speed never reaches zero even at the surface, a more practical parameter is aerodynamic roughness, the height at which extrapolation of the wind speed reaches zero. Microwave reflectivity is a function of the radar parameters used and the surface properties (surface topography and complex dielectric constant). For modest topography and typical materials, the roughness at or near the radar wavelength dominates.

Since both radar and wind flow respond directly to surface roughness, it is reasonable to suspect that a fairly well-behaved quantitative relationship might exist

between normalized radar backseat ter coefficient, σ^O, and z_O [*Ulaby et al., 1982].* There arc, however, also reasons to suspect that such a relationship might be limited. The Radar and Aeolian Roughness Project (RARP) has been formed in order to investigate whether such a relationship exists, 10 determine the relationship(s) over a variety of surface types, and to seek a theoretical basis from which to extend the relationship to surfaces that cannot be directly examined [*Greeley et al., 1991*]. We have collected wind data using towers instrumented with anemometers in both desert and vegetated areas, and have overflown these same sites with the NASA DC-8 aircraft fitted with AIRSAR, a three frequency, polarimetric SAR developed by JPL, operating at P, L and C bands [*Evans et al., 1986; Vogt, and Kobrick, 1991*]. Multiple **overflights** of each site created a data set from which σ^O can be calculated at multiple incidence angles, frequencies and polarizations. Desert sites were chosen on lava flows, alluvial fans dominated by sand and gravel of differing ages and rough nesses, and on a silt-clay playa. One vegetated site in Denmark includes a variety of tree and crop types (barely, rape, beet, peas and grasses and a stand of Spruce trees). Surface roughness height varies from centimeters to several meters, and the corresponding roughness lengths arc z_O = 0.001 to 0.75.

The resultant relationship of σ^O to z_O shows for seven of the vegetated areas (the agricultural fields) the radar backscatter values of the same order of magnitude (in dB), and the Spruce site is much brighter. Although all of the vegetated sites arc both brighter in backscatter and rougher than the previous study, there is an overall good correlation between the two data sets. Coefficient of fits (R^2) is 0.79 for the entire plot,

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