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Supplementary Material for

Spectral Albedo of Dusty Martian CO_2 Snow and Ice

Sehajpal Singh[1], Deepak Singh[1], and Chloe A. Whicker[2]

[1] Indian Institute of Technology Bombay, Mumbai, India

[2]University of Michigan, Ann Arbor, Michigan, USA

SNICAR-Adv4 Model

Since the model perceives snow as a mixture of independently dispersing ice grains suspended in an air medium, a layer of snow has the same bulk refractive index as air. Ice is described as independently dispersing air bubbles within a solid ice medium with spectrally variable refraction (Picard et al., 2016; Warren and Brandt, 2008).

CRISM dataset

CRISM observation ID FRT000075B1_01 (L_s= 303.4° of MY 28) of Wolf glacier (as described by Smith et al., 2022) is processed, analyzed and used for comparison with modeling results.

Modeling Results

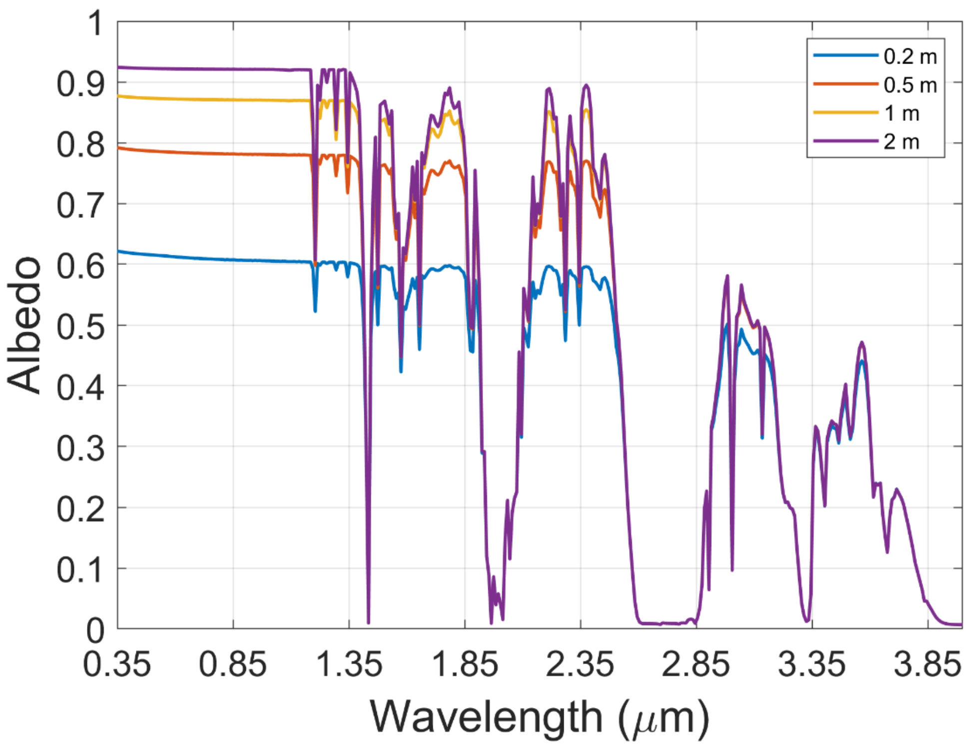

Figure S1: Albedo variation with change in thickness of the topmost layer pure CO_2 snow (snow grain size: 5000 µm, density=327.15 kg/ m^3) is overlaying CO_2 ice (layer thickness= 10m, density= 1200 kg/ m^3)

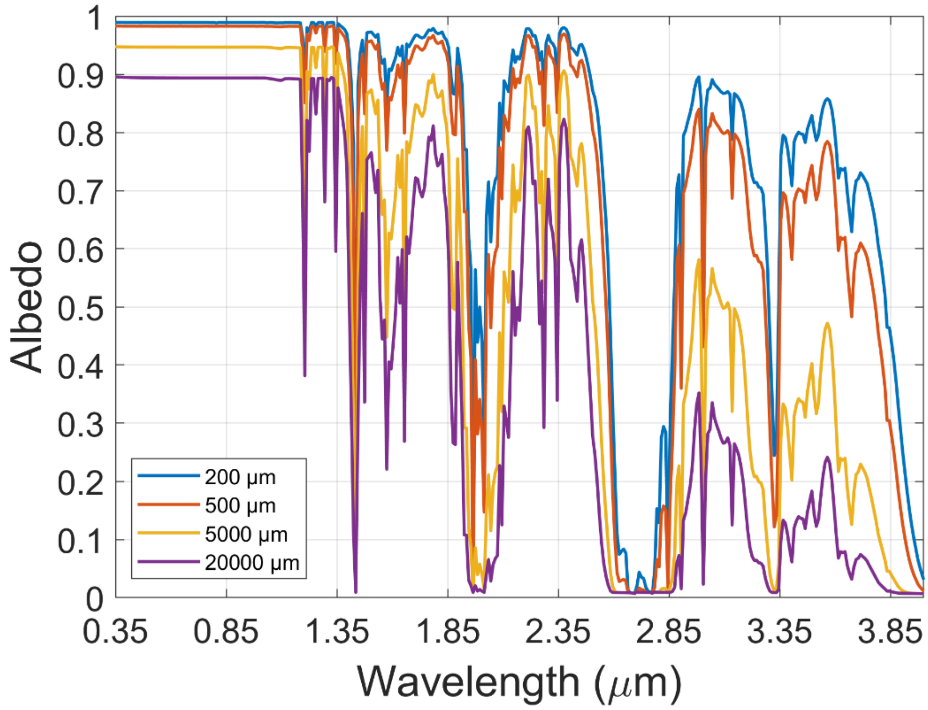

Figure S2: Variation of pure CO_2 snow albedo with effective grain radius. Density of CO_2 snow assumed: 327.15 kg/m3)

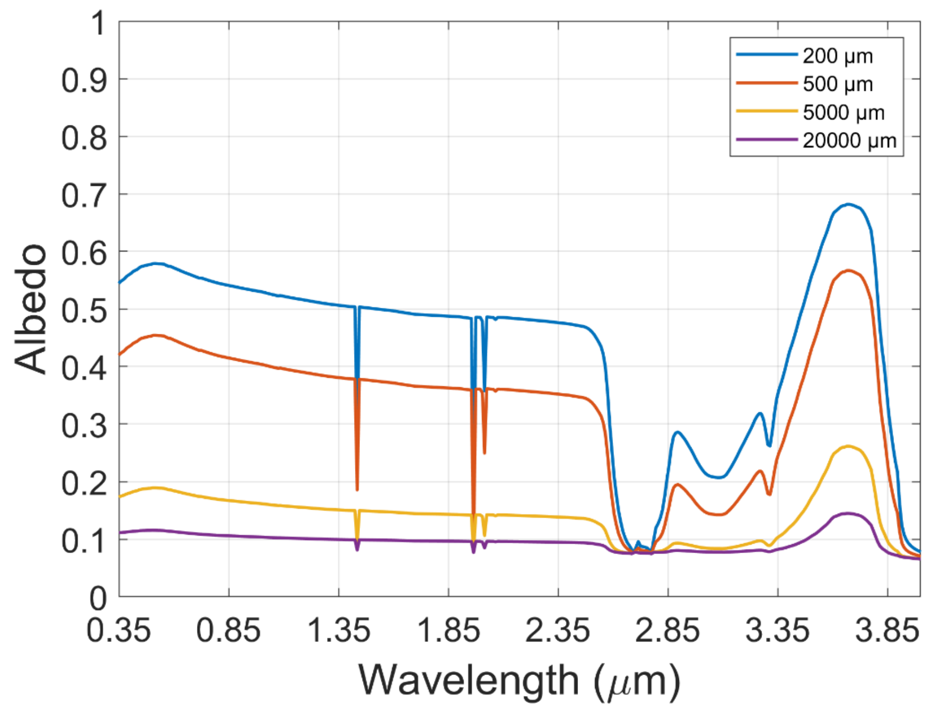

Figure S3: Initial results on CO_2 glacier ice albedo variation with effective grain radius. Density of CO_2 ice assumed: 1000 kg/m^3

The reflection by very dense ice is due to the Fresnel reflection. The ice spectral albedo has a peak at 3.5 µm due to the reflectivity of ice at normal incidence based on the spectrally varying indices of refraction utilized in SNICAR-ADv4.

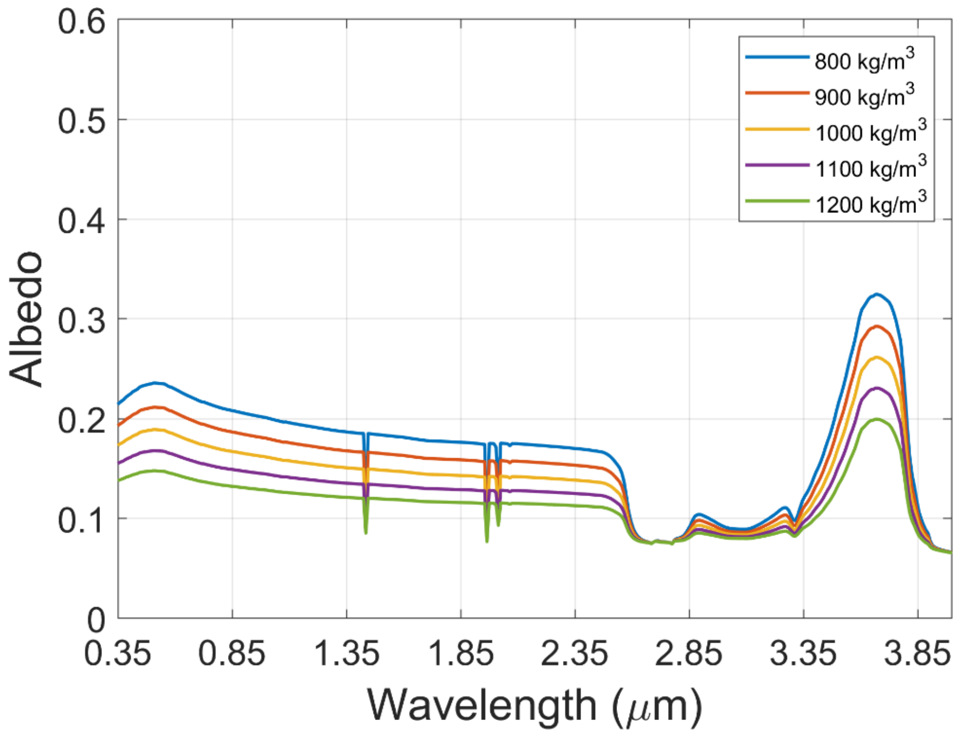

Figure S4: Initial results on variation of CO_2 glacier ice albedo with change in density of the ice for air bubble radius of 5000 µm.

While there is no effect on spectral curve with variation in density of CO_2 snow, there is noticeable change in spectral profile of CO_2 glacier ice with change in density, keeping the air bubble size and layer thickness constant.

Note: The initial results (Figure S3 and S4) maybe not accurate as the model is still being improved for representing CO_2 glacial ice.

References

Picard, G., Libois, Q., Arnaud, L., Verin, G., and Dumont, M.: Development and calibration of an automatic spectral albedometer to estimate near-surface snow SSA time series, The Cryosphere, 10, 1297–1316, https://doi.org/10.5194/tc-10-1297-2016, 2016.

Smith, I. B., Schlegel, N. -J., Larour, E., Isola, I., Buhler, P. B., Putzig, N. E., and Greve, R.: Carbon Dioxide Ice Glaciers at the South Pole of Mars, J. Geophys. Res. Planets, 127, e2022JE007193, https://doi.org/10.1029/2022JE007193, 2022.

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