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Mars surface materials from MARSIS and SHARAD radar reflectivity.

Wlodek Kofman (1), Cyril Grima (1), Jeremie Mouginot (1,2), Alain Herique (1), Pierre Beck (1), Antoine Pommerol (1,3)

(1) Université Joseph Fourier/CNRS, Laboratoire de Planétologie de Grenoble, Grenoble cedex 9, France (wlodek.kofman@obs.ujf-grenoble.fr, +33-(0)47-6514146), (2) University of California, Irvine, (3) Physikalisches Institut - Universität Bern

SHARAD and MARSIS radars have now achieved a Martian survey covering the large regions of the planet. In Laboratoire de Planétologie de Grenoble we have studied extensively these radar data and have developed methods to extract the surface reflectivity and the dielectric constant of surface materials. These methods involve the extraction of the intensity of the first radar echo. Then there are differences in the data treatment and analysis for MARSIS and SHARAD data, the former being quasi deterministic and the later statistical one. The ionospheric distortion, surface slope and roughness are approached in different way for these two datasets.
In this presentation we discuss deeply these methods showing their strengths and weaknesses. As a result, we obtain a map that characterizes the dielectric properties of the materials down to a few decameters below the surface for MARSIS and meters for SHARAD. We show the global map of surface echo power and the map of the dielectric properties of the Martian surface. The roughness of the surface is also studied.
Dielectric properties vary with latitude, with high values in mid-latitudes belts (20–40°) and lower values at both equatorial and high latitudes. We compare MARSIS and SHARAD reflectivity maps to other types of observations, we conclude that the reflectivity decrease observed poleward of 50–60° corresponds to the onset of water-ice occurrence within the regolith. Low reflectivity areas are also observed in equatorial regions. We detect also a seasonal variation of the reflectivity at poles that we attribute to the seasonal CO2 frost. The statistical approach for the reflectivity, associated with a three layers backscattering model, allows deriving the thickness variation of the frost.