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Calibration over North Polar Caps of SHARAD data

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SHARAD (SHAllow RADar) is the sub-surface sounding radar provided by the Italian Space Agency (ASI) as a facility instrument for NASA's 2005 Mars Reconnaissance Orbiter (MRO). The science objective of SHARAD is to map, in selected regions, dielectric interfaces to depths of up to one kilometre in the Martian subsurface and to interpret these interfaces in terms of the occurrence and distribution of materials such as rock, regolith, ice or water. The aim of this paper is to describe a calibration procedure for SHARAD data. No in-situ measurement of the dielectric properties of the Martian surface is available, and thus any attempt to correlate the echo strength from the surface with its dielectric properties requires an hypothesis on surface composition. We considered an area of the North polar cap where available data indicate an almost pure water ice composition, and thus whose dielectric properties are known. We estimated the other factor contributing to surface echo strength, i.e. scattering due to surface roughness, using a theoretical model based on fractal geometry, deriving model parameters from the MOLA topographic dataset. It was thus possible to derive a relationship between the geophysical parameters, dielectric constant, and a set of radar backscatter measurements. We used these results to produce maps of the dielectric constant of the Martian surface.