INFERRING THE DIELECTRIC PROPERTIES OF THE SURFACE OF MARS FROM MARTIAN MISSIONS AND ANALOGUES SAMPLES. L. Marinangeli[1], E. Pettinelli[2], G. Vannaroni[3], A. Cereti[3], A. P. Rossi[4], A. Baliva[1], D. Biccari[5] and R. Seu[5]. [1]IRSPS, Univ. d'Annunzio, Pescara, Italy, email: luciam@irsps.unich.it, [2]Universita' Roma 3, Rome, Italy, [3]INAF-IFSI, Rome, Italy. [4]RSSD of ESA. ESTEC, Noordwijk, The Netherlands [5]INFOCOM, Universita' Roma 1, Rome, Italy.

Introduction: The subsurface of Mars is currently under screening by two radar instruments: MARSIS on board Mars Express and SHARAD on board Mars Reconnaissance Orbiter. However, the lack of information about the dielectric properties of the Martian subsurface leaves several uncertainties in the radar data interpretation. In the last years, the knowledge on the properties, geology and composition of the Martian surface has been strongly improved and this may represent a starting point to assess the characteristics of the rock sequences hidden in the subsurface. We present a preliminary attempt to characterize the the dielectric properties of the surface of Mars at global scale. The rationale behind this project has been to identify different classes of surface material with similar dielectric behaviour. An experimental value of the dielectric permittivity and attenuation measured on analogue samples have been attributed to each class. Thus, the surface of Mars can be divided in areas with different attenuation of the radar signal (Figure 1). A rough estimation of the dielectric parameters at depth can be pursued assuming a homegeneus rock sequence for the uppermost crustal stratification, which allows the estimation of the wave propagation velocity and attenuation at various propagating signal frequencies [1].

GIS archive of the Martian dataset: The available thematic digital maps for the surface have been ingested in a GIS based archive in order to display simultaneously different information for the same area. The maps used for this preliminary work are: i) spectral information from orbiter (TES, OMEGA); ii) the H_2 distribution measured by the GRS on board Mars Odyssey as information of the water ice volume; iii) chemical and mineralogical analyses from in situ measurements (Pathfinder, MER). The GRS map was considered as reference to extrapolate the pore-filling mixture for the surface material. The geological map has been included for reference as well.

Terrestrial Samples description. A collection of natural rocks and artificial mixture have been used to measure the dielectric parameters, and specifically: i) Mixtures containing solid CO2 (CO2 ice, CO2 snow, CO2 powder, CO2 snow/Glass beads, CO2 powder/natural sand); ii) Mixtures containing liquid or solid H2O (glass beads/liquid H2O, natural sand/liquid H2O, glass beads/H2O ice, natural sand/H2O ice, pure H2O ice); iii) Solid rocks (Riolite, Andesite, Basaltic andesite, Trachy basalt, Trachyte, Leucitite, Sulphates, Salts); iii) Dry granular mixtures (glass beads, natural sand, glass beads/magnetite, glass beads/hematite) [1]. These samples are representative of the various compositions and rock types found on Mars.

Electromagnetic measurements: Dielectric spectroscopy laboratory technique, has been applied to characterize the e.m. properties of terrestrial analogue materials as a function of frequency [2,3]. In particular, capacitive cells and toroidal solenoids has been used to obtain the dielectric permittivity ε^* and magnetic permeability μ^*, respectivelly.

The constitutive e.m. parameters, measured on the different samples, have been used to estimate the e.m. properties of mixtures with different componets volume fractions, by using various semi-empirical mixing models.

Description of surface types material: Table 1 summarise the obtained electromagnetic values for the analysed samples and their respective type of Martian surface material. The areas with higher attenuation mainly lie on the equatorial region, whereas mid and high latitude indicates a good radar signal penetration.

Conclusions: Radar data invesion requires the knowledge of the e.m. soil properties as a preliminary constrain. The measurements of soil analogs provide a useful tool in order to estract geological information from radar echoes. The results of such measurements have been collected to build an archive.

Further additional data on the surface composition and stratigraphy will be added in this archive in order to better define the various areal classification. This work will support the data analysis and relevant interpretation of the on-going MARSIS and SHARAD investigations, as well as future GPR missionns.

References: [1] Cereti A. et al (2007) *PSS,* 55, 193-202, in press. [2] Pettinelli E. et al. (2005) *JGR*, 110, doi:10.1029/2004JE002375. [3] Pettinelli E. et al. (2003) *JGR*, 108 doi:10.1029/2002JE001869.

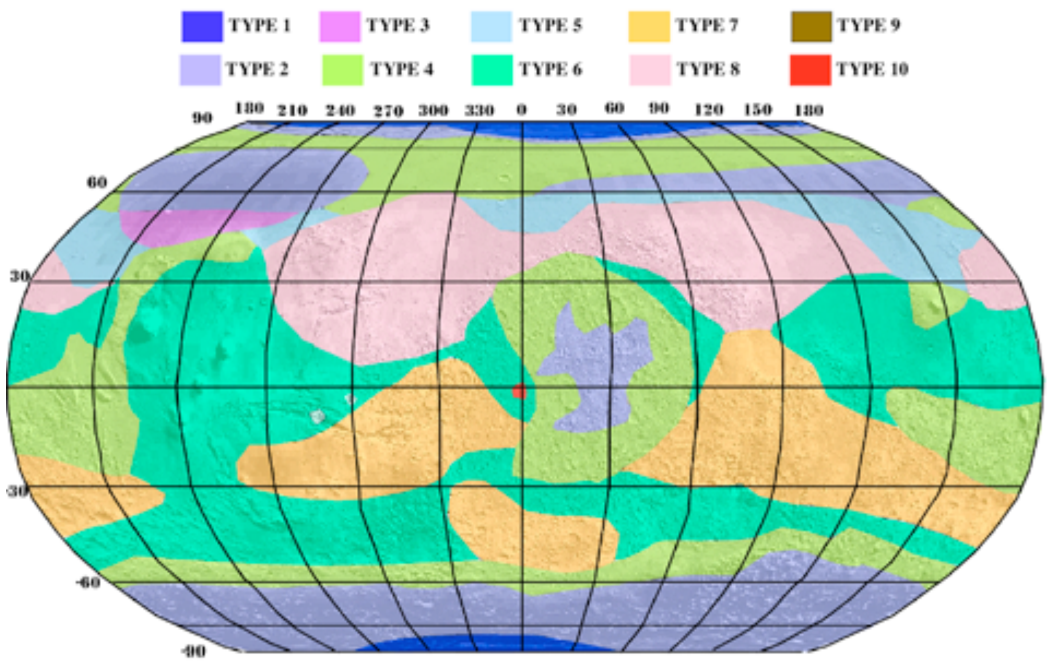

Figure 1. Preliminary map with the distribution of the types of material inferred from available Mars data and measurements on rock analogues.

Material	Dielectric constant, real part (ε')	Loss tangent (tan δ)	Attenuation (α)
Type 1: 70% H_2O ice+30% CO_2 ice 70% CO_2 ice + 70% H_2O ice	2.81	0.001	0.00036
Type 2: basaltic-andesite with >70% H_2O ice and Type 3: andesite with >70% H_2O ice	1.87	0.0013	0.00038
Type 4: basaltic-andesite with 50-15% H_2O ice and Type 5: andesite with 50-15% H_2O ice	4.27	0.0077	0.0033
Type 6: basaltic-andesite with <15% H_2O ice and Type 8: andesite with <15% H_2O ice	5.83	0.02	0.01
Type 7: basalt with <15% H_2O ice	5.48	0.0016	0.00077
Type 9: sulfates and salts (gypsum+halite powder)	2.67	0.013	0.0059
Type 10: hematite 10% volume, grain size 200-500 microns	3.85	0.001	0.00042

Table 1. Dielectric parameters measured for the rock samples and mixtures with different water and carbon dioxide ices content.