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Dielectric Properties of North Polar Layered Deposits of Mars from the MARSIS Data Inversion

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MARSIS (Mars Advanced Radar for Subsurface and Ionosphere Sounding) has offered abundant data useful in the estimation of dielectric properties of the north polar layered deposits of Mars. This paper describes an approach to such an estimation. We make the estimation by searching for reasonable permittivity and conductivity values in the complex parameter space to fit (with least square approach) the observed curve of Pss/Ps versus Δt, where Pss and Ps are power reflected from the subsurface and surface interfaces respectively, and Δt is the time separation between the two reflection peaks. Corresponding to the nadir looking feature of MARSIS, we adopt a normal incidence reflection model of two-layer mediums with a short pulse. To deal with the ill-posed nature of the problem, we employ the Bayesian inferring method, which enable us to decide feasible solutions on a maximum posteriori probability basis. To circumvent the problem of solving the highly nonlinear multi-variant integral equations concerned, we designed a genetic algorithm to do the search. Combined with some necessary a priori knowledge, we conclude that the first layer of the north polar layered deposits has relative permittivity of 3-4, conductivity of 6.0×10^{-7}–2.0×10^{-6}mho/m, and the basal layer has permittivity of 8$\sim$14, conductivity not constrained. These results are consistent with a suggestion that the top layer is very probably composed of dirty ice and the basal layer damp basalt.