

**DEEP SOUNDINGS OF THE ANTARCTIC ICE SHELF WITH AN IMAGING GROUND PENETRATING RADAR**

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Remote observations can provide information of prime interest to understand the processes involved in the dynamics and long-term evolution of the Antarctic polar cap and glaciers. In particular, ground penetrating radar soundings are among the most useful instruments to measure the ice thickness and the Antarctic ice-bed rock topography. Such information is required to properly model the dynamical behaviour of the ice shelf and help predicting its future.

In the frame of the NetLander mission, an HF impulse polarimetric Ground Penetrating Radar (GPR) has been developed in order to explore the martian subsurface, determine the main geological features and search for possible water reservoirs. This GPR operates at low frequencies, from ~2 to 8MHz, and relies on a novel concept that allows to retrieve not only the distance but also the direction of arrival of the backscattered waves, thus providing a 3D imaging of the underground reflectors with a spatial resolution of ~ 50 meters. The direction of arrival of the backscattered waves is computed from the measured values of 5 components of the wave field, 2 horizontal electric components and 3 magnetic components.

The first validation of the instrument was carried out during the RANETA (RADar of NETlander in Terre Adélie) campaign organized by the Institute Paul-Emile Victor in January-February 2004. This campaign took place on the Antarctic ice shelf close to the French-Italian Cap Prudhomme station. Due to the electromagnetic properties of ice at low temperatures (below -10°C, the permittivity  $\epsilon_r \sim 3.2$  and the conductivity  $\sigma \sim 10^{-5}$  S/m), the Antarctic ice cap constitutes an appropriate environment for GPR operations. 8 soundings of the ice shelf were performed on various sites corresponding to different altitudes above the sea level (ranging from ~285m to ~1100m). We shall provide a detailed description of the principle of operation of the radar and of the method of analysis of the observations. The ice-bedrock interface was detected in all of the soundings with clear signals on both electric and magnetic antennas. The measured ice thicknesses show that up to ~ 45 km from the coast the bed-rock stays at an altitude close to the sea level. In several occasions several echoes have been detected and a dedicated data processing algorithm allows to disentangle the various echoes and determine the location of the reflecting facets of the bed-rock. In support to the data analysis, numerical simulations have been conducted using a FDTD method and reproduce with a very good consistency the actual observations. These numerical simulations are also used to interpret the frequency profile of the electric antenna and obtain the electromagnetic characteristics of the upper layer of the ice.

These promising results exhibit the key role that ground penetrating radars can play in the effort of investigation of the Antarctic continent. In particular, GPR can bring an original insight on subglacial lakes environment.