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Subsurface planetary data streamed on the web by 2D and 3D visualizations

R. Seu, roberto.seu@alice.it (1), C. Abbattista, crisabba@planetek.it (2) M. Tragni, mario.tragni@planetek.it (2) C. Catallo, Claudio.Catallo@thalesaleniaspace.com (3)
(1) Università Sapienza Roma Dip. DIET, Italy, (2) Planetek Italia, Italy, (3) Thales Alenia Space Italia, Italy

Abstract

Subsurface data analysis and visualization represents one of the main aspects in Planetary Observation (i.e. search for water or geological characterization). The data are collected by subsurface sounding radars as instruments on-board of planetary space missions.

The products and the demonstrators shown in this paper are based on the Sharad Mars Reconnaissance Orbiter and Marsis Mars Express mission data, and are used in the ASI PROC (Planetary Radar Operation Center) facility in Matera.

Generally, subsurface data are represented as 2D radargrams in the perspective of space track and z axes (perpendicular to the subsurface) but as stand-alone pictures and without direct correlation to other data acquisition or knowledge on the planet. In many case there are plenty of data from other sensors of the same mission, or other ones, with high continuity in time and in space and especially around the scientific sites of interest (i.e. candidate landing areas or particular scientific interesting sites).

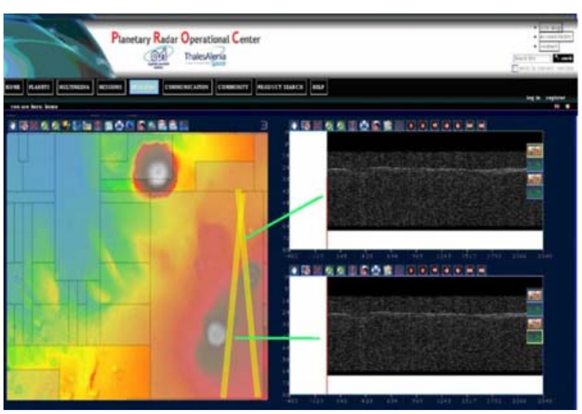

Figure 1: The SpaceGIS tool showing Mars DEM and two radargrams with their relative tracks

Thanks to the web facility of the PROC center all the radardgrams for each level of products (from EDR to RDR and MDR) are catalogued, by the extraction of the most important metadata of the acquisition, and prepared for the streaming on the web. The users can search for the products and navigate them via the interactive web tool SpaceGIS which gives the possibility to integrate Mars maps, radargrams and their data ground tracks in a unique vision allowing the use of different on-line analysis tools.

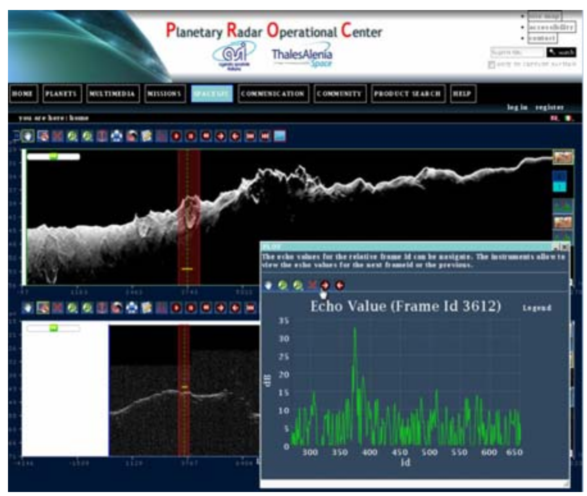

Figure 2: the “Echo Value” SpaceGIS tool

The 2D perspective is good to analyze single acquisitions and to perform detailed analysis on the returned echoes but a better way is to approach the analysis of a 3D visualization model generated from the entire stack of data.

This approach allows to navigate the subsurface in all directions and analyze different sections and slices or moreover navigate the iso-surfaces with respect to a value (or interval). The last one allows to isolate one or more iso-surfaces and remove, in the visualization mode, other data not interesting for the analysis; finally it helps to individuate the underground 3D bodies. Another aspect is the need to link the onground data, as imaging, to the underground one by geographical and context field of view.

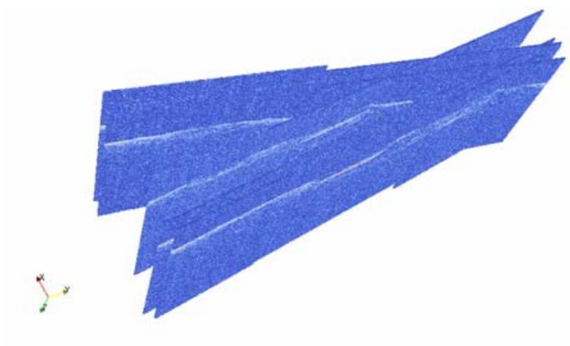

Figure 3: A synoptic 3D view of five different radargrams

The 3D model allows the synoptic analysis of all available data. That visualization models need a pre-processing of the data to re-project all heterogeneous data in a common coordinate system; finally it is necessary to proceed with the volumetric rendering to interpolate\extrapolate the information for the volume area where the data are not acquired or available.

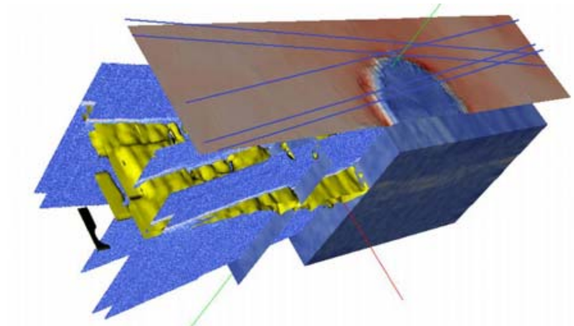

Figure 4: A contextual 3D view fusing the Digital elevation model, the original radargrams and the relative self extracted isosurfaces

The 3D interpolation algorithms are different and based on the final use case, so they need to be developed starting from scientific analysis of the research field.

The 3D result is possible thanks to the integration into a processing chain of mature software technologies and algorithms, used operatively on the Earth science, with adaptation for the planetary context.