SHOC: the SHARAD Operational Center. R. Seu[1], R. Phillips[2], E. Flamini[3], D. Biccari[1], E. Giacomoni[1], M. Cutigni[1], M. Provenziani[1], O. Fuga[1], C. Catallo[4], A. Croce[4], M. Guelfi[4], F. Fois[4], R. Mecozzi[4], R. Croci[4], M. Poletti[4], D. Ravasi[4], M. Molteni[4], P. Marras[5], B. Tattarletti[5], D. Vicari[5], A. Di Placido[5], A. Morlupi[5], F. Bonaventura[5], T. Paternò[5], G. Alberti[6], S. Mattei[6], C. Papa[6], [1]INFOCOM Dept., Università "La Sapienza", Rome, Italy, Roberto.seu@uniroma1.it, [2]Washington University, USA, [3]A.S.I. Agenzia Spaziale Italiana, Rome Italy, [4]Alcatel Alenia Space Italy, Rome, Italy, [5]INFO SOLUTION, Rome, Italy, [6]CO.RI.STA., Università Naples, Naples, Italy.

Introduction: SHARAD (SHALLOW RADAR) is the sub-surface sounding radar provided by the Italian Space Agency (ASI) as a facility instrument to NASA's 2005 Mars Reconnaissance Orbiter (MRO).

The primary objective of the SHARAD investingation is to map, in selected locales, dielectric interfaces to depths up to one kilometre in the martian subsurface and to interpret these interfaces in terms of occurrence and distribution of expected materials, including water, ice, rock and regolith.

The scientific phase of the mission, started on November 8th, 2006, will last for 2 years. During this time the task of the SHARAD Operations Team will be to manage the instrument observations and accordingly ensure the coverage of all the targets specified and submitted by the scientific community. In addition, a continuous quality and integrity check on the behaviour of the Radar instrument will be performed together with the analysis of the collected scientific data. In concrete the activities of the SHARAD Operations Team can be summarized in several steps which can be organized in three consecutive phases.

Uplink: The following phases have to be managed and optimized for SHARAD, taking all MRO instruments into account.

Targeting. During the entire mission the science team identifies and submits the targets to be covered. As an outcome of the Science Team Meeting, involving scientists and the SHARAD Operations Team, the attention is focused on a specific number of those targets, on possible agreed campaigns and on coordinated observations with other MRO instruments (even with the MARSIS Radar of the Mars Express mission).

Planning. The observations for a single planning cycle, which lasts for a specific time range, are chosen on the basis of what has been agreed in the previous phase. The SHARAD Operations Team, considering the spacecraft activities as well, selects the observation opportunities that have to be acquired through the Planning Tool.

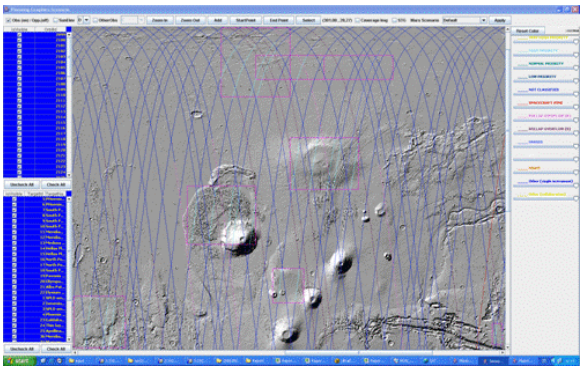

Fig. 1 Planning tool equatorial map showing orbits, target opportunities and spacecraft activities.

Commanding. This phase, done using the Commanding tool, aims at generating the command files, which will be uplinked to the spacecraft. For example, a commanding cycle relative to a weekly planning cycle, could be divided in two weekly groups of commands, each group having a 4 days time coverage, with the superposition of the last day of the first block and the first day of the second block. In this way the most updated predicted scenario is guaranteed.

Downlink: The raw science data produced by SHARAD are typically coherent radar data, i.e., samples on the carrier vs. time of the received radar signals, with a simple coherent pre-summing. During its operation SHARAD also produces housekeeping telemetry (engineering parameters, command acknowledges, events), which enable ground monitoring of the instrument operations.

Monitoring. This is the first step of the on ground processing chain and it is achieved automatically using the Monitoring tool. The members of the SHARAD Operations Team have to check syntax, integrity and quality of the raw science telemetries and that engineering parameters, like temperatures and voltages, are in the right working range.

L1A Processing. The operational engineer chooses to process the products which have a high level of integrity. This step leads to the L1A format for the data, that substantially means to give a spatial and temporal collocation to the processed observed products.

L1B Processing. The final ring of the processing chain consists in the proper signal processing, obtained running the L1B tool. The software uses the chirp scaling algorithm with the possibilities to include spurious correction and PGA correction (for the compensation of the effects of Mars Ionosphere in terms of time delay, widening of the main lobe and phase distorsion). The output is the so called L1B product.

Output generation and delivery:

Graphic analysis. Once the L1B product has been generated, the final move is to have a graphic visualization of the data by it's radargram interrelated with: the altimetric profile of the ground track to check that the behaviour of the radargram and altimetric profile match each other;

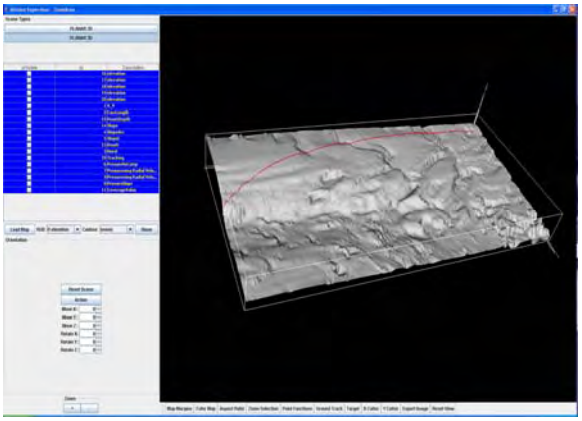

Fig. 2 Graphic Visualization Tool showing a 3D MOLA scenario with a ground track .

the simulated radargram and the 2 and 3 dimensional MOLA scenario (flight scenario reconstructed on the basis of MOLA data) with the possibility to get cross-track cuts, in order to detect features that can be assigned to side clutter rather than subsurface scattering interfaces. This action can be considered as a sort of clutter cancellation;

the range-cuts of the radargram so that single frames can be obtained and a scientific numerical analysis of the data, aimed at obtaining depth and thickness for subsurface interfaces, can be accomplished. Further, an evaluation of the material composition for the crust of Mars can be made by estimating the dielectric constants.

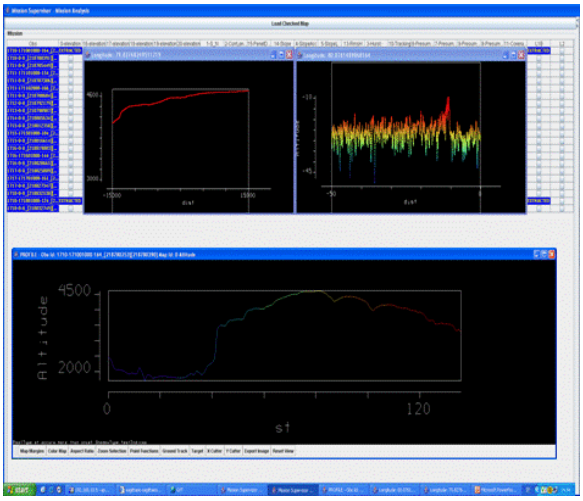

Fig. 3 Graphic Visualization Tool interactive panel showing range-cuts (upper part) and an altimetric profile (lower part).

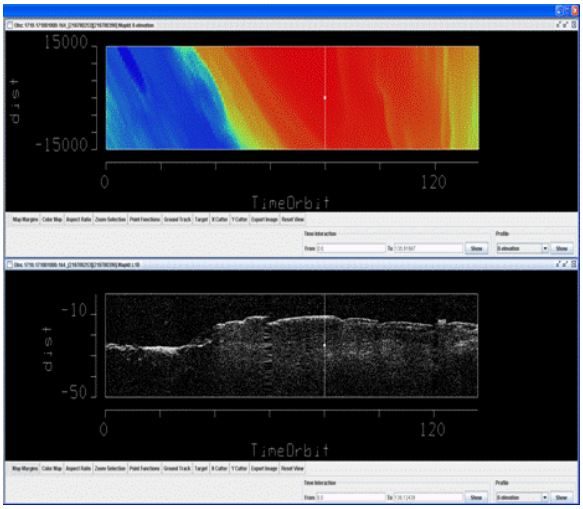

Fig. 4 Graphic Visualization Tool interactive panel showing 2D MOLA scenario compared to the relative radargram.

Delivery. At last there are archiving and delivering activities concerning L1A and L1B products and the SHARAD Team's results to the scientific community.