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MARSIS data and simulation exploited using array databases: PlanetServer/EarthServer for sounding radars

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MARSIS is an orbital synthetic aperture radar for both ionosphere and subsurface sounding on board ESA's Mars Express (Picardi et al. 2005). It transmits electromagnetic pulses centered at 1.8, 3, 4 or 5 MHz that penetrate below the surface and are reflected by compositional and/or structural discontinuities in the subsurface of Mars.

MARSIS data are available as a collection of single orbit data files. The availability of tools for a more effective access to such data would greatly ease data analysis and exploitation by the community of users.

For this purpose, we are developing a database built on the raster database management system RasDaMan (e.g. Baumann et al., 1994), to be populated with MARSIS data and integrated in the PlanetServer/EarthServer (e.g. Oosthoek et al., 2013; Rossi et al., this meeting) project.

The data (and related metadata) are stored in the db for each frequency used by MARSIS radar. The capability of retrieving data belonging to a certain orbit or to multiple orbit on the base of latitute/longitude boundaries is a key requirement of the db design, allowing, besides the "classical" radargram representation of the data, and in area with sufficiently hight orbit density, a 3D data extraction, subset and analysis of subsurface structures. Moreover the use of the OGC WCPS (Web Coverage Processing Service) standard can allow calculations on database query results for multiple echoes and/or subsets of a certain data product.

Because of the low directivity of its dipole antenna, MARSIS receives echoes from portions of the surface of Mars that are distant from nadir and can be mistakenly interpreted as subsurface echoes. For this reason, methods have been developed to simulate surface echoes (e.g. Nouvel et al., 2004), to reveal the true origin of an echo through comparison with instrument data. These simulations are usually time-consuming, and so far have been performed either on a case-by-case basis or in some simplified form.

A code for parallel computing has been developed and tested on a Tier 0 class HPC cluster computer located at CINECA, Bologna, Italy, to produce accurate simulations for the entire MARSIS dataset. Although the necessary computational resources have not yet been secured, through the HPC cluster at Jacobs University in Bremen it was possible to simulate a significant subset of orbits covering the area of the Medusae Fossae Formation (MFF), a seeimingly soft, easily eroded deposit that extends for nearly 1,000 km along the equator of Mars (e.g. Watters et al., 2007; Carter et al., 2009).

Besides the MARSIS data, simulation of MARSIS surface clutter signal are included in the db to further improve its scientific value. Simulations will be available throught the project portal to end users/scientists and they will eventually be provided in the PSA/PDS archives.

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