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MA_MISS and WISDOM data integration

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Abstract

1. Introduction

The 2020 mission of the ExoMars programme will deliver a European rover and a Russian surface platform to the surface of Mars. Among all the experiments onboard the rover, two of them are particularly innovative. In fact, for the first time they will explore the very shallow subsurface of Mars, delivering hyperspectral and electromagnetic imaging of the martian underground at the landing site.

MA_MISS (Mars Multispectral Imager for Subsurface Studies) is the spectrometer which will deliver hyperspectral data from the hole drilled in the Martian ground by the ExoMars Drilling system [1]. The experiment has been funded by the Italian Space Agency (ASI) and developed in Italy by SELEX Galileo.

WISDOM is a ground penetrating radar to study and characterize the structure of the Martian underground [2]. It has been funded by the french Centre National d'Etudes Spatiales (CNES) and german DLR and developed at the Laboratoire Atmosphères, Milieux, Observations Spatiales (LATMOS) in Paris, France.

Herein we introduce the work we are doing in order to delineate the elements for a synergic scientific activity between MA_MISS and WISDOM experiments.

2. MA_MISS and WISDOM Data

The ExoMars rover will land on the selected landing site where all experiments will collect data to characterize the environment and the geologic setting.

MA_MISS is going to deliver hyperspectral data of the borehole produced by the drill while WISDOM is going to collect radar traces which will deliver the dielectric properties of the martian shallow subsurface.

2.1. MA_MISS Hyperspectral Data

MA_MISS [1] is a miniaturized near-infrared imaging spectrometer working in the range 0.4-2.2 μm with 20nm spectral sampling. The spectrometer is placed into the drill shaft and the spectra of a point on the borehole is acquired through a sapphire window.

The acquisition of spectra along the drills' axis and around the borehole results into an hyperspectral image of the wall of the borehole.

This image will define the mineralogic composition of the rocks being investigated and the geometry of geologic structures (dip an dip direction).

2.2. WISDOM Radar Data

The WISDOM Ground Penetrating Radar (Water Ice Subsurface Deposits Observation On Mars, [2]) is one of the experiments onboard ESA-Roscosmos ExoMars Rover mission to Mars. It has been designed to investigate the shallow subsurface od Mars by imaging the subsurface using pulses in the V/U-HF portion of the electro-magnetic spectra.

The depth and the resolution of the survey depends on the operative frequency of the radar and the characteristics of the terrain being penetrated. WISDOM operates at frequencies from 500 MHz to 3 GHz, which results in penetration depths of about 3 meters for dry deposits up to 30 meters in ice and snow. Penetration depths lowers aburptly in case of moist or clay-laden soils and materials with high electrical conductivity.

3. Data integration

Subsurface radar soundings from WISDOM will return subsurface images, or radargrams, generated from two way travel times of echoes depicting the subsurface settings of geologic structures.

While WISDOM data should allow to get an estimate of the permittivity of the subsurface, that is needed to convert measured delays in distances, MA_-MISS will provide accurate composition measure-

ments that will be used to calibrate the depths measured by WISDOM.

We are planning to use GIS-based data-models in order to have a location-aware database system where to organize, analyze and visualize data from both instruments.

4. Discussion

MA_MISS data is important to WISDOM as it allow to extract a realistic model of the martian subsurface. At the same time, WISDOM echoes taken along sections (radargrams) or areas (volumes) will extend the puctual measurements of MA_MISS , extrapolating the layering that has been detected and characterized by MA_MISS during a vertical survey.

The practice of data integration is starting by planning hyperspectral imaging of cores taken along WISDOM radar profiles acquired during field tests. This way, the scientific teams of the two instruments will start to refine strategies to integrate data in the most efficient way. This will be critical during mission operations where observation planning will be done on a daily basis.

5. Summary

MA_MISS and WISDOM onboard ExoMars 2020 rover will deliver data from the very shallow subsurface of Mars for the first time ever. The observations from these instruments will be the link of existing dataset acquired from orbital platforms: highr resolution mapping imagers and spectrometers and subsurface planetary radar sounders. We are working to optimize the synergy of operation and data integration between the instruments in order to maximize the exploration cababilities and thus the scientific returns of thse two experiments.

Acknowledgements

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References

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