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Mars Express Science Ground Segment evolution along 15 years of mission, new challenges and future perspectives.

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Abstract

We present the synthesis of 15 years of mission operations from the perspective of the Science Ground Segment (SGS), showing the evolution of the planning mission system and summarising the new challenges for the remaining years of the mission. We will analyse some observation statistics and we show the proposed system improvements.

1. Introduction

Mars Express remains one of ESA's most scientifically productive missions and has fully accomplished its mission objectives . The mission provides a unique platform for Mars climate evolution research to help understand the complex atmospheric processes.

The Mars Express (MEX) Science Ground Segment team is composed of 6 scientist-engineers, responsible for the definition and maintenance the overall scientific plan in cooperation with the Project Scientist (PS). The overview of the SGS system is shown in figure 1 .Some of the team duties are:

- coordinating the candidate observation selection process between the Instrument Teams and the relevant Mission Operation Centre (MOC) teams, supporting the planning activities of the MEX Principal Investigators (PI) in the preparation of science operations for their instruments and shielding MOC from the details of this iterative process,
- producing a set of consolidated instrument payload operations requests and pointing timeline requests based on the Long Term Plan (LTP) and the output of the medium term planning (MTP) exercise, and transferring these to MOC,

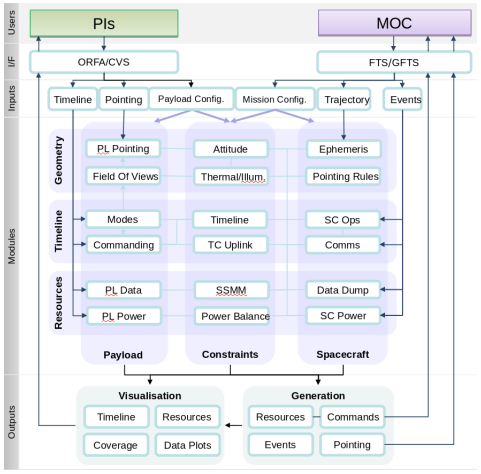

Figure 1: SGS system based on the mission planning tool structure.

- iterating the instrument payload operation requests with the MOC and the PIs to resolve inconsistencies,
- Coordinating software patching for instruments,
- Participating in Mission Review Boards (MRBs) for instrument anomalies.

2. Recent changes in science operations

After operating for 15 years, through changing Martian seasons and changes in the spacecraft condition,

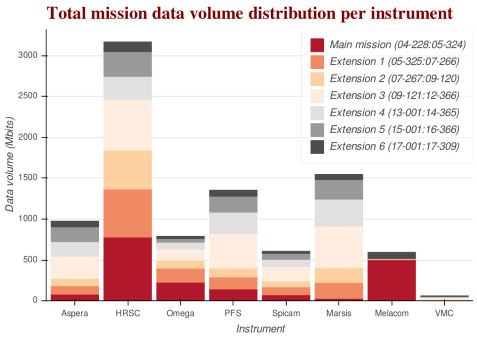

Figure 2: Downlink mission statistics per instrument along mission phases.

planning the science operations of the mission continue to be a challenge. We will present the improvements over the last few years of to our operating methodologies, instrument operation changes, software improvements (e.g. gyroless mode) and scientific observation modifications.

3. Some planning statistics

Versatility in SGS is the key to success, as there are continue changes in the Martian seasons, data volume, illumination conditions, power during eclipses and many other factors.

We will provide some mission downlink observation statistics for the overall MEX mission science as well as useful statistics for comparison with other ESA planetary missions.

Note the figure 2 only represents volume of data, which is not necessarily correlated with either the quantity or quality of the final science data. It must be considered as a tool for trend analysis among different mission phases. For many years, the MEX archive has supported the archiving of high level science products as a service to the science community. Detailed information can be found at the official website of the Planetary Science Archive (PSA).

4. Future of the mission and system improvements

Finally we will summarize the future objectives for the long term planning period up to 2020 and the general status of the spacecraft, instruments and staffing. All these are aligned with the changing Martian seasons as represented in figure 3. Among these activities are:

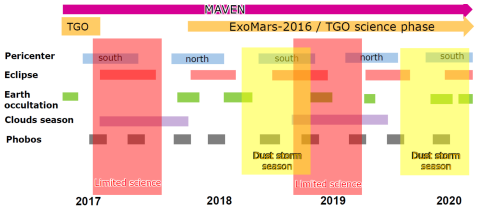

Figure 3: Mission scheme in function of the Martian climate and joint science with other space missions.

- Continue the observations of all instruments to fulfill the scientific objectives of the mission extension and new scientific challenges.
- Prepare joint science observations with Trace Gas Orbiter (TGO), providing scientific context to the new observations.
- Updates of the ground segment to ensure the extended lifetime of the mission with new operational constraints.
- Support the communications with surface assets and characterize landing sites for future robotic missions.

5. Summary and Conclusions

Flexibility is key for science missions and it requires a qualified science operations team with both engineerings and scientific experience to achieve the goals of the mission. In order to improve SGS planning systems for planetary missions it is vital to take advantage of long term missions as MEX in order to transfer the planning knowledge and experience to complex planetary missions of the future.

Acknowledgements

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