

Mars Express Science Ground Segment overview: A study about the mission's evolution, new challenges and future perspectives

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Abstract

We present an overview of more than 13 years of mission operations from the perspective of the Science Ground Segment (SGS), including the evolution of the mission planning system and summarizing the new challenges ahead for the years remaining until the end of the mission. In addition, we will emphasize the planning for the solar conjunction season during the Summer of 2017. In comparison with the SGS planning for the Rosetta mission, we will present some observation statistics and we will conclude with the planned system improvements and future mission perspectives.

1. Introduction

Mars Express remains one of ESA's most scientifically productive missions and has fully accomplished its objectives. The mission provides a unique enabling capability for Mars climate evolution research and complex process understanding [9].

The Mars Express (MEX) Science Ground Segment team is composed of 6 scientist-engineers who are responsible for the definition and maintenance of the overall scientific plan in cooperation with the Project Scientist (PS) [13]. Their duties include:

- coordinating the candidate orbit selection process between the Instrument teams and the relevant Mission Operation Center (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 the MOC,
- iterating the instrument payload requests with the MOC and possibly the PIs to resolve inconsistencies,
- coordinating software patching for instruments,
- participating in the Resource Allocation Board (RAB) which convenes during the MTP and STP phases,
- participating in Mission Review Boards (MRBs) which investigate instrument anomalies.

2. New challenges: the case of the 2017 solar conjunction

Dealing with a long-term mission in an operational phase, there are constant challenges, such as adjusting the planning for Mars seasons and the evolution of the spacecraft systems. We will present the improvements and new methodologies created for the science scheduling challenges faced during the Summer 2017 conjunction season.[3]

3. MEX - Other planetary missions science planning system comparison

SGS personnel is based at the ESAC ESA centre where the operations engineers are involved across the various planetary missions. This provides an important know-how transfer among similar but technically different ground segments. We will show an overview of the differences that exist between some other newer missions as Rosetta and Mars Express SGS systems.

4. Some planning statistics

We will provide some downlink observation statistics for the overall MEX mission science as well as a useful analysis of SGS planning in comparison with other ESA planetary missions.[4,5 and 6]

5. Future of the mission and system improvements

Finally, we will summarize the future objectives for the mission planning up to 2020 and the general status of the spacecraft, instruments and manpower.[1,2]

6. Summary and conclusions

Flexibility is key for science missions in comparison with Earth Observation planning tools for which automation is vital for their development. Unfortunately, this implies manual processes and requires qualified operators, both engineers and scientists to achieve the PIs goals. In order to improve SGS systems across planetary missions, it is vital to maintain accurate reporting and documentation for long-term missions such as MEX and for an optimized transfer of know-how to future, potentially more complex planetary missions.

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