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The Science Operations Concept for the ExoMars 2016 Trace Gas Orbiter

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Abstract

The ExoMars 2016 Science Operations Centre (SOC) based at the European Space Astronomy Centre is responsible for coordinating the science planning activities for the Trace Gas Orbiter. Science planning will involve all members of the ExoMars 2016 science ground segment (SGS), namely the SOC at ESAC, the Russian SOC at IKI, the orbiter instrument teams and the science management of the 2016 mission represented by the science working team (SWT) that is chaired by the project scientist.

The science operations concept for the mission builds on the legacy inherited from previous ESA planetary missions, in particular from Mars Express for the core plan validation aspects and from the Smart-1 lunar mission for the opportunity analysis and long-term planning approach. Further concept drivers have been derived from the ExoMars 2016 mission profile in the areas of orbit predictability, instrument design and the usage of TGO as a relay for surface assets including the ExoMars 2018 rover.

This paper will give an over view of the entire uplink planning process as it is conducted over 3 distinct planning cycles.

The Long Term Plan (LTP) establishes the baseline science plan and demonstrates the operational feasibility of meeting the mission science goals formulated by the science working team (SWT) at science management level. The LTP has a planning horizon of 6 months.

Each month of the baseline science plan is refined with the instrument teams within the Medium Term Plan (MTP) to converge on a frozen attitude request and resource envelopes for all of the observations in the plan.

During the Short Term Planning cycle the SOC will iterate with the teams to finalise the commanding for all of the observations in the plan for the coming week.

The description of the uplink planning process will focus on two key areas that are common to all of the planning cycles mentioned above:

- **Science Plan Abstraction:** Interacting with the science plan at the appropriate level of abstraction to be able to iterate over different planning horizons with the rest of the science ground segment.

- **Science Planning Decisions:** the decision making process that will allow the science ground segment to converge on an agreed science plan in time for delivery of requests to the mission operations centre for subsequent uplink to the spacecraft.

This paper will also show how the science planning process has been analysed to ensure compatibility with the broader mission-planning concept defined by the MOC. Evidently the science planning process has a strong dependence on the availability of planning inputs from the mission operations centre (MOC) to ensure that the science plans are assembled within operational constraints and that the latest information from flight dynamics is taken into account, critically the predicted orbit.

Finally the science operations concept for TGO attempts to address some of the acknowledged shortcomings identified on previous ESA planetary missions.

- **Improved Long-Term Planning:** One of the main responsibilities of the SOC will be to properly establish and maintain the long-

term plan baseline to ensure that progress is being made towards the desired science goals as well as allowing trade offs to be made at the science management level within a mission wide context.

- **Operationally Validity:** All planning iterations will be placed within the known operational engineering constraints, and any decisions made with longer lead-in times must be robust to prediction uncertainties. The ExoMars 2016 science operations process will ensure that all proposed science plans are operationally valid, regardless of the level of abstraction used to iterate with the science management or the instrument teams.

In summary the science-planning concept for the ExoMars 2016 Trace Gas Orbiter builds on the experience gained from Mars Express, and increases the role of long-term planning to link the mission science goals with a science plan that is iteratively refined within operational engineering constraints.