EPSC Abstracts
Vol. 10, EPSC2015-839, 2015
European Planetary Science Congress 2015

Planning the HRIC (High Resolution Imaging Channel) observations of Mercury surface

M. Zusi (1, 2), G. Di Achille (3), V. Galluzzi (4), E. Mazzotta Epifani (5), V. Della Corte (2), P. Palumbo (4), E. Flamini (7)
(1) INAF-OAC, Naples, Italy, (2) INAF-IAPS, Rome, Italy, (3) INAF-OATe, Teramo, Italy, (4) Università Parthenope, Naples, Italy, (5), INAF-OAR, Rome, Italy, (6) ASI, Rome, Italy (zusi@na.astro.it)

Abstract

The High Resolution Imaging Channel (HRIC) of SIMBIO-SYS [1] onboard the BepiColombo mission to Mercury, is the visible imaging camera devoted to the detailed characterization of the Hermean surface. The potential huge amount of data that HRIC can produce must cope with the allocated (and shared) mission resources in terms of power, data volume, and pointing maneuvers. For this reason, well before the mission launch, it is extremely important the definition of an operative plan compatible with both the available resources and the scientific objectives accomplishment.

1. Introduction

With its 2.5"/pxl angular resolution and a 4Mpx Hybrid Si-PIN CMOS sensor [2], HRIC acquires 150 square kilometers footprints images (at 480 km of altitude) which correspond to about 0.0002% of Mercury surface that rises up to about 10% when considering the mean 8 Mbit for compressed full-frame acquisition [3] and the allocated data volume. The latter figures immediately show that HRIC operation plan must be carefully defined to guarantee the satisfaction of scientific objectives in compliance with the available resources.

2 Observation planning strategy

The core strategy for the definition of a HRIC observation plan is to build a set of realistic, scientifically interesting and resource-feasible operative scenarios through the following steps:

- build a database of high priority scientific targets based mostly on MESSENGER data and recent results
- simulate target observations using the ESA MAPPS (Mapping and Planning Payload Science) tool to retrieve the synthetic footprints and the report in terms of resource allocation
- evaluate occurrence and quality of planned observations by importing all the MAPPS footprints and geometrical data (e.g., illumination angle) and radiometric conditions into GIS (Geographic Information System) environment
- prioritize targets as a trade-off between their scientific relevance, possible observational windows, quality of acquisition parameters, and the resource demand availability

Finally, since the prioritizing phase could evidence the infeasibility of some observations, the initial observables database must be updateable / extendible to integrate additional interesting areas.

2.1 Definition of interesting areas

The definition of the observables database represents a long and complex task since it requires to:

- collect all latest images (e.g., MESSENGER-MDIS data)
- build the GIS database
- identify all Mercury's geological units and interesting features such as hollows, volcanic vents, tectonic structures, etc.

The geological map of the Victoria quadrangle [4] represents a solid and complete reference for building a preliminary database of observables.

2.2 Observation simulations

Pending the completion of a global Mercury geological map, a simulation of HRIC operations has been done considering the presently known Mercury geological units (i.e., USGS database).

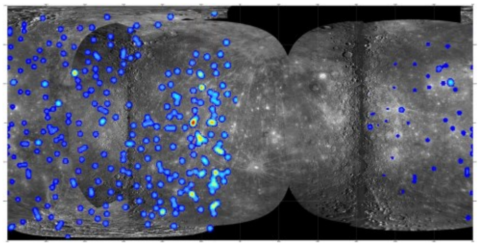

Figure 1: Mercury's topographic map with USGS surface features (blue spots).

Potential targets have been imported in GIS environment and compared with the HRIC footprints computed with the ESA MAPPS tool to compute the real HRIC operations in terms of resources and computation demands (i.e., data volume, power, special pointing requests).

2.3 Observations quality evaluation

Resulting footprints are then filtered considering geometrical (e.g., illumination angle, umbra) and radiometric (e.g., SNR [5], image contrast) conditions (Figure 2). Once completed the MAPPS simulations for all defined observational targets, the on-orbit data production profile has been computed (Figure 3).

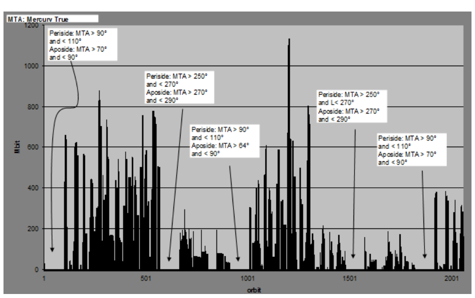

Figure 3: HRIC data volume per orbit.

2.4 Target prioritization and database update

On the completion of the scientific and performance evaluation of the observables plan, the ESA SGS team is involved in comparing the observable plan of all BepiColombo instruments to find out possible conflicts and/or opportunities and to allow an optimal usage of mission resources (Figure 4).

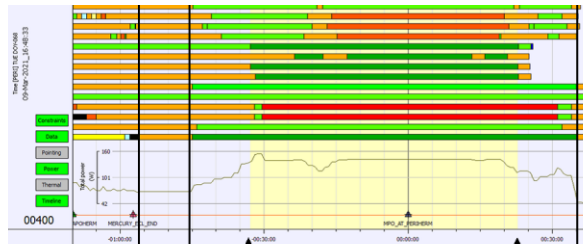

Figure 4: Instrument resource demand comparison.

Operation conflicts (e.g., not enough power, incompatible pointing maneuvers, operation cross-interferences) are then scientifically discussed between the involved teams eventually considering revisions of the observational targets database.

Acknowledgements

We gratefully acknowledge funding from the Italian Space Agency (ASI) under contract I/022/10/0. Special thanks to my wife Katia and my beautiful son Emanuele for supporting my work every day.

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