BEPICOLOMBO QUICK-LOOK ANALYSIS (QLA) SYSTEM. A. J. Macfarlane[1], M. S. Bentley[2], T. Cornet[3], S. Martínez[4], M.A. Cuevas[5], N. Fajersztejn[6], M. Freschi[1], D. Galan[2], J.Gallegos[1], F. Vallejo[2], and the Science Ground Segment; [1]SERCO for European Space Agency (ESA), European Space Astronomy Centre (ESAC), Camino bajo del Castillo, s/n Urbanización Villafranca del Castillo, Villanueva de la Cañada, E-28692 Madrid, Spain, [2]HESpace for ESA, [3]AURORA for ESA, [4]ESA, [5]Rhea for ESA, [6]Vega Telespazio for ESA. Contact: alan.macfarlane@esa.int).

Introduction: The BepiColombo Quick-Look Analysis (QLA) system is a web-based application being developed and maintained by the Science Ground Segment (SGS) team for the BepiColombo mission. The QLA provides a means to interactively visualise and assess the science and house-keeping data products soon after the telemetry has been received from the spacecraft.

The Mission: BepiColombo is a joint ESA/JAXA mission [1] that launched on 20th October 2018 and will arrive at Mercury in late 2025, including several flybys of the Earth, Venus and Mercury along the way. It will separate into the two orbiters: the Mercury Planetary Orbiter (ESA/MPO), hosting 11 scientific instruments, and the Mercury Magnetospheric Orbiter (JAXA/MMO or 'Mio'), hosting 5 scientific instruments.

Quick-Look Analysis: The goal of the QLA is to provide a tool that allows a preliminary analysis of the science products produced by the instruments as well as continuous monitoring of the spacecraft and instrument health. By providing quick visibility of the data the system aims to facilitate the monitoring of the completion of the observations with respect to the scientific objectives and to feed this back into the mission planning process. The design of the QLA is guided through close collaboration with the Instrument Teams to ensure that the system is adapted to the needs of its principal users. An interactive interface to the data assists in identifying regions or periods of interest, manipulating and displaying data in various ways, performing trend analyses, notification of events and out-of-limit detection.

Rapid Access to Data: The QLA is under development by the SGS as part of a wider collection of subsystems that make up the BepiColombo Science Operations Control System (BSCS) [2]. The functions of the BSCS subsystems include the retrieval of telemetry packets, parameters and auxiliary files from the EGOS Data Dissemination System (EDDS) and converting these into archivable PDS4 data products, thanks to data processing pipelines developed by both the SGS and the Instrument Teams. The design of this system is such that soon after the telemetry has been retrieved from the spacecraft the raw and calibrated data products are available for display in the various tools such as the Planetary Science Archive (PSA) [3] and the QLA.

Web-based Data Visualisation: The web interface of the QLA is being built using Angular [4], one of the leading JavaScript frameworks at this time. Advancements in web technologies in recent years mean that visualising and manipulating large quantities of data through a web browser is a valid possibility, particularly in terms of user accessibility. This enables a single development of an application to be accessible across multiple platforms with frequent updates transparently pushed to the end-user.

Displaying data from multiple sources. Data is displayed in the QLA through a number of different dashboard views. These dashboards typically group together data that is considered useful to compare side-by-side. Filters can be applied to the dashboards as a whole, such as the time-range or data type to display. This is useful for comparing a given moment across multiple data sources as well as for analysing trends in the data over longer time periods.

Dashboards contain a grid-layout of widgets in order to organise the different ways of viewing the data. Widgets are containers with a set of common functionality for visualising and interacting with the data – such as widgets for displaying charts, images, maps or tables

Interacting with the data. The most common type of widgets in the current implementation are time-series and spectra plots. These plots rely heavily on the Plotly.js library which was open-sourced in 2015 [5]. Based on D3.js and WebGL for graphics rendering this library facilitates the display of a large number of data points and provides functionality allowing users to zoom, toggle plot types and the display of additional metadata.

Widgets provide extra functionality to be able to interact more easily with the data such as linking user actions across several widgets. Also additional metadata or functionality may be visible by maximising a widget. Furthermore most widget types can be exported as images or PDF as well as being able to download the actual data for further analysis in other tools.

Sharing and Customisation. Access to the QLA is restricted to authorised users of the BepiColombo mission. For the spacecraft and each instrument several dashboards have been pre-defined containing groups of

specific widgets for which a quick-look of the data is desired. The visibility of the pre-defined instrument dashboards is typically restricted to a given Instrument Team although shared dashboard views are available including widgets that may be of interest to other teams.

The system has been designed to encourage users to be able to make custom views. Users can create new dashboards in their own space and drag widgets of interest into their preferred layout. Depending on the type of data, they may wish to share their customised dashboards with other team members or with the rest of the mission.

Future plans: The Cruise Phase includes flybys of the Earth, Venus and Mercury during which science observations will be performed by a subset of instruments. These observations will be used to further define and test the system in a more realistic context of planet observations. Besides this, to further enhance collaboration, it is planned to implement a Science Logbook through which team members will be able to discuss scientific points of interest or apparent anomalies and to link back to the data in the QLA interface.

Once BepiColombo approaches the Mercury Science Phase it will also be necessary to visualise geolocated data such that GIS technologies will play a key role in the future QLA.

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