**GLOBAL SPECTRAL PARAMETER MAP OF MERCURY: DERIVED FROM MASCS SPECTROMETER ONBOARD NASA MESSENGER MISSION.** I. Varatharajan[1], M. D'Amore[1], D. Domingue[2], J. Helbert[1], and A. Maturilli[1], [1]Institute for Planetary Research, German Aerospace Center DLR, Rutherfordstrasse 2, 12489 Berlin, Germany (indhu.varatharajan@dlr.de), [2]Planetary Science Institute, Tucson AZ, 85719, USA

**Introduction:** The Mercury Atmospheric and Surface and Composition Spectrometer (MASCS) instrument on the MErcury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) spacecraft mapped the entire surface of Mercury in the VIS-NIR spectral range during its primary and extended orbital mission. The MASCS instrument [1] consists of a small Cassegrain telescope with an aperture that simultaneously feeds the incoming light to an Ultraviolet and Visible Spectrometer (UVVS) and a Visible and Infrared Spectrograph (VIRS). VIRS has two spectral channels, one in the ultraviolet (UV) to visible (VIS) region from ~300 to 1050 nm, and one in the near-infrared (NIR) region from ~850 to 1450 nm at spectral resolution of 4 nm for VIRS. MASCS is currently the only hyperspectrally enabled instrument that has orbited Mercury until BepiColombo arrives at Mercury. With the availability of new photometrically calibrated datasets, it is now possible to finally derive a global spectral parameter map of Mercury using MASCS as it records more spectral information than the multiband Mercury Dual Imaging System (MDIS). The results of this will help us to better understand the spectral and compositional diversity of Mercury in association with its surface features.

**Creation of MASCS Data Cube:** We prepared a global hyperspectral data-cube image from radiometrically [2] and photometrically [3,4] calibrated MASCS VIRS reflectance spectra. Data coverage varies by region, but a global map at 1 pixel per degree (ppd) can be obtained with a high signal-to-noise ratio. We restricted our analysis to observations with the VIS detector of VIRS, because measurements with the NIR detector were at a lower signal-to-noise ratio, which can influence data classification in an unpredictable manner. From the more than 4 million VIS spectra collected between April 2011 and December 2013, we excluded from our analysis the spectra taken at the most extreme observing geometries, limiting the observations to those with incidence and emission angle less than 85° respectively. A side effect of this data selection is a reduction of the latitudinal coverage to within ±80°N and the exclusion of some off-nadir observations. We also set up an empirical check on the calibration routine to test for inconsistent reflectance values at specific wavelengths to ensure that bad data or mislabeled ancillary data were not included in the data subset.

The data were spatially binned on an equant surface grid in a simple cylindrical projection, which permits the ready production of hyperspectral data cubes of different spatial resolutions. All spectra in the data cube were resampled to the same 2 nm wavelength resolution. For each grid pixel, the hyperspectral data cube contained the averaged reflectance spectrum of all the data points falling within the pixel. As an example reflectance at 700 nm for the entire data-cube is shown in Fig. 1.

**Global Spectral Parameter Map:** Spectral characterization of the data-cube was undertaken using data from the VIS on VIRS channel of the MASCS instrument. Previous studies defined a number of spectral parameters to characterize the pyroclastic deposits of Mercury such as UV downturn, visible slope, and NIR slope [5,6]. They encompass the entire spectral range of MASCS (i.e., 300 to 1450 nm), with emphasis on both the VIS and NIR. The UV downturn parameter introduced by [5] to characterize the variability of the pyroclastics deposits in the UV range and is defined as:

$$UV_{depth} = Depth_{300} + Depth_{325} + Depth_{350}$$

where $Depth_{300}$, $Depth_{325}$, and $Depth_{350}$ are defined as:

$$Depth_{300} = \frac{\{[R(401)] - [401-303]VIS_{slope}\}}{[R(303)]},$$
$$Depth_{325} = \frac{\{[R(401)] - [401-324]VIS_{slope}\}}{[R(324)]},$$
$$Depth_{350} = \frac{\{[R(401)] - [401-350]VIS_{slope}\}}{[R(350)]},$$

and

$$VIS_{slope} = \frac{\{[R(550)] - [R(750)]\}}{\{550-750\}}.$$

We applied the same equations to the entire data-cube irrespective of the surface morphology. The results are shown in Fig. 2.

**On-going work and Conclusions:** Current analyses are focused on defining additional spectral parameters using unsupervised classification methods. These classification methods will enable better characterization of the global MASCS datasets, and help identify the key spectral properties of Mercury's surface. This is essential for understanding the surface alteration processes The results are to be presented at the meeting.

**References:** [1] McClintock W. E. and Lankton M. R. (2007) *Space Sci. Rev.*, 131, 1-4, 481-521. [2] Holsclaw G. M. et al. (2010) *Icarus*, 209, 179–194. [3] Domingue, D. L. et al. (2019) Icarus, 319, 247-263.[4] Domingue, D. L. et al. (2019) Icarus, 319, 140-246. [5] Goudge T. et al. (2014) *JGR Planets*, 119, 635–658. [6] Besse S. et al. (2015) *JGR Planets*, 120, 2102–2117.

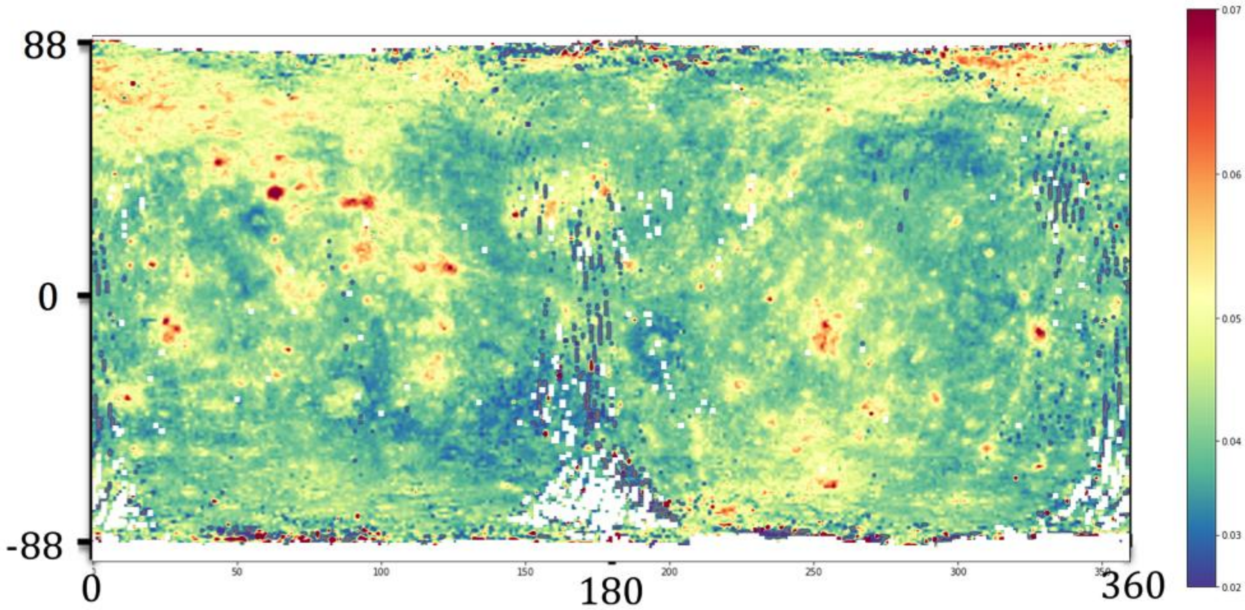


**Figure 1.** MASCS based Global Reflectance Map at 700 nm

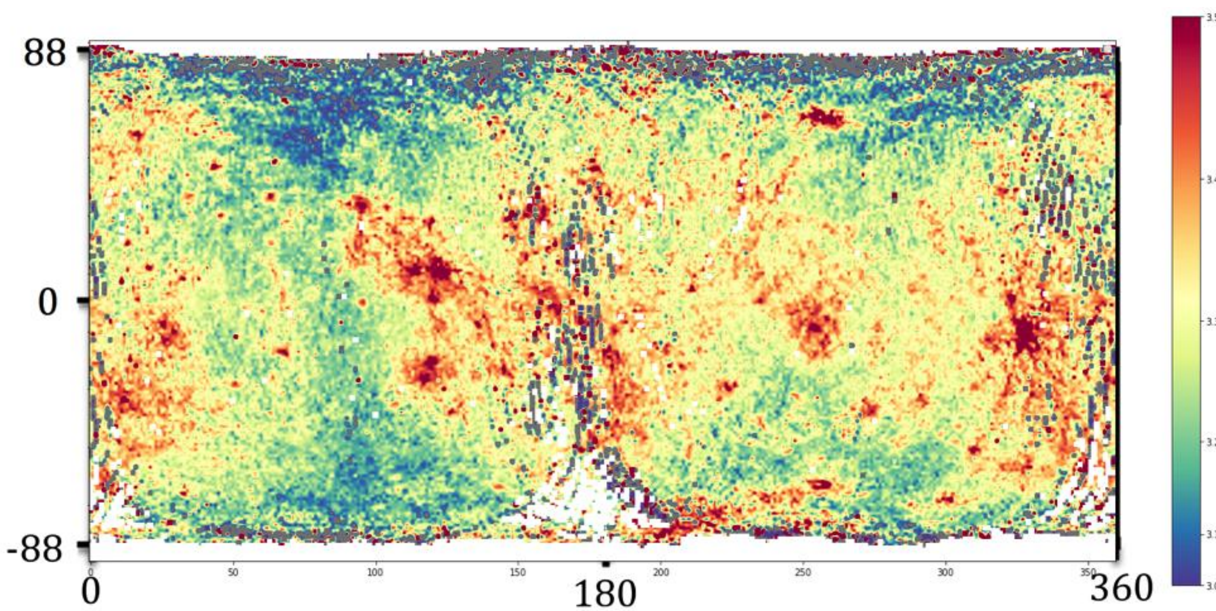


**Figure 2.** MASCS based Global UV Downturn map created using $UV_{depth}$equation from [5].