MESSENGER'S MERCURY GLOBAL COLOR MOSAIC: PHOTOMETRIC UPDATE. Deborah L. Domingue[1], Scott L. Murchie[2], Brett W. Denevi[2], Nancy L. Chabot[2], [1]Planetary Science Institute, 1700 E. Fort Lowell, Suite 106 Tucson, AZ 85719, E-mail: Domingue@psi.edu, [2]Johns Hopkins University Applied Physics Laboratory, Laurel, MD 20723.

Introduction: Acquisition of global multispectral imaging coverage of Mercury, a major objective of the MESSENGER mission, was accomplished by the Mercury Dual Imaging System wide-angle camera (MDIS WAC) largely within the first solar day of orbital observations (6 April 2011 through 29 September 2011). Because of MESSENGER's non-Sun-synchronous, highly eccentric orbit, it was unavoidable that this coverage encompassed a wide range of illumination conditions. To develop an initial photometric correction to a standard geometry (incidence, emission, and phase angles of i=30°, e=0°, and α=30°) for mosaicking multispectral images with minimized mismatches at seams, both disk-integrated and disk-resolved photometric observations were acquired during the three flybys preceding Mercury orbit insertion [1]. Additional photometric measurements of targets near the Beethoven and Rembrandt basins were acquired from orbit in order to cover photometric geometries not attainable during the flybys.

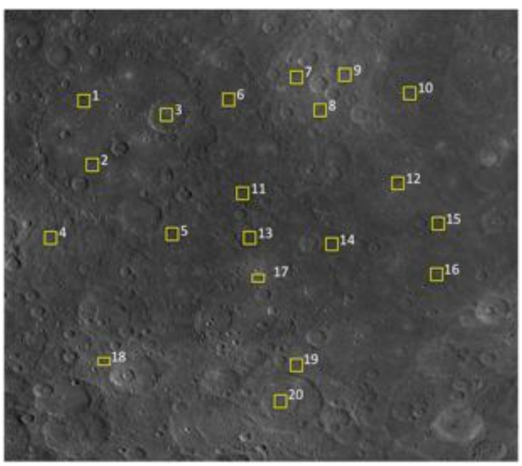

Figure 1. Photometric regions sampled in the Beethoven basin (upper left corner) region centered at -30°N, 247°E. Image covers latitude -9.3° to -50.5°N and longitude 225° to 272°E .

Application of the "flyby" correction to hemispheric color mosaics taken during the flybys showed that the photometric correction produced a relatively seamless global color mosaic for images acquired at <110° phase angle and at incidence and emission angles below 70° [1]. Application of the same photometric correction to images acquired from orbit, at photometric geometries largely outside the range of those acquired during the flybys, however, show that the "flyby" correction leaves large residuals in modeling images acquired at high incidence angles.

Partway through the first solar day (24 May 2011), contamination affected the outer optic of the WAC and cleared only gradually thereafter [2], resulting in time-variable radiometric calibration for the subsequent six months or longer. A correction to the radiometric calibration for this event has been developed [2], but only the first photometric target near the Beethoven basin was measured before the contamination event. Therefore, the next generation of photometric correction was developed in parallel with the calibration correction, using 20 areas (Fig. 1) selected from this photometric target region for analysis. An additional 10 regions selected from a portion of the color mosaic image set (Fig. 2) were also included to provide complementary incidence and emission angle coverage.

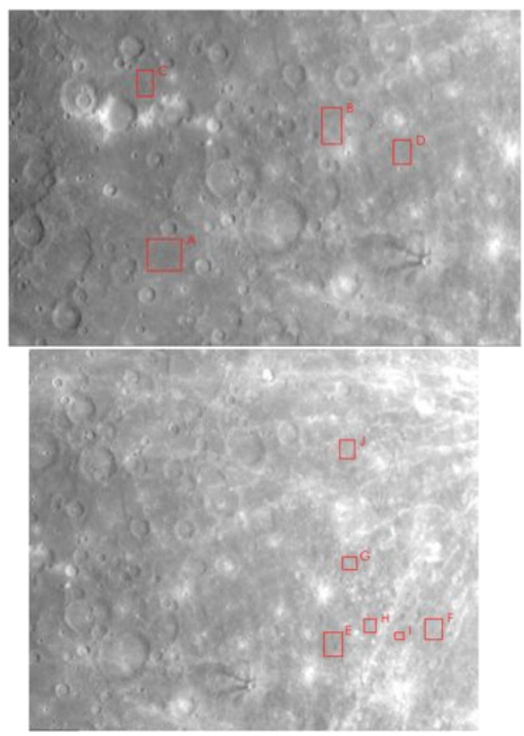

Figure 2. Photometric regions sampled from the color mosaic image sets. Matabei crater (22.2-km-diameter crater with dark rays) at -39.9°N, 356.1°E, is seen in this region.

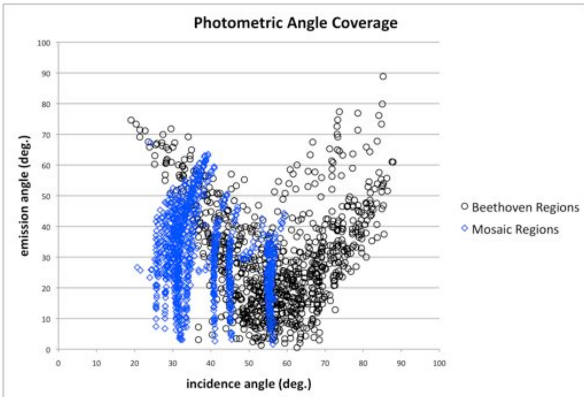

Figure 3. Photometric angle coverage from the Beethoven regions (black circles) and the mosaic regions (blue diamonds) used in the derivation of the photometric correction.

Analysis Strategy: The regions selected for photometric analysis (Figs. 1 and 2) are representative of average Mercury terrain. Figure 3 shows the distribution of incidence versus emission angle spanned by the sampled photometric regions near Beethoven basin. The angle space covered by the dedicated photometric observations did not sample well the photometric conditions under which the color mosaic images were acquired or the photometric geometry to which the color mosaic images are to be corrected (i=30°, e=0°, α=30°). The additional 10 generic regions (from color mosaic image sets) were therefore added to the analysis to provide additional coverage in photometric angle space and to include these geometries (Fig. 3).

All regions were sampled to provide incidence, emission, phase, and reflectance values that were then modeled using Hapke's equations with the methods described earlier [1]. The data were modeled in several combinations: (1) using data derived only from the Beethoven photometric region, (2) using data derived only from the mosaic images (the "mosaic" solution), (3) combining data derived from all sampled regions (the photometric "area" solution). Figure 4 shows the global color mosaic derived from the photometric modeling results for the analysis with data only from the mosaic region (used for the global color mosaic delivered to the Planetary Data System).

Results: The global color mosaic derived with the "flyby" photometric corrections shows mismatches at boundaries of images taken at high incidence angles but good matches in regions of high incidence and high emission angles. The global color mosaic produced with the "mosaic" solution shows better fits in regions of high incidence angle, but mismatches in regions of high incidence and emission angles. The global color mosaic produced with the "area" solution also shows better fits in the regions of high incidence angle, but it has the poorest matches in regions of high incidence and emission angles.

References:

[1] Domingue D. L. et al. (2011) *Planet. Space Sci.*, 59, 1873-1887, doi:10.1016/j.pss.2011.03.014. [2] Keller M.R. et al. (2013) *LPS, 44*, this meeting.

Figure 4 (below). MESSENGER global color mosaic produced with the "mosaic" photometric correction. The 1000-nm, 750-nm, and 430-nm filters are displayed in the red, green, and blue channels, respectively.