The version 2 MRO MARCI MDGM is generated one mission subphase at a time. The production procedure involves the following steps.

(1). Download the MRO MARCI EDR images for the mission subphase from the PDS. Split each image into individual filters. Calculate image backplanes (incident angle, emission angle, phase angle, latitude, and longitude) using SPICE toolbox and NAIF kernels.

(2) Perform radiometric calibration to convert raw image Data Number (DN) to physical unit following the procedure described in the "marcical.txt" file in the MARCI PDS archive (including flat field). Remove any residual down-track "stripes" using a dynamically derived normalization framelet for each filter. To derive the normalization framelet, the average framelet for each filter is calculated and each line of the average framelet is divided by its smoothed version.

(3). For each filter, an averaged radiometrically processed image is derived. This averaged image is used to derive parameter values for the photometric function in [Wang and Richardson, 2015] using a non-linear least-squares fit. The derived parameter values for each filter are listed in the photoparam/ folder. These values are for the sole purpose of flattening the brightness variations related to the observation geometries and are likely non-unique. Photometric function correction is then applied. i.e., each radiometrically calibrated pixel from Step (2) is divided by the value calculated using the photometric function.

(4). For each filter, an averaged photometrically corrected image swath is derived for each resolution. All MARCI UV images have 128 samples per line. For MARCI visible images, a mission subphase often contains two resolutions – (a) 1024 samples per line and (b) 512 samples per line. Occasionally, there are not enough images of one resolution or the other within a mission subphase to generate the average. When this happens, images of the same resolution in adjacent mission subphases are combined to calculate the average.

One or both bright polar cap(s) in the averaged swath are sometimes "removed" by extrapolating values from the none-ice area near the cap edge toward the pole. Different extrapolation methods were experimented, none has been found to outperform others for all subphases. The simplest extrapolation method substitutes the affected image lines with an empirically chosen image line near the polar cap. It is currently the default as it leads to acceptable results for all times of year.

Each image swath from Step (3) is divided by the averaged swath. This normalization step is meant to further flatten the brightness variation due to illumination and viewing geometries.

For UV swaths and some blue swaths, semi-manually crop out the area with severe anomalies and smooth out obvious residual along-track stripes.

(5). Calculate the weight to be used to merge image swaths into MDGMs. The weight is based on the sum of the incidence angle, emission angle, and phase angle. Larger weight is assigned to

smaller sum. As the pixels with extreme geometries near the north and south terminators cause apparent anomalies in MDGM, they are assigned zero weight.

(6). Organize MARCI images into different days according to their imaging time. Each day contains images taken within 13 consecutive MRO orbits. Daily mosaic is made for each filter using the image processed through Step (4), the weight assigned in Step (5), and the latitude and longitude backplanes calculated in Step (1). For visible bands, both 0.1° and 0.05° MDGMs are made. Since the highest spatial resolution of UV swath is about 8 km/pixel at nadir, only the 0.1° MDGMs are made for band6 and band7.

(7). Make color MDGM by using the band4, band2 and band1 maps (or band3, band2 and band1 when band4 is unavailable) from Step (6) as the R, G, and B band of the color composite. A consistent color scheme is applied for all color MDGMs whereby, for each band, the median is scaled to a selected value and the range is stretched to 0-255 using the table below. The choice of the values in the table is arbitrary. Users can apply further color stretch to achieve their desired color. The RGB color composite is saved in TIFF format.

Band	**median**	**range**
R	2.5	1.0 – 4.5
G	1.75	0.5 – 4.5
B	1.5	0.5 – 4.0

(8) Convert the black-and-white maps from Step (6) into TIFF images by scaling their medians to 1.5 and stretching the values between 0.0 and 3.0 to the range of 0-255.