PHOTOMETRIC MODELS FOR CORRECTING CHANG'E-3 VNIS DATA. J. Zhang[1] , B. Li[1], Z. C. Ling[1], [1]Institute of Space Sciences and Shandong Provincial Key Laboratory of Optical & Solar-Terrestial Environment, Shandong University (Weihai), Weihai 264209, China (zhang_jiang@sdu.edu.cn).

Introduction: The VIS/NIR Imaging Spectrometer (VNIS) is an instrument onboard the Chang'E-3 Yutu Rover, which can obtain high resolution spectra between 450 nm and 2400 nm. During its operation, the spectral measurements at the four locations near the landing site have been taken at solar phase angles of 108°, 87°, 85°, and 96° (Fig. 1). To understand the mineralogical compositions in this area [e.g., 1], these VNIS spectra have to be photometrically corrected into a standard illumination-viewing geometry, i.e., incidence (i) and phase angles (g) are 30°, emission angle (e) 0°.

Previous photometric corrections has been developed with Hapke modeling and the in situ Chang'E-3 PanCam measurements at 640 nm [2], or directly using photometric models derived from other orbital observations such as the Chandrayaan-1 Moon Mineralogy Mapper [3], both of which are based on the ratio of photometric function to that at the standard illumination-viewing geometry [4].

When multiple scattering term is considered in Hapke function, the Ambartsumian-Chandrasekhar H function contains single scattering albedo (SSA), which cannot be eliminated in the ratio method mentioned above and albedo difference might cause flaws in photometric normalization. In this work we will present Hapke modeling result with multi-angle reflectance measurements of the Apollo soils in laboratory, and apply it to photometric correction of the Chang'E-3 VNIS data.

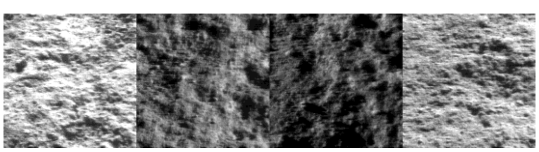

Figure 1: Four Chang'E-3 VNIS observations at 750 nm

Methods: We used a simplified Hapke model without macroscopic roughness term; the parameters in the double Henyey-Greenstein phase function are related by the Hockey-stick relation [5]; the amplitude of shadow-hiding opposition effect is set to 1.0 as been done in [6].

The multi-angle reflectance meaurements, obtained from the Apollo mare soils (10084, 12001, 15071, and 70181), were used to fit the Hapke model with the nonlinear least squares method (Table 1). These data were taken by the Bloomsburg University Goniometer, covering solar phase angles from 3° to 155° [7].

Table 1: Hapke modeling result

Sample	***w***	***hs***	***b***
10084, ,	0.098	0.047	0.312
12001	0.112	0.044	0.307
15071	0.120	0.369	0.299
70181	0.099	0.437	0.302

Then we use the Hapke model and the parameter values of hs and b in Table 1 to solve the unkown SSA for each pixel in the VNIS images; Hereafter, the reflectance at standard geometry (i=g=30°, e=0°) can be calculated.

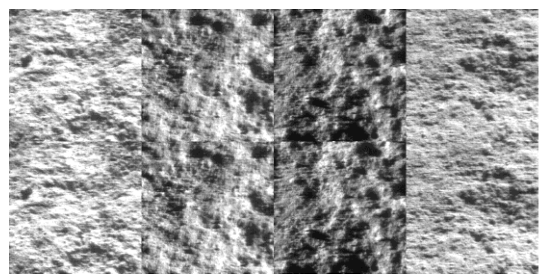

Figure 2: Photometrically corrected Chang'E-3 VNIS image at 750 nm. Top: SSA-solved; Bottom: Ratio method

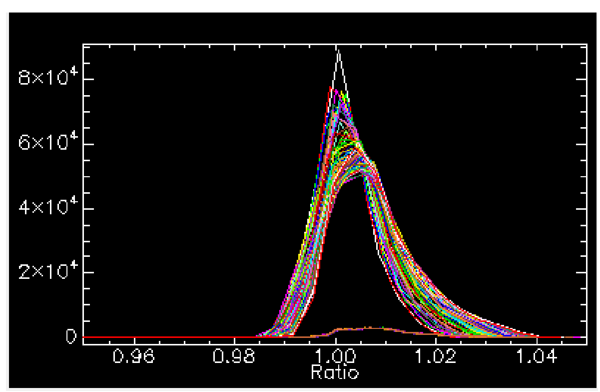

Figure 3: Histogram statistics for the ratio between Ratio- and SSA-solving photometric correction of Chang'E-3 VNIS image.

Results and Discussion: As shown in Fig. 2, photometric correction based on the SSA-solving shows similar result to that derived by the ratio method. Histogram statistics indicates that the ratio between the two photometrically corrected Chang'E-3 VNIS images varies from 0.98 to 1.04 (Fig. 3). In future, more work should be done to compare the above results with those based on in situ Chang'E-3 PanCam observations.

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References: [1] Z. C. Ling et al. (2015) *Nat. Commun., 6:8880*. [2] W. D. Jin et al. (2015) *GRL, 42*, 8312–8319. [3] Y. Z. Wu et al. (2018) *EPSL, 484*, 145–153. [4] A. S. McEwen (1996) *LPSC XXVII*, 841–842. [5] B. W. Hapke (2012) *Icarus, 221*, 1079–1083. [6] J. R. Johnson et al. (2013) *Icarus, 223*, 383–406. [7] M. K. Shepard (2001) *LPSC XXXII, Abstract #101590*, 1151–1154.