DATA PRODUCTS OF SELENE (KAGUYA) TERRAIN CAMERA FOR FUTURE LUNAR MISSIONS. J. Haruyama[1,2], M. Ohtake [1,2]. T. Matsunaga[3], H. Otake[1], Y. Ishihara[1], K. Masuda[1], Y. Yokota[3], S. Yamamoto[3], [1] Japan Aerospace Exploration Agency (JAXA), JAXA Space Exploration Center, 3-1-1 Yoshino-dai, Chuo-ku, Sagamihara, Kanagawa 252-5210, Japan., [2] JAXA, Institute of Space and Astronautical Science, Institute of Space and Astronautical Science, [3] Center for Environmental Measurement and Analysis, National Institute for Environmental Studies, 16-2 Onogawa, Tsukuba, Ibaraki 305-8506, Japan. E-mail: haruyama.junichi_at_jaxa.jp.

Introduction: Recent lunar missions, including the US Lunar Reconnaissance Orbiter (LRO), Gravity Recovery and Interior Laboratory (GRAIL), Lunar Atmosphere and Dust Environment Explorer (LADEE); Indian Chandrayaan-1; Chinese Chang' E- 1, 2, and 3; and Japanese Selenological and Engineering Explorer (SELENE; nicknamed Kaguya) have acquired enormous data sets for the Moon. Those data sets provide excellent bases for new lunar science and future lunar missions.

Among the data sets, the surface image and morphology data of the Moon such as from the SELENE Terrain Camera (TC), a 10 m/pixel stereo imager, are especially important for selecting future landing sites and planning approach routes from the landing site to research locations. We calibrated and corrected the data and released several TC higher products through the "SELENE (Kaguya) data archive system [1]." In this presentation, we will introduce TC products that have been or will be released.

SELENE Terrain Camera: The Terrain Camera (TC) is a mission instrument of the Lunar Imager/SpectroMeter (LISM) camera system aboard SELENE [2]. The other two LISM instruments are the Multi-band Imager (MI) and the Spectral Profiler (SP). The TC consists of two telescopes with slant angles of ±15° to obtain stereo-pair data, from which digital terrain models (DTMs) of the lunar surface can be produced. Each telescope has a one dimensional CCD, and surface images are obtained by a push-bloom scanning method. The TC resolution is 10 m/pixel at the surface from a nominal SELENE altitude of 100 km. Each CCD has 4096 pixels. TC acquires data with a nominal 3504 pixels, though occasionally 4096 or 1752 pixels, depending on allowed data acquisition resources. TC has three observation modes: a "stereoscopic" observation mode used at relatively high solar elevation angles, the "singlescopic" observation mode at lower solar elevation angles, and the SP support observation mode with high compression and 1752 pixels to obtain supportive image data to determine SP observation locations. In the nominal one-year SELENE mission period and a half year extended mission, TC observed almost the entire lunar surface.

TC L2B and L3D: Released LISM products through the SELENE data archive system [1] are classified into four processing levels , L2B, L2C, L3D, and MAP (see Table 1). L2B, L3C, and L3D were cut from originally longer strip data and registered as "scene" products for easier handling [2]. "MAP" products are globally mosaicked data.

L2B is image data of radiance values after dark and flat image calibrations are performed on L2A raw data that is neither geometrically corrected nor radiometrically calibrated. TC L2A data have not been opened to the public but will be released in the future. The main products of L3D level data are digital terrain models (DTMs) and ortho-rectified images (TCOrtho) from L2B data. TCOrtho images of L3D are reflectance data (radiance-factor defined by Hapke [3]) [4-7]. Only a set of illumination angles (incidence, emission, and phase angles) of the center of each scene were used in converting from radiance to radiance-factor to leave local topographic reliefs. There is no TC products classified at the L3C.

TC MAP Products: We have released four "MAP" type products mosaicked from TC data: "TCOrtho_MAP" from TC stereoscopic observation data acquired at higher solar elevation angles, "DTM_MAP" of mosaicked digital terrain models as a pair of TCOrtho_MAPs, and "TC_Morning_MAP" and "TC_Evening_MAP" that are from mostly TC singlescopicobservation data acquired in the morning and evening.

Missing and low-quality areas remain in the DTM MAP because of SELENE operation and shadows especially at higher latitudes. The missing areas were provided by the elevation data from SELENE MI DTM (20m/pixel, Base-Height

ratio 0.38) and LRO LOLA. The resultant global elevation model, called the "SELENE and LRO Elevation Model (SLDEM)" [8], has an elevation accuracy of 10 m or better.

SLDEM is a global, seamless elevation model of the Moon. The L3D DTM TCOrtho scene data set is revised by SLDEM. First, SLDEM is used for complementing the shadowed region's DTM that was filled by an artificial value in the current version (ver. 3). Next, TC singlescopic data with no stereo-pair is ortho-rectified using the SLDEM. The new data set of ortho-rectified images and corresponding elevation models from all the TC stereoscopic and singlescopic observation data are being prepared and will be released as "TCOrtho DEM." Prior to all the singlescopic data ortho-rectification, we revised Morning and Evening Maps using some ortho-rectified singlescopic image data. The mismatched boundaries seen in the previous version of the map products are not seen in these revised Map products (ver. 4).

Conclusions: We have provided several types of SELENE TC products. The total TC data products exceed 25 TB (after lossless compression) that are more than 70% volume of the SELENE products registered in the SELENE data archive system. We hope that the TC products will be used for various fields of lunar science and will enable future lunar mission planning.

References: [1]ttp://l2db.selene.darts.isas.jaxa.jp /index.html.en. [2] Haruyama, J. et al, (2008) *Eearh Planets and Space*, 60, 243-255. [3] Hapke, B., (1993) *Theory of Reflectance and Emittance Spectroscopy*, 262, Cambridge Univ. Press. [4] Haruyama, J. et al., (2008) *Adv, Space Res.* 42(2), 310-316.[5] Besse, B. et al., (2013) *Icarus* 226, 127-139.[6] Ohtake, M. et al., (2013) *Icarus* 226, 364-374.[7] Pieters, C. M. et al., (2013) *Icarus* 226, 951-963. [8] Haruyama et al., (2012) *43rd LPSC*, Abstract #1200.

Table 1. TC products archived in the SELENE data archive system [1] (2013 27/Dec)

Product_ID	Value	Projection Type	Product Type	Directry	Total Volume
TC_SPsupport_Level2A[1]	Raw data [DN]	(Raw)	Scene	/LISM/L2A/TC_SPsupport_Level2A	111G
TC_s_Level2A[2]	Raw data [DN]	(Raw)	Scene	/LISM/L2A/TC_s_Level2A	414G
TC_w_Level2A[3]	Raw data [DN]	(Raw)	Scene	/LISM/L2A/TC_w_Level2A	934G
TC_SPsupport_Level2B0[1]	Radiance	(Raw)	Scene	/LISM/L2B/TC_SPsupport_Level2B0	789G
TC_s_Level2B0[2]	Radiance	(Raw)	Scene	/LISM/L2B/TC_s_Level2B0	1.4T
TC_w_Level2B0[3]	Radiance	(Raw)	Scene	/LISM/L2B/TC_w_Level2B0	4.3T
DTM_TCOrtho	Radiance factor[7]	Simple Cylindrical[8], Polar Stereo[9]	Scene	/LISM/L3D/DTM_TCOrtho	4.4T
TC_Morning_MAP[4]	Radiance factor[7]	Simple Cylindrical	Mosaic[10]	/LISM/MAP/TC_Morning_MAP	2.0T
TC_Evening_MAP[5]	Radiance factor[7]	Simple Cylindrical	Mosaic[10]	/LISM/MAP/TC_Evening_MAP	2.0T
DTM_MAP	Elevation [m]	Simple Cylindrical	Mosaic[10]	/LISM/MAP/DTM_MAP	2.0T
TCOrtho_MAP	Radiance factor[7]	Simple Cylindrical	Mosaic[10]	/LISM/MAP/TCOrtho_MAP	2.0T
SLDEM2013[6]	Elevation [m]	Simple Cylindrical	Mosaic[11]	/LISM/L3D/SLDEM2013	2.0T

[1] Product from SP support observation

[2] Product from singlescopic observation

[3] Product from stereosopic observation

[4] Product from mostly TC singlescopicobservation data acquired in the morning

[5] Product from mostly TC singlescopicobservation data acquired in the evening

[6] Digital elevation model (DEM) from SELENE TC, MI, and LRO LOLA

[7] A set of illumination angles (incidence, emission, and phase angles) of the center of each scene were used in conversion

[8] Simple cylindrical projection for products of higher latitudes (+/- 60deg +)

[9] Polar stereo projection for products of lower latitudes (+/- 60deg -)

[10] 3600 x 3600 pxls/ 3x 3°

[11] 1200 x 1200 pxls/ 1x 1°