VISUALIZATION OF NEAR-INFRARED SPECTRAL DATA OF EROS USING THE SMALL BODIES MAPPING TOOL. Rachel L. Klima (Rachel.Klima@jhuapl.edu)[1], Olivier Barnouin[1], Carolyn M. Ernst[1], Noam R. Izenberg[1] and Eliezer Kahn[1]. [1]Johns Hopkins University Applied Physics Laboratory, Laurel, MD 20723, USA.

Introduction: One of the primary drivers for many missions visiting asteroids is to advance our understanding of their composition beyond what can be (and is) already measured by telescopes. Without sample return or lander missions, this task relies primarily on resolved near-infrared spectroscopic measurements. Scientific analysis using spectral data collected by point spectrometers is not as straightforward as for imaging spectrometers, where the local spatial context is immediately available. In the case of Eros and other highly non-spherical bodies, this problem becomes even more severe when trying to locate spectra that cross a mapped feature that bends over an irregularly shaped surface. Thus, it is often the case that outside of the mission teams, few from the community at large delve into these data sets, as they lack the tools necessary to incorporate the spectral information into geological analyses of the asteroids. Ultimately, we seek to make such spectral datasets, which NASA has invested significant amounts of money to obtain, more widely accessible and user-friendly. We focus here primarily on the NEAR/Near-Infrared Spectrograph (NIS) data, first improving the calibration to make it more scientifically accurate and then developing the SBMT to allow spectral visualization of these data in a spatial context.

Small Bodies Mapping Tool: The Small Bodies Mapping Tool (SBMT) is a Java-based, interactive, three-dimensional visualization tool (Fig. 1) written and developed at APL to map and analyze features on irregularly shaped solar system bodies. The SBMT can be used to locate and then "drape" spacecraft images, spectra, and laser altimetry around the shape model of such bodies. It provides a means for rapid identification of available data in a region of interest and allows features to be mapped directly onto the shape model. The program allows the free rotation of a shape model (including any overlain data) in all directions, so that the correlation and distribution of mapped features can be easily and globally observed. A zoom feature also allows the evaluation of individual structures on scales both small (e.g., morphology) and large (e.g., orientation).

NIS Data Visualization in the SBMT: NIS spectral footprints can be visualized on Eros by selecting the 'NIS' tab in the top interface of the SBMT. On this panel, data can be searched for by time range, spacecraft distance from Eros, or incidence, emission or phase angle. Once these footprints have been located by the tool, a user-defined number of them can be displayed for a specific region. The shapes of the footprints are draped on the model, as shown in Fig. 1. The footprints can be colored either as greyscale or as using three color channels, each of which can display either reflectance in a single channel or the result of a user-defined band math algorithm (Fig. 2). These equations are input by clicking custom formulas, which then appear in the pull-down menus for each of the colors. A custom stretch for each color is also available.

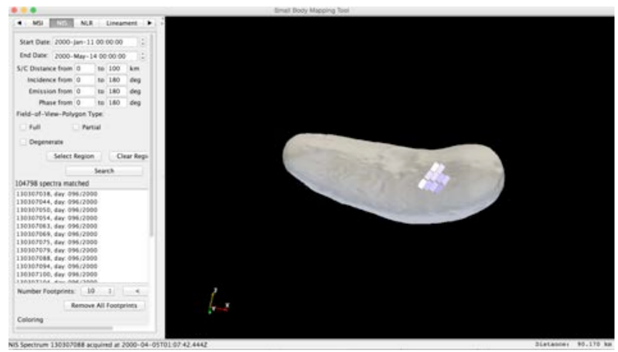

Fig. 1. The Small Bodies Mapping Tool projects spectral, image, and altimeter data onto shape files of irregularly shaped objects. The objects can be rotated and zoomed simply with a mouse to examine regions of interest.

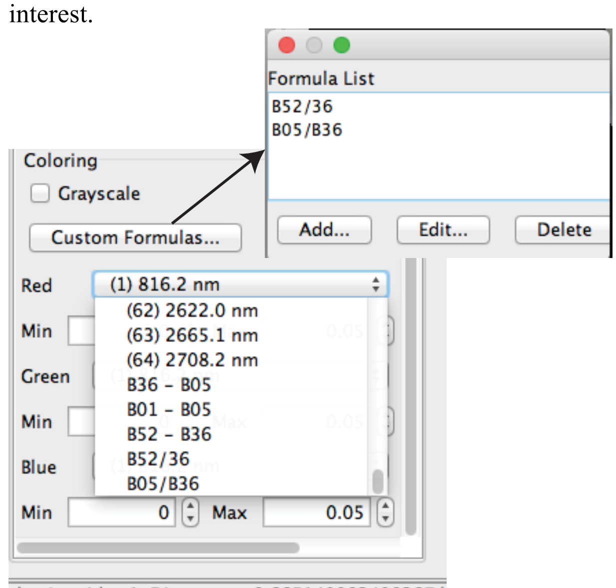

Fig. 2. The SBMT can be used to visualize spectra data in three colors as reflectance or as user-defined band-math parameters.

The spectra of individual footprints can be directly inspected by right-clicking on the spectrum and selecting 'spectrum', which displays the spectrum as well as ancilliary information, as shown in Fig. 3. A text version of the spectrum can also be saved, again by right clicking on the footprint and selecting 'save spectrum'.

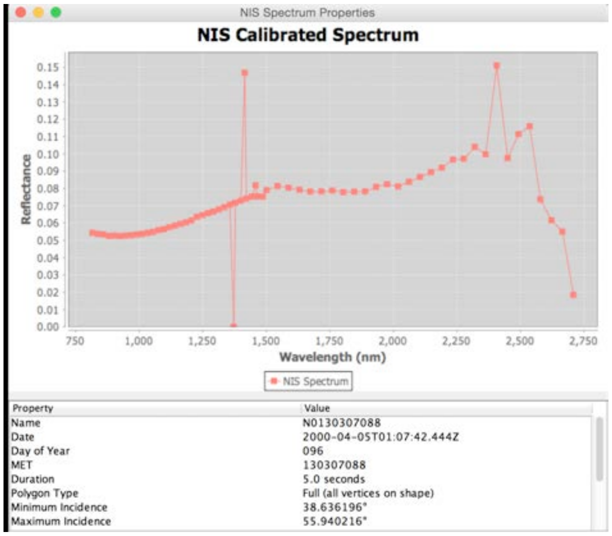

Fig. 3. Spectral display interface in the SBMT. Each spectrum is displayed with the time of the observation as well as viewing geometry information.

NIS Recalibration: In parallel with the development of the spectral data visualization capabilities of the SBMT, we are reexamining the spectral calibration of the NIS data of Eros. NIS is a grating spectrometer with 64 channels across two separate detectors. Initial in-space calibration of NIS was presented in Izenberg *et al.* 2000. NIS observations of the Earth, Moon, and Eros discussed in [1] supplied initial cross-calibrations of the imager and spectrometer before orbital observations. Acquisition methods, analysis, and early interpretation of NIS photometric and spectral data from the initial low phase angle flyby period of the NEAR mission were described in [2]. Additional details on the photometric and mineralogic properties of Eros derived from NIS observations can be found in [3-5].

The primary goal in the recalibration is to revisit the scattered light correction. The NIS scattered light correction in [6] was applied using a "back-end" method on previously calibrated and photometrically corrected data. More appropriately, scattered light should be removed from each individual spectrum and the radiance conversion coefficients as part of the calibration process, before photometric correction.

In addition to the scattered light correction, we are examining the dark measurements collected throughout the mission to evaluate background signal as a function of time. Changes to the dark current subtraction will be folded into the re-calibration pipeline before the scattered light correction, and the resulting data will be despiked to remove hot pixels (such as seen in the s spectrum in Fig. 3). The calibration procedure will be applied to the full NIS spectral dataset.

In parallel with the calibration efforts, we are using the SBMT to derive new average incidence, emission and phase angles for each of the footprints in the NIS observations relative to the topography of Eros using the improved Gaskell shape model. We will also characterize the macroscopic roughness of the sites. Two photometric models have been developed to describe the scattering properties of the surface of Eros [3,5]. Once the spectra have been corrected to radiance and the revised angles have been calculated, we will test each of these photometric models using sets of overlapping spectra. As illustrated in Fig. 4, there are currently cases where pixels imaging the same region of Eros have significantly different shapes. Ideally, applying the photometric corrections should result in all overlapping spectra appearing nearly equivalent in both absolute radiance and spectral shape. Once a model has been tested and selected, we will apply it to the full suite of data.

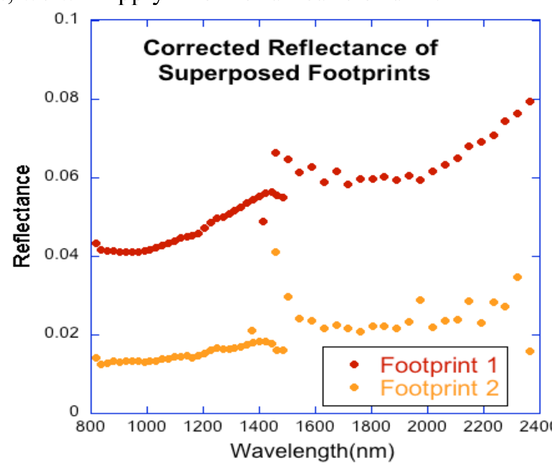

Fig. 4. Comparison of NIS spectra for two footprints of the same region of Eros.

Public Availability of SBMT and Recalibrated Data: The SBMT and associated documentation are available for download at http://sbmt.jhuapl.edu/. Versions are available for Mac, Windows and Linux. Work is underway to also provide a portal to the SBMT through the Small Bodies node of the PDS. Once recalibration of the NIS data is complete, these data will be submitted to the PDS for peer-review. Following peer-review, they will replace the current NIS data in the SBMT.

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References: [1] Izenberg, N R. et al. (2000), Icarus 148, 550. [2] Bell, J. F., et al. (2002), Icarus 155, 119. [3] Clark, B. E. et al. (2002), Icarus 155, 189. [4] McFadden, L. A. et al. (2001), MAPS 36, 1711. [5] Li, J. Y. et al. (2004), Icarus, 172, 415. [6] Izenberg, N. R. et al. (2003), MAPS 38, 1053.