**EUROPA CLIPPER PREPARATORY PHOTOMETRY TO CONSTRAIN SURFACE PROPERTIES.** R. D. Dhingra[1], B. J. Buratti[1], and B. S. Seignovert[2], [1]Jet Propulsion Laboratory, California Institute of Technology, CA, USA, (*rajani.dhingra@jpl.nasa.gov), [2]Laboratory of Planetary and Geodynamics at Nantes, France

**Introduction:** Europa, the target for NASA's upcoming mission Europa Clipper [1], hosts a subsurface salty ocean beneath its ice layer [2]. Europa serves as one of the prime targets for investigating habitability in our solar system [3]. Photometry –the quantitative measurement of reflected and emitted radiation –provides insight into many surface properties of a planetary body, like the compaction state of the upper regolith, the roughness of the surface, the size distribution of particles, the single-particle albedo and the phase function. We perform a photometric study of Europa [4] to understand its surface properties below the resolution limit of the scientific instruments, providing fundamental parameters for planned and future scientific investigations.

**Data:** We use data available from the five NASA missions, *Voyagers* 1 and 2, *Galileo*, *Cassini*, and *New Horizons* that have examined Europa dramatically increasing the range in viewing geometry, surface coverage, spatial resolution, spectral range, and temporal range.

The Galileo Imaging Subsystem dataset's resolution (10s of meters) far exceeds the one from Voyager (100s of meters). We majorly use the Galileo data from the Imaging System's (SSI) clear filter for generating a plot that depicts the variation of reflected light (I/F) at varying observation geometries. The Galileo clear filter is a broadband filter that covers the peak of solar radiation.

**Method:** First, we select the images from the PDS (Planetary Data System). Then we performed a radiometric calibration on them in ISIS3. We find that most of the Galileo images need correction for the effects of viewing geometry and carry that out in all the selected images.

We use 21 full disk images of Europa from *Voyager's* Imaging Science System (ISS), *Galileo's* Solid-State Imaging (SSI), and *New Horizons'* LOng Range Reconnaissance Imager (LORRI) at differing observation geometries (10◦- 128◦ (phase angle)) to compute disk integrated surface scattering properties over various geomorphological units.

We fit the I/F of these images to two photometric functions – the Minnaert function [5], given by:

$$I/F\ (\mu_0, \mu_1) = B_0 * \mu_0^{k} * \mu_1^{k-1}$$

and the Lommel-Seeliger plus Lambert photometric function given by:

$$I/F\ (\mu_0, \mu_1, \alpha) = A * f(\alpha) \frac{\mu 0}{(\mu 0+\mu 1)} + B\mu_0$$

where I/F is the ratio of incident to reflected radiance, and $B_0$ and k are empirical parameters. $\mu_0$ and $\mu_1$ are the cosines of incidence and emission angles.

We extract the fit parameters (k, $B_0$, A, and f(α)) for each geomorphological region —Plains; Bands; High albedo chaos; Mottled albedo chaos; Low albedo chaos, and Craters [6].

**Results:** The photometric models we use in this study can distinguish only four photometric units: Plains; Bands, High Albedo Chaos (which exhibit a brighter ($B_0$) than the Mottled & Low Albedo Chaos, and are close to the Plains & Bands n parameter fits) and the Crater terrain in general.

We find that the surface albedo parameter, $B_0$, in the Minneart function gradually decreases with increasing phase angle. The model parameters' variation over a broad observation geometry suggest that the geomorphic units tend to behave similarly. We also observe that the photometric parameters (proxy for albedo) are not highly dependent on the geologic terrain type. We infer the variation of our model parameters — $B_0$, k, A, and f(α) with respect to phase angles for geological units by fitting a first-degree polynomial. For all the geological units the model parameters can be fit by a line.

The linear fit provides an analytical function that can be used for the photometric models. The photometric correction will then depend explicitly on the observation geometry (incidence, emission, and phase).

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