We performed linear modeling of E6TERINC along the lines of [13, 14], using two hydrates and water ice of various grain sizes. The first hydrate was taken from the data, equivalent to the "average" hydrate spectrum from [3] (Figure 3). In addition we used a wavelength-extended version of sulfuric acid hydrate from [5, 6] (Figure 3). A scaling function taken to a variable power is used to modify the average hydrate spectrum to account for photometric variations (Figure 4). We used a bidirectional reflectance model for water ice (at a temperature of 110 K) whose grain sizes were created for the lighting geometry of the cube as a third component.

The linear model of E6TERINC produced very good fits in general. The map of the average hydrate is shown in Figure 5, reaching near unity at some places in the observation. This component is smallest towards the poles. The sulfuric acid hydrate (Figure 6) is present on the trailing side but is strongest (max ~35%) in the mid latitude areas east of 210 W longitude. Water ice is most abundant in the polar regions reaching over 60% there (Figure 7). Figure 8 shows the water ice grain radius (in the upper right corner, the fit is improved by using a mixture of two discrete grain sizes, the largest one near a radius of 1 mm) is largest on parts of the trailing hemisphere (~1 mm), and is smallest towards the leading hemisphere (10-20 µm). The scale factor exponent varies from -1 to 1.5 over the image, generally the highest on the left side and lowest on the right side. A couple of spectral fits spanning the full least squares range of 0.015 to 0.15 are shown in Figures 9 and 10. The misfits on the right side are mostly caused by long wavelength water ice features that are stronger in the model than the data.

Modeling Results

The NIMS builds up spectral images by recording a spectrum over 20 mirror positions and up to 408 wavelengths. These wavelengths are sensed by 17 discrete detectors, each of which covers a small region of the spectrum. The third dimension of the spectral image is filled out by scanning the instrument field-of-view slowly perpendicularly to the direction of the mirror motion [7]. The NIMS observations of the icy satellites are now being reexamined and recalibrated using new techniques [8, 9, 10]. The Europa observations needed an improved despiking process for the spectra longer than 3 µm, where radiation spikes outnumber the good data by a ratio of 2 to 1, or more. The first Europa observation to be processed was TERINC (Terra Incolita) from the E6 orbit, which was known to have fewer spikes overall than average. This is a global scale observation with a pixel scale of 47 km.

This observation was dark-corrected and radiometrically calibrated using the best dark and calibration values and wavelength list [11]. The wavelengths up to 2.4 µm were despiked using our usual procedure [12]. The short wavelength process yielded about 20% spikes. For the wavelengths longer than about 2.75 µm the same despiking was used with much tighter parameters. This despiking was repeated three times to remove most of the visible spikes. Then a few hundred remaining small spikes were manually removed up to 4.2 µm. Beyond this wavelength the spectra have a few digital numbers (DN) of signal, and contain no information other than a general shape. These wavelengths were constrained to be near spectra from auroral averages [1]. The final frequency of spikes in this region was 70-80%.

Three additional Europa data sets were calibrated, SUCOMP2 (pixel scale 7.5 µm) [2] from orbit 6, LINEA (pixel scale 17 km) from orbit 3, and NHILAT (pixel scale 79 km) [13] from orbit 1. Both have considerable amounts of data, but both have a spike abundance of 80-90% in the longtime part that keep that region from detailed analysis. Due to illness in the last several months, I was only able to complete the modeling of the TERINC observation.

NEWLY CALIBRATED AND MODELED OBSERVATIONS

Using the model developed for the NHILAT cube [13], we modeled the TERINC observation. A map of the prime mission observations (with this observation the large one outlined in orange) is shown in Figure 1. A monochrome image of the cube with approximate photometric correction and a labelled lat-long grid is shown in Figure 2. The calibration and projection were complicated by the fact that the two parts of the cube were recorded in different gain states and projected separately in the PDS data. We combined the calibrated raw data and projected them together.