GALILEO PPR OBSERVATIONS OF EUROPA: CORRELATIONS OF THERMOPHYSICAL PROPERTIES WITH SURFACE FEATURES. J. A. Rathbun[1], J. R. Spencer[2] and C. J. A. Howett[2], [1]Planetary Science Institute (1700 E. Fort Lowell, Tucson, AZ 85719 *rathbun@psi.edu*), [2]Southwest Research Institute (1050 Walnut Street, Suite 300, Boulder, CO 80302, USA).

Introduction: Europa is the second innermost of the Galilean satellites of Jupiter, with a relatively young, icy surface [1-3]. Two of the most important questions remaining about Europa are: is liquid water involved in the formation of surface features and how active is Europa today? [4]. Both of these questions can be addressed with thermal measurements of the surface.

The Gaileo Photopolarimeter-Radiometer (PPR) instrument mapped thermal infrared radiation from Europa, but found no signs of endogenic activity [5,6]. The data have, however, been used to determine thermophysical properties of the surface, which provide insight into the physical state of the surface [6]. This earlier study of Galileo PPR data derived thermal inertia and bolometric albedo for 20% of Europa's surface using 13 PPR data sets. They also determined hotspot detection limits for 15 data sets. While no endogenic thermal features have been found, 100 km^2 hotspots with temperatures of 116 K to 1200 K could exist on the surface without being detected, depending on location.

Rathbun et al. [6] chose 13 PPR data sets based on signal to noise and large coverage. They then divided the Europan surface into 10 degree square bins. For each bin, they searched the data sets for observations at different times of day. For each bin with observations at night and within 2 hours (22 degrees) of noon, they matched the temperature curves to a thermal model in order to determine the average thermal inertia and bolometric albedo within the bin (figure 1).

To determine the detection limit for each location on each observation, Rathbun et al. [6] added synthetic unresolved thermal anomalies of various brightnesses to the data and noted the brightness at which these became detectable above the background. This detection limit could depend on the thermal properties of the material, the spatial resolution of the observation, and the filter used in the observation. In order to compare detection limits in different filters, assumptions must be made. Since the average diameter for lenticulae, spots, and domes (potential sites of cryovolcanism) is 10 km, they calculated the temperature of a 100 km^2 hotspot with the brightness of the minimum detectable level. Figure 2 shows the maximum surface temperature that could exist without being detected by PPR. Most of the temperatures are well

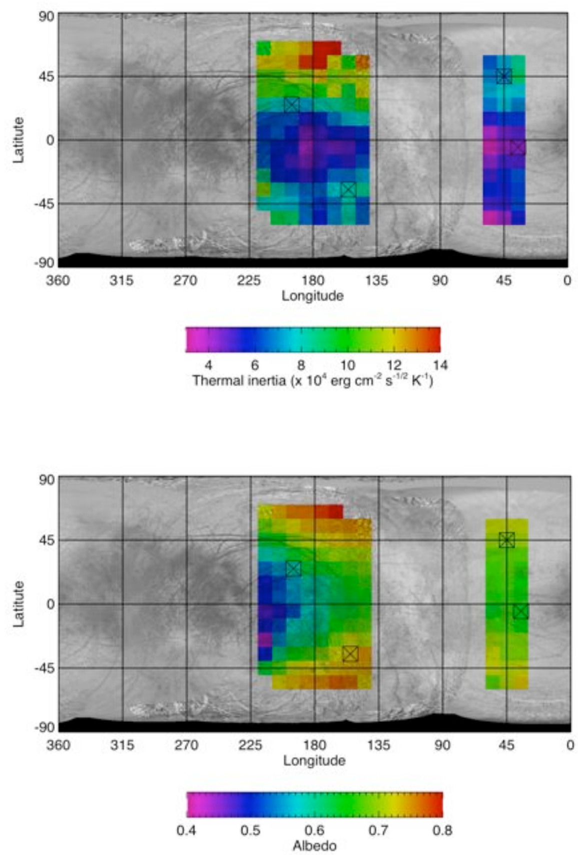

Figure 1: From [6], thermal inertia and bolometric albedo found by fitting a thermal model to PPR data.

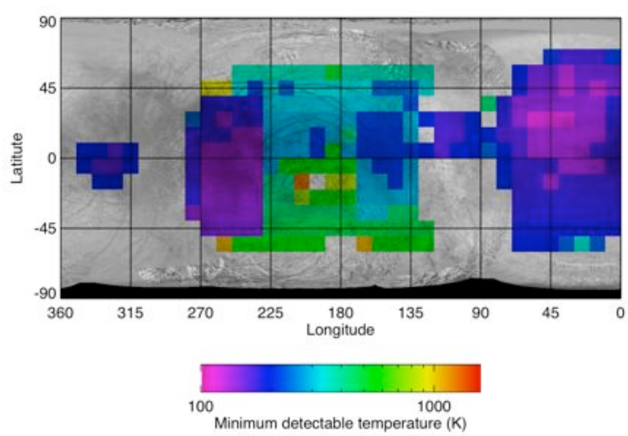

Figure 2: From [6], PPR detection limits in terms of the minimum detectable temperature of a 100 km^2 hotspot.

above the melting temperature for ice (shown in light blue in the figure). Note that clear areas are where none of the 15 PPR data sets covered. As a result, 71% of the surface has not been mapped to a degree sfficient to detect liquid water.

New Directions: The earlier study [6], was concerned with the global variation in thermophysical properities on Europa. In this work we address the question: are the thermophysical properties correlated with surface features? Howett et al. [7] found that thermophysical properties of Mimas, a Saturnian icy satellite are correlated with exogenic processes and not surface geology. However, a preliminary look at the Europa data indicate that is not the case on some parts of Europa.

An area near the antijovian point was observed during the day in Galileo's 7th orbit and at night during the 25th orbit. The left panel in figure 3 shows a portion of a geologic map of Europa [8], the middle panel shows the daytime temperature data for the same region (range 120-140 K), and the right panel shows the nighttime data (range 73-85 K). The subsolar point in the daytime data is near 175 W, 2 S. Note the abnormally warm material in the daytime image at 180 W and both 10 S and 7 N. These regions appear abnormally cool at night and correlate with a chaos region (medium blue) in the geologic map. Similarly, there is an abnormally cold region near 165 W, 15 S that appears abnormally warm in the nighttime map and correlates with a plains unit (light blue) in the geologic map. This suggests that the chaos material may have a lower thermal inertia than the plains and that thermophysical properties might be correlated with surface geology on Europa.

To test this more thoroughly, we will loosen the constraints on the earlier thermophysical study and incoroporate more PPR data sets. We will incorporate at least 3 additional PPR datasets: one each from orbits 3,4, and 17. We will fit a thermal model to the data discussed above to determine thermophysical properties in these areas. We will also separate the PPR data by terrain type instead of 10 degree bins when fitting the thermal model to exploit the maximum spatial resolution of the data.

References:

[1] Zanle, K. et al. (1998) *LPSC XXX*, Abstract #1815. [2] Pappalardo, R.T. et al. (1999) *JGR*, **104**, 24015-24056. [3] Schenk, P.M. et al. (2004) In: Jupiter: The Planets, Satellites and Magnetosphere, 427-456. [4] Pappalardo, R.T. (2011) *LPSC XLII*, Abstract #1635. [5] Spencer, J.R. et al. (2000) *Science*, **282**, 87-91. [6] Rathbun, J.A. et al. (2010) *Icarus*, **210**, 763-769. [7] Howett C. et al. (2011) *Icarus*, **216**, 221-226. [8] Doggett et al. (2009) *Mappers Meeting* abstract p. 81-82.

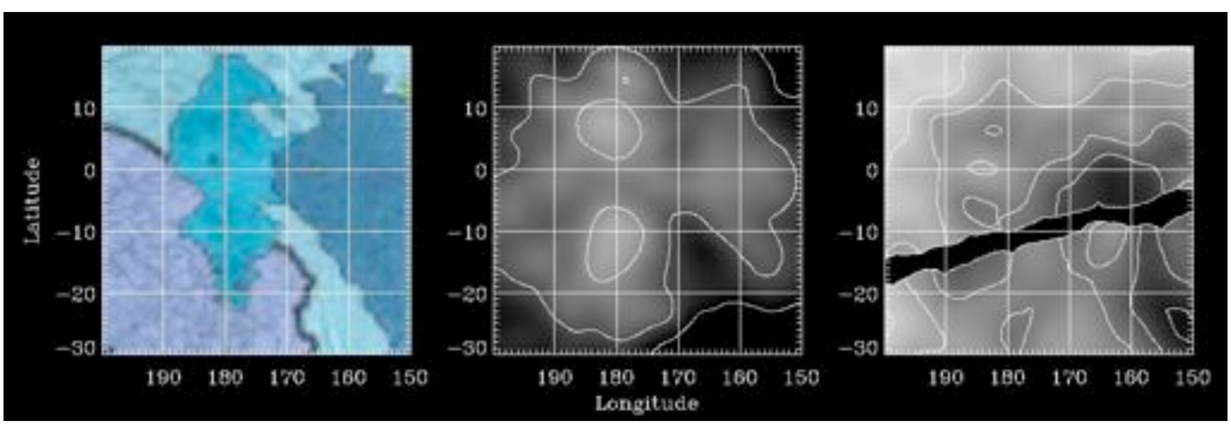

Figure 3: Correlations between temperature and geology on Europa. Left Panel: Portion of geologic map [8] showing chaos in medium and dark blue and plains in light blue and purple. Middle Panel: Daytime PPR temperatures in the range 120-140 K. Right Panel: Nighttime PPR temperatures in the range 73-85 K. Note that there is a gap in the nighttime PPR coverage.