

**COMBINING GALILEO SSI, NIMS, AND PPR DATA INTO GIS TO STUDY VOLCANIC CENTERS ON IO.** J. A. Rathbun and S. E. Barrett, University of Redlands (1200 East Colton Ave., Redlands CA 92373, USA [jullie\\_rathbun@redlands.edu](mailto:jullie_rathbun@redlands.edu))

**Introduction:** Io is the most volcanically active body in the solar system, with nearly one hundred active at one time. The Galileo spacecraft observed these volcanoes with three of its remote sensing instruments. The Solid State Imager (SSI) is a high-resolution, visible wavelength imager [1] which can detect high temperature ( $> 1000$  K) thermal emission. The Near-Infrared Mapping Spectrometer (NIMS) has a lower spatial resolution with a spectral range from 1 to 5 microns [2] and can detect thermal emission down to a temperature of approximately 200 K. PPR has the lowest spatial resolution of the three instruments [3] but, since it is sensitive to longer wavelength infrared radiation (100 microns), it can detect the low temperature emission from older lava flows. Recently researchers have begun to examine individual volcanoes by analyzing all three complimentary data sets [4,5]. Also, some work has been done to combine PPR data with data taken simultaneously with SSI or NIMS [4,6,7,8]. However, no one has combined all three data sets into a single image (or image cube) in order to correlate observed features.

Geographic Information System (GIS) software provides an easy-to-use method to visualize, manipulate, and study simultaneously the data from these three Galileo remote sensing instruments. As a prototype, we imported all of the collected data of the Amirani region of Io into ArcGIS and set up a website to share the data.

Amirani has been interpreted as the site of very long, insulated, tube-fed, compound pahoehoe lava flows [9, 10, 11]. The flows appear to have many breakouts and a haphazard temperature distribution along the length of the flow [11].

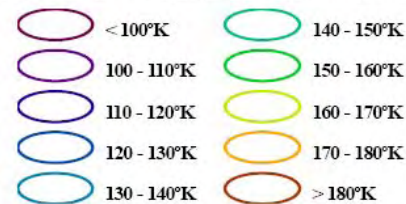
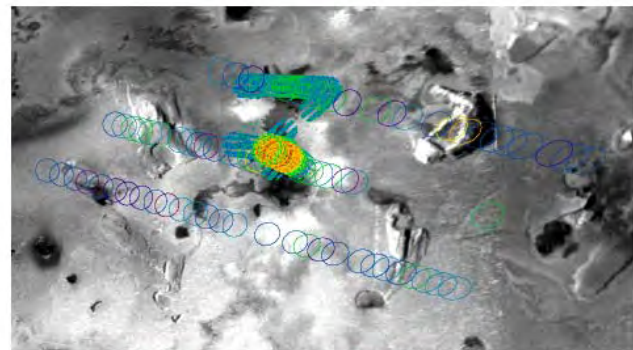
**Data Import:** We began by importing 8 datasets into ArcGIS (table 1). Two of the datasets were global mosaics, one was a high-resolution SSI mosaic, two were high-resolution NIMS, and three were PPR scans taken simultaneously with the previous three datasets. Additionally, we performed one temperature fits to the NIMS data and imported the resulting temperature maps.

The global mosaics served as the background and coordinate system and all other data was tied to it by matching surface features. We encountered some problems with data types and had to change all raster data to floating point.

**Table 1: List of Galileo data included in the prototype GIS geodatabase.**

Name	Format	Purpose	Orbit
Color mosaic	Raster	Global Image	Color Multiple
BW mosaic	Raster	Global Image	Grayscale Multiple
SSI	Raster	Grayscale Image	24
NIMS_24	Raster	Multispectral Image	24
NIMS_27	Raster	Multispectral Image	27
PPR_24IN	Tabular	Brightness temperatures	24
PPR_24IS	Tabular	Brightness temperatures	24
PPR_27IN	Tabular	Brightness temperatures	27

The PPR data were the most difficult to import. Since PPR data consist only of average temperatures in a field of view, most of them are available from the Planetary Data System (PDS) as tables instead of images or rasters. The tabular data of latitude and longitude of each field of view along with the measured temperature were relatively easy to import into GIS.



**Figure 1: All three PPR datasets represented by elliptical fields of view in ArcGIS**

However, these temperature data are averages across the entire field of view and therefore, are not true point data. We developed a system of calculations made in Excel and GIS to calculate the instrument's field of view for each data point and wrote a script to draw these resulting elliptical fields of view in ArcGIS. (For details of calculations, see [12]). Another problem encountered, was correctly georeferencing the PPR data. While the tabular data include latitude and longitude of each field of view, the pointing was not always accurate. Since PPR is boresighted with SSI, for those data taken simultaneously, we recalculated the PPR coordinates by matching the appropriate PPR field of view with the simultaneously captured SSI image. All of the imported PPR data are shown in figure 1.

**Results:** The data from all three instruments was successfully imported in ArcGIS and can be visualized in different ways by different users of the software. Figure 2 shows one representation of data. The background is the global mosaic (both grayscale and color have been merged in this image), the NIMS temperatures are shown in color and the PPR fields of view are also colored by temperature. Because of the degradation of SSI images during i24 and the high quality of the global mosaic, the global mosaic is shown as the background.

A website was also constructed to distribute the data, and can be accessed online at [http://lucy.institute.redlands.edu/website/Io\\_Prototype](http://lucy.institute.redlands.edu/website/Io_Prototype).

Figure 3 shows a screen capture of this website.

**References:** [1] Turtle E. P. et al. (2004) *Icarus*, 169, 3-28. [2] Lopes-Gautier, R. M. C. (1999) *Icarus*, 140, 243-264. [3] Rathbun J. A. et al. (2004) *Icarus*, 169, 127-139. [4] Williams D. A. et al. (2005) *Icarus*, 177, 69-88. [5] Millazzo M. P. et al. (2005) *Icarus*, 179, 235-251. [6] Rathbun J. A. et al. (2005) *LPS*

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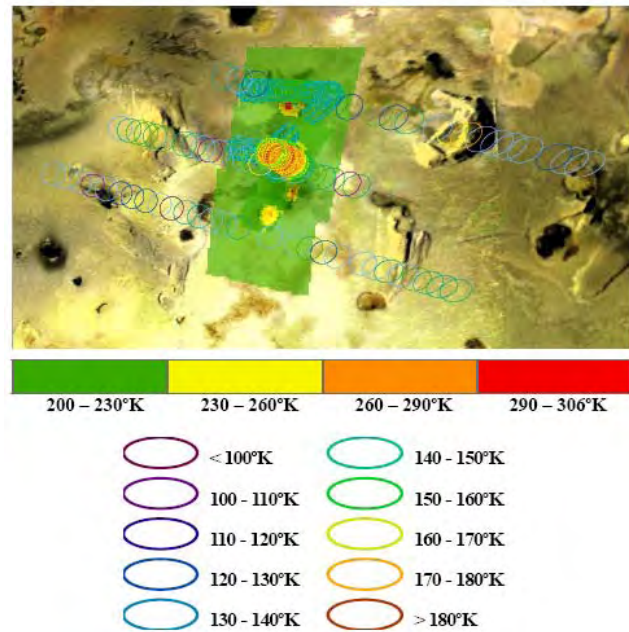


Figure 2: One view of the final processed data.

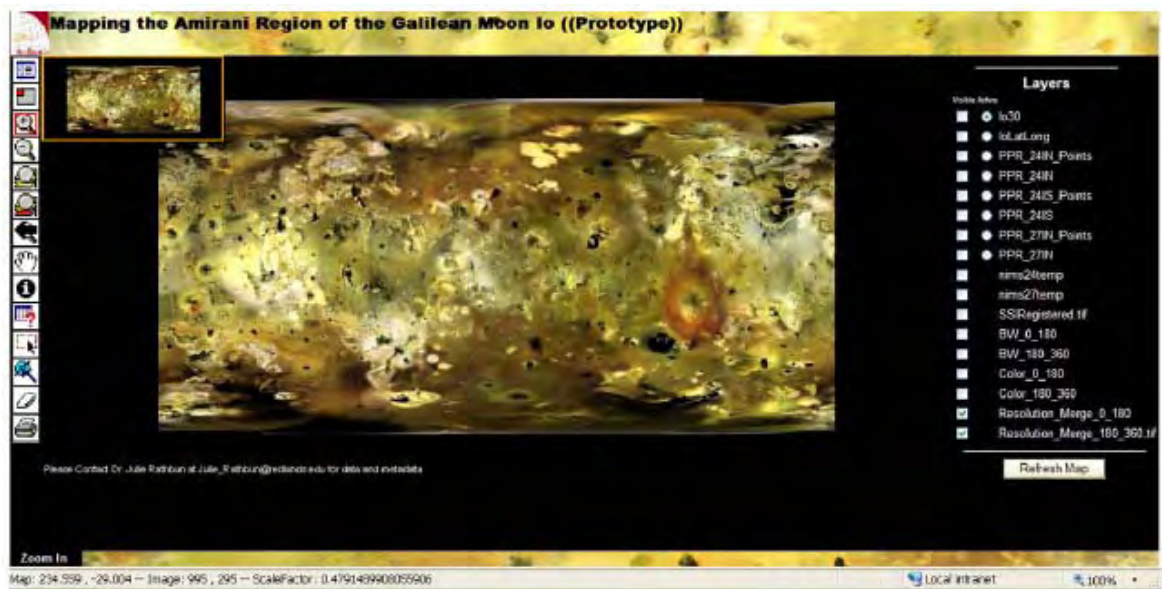


Figure 3: Screen capture of the Io website at [http://lucy.institute.redlands.edu/website/Io\\_Prototype](http://lucy.institute.redlands.edu/website/Io_Prototype).

*Science*, 288, 1193-1198. [10] Keszthelyi L. et al. (2001) *JGR*, 106, 33025-33052. [11] Lopes R. M. C. et al. (2001) *JGR*, 106, 33053-33078. [12] Barrett S. E. (2006) Major Individual Project for Master of Science in Geographic Information Systems, University of Redlands.