

SPATIAL AND TEMPORAL VARIATIONS IN IO'S ACTIVE VOLCANOES: INSIGHTS FROM JUNO JIRAM DATA. J. A. Rathbun¹, A. Mura², A. Adriani², F. Tosi², R. M. C. Lopes³, ¹Planetary Science Institute (rathbun@psi.edu), ²INAF-IAPS, ³Jet Propulsion Laboratory.

Introduction: Io is the most volcanically active body in the solar system. Prior to the prediction and discovery of tidal heating at Io in the late 1970s, tidal heating as a heat source was completely unknown. Now, we know of several hundred active volcanoes on Io's surface and that tidal heating is the primary heat source in the outer solar system. But, we do not have a good understanding of how Io's volcanic output changes with time and space, and, therefore, the detailed mechanics of tidal heating.

The shortest time-variations observed were by the New Horizons spacecraft [1] which observed 7 volcanoes on timescales of seconds to hours. Pele, Reiden, and a new volcano east of Girru were observed 39 times over the course of a minute and no large variations in brightness were observed. E. Girru's brightness, however, decreased over the several days of observations. The surface source of this eruption also moved eastward slightly over 3 days. Observations of the variation in volcanoes during the Galileo era has led to more thorough understanding of volcanic processes [2-4]. Longer-term variations in brightness level

has led to a more complete understanding of Loki Patera [5]. More recent ground-based observations of time variability has enabled categorization of hotspot types [6].

Spatial variations in Io's volcanoes have been used to understand Io's interior and the tidal heating process [7-8]. Ground-based observations were difficult to match to current tidal heating models, but the leading hemisphere hotspots did match the predictions that incorporate a partially fluid interior [7]. Observations of Io's volcanoes from the New Horizons spacecraft, combined with observations from the Galileo Photopolarimeter-Radiometer (PPR) and Near Infrared Mapping Spectrometer (NIMS) showed a dearth of volcanoes at high latitude and near the anti- and sub-Jovian points (figure 1). This later observation is more consistent with tidal heating that is concentrated in Io's mantle [8]. The dearth of volcanoes at high latitudes could be due to an observational bias, since all three instruments (and ground-based telescopes) observed from the Jovian equatorial plane. Additionally, persistent hotspots tend to occur at lower latitudes while

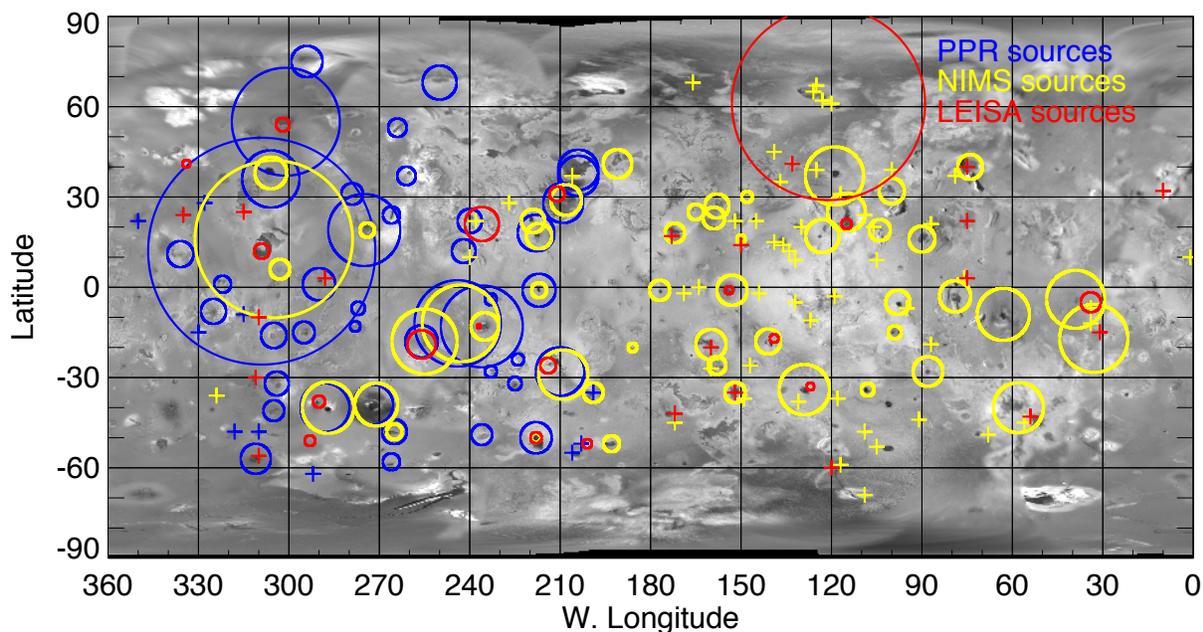


Figure 1: From [8]: Location and relative strength of active volcanoes observed by PPR, NIMS, and New Horizons LEISA. The area of each circle is proportional to the strength of each eruption. Plus signs indicate volcanoes that were detected, but a strength could not be measured.

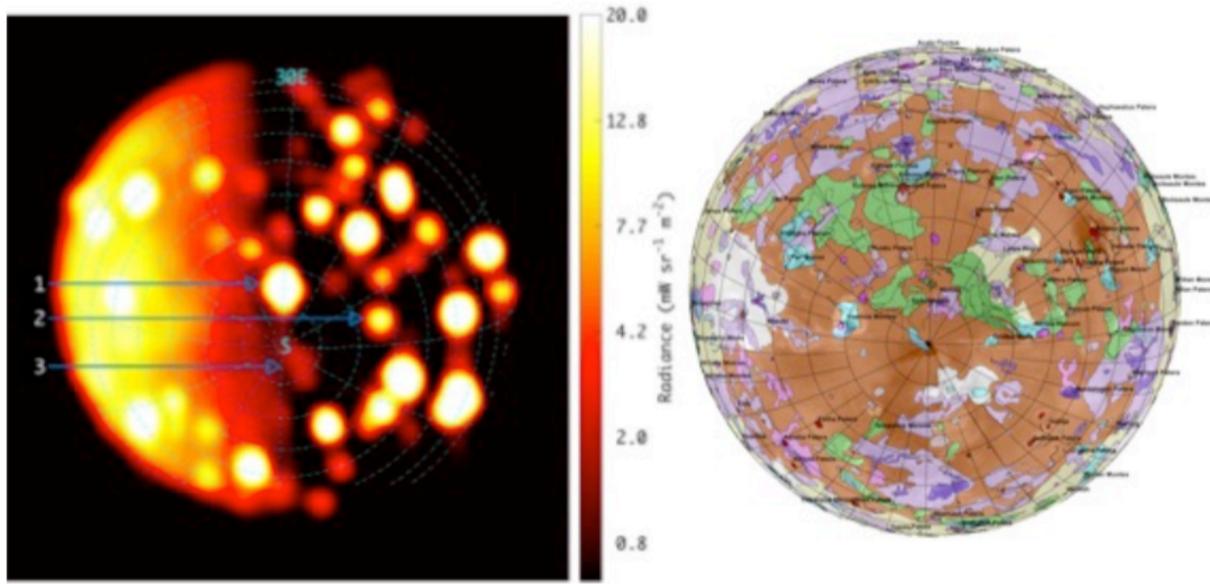


Figure 2: From [12]: On the left is a combination of all M-band images obtained in Juno's 10th orbit. On the right is the Geologic map of Io [13] shown in the same orientation.

short-lived, brighter eruptions tend to occur at higher latitudes [8-9], though this difference is difficult to quantify with the current, equator-biased data sets.

JUNO: The Juno spacecraft, with its polar orbit around Jupiter, is in a unique position to determine if the dearth in Ionian volcanoes at high latitudes is an observational effect. While the Jovian Infrared Auroral Mapper (JIRAM) instrument was primarily designed to study the Jovian atmosphere and aurorae, its sensitivity to infrared wavelengths between 2 and 5 microns is perfect for detecting active volcanoes on Io. These wavelengths are similar to those used by the Galileo Near Infrared Mapping Spectrometer (NIMS), which successfully observed Io's volcanoes for years [2-4, 8-10] and wavelengths used for ground-based observations [5-7]. JIRAM has been observing Io's volcanoes during multiple orbits [11-12]. Recent results indicate that the brightness of individual volcanoes can be measured in 4.8 micron JIRAM images [12, figure 2] and that their brightness varied from ~ 2 to $40 \text{ mW/m}^2/\text{str}$.

Here, we present preliminary results of a systematic search of all JIRAM data to create a database of each volcano's location, times and brightness. While [12] combined all images obtained during a single orbit to increase signal to noise and improve spatial resolution, we will begin by examining each image individually, to search for any extremely short period time variability. We will also compare our results to theirs to test the robustness of the methods.

Once a database of brightness measurements has been created, we can examine variability at various

time scales, from the intra-orbit timescale of minutes to the inter-orbit timescales of a few weeks. We will also compare them to brightness values previously measured by other sources to examine variability on longer, many-year, timescales. The brightness measurements will also be used to understand the spatial variation of volcanic output on Io and what that implies for tidal heating.

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