NEW TOPOGRAPHIC MAPS OF IO USING VOYAGER AND GALILEO STEREO IMAGING AND PHOTOCLINOMETRY. O.L. White[1], P.M. Schenk[1], and T. Hoogenboom[1]. [1]Lunar and Planetary Institute, 3600 Bay Area Boulevard, Houston, Texas, 77058 (white@lpi.usra.edu).

Introduction: No instrumentation specifically designed to measure the topography of a planetary surface has ever been deployed to the Galilean moon Io. Available methods that exist to perform such a task include stereogrammetry [1], photoclinometry (PC) [2], and shadow length measurement [3, 4]. In addition, Galileo limb profiles provide the only available global topographic 'ground data' [5].

Stereo-derived digital terrain models (DTMs) are reliable at long-wavelength, regional scales, but are unable to resolve fine-scale topographic features; PC-derived DTMs are primarily used for mapping local-scale topography, displaying significant topographic undulations over longer distances. Io presents a challenging subject for stereo imaging given that much of its surface is comprised of smooth, low-contrast plains, at least at the resolution of most global images. In addition, changing surface patterns and radiation noise-can confuse attempts to correlate stereo images. PC can be complicated by surface albedo variations and phase variability.

We have begun to combine stereo- and PC-derived DTMs to create a global topographic map of Io in order to constrain the shapes of local- and regional-scale features on this volcanic moon. A key advance is that our DTMs are being controlled using Galileo limb profiles. Applications include relation of regional-scale topographic variations to global heat flow patterns resulting from convection in Io's silicate mantle [6], in addition to precise characterization of the shapes of local topographic features such as paterae and mountains. This abstract discusses current progress and presents preliminary mapping results.

Methods: Customized ISIS software at LPI has been used to create and process stereo- and PC-derived DTMs of Io's surface using Voyager and Galileo imagery. The stereo routine determines parallax and associated topographic relief by identifying corresponding pixels within the two stereo images through matching albedo patterns in finite-sized patches; where the surface is smooth and featureless, the inability of the program to identifying corresponding pixels can contribute to noise in the data. To model the variable surface albedo, the PC routine reprojects a high-Sun image of the study area to the same lighting conditions as a low-Sun image; slope and topographic relief are determined by comparing the shading of corresponding pixels in the two images. PC DTMs, which display significant topographic undulations over longer distances, may be controlled through merging them with stereo DTMs, which themselves are controlled using the Galileo limb profiles.

Results: As of completion of this abstract, 20 stereo DTMs covering ~20% of Io's surface have been created, processed and mosaiced together (Fig. 1). Data dropouts on the map represent masked noise and null data, which occur mainly in smooth, featureless plains. Prominent geologic features in the map include Ra, Ruwa and Mbali Paterae, Euboea and Haemus Montes, Pan and Echo Mensae, and Inachus Tholus. The DTM may be compared with the 'ground data' by plotting a topographic profile (A-B in Fig. 1) with the same groundtrack as one of the Galileo limb profiles (Fig. 2). Noise reaching amplitudes of several hundred meters over lateral distances of several kilometers afflict the two profiles. The profiles are consistent over long wavelengths, with the exception of the divergences beyond ~2750 km and the 'mountain' in the limb profile at ~550 km, which is a projection artifact; the base of the mountain lies below the observed horizon.

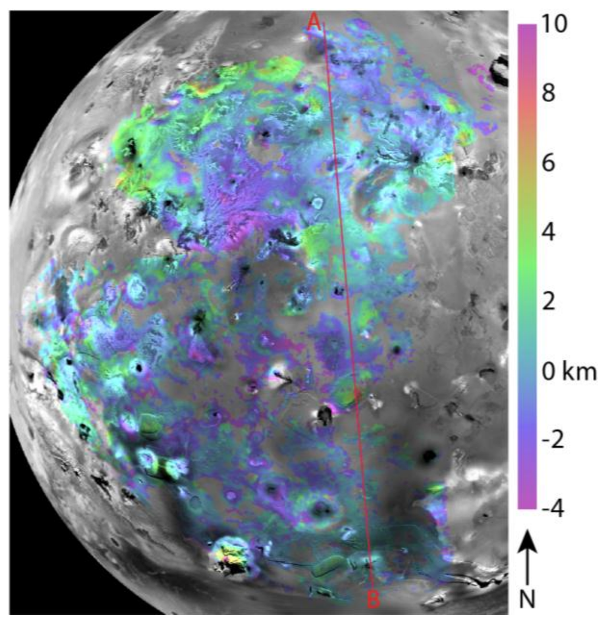

Fig. 1. Mosaic of 20 controlled stereo DTMs overlain on top of a mosaic of visible Galileo and Voyager images. Orthographic projection centered at 34.5°S, 336°W. Profile A-B is shown in Fig. 2.

PC DTMs have been created for localized topographic features including paterae, mountains and layered plains within this area. Figure 3 shows a DTM of Echo Mensa, an example of layered plains at 80°S, 354°W, that merges stereo and PC data. Long-wavelength variability still afflicts the data, yet useful

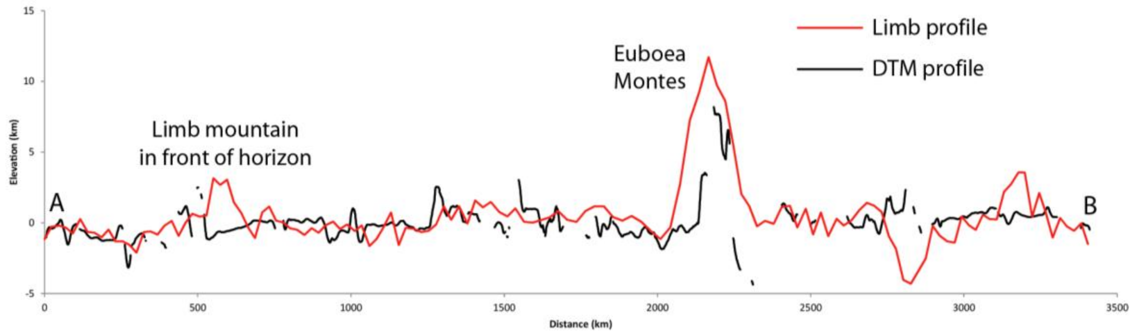

Fig. 2. N-S limb and DTM profiles taken along the line A-B in Fig. 1. Limb profile is the mean of two limb profiles (from images 349542165 and 349542200) that share identical groundtracks.

measurements can still be extracted from it. The plateau of Echo Mensa rises 800 m above the surrounding terrain based on profile C-D in Fig. 3; it is not certain at present if the increase in elevation towards the NE end of Echo Mensa is genuine or an undulation in the data. In addition, the smaller mesas towards the east of the profile display heights of 400 m above the surrounding plains.

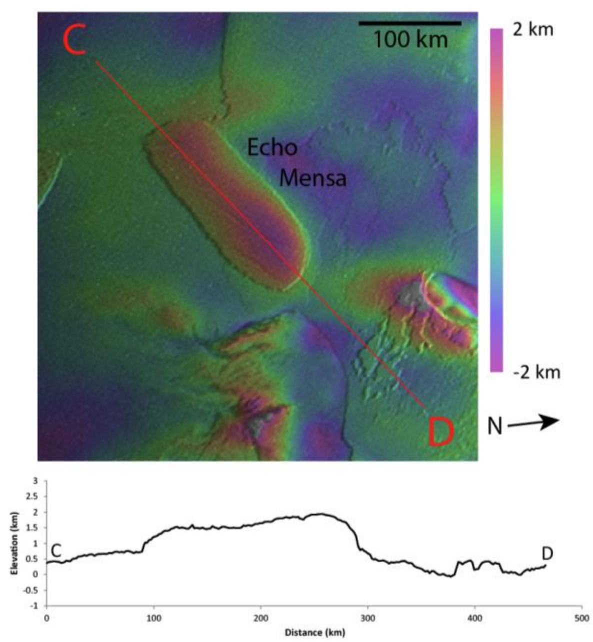

Fig. 3. Merged PC and stereo DTM of Echo Mensa, overlain on a visible Voyager image. Profile C-D is shown beneath.

Figure 4 displays a stereo DTM of Huo Shen Patera, located at 15°S, 329°W; Galileo and Voyager images of this area have solar incidence angles unsuitable for PC processing. Two nearly perpendicular profiles have been plotted across the patera; profile E-F indicates a rim elevation of 1.25 km and a rim-floor depth of 1.55 km. The visible data indicate that the SW rim of the patera is absent, which is corroborated by the topography data in profile G-H; the raised rim is apparent in the NE, whereas the profile remains at the floor elevation of -0.5 km to the SW.

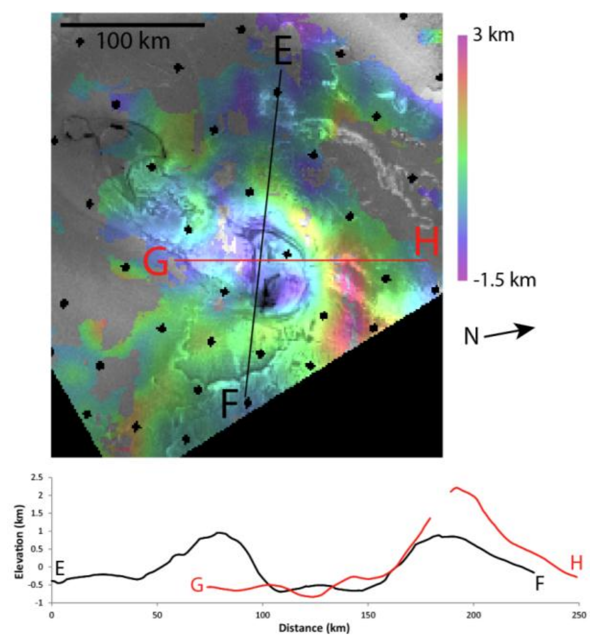

Fig. 4. Stereo DTM of Huo Shen Patera, overlain on a visible Voyager image. Profiles E-F and G-H are shown beneath.

Summary: A new global DTM of Io is emerging that will allow a thorough geologic investigation, and is already revealing patterns in long-wavelength topography and the detailed morphologies of local topographic features. A global survey of patera morphologies is progressing in an associated study using our DTMs [7].

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