Magellan Intra-Cycle Venus Stereo Topography. Scott Hensley, Daniel Nunes, Karl Mitchell and Kevin Cotton, Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr., Pasadena, CA, 91109, scott.hensley@jpl.nasa.gov.

Introduction: Topographic data are a key piece of information for identifying and quantifying geological processes that have and continue to modify the surface of Venus and aid the establishment of the chronology of these processes. Venus topography knowledge comes primarily from either Magellan radar altimetry with a spatial resolution of 15-20 km and a elevation accuracy of no better than 100 m or derived from radar stereo data collected by Magellan during Cycles I and III with spatial resolution on the order of half a kilometer and elevation accuracy of 20-50 m that only covered roughly 20% of the surface. We present a previously unexploited source of Venus topography with intermediate spatial resolution and elevation accuracy to the aforementioned sources thereby extending the available Venus topographic data. We describe the use of intra-Cycle stereo between adjacent orbit pairs as a source of topographic data and show that the spatial resolution and elevation accuracy are suitable for use in scientific investigations.

This Intra-Cycle stereo work is funded by an effort that is utilizing all available F-BIDR imagery to produce the best achievable topographic solution for all surface regions of Venus covered by Magellan SAR imaging. Although Cycle I-III stereo topography has been notably produced by colleagues in the community [e.g., [1], [2]], their efforts have used different combinations of F-MAPs mosaics of the surface, older Magellan ephemeris, or significant manual input. Each of those aspects represents a compromise of either stereo quality or spatial coverage. Our approach of using individual F-BIDR noodles and updated ephemeris [3] for fully automated stereo matching and elevation calculations should yield the best results and global coverage, with the added benefit of producing formal elevation uncertainties.

Radar Stereo: Radar stereo used data collected from two vantages with different incidence to derive topography measurements. Cross-track image offsets that can be measured either manually or by automated matching algorithms are related to height by a factor which is a function of the incidence angles given by

$$h = \frac{\Delta p}{\cot\theta_2 - \cot\theta_1} \quad (1)$$

where h is the elevation above the reference surface, Δp is the parallax measurement and θ_1 and θ_2 are the incidence angles. From Equation 1 it follows that the sensitivity to topography increases as the incidence angle difference increases, however the ability to accurately match decreases due to the image distortion resulting from the different incidence angles. Radar stereo pairs are usually designed to have incidence angle differences between 5°-15° to balance these considerations. The Magellan Cycle III incidence angle profile was specifically designed to enable good radar stereo measurements.

Intra-Cycle Measurements: By utilizing the F-BIDR data which was designed to have overlap between adjacent orbit pairs, we have an additional source of radar stereo data albeit with less than optimal relative incidence angle geometry. However, because the imaging geometry is more nearly identical than the Cycle I-III, pairs the automated matching accuracy would be expected to be much better. In fact measurements indicate the matching accuracy is better by about a factor of 3-4. We have conducted a global assessment of the expected intra-Cycle stereo elevation accuracy for all three Cycles taking into account imaging geometry and expected matching accuracy and found that useful elevation measurements are possible with intra-Cycle data. For latitudes away from the poles it is possible to make elevation measurements with greater spatial resolution and accuracy than Magellan radar altimeter data.

Summary: This talk will present an outline of our stereo processing methodology using radar sensor model that allows us to include improved ephemeris, include improved atmosphere compensation and produce a height precision map to accompany the elevation data. Based on the radar geometry and expected matching accuracy, we will present our global assessment of the expected intra-Cycle stereo elevation measurement accuracy and compare it with Cycle I-III stereo data. We will then show an example of Cycle I-III stereo and intra-Cycle stereo data for the Artemis region and compare the elevation accuracies in the region. These data illustrate the utility of augmenting the standard topographic measurements in both quality and coverage for scientific analysis.

References: [1] R. Herrick et. al. (2012) *Trans. Amer. Geophy. Union,* 125-126. [2] E. Howington-Kraus et. al. (2006) European Planetary Science Congress, [3] N. Rappaport et. al. (1999), Icarus, 139.

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