RELIABILITY OF MAGELLAN ALTIMETRY: EVIDENCE FROM A STEREO DIGITAL ELEVATION MODEL; D.G. Jankowski, Department of Physics and Astronomy, University of Wisconsin - Eau Claire, Eau Claire, WI 54702-4004; S.W. Squyres, Department of Astronomy, Cornell University, Ithaca, NY 14853

The topography of a ridge belt on Venus has been determined from: 1) an analysis of Magellan SAR stereo pairs; and 2) Magellan altimetry data. A comparison of the two data sets suggests that Magellan altimetry data becomes significantly less reliable in regions with complex topography. This reduction in reliability results from the difficulty in interpreting the complex radar echo returns coming from such terrains.

Our knowledge of the global topography of Venus has improved tremendously due to the data provided by the Magellan altimeter, which has observed ~93% of the surface [1,2]. Another powerful method for determining topography on Venus comes from the analysis of stereo pairs of Magellan SAR images taken at different look angles [3,4]. Stereo analysis results in a much higher resolution data set than the Magellan altimetry, but it is useful only for the small fraction of the surface for which stereo pairs exist.

We have determined the topography of a ridge belt located between Niobe Planitia and Atalanta Planitia using both stereo analysis (with the Magellan Stereo Toolkit from Vexcel Corporation) and Magellan altimetry data. Our results indicate that in topographically smooth regions (on the plains adjacent to the ridge belt, for example) the altimetric and stereo-derived elevations match up extremely well. In topographically complex regions, on the other hand, the derived elevations do not match up nearly as well. As an example, Fig. 1 compares altimetry data and stereo digital elevation model (DEM) data along a line through topographically complex terrain.

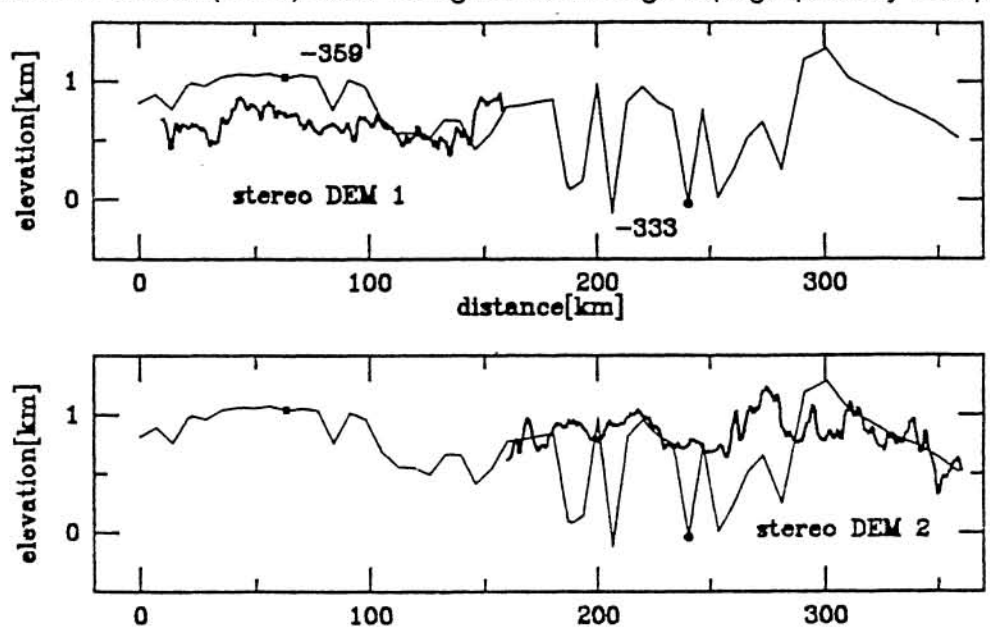

Figure 1. Topography along the Magellan orbit 1326 ground track derived by the altimeter (light line) and from stereo digital elevation models (heavy lines). The numbered points indicate altimeter footprints -359 and -333.

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Note in Fig. 1 that there are some regions, such as at footprint -359, where the altimetry data lies well above the stereo DEM data. At other points, such as at footprint -333, the altimetry data lies well below the stereo DEM data.

Discrepancies between the altimetry and stereo results can be investigated by examining the individual altimetry echo returns used to derive elevations. Figure 2 shows Magellan altimeter data for two footprints. The profiles show the returned echo power as a function of delay time. The solid lines give altimeter data; the dotted lines give best-fit profiles constructed by the automated fitting algorithm used by the Magellan team to determine an elevation.

Figures 2a and 2b show echo profiles from a region of rough terrain (footprints -341 and -333 from orbit 1326; see Fig. 1). In both cases the complex terrain has resulted in an echo profile with multiple peaks. An unambiguous elevation can clearly not be found from such profiles. In fact, the profile in Fig. 2a determined an elevation above the stereo DEM. If the second peak of the profile had been fit, the derived elevation would lower by ~350 m, where it would then well match the stereo DEM. Similarly, the profile in Fig. 2b determined an elevation well below the stereo DEM (and its neighboring footprints). If the first peak of the profile had been fit, the derived elevation would rise by ~850 m, where it would then well match the stereo DEM.

In regions of relatively smooth terrain, the echo profiles tend to have one well defined peak which is easily fit. In such cases the derived elevations match those of the stereo DEM.

Clearly care must be exercised in the interpretation of Magellan altimetry data. Unfortunately, topographic data is most interesting in regions where the Magellan altimeter is least reliable. Therefore the effects discussed above must be understood, and monitored, when interpreting topography derived with altimetry.

References:
[1] Pettengill, G.H. et al. (1991) Science, **252**, 260. [2] Ford, P.G. and Pettengill, G.H. (1992) JGR, **97**, 13,103. [3] Leberl, F.W. et al. (1992), JGR, **97**, 13,667. [4] Leberl, F.W. et al. (1992), JGR, **97**, 13,675.

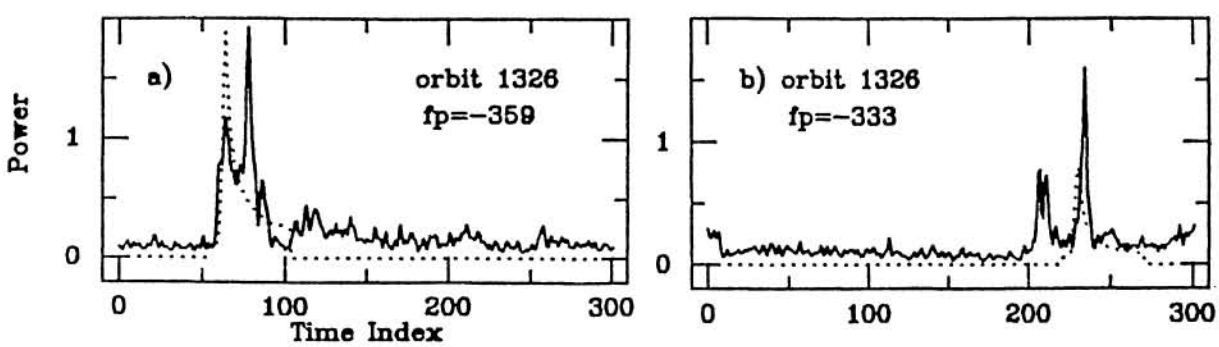

Figure 2. Altimeter echoes for the footprints identified in Fig. 1. The solid line is the echo return profile; the dotted line is the best-fit profile used to determine an elevation.