APPLICATION OF THE MAGELLAN GVDR TO VENUS SURFACE STUDIES; R.A. Simpson, M.J. Maurer, and G.L. Tyler, Stanford University, Stanford, CA 94305-4055.

Radar scattering by planetary surfaces is controlled both by properties of the bulk surface material and also by surface "texture" — including the population of inhomogeneities intermixed with the regolith as well as the surface roughness. Full understanding of the nature of the surface from remote sensing data typically requires integration of several data sets. In the case of Venus, the existing data from Magellan include both near-nadir and oblique radar backscatter as well as microwave thermal emission. Each data type provides information on a different aspect of the surface. We are completing the second version of the Global Vector Data Record (GVDR) which will include composite scattering functions for Venus at 18.225 km resolution from Magellan mapping Cycles 1-3.

Radar backscattering functions for planetary surfaces have the general shape shown in Figure 1. Near normal incidence the quasi-specular scattering component dominates. Mirror-like reflections comprise the majority of the echo; dispersion with incidence angle is a function of surface roughness — smoother surfaces have the most pronounced peaks at normal incidence. At highly oblique incidence angles, diffuse scattering dominates. This component arises from interactions of the electromagnetic wave with irregular discrete objects, heterogeneities in the surface, and a few highly tilted planar facets. The Magellan altimeter (ALT) sampled the near-nadir part of the Venus backscattering function (to angles as large as about 10°); the Magellan SAR sampled oblique scattering over a few degrees (typically 2-3°) at some point within the incidence angle range 15-45° (SAR incidence angle varied with spacecraft position in its orbit). At intermediate angles, the backscatter function is a combination of quasi-specular and diffuse contributions. The magnitude of the backscatter function is proportional to the Fresnel reflectivity in most interpretive models. An independent measure of the dielectric constant of Venus' surface can be derived from microwave thermal emission measured by the Magellan radiometer; in simple electromagnetic models emissivity and reflectivity sum to unity.

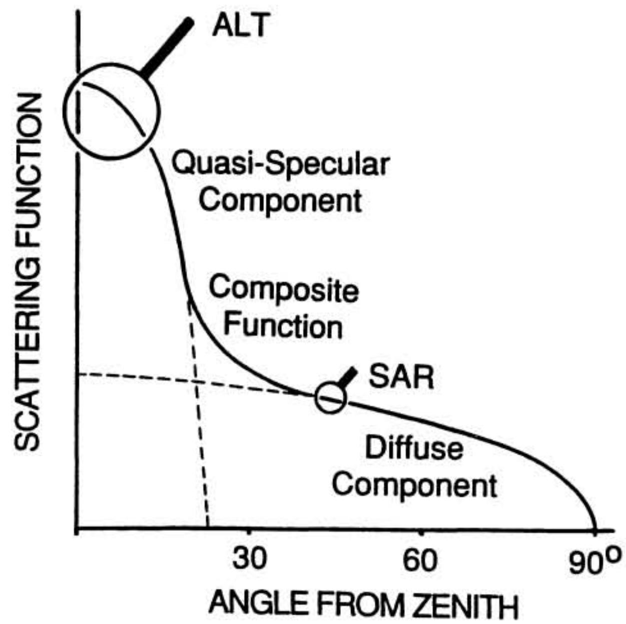
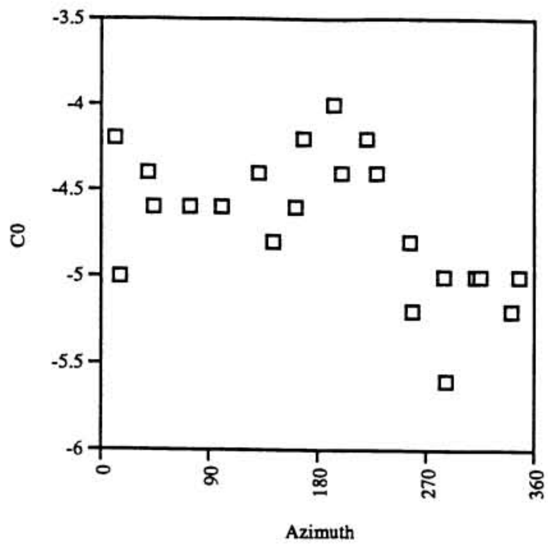


Figure 1. Example backscatter function illustrating variation with incidence angle and transition from quasi-specular to diffuse scattering. Magellan altimetry (ALT) and imaging (SAR) systems sampled the backscatter function as illustrated.

The GVDR is a collection of the fundamental scattering and emission data from the Magellan mission, gridded for ease of use. Inversions of altimetry echoes give the backscatter function to incidence angles as large as 10° from nadir; fits to C-BIDR image data yield the highly oblique scattering over a few degrees in the incidence angle range 15-45°. Multiple observations under similar viewing conditions are averaged, but unique geometries (such as different SAR viewing or azimuthal angles) are preserved so that variations with observing conditions may be studied.

Only at the Venus poles is it possible to view a piece of the surface over 360° of azimuthal variation. Leberl *et al.* [1] have examined images of this location in regard to its potential for stereo analysis. They conclude that azimuth separations of 20° are useful for stereo but that separations as large as 80° are not. Figure 2 shows the variation in SAR scattering at representative azimuthal angles from the GVDR for the Venus north pole; Figure 3 shows the variation in emissivity. In both cases a modest variation may be inferred from the figures, but the scatter in data points plus the fact that C0 values appear to be discontinuous at 0/360° argues for caution.



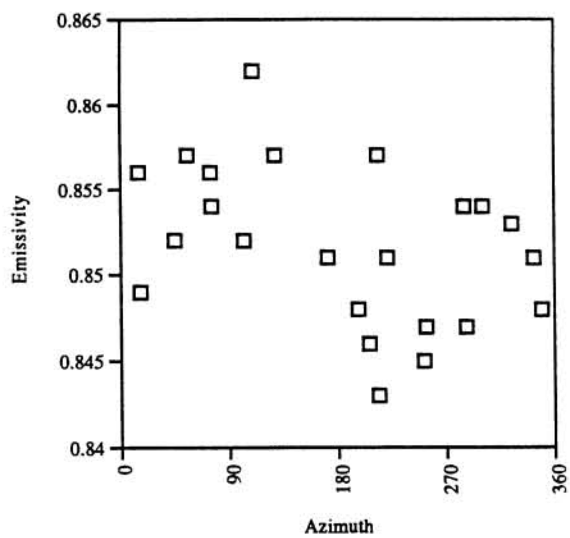


Figure 2 (left). Constant term (C0) in quadratic fit to SAR scattering function near 16° incidence angle at the Venus north pole; C0 is approximately the specific cross section averaged over about 350 km^2 at the pole. Variations in C0 suggest a slight dependence of C0 on azimuthal angle, but the 1.5 dB total excursion in C0 could also be attributed to slowly changing systematic effects. C0 is obtained from the Magellan Surface Characteristics Vector Data Record (SCVDR) produced at Stanford. Figure 3 (right). Measured dependence of emissivity on azimuthal angle at the Venus north pole. Emissivity values were obtained from the Altimetry and Radiometry Composite Data Record Compact Disc (ARCDRCD) set produced at MIT.

Regional variations in scattering behavior (and, by inference, regional changes in surface properties) should be readily identified and characterized using the GVDR. The combination of nadir scattering, oblique scattering, and oblique radiometry provide maximum constraints on the Venus surface at the 18.225 km GVDR resolution. Higher resolution results can be obtained, but only by using the SAR data alone.

[1] Leberl F.W. *et al.* (1992) J. Geophys. Res. 97, 13667.