MODEL FOR MARS DEPOLARIZED RADAR ECHOES; T. W. Thompson and H. J.
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Recent radar observations of Mars at Arecibo in 1980 and 1982 (Harmon,
et. al. 1982 and 1985) and at Goldstone in 1986 were conducted by
transmitting pure sinusoidal signals and receiving Doppler spread signals at
Earth. Radar transmissions were circularly polarized and the radar echoes
were recorded in both senses of circular polarization. Thus, radar echoes
from Mars were separated into the polarized (OC, opposite-sense circular)
and the depolarized (SC, same-sense circular) components.

Here we have modelled depolarized echoes using areas where we expect to
find large concentrations of fine-scale (decimeter-sized) roughness elements
as sources of enhanced radar echoes. These areas (Figure 1) include the
four large montes of the Tharsis region, Elysium Mons, and the extensive
lava plains that surround them. These areas are assigned backscatter up to
ten times that of other Martian areas. More detailed definition of our
model is planned, including refinement of anomaly boundaries and inclusion
of other areas.

Our model assumes that Martian depolarized radar echoes are uniformly
bright so that backscatter varies as cosine (angle-of-incidence). This is
the behavior observed for depolarized echoes from the Moon, where lunar
radar echoes mimic the appearance of the full-moon's uniform disk at visual
wavelengths. We assume further that the Martian anomalies behave like the
large, young lunar craters such as Tycho, Copernicus, Aristarchus,
Langrenus, Theophilus, and Kepler. These craters, regardless of their angle
of incidence, backscatter ten times more depolarized power than average
lunar areas.

Our model accounts for the major parts of the depolarized echo spectra.
There is a good match with the variation of total depolarized (SC) radar
cross-section with longitude. In Figure 2, the solid line is the model; the
hatched area includes 1986 data from Goldstone; the circles are 1980 and
1982 data from Arecibo; and the X's are our model predictions. Our model
also predicts spectra shapes that compare favorably to those observed (see
Figure 3).

The Tharsis region provides the largest anomaly and is responsible for
the broad enhancement seen in the fifteen spectra of Harmon, Campbell and
Ostro, (1982, Figure 2b). This anomaly occupies about two-thirds of the
echo-spectra and moves from left-to-right across the fifteen spectra. The
Tharsis region also produces the broad increase in total depolarized
cross-section centered near longitude 125 (Fig. 2). Tharsis as well as the
Elysium and Amazonis Planitia anomalies are responsible for three features
in the model spectra (Fig. 3). In addition, the Elysium and Amazonis
Planitia areas produce the variation in longitude seen as the ramp from
longitudes 230 to 190 in Figure 2.
References


Figure 1: Generalized Areas for the Assumed Martian Radar Anomalies

Figure 2: Model and Observed Depolarized Radar Cross-Sections Versus Longitude

Figure 3: Model Spectra for Arecibo Observation at 24.8°N, 149.3°W. See Figure 3d of Harmon and Ostro, 1985.