

SCIENTIFIC APPLICATIONS OF PLANETARY LASER ALTIMETER RADIOMETRY

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Abstract

Laser altimeters in addition to providing topographic data of planetary bodies are sometimes able to provide a measurement of the radiance of the object at the wavelength of the laser/detector. At Mars the laser altimeter on the Mars Global Surveyor spacecraft had an adjustable threshold for the detector so that return signals would be kept within a specified dynamic range. The threshold was adjusted according to the strength of the previous return and thus the variation in threshold became an approximate measure of the reflectance of Mars at 1064 nm over the illuminated laser spot on the surface of Mars, approximately 165 meters in diameter. This method we refer to as the active radiometry mode. After the laser ceased to operate in June 2001, and in between laser firings when the laser was operating, the detector measured the radiance of the solar illuminated surface at 1064 nm over the detector field of view of approximately 385 meters. This mode is referred to as the passive radiometry mode. In the active mode the instrument acquired radiometry at 1 Hz, with a S/N of about 10; in the passive mode the instrument acquired radiometry at 8 Hz with a S/N of about 100. We now have nearly 3 Mars-years (over 5 Earth-years) of high resolution passive radiometry of Mars at 1064 ± 1 nm for spatial footprints of under 400 meters. These observations are being used to study the intrinsic brightness of Mars and to monitor the changes in the polar icecaps due to the seasonal exchange of CO_2 between the atmosphere and the surface. Fig 1 shows the two polar regions of Mars at the same time of year ($L_s = 260$) when the sun is just below the equator and moving northwards. Note the difference in radiance of the two regions and the lack of symmetry of the south polar icecap.

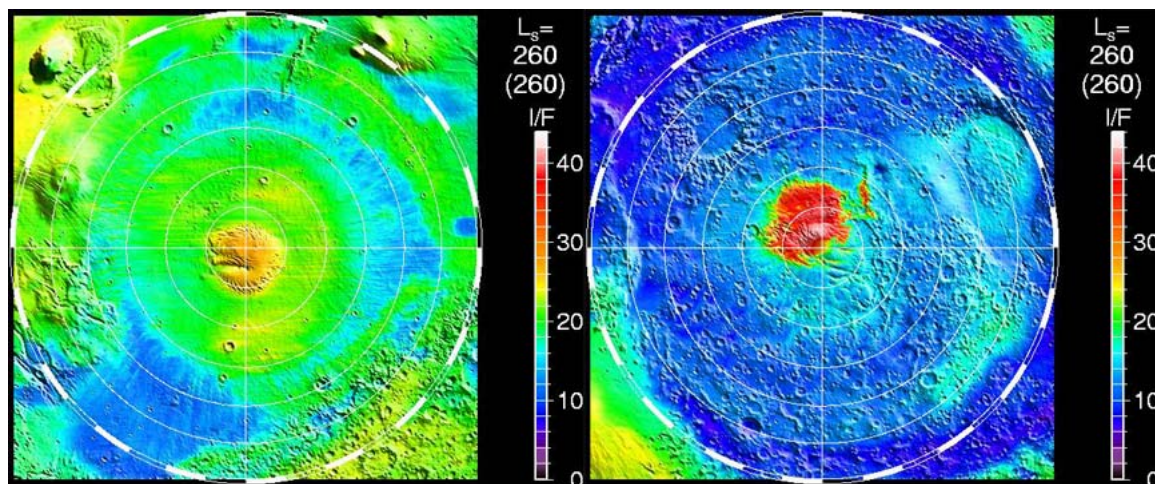


Fig 1. Radiometry at 1064 nm obtained by the laser altimeter at Mars during late Fall in the northern hemisphere (left chart) and late Spring in the southern hemisphere (right chart).