Geophysical Research Abstracts
Vol. 12, EGU2010-5663, 2010
EGU General Assembly 2010

Bathymetry and Absorptivity of Titan's Ontario Lacus

Alexander Hayes (1), Oded Aharonson (1), Howard Zebker (2), Ralph Lorenz (3), Randolph Kirk (4), Philippe Paillou (5), Jonathan Lunine (6), Philip Callahan (7), Stephen Wall (7), and Charles Elachi (7)

(1) California Institute of Technology, Pasadena, CA, 91125 USA, (2) Standford University, Stanford, CA, 94305 USA, (3) John Hopkins University Applied Physics Laboratory, Laurel, MD 20723 USA, (4) US Geological Survey, Flagstaff, AZ 86001 USA, (5) University of Bordeaux, 33270 Floirac, France, (6) University of Rome, Tor Vergata, 00173 Rome, Italy, (7) Jet Propulsion Laboratory, Pasadena, CA 91109 USA

Ontario Lacus is the largest and best characterized lake in Titan's south polar region. In June and July 2009, the Cassini RADAR acquired its first high resolution Synthetic Aperture Radar (SAR) images of the area. Together with closest approach altimetry acquired in December 2008, these observations provide a unique opportunity to study the lake's near-shore bathymetry and complex refractive properties. This work represents the first empirical estimate of the imaginary dielectric properties of liquid hydrocarbons on Titan using Cassini observations.

The normalized radar backscatter cross-section (σ_o) is observed to decrease exponentially with distance from the local shoreline. This behavior is consistent with attenuation by a deepening layer of liquid and, if local topography is known, can be used to derive absorptive optical properties. Accordingly, we estimate near-shore topography from radar altimetric profiles and then analyze SAR backscatter to determine the imaginary component of the liquid's complex index of refraction (κ). The complex refractive index at microwave wavelength determines the depth to which radar waves can penetrate lakes on Titan, and is a function of liquid composition. The derived value, $\kappa = (6.6^{+1.6}_{-1.2}) \times 10^{-4}$, corresponds to a loss tangent of $\tan \Delta = (1.0^{+0.25}_{-0.18}) \times 10^{-3}$ and is compatible with a composition dominated by liquid hydrocarbons. This value is consistent with previous laboratory estimates of simple hydrocarbons and will help constrain Ontario's liquid composition when additional laboratory data become available. Significant amounts of highly absorptive material, such as tholins, are inconsistent with the measured loss tangent.

In areas that do not intersect altimetry profiles, relative slopes can be calculated assuming the index of refraction is constant throughout the liquid. Slope estimations are provided for eight areas, in addition to the two which contain altimetry intersections, forming a coarse bathymetry map. The derived bathymetric slopes vary from $(0.5 - 2.5) \times 10^{-3}$ and correlate well with observed shoreline morphologies. Slope values on the eastern shore, which exhibits a beachhead morphology, are characteristically steeper than the western shore, where a more complex shoreline exists. The shallowest slope occurs in the southwestern tip of Ontario, where the greatest magnitude of shoreline recession has been observed between 2005 and 2009 ISS and Radar observations. A linear relationship is observed between shoreline recession magnitude and the inverse of near-shore slope, consistent with a depth reduction of 4.0 ± 1.3 m over the four years between observations. Together, these observations provide a new understanding of Ontario Lacus and its role in Titan's hydrocarbon cycle.