Geophysical Research Abstracts, Vol. 9, 06489, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-06489

Cassini RADAR: modeling and Bayesian inference of physical and morphological parameters of Titan's surface features

B. Ventura (1), D. Casarano (2), C. Notarnicola (1), D. Di Rosa (1), F. Posa (1,3), and the Cassini Radar Science Team (4)

(1) Dipartimento Interateneo di Fisica, Via Amendola 173, Bari, Italy, (2) CNR-IRPI, Via Amendola 122 I, Bari, Italy, (3) Politecnico di Bari, Via Orabona 4, Bari, Italy, (4) Jet Propulsion Laboratory, Pasadena, California, USA

Titan's surface, before Cassini reached the saturnian system, was essentially unexplored. Nowadays, after two years of the Cassini mission, a great amount of data dealing with Titan's surface has been collected by means of a radar able to operate in four modes: radiometry, scatterometry, altimetry, and synthetic aperture radar (SAR) imaging, mounted on the Cassini spacecraft. In particular the analysis derived from the SAR imagery, reveal a complex surface with peculiar features such as: dark and bright areas, periodic structure ("sand dunes") and, above all, hydrocarbon lakes. A first analysis of the Radar Cross Section, RCS, of these features, by the means of the Integral Equation Method, IEM, had been carried out resulting in variations of the RCS in excess of 20 dB between the "brightest" and the "darkest" areas. Estimation of dielectric constants of these peculiar features and description of RCS trends for sand dunes in terms of tilt angle effect have been also performed.
In this paper, the investigation of Titan's surface parameters (physical and morphological) has been carried out by the means of the Bayesian inversion technique.
In order to extract surface parameters hypothesis on dielectric constant values and surface parameters, have been formulated. These hypotheses and the Titan's surface morphology have been used in simulations with the IEM approach in order to build a training data set of expected RCS. Starting from these model simulations and the corresponding radar data, a family of probability density functions (pdfs) has been built through a comparison between real and simulated radar data; the sensor noise has been also taken into account. Then, each pdf can represent a surface single hy-

pothesis. These pdfs have been used in an inversion procedure, based on Bayesian methodology. The probability values obtained for the different pdfs can be compared by using the Bayes factor which provides a scale of evidence in favour of one scenario versus another. This approach has been initially applied to the area characterized by the presence of hydrocarbon lakes and then extended to other areas. Beside the estimation of dielectric constant and surface parameters, this inversion allows to identify the predominant scattering mechanism (surface or volume); in the case of the dunes, it allows also the estimation of the tilt angle and the average dune height. The roughness parameters for the hydrocarbons lakes were also matched with the findings of a gravity capillary wave model, implemented to study the dependence of radar-scale roughness of the liquid surfaces on the wind speed. This model uses a set of viscosity, surface tension and density parameters expected for the hypothesized liquid hydrocarbon mixture.