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Preface

Surfaces, atmospheres and magnetospheres of the outer planets and their satellites and ring systems: Part VII

The sessions organized this past year in several international meetings and congresses (like those of the European Geosciences Union (EGU), the Asia Oceania Geosciences Society (AOGS), the European Planetary Science Congress (EPSC) and others) focused on recent observations and models of the atmospheres, magnetospheres and surfaces of the giant planets and their satellites, as well as on their ring systems. Particular interest was devoted to results from space missions such as the Cassini–Huygens mission in the Kronian System. After the successful descent and landing on Titan of the Huygens probe in 2005, the Cassini spacecraft has indeed been returning a wealth of new data almost continuously, revealing an astonishingly complex and dynamic system around Saturn. Complementary observations of the giant planets and their satellites were obtained from the ground, but also by the new space observatory Herschel, launched on May 14, 2009. Besides the observations, several of the papers in this issue discuss results from laboratory experiments and models.

Cavalié et al. find little variation in the line-to-continuum ratio of H_2O line at 556.936 GHz from Jupiter's stratosphere between 2002 and 2009, with the exception of a measurable 15% decrease between 2002 and the 2007–2009 period. IDP and SL9 remain as the potential source, but neither can be pinned down with certainty from the authors' Odin space telescope observations nor from previous data.

In their modeling study of Jupiter's upper atmosphere and magnetosphere, Yates et al. investigate how upstream solar wind conditions control energy deposition and ion drag and thereby the global temperatures and winds in the thermosphere. By assuming three magnetic field configurations representing a compressed, average and expanded middle magnetosphere and calculating the magnetosphere plasma angular velocities for each, the efficiency of angular momentum transfer from atmosphere to magnetosphere is investigated.

B. Cecconi et al. contribute in the paper "*Natural radio emission of Jupiter as interferences for radar investigations of the icy satellites of Jupiter*" to the discussion of the characteristics of a radar system sounding the icy moons of Jupiter, by providing an exhaustive review of the effect of Jupiter radio noise. This work is much more than a review paper, because it presents original research in it, mostly consisting of the application of existing models of the Jovian radio emission to specific scenarios. The discussion clearly presents the implications of these natural radio data for future radar measurements at Europa and Ganymede by foreseen future missions.

The manuscript by Peplowski et al. proposes an original study aiming to extend the use of neutron spectroscopy to the detection of water-bearing minerals on Ganymede. Based on their experience with Lunar Prospector, the authors simulate the behavior of a Lunar-Prospector-like detector in orbit around Ganymede. They calculate the magnetospheric particles induced background and the neutron signal from the planet. With a rigorous approach, the authors draw a clever parallel between their Lunar Prospector detector during a flare event and the expected behavior of the same detector at Ganymede. Under this assumption, they show that a neutron detector, with significant science results, can be flown around Ganymede. To obtain a signal-to-noise equivalent to a measurement around the Moon, the authors calculate the mass of shielding needed around their detector.

The manuscript presented by V. Zakharenko et al. entitled "*Ground-based and space observations of planetary thunderstorm activity*" is a research devoted to the analysis of information derived from observations performed with a radio telescope (UTR-2) and a spacecraft (the RPWS onboard the Cassini orbiter), in order to identify Saturn Electrostatic Discharges (SED). They conclude that a high degree of coincidence between the UTR-2 and the spacecraft observations exists and that their method can be used in the searching of SED-like signals in environments different from Saturn.

In their study "*Energetic charged particle weathering of Saturn's inner satellite*" Paranicas et al. model the contribution of energetic particle to modifying the surface of Saturn's medium-sized satellites Mimas, Enceladus, Tethys, Dione, and Rhea. From numerical modeling constrained by data from the Cassini Magnetospheric Imaging Instrument, these authors evaluate the relative impact of electrons and protons and provide estimates for the energy deposited at these satellites. They find that the electron energy deposition is maximum at Mimas and decreases with increasing distance from Saturn. With their refined numerical framework, these authors confirm the existence of a correlation between unusual features observed at Mimas' and Tethys' leading hemispheres and the particle environments at these objects.

A global hybrid simulation of the interaction of Saturn's magnetospheric flow with Titan during the Cassini T9 encounter is described in the study of Lipatov et al. presenting case studies for two different upstream conditions of low and high density H^+ ions and investigating the sensitivity of magnetic field, plasma densities and velocities in Titan's vicinity to these upstream conditions.

The paper by A. Schaufelberger et al. deals with the hypothesis invoked by Strobel (2009) that in Titan's exobase region light species relative to N_2 can be accelerated to escape velocities considerably beyond what would be possible by either thermal Jeans escape or non-thermal escape processes. The paper provides a calculation for the collision probability of N_2 and CH_4 molecules

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in Titan's atmosphere with the rest of the atmospheric species. The goal of this investigation is to clarify if such collisions are efficient in Titan's upper atmosphere, and hence, if they can support the proposed mechanism of slow hydrodynamic escape for explaining the large loss rates of heavy species.

The study by de Bergh et al. models Titan's spectra in the 1.58 μm window at low and high spectral resolution from the ground and from Cassini, using newly measured methane line parameters in the right temperature and pressure conditions for Titan. Previously, work had been limited by the lack of information on methane absorption at near-IR wavelengths. By comparing new calculations with previous work, the authors investigate the uncertainties involved in modeling near-infrared methane absorption features. The study also evaluates CO and CH_3D abundances in Titan's atmosphere, illustrating the further value of the updated methane line lists.

Several studies in this issue focus on interpreting observations returned by the Cassini spacecraft but also aim to pave the way toward the development of models that will help prepare future missions to Titan's surface.

"*Titan's lakes chemical composition: sources of uncertainties and variability*" by Cordier et al. tackles the thermodynamic modeling of a lake–atmosphere equilibrium at Titan. While such modeling holds many promises, the authors point out its limitations due to the lack of fine constraints on several key input parameters. Still, with the data at hand they rule out a possible dissymmetry in composition between the lakes located in the north and south polar regions. By evaluating the dependence of the lake compositional model results on thermodynamic parameters, they highlight experimental work needed to improve such models and that discussion can serve as a roadmap for future investigators.

In "*A despeckle filter for the Cassini Synthetic Aperture Radar images of Titan's surface*" Bratsolis et al. revisit the interpretation of Cassini Synthetic Aperture Radar observations of Titan's surface by introducing a technique that can filter out the speckle noise and restore the texture information contained in SAR images. The authors also introduce an approach for discerning lakes from their surroundings, making it easier to study these features and their seasonal variations. The proposed methodology facilitates the study of Titan's geomorphology and the search for specific features, such as dunes, tectonic features, impact craters, isolate features and a specific application is shown for the lakes. This should prove instrumental to mapping the distribution of these features as a first step toward classification and geological mapping by combination with the Cassini Visual and Infrared Mapping Spectrometer (VIMS) data. The method will also help track the evolution of these features over the course of the Cassini mission and lead to constraints on Titan's methane cycle.

P. Coll et al. present interesting experimental studies on the chemical evolutions of tholins when in contact with ammonia aqueous solutions. The possible resemblance with Titan's aerosols in contact with liquid NH_3/H_2O in the surface of the satellite have strong implications for the formation of organic molecules of astrobiological interest. Indeed, the chemical evolution of Titan's aerosols is of key interest for astrobiology, as well as for our understanding of the geological processes occurring on Titan's surface. This work contributes to this field by making some of the first calculations of biomolecule yields under Titan-like conditions. The determination of production yields carried out by the present study is a major step into the characterization of potential aerosols evolution on Titan.

Other Saturnian satellites are also investigated in this issue, in particular, Enceladus and Rhea.

The paper by C. Taffin et al. is entitled "*Temperature and grain size dependence of near-IR spectral signature of crystalline water ice: from lab experiments to Enceladus' south pole*". Starting from laboratory experiments to acquire infrared spectra of pure water ices with controlled grain sizes temperatures, they propose at the end a method for retrieving temperature and grain size of laboratory icy samples. They illustrate this method capabilities by characterizing the icy surfaces of the outer solar system. As an example, the VIMS spectral images of Enceladus' south pole have been used to retrieve both the grain size distribution around the tiger stripes area and the distribution of temperature anomalies along the ridges.

T. Roatsch et al. combine high resolution images of Rhea by the Cassini Imaging Science Subsystem (ISS) with lower resolution images from Cassini and Voyager to produce a high resolution mosaic of the icy moon's surface, forming a basis for a high resolution atlas for Rhea and completing the series of atlases produced for Saturn's medium sized icy moons.

The spectral properties across Rhea's surface as seen in the Cassini Visual and Infrared Mapping Spectrometer (VIMS) data have been analyzed in Stephan et al. this issue. Magnetospheric and dust impacts appear to be the sources of the concentration of dark material and minor amounts of carbon dioxide on the trailing hemisphere. Geologically fresh impact craters and the concentration of water ice in the steep scarps implies an icy crust in the upper few kilometers.

Orton et al. report that the south polar hot spot of Neptune was detected only three times in their ground-based observations from 2003 to 2010. This led them to conclude that this stratospheric feature is ephemeral. They suggest its likely origin is a large planetary wave that is episodically triggered by dynamical activity in Neptune's interior.

Editors
A. Coustenis
LESIA, Paris-Meudon Observatory, 92195 Meudon Cedex, France

S. Atreya
University of Michigan, Ann Arbor, MI, USA

J. Castillo
JPL/Caltech, Pasadena, CA, USA

P. Coll
LISA, Universities Paris 7-Denis Diderot, Paris-Est Créteil & CNRS, Créteil, France

I. Mueller-Wodarg
Imperial College, London, UK

L. Spilker
Jet Propulsion Laboratory, Pasadena, CA, USA