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Preface

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

Several scientific sessions in international meetings and congresses last year, including European Geosciences Union (EGU), Asia Oceania Geosciences Society (AOGS), European Planetary Science Congress (EPSC) and others, focused on recent observations and models of the atmospheres and surfaces of the giant planets and their satellites. This special issue of Planetary and Space Science contains papers on a subset of research presented at above meetings. A number of presentations were based on results from the Cassini–Huygens observations during the Jupiter flyby and the ongoing observations of the Saturnian System. After the successful descent and landing on Titan of the Huygens probe in 2005, the Cassini spacecraft has been returning a wealth of new data almost continuously, revealing an astonishingly complex and dynamic system. Complementary observations of the giant planets and their satellites were obtained from the ground, and also by the new space observatory Herschel, launched on May 14, 2009. In addition to the observations several papers in this issue discuss results from laboratory experiments and models.

From an analysis of the CIRS observations of Jupiter during Cassini's flyby in 2000–2001 (northern summer solstice), Nixon et al. working on *"Abundances of Jupiter's Trace Hydrocarbons From Voyager and Cassini"* derived the stratospheric abundances of C_2H_6 and C_2H_2, and compared them to the IRIS measurements made from Voyager over two solar cycles ago during northern fall equinox. They find that although the equator-to-pole increase in C_2H_6 persists between the two epochs, Cassini data show an equator-to-pole decrease in C_2H_2 in both hemispheres whereas no latitudinal change was evident in the Voyager data. This is another indication that the seasonal behavior of Jovian hydrocarbons is controlled by both chemistry and dynamics.

In "*Jovian's plasma torus interaction with Europa: 3D Hybrid kinetic simulation. First results*", Lipatov et al. demonstrate the capability and limits of the hybrid kinetic modeling approach to simulate processes resulting from the interaction of the Galilean satellite Europa (considered at this stage without a liquid, conductive layer) and the Jovian magnetosphere. The modeling is extensive as it deals with the density and distribution of plasma and energetic ions, electrons, and neutrals, investigates processes such as the photoionization, electron-impact ionization, and the effect of electron pressure on the plasma wake structure, and predicts ion velocity distribution and the fluxes along the magnetic field. Among other results, the study highlights the role of electron temperature in the plasma structure formation, and that of heavy pickup ions in structuring Europa's wake.

In their paper *"Preparation for the Solar system observations with Herschel: Simulation of Jupiter observations with PACS"*, Sagawa et al., give an overview of the unsettled scientific issues concerning Jupiter, which will be entirely re-addressed by new and sensitive observations to be carried out with the Herschel Space Observatory, which covers a wide spectral range in the far-infrared and submillimetre domains (approximately 55–672 mm). The guaranteed time key program *"Water and related chemistry in the Solar system"* (Hartogh et al., 2009; previous Plan. Space Science Special issue in this series), is a dedicated project to observe water and other minor species.

Further in the future, the paper "*High resolution remote sensing observations for missions to the Jovian system: Io as a case study*" by Delory et al. assesses the science return from prospective observations at Jupiter's satellite Io as a function of the aperture size and wavelength of the payload imager and the distance of a spacecraft cruising to and then touring in the Jovian system. The authors simulate the images to be expected using different configurations of the imager and observational distance, taking Mount Saint Helens as a reference. This article also reviews the capability of heritage and future imaging systems. That study is particularly timely as the Europa and Jupiter System Mission is in its early stage of development.

This special issue of Planetary and Space Science then moves on to the next outer planet, Saturn, its fascinating satellite Titan and the ring system.

Cours et al. discuss a thorough re-analysis of 2-micron NAOS/CONICA observations of Titan taken at the ESO/VLT in 2005. They confirm the previous findings that the winter northern hemisphere contains more haze than the southern summer hemisphere. They also conclude on the compatibility of water and methane ices as present on the surface.

In *"High Spectral Resolution Infrared Studies of Titan: Winds, Temperature and Composition"* Kostiuk et al. compare measurements of Titan's wind speed, stratospheric temperature, and atmospheric composition obtained from ground-based observations taken with the (Infrared Heterodyne Spectrometer (IRHS) and the Heterodyne Instrument for Planetary Wind And Composition (HIPWAC)) against spaceborne observations with the Cassini Composite Infrared Spectrometer (CIRS). This study highlights the complementarity of ground-based and spaceborne observations in terms of spectral resolution, spatial resolution, and time coverage. From the combination of these multiple observations the authors investigate the seasonal variations of Titan's winds. They also infer from high-resolution ground-based observations new constraints on the ethane mole fraction in Titan's atmosphere, and highlight their consistency with recent analyses of CIRS data.

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Lellouch et al. discuss the capabilities of a submillimeter sounder on a future Titan mission for determining the characteristics of the middle atmosphere of Titan (500–900 km) that is largely unexplored by available observations. Their analysis shows that the proposed 300–1300 GHz range would allow for measurements of trace hydrocarbons, nitriles and isotopic temperatures, and winds (in 200–1200 km), thus filling the gap in our understanding of the part of Titan's atmosphere where photochemistry dominates.

Barth et al. look at *"Cloud formation along mountain ridges on Titan"* using the Titan Regional Atmospheric Modeling System (TRAMS). This paper presents the first model of orographic clouds on Titan. The paper deals with an interesting topic since clouds and mountains are known to exist on Titan, but nobody knows how they are correlated with each other. The variety of cloud appearance in different scenarios is an interesting result, as the conclusions on the presence of condensation depending on the amount of methane and humidity in the atmosphere.

Romanzin et al.'s paper presents *"Combined experimental and theoretical studies on methane photolysis at 121.6 and 248 nm"*. This paper is a continuation of a previous paper (Romanzin et al. 2009, in the previous Plan. Space Science Special issue in this series), whose goal was to compare photolysis experiments of methane at 248 nm and Ly-α in order to establish the relevance of using a multiphotonic absorption process in their experimental device regarding the hydrocarbons production. The present paper presents new results on the production of C_2H_2, C_2H_4, and C_2H_6 as a function of irradiation time at both wavelengths, and OD photochemical modeling is here used to interpret the experimental data. This combined experimental and theoretical approach shows that the chemical evolution after methane photolysis is significantly different depending on the wavelength. The authors further discuss the implications on a program of laboratory simulations of Titan's atmosphere (SETUP).

Flandes et al. tackle the problem of reproducing the variation in temperature of Saturn's main rings as a function of solar elevation angle in their paper *"Brightness of Saturn's Rings with Decreasing Solar Elevation"* by using temperature data obtained with the Cassini CIRS instrument. The data are analyzed using models in which the albedos of the ring particles are the unknown parameter to be fitted. An analytic approximation and a computer simulation were used to model mutual shadowing.

The Editors wish, once more, to recognize here the excellent work of the conveners of these sessions, who organize excellent meetings with state-of-the-art presentations of the studies in this field of the outer planets' systems attracting large audiences. We also wish to express our gratefulness to the reviewers who have done an excellent job in evaluating the 10 papers contained in this special issue.

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