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Preface

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

This special issue of PSS represents select articles based on research presented during the PS3.02 and PS3.03 sessions of the European Geosciences Union (EGU) meeting in Vienna, Austria, from 2 to 7 April 2006, and includes updates since the meeting. These EGU sessions focused on recent observations and models on the atmospheres and surfaces of the giant planets and their satellites, as well as their ring systems.

Particular attention was given to results from the Cassini-Huygens mission to Saturn and Titan, which has been returning a wealth of new data over the past 3 years, and revealing an astonishingly complex and dynamic system. Complementary Earth-based observations were also obtained during the Saturn approach phase and the early in-orbit phase. A series of papers in this issue therefore discuss results from this mission on all of these aspects of the Saturnian system: the planet, its moons and the rings.

In particular, there are several studies reported here from session **PS3.02** on the Kronian icy satellites and the rings. Studies of Saturn's moon, Enceladus, are reported here by Roatch et al. who present a new global mosaic of Enceladus, derived from Cassini and Voyager images. The spatial resolution is about 110 m/pixel for the regions imaged by Cassini and lower resolution for the north polar Voyager images. Altobelli et al. present an overview of the Composite Infrared Spectrometer (CIRS) ring thermal measurements obtained since Saturn orbit insertion in 2004. This thermal mapping of Saturn's rings shows that the largest temperature changes on the lit face of the rings are driven by variations in phase angle while differences in temperature with changing spacecraft elevation are a secondary effect. Leyrat et al. present an overview of the thermal behavior of Saturn's rings and their dependencies with the phase angle and the local hour angle, using azimuthal scans obtained by the Cassini CIRS instrument to date. The ring temperatures vary with ring longitude as the input heating from Saturn and the Sun changes. The temperatures change rapidly in the ring shadow, indicating very low thermal inertias for the ring particles.

Session **PS3.03** included presentations on the neutral atmospheres of the outer planets and Titan—the largest moon of Saturn with an atmosphere of nitrogen. Two papers in this issue have Titan's haze as their primary focus. In their two-part paper, Lavvas, Coustenis and Vardavas present a comprehensive one-dimensional photochemical-radiative transfer model of Titan's atmosphere. This work goes beyond previous such studies by including iteratively the gas and aerosol opacities and comparing the model results with current observations. It also finds a new haze layer between 500 and 900 km, comprising copolymers of nitrile/hydrocarbons. Using constant mass flux for aerosols and observational constraints from Huygens, Borucki and Whitten find haze concentrations and sizes to vary from 150 km ($5 \times 10^7\,m^{-3}$; $0.25\,\mu m$) to the surface ($0.3 \times 10^7\,m^{-3}$; $1.1\,\mu m$). Furthermore, they suggest that aerosols are needed to explain fully the ion and electron conductivities on Titan.

Paganelli et al. present new investigations in terms of brightness temperature of Titan's surface and compare RADAR SAR-radiometry maps with SAR imaging to show that the observations from both sets are strongly correlated and offer the possibility to associate brightness temperatures with surface features in terms of composition. Sittler et al. make a compelling case for the sources of ions and neutral species in Saturn's Inner magnetosphere. They use the Cassini Plasma Spectrometer (CAPS) observations to infer ion fluxes, which are dominated by two groups: protons and water-group ions. Temperature anisotropies are used to show that water molecules are the dominant source of ions within Saturn's inner magnetosphere. They show that the ion production has localized peaks near the L shells of Tethys, Dione and Rhea, but not Enceladus. They

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further estimate the neutral production rate and the time scale for loss of neutrals by ionization and charge exchange. They find that the estimated source rate for water molecules shows a pronounced peak near Enceladus' L shell.

This issue then aims to report on current progress in the studies of the Saturnian system within the context of our Solar System and from ongoing space missions.

Editors
Athena Coustenis*
Sushil Atreya
Cécile Ferrari
Linda Spilker
LESIA (Bat 18), Observatoire de Paris-Meudon, 5 Place Jules Janssen, 92195 Meudon Cedex, France
E-mail address: athena.coustenis@obspm.fr (A. Coustenis)

*Corresponding Editor.