TEMPORAL VARIATIONS IN TITAN'S ATMOSPHERE AND SURFACE

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Atmospheric variations: By 2010, one whole year (a Saturnian orbital revolution) would have elapsed on Titan since the Voyager encounter in 1980, our first chance to thoroughly probe the satellite's chemical composition in the stratosphere. This is a good opportunity to look for seasonal effects to draw conclusions on the interannual evolution of the atmosphere. Voyager results on Titan's chemical and thermal composition 30 years ago [1] are used, along with ISO disk-averaged inferences [2]. Furthermore, CIRS nadir spectra taken during the past 5 years were averaged and binned over 10° in latitude for both medium (2.5 cm^{-1}) and high (0.5 cm^{-1}) resolutions. Latitudinal variations were then inferred from CIRS in a number of works [3-10]. We used that data to look for temporal variations in temperature and composition, within the duration of the Cassini mission by forming 5 year-around spectral selections (one for each mission year from 2005 to 2009) in the FP3 and FP4 CIRS focal planes and searched for variations in temperature and composition at northern (around 50°N) and southern (around 50°S) latitudes. We look for variations in temperature and composition as the season on Titan progresses. The results show that the gases generally increase in abundance from 2004 to 2009 in the northern hemisphere and decrease in the southern in agreement with [8]. We the n compare to previous findings using the same radiative code and model, thus ensuring consistency. When compared to the Voyager data (res=4.3 cm^{-1}), we find the current mixing ratio values for the gaseous components to be lesser in the Northern hemisphere with a possible indication for interannual variations, because - for at least some of the species - the abundances will not reach the enhancement in the North found in 1980. The contrary trends are observed in the South. We also compare with the disk-average results from ISO (1997). With this study (Coustenis et al., in preparation) we seek to set constraints on seasonal, photochemical and circulation models and to make predictions as to the spatial variations of the chemical composition on Titan for the upcoming years, when the season will finally become exactly the one of the Voyager encounter in 1980 and then move towards summer solstice in the north during the Cassini extended Solstice mission.

Surface variations: The Cassini-Huygens mission measurements suggest that several of the Saturnian satellites could be geologically active and support tectonic processes. Titan, for example, possesses a complex and dynamic geology as witnessed by its varied surface that is modified by aeolian, fluvial, tectonic and probably cryovolcanic processes. The Synthetic and Aperture Radar (SAR) instrument on board Cassini spacecraft captured evidence of tectonic features on Titan's surface such as mountains, ridges, faults and canyons, as well as tectonic terrains consisting of various intersecting tectonic elements. The processes that formed these structures are still unclear since erosional processes might have re-shaped or partially covered them. Nevertheless, the hypothesis that contractional tectonism has formed the observed features is the most probable one. We herewith present an overview of the tectonic features seen on Titan and Enceladus based on Cassini-Huygens mission data together with models relating these satellites with the tectonic processes that may have resulted in the observed topographies [11]. We discuss in particular changes in the surface morphology (such as the shrinkage of the lakes) that may be indicative of seasonal processes. None of the current exploration means of the Saturnian system permits the acquisition of in situ geo-tectonic measurements or samples, nor of high spatial resolution images that could reveal in detail the morphology and topography. Thus, a comparative study to terrestrial tectonic systems is a good informative method. However, additional higher resolution data are required in order to analyze the topography, the macro and micro structures and textures of the tectonic structures. Future missions to Titan with multiple elements and in particular in situ ones would be an important step forward to our better understanding the temporal / seasonal variations in the satellite's complex system.

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