EPSC Abstracts
Vol. 8, EPSC2013-625-1, 2013
European Planetary Science Congress 2013
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Investigating the Vertical Composition of Titan's Atmosphere with VIMS/Cassini Solar Occultations

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The VIMS imaging spectrometer onboard the Cassini spacecraft observes the vertical distribution of gases and aerosols' characteristics of Titan's atmosphere in the infrared (1-5 µm) through the acquisition of solar and stellar occultations. In particular, VIMS has acquired 10 solar occultations since the beginning of the Cassini-Huygens mission and the dataset covers different seasons and latitudes. The VIMS solar occultations probe a large portion of the atmosphere, between 50 and 650 km, at an average vertical resolution of 10 km.
We present the vertical profiles of gases and other atmospheric components, together with their spatial and temporal evolution. Two main gases (CH4 and CO) are observed by VIMS occultations. Methane presents strong bands at 1.2, 1.4, 1.7, 2.3 and 3.2 µm. Its vertical profile, computed by the inversion of the 2.3 µm band, shows an almost constant abundance of ~ 1.2-1.3% above 250 km, less than the reference value of 1.41% from the GSMS instrument (Niemann et al. 2010). CO is detectable between 50 and 180 km through its band at 4.7 µm. The resulting profiles are in good agreement with CIRS results that indicate a constant mixing ratio of 50 ppm (De Kok et al. 2007).
The presence of other spectral signatures has also been detected by VIMS solar occultations. The strongest of these signatures is blended with the 3.2 µm CH4 band. It is centered at 3.4 µm and was discovered by a previous analysis of one solar occultation (Bellucci et al. 2009). It has been attributed to the C-H stretch by alkanes and aromatics present in Titan's aerosols. An additional absorption observed at 2.4 µm, within the 2 µm methane band, can tentatively be attributed to overtone signatures of this C-H stretch. We will discuss this interpretation and its implications on the composition of aerosols and their temporal and spatial variability. Other two bands at 2.7 µm and 4.2 µm have been detected for the first time by the present study and are still unidentified. Their characteristics and possible attribution will be analyzed.