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Seasonal variation of trace species in Titan's ionosphere

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Introduction

With 13 years of observations, the Ion and Neutral Mass Spectrometer (INMS) onboard the Cassini spacecraft has observed the upper atmosphere of Titan through two seasons: winter and spring. The complex atmosphere is mainly composed of N₂, CH₄, H₂ and Ar, but a lot more carbon and nitrogen bearing trace species have been observed by INMS and other instruments. Using data from the closed source neutral mode of INMS instrument, we studied the abundance and variation of traces neutral species in Titan ionosphere, between 1500 and 950 km of altitude. We will present an ongoing effort on the reanalysis of the entire INMS Titan's observation dataset.

Method

To do so we recalibrated INMS data by taking into account the dead time correction, the ram pressure enhancement, the saturation correction, the increase of pressure in the chamber with the decreases of altitude, the sensitivity and the contamination by thruster firing (Cui et al., 2009, 2012). In addition, species entering the instrument were ionized and fragmented into ions inside INMS chamber, making difficult the identification of different species in such complex mass spectra. To retrieve the molecular mixing ratios we used a Monte-Carlo sampling on the fragmentation pattern to deconvolve the signal. To obtain a complete mass spectrum (m/z 1 to 99), we stacked INMS data, which increases the uncertainty on the altitude. We used the mass spectra deconvolution code developed by Gautier et al., (2020), also employed by Serigano et al., (2020) when they treated Saturn INMS data.

This enabled the retrieval of vertical and seasonal variation of Titan's atmosphere minor components. We expect to be able to link our results with the seasonal variations observed by other instruments [such as CIRS (Mathé et al., 2020)] in lower atmospheric layers.

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