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# Methane vertical profile in Titan's atmosphere

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More than a decade after the arrival of the Cassini-Huygens mission in Saturn's system, data returned by the Huygens probe during its descent remain a unique source of *in-situ* information on the lower atmosphere of Titan. Among the Huygens instrumental suite was the GCMS (Gas Chromatograph Mass Spectrometer) instrument which returned hundreds of mass spectra acquired in the atmosphere below 145 km of altitude.

We will present a reanalysis of GCMS data focusing on the methane vertical profile thanks to recent advances in our knowledge of Titan's atmosphere and in mass spectrometry data treatment [1-3].

We retrieved methane mixing ratio slightly lower than the one reported by the original team[4] and obtained its profile between 145 km and 30 km of altitude with a kilometric vertical resolution, and a sub-kilometric one between 30 km and the surface.

Such a vertical resolution unveiled clear oscillations in the methane mixing ratio in Titan's troposphere and methane vertical concentration diverging from an ideal adiabat. Such features could for example be a sign of small-scale convective zones in the troposphere which could have triggered the gravity waves detected by Huygens in the stratosphere. We hope that the discovery of previously unnoticed features in GCMS data will also enable the reanalysis of data returned by other Huygens instruments such as HASI and DISR on Titan lower atmosphere.

[1] Gautier et al. *Decomposition of electron ionization mass spectra for space application using a Monte-Carlo approach.* Rapid. Com. Mass Spec. 34(8), e8659 (2020)

[2] Serigano et al. *Compositional measurements of Saturn's upper atmosphere and rings from Cassini INMS*. JGR:Planets, 125 (8), E006427 (2020)

[3] Serigano et al. *Compositional Measurements of Saturn's Upper Atmosphere and Rings from Cassini INMS: An extended Analysis of Measurements from Cassini's Grand Finale Orbits.* JGR:Planets, 127, E007238 (2022)

[4] Niemann et al. *Composition of Titan's lower atmosphere and simple surface volatiles as measured by the Cassini-Huygens probe gas chromatograph mass spectrometer experiment*. JGR 115, E12006, 2010