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Wide-altitude range H_2O profile from ACS MIR and ACS NIR data

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Abstract

While the H_2O column density in the Martian atmosphere has been characterized in depth, with decades of monitoring by different missions, the vertical distribution of water and its behavior in the middle atmosphere, its interannual and seasonal variability is still poorly understood. Direct and long-term observations of the H_2O vertical distribution in the Martian atmosphere have been delivered by SPICAM on Mars Express for several Martian years [1, 2] but the Mars Express occultations are limited in season/location, and the profiling accuracy of SPICAM is perfectible.

Recent findings proved that water vertical distribution plays major role in the hydrogen escape processes on Mars and the water loss from the atmosphere [2, 3, 4]. Contrarily to our previous understanding, it has been discovered that water molecules reaching altitudes of 80 km in the perihelion season on Mars can be a direct source of escaping hydrogen.

The Atmospheric Chemistry Suite (ACS) began nominal science operations in March 2018 onboard the Trace Gas Orbiter (TGO) of the ExoMars mission [5]. ACS is a set of three spectrometers (NIR, MIR, and TIRVIM) intended to observe Mars atmosphere. The spectrometers can measure the vertical distribution of water vapour in different spectral bands providing a wide coverage of altitudes.

The H_2O profile is best measured with the strong 2.6 µm band by MIR channel. ACS will be sensitive up to 100 km with the accuracy better than 1 ppm. At the lower altitude bound, MIR can detect water lines down to 3 km provided the aerosol content is low. This can help us better constrain poorly known water distribution within the lowermost scale height. However, measuring the 2.6-µm band with MIR requires a special secondary grating position, and these sensitive H_2O measurements can be implemented only during dedicated campaigns. Routine monitoring of water profiles are planned with the NIR channel in the 1.38 µm band with an accuracy better than 10 ppm at 90 km. Such measurements can be performed in parallel with any other ACS channel.

In this talk we will present the first water vertical distributions obtained by NIR and MIR channels with the wide altitude extension from 0 to 100 km, discuss the retrieval algorithms and specifics of observations in different channels.

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References

[1] Maltagliati, L., Montmessin, F., Korablev, O., et al. 2013. Annual survey of water vapor vertical distribution and water–aerosol coupling in the martian atmosphere observed by SPICAM/MEx solar occultations. Icarus 223, 942-962.

[2] Fedorova A., Jean-Loup Bertaux, Daria Betsis, Franck Montmessin, Oleg Korablev, Luca Maltagliati, John Clarke, Water vapor in the middle atmosphere of Mars during the 2007 global dust storm, Icarus 300, 15 January 2018, Pages 440-457.

[3] Heavens, N. G., et al. (2018). "Hydrogen escape from Mars enhanced by deep convection in dust storms." Nature Astronomy **2**(2): 126-132.

[4] Chaffin, M.S., Deighan, J., Schneider, N.M., Stewart, A.I.F., 2017. Elevated atmospheric escape of atomic

hydrogen from Mars induced by high-altitude water. Nature Geoscience 10, 174–178. https://doi.org/10.1038/ngeo2887

[5] Korablev, O., Montmessin, F., and ACS Team: The Atmospheric Chemistry Suite (ACS) of three tpectrometers for the ExoMars 2016 Trace Gas Orbiter, Space Sci. Rev., 214:7, 2018.