The distribution and saturation of water vapor as inferred from ACS during the first Martian year of TGO Science observations

Anna Fedorova¹, Franck Montmessin², Oleg Korablyev¹, Mikhail Luginin¹, Alexander Trokhimovskyi¹, Denis Belyaev¹, Juan Alday³, Nikolay Ignatiev¹, Franck Lefèvre², Kevin Olsen³, Ehouarn Millour⁴, Jean-Loup Bertaux², Alexey Shakun¹, Alexey Grigoriev¹, Andrey Patrakeev¹, Svyatoslav Korsa¹, Colin Wilson³, François Forget⁴, and Anna Maattanen²

¹Space Research Institute (IKI) RAS, Physics of planets, Moscow, Russian Federation (fedorova@iki.rssi.ru)
²LATMOS-UVSQ, Guyancourt, France
³Physics Department, Oxford University, Oxford, United Kingdom
⁴LMD, Sorbonne Université, CNRS, Jussieu, Paris, France

The water vapour vertical distribution is an eloquent gauge of the relative roles of the various sources, sinks and processes that control the Martian water cycle. However, its behaviour is still poorly studied while it is instrument for our understanding of the loss of water from Mars to space, which results from the transport of water to the upper atmosphere where it is disassociated to hydrogen atoms that later escape. We use the Atmospheric Chemistry Suite on the ExoMars Trace Gas Orbiter to characterize the water distribution with altitude. Here we present results of the Atmospheric Chemistry Suite (ACS) instrument NIR channel for the first year of TGO observations covering the almost full year from Ls 160° of the Martian year 34 (April 2018) to Ls 130° of the Martian year 35 (January 2020). Simultaneous measurements of the water vapour mixing ratio, temperature and dust vertical distribution and formation of water ice clouds allow us to constrain the complex water behaviour and estimate the saturation state of H₂O. Water profiles during the 2018-2019 southern spring and summer stormy seasons show that high altitude water is preferentially supplied close to perihelion and that large supersaturation occurs even when clouds are present. Here we attempt to complete the story by studying water vapor during the northern spring and summer to explore whether saturation impacts water transport between hemispheres in this season. The data analysis of MY35 was supported by RSF (project No. 20-42-09035).