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Ground-based infrared mapping of H_2O_2 on Mars near opposition

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We have carried out ground-based seasonal monitoring of hydrogen peroxide on Mars since 2003. This presentation is on the latest set of observations using thermal imaging spectroscopy, with two observations of the planet near opposition, in May 2016 (Ls = 148.5°, diameter = 17”) and July 2018 (Ls = 209°, diameter = 23”). Data have been recorded in the 1232 - 1242 cm-1 range (8.1 micron) with the Texas Echelon Cross Echelle Spectrograph (TEXES) mounted at the 3-m Infrared Telescope Facility (IRTF) at Maunakea Observatory in Hawaii. As in the case of our previous analyses, maps of H_2O_2 have been obtained using line depth ratios of weak transitions of H_2O_2 divided by a weak CO_2 line. The H_2O_2 map of April 2016 shows a strong dichotomy between the Northern and Southern hemispheres, as predicted by the photochemical model developed in the Mars Climate Database (Forget et al. 1999) and in the Global Environmental Multiscale model (Daerden et al. 2019). The second measurement in July 2018 was taken in the middle of the MY 34 global dust storm. H_2O_2 was not detected, with a disk-integrated 2-sigma upper limit of 10 ppbv, while both the MCD and the LEM models predicted a value above 20 ppbv that was actually observed by TEXES in 2003 in the absence of dust storm (Encrenaz et al., 2004). This July 2018 depletion is probably the result of the high dust content in the atmosphere at the time of our observations, which led to a decrease of the water vapor column density in the relevant altitude range, as observed by PFS on Mars Express during this period (Giuranna and Wolkenberg, 2019). GCM simulations using the GEM model show that the H_2O depletion leads to a drop of H_2O_2 due to the depletion of HO_2 radicals whose self-recombination gives rise to H_2O_2. Our data provide new constraints to the photochemical modelling of H_2O_2 in the presence of a high dust content. In parallel, we have reprocessed the whole TEXES dataset of H_2O_2 measurements using the latest version of the GEISA database (2015). We have recently found that there is a significant difference in the H_2O_2 line strengths between the 2003 and 2015 versions of GEISA. Therefore, all H_2O_2 mixing ratios up to 2014 from TEXES measurements have been reduced by a factor of about 1.75. As a consequence, in four cases (Ls around 80°, 100°, 150° and 209°), H_2O_2 abundances show contradictory values between different Martian years, while, at Ls = 209°, the cause seems to be the increased dust content associated with the global dust storm. The inter-annual variability in the three other cases remains unexplained at this time.