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Diurnal variation of atmospheric water vapor at Gale crater: Analysis from ground-based measurements

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We analyze measurements obtained by Curiosity's Rover Environmental Monitoring Station (REMS) and ChemCam (CCAM) instruments to shed light on the hydrological cycle at Gale crater. In particular, we use nighttime REMS measurements taken when the atmospheric volume mixing ratio (*VMR*) and its uncertainty are the lowest (between 05:00 and 06:00 LTST) [1], and daytime CCAM passive sky measurements taken when the *VMR* is expected to be the highest (between 10:00 and 14:00 LTST) [2].

VMR is calculated from simultaneous REMS measurements of pressure (P), temperature (T) and relative humidity (*RH*) at 1.6 m (*VMR* is defined as $RH \times e_s(T)/P$, where e_s is the saturation water vapor pressure over ice). The REMS relative humidity sensor has recently been recalibrated (June 2015), providing *RH* values slightly lower than those in the previous calibration (Dec 2014). The full diurnal cycle of *VMR* cannot be analyzed using only REMS data because the uncertainty in daytime VMR derived from REMS measurements is extremely high. Daytime *VMR* is inferred by fitting the output of a multiple-scattering discrete-ordinates radiative transfer model to CCAM passive sky observations [3]. CCAM makes these observations predominately in the vicinity of 11:00 – 12:00 LTST, but occasionally in the early morning near 08:00 LTST.

We find that throughout the Martian year, the daytime *VMR* is higher than at night, with a maximum day-to-night ratio of about 6 during winter. Various processes might explain the differences between nighttime REMS and daytime CCAM *VMR* values. Potential explanations include: (i) surface nighttime frost formation followed by daytime sublimation [1], (ii) surface nighttime adsorption of water vapor by the regolith followed by daytime desorption and (iii) large scale circulations changing vertical H_2O profiles at different times of the year. Potential formation of surface frost can only occur in late fall and winter [1], coinciding with the time when the diurnal amplitude of the near-surface *VMR* at Gale is maximum, while adsorption/desorption by the regolith can occur throughout the year [2]. Adsorption by the regolith is expected to be more efficient at lower temperatures (i.e. winter), although it remains unclear whether kinetics would allow for the exchange of adsorbed water on hourly time scales necessary to track insolation [4-5]. Local surface-atmosphere interactions, either via frost formation and/or exchange of adsorbed water with the atmosphere, might play a significant role in the diurnal hydrological cycle at Gale.

REFERENCES:

[1] Martínez G. M. et al. (2016) *Icarus*, doi: http://dx.doi.org/10.1016/j.icarus.2015.12.004

[2] Savijärvi H. (2016) *Icarus, 265,* 63–69.

[3] McConnochie T. et al. (2015) *AGU Fall Meeting*.

[4] Beck P. et al. (2010) *JGR*, 115, E10011.

[5] Zent A. P. et al. (2001) *JGR*, 106, 14667-14674.