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Three full martian years of in situ humidity at Gale crater through MSL/REMS observations

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Mars Science laboratory (MSL) has been operating successfully since early August 2012 with the REMS instrument providing extremely valuable atmospheric observations of atmospheric pressure, temperature of the air, ground temperature, wind speed and direction, relative humidity (REMS-H), and UV measurements.

The REMS-H relative humidity device is based on polymeric capacitive humidity sensors developed by Vaisala Inc. and it makes use of three (3) humidity sensor heads. The humidity device is mounted on the REMS boom providing ventilation with the ambient atmosphere through a filter protecting the device from airborne dust. The REMS-H humidity instrument has created an unprecedented data record of more than two full Martian years. It has measured the relative humidity and temperature at 1.6 m height for a period of 5 minutes every hour as part of the MSL/REMS instrument package. Mars Science laboratory (MSL) has been operating successfully since early August 2012 with the REMS instrument providing extremely valuable atmospheric observations of atmospheric pressure, temperature of the air, ground temperature, wind speed and direction, relative humidity (REMS-H), and UV measurements.

The annual in situ water cycle based on three full Martian years at the Gale crater will be discussed. We will utilize the REMS-H instrument's in situ observations accompanied by orbital observations and modeling efforts. We will infer the hourly atmospheric VMR from the REMS-H observations and compare these VMR measurements with predictions of VMR given by our 1D column Martian atmospheric/regolith model to investigate the local water cycle, exchange processes and the local climate in Gale Crater.

The strong diurnal variation suggests there are surface-atmosphere exchange processes at Gale Crater during all seasons, which deplete moisture to the ground in the evening and nighttime and release the moisture back to the atmosphere during the daytime. Our modeling results presumably indicate that adsorption processes take place during the nighttime and desorption during the daytime. Other processes, e.g. convective turbulence play a significant role in the daytime in conveying the moisture into the atmosphere.

A clear increase in the amount of early morning atmospheric humidity was detected from about sol 1800 onward, when Curiosity started to climb onto Mt. Sharp. The MSL MastCam pictures from this time show exposed bedrock scenery with very sparse and thin layers of wind-blown dust. Our simulations indicate that a plausible explanation for the increase of the atmospheric humidity during early mornings could be the Mt Sharp bedrock material a higher inertia low porosity of an exposed bedrock material.