REMS Mars Weather Report #1 (Landing to Sol 19)

This first weather report covers the first weeks after landing (5 Aug2012) until mission Sol[1] 19 (25 Aug 2012). The season on Mars for this period late northern summer, which is the equivalent of early September on the Earth (Ls=150°-160°; where Ls is the seasonal date[2]). Pressure measurements show a mean pressure of roughly 730 Pa. This mean pressure was as expected based on the seasonal cycle of the total atmospheric mass on Mars. The cycle of total mass results from the fact that the poles gets cold enough for carbon dioxide to freeze and form seasonal ice deposits. Since carbon dioxide makes up most of the atmosphere, this process causes the total atmospheric pressure to vary. At landing, models and previous mission data suggested that we would be at the minimum mean pressures that we would see during the year, and pressure does indeed rise slowly across the period of this first report.

The pressure data also show a very significant daily variation of pressure. The minimum is near 685 Pa and the maximum near 785 Pa. The pattern of pressure change across the Sol is very similar from Sol-to-Sol. The majority of the variation is due to large scale waves in the atmosphere called tides. These tides are different from tides in the Earth's ocean because they are forced by heating due to the sun rather than the gravitational pull of the Moon. The tides are sensitive to the distribution of cloud and dust in the atmosphere, and also the large scale pattern of winds (on scales similar to the jet streams that we are familiar with from Earth weather forecasts). There are also shorter timescale variations in the pressure that may be associated with flows within the Gale Crater system.

As the season progresses, the sun is rising higher at noon each Sol. The UV measurements show this and have been measuring sunrise and sunset to occur at around 0525LT and 1720LT within Gale Crater. The REMS UV sensor uses magnets to prevent dust from settling on its sensors. These have been successful in preventing the sensor from degradation due to the dust plume generated during landing and the sensors remain clean after the first weeks of operation. The maximal irradiance values obtained by the UV sensors can be used to estimate the amount of dust in the atmosphere, and provide similar values to those obtained previously by the MER rovers cameras for this season. We expect the dust storm season to begin soon on Mars, with generally higher dust amounts even when storms are not active. This increased dust will make the atmosphere more opaque to UV radiation and thus help shield the Martian surface from damaging UV radiation. Despite the magnetic protection, we expect a slow build up of dust on the UV sensors, which will be able to systematically observe using the Curiosity cameras.

As Gale Crater is just south of the equator, the sun is still not quite overhead at noon – this will happen just after the equinox in about a month. Currently, we do not see a major trend in mean temperatures. However, just as with pressure, the ground and air temperatures are dominated by the daily cycle. Unlike pressure, the reason is direct and local heating by the Sun, and the fact that the Martian atmosphere is much thinner than the Earth and the surface is much drier than the Earth. As a result, there is much more response of the temperature to solar heating, with as much as 70°C change in air temperature from the lowest just before dawn and a maximum just after 1400 LT. The ground temperature change is even larger, at over 100°C. The daytime peak ground temperatures just barely reach above 0°C.

[1] Sol is the term used to refer to a solar day on Mars and lasts about 24 hours and 39 minutes

[2] Ls refers to the solar latitude, which is the position of Mars in its orbit around the Sun, with Ls = 0° corresponds to the vernal equinox (in the northern hemisphere), 90° is the summer solstice, autumnal equinox is 180° and 270° the winter solstice