Monitoring Martian Opacity

1) The aim of this experiment is to monitor the opacity of the Martian atmosphere in order to learn more about the composition of the atmosphere and its evolution over time on a daily and seasonal basis. This parameter can also be used for operational need like forecasting the solar panel efficiency, for example. The opacity of the Martian atmosphere as well as the optical depth has already been measured at four different wavelengths by Viking Lander missions and Mars Pathfinder. It allowed the scientific community to emphasize the presence of particle of water ice aerosols and dust.

   In this particular case, the objective of this experiment is to determine and monitor the opacity and optical depth during the day and during the night. A comparison between the data retrieved from this experiment and the actual value known by the Planetary Sciences and Radiative Transfer experts is planned. The main purpose is to see how close from the real value on can get using reasonably cheap means.

   This idea of experiments is a part of a project conducted during the final year of Aerospace Engineering at ISAE-Supaero by Principal Investigator Mehdi Scoubeau and whose goal was to work on the theoretical and practical ways to monitor the opacity of the Martian atmosphere.

2) Although it is composed primarily of CO2, with a surface pressure of about 7 mbar, the atmosphere of Mars has many similarities with that of the Earth. Therefore, one of the aspects that could be interesting to study is the dynamical state of the atmosphere. It is also essential to know more about planet weather and to try and improve in its forecasting before installing any colony on it. Once we are able to efficiently monitor the atmosphere opacity, we could be able to forecast any imminent dust storm. This information could be used to verify and validate other weather forecast we might have. It is known that the dust storms on Mars are a real issue and could cause a grave prejudice to any EVA ongoing or even put the whole mission in jeopardy. Finally, the amount of sunlight reaching the ground is important for the engineers designing solar arrays and optical instruments but also to plan the daily activities.

   It is however obvious that the data measured on Earth in Utah would very different from the data on Mars because the atmosphere there is far more thin. The compositions of the two atmospheres are quite different, too. Altogether, monitoring the opacity is an application that can be later transposed to another model of atmosphere. There exist quite a few models of atmosphere that could be used to foresee what data shall be measured on Mars.

3) The feasibility and cost assessment of that experiment was part of a final year project conducted by the Principal Investigator. It showed that monitoring the opacity would be quite easy during the day using a photometer.

   The particularly bright sky over the MDRS, away from light and air pollution, makes it a special spot to study the atmosphere.

4) Firstly, the extinction coefficient will be measured using a homemade photometer using an Arduino and several LED lights for calibration. This setup has already been tested and is described in a project book called "Atmospheric Monitoring with Arduino". No specific EVA will be needed for that experiment. The setup could be made at the beginning of an EVA. Then, the device could stay outside during the time of the EVA and be removed at the end and placed in the Engineering Airlock by any of the Crew Members. At least one measurement will be necessary for calibration and then two or three other measurements in order to have several samples of data.