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A Novel Technique to Calculate UV Opacity at Gale Crater from MSL/REMS Measurements

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The Rover Environmental Monitoring Station (REMS) on board the Mars Science Laboratory (MSL) mission carries a UV sensor that for the first time is measuring the solar radiation at the surface of Mars in six bands between 200 and 380 nm [1]. Here we present a novel methodology to calculate the atmospheric opacity by using the UV photodiode output currents measured by this sensor (TELRDR products) and ancillary (ADR) data.

We estimate the diffuse and total radiation signals by analyzing the events in which the direct solar beam was temporarily blocked by the masthead or by the mast of the rover. Then we use a radiative transfer model with updated radiative properties of the Martian aerosols ([2], [3]) based on the Monte-Carlo method to retrieve the UV opacity from those measurements. Therefore, this methodology is not sensitive to the degradation of the sensor due to the deposition of dust on it. In addition, by using TELRDR and ADR data, inconsistencies in the processed reduced data (ENVRDR and MODRDR products, in units of W/m^2) found when the solar zenith angle relative to REMS rover frame is above 30º are avoided.

In order to validate our technique, we compare the UV opacities with those derived from Mastcam observations at 880 nm. We find that both opacities show a good agreement and follow a similar seasonal trend, with the UV opacity showing values generally lower than at 880 nm. The difference between both opacities varies over the year, with the minimum difference occurring during the first half of the winter, when both opacities show their annual lowest values. The temporal variation of this difference may be used to analyze changes in the dust size distribution.

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