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Dependence of Martian radiation environment on atmospheric depth: modeling and measurement

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The energetic particle environment on the Martian surface is influenced by solar and heliospheric modulation and changes in the local atmospheric pressure (or column depth). The Radiation Assessment Detector (RAD) on board the Mars Science Laboratory (MSL) rover Curiosity on the surface of Mars has been measuring this effect for over four Earth years (about two Martian years). The anti-correlation between the recorded surface Galactic Cosmic Ray (GCR) induced dose rates and pressure changes has been investigated by Rafkin et al. (2014) and the long-term solar modulation have
also been empirically analyzed and modeled by Guo et al. (2015). This paper employs the newly updated HZETRN2015 code to model the Martian atmospheric shielding effect on the accumulated dose rates and the change of this effect under different solar modulation and atmospheric conditions. The modeled results are compared with the most up-to-date (from 14 August 2012 until 29 June 2016) observations of the RAD instrument on the surface of Mars. Both model and measurements agree reasonably well and show the atmospheric shielding effect under weak solar modulation conditions and the decline of this effect as solar modulation becomes stronger. This result is important for better risk estimations of future human explorations to Mars under different heliospheric and Martian atmospheric conditions.