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# Influence of Particle Precipitation on CO2 Infrared Emission in Earth's Upper Atmosphere and Implications to Infrared Remote Sensing of the Martian Atmosphere

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The large thermospheric infrared radiance enhancements observed by the TIMED-SABER experiment during recent solar storms provide an exciting opportunity to study the influence of solar-geomagnetic disturbances on Earth's upper atmosphere and ionosphere. In particular, SABER observed several orders of magnitude enhancement of nighttime 4.3 um emission, for example, during the April 2002 and October-November 2003 storm periods. The primary process responsible for auroral enhancements of 4.3 um emission is vibrational excitation of NO+, caused by ionization of the neutral atmosphere, followed by exothermic ion-neutral chemical reactions and subsequent emission at 4.3 um. For certain energy distributions of the precipitating electrons, auroral dosing can have an indirect effect on CO2 4.3 um emission through the near resonant V-V transfer between the CO2 4.3 um fundamental band and vibrationally excited N2, since N2 is vibrationally excited by inelastic electron collisions and chemical reactions. Analysis of the SABER nighttime 4.3 um measurements are providing new insight into the E-region electron density during solar-geomagnetic storms, lower thermospheric ion-neutral chemistry, and auroral influences on CO2 non-LTE radiation transfer. An obvious extension of this analysis is to determine to what extend does particle precipitation influence infrared radiative emission in the Martian atmosphere. What are the possible mechanisms that could lead to enhanced infrared emission by auroral dosing? If a signature is discernable, can one derive characteristics of the Martian ionosphere from infrared measurements? To what extent may retrievals of temperature, pressure, and chemical abundances from infrared limb emission measurements be contaminated by auroral processes if uncorrected? In this

paper we review our current understanding of the auroral influences on CO2 infrared emission in Earth's upper atmosphere and begin to answer the previous questions concerning the Martian atmosphere.