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Utilities of $O_2(^1\Delta)$ Airglow Emission for Mars Atmospheric Ozone Remote Sensing

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The $O_2(^1\Delta)$ 1.27 micron emission is one of the brightest emissions observed in the Mars dayglow spectrum and provides an ideal light source for passively sensing the Mars atmosphere. It is believed that the excited $O_2(^1\Delta)$ molecules in the daytime Mars atmosphere are produced by ozone photolysis by solar UV radiation. Its measured emission rates have thus been used to obtain the abundances of ozone in the Mars atmosphere by Earth-based observers. This paper uses a recently developed 1-D photochemical model to examine the utility and feasibility of this Mars ozone sensing technique, especially the effects due to the presence of dust on ozone photolysis rates and the relatively long lifetime of the $O_2(^1\Delta)$ molecules on their production/loss time-dependency. The radiative transfer module used to calculate the ozone photolysis rates includes multiple scattering by dust layers to evaluate the impacts of dust on ozone photolysis rates. The 1-D time-dependent model is used to calculate the degrees of departure of $O_2(^1\Delta)$ molecules from their local photochemical equilibrium values and evaluate this critical assumption for accurate ozone abundance retrievals from the 1.27 micron dayglow emission. In addition, we will also examine the relative importance of $O_2(^1\Sigma)$ collisional cascade source of $O_2(^1\Delta)$ from the O_2resonance excitation of 762 nm photons. The effects of dust on this additional source and its impact on ozone abundance retrievals will also be reported.