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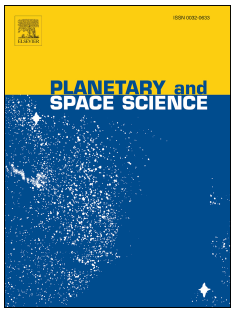

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Retrieval of wind, temperature, water vapor and other trace constituents in the Martian Atmosphere.

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Abstract

Atmospheric limb sounding is a well-established technique for measuring atmospheric temperature, composition, and wind. The theoretical capabilities of a submillimeter limb sounder placed in low Mars orbit are quantified, with a particular focus on the ability to make profile measurements of line-of-sight wind, temperature, water vapor, deuterated water vapor, several isotopes of carbon monoxide, oxygen-18 carbon dioxide, ozone, and hydrogen peroxide. We identify cases where all such measurements can be made within a single 25–70 GHz wide region of the submillimeter spectrum, enabling use of a single state-of-the-art submillimeter receiver. Six potential spectral regions, approximately centered at 335 GHz, 450 GHz, 550 GHz, 900 GHz, 1000 GHz, and 1130 GHz are found, any one of which can provide a complete measurement suite. The expected precision and vertical resolution of temperature, composition, and wind measurements from instruments in each range are quantified. This work thus follows on from that of Urban et al. (2005), Kasai et al. (2012), and earlier studies, expanding them to consider many alternative observing frequency regions. In general, performance (in terms of measurement precision and vertical resolution) is improved with increasing observation frequency. In part this is due to our choice to assume the same antenna size for each frequency, thus providing a narrower field of view for the higher frequency configurations. The general increase in emission line strengths with increasing frequency also contributes to this improved performance in some cases. However, increased instrument power needs for the higher frequency configurations may argue against their choice in some mission scenarios.

Keywords: Mars, Atmosphere, Wind, isotopes, temperature, humidity, composition

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