IONIZATION PATCHES ON THE NIGHT SIDE OF MARS AND THEIR SEASONAL AND SOLAR CYCLE VARIATIONS. M. O. Fillingim[1], L. M. Peticolas[1], R. J. Lillis[1], D. A. Brain[1], J. S. Halekas[1], D. Lummerzheim[2], and S. W. Bougher[3], [1]Space Sciences Laboratory, University of California, Berkeley, CA 94720-7450 (matt@ssl.berkeley.edu), [2]Geophysical Institute, University of Alaska, Fairbanks, AK 99775-7320, [3]Department of Atmospheric, Oceanic and Space Sciences, University of Michigan, Ann Arbor, MI 48109-2143.

Introduction: Recently, both Mars Global Surveyor and Mars Express have observed downward traveling auroral-like accelerated electrons on the night side of Mars [1, 2]. The spatial distribution of accelerated electrons is patchy and inhomogeneous tending to cluster near magnetic cusps at the periphery of strong crustal magnetic field sources. Upon interacting with the atmosphere, these accelerated electrons will create significant enhancements in the electron number density and total electron content in the Martian ionosphere. These enhancements in ionization will also be patchy and distributed nonuniformly on the night side. Such ionospheric structure has been recently observed by MARSIS onboard Mars Express on both the day and night sides [3–6].

Model: Using a modification of the terrestrial electron transport code of [7], we model the effect of accelerated electrons on the nighttime Martian ionosphere. Appropriate modifications include the incorporation of Martian neutral density profiles given by the MTGCM atmosphere of [8] and the addition of appropriate CO and CO2 cross sections for electron impact compiled by [9] and [10], respectively.

Model Results: We find that a typical accelerated electron spectrum increases the maximum ionospheric electron number density and TEC by a factor of 3 over that produced by a nominal magnetotail electron spectrum. This factor should not be regarded as an upper limit since electron spectra with downward energy fluxes over an order of magnitude larger than that of the example used here have been observed in the MGS data set [1]. The latitudinal width of the region of enhanced ionization is less than 200 km.

*Seasonal and Solar Cycle Variations***:** We also investigate how seasonal and solar cycle changes in the upper atmosphere of Mars affect the maximum electron density, the altitude of the maximum, and the total electron content resulting from the precipitation of accelerated electrons. During northern winter (perihelion) conditions, the ionization peak, as well as the ionosphere in general, moves to higher altitude. Also the peak ionospheric density slightly decreases while the TEC slightly increases due to the larger atmospheric scale height at perihelion versus aphelion. During active solar conditions, the thickness of the ionospheric layer and the TEC increase as the peak ionospheric density decreases. Again this can be understood in terms of a larger upper atmospheric scale height under active solar conditions as compared to solar minimum.

Implications and Conclusions: The spatial and temporal variability of the nighttime Martian ionosphere has important implications for planning and carrying out subsurface radar soundings from orbit. The penetration depth to which soundings can reach is inversely proportional to the signal frequency. To penetrate the ionosphere, this frequency must be above the ionospheric electron plasma frequency which is determined by the maximum electron density. Therefore, increased ionospheric densities lead to decreased penetration depths. Recently [11] showed that MARSIS radar reflections from the surface can completely disappear on the night side during solar energetic particle events due to increased ionospheric electron densities. Finally, most previous work addressing how radio waves propagate through ionospheres assumes horizontal uniformity. This work shows that such an assumption is not valid in the night side ionosphere of Mars.

References: Use the brief numbered style common in many abstracts, e.g., [1], [2], etc. References should then appear in numerical order in the reference list, and should use the following abbreviated style:

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