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Deriving Ionospheric Content at Mars from Relay

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A novel technique to derive ionospheric properties at Mars is presented. This technique uses the attenuation of radio communication between orbiter and lander/rover during relay communication passes to derive total electron content.

Surface assets at Mars, such as Curiosity (MSL), Perseverance (M20), and Insight (NSY) utilize relay radio communication at UHF frequencies to transmit data and receive commands via orbiters, such as Mars Atmosphere and Volatile Evolution mission (MVN), Mars Reconnaissance Orbiter (MRO), and Trace Gas Orbiter (TGO). As radio waves propagate from surface asset to space asset, they are attenuated by electrons in the ionized region of the Martian atmosphere. This region is referred to as the ionosphere. The ionosphere contains variable electron abundances that can directly inform us of the dynamics of the Martian atmosphere that can be driven both by both intrinsic as well as extrinsic sources. Analysis of the difference between transmitted and received frequencies of radio signals that propagate through the ionosphere are used to derive the total electron content (TEC) along the signal propagation path between the surface and orbiting spacecraft. An ionospheric model is then used to interpret the TEC with other concurrent atmospheric measurements.

This presentation will describe the analysis of relay signal propagation used to derive TEC, and how an empirically constrained 1-D ionospheric model of Mars is used to interpret the derived value to determine the distribution of electrons with altitude.

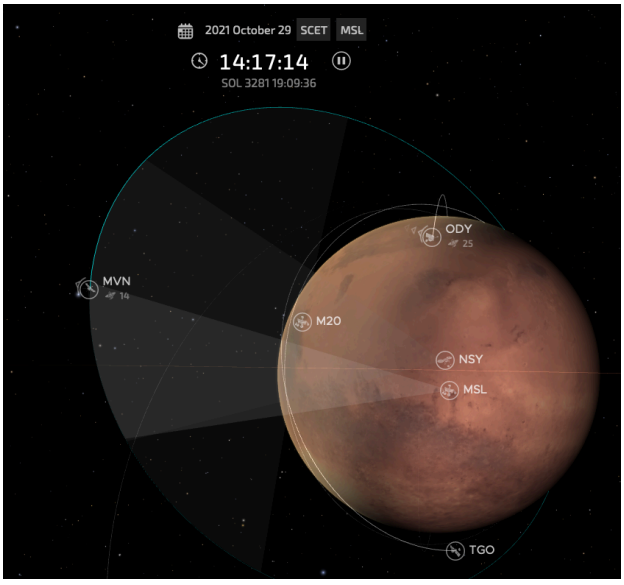

Figure 1. Cartoon demonstrating the geometry of orbiting assets (e.g., MVN) and surface assets (e.g., MSL) on Mars to derive atmospheric and ionospheric properties from Electra UHF transmissions [generated from www.nasa.gov/explore/mars-now].