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HF Propagation Results from the METAL OXIDE SPACE CLOUD (MOSC) Experiment

Abstract:

With support from the NASA sounding rocket program, the Air Force Research Laboratory (AFRL) launched two sounding rockets in the Kwajalein Atoll, Marshall Islands in May 2013 known as the Metal Oxide Space Cloud (MOSC) experiment to study the interactions of artificial ionization and the background plasma and measure the effects on high frequency (HF) radio wave propagation. The rockets released samarium metal vapor at preselected altitudes in the lower F-region that ionized forming a plasma cloud.

Data from the releases have been analyzed to understand the impact of the artificial plasma cloud on HF radio wave propagation and potential applications. The HF radio wave ray-tracing toolbox PHaRLAP along with the Parametrized Ionospheric Model (PIM) constrained by electron density profiles measured with the ALTAIR radar have been used to successfully model the effects of the cloud on HF propagation. Comparisons between the results, observed and modeled, for both releases will be discussed.

The results confirm that the injection of artificial ionization in the lower F-region results in significant changes to the ambient HF propagation environment. Specifically it is shown that the presence of the plasma cloud acted to refract HF energy away from great circle paths through a wide range of frequency-dependent propagation angles.