#120 Received 01/21/2015

Caton, Ronald G.[1]; Groves, Keith M.[2]; Pedersen, Todd R.[1]; Parris, Richard T.[1]; Holmes, Jeffrey M.[1];
1. US Air Force Research Laboratory, Space Vehicles Directorate
2. Boston College, Institute for Scientific Research

Incoherent Scatter Observations of Artificially Enhanced Ionosphere during the AFRL Metal Oxide Space Cloud Experiment (MOSC)

Abstract:
In May 2014, the Air Force Research Laboratory conducted a series of two sounding rocket experiments designed to probe and characterize an ionospheric plasma cloud generated from the release of samarium vapor in the upper atmosphere. The Reagan Test Site at Kwajalein Atoll was selected as the optimal location for the flight experiment due to the presence of the ARPA Long-Range Tracking and Instrumentation Radar (ALTAIR) on the island of Roi-Namur. Primarily used as a deep space tracking radar, with its 46m dish and 6 MW peak power, ALTAIR provides the necessary capabilities for monitoring and tracking the plasma cloud as the only fully steerable incoherent scatter radar in the equatorial region.

The two Metal Oxide Space Cloud (MOSC) flight experiments were conducted near dusk on separate evenings with releases of 5 kg of samarium (Sm) vapor at altitudes of 170 km and 180 km. Through both photo- and chemi-ionization processes, the reaction between the vaporized Sm metal with background oxygen atoms produced long-lived and localized plasma clouds (Sm + O --_ SmO+ + e –) visible in incoherent scatter observations more than two hours after the release. A network of ground sensors were deployed throughout the Marshall Islands to probe the cloud providing the first ever density measurement of an ionospheric Sm plasma cloud.

In this paper, we will present a brief overview of the MOSC experiment and focus in more detail on observations from ALTAIR and its role in helping characterize the samarium plasma cloud as part of a multi-instrument study. The MOSC experiment was primarily designed to allow for diagnosis and characterization of the artificially generated plasma clouds for use in improving existing models and the eventual tailoring of future experiments directly targeted at investigating the effects of such clouds on the ambient ionosphere. Even so, initial results from ALTAIR suggest that noticeable effects were evident in both coherent and incoherent returns with the moderate amount of material vaporized during the two chemical releases.