Measurements of the Impact of the Solar Eclipse on the Ionosphere Using HF Waves

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The effects of a solar eclipse on the ionosphere are different than sunset. During an eclipse, the sunlight is blocked by the moon as the solar Extreme Ultraviolet (FUV) passes through a fixed amount of atmosphere whereas at sunset the earth's limb block the sunlight with ever increasing amounts of atmosphere. The solar eclipse gives modelers and experimenters to better understand the ionosphere.

During the Solar Eclipse of 21 August 2017, a number of HF experiments were conducted using oblique ionograms with swept frequency transmissions between to ground sites, range-Doppler maps of a ground HF beacon to a satellite in low earth orbit, and ground clutter maps of HF backscatter from the earth. All of these observations occurred with a total eclipse for the ionosphere supporting the HF propagation. The observations spanned the United States starting with Oregon, through Idaho and Kansas, and ending at South Carolina.

Using empirical and physics based models such as the NRL SAMI 3, HF raytracing can elucidate the characteristic features of HF observations from Oblique Ionograms (OI), Ground to Satellite Range Doppler Maps (RDM), and SuperDARN Ground Backscatter Maps (GBM). During the total eclipse, the F-layer vanishes but the sporadic E-Layers can be minimally affected. Through the eclipse recover phase, a stronger F-layer is observed and multiple E-layers are recorded in the oblique ionogram data. Attempts are made to relate the eclipse time changes with both variations ion FUV flux and pressure driven winds in the upper atmosphere.