# Analysis of TEC Measurements from Sounding Rockets using Differential Phase from Two-Frequency Radio Beacons

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Detecting the differential phase delay of two phase-locked Beacon signals has long been used to measure ionospheric Total Electron Content (TEC). When making such measurements from sounding rockets the analysis of the data is complicated by the spin of the rocket which is often several revolutions per second. This introduces a constant frequency offset to both signals at the ground receivers. Because this offset does not scale with the frequency it manifests as a constant phase rate enhancement in the differential phase and, thus, an apparent slope in the TEC detected by a receiver as long as the spin rate is constant. The spin frequency shift can removed from the measurements by fitting a slope to a portion of the flight where the rocket is below the ionosphere where the TEC is zero or close to zero.

We will present analysis of TEC data from several recent rocket experiments. These include the NRL Charged Aerosol Release Experiment (CARE) and the AFRL Metal Oxide Space Cloud (MOSC) experiments. In both cases, the ionosphere was artificially modified. During CARE a solid rocket motor released dust into the F-Region ionosphere and during the MOSC campaign Samarium was released into the E-Region ionosphere on two separate occasions. The TEC measurements are made using beacons on-board the sounding rockets transmitting at 150 MHz and 400 MHz, the same frequencies historically used by many satellite beacons (e.g. NIMS/Transit). Signals were received on the ground using two types of receivers: 1) North West Research Associates (NWRA) analog receivers and 2) Modern digital software receivers. We will discuss the difficulty in making TEC measurements from rockets and the advantages and disadvantages of each type of receiver. The data indicate that an ionospheric electron density depletion was formed during CARE and ionospheric electron density enhancements formed during MOSC.

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