Investigating COSMIC GPS Radio Occultation Observables as Diagnostics for Active Ionospheric Heating Experiments

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Experiments since the High Frequency Active Auroral Research Program (HAARP) transmitter reached full power of 3.6 MW have produced consistent TEC increases of a few tenths of a TEC unit and occasional significant enhancements of density in localized regions on the bottomside of the F region during periods of strong heating [Pedersen et al., 2009]. We have analyzed COSMIC Radio Occultation data for possible signatures of ionospheric electron heating during the March 2009 HAARP experiments. Optical, ionosonde, and ground GPS TEC measurements suggest the larger density enhancements are highly structured and far from homogenous, in addition to occurring in relatively small regions near the center of the beam. GPS radio occultation (RO) data is a potential diagnostic for determining the altitude distribution of the HAARP-produced density enhancements, which is not observable with ground GPS TEC or ionosondes, although the localized inhomogenous nature may prevent effective measurement using RO geometry. Relative TECs along the GPS radio occultation path are simulated using the Field Line Interhemispheric Plasma (FLIP) model with the HAARP experiment parameters. Plasma heating is imposed at altitude of the RF resonance frequency and ionospheric convection is included in the model. Electron density profiles are then inverted from the GPS RO data by assuming localized density perturbations are created in the HAARP beam relative to the uniform background plasma. The results are discussed in relation to planning future COSMIC observations in conjunction with HAARP campaigns.

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