Ionospheric Storm Enhanced Density Observations using the DICE CubeSat Langmuir Probes

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ABSTRACT

High density F-region stormtime plasma enhancements at upper mid-latitudes known as Storm Enhanced Densities (SEDs) are caused by Sub-Auroral Polarization Stream (SAPS) electric fields. In conjunction with SEDs, plasma enhancements are also observed at low latitudes, but their source and possible connection with SEDs have not been explained. In this presentation, we compare in-situ observations from Dynamic Ionosphere CubeSat Experiment (DICE) and from DMSP satellites with assimilative models of the global ionosphere and of polar electrodynamics. We compare several days of data during quiet and geomagnetically disturbed conditions and find evidence of an SED on March 17th 2013. During this event, high density plasma appears to be convected through the throat region near 15 SLT.

The DICE CubeSat mission has three scientific objectives: (1) Investigate the physical processes responsible for formation of the midlatitude ionospheric Storm Enhanced Density (SED) bulge in the noon to post-noon sector during magnetic storms; (2) Investigate the physical processes responsible for the formation of the SED plume at the base of the SED bulge and the transport of the high density SED plume across the magnetic pole; (3) Investigate the relationship between penetration electric fields and the formation and evolution of SED.

The DICE mission consists of two identical 1.5U CubeSats deployed simultaneously from a single P-POD (Poly Picosatellite Orbital Deployer) into the same orbit. DICE was selected for flight under the NSF "CubeSat-based Science Mission for Space Weather and Atmospheric Research" program. The DICE twin satellites were launched on a Delta II rocket on October 28, 2011. The satellites are flying in a “leader-follower” formation in an elliptical orbit which ranges from 820 to 400 km in altitude. Each satellite carries a fixed-bias DC Langmuir Probe (DCP) to measure in-situ ionospheric plasma densities, a science grade magnetometer to measure DC and AC geomagnetic fields, and an Electric Field Probe (EFP) to measure DC and AC electric fields. These measurements will permit accurate identification of storm-time features such as the SED bulge and plume, together with simultaneous co-located electric field measurements which have previously been missing. The mission team combines expertise from ASTRA, Utah State University/Space Dynamics Laboratory (USU/SDL), Embry-Riddle Aeronautical University.