The Charged Aerosol Release Experiment (Care II) to Study Artificial Dusty Plasmas and Irregularities in the Upper Atmosphere

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A sounding rocket launched from Andoya, Norway on 16 September 2015 carried 37 rocket motors and a multi-instrument daughter payload into the ionosphere to study the generation of plasma wave electric fields and ionospheric density disturbances by the high-speed injection of dust particles. The primary purpose of the CARE II mission is to validate the dress-particle theory of enhanced incoherent scatter from a dusty plasma and to study plasma instabilities driven by high-speed charged particles. The CARE II chemical payload produces 66 kg of micron-sized dust particles composed of aluminium oxide. In addition to the dust, simple molecular combustion products such as N_2, H_2, CO_2, CO, H_20 and NO will be injected into the bottomside of the F-layer. Charging of the dust and ion charge exchange with the molecules yields plasma particles moving at hypersonic velocities. Streaming instabilities and shear electric fields causes plasma turbulence that can be detected using ground radars and in situ plasma instruments. The instrument payload was separated from the chemical release payload soon after launch to measure electric field vectors, electron and ion densities, and integrated electron densities from the rocket to the ground. The chemical release of high speed dust was directed upward on the downleg of the rocket trajectory to intersect the F-Layer. The instrument section was about 600 meters from the dust injection module at the release time. Ground HF and UHF radars were operated to detect both scatter and refraction by the modified ionosphere. Optical instruments from airborne and ground observatories were used to map the dispersal of the dust using scattered sunlight. Numerous collaborators from England, Germany, Norway, Sweden, and Finland participated in CARE II. The plasma interactions are being simulated with both fluid and particle-in-cell (PIC) codes. CARE II is a follow-on to the CARE I rocket experiment conducted from Wallops Island Virginia in September 2009.