

Study of Spatial Structure of E-region irregularity from the SEEK-2 experiment

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Ionospheric irregularities in the mid-latitude E-region has been one of the study topics for more than ten years. We have been studying the phenomena by using HF/VHF radars, ionosondes, optical instruments, sounding rockets, and computer simulation. The QP structures appear in the E-region FAI as a reflection of modulation pattern in the Sporadic-E (Es) layers. The structures are associated with polarization electric field, which suggests strong coupling process between the ionized and neutral atmosphere. Electrodynamic coupling of different altitudes of E-region ionosphere is also an important issue together with E- and F-region coupling processes. Detailed generating mechanism of the QP echoes is, however, still unresolved. In August 2002, we conducted SEEK-2 (Sporadic-E Experiment over Kyushu 2) campaign in Japan under collaboration with many scientists from Japan, USA and Taiwan. Since the SEEK-2 follows the achievements of the first SEEK campaign in 1996, it was extended in some aspects. The SEEK-2 consists of two sounding rockets of Institute of Space and Aeronautical Sciences that include in-situ experiment of electron density, electron temperature, electric field, plasma fluctuation and waves, and geomagnetic field as before. As a new rocket experiment, we conducted rocket-beacon experiment to measure TEC (Total Electron Content) of the Es-layers, and both up-leg and down-leg releases of TMA (Tri-Methyl Aluminum) to measure the neutral winds and waves. From the ground we measured the same observation region of the rockets with two radars of 24.5MHz and 31.6MHz, ionosonde network of Japan, an MF radar, several airglow imagers, and a GPS scintillation-receiver system. We observed intense QP echoes with radars after 23 LT (= UT + 9 hours) on August 3, 2002, and launched rockets into the E-region at 2324 LT and 2339 LT. The operation of the SEEK-2 was very successful as we could select a good event for the launches. All instruments on the rockets worked fine. From preliminary data analyses we are finding that the rockets detected multi-layered Es-layers at 103, 105 and 129km altitudes, and intense electric fields that approach +/-10 mV/m. The rocket-beacon experiment measured horizontal structures of the E-region TEC. The TMA release showed rippled structures which may prove existence of wave or instability in the neutral atmosphere. In the presentation we will show more results from the SEEK-2, and discuss newer view on the spatial structures of the mid-latitude E-region FAI.