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Preface

SEEK-2 (Sporadic-E Experiment over Kyushu 2)

SEEK-2 was an experimental campaign with two sounding rockets, two portable FAI radars, several airglow imagers, and other instruments for investigations of structures of the midlatitude E-region ionosphere. A successful experiment was carried out in August 2002. This is a special issue of papers from that campaign. Previously, the midlatitude ionosphere used to be considered quiet compared with the ionosphere at the geomagnetic equator and in the auroral region. However, intense ionospheric field-aligned irregularities (FAIs) are excited in association with the sporadic-E (Es) layers. By using the MU radar in Japan, we first clearly observed the phenomenon that the E-region FAI echoes fluctuate in time with clear phase propagation in range. These are the quasi-periodic (QP) echoes that interest many researchers in the field. The first experimental campaign for this study was SEEK, conducted in 1996 in Japan. The SEEK-2 experiment is an improved second attempt of the first experiment. This series of experiments was conducted in close collaboration with scientists from Japan, USA, and Taiwan. All sounding rockets were launched from Uchinoura Space Center (USC) of the Japan Aerospace Exploration Agency (JAXA).

The series of SEEK and SEEK-2 experiments was very successful, with numerous scientific results obtained from each campaign. They also functioned as an engine for the ideal "Observation-Modelling-Verification" research cycle. Based on earlier results from radar observations, we had a simple model for the QP-echo generation whereby deep altitude modulation of the Es layers may generate the phenomenon. The model was validated and found not to be true by the SEEK experiment. But we obtained interesting findings from the experiment that there exist intense polarization electric fields and sharp neutral wind shears in the midlatitude E-region. New conceptual models were proposed based on these results, and were verified with results from SEEK-2. In SEEK-2 we tried best to observe the horizontal structure of the Es layers. For that purpose we employed a rocket-beacon experiment and selected low-horizontal path for the TMA trail. The main VHF radar for QP-echo detection has an interferometry capability for more accurate measurements.

In this special issue we gather ten papers based on the results from SEEK-2. There are one summary paper, five papers for rocket experiments, three papers from ground-based observations, and one paper that simulates formation of Es layers and surrounding electrodynamics during the experiments. Through these efforts we now consider that it is the close interaction between the E-region ionosphere and the background atmosphere that generates this very interesting phenomenon. Intense polarization electric fields that arise from spatial inhomogeneity of the Es layer propagate upward to the upper E-region, generating complicated spatial structures there. The electric fields might even influence the F-region electrodynamics. We strongly hope that the papers in this special issue would contribute much to enhance understanding of the midlatitude ionosphere.

We are grateful to the Editor, the Topical Editor, and all reviewers who contributed to this special issue. We deeply thank the Institute of Space and Aeronautical Science (ISAS) of JAXA, who gave us the opportunity of conducting the SEEK and SEEK-2 experiments.

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