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PREFACE

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Special issue "Coupling of the high and mid latitude ionosphere and its relation to geospace dynamics"

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The EPS special issue, *Coupling of the High and Mid Latitude Ionosphere and Its Relation to Geospace Dynamics*, originated from a session held during the Asia Oceania Geosciences Society (AOGS) 2014 meeting in Sapporo (Japan). In addition to the papers presented at the conference, others of common scientific interest have been included. In the end, 12 papers have been published, covering a wide variety of scientific topics.

The focus of this special issue is on the coupling of the high and mid latitude ionosphere, which plays an important role in geospace dynamics. Recently, the coverage offered by ground-based observation networks, such as magnetometers, high-frequency (HF) radars, Global Positioning System (GPS) receivers and others, has increased dramatically, improving our understanding of the coupling between the high and mid latitude ionosphere. In addition, several satellites in geospace provide essential in situ data, yielding numerous new findings, as well as posing new questions. The papers in this issue contribute to our understanding of the high/mid (and low/equatorial) latitude ionosphere and geospace coupling, as well as geospace dynamics.

Sudden changes in the dynamic pressure of solar wind, known as sudden impulses (SI), have a major influence on the magnetosphere and ionosphere. Specifically, the SI have a significant effect on ionospheric convection at high and mid latitudes, as observed by the Super Dual Auroral Radar Network (SuperDARN) HF radars (Hori et al. 2015), as well as on auroral emissions (Liu et al. 2015). In addition, the interaction between solar wind and the magnetosphere leads to substorms, which are manifestations of the explosive energy release processes.

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The inductive effects of the magnetosphere during the course of a substorm have been studied by Mishin et al. (2015).

Magnetosphere–ionosphere interaction, equatorward of the auroral emission region (subauroral latitudes), often generates subauroral polarization streams (SAPS). Nagano et al. (2015) have identified the slowest speed limit of SAPS and have suggested that the ionospheric feedback mechanism does not play a significant role in the slower part of the SAPS.

The ionosphere is formed as a result of solar emission, magnetosphere–ionosphere coupling, and ionosphere–thermosphere coupling processes. It is important to know the distribution of ionospheric plasma densities in order to understand the formation processes of the ionosphere. The characteristics of the distribution of ionospheric plasma density were studied by employing FORMOSAT-3/COSMIC satellite data (Chang et al. 2015), GPS TEC data (Kumar et al. 2015), and SuperDARN HF radar data (Oinats et al. 2016a). The results of the analysis of the observation data were compared with HWM93 simulation or International Reference Ionosphere (IRI)-2012 model.

Additionally, the ionosphere is disturbed by ionospheric plasma instability processes and ionospheric–thermosphere coupling processes. The characteristics of traveling ionospheric disturbances of various origins were studied by employing SuperDARN HF radar data (Oinats et al. 2016b). Tsunami-driven traveling ionospheric disturbances were studied by employing GPS TEC data (Tang et al. 2015). Seif et al. (2015) have studied the detailed characteristics of daytime ionospheric scintillation near the magnetic equator and have discussed the role of gradient-drift instability in generating ionospheric plasma irregularities.

In addition, in order to study ionospheric characteristics, it is important to develop techniques to enhance the precision of analyzing observational data. Ponomarenko et al. (2015) have developed an algorithm for calibrating the elevation angle parameter of the SuperDARN radars, which is important in identifying echo locations. Furthermore, it is important to model the ionospheric parameters to extract the main characteristics of ionospheric disturbances. Mandrikova et al. (2015) have developed an algorithm for modeling ionospheric parameter FoF2 and extracting the main characteristics of ionospheric perturbations during different seasons and geomagnetic activities.

With the advance of observational techniques and the expansion of the field of view of the existing observation network, as well as the development of modeling/numerical simulation algorithms, we hope to enhance the understanding of the ionosphere, ranging from the high to mid/low latitude, and its relation to the dynamics of the geospace and upper atmosphere.

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