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Preface to the Special Issue on "Connection of Solar and Heliospheric Activities with Near-Earth Space Weather: Sun-Earth Connection"

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This special issue of the Terrestrial, Atmospheric and Oceanic Sciences (TAO) presents a small collection of the materials presented at the 2011 International Space Plasma Symposium (ISPS), held at National Cheng Kung University (NCKU) in Tainan, Taiwan, Republic of China (ROC), during August 15 - 19, 2011. The purpose of the Symposium was to bring space physicists together to present their recent research results and discuss some outstanding questions in, but not limited to, the solar corona, interplanetary medium, planetary magnetosphere and ionospheres. A total number of 59 papers were presented at the Symposium by scientists from 11 countries and regions.

We appreciate the host and sponsor institutes (Plasma and Space Science Center, NCKU, Taiwan, and Institute of Space, Astrophysical and Plasma Sciences, NCKU, Taiwan) and the local organizing committee [Sunny W. Y. Tam (Chair), Frank C. Z. Cheng, Alfred Chen, Kaiti Wang, Ya-Hui Yang, and Marty Chou] for their hospitality, the conveners (Sunny W. Y. Tam, Frank Cheng, Masahiro Hoshino, and Chin-Chun Wu) and program committee (Sunny W. Y. Tam, Frank Cheng, Katya Georgieva, Tohru Hada, Masahiro Hoshino, Bernard Jackson, Kanya Kusano, Guan Le, Kan Liou, Gang Lu, Anthony T. Y. Lui, and Chin-Chun Wu) for organizing the Symposium. We also thank TAO for publishing the papers in this special issue.

The Sun continuously emits materials into the heliosphere to form the solar wind. It also occasionally ejects denser materials, i.e., the so-called coronal mass ejections (CMEs). When these materials and their accompanied interplanetary magnetic field (IMF) encounter the Earth, geomagnetic and auroral activity may result. Understanding the formation, transport and interaction of the solar events with the Earth and the Earth's response constitutes solar physics and the realm of space weather. This special issue publishes a collection of 13 papers addressing these issues.

When a magnetic cloud (MC) or an interplanetary coronal mass ejection (ICME) encounters the Earth, its large amplitude flux rope structures couples with the magnetosphere and may cause geomagnetic activity. Wu et al. (2013a, this issue) addressed the magnetospheric response to different types of solar events. They found that the average magnetic field component, i.e., $|Bz_{\min}|$, is larger within MCs than within ICMEs and concluded that the average geomagnetic storm intensity associated with MCs is higher than that for ICMEs and co-rotating interaction regions (CIRs).

Petrinec (2013, this issue) compiled 9.5 years of magnetosheath measurements made by Geotail and Wind and constructed synoptic maps of the magnetic field throughout the equatorial magnetosheath as a function of the solar wind IMF direction. He concluded that his result is in agreement with the predictions of Rankine-Hugoniot conditions and with global numerical models.

During strong geomagnetic disturbances, the Earth's magnetosphere exhibits unusual and nonlinear interaction with the incident flow of magnetized solar wind plasma. Dmitriev and Suvorov (2013, this issue) found that magnetopause distortion was controlled by a strong southward interplanetary magnetic field. Variations in the solar wind dynamic pressure can also enhance geomagnetic activity. Liou et al. (2013a, this issue) show that during northward IMF solar wind pressure pulses can be an important source of geomagnetic and auroral activity.

During geomagnetic disturbances, energetic electrons of inner radiation belt can penetrate into the forbidden region of drift shells located at the height of the topside equatorial ionosphere (Suvorova et al. 2013, this issue). CME-driven shocks are generally believed to be the acceleration site for gradual solar energetic particle (SEP) events. Liou et al. (2013b, this issue) demonstrated that there is a good correlation between the Mach number of magnetohydrodynamic (MHD) fast-mode shocks and the time-intensity profile of He^4 and O with energies greater than ~10 MeV. Solar wind particles are not only accelerated by IP shock, but solar wind electrons may also be accelerated by Langmuir turbulence (Yoon et al. 2013, this issue). Chen et al. (2013, this issue) used a Vlasov solver with a splitting scheme to study Langmuir turbulence to capture the non-Maxwellian distribution function effect on Landau damping.

The extended solar minimum during 2007 - 2009 resulted in a record low solar wind density and magnetic field at Earth. Wu et al. (2013b, this issue) proposed a "heliospheric plasma-sheet inflation" model to explain the extreme solar wind density. The extremely low solar activity provides a good opportunity for studying various phenomena associated with the quiet time near the Earth space environment. For example, Chiang et al. (2013, this issue) studied 535 cases of nighttime airglow in geomagnetic quiet conditions over the period between February 2007 and October 2008. The global midnight brightness can be attributed to several effects, which include the influence of the troposphere, the thermospheric midnight temperature maximum effect, summer-to-winter neutral wind and ionospheric anomaly. Chang et al. (2013, this issue) performed a statistical comparison between the zonal mean, migrating diurnal, migrating semidiurnal and DE3 non-migrating tides in the total electron content (TEC) from FORMOSAT-3/COSMIC (F3/C) and global ionosphere map (GIM) datasets in 2008. They found that the zonal mean and the tidal TEC components in F3/C and ground-based GIM data show qualitatively similar seasonal variability and spatial structure.

During the declining phase of solar cycle 23 in 2005, a clear 9-day period in the coronal hole (CH) time series was identified in 2005, resulting in the recurrence of fast streams in the solar wind and recurrence of auroral and geomagnetic activities/storms. The effect of this periodic solar and geomagnetic activity also caused global neutral density increases and thermospheric O/N_2 decreases as the heated and disturbed polar thermosphere expanded and transported to mid and low latitudes over the period of 2005 to 2006 (Zhang et al. 2013, this issue).

Ho et al. (2013, this issue) studied electromagnetic ELF waves observed at the Lulin station in Taiwan. They concluded that the source of the ELF waves was not associated with geomagnetic activity. ELF wave enhancements in some of their studied events are attributed to earthquake precursors.

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