Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-01 Room:302 Time:May 27 11:00-11:15

Secondary instability in the magnetosphere-ionosphere feedback coupling

WATANABE, Tomo-hiko[1*]

[1]Department of Physics, Nagoya Univ.

The Alfvenic coupling with the feedback mechanism from the ionosphere to the magnetosphere provides us a potential framework to describe spontaneous growth of auroral arc structures. The shear [1] (or kinetic [2]) Alfven wave is destabilized though the feedback instability, providing growth of auroral arc structures in the polar ionosphere. The spontaneous growth of auroral arcs is accompanied with enhancement of ionospheric density perturbations, localized field-aligned currents, and sheared ExB flows. When the feedback instability has grown to a large amplitude, a nonlinear mode coupling leads to deformation of the arc structure [3]. In the present study, we have made a perturbation analysis for the secondary unstable mode, numerically solving the initial value problem. It is shown that the secondary mode can be destabilized when the primary mode amplitude exceeds a critical level, and that the typical growth rate can be several times higher than that of

the primary one. We also discuss the secondary mode structure embedded in the linear eigenfunction of the feedback instability.

[1] T. Sato, J. Geophys. Res., 83, doi:10.1029/JA083iA03p01042.
[2] T.-H. Watanabe, Geophys. Res. Lett., 41, doi:10.1002/2014GL061166 (2014).
[3] T.-H. Watanabe, Phys. Plasmas, 17, 022904 (2010).

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-02 Room:302 Time:May 27 11:15-11:30

Long-term trends in ionospheric parameters measured by the EISCAT radars

BJOLAND, Lindis merete[1*] ; BELYEY, Vasyl[1] ; LOVHAUG, Unni pia[1] ; LA HOZ, Cesar[1]

[1]Department of Physics and Technology, University of Tromso

Incoherent scatter radar measurements are an important source for studies of ionospheric plasma parameters. Data from the EISCAT Svalbard Radar (ESR), which covers the polar cap and cusp, and the UHF and VHF radars, which cover the auroral zone, can be used to obtain information about the electron density, electron- and ion temperature, and line-of-sight plasma velocity from an altitude of about 50 and up to above 1600 kilometers. As the ESR radar has been operational since 1996 and the UHF and VHF radars since the early 1980s, the accumulated database covers more than one solar cycle in the polar cap and cusp and several solar cycles in the auroral zone.

Results from the study of long-term trends in the ionospheric parameters both from the ESR and UHF/VHF will be shown and a comparison with the IRI-model will be discussed.

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-03 Room:302 Time:May 27 11:30-11:45

Cusp aurora as a backward-elongated image of the moving region of electron precipitation

TAGUCHI, Satoshi[1*] ; CHIBA, Yasunaga[2] ; HOSOKAWA, Keisuke[2] ; OGAWA, Yasunobu[3]

[1]Graduate School of Science, Kyoto Univ., [2]Graduate School of Informatics and Engineering, Univ. of Electro-Communications, [3]National Institute of Polar Research

We present high time resolution observations of the red-line moving cusp aurora made on 27 November 2011 by an all-sky imager at Longyearbyen, Svalbard, and their comparison with EISCAT observations. The EISCAT radar pointing in the magnetic field-aligned direction detected several enhancements of electron temperatures whose durations are 1-5 min. The all-sky imager data obtained with a time resolution of 4 s allowed us to determine a one-to-one correspondence between electron temperature enhancements and cusp aurora intensifications. The radar beam entered the moving cusp aurora structure from its forward side, and exited from the backward side in some events, while in others the beam skimmed the moving aurora. Further analyses of the former events revealed that the enhancement of the electron temperature, which was produced by the intense electron precipitation, terminated 60-90 s earlier than the exit of the radar's field-of-view from the moving aurora. This duration is consistent with the lifetime of the O(^{1}D) state. Our observation provides evidence demonstrating that the cusp aurora is a backward-elongated image of the moving region of electron precipitation. The enhancement of ion temperature was also found to be in the moving cusp aurora structure. On the basis of these results we discuss the spatial relationship between electron precipitation and fast plasma flow, which causes the ion temperature enhancement.

Keywords: aurora, cusp, plasma flow, electron precipitation, electron temperature, ion temperature

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-04 Room:302 Time:May 27 11:45-12:00

Towards quantification of auroral properties based on image data with high temporal resolution

NAKANO, Shin'ya[1*] ; OGAWA, Yasunobu[2]

[1]The Institute of Statistical Mathematics, [2]National Institute of Polar Research

We are developing a technique to extract various information from aurora image data with temporal resolution of 1 second. The variations of aurora can be decomposed into a persistent component and residual fluctuations. We thus aim at quantifying various auroral properties by analyzing each of the components. For example, the motion of the persistent component would provide the information on the convection electric field. The properties of the convection can thus be obtained using optical flow analysis of this component. On the other hand, the residual fluctuations are mainly attributed to pulsating aurorae. It could therefore be possible to obtain the information on the frequency and amplitude of a pulsating aurora. We will report the current status and outlook.

Keywords: aurora, magnetospheric convection, pulsating aurora

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-05 Room:302 Time:May 27 12:00-12:15

Tomography analysis of eastward propagating auroral vortices

TANAKA, Yoshimasa[1*] ; OGAWA, Yasunobu[1] ; KADOKURA, Akira[1] ; GUSTAVSSON, Bjorn[2] ; PARTAMIES, Noora[3] ; WHITER, Daniel[3] ; ENELL, Carl-fredrik[4] ; BRAENDSTROEM, Urban[5] ; MIYAOKA, Hiroshi[1] ; KOZLOVSKY, Alexander[6]

[1]National Institute of Polar Research, [2]University of Tromso, Norway, [3]Finnish Meteorological Institute, Finland, [4]EISCAT Scientific Association, [5]Swedish Institute of Space Physics, Sweden, [6]Sodankyla Geophysical Observatory, Finland

We have studied characteristics of mesoscale auroral vortices observed in the Northern Scandinavia by aurora campaign observation using multi-point camera network with the EISCAT UHF radar in March, 2013. Three eastward propagating auroral vortices were observed intermittently at about 15-minute intervals in the post-midnight sector (0:00-0:40 UT; 2:30-3:10 magnetic local time) on March 9 just after the substorm onset. They were simultaneously detected by monochromatic (428nm wave length) all-sky EMCCD imagers at Tromso (69.6N, 19.2E), Norway, Kilpisjarvi (69.0N, 20.9E), Finland, and Abisko (68.4N, 18.8E), Sweden, with an exposure time of about 2 seconds and an sampling interval of about 10 seconds. We showed the difference between the eastward propagating auroral vortices and typical omega bands/torches: (1) The auroral vortices occurred during the expansion phase of the substorm, coincident with Pi 2 pulsations at the magnetic equator. The omega bands/touches are usually observed during the substorm recovery phase. (2) The drift velocity of the vortices was approximately 3 - 10 km/s at 100 km altitude, which is much faster than the typical velocity of the omega bands. (3) The ionospheric equivalent current systems derived from the magnetometer data indicated the upward FAC in the dark region inside the vortices, whereas the downward FAC is typically detected in the dark region between the torches. We speculated that the eastward propagating aurora vortices might be transient phenomena that are related to the generation process of the omega bands.

In this study, we further investigated three-dimensional (3D) structure of the auroral luminosity and energy distribution of the precipitating electrons. The generalized aurora computed tomography technique (e.g., Aso et al., 2008; Tanaka et al., 2011) was applied to the second vortex event observed at 0:15-0:18 UT. We found that the average energy of the precipitating electrons tends to be higher for thinner auroral arcs. To confirm that this tendency is common for all auroral arcs, we apply the tomography analysis to the other vortex events. In addition, we perform the numerical simulation to check if this result is not due to the analysis techniques.

Keywords: aurora, tomography analysis, vortex structure, 3D distribution, energy distribution, post-midnight

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-06 Room:302 Time:May 27 12:15-12:30

Visualization of wave-particle interactions by high-speed imaging of aurora

KATAOKA, Ryuho[1*] ; FUKUDA, Yoko[2] ; MIYOSHI, Yoshizumi[3] ; SHIOKAWA, Kazuo[3] ; OZAKI, Mitsunori[4] ; KATOH, Yuto[5] ; EBIHARA, Yusuke[6]

[1]National Institute of Polar Research, [2]The University of Tokyo, [3]Nagoya University, [4]Kanazawa University, [5]Tohoku University, [6]Kyoto University

A variety of wave-particle interactions working in the magnetosphere-ionosphere coupled region and in the magnetosphere cause many different types of fast and fine-scale auroras, such as flickering and pulsating aurora as well as curls and folds. Some compound microstructures have also been found from the cutting-edge optical instrument (Kataoka et al., 2015, EPS Frontier Letter). We review our new challenges of ground-based high-speed imaging observations using EMCCD and sCMOS cameras as a new tool of the visualization of wave-particle interactions to diagnose the local plasma environment.

Keywords: aurora

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-07 Room:302 Time:May 27 12:30-12:45

Omega band pulsating auroras observed simultaneously onboard THEMIS and on the ground

SATO, Natsuo[1*] ; KADOKURA, Akira[1] ; TANAKA, Yoshimasa[1] ; NISHIYAMA, Takanori[1] ; YUKIMATU, Akira sessai[1]

[1]National Institute of Polar Research

Omega band auroras were observed with the THEMIS ground based All-Sky Imagers array at SNKQ in Canada at ˜0230 MLT on 1st March 2011. We could find almost whole processes of the generation of omega band aurora from the initial growth phase to the declining phase through enhancement phase. Scale size of the omega band aurora during the maximum phase was ˜500 km and ˜200 km for north-south and east-west direction, respectively. Growth of omega band-like structure started in the western sky of SNKQ field of view. Then the auroras enhanced their intensity and drifted eastward with speed of 0.15 km/sec. Fine structure of the omega band aurora consists of intense pulsating auroras with ON-OFF period of about 10 sec. Ps 6 magnetic pulsations with a period of ˜600 sec were observed in association with the omega band auroras. Footprint of THEMIS-D spacecraft crossed poleward part of the omega band aurora. THEMIS-D observed significant signatures on electromagnetic field and particles in association with the time when the spacecraft crossed the omega band pulsating aurora. In particular it is very interesting and important that DC electric field intensity modulated with almost the same period of optical pulsating auroras. In this presentation we will demonstrate characteristics of optical features of omega band pulsating aurora obtained by all-sky imagers and also particle and field signatures onboard spacecraft when the footprint of THEMIS-D crossed the omega band aurora.

Keywords: aurora, pulsating aurora, omega band aurora, THEMIS, magnetosphere, ionosphere

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-08 Room:302 Time:May 27 14:15-14:35

Remote sensing of the dynamic plasmasphere by ground-based magnetometer arrays with the magnetoseismic technique

CHI, Peter[1*]

[1]Department of Earth Planetary and Space Sciences, UCLA

Ground-based magnetometers can monitor the dynamic plasmasphere through the use of the normal-mode magnetoseismic technique, which infers the equatorial plasma mass density from the observed field line resonance (FLR) frequencies. When two ground magnetometers are located at similar local times and separated by one or a few degrees in latitude, even the weak hum of closed magnetospheric field lines can be detected on a daily basis by comparing the phase differences at the two sites.

By using the magnetoseismic technique, we have observed variations in plasmaspheric density over different time scales, including the annual cycle, the diurnal cycle, and the phases of magnetic storms. In particular, the depletion or density enhancement in the plasmasphere during magnetic storms is found to correlate with concurrent changes in the ionosphere. The diurnal variation in plasmaspheric density at low L shells may be a consequence of the similar variation in the mass density of the thermosphere.

To better understand the coupling between the plasmasphere and the ionosphere using the ground-based magnetometer data, we have developed automated procedures to extract FLR frequencies from data as well as to calculate the equatorial plasma density. We have also extended the magnetoseismic technique to producing two-dimensional snapshots of plasmaspheric density using observations collected by a two-dimensional magnetometer network. We conclude by presenting a new database of plasmaspheric density named ”Ground-based Observations of the PlasmaspHEre through Resonance Sounding (GOPHERS).” The density data are derived from the geomagnetic field observations collected by AUTUMN/AUTUMNX, CARISMA, Falcon, GIMA, McMAC, THEMIS, and USGS stations in North America. We will present examples of the plasma densities in the GOPHERS database, demonstrating the spatio-temporal variations of the plasmasphere in response to solar and geomagnetic activities.

Keywords: plasmasphere, magnetoseismology, magnetic storms, plasmasphere-ionosphere coupling, ground-based magnetometer arrays, remote sensing

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-09 Room:302 Time:May 27 14:35-14:55

Plasmapause location under quiet geomagnetic conditions (Kp $\leq$ 1): THEMIS observations

KIM, Khan-hyuk[1*] ; KWON, Hyeuk-jin[2] ; NISHIMURA, Y[3]

[1]School of Space Research, Kyung Hee University, Gyeonggi, Korea., [2]Division of Climate Change Research, Korea Polar Research Institute, Incheon, Korea., [3]Department of Atmospheric and Oceanic Science, University of California, Los Angeles, California, US

Since the radial distance of the plasmapause is strongly controlled by geomagnetic activity, empirical plasmapause models have used geomagnetic Kp index to determine the average location of the plasmapause. In previous empirical models, the number of plasmapause crossings under quiet geomagnetic conditions is very small comparing to that under moderate geomagnetic conditions. Thus, quiet-time plasmapause locations estimated from previous models have a large uncertainty. In this study, we statistically examined the plasmapause location under quiet geomagnetic conditions (Kp $\leq$ 1) using the electron density inferred from the THEMIS spacecraft potential. Two-year period (2008 and 2009) was chosen for analysis because both years were marked by extremely weak solar wind conditions. A total of 1193 plasmapause crossings were obtained when Kp $\leq$ 1. We examine the average plasmapause location in radial distance and along the longitude under such quiet geomagnetic conditions. The average plasmapause location determined in our study is compared with that in previous studies.

Keywords: Plsmapause, Kp index, Geosynchronous orbit, Solar wind, Geomagnetic condition, Plasmasphere

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-10 Room:302 Time:May 27 14:55-15:10

Quarter Waves Localized in the Plasmasphere

OBANA, Yuki[1*] ; WATERS, Colin L.[2] ; SCIFFER, Murray D.[2] ; MENK, Frederick W.[2] ; LYSAK, Robert L.[3] ; MOLDWIN, Mark B.[4] ; MANN, Ian R.[5] ; BOTELER, David[6] ; ANGELOPOULOS, Vassilis[7] ; RUSSELL, Christopher T.[7]

[1]Osaka Electro-Communication University, [2]The University of Newcastle, [3]University of Minnesota, [4]University of Michigan, [5]The University of Alberta, [6]Natural Resources Canada, [7]UCLA, IGPP

The latitudinal distribution of quarter-wave mode ULF pulsations was investigated. We examined the diurnal variation of the local field line eigenfrequency over the latitude range L=1.7-6.8 using cross-phase analysis of magnetic data from the MEASURE, THEMIS, CANMOS, and CARISMA magnetometer arrays. The detected eigenfrequencies for L-shell in middle latitudes were remarkably low (1.5-2 times lower than usual daytime value) near the dawn terminator. This occurred when a field line was mapped into the plasmasphere, and one end of the field line was sunlit while the other end was in darkness. However, the eigenfrequencies for higher L-shells were not extraordinarily low. These results suggest that resonant quarter-wave modes were localized in the mid-latitude region, in the plasmasphere, but were not generated at high latitudes even though the ionospheric conditions were strongly asymmetric there. Our previous study showed that the mode transition from quarter wave to half wave depends on the ratio of ionospheric Pedersen conductances between sunlit and dark sides, and the typical value is approx. 10. The ionospheric conductances in this study seem to have satisfied this generation condition for stations at all latitudes. Therefore another condition may be necessary to explain the latitudinal localization of the waves. Some properties of quarter wave modes were examined using computer simulations. Our simulation results suggested that the resonance properties of heavily damped quarter mode waves may be masked by cavity mode energy when the cavity resonance is effective. This may control localized distribution of the quarter waves.

Keywords: ULF, magnetosphere-ionosphere coupling, plasmasphere, field line resonance

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-11 Room:302 Time:May 27 15:10-15:25

Effect of escaping photoelectrons on the polar wind outflows

KITAMURA, Naritoshi[1*] ; SEKI, Kanako[1] ; NISHIMURA, Yukitoshi[2] ; MCFADDEN, James P.[3] ; ABE, Takumi[4] ; YAMADA, Manabu[5] ; WATANABE, Shigeto[6] ; YAU, Andrew[7]

[1]STEL, Nagoya University, [2]Dept. of Atmos. and Oceanic Science, UCLA, [3]Space Science Laboratory, UCBerkeley, [4]ISAS/JAXA, [5]PERC, Chiba Institute of Technology, [6]Hokkaido Information University, [7]Dept. of Phys. and Astronomy, Univ. of Calgary

A statistical analysis using a long-term (over one solar cycle) photoelectron dataset obtained by the Fast Auroral SnapshoT (FAST) satellite (3000-4200 km altitude) during geomagnetically quiet periods demonstrates that the polar wind ion flux estimated from electron outflows does not change with increasing photoelectron production due to increasing solar activity, while the magnitude of the field-aligned potential drop (~15-25 V), which reflects low-energy photoelectrons back to the ionosphere, increases with increasing solar activity. The magnitude of the field-aligned potential drop is likely developed by photoelectrons themselves so as to equilibrate electron fluxes with the ion fluxes. Another statistical analysis using the thermal ion data obtained by the Akebono satellite at solar maximum implies that contribution of O^+ ions to the total ion flux in the polar cap is small owing to almost zero upward bulk velocity at least below ~7000 km altitude during geomagnetically quiet periods. Thus, the polar wind ion flux is dominated by H^+ ions, and the H^+ ion flux has been predicted to be regulated by the production rate in the topside ionosphere. The combination of these results indicates that it is the source region of H^+ ions in the topside ionosphere and not the photoelectron flux that control the polar wind outflow.

Keywords: Polar wind, Ion outflow

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-12 Room:302 Time:May 27 15:25-15:40

Dayside ionospheric current system of Pi2 pulsations: Comparison between equivalent currents and numerical simulation

IMAJO, Shun[1*] ; YOSHIKAWA, Akimasa[1] ; UOZUMI, Teiji[2] ; OHTANI, Shinichi[3] ; NAKAMIZO, Aoi[4] ; CHI, Peter[5]

[1]Dept. Earth Planet. Sci., Kyushu Univ., [2]ICSWSE, Kyushu Univ., [3]APL, Johns Hopkins Univ., [4]NICT, [5]IGPP, UCLA

We present the two-dimensional distribution of equivalent currents of Pi2 pulsations in the dayside middle-to-equatorial latitude regions (|geomagnetic latitude|<60 degrees and sunlit region at 100 km in altitude), using magnetic data from globally distributed magnetometers. Equivalent current vectors of Pi2s are determined by rotating filtered horizontal magnetic field vectors by an angle of 90 degrees clockwise. We found that meridional equivalent currents in the prenoon and postnoon sectors are in antiphase, and they close with an enhanced zonal current near the magnetic equator forming a global equivalent current system oscillating with a period of Pi2s. The current system shows the prenoon-postnoon asymmetry, that is, meridional equivalent currents in the prenoon sector is larger than in the postnoon sector. We also numerically simulated the distribution of ionospheric currents produced by a pair of field-aligned currents (FACs) around midnight under the assumptions that the ionosphere is a thin spherical shell and the electric field can be described as the gradient of an electrostatic potential. The essential features of the simulated ionospheric current on the dayside are consistent with the observed equivalent current system. In the simulation Hall currents and their polarization charges at the terminator contribute essentially to the prenoon-postnoon asymmetry. The east-west magnetic perturbations expected from the FACs and meridional ionospheric currents in the simulation may explain the observed four longitudinal phase reversals of east-west magnetic fields around midnight, noon, dawn and dusk. We thus conclude that the oscillatory ionospheric current system produced by the nightside FACs is the dominant source of dayside Pi2 pulsations.

Keywords: Pi2 pulsation, ionospheric current, current oscillation, equatorial enhancement, global potential solver, solar terminator

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-13 Room:302 Time:May 27 15:40-15:55

Dawn-dusk asymmetry of SI-induced transient ionospheric convection

HORI, Tomoaki[1*] ; SHINBORI, Atsuki[2] ; FUJITA, Shigeru[3] ; NISHITANI, Nozomu[1]

[1]STE Lab., Nagoya Univ., [2]Research Institute of Sustainable Humanosphere, Kyoto Univ., [3]Meteorological College

The statistics based on SuperDARN (SD) observations revealed that the transient oscillation of ionospheric convection associated with sudden impulses (SIs) showed some dawn-dusk asymmetric structures. The previous study showed that the higher latitude portion of the twin vortex-shaped convection perturbation has a dawn-dusk asymmetry depending on the combination of IMF-By polarity and SI polarity. In addition to the asymmetry depending on IMF-By polarity, the lower latitude portion of the induced twin vortices has a dawn-dusk asymmetry in such a way that the dawn side flow perturbation is always weaker than the dusk side one. Interestingly, our statistical study shows that this feature does not depend on either the IMF-By polarity or SI polarity, existing more or less for all conditions. This fact suggests that a different mechanism causes the difference in flow magnitude of lower latitude side of vortices between dawn and dusk. We perform a set of global MHD simulation runs to examine physical mechanisms causing the response of ionospheric convection associated with SIs. The simulations basically reproduce a weaker flow at the lower latitude portion of the dawn-side vortex, quite similar to those observed by SD. In addition to the realistic situations, a simulation run without the ionospheric Hall conductance (only with finite Pedersen conductance) shows a fairly dawn-dusk symmetric pair of flow vortices. This result strongly suggests that the Hall current closure in the ionosphere plays an important role in causing the dawn-dusk asymmetry of the vortex pair induced by SIs.

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-14 Room:302 Time:May 27 16:15-16:35

Direct observations of the full Dungey convection cycle in the polar ionosphere for southward IMF

ZHANG, Qing-he[1*] ; LOCKWOOD, Michael[2] ; FOSTER, John C.[3] ; ZHANG, Shun-rong[3] ; ZHANG, Bei-chen[4] ; MCCREA, Ian W.[5] ; MOEN, Joran[6] ; LESTER, Mark[7] ; RUOHONIEMI, J. michael[8]

[1]Institute of Space Sciences, Shandong University,Weihai, Shandong, 264209, China, [2]Department of Meteorology, University of Reading, Earley Gate, Post Office Box 243, RG6 6BB, UK, [3]MIT Haystack Observatory, Westford, MA 01886, USA, [4]Polar Research Institute of China, Shanghai, China, [5]Space Sciences Division, SSTD, Rutherford Appleton Laboratory, Didcot, UK, [6]Department of Physics, University of Oslo, Blindern, Oslo, Norway, [7]Department of Physics and Astronomy, University of Leicester, Leicester, UK, [8]Bradley Department of Electrical and Computer Engineering, Virginia Tech, Blacksburg, VA, USA

Tracking the formation and full evolution of polar cap ionization patches in the whole polar ionosphere, we directly observe the full Dungey convection cycle for southward interplanetary magnetic field (IMF) conditions. The patches were segmented from the tongue of ionization (TOI) at the equatorward edge of the cusp by the expansion and contraction of the polar cap boundary (PCB) due to the pulsed dayside magnetopause reconnection indicated by in-situ THEMIS observations. Convection leads to the patches entering the polar cap and being transported antisunward across the polar cap along the streamlines continuously monitored by the globally distributed arrays of GPS receivers and SuperDARN radars. The pulsed nightside reconnections, occurring as part of the magnetospheric substorm cycle, modulated the exit of the patches from the polar cap, as confirmed by the coordinated observations of the magnetometer at Tromso and EISCAT Tromso UHF Radar. After exiting the polar cap, the patches broke up into a number of plasma blobs, and returned sunward in the auroral flow of the dawn and/or dusk convection cell. The full evolution time, corresponding to the full circulation of energy and momentum from the solar wind to the magnetosphere, is about three hours.

Keywords: Dungey convection cycle, Magnetic reconnection, polar cap patches

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-15 Room:302 Time:May 28 09:00-09:15

Dynamics of the three-dimensional separator reconnection in the dayside magnetosheath-magnetopause region

FUJITA, Shigeru[1*] ; TANAKA, Takashi[2]

[1]Meteorological College, [2]Kyushu University

We have studied a driving mechanism of the magnetosphere-ionosphere coupling convection in the southward IMF condition. This study is divided into two parts. One is energy conversion in the null-separator structure in the dayside magnetosheath-magnetopause region. The other is transport of mass, momentum, and energy from the solar wind to the magnetosphere as well as a dynamo mechanism of the Region1 field-aligned current. Now, the former issue is discussed from the viewpoint of the three-dimensional separator reconnection.

The global MHD simulation reveals that interaction between the solar wind and the magnetosphere always exhibits a special magnetic field configuration called as the null-separator structure. This structure is essentially derived from a superposition of the dipole field and a uniform magnetic field (namely, the uniform IMF). Therefore, the structure is naturally generated from superposition of two source-free magnetic fields. This fact indicates that the null-separator structure does not yield significant energy conversion from the magnetic energy to others. We confirmed no energy conversion in the vicinity of the null point from the numerical simulation. This feature is quite different from the two-dimensional reconnection such as that in the plasmasheet at the substorm onset. On the other hand, the separator reconnection exhibits substantial energy conversion in the region apart from the null point. As this energy conversion is a mild one, it does not modify the plasma structure in the magnetosheath so much. Whereas, for the two-dimensional reconnection, the plasma structure consisting of anti-parallel magnetic fields and a sheet current after the reconnection onset is altered considerably after the onset. In the last, we confirm that the plasma structure in the dayside magnetosheath-magnetopause region is essentially formed by the solar wind dynamic pressure. The separator reconnection just modifies the plasma structure.

Keywords: null-separator structure, separator reconnection, three dimensional reconnection, magnetosphere-ionosphere coupling convection, MHD simulation

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-16 Room:302 Time:May 28 09:15-09:30

Generation of geomagnetic Pc5 pulsations by compressional waves penetrating from the solar wind: a case study

MOISEEV, Aleksei[1*] ; BAISHEV, Dmitry[1] ; MULLAYAROV, Victor[1] ; SAMSONOV, Sergey[1] ; MISHIN, Vladimir[2] ; UOZUMI, Teiji[3] ; YOSHIKAWA, Akimasa[3] ; KOGA, Kiyokazu[4] ; MATSUMOTO, Haruhisa[4]

[1]Yu.G. Shafer Institute of Cosmophysical Research and Aeronomy, SB RAS, Yakutsk, Russia, [2]Institute of Solar-Terrestrial Physics Siberian Branch RAS, Irkutsk, Russia, [3]International Center for Space Weather Science and Education, Kyushu University, Japan, [4]Japan Aerospace Exploration Agency

It was considered the development of compression geomagnetic pulsations in the Pc5 range during the recovery phase of the magnetic storm on May 23, 2007. Pulsations were excited in the spatially localized region: the maximum amplitude (150-200 nT) observed at latitudes 63-66 ^{o} in the midnight-morning sector 23-05 MLT, outside this region experienced a sharp decline in the oscillation amplitude. Region of pulsations excitation coincided with the location of the westward electrojet.

There were two maxima ~1.3 mHz and ~1.7 mHz in the spectra of the oscillations in the interplanetary medium, in the magnetosphere and on the ground. In the interplanetary medium the compression oscillations corresponding to the slow magnetosonic wave were recorded. According to the observations in the magnetosphere (in noon and evening sectors), the maximum amplitude of the oscillations of the magnetic field has been registered in the compression component. Modulation of energetic protons fluxes was caused by pulsations. Anti-phase variations of the magnetic field and plasma pressure were registered.

Pulsations by both ground and satellite observations in the magnetosphere in the morning sector were circularly polarized corresponding to the formation of vortices in the ionosphere and magnetosphere. The change of polarization to the opposite at latitudes above 66 ^{o} was observed.

By ground-based observations in the morning sector, the geomagnetic pulsations accompanied by modulation of intensity of riometer absorption and VLF emission at latitudes 66 ^{o} and 56 ^{o}, correspondingly.

The results of the data analysis indicated the resonance excitation mechanism of pulsations due to the penetration of compression waves from the interplanetary medium to the magnetosphere.

The work was partially supported by RFBR grants №. 13-05-00363 (MA) and №. 15-45-05090 (MV).

Keywords: geomagnetic pulsations, ULF waves, substorm, energetic particles

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-17 Room:302 Time:May 28 09:30-09:45

Characteristics of sudden commencements observed by Van Allen Probes in the inner magnetosphere (L <6)

FATHY, Adel[1*] ; KIM, Khan-hyuk[1] ; PARK, Jong-sun[1] ; KURTH, W. S.[3] ; WYGANT, J.r.[4]

[1]School of Space Research, Kyung Hee University , Gyeonggi, South Korea., [2]Fayoum University, Faculty of Science Physics Department, Fayoum, Egypy., [3]Department of Physics and Astronomy, Universirt of Iowa, Iowa City, Iowa, USA, [4]School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota, USA.

It has been known that sudden commencement (SC) is produced by an interplanetary shock passing over the Earth's magnetosphere. Understanding its characteristics in the electric and the magnetic fields is one of the important research topics. Until now, there are many studies for SC using the data on the ground at high to low latitudes and in space at and beyond geosynchronous orbit. However, few SC studies have been done using the data obtained in the inner magnetosphere (L <6). In this study we use the magnetic and electric field data acquired from the Van Allen Probes in the inner magnetosphere. During two year intervals from September 2012 to September 2014, 55 SC events were identified. The local time variations of SC-associated magnetic field perturbations in the inner magnetosphere are similar to those at geosynchronous orbit. Unlike previous studies at geosynchronous orbit, however, we observed only few numbers of negative perturbation ($\triangle B_H$) 15% (3 of 19events) in the B_H component (positive north) in the VDH coordinates near midnight (MLT = 21-03), while the majority of nighttime GOES 67% (12 of 18events) showed negative perturbation. This indicates that main contribution of SC near midnight in the inner magnetosphere is the dayside magnetopause current rather than nightside SC-associated cross tail current. Regardless of the L-value, the dayside electric field revealed a dawnward(negative) direction with higher amplitude around the noon, while nightside electric field showed a slightly duskward(positive) amplitude for all events, which is consistent with previous studies.

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-18 Room:302 Time:May 28 09:45-10:00

Earthward and tailward propagation of high plasma pressure region as pre-cursor and post-cursor of substorm onset

YAO, Yao[1*] ; EBIHARA, Yusuke[1] ; TANAKA, Takashi[2]

[1]Research Institute for Sustainable Humanosphere, Kyoto University, [2]SERC, Kyushu University

Cause of substorm expansion onset is one of the major problems in the magnetospheric study. On the basis of a global magnetohydrodynamic (MHD) simulation, Tanaka et al. [2010] suggested that substantial accumulation of the plasma pressure caused by the state transition in the plasma sheet could cause sudden intensification of the Region 1 an 2 field aligned currents and the westward auroral electrojet. In this sense, the accumulation of the plasma pressure is a key in understanding the substorm onset in the magnetosphere. On 5 April 2009, three probes of the Time History of Events and Macroscale Interactions during Substorms (THEMIS) were located at $X_{GSM} \sim$ — 11 Re around the equator, which provide unique opportunity to investigate the spatial-temporal evolution of the high-pressure region (HPR) near the substorm expansion onset. Just before the onset, a positive excursion of the plasma pressure appeared at the outermost probe first, followed by the innermost one. Just after the onset, the opposite sequence took place. These features are consistent with the simulation result that the HPR implodes earthward before the onset associated with the plasma sheet collapse, and expands tailward after the onset. A positive excursion of the Y-component of the current density was observed, which is also consistent with the simulation. These results may provide evidence for the accumulation of the plasma pressure predicted by the MHD simulation, and suggested that the earthward implosion of the HPR may be regarded as a pre-cursor of the substorm expansion onset and the tailward expansion as a post-cursor.

Keywords: High plasma pressure region, Substorm expansion onset, THEMIS satellite, Global MHD simulation

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-19 Room:302 Time:May 28 10:00-10:15

High current density observations in the near-Earth plasma sheet and substorm dynamics

SAITO, Miho[1*]

[1]Earth and Planetary Sciences, Tokyo Institute of Technology

The statistical properties of the near-Earth current sheet from 8 Re to 12 Re were recently revealed by the THEMIS multi-spacecraft measurements. A typical cross-tail current density was found to be ~2 nA/m^2, while in some cases, the current density increased above 4 nA/m^2. In contrast to the commonly accepted picture, these high current densities appeared in two magnetic configurations: tail-like and dipolar structure. The former configuration is a typical feature during the substorm growth phase and quiet times. Although the high current density was associated with the tail-like structure, we ruled out the notion that the high current density is caused by plasma sheet compression. Instead, we discuss that an alternative process of plasma sheet thinning proposed by *Hsieh and Otto* [2014], which is caused by an erosion of the magnetic flux in the dayside rather than the loaded magnetic flux in the tail, is relevant. The latter configuration of dipolar structure is a typical feature during the substorm expansion phase. A strong field aligned current was also associated with the high cross-tail current density observations. These high current densities lasted several to a few tens of minutes after the local dipolarization onsets. While the dipolarization is a fast process with a time scale of $<$1 min, diminishing the growth phase current sheet, which is a measure of the magnetic energy, is found to be a slower process.

Keywords: substorm, THEMIS, magnetotail, current sheet

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-20 Room:302 Time:May 28 10:15-10:30

Statistical analysis of magnetic field fluctuations in the near-Earth magnetotail by THEMIS

XU, Heqiucen[1*] ; SHIOKAWA, Kazuo[1]

[1]Solar-Terrestrial Environment Laboratory, Nagoya University

Abstract. We made a statistical analysis of severe magnetic field fluctuation around the inner magnetosphere (X = – 6 ∼ – 12 R_E), which is considered as a necessary cause for current disruption in the substorm model raised by *Lui* (2001). We used two-year magnetic field data of 2013 and 2014 with a sampling rate of 4 *Hz*, which were obtained by the FGM instrument aboard the TH-E (P4) probe of THEMIS. The occurrence rates of severe magnetic-field fluctuation events with C >0.5 were estimated for the nightside near-earth tail at (X_{GSM}, Y_{GSM}, Z_{GSM}) = (– 9 ± 3, ± 5, ± 3) R_E, where C was defined as a ratio between standard deviation and average value of magnetic field intensity during 10-s interval. We found that the occurrence rates are extremely low, of 0.011% for all regions, 0.002% for $|X_{GSM}|$= 6 – 8 R_E, 0.010% for $|X_{GSM}|$= 8 – 10 R_E, and 0.017% for $|X_{GSM}|$= 10 – 12 R_E. We also compared these fluctuation events with simultaneous ion velocity and spectrum data from the ESA instrument on the same probe, and found that magnetic field fluctuation and ion acceleration do not always happen synchronously. Assuming that two substorms occur every day with a 5-min duration of current disruption, we suggested that the low occurrence rate (0.011%) of severe magnetic field fluctuations may indicate that the current disruption region is very localized (∼ 2.6 $R_E{}^3$) in the tail, or the current disruption model is not suitable for most substorm cases. In the presentation, we will show results of similar statistical analysis to magnetic field fluctuations with time scales faster than the local ion cyclotron periods by using higher time-resolution data, in order to investigate the importance of non-MHD processes in the near-Earth tail dynamics.

Reference

A. T. Y. Lui., A multiscale model for substorms, *Space Sci. Rev.,* 95, 325-345, 2001.

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-21 Room:302 Time:May 28 10:30-10:45

Tailward leap of magnetic reconnection: A THEMIS case study

IEDA, Akimasa[1*] ; MIYASHITA, Yukinaga[1] ; MACHIDA, Shinobu[1]

[1]STEL, Nagoya University

A multiple-onset substorm is studied using observations of aurora and the magnetotail. Four successive auroral brightenings were identified in all-sky images roughly every 10 minutes starting at 0219 UT on 27 March 2009. The first brightening was ”initial brightening” while other brightenings were auroral breakups. Corresponding reconnection signatures are studied using THEMIS satellites observations betwee 8 and 24 Re down the tail. At the time of the initial brightening, no fast plasma flows were observed by THEMIS satellites. It is thus unclear whether reconnection is involved in the initial brightening from a classical point of view. An auroral breakup occurred 6 min later and was accompanied by a tailward fast flow observed THEMIS-1 satellite at 24 Re down the magnetotail. This breakup is thus associated with reconnection in the tail as previously reported.

Another auroral breakup occurred 12 min further later at a latitude higher than the previous breakup. At the same time a change of the flow direction from tailward flow to earthward flow was observed by the THEMIS-1 satellite. This flow reversal is often interpreted as the tailward retreat of a single magnetic reconnection site. However, another THEMIS satellite located 5 Re earthward from THEMIS-1 observed the earthward flow 1 min later. Thus, the observed sequence rather corresponds to a tailward leap of the reconnection site. We suggest that the poleward leap of auroral breakup is associated with the tailward leap of reconnection site as a consequence of the magnetic flux pileup in the dipolarization region.

Keywords: magnetotail, magnetic reconnection, substorm, auroral breakup

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-22 Room:302 Time:May 28 11:00-11:15

Ion accelerations due to two approaching flow fronts: Application to high-energy ion production in the magnetotail

UCHINO, Hirotoshi[1*] ; MACHIDA, Shinobu[2] ; IEDA, Akimasa[2] ; IMADA, Shinsuke[2]

[1]Graduate School of Science, Kyoto University, [2]Solar-Terrestrial Environment Laboratory, Nagoya University

In some cases, high-energy ions ($\sim$ MeV) are observed in the magnetotail during disturbed time of the magnetosphere. Such ions, however, cannot be produced by the duskward electric field in flows due to the limitation of the dawn-dusk scale length of the flows in the magnetotail. We propose that such high-energy ions can be produced if there exist two flow fronts which approach together by ExB drift. Namely, some ideal ions are repeatedly reflected by the two fronts and accelerated to high energies exceeding the energy given by the product of the duskward electric field and dawn-dusk scale length of the flows.

By performing spatially 1-D (2-D in velocity) test particle simulations where we assumed a couple of approaching ExB-drift flows, we have confirmed the production of high-energy ions as well as the change of the energy spectrum of ions associated with the acceleration. The simulation result shows that such high-energy ions are produced with scale length shorter than the magnetotail diameter. Furthermore, we find that the maximum energy of the accelerated ions depends on the distance of the two flow fronts and the dawn-dusk scale lengths of the flows. If the dawn-dusk scale length is infinite, the energy spectrum of accelerated ions is well fitted by the analytically calculated spectrum. Our simulation results and analytical calculation indicate that the distance and dawn-dusk scale length of two flow fronts can be estimated from the observations of electromagnetic field and flow speed, the maximum ion energy and the change of the energy spectrum of ions in the magnetotail, where such two approaching flow fronts commonly exist.

Keywords: magnetotail, high-energy ion, substorm

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-23 Room:302 Time:May 28 11:15-11:30

Non-active flow reversals in magnetotail

SHINOHARA, Iku[1*] ; NAGAI, Tsugunobu[2] ; FUJIMOTO, Masaki[1]

[1]Japan Aerospace Exploration Agency / Institute of Space and Astronautical Science, [2]Tokyo Institute of Technology

Geotail observation over 20 years in magnetotail provides us with about 200 rapid flow reversal events where tailward flow (<-500 km/s) turns to earthward flow (>+300 km/s) within 10 minutes. Nagai et al. (2013) proposed that V_{ey} <-1000 km/s is an important criterion to select active X-lines. As a result, we get 30 active X-line crossing events. Active X-line events show electron acceleration during flow reversals and existence of ion-electron decoupling region. These features are consistent with the collisionless reconnection model demonstrated by recent full kinetic numerical simulations. In contrast, other 16 flow reversal events do not present any of them. No visible ion-electron decoupling is found in these non-Active flow reversal events. In this presentation, we will discuss physical meaning of the difference between active X-line and non-active flow reversal events.

Keywords: magnetotail, flow reversal, magnetic reconnection

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-24 Room:302 Time:May 28 11:30-11:45

Kink-type oscillations of the magnetotail current sheet with a quasi-continuous magnetic reconnection jet

HASEGAWA, Hiroshi[1*] ; SHINOHARA, Iku[1] ; NAGAI, Tsugunobu[2] ; SAITO, Yoshifumi[1]

[1]Institute of Space and Astronautical Science, JAXA, [2]Tokyo Institute of Technology

We present and analyze quasi-periodic crossings of the magnetotail current sheet observed by the Geotail spacecraft at (-26, 9, 0) Re in GSM on 11 October 2014. The event occurred when the magnetosphere was moderately driven by the solar wind and southward interplanetary magnetic field, i.e., during a period of so-called steady magnetospheric convection. Reconnection jets with an earthward velocity ∼700 km/s, comparable to the lobe Alfven speed, were observed almost continuously in the plasma sheet for an interval 0900-1100 UT. In order to reveal the orientation and structure of the observed current sheet, whose crossings occurred with a period of 2-3 minutes, we applied the Grad-Shafranov reconstruction technique [Hau and Sonnerup, 1999; Hu and Sonnerup, 2002] assuming 2-D structures. The results indicate that kink-type waves were propagating approximately earthward in the plasma sheet, with a wavelength of ∼15 Re and amplitude of order 1 Re. To the best of our knowledge, this is the first identification of sunward-propagating MHD-scale kink-mode waves in the magnetotail. The generation mechanism of the observed oscillations is discussed based on the nature of the reconstructed current sheet structures, ion velocity distributions observed in the current sheet, and results from other single-spacecraft methods such as minimum variance analysis and minimum Faraday residue method [Terasawa et al., 1996; Khrabrov and Sonnerup, 1998].

References:

Hau, L.-N., and B. U. O. Sonnerup (1999), Two-dimensional coherent structures in the magnetopause: Recovery of static equilibria from single-spacecraft data, J. Geophys. Res., 104, 6899-6917.

Hu, Q., and B. U. O. Sonnerup (2002), Reconstruction of magnetic clouds in the solar wind: Orientation and configuration, J. Geophys. Res., 107(A7), 1142, doi:10.1029/2001JA000293.

Khrabrov, A. V., and B. U. O. Sonnerup (1998), Orientation and motion of current layers: Minimization of the Faraday residue, Geophys. Res. Lett., 25, 2372-2376.

Terasawa, T., H. Kawano, I. Shinohara, et al. (1996), On the determination of a moving MHD structure: Minimization of the residue of integrated Faraday's equation, J. Geomagn. Geoelectr., 48, 603-614.

Keywords: magnetic reconnection, magnetotail, current sheet, kink-mode, Grad-Shafranov equation, steady magnetospheric convection

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-P01 Room:Convention Hall Time:May 27 18:15-19:30

The properties of ionosphere during extreme low solar activity over the equatorial ionization anomaly crest area

CHUO, Yu-jung[1*]

[1]Department of Information Technology, Ling Tung University

The solar activity during 2008-2009 is extremely unusually long lower, which offers us an opportunity to study the properties of ionosphere over the equatorial ionization anomaly crest area. This study collected ionospheric data from ground-based observation of Chung-Li and GPS data of TWTF receiver during 2008-2009. In this investigation, we show the seasonal, monthly, and daily variations during the prolonged low solar activity. Meanwhile, the result also compared with the ionospheric properties during high solar activity period. Furthermore, a comprehensive discussion of the physics processes for the variation of ionosphere during the prolonged low solar activity period.

Keywords: ionosphere, EIA, ionospheric dynamics, ionospheric physics

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-P02 Room:Convention Hall Time:May 27 18:15-19:30

Advanced Ionospheric Probe onboard the FORMOSAT-5 Satellite

CHAO, Chi-kuang[1*] ; CHANG, Yeou-shin[2] ; MINAMI, Shigeyuki[3]

[1]Grad. Inst. of Space Science, National Central Univ., [2]National Space Organization, [3]Osaka City University

Advanced Ionospheric Probe (AIP) designed by National Central University is recently accepted by National Space Organization to built for the FORMOSAT-5 (FS-5) satellite as a piggyback science payload in early 2012. The FS-5 satellite is scheduled to launch in 2016 and anticipated to flight in a 98.28^{o} inclination sun-synchronous circular orbit at 720 km altitude in the 1030/2230 LT sectors. The orbital coverage provides a great opportunity to survey the Earth globally from equatorial to polar region. The AIP is an all-in-one plasma sensor under constraints in power (5 W), weight (5 kg), and form factor (100 mm L x 100 mm W x 100 mm H) in sensor size but with sampling rate up to 8,192 Hz to measure ionospheric plasma concentrations, velocities, and temperatures over a wide range of spatial scales. Once comprehensive dataset available from the AIP, a systematic examination of longitudinal and seasonal variations of the ionospheric parameters in the topside F region can be conducted for all latitudinal coverage. The transient and long-term variations of ionospheric plasma can be monitored in the upcoming solar maximum period and are benefit to public and scientists who are interested in space weather and seismic precursors associated with strong earthquakes.

Keywords: Science payload, Ionosphere, FORMOSAT-5, Advanced Ionospheric Probe

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-P03 Room:Convention Hall Time:May 27 18:15-19:30

Observation and IRI-2012 comparison of F1-layer parameters at the geomagnetic equator during solar minimum

LEE, Chien-chih[1*]

[1]General Education Center, Chien Hsin University of Science and Technology

This study is to assess the predictability of IRI-2012 on the equatorial F1 layer during solar minimum. The observed characteristics of F1 layer by the Jicamarca digisonde are compared with the model outputs. The results show that the time range for F1-layer appearance of observation is longer than that of IRI-2012, by at least 1 hour in the early morning and later afternoon. In IRI-2012, there are three options for the occurrence probability of F1 layer: IRI-95, Scotto-97 no L, and Scotto-97 with L options. The first option predicts the probability well, but the last two underestimate the probability. The peak density of F1 layer (NmF1) of observation is very close to that of IRI-2012. For the F1 peak height (hmF1), the modeled values are smaller than the observed ones. The observed seasonal variation of hmF1 is not found in the modeled results. Nevertheless, the observed diurnal variation of hmF1 is similar to the modeled results with the B0 choices of Bil-2000 and ABT-2009. Regarding the shape parameter, the values of D1 (the shape parameter of F1 layer in observation) are much greater than the values of C1 (the shape parameter of F1 layer in IRI-2012). The D1 values are 3-6 time of the C1 values. The diurnal variation of D1 is similar to that of C1, but the seasonal variation of D1 is not.

Keywords: F1-layer, IRI-2012

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-P04 Room:Convention Hall Time:May 27 18:15-19:30

Numerical simulation on electrodynamics of the pre-earthquake ionospheric anomalies

LIAN, Chuan-ping[1*] ; LIN, Charles[1]

[1]Institute of Earth Sciences, College of Sciences, National Cheng Kung University

Over the last few decades, ionospheric observations indicate that the total electron content (TEC) often significantly decreases in afternoon on 3-5 days before the M>6.0 earthquakes. It is generally considered that electric currents driven by stressed rock flow into ionosphere. We use NRL 3D ionosphere model, SAMI3 to simulate this phenomenon, and add external current terms into current continuity equation. The range of external current distribution is 120±20oE, 30±20oN, 85˜170km, and the maximum current density is 500nA/m2. Our simulation result indicates that the upward current on the bottom of ionosphere produces the maximum (minimum) variation of increasing (decreasing) ˜30% (˜10%) △TEC. The increasing △TEC is mainly located in west region of external current; however, the decreasing △TEC is mainly located on both sides of increasing region.

Keywords: earthquake precursor, ionospheric dynamics, total electron content

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-P05 Room:Convention Hall Time:May 27 18:15-19:30

Reconnection electric fields in the ”2 null - 2 separator” magnetosphere simulated by a global magnetohydrodynamic model

WATANABE, Masakazu[1*] ; FUJITA, Shigeru[2] ; TANAKA, Takashi[1]

[1]Kyushu University, [2]Meteorological College

It is known that the magnetic reconnection rate is proportional to the field-aligned electric field along the so-called X line. It represents the rate of the magnetic field vanishing in the diffusion region. In global magnetohydrodynamic (MHD) modeling of the magnetosphere, the field-aligned electric field can be used to identify the reconnection mode occurring in the simulated magnetosphere. This is particularly useful when antiparallel field line geometry are not formed. One example is the magnetosphere for northward interplanetary magnetic field (IMF). Global MHD simulations generally reproduces the magnetospheric structure characterized by two magnetic nulls and two separators (which we call here the ”2 null - 2 separator” structure, or ”null-separator” structure for short). In this configuration, antiparallel magnetic fields do not exist. In addition, the field line geometry for northward IMF is often too complicated to grasp intuitively. In this study, in order to identify the reconnection mode clearly, we explicitly calculate the reconnection electric fields in the simulated magnetosphere during northward IMF periods. We apply this approach to the modeling of the interchange cycle proposed by Watanabe and Sofko [2009, doi:10.1029/2008JA013426]. Although Watanabe et al. [2010, doi:10.1029/2009JA015041] reported observations showing ionospheric signatures of the interchange cycle, there seem to be some debates on the interpretation of the observational data. We aim to support Watanabe et al. [2010] from the modeling point of view. We also discuss the partial collapse of the null-separator structure when the IMF clock angle (measured from due north) is around 45 degrees. In this case, unconnected IMF lines tangle in the closed field lines on the nightside, showing a collapse of the null-separator structure. We argue how such a topology is created by analyzing the field-aligned electric field on separatrices.

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-P06 Room:Convention Hall Time:May 27 18:15-19:30

Features of long period geomagnetic pulsations caused by the inclined front of the solar wind discontinuity

KLIBANOVA, Yulia[2] ; MISHIN, Vladimir[2] ; TSEGMED, B.[3] ; MOISEEV, Aleksei[4*]

[1]A.A. Ezhevsky Irkutsk State Agrarian University, Irkutsk, Russia, [2]Institute of Solar-Terrestrial Physics Siberian Branch RAS, Irkutsk, Russia, [3]Research Center for Astronomy and Geophysics, Academy of Sciences of Mongolia, Ulan Bator, [4]Yu.G. Shafer Institute of Cosmophysical Research and Aeronomy, SB RAS, Yakutsk, Russia

We study long-period geomagnetic pulsations caused by the solar wind discontinuity impact during the July 14, 2012 magnetic storm onset from data of satellite observations in the solar wind and magnetosphere, as well as of ground stations located at low, middle and high latitudes. The character of pulsations propagation is shown to correspond to their excitation mechanism by the discontinuity front at the magnetopause. Location relative to the noon of the sector, from which the waves propagate to both magnetosphere flanks, is determined by the front azimuthal angle inclination. We discuss a change of polarization both by longitude and latitude directions. The frequency of spectral maximum of the pulsations does not coincide with one of the solar wind oscillations.

Keywords: geomagnetic pulsations, ULF waves, solar wind discontinuity, wave propagation

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-P07 Room:Convention Hall Time:May 27 18:15-19:30

Evolution and propagation of electric fields during magnetic impulses based on multiple observations

TAKAHASHI, Naoko[1*] ; KASABA, Yasumasa[1] ; SHINBORI, Atsuki[2] ; NISHIMURA, Yukitoshi[3] ; KIKUCHI, Takashi[4] ; HORI, Tomoaki[4] ; NISHITANI, Nozomu[4]

[1]Tohoku Univ., [2]Research Institute for Sustainable Humanosphere, Kyoto University, [3]University of California, Los Angeles, [4]Solar-Terrestrial Environment Laboratory, Nagoya University

Magnetic impulses triggered by the input from the solar wind lead to the variation of the particle and electromagnetic field. Sudden commencements (SCs), known as one of the most distinct magnetospheric disturbance phenomena, are triggered by the compression of the magnetosphere due to solar wind disturbances. Unlike magnetic storms and substorms, SCs can be identified as sharp magnetic variations on the global scale. Since SCs are isolated phenomena, their onset time and driver are relatively easy to identify. Several spacecraft observations of the electric field have indicated that the Alfven wave launching from the ionosphere toward the magnetosphere plays a crucial role in inducing the transient response of the electric field in the magnetosphere. However, this suggestion has not been tested sufficiently due to lack of the electric field observation in the ionosphere. Therefore, the interaction in the magnetosphere?ionosphere coupled system, such as the electric field propagation and energy transport process, is still an open issue.

Motivated by these issues, we try to investigate electric field characteristics associated with SCs by simultaneous multiple ground-based and spacecraft observations that can recently be utilized. We investigate the evolution and propagation of electric fields during SCs using in situ electric field data obtained by five THEMIS spacecraft and two Van Allen Probes (VAPs) spacecraft. We also investigate the propagation of electric fields to/in/from ionosphere with SuperDARN radar, HF Doppler radar, and ground magnetometer data. SC events are identified by the SYM-H index provided in OMNI database and geomagnetic field data. The event criteria were set as follows: (1) SCs occur from January 2013 to December 2014. (2) The amplitude of the SYM-H is more than 10 nT, and its rise time is less than 5 min. (3) Preliminary Impulse (PI) is recorded on high-latitude geomagnetic field (FSIM and FSMI stations).

We found 70 SC events satisfying these conditions. For all of them, both THEMIS and VAPs detect the enhancements of the electric field. The direction of the electric field is westward, which is consistent with that of the magnetospheric electric field observed by the Akebono satellite [Shinbori et al., 2004]. We found that the nightside magnetospheric electric field follows the dayside one within 5 s delay from the PI onset, despite the large distance between them (~5-10 R_E). In the ionosphere, SuperDARN and HF Doppler radars detected the westward electric field during the PI phase. The PI onset time of ionospheric electric field is almost same (within 5 s) with the magnetospheric electric field detected by THEMIS and VAPs regardless of local time, which indicates the simultaneous response between magnetospheric and ionospheric electric fields. These results suggest that the electric field propagates from dayside to nightside magnetospheres via the ionosphere. That is, the dayside magnetospheric electric field propagates into the polar ionosphere along the magnetic field line, and then from polar toward low-latitude ionospheres at the speed of light between the ionosphere and ground propagation path. On the other hand, the ionospheric electric field propagates within 5 s toward the plasmasphere and inner magnetosphere (~5-10 R_E). Although previous results have shown that the electric field associated with SCs is propagated into the magnetosphere by the Alfven wave along the magnetic field lines, the propagation velocity estimated by our observational results may be faster than the velocity of the Alfven wave.

In this paper, we report the validity of these data interpretation. We will also present the statistical results (i.e., the superposed epoch analysis) and the Poynting fluxes that play a crucial part in the energy transmission associated with the PI onset of electric fields, which is expected to clarify the propagation path of the electric field.

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-P08 Room:Convention Hall Time:May 27 18:15-19:30

The feature of global current circuit in the ionosphere from polar to dip equator during Dp2 event

MATSUSHITA, Hiroki[1*] ; YOSHIKAWA, Akimasa[2] ; UOZUMI, Teiji[3]

[1]Department of Earth and Planetary Sciences, Graduate School of Sciences, Kyushu University, [2]Department of Earth and Planetary Sciences, Graduate School of Sciences, Kyushu University, [3]International Center for the Space Weather Science and Education, Kyushu University

In the ionosphere, it is well known that the electromagnetic coupling is formed globally from polar region to dip equator region in daytime seen as penetration of electric field during Dp2 events. Yoshikawa et al., [2012, AGU] suggests the formation of the current system by Cowling channel model as the explanation of this coupling. The highly gradient of electric conductivity at the terminator between sunlit region and shaded region at dawn and dusk sides is assumed in this paper, which produces positive polarization electric field there and this electric field forms the connection between polar and dip equator.

In our previous study, the asymmetry of the ionospheric electric field, which is calculated from observed magnetic field variation and the model of conductivity, is found between morning side and afternoon side in the dip equator region, and we concluded that the positive electric charge at both dawn side and dusk side by Cowling channel formation enhances and weakens at dawn side and dusk side, which are primary positive and negative electric fields respectively. However, it was still not clear that there is actually such asymmetry in not only dip equator region but also in global.

To clarify this existence of global asymmetric feature of the electric field and the possibility of the formation of global Dp2 current system by Cowling channel model, we investigated global feature of Dp2 variation on simultaneous and multipoint observations. More than 200 stations data are used in this study, and their spatial distributions are from approximately -85 to 85 degree of geomagnetic latitude. The result shows that there is obvious asymmetry on the polarity of horizontal component of Dp2 variation in low and mid latitude region between morning side and afternoon side, but not obvious asymmetry in polar region. This unclear asymmetry in polar region might be because of the complexity of primary electric field which is penetrated from magnetosphere.

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-P09 Room:Convention Hall Time:May 27 18:15-19:30

Study on Omega signals detected by Poynting Flux analyzer onboard Akebono

SUARJAYA, I made agus dwi[1*] ; KASAHARA, Yoshiya[1] ; GOTO, Yoshitaka[1]

[1]Kanazawa University

The Akebono satellite was launched 1989 to observe the Earth's magnetosphere and plasmasphere. Wave normal and Poynting flux Analyzer (PFX) subsystem is equipped on the spacecraft. It measures two components of electric field (Ex and Ey) and three components of magnetic field (B1, B2, and B3) with band-width of 50 Hz in a frequency range from 100 Hz to 12.75 kHz. The center frequency of the PFX can be changed by command. By using the PFX, we measure the signals at 10.2 kHz transmitted from the omega stations which were operated until 1997. This omega signal was intended to be used as navigation signal similar to GPS nowadays. By automatically detecting the omega signals included in the PFX data, we study propagation patterns of VLF waves across the plasmasphere, because the propagation characteristics are strongly affected by plasma density and ambient magnetic field. First we developed a method to detect the omega signals automatically and accurately, especially for the delay time and signal existence within specific earth coordinate and time span observed by the Akebono satellite. The PFX data measures 5 channels which correspond to 3 axis of magnetic field (B1, B2, B3) and 2 axis of electric field (Ex, Ey) in satellite coordinate. The waveform data with band-width of 50 Hz centered at 10.2 kHz are sampled at rate of 320 Hz and sent to the ground by PCM telemetry. As for the omega signal, the omega station was transmitting its signal with transmission pattern every 10 s. Each station transmitted a different pattern of frequency but has common frequency at 10.2 kHz. By using this 10.2 kHz signal and the detection time represented by UTC on the satellite, we can determine when and which station was transmitting the signal. As for the detection algorithm, we first estimate the delay time of each signal by comparing average intensity of specific time frame then expecting sudden increase of intensity based on specific threshold on the expected omega signal's time and duration. Second, we detect the signal existence by comparing the intensity of expected omega signal's time and duration with the surrounding intensity based on specific threshold. In this study we used advanced detection algorithm to process huge amounts of several years' data. The algorithm enables us to distinguish noises and real omega signal and also handle the error detection to produce more accurate result. Currently we have analyzed data sets from 1989 to 1990. We found that the magnetic field intensity of the signal become weaker and the electric field intensity become higher on the other part of earth hemisphere far from the original transmission station. We will analyze further data sets from 1991 to 1997 for more credible analysis and discovery.

Keywords: VLF wave, Omega signal, Plasmasphere, Akebono satellite, Signal processing

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-P10 Room:Convention Hall Time:May 27 18:15-19:30

Ground-based observation of fine structures of MF/HF auroral radio emissions

SATO, Yuka[1*] ; OGAWA, Yasunobu[1] ; KUMAMOTO, Atsushi[2] ; UENO, Genta[3]

[1]National Institute of Polar Research, [2]Graduate School of Science, Tohoku University, [3]The Institute of Statistical Mathematics

The terrestrial auroral ionosphere is a natural source of electromagnetic waves in the MF/HF ranges (up to 6 MHz) as well as well-known intense VLF/LF emissions (auroral kilometric radiation and auroral hiss). In the MF/HF ranges, three types have been identified at ground level: auroral hiss, medium frequency burst (MFB), and auroral roar. In addition, recent studies have resulted in ground-level detection of auroral kilometric radiation [LaBelle and Anderson, 2011] and discovery of a natural radio emission between f_{ce} and $2f_{ce}$ [Broughton et al., 2014]. Previous studies have also shown that observation of fine structures open new frontiers for these auroral radio emissions [e.g., LaBelle et al., 1995; Shepherd et al., 1997; Ye et al., 2006; Bunch and LaBelle, 2009]. In August 2008, we installed new instrumentation referred to as Auroral Radio Spectrograph (ARS) at Kjell Henriksen Observatory (KHO) in Svalbard (latitude 78.15^{o}N, longitude 16.04^{o}E, 75.2^o magnetic latitude). ARS consists of magnetic loop antennas whose size is 2.7 m $\times$ 6.0 m and two types of receivers: ARS-S and ARS-WF. The former is designed for the continuous measurement of wave spectra with a time resolution of 1 sec, and the latter is designed to obtain waveform data digitalized by an A/D converter with a sampling rate of 10 M samples/s (Nyquist frequency 5 MHz). Using ARS-WF, we succeeded in the first simultaneous measurements of structured $2f_{ce}$ auroral roar and optical aurora during 1710-1750 UT on February 1, 2011. In this event, the structured $2f_{ce}$ auroral roar showed temporal evolutions in frequency band width (300 Hz at minimum) and frequency drift rate (15 kHz/s at maximum). However, because ARS-WF recorded a series of 8 M samples (i.e., only 800-msec data) once every 40 sec, it was difficult to capture the entire temporal evolution of the structured auroral roar. In order to solve this problem, we carry out development and trial manufacture of a new receiver using USRP^{TM} (Universal Software Radio Peripheral). Such software-defined radio (SDR) receiver can implement high-speed, flexible digital signal processing of RF signals. This new receiver is designed to obtain higher-resolution spectra of RF signals pauselessly throughout the night in a wide frequency range up to 6 MHz. It is installed at KHO in Svalbard in March 2015. In this presentation, we also show detailed design of this receiver and some initial results.