Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

PEM031-01 Room:103 Time:May 26 08:30-08:45

Seasonal dependence of magnetic field variations from high latitude to the magnetic equator during geomagnetic sudden co

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Seasonal dependence of diurnal variation of the main impulse (MI) of geomagnetic sudden commencements (SCs) has been investigated using the long-tern geomagnetic field data with high time resolution of 1 sec within a period from 1996 to 2008 provided from the NSWM [Kikuchi et al., 2008] and CPMN [Yumoto and the CPMN group, 2001] chains and the WDC for Geomagnetism, Kyoto. In the present analysis, we used the geomagnetic field data obtained from the 12 stations: Pohnpei (geomagnetic latitude, MLAT = 0.27 degree), Yap (MLAT = 0.38 degree), Cebu (MLAT = 0.85 degree), Guam (MLAT = 5.22 degree), Okinawa (MLAT = 16.54 degree), Kakioka (MLAT = 27.18 degree), Memanbetsu (MLAT = 35.16 degree), St. Paratunka (MLAT =45.58 degree), Magadan (MLAT = 53.62 degree), Zyryanka (MLAT =59.74 degree), Chokurdakh (CHD, 70.62N, 147.89E GR, 64.81N, 212.53E GM), Kotel'nyy (KTN, 75.94N, 137.71E, 70.08N, 201.39E), and King Salmon (KSM, 58.68N, 203.35E GR, 58.09N, 258.39E, GM). In this study, the SC events have been defined as a rapid increase with its amplitude of more than 5 nT within 10 minutes in the SYM-H index. In this case, 3535 events of the magnetic field disturbance are found in a long period from January 1996 to October 2010, which has no Pi 2 signature around 10 minutes at the SC onset. Details of the analysis method have been described in the paper of Shinbori et al. [2009]. Moreover, the SC amplitude obtained at the above 12 stations has been normalized by that in the SYM-H index with latitude correction in order to minimize the different contribution of the rapid change in solar wind dynamic pressure. We also used solar wind data obtained from the IMP-8, Geotail, Wind and ACE satellites within the same period. As a result, the diurnal variation of SC amplitude in a region from the high latitude (KTN) to the middle latitude (MMB) shows a remarkable DP-2 type magnetic signature in the daytime (6-18 h) produced by the ionospheric currents. The ionospheric currents are driven by a dawn-to-dusk polar electric field carried by a pair of field-aligned currents (FACs). In the nighttime (18-06 h), the SC amplitude in the sub-auroral latitude (ZYK) to low latitude (KAK) tends to increase significantly and increases with increase of magnetic latitude. This tendency indicates that the nighttime enhancement of SC amplitude is caused by the magnetic effect of FACs. The size of the diurnal variation of SC amplitude tends to be more enhanced in the summer, compared with that in the winter. This result implies that ionospheric currents (ICs) and field-aligned currents (FACs) generated during the MI phase of SC are intensified due to the increase of ionospheric conductivity in the summer. This feature of SC current system shows the voltage generator rather than the current generator. On the other hand, the diurnal variation of SC amplitude near the equatorial region shows a remarkable equatorial enhancement in the daytime (6-18 h) with its maximum around 11 h produced by the enhanced eastward ionospheric currents due to the Cowling effect. The seasonal variation of the daytime SC amplitude showed quite a different signature from that in the middle latitudes. The remarkable feature is that the equatorial enhancement of SC amplitude tends to become relatively smaller in the summer than in the equinox or winter. This tendency suggests that the intensity of the equatorial electrojet current does not depend on only the solar zenith angle. One of the implications of the equatorial seasonal dependence is that the penetration polar electric field tends to become weak in the summer, compared with that in the winter. In future, in order to verify this feature, we will need to investigate the response of the penetration polar electric field to equatorial conductivity variation by solving the global ionospheric potential solver which uses three-dimensional ionospheric conductivity model.

Keywords: geomagnetic sudden commencement, high latitude, magnetic equator, seasonal dependence, ionospheric conductivity, voltage generator

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

PEM031-02 Room:103 Time:May 26 08:45-09:00

Magnetospheric Substorm Observed by QZS, ETS-VIII and MAGDAS on October 25, 2010 - Preliminary result-

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In this study, we analyzed magnetic field variations observed by the quasi-zenith satellite QZS [Matsumoto et al., 2011] and the geostationary satellite ETS-VIII [Koga and Obara, 2008] during magnetospheric substorms. The field configuration quickly changes from tail-like to dipole-like after expansion phase of magnetospheric substorms. The magnetic data from MAGDAS (MAGnetic Data Acquisition System) [Yumoto et al., 2006] low- latitude station were used to identify the onset of magnetospheric substorms. At the onset of the magnetospheric substorms, Pi 2 magnetic pulsations occur globally in the magnetosphere. We focus on the October 25, 2010 substorm event. On the day, the isolated substorm occurred around 13:30UT. The azimuthal distance between QZS and ETS-VIII is about 2Re. They moved eastward at the speed of about 1.7Re/hour.

The following results are obtained;

(1) X-component (azimuthal) variation observed by QZS and ETS-VIII changed from negative to positive (Westward is positive sense) within 10 minutes. It means the QZS and ETS-VIII crossed the very thin plasma sheet.

(2) Y-component (compressional) variation observed by QZS changed from positive to negative (Northward is positive sense) after substorm onset. It means that QZS was located inside Substorm Current Wedge (SCW) at 13:33-13:38UT and then QZS moved outside SCW.

On the other hand, Y-component variation observed by ETS-VIII increased except 13:38-13:43UT period. ETS-VIII was located outside SCW in this period due to traveling of ETS-VIII. After that ETS-VIII was located inside SCW again. It indicates that SCW expanded eastward.

The difference of Y-component variation between QZS and ETS-VIII indicates that a transition region of the SCW is about 0.3 Re.

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PEM031-03 Room:103 Time:May 26 09:00-09:15

Correlation of Pi 2s Observed by ETS-VIII and MAGDAS/YAP

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Pi 2 is an impulsive geomagnetic pulsation with the period range from 40 to 150 seconds. Pi 2 is believed to be globally detectable with aurora breakup. Propagation modes of Pi 2 depend on geomagnetic latitude , local time and so on[cf. Yumoto et al., 2001].

In this study , we analyzed similarity and time lag of Pi 2s observed by ETS-VIII (Engineering Test Stellite-VIII ; M.Lat=-7.88 , M.Lon=218.56 , Hight=36000km)[Koga and Obara , 2008] and by MAGDAS(MAGnetic Data Acquisition System)[Yumoto et al., 2006] station located at the magnetic equator ,YAP(M.Lat=1.49 , M.Lon=209.09) , using cross-correlation. For the analysis, we selected 88 Pi 2 events which showed clear Pi 2 pulsation (p-p more than 0.3nT) during 19:00-03:00LT. The analysis period covered a year from 16 September 2008 to 31 August 2009.

From the analysis , the following results are obtained;

(1)The correlation coefficient between Y-component(compressional) of ETS-VIII and H-component(compressional) of YAP is the highest for combinations of each components , X-, Y-, Z- components of ETS-VIII and H-, D-, Z- components of YAP.

(2)The correlation coefficient betweenY-component of ETS-VIII and H-component of YAP depend on local time. In the sector 19:00-21:00LT , 45% of Pi 2s shows positive correlation. In the sector 21:00-03:00LT , 68% of Pi 2s shows positive correlation.

(3)Time lag of Pi 2s from Y-component of ETS-VIII to H-component of YAP also depends on local time. In the sector 19:00-21:00LT , 19% of Pi 2s shows good coherency and time delays of at ETS-VIII 20-75 sec earlier than at YAP. In the sector 21:00-01:00LT , 67% of Pi 2s shows good coherency and time delays of at ETS-VIII 25-50 sec earlier than at YAP.

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PEM031-04 Room:103 Time:May 26 09:15-09:30

Comparison of ionospheric Pc5 oscillations with geomagnetic pulsations observed on the ground and in geostationary orbit

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Pc5 pulsations are electromagnetic wave at periods of 150-600 s in the ultra-low frequency (ULF) range, which are frequently observed and have been studied well by ground and satellite magnetometers. The most common generation process of Pc5 pulsations is the field line resonance (FLR) of shear Alfven waves standing along Earth's magnetic field lines, which are coupled with fast compressional mode propagating from the flank side of magnetopause. The ionosphere in both hemisphere acts the reflection boundary of FLR and the ionospheric current generated by waves results in Pc5 geomagnetic pulsations on the ground. In the magnetosphere, magnetometers and electric field instruments onboard satellites observe directly in situ amplitude of Pc5 pulsations. Previous studies identified Pc5 pulsations as one of the key mechanisms of transport and acceleration of energetic electrons in Earth's outer radiation belt; wave power of Pc5 band is well correlated with radiation belt electron fluxes. In particular, waves in global mode (low-m) are likely more effective than localized mode (high-m). However, it is difficult to know correct wave numbers from satellite nor ground observations, because satellites are in situ and ground magnetometers integrate all neighbor signals. Thus, we investigated Pc5 pulsations using data from King Salmon HF radar (KSR), which observe two-dimensionally the doppler velocity of ionospheric plasma (E x B drift) due to electric-field components of Pc5 pulsation. First of all, we searched Pc5 oscillation observed by KSR beam 3 (westward beam) in 2007. Secondly, we investigate the similarity and difference of ionospheric Pc5 oscillations with geomagnetic variations simultaneously observed on the ground (Pebek and King Salmon) and in geostationary orbit (ETS-8); these align the almost same meridian. In this presentation, we show the local time distribution of ionospheric Pc5 oscillations, their relations with solar wind parameters, and event and statistical analyses of Pc5 events on the ground, in the ionosphere and in geostationary orbit.

Keywords: Pc5 pulsation, HF radar

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

PEM031-05 Room:103 Time:May 26 09:30-09:45

Observations of escaping and reflected photoelectrons by the FAST satellite in the polar cap magnetosphere

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The polar wind process is strongly controlled by solar radiation. Modeling studies suggested that escaping photoelectrons, which are produced by solar extreme ultraviolet radiation, originating from the polar cap ionosphere drive the polar wind which includes heavy ions. A photoelectron driven polar wind models described by Wilson et al. [1997] indicated that a potential drop (about 60 V), which reflects most of the escaping photoelectrons, exists at high-altitudes (about 7 R_E) to achieve zero field-aligned current. Although presence of such a potential drop was reported for some cases [Winningham and Gurgiolo, 1982; Horwitz et al., 1992], the statistical characteristics of the potential drop (e.g., potential difference, and occurrence frequency) have not been studied in detail.

We have statistically examined the photoelectron spectra obtained by the electron spectrometer aboard the Fast Auroral Snapshot (FAST) satellite at about 3800 km altitude during geomagnetically quiet periods near solar maximum. The data obtained from 2 to 16 July 2002 (quiet-time: about 50 orbit passes) are used for the statistical study. In this period, the apogee of the FAST satellite located at high latitudes in the Northern (summer) Hemisphere. Magnetic field data are used to estimate field-aligned currents. The reflected photoelectrons, which were likely reflected by a potential drop, were almost always (about 90%) observed in the region of a weak field-aligned current ($-1.6*10^{-7}$-$1.6*10^{-7}$ A/m^2 mapped to 1000 km altitude). The typical potential difference estimated in the present study is about 20 V, which is about a half of that predicted by photoelectron driven polar wind models [Wilson et al., 1997; Su et al., 1998]. When the potential difference are above 20 V, the typical number flux of the reflected photoelectrons with energy below the potential difference is about 90% of that of the escaping photoelectrons in the same energy range. The high reflection rate supports the presence of field-aligned electric fields.

Keywords: ion outflow, polar wind, potential drop

Japan Geoscience Union Meeting 2011
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PEM031-06 Room:103 Time:May 26 09:45-10:00

On the origin of low-energy downward electrons in the polar cap ionosphere

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It is known that the thermal ions are accelerated by ambipolar electric field due to ambipolar diffusion caused by plasma pressure gradient along field lines in the polar cap where the geomagnetic field lines are basically open.

There is an idea that the strong potential difference may be generated to keep current continuity between the magnetosphere and the ionosphere approximately above 2 Re altitude in the polar cap. Upward moving ions are further accelerated by such a potential difference because such a potential difference is upwardly directed. This idea may suggest that the potential difference plays an important role in transporting ions from the ionosphere to the magnetosphere. On the other hand, since this potential difference can accelerate electrons downwardly, it is possible that low energy component of upward photoelectrons with energy of about 10-50 eV originated from the ionosphere is reflected by the potential gap. Therefore it is possible that a part of low energy (about 10-50[eV]) downward electrons observed in the polar cap ionosphere is attributed to the potential difference above 2 Re altitude. In fact, such low energy downward electrons are observed by Low Energy Particle (LEP) instrument on Akebono satellite below 2 Re altitude in the polar cap. Thus, we believe that such a potential difference actually exists and plays a role in reflecting upward photoelectrons above 2 Re altitude.

A statistical analysis of long-term observations of the photoelectron flux with the LEP on Akebono in the polar cap region suggests that even when the upward photoelectron flux is in the same level the downward flux of electrons with the same energy changes. Such downward electrons may be originated from the deep magnetosphere. However, a fact the energy spectra are similar between upward and downward electrons implies that the downward electrons are originated from the ionosphere and reflected by the upward electric fields. The observational result of variable downward flux may indicate that the flux is controlled by the magnitude of the potential difference existing in the high altitude polar cap. The purpose of our study is to elucidate what the dominant process or condition is for determining the size of the potential difference. It is suggested from our statistical analysis that the potential difference is about 30 V on the average but the actual magnitude changes from 10 to 50 V in some cases.

In this presentation, we show the detailed result of our analysis and discuss the dependence of the potential difference in the high-altitude polar cap on the solar activity, the geomagnetic activity, and the ionospheric plasma condition.

Keywords: polar cap, polar wind, photoelectron

Japan Geoscience Union Meeting 2011
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PEM031-07 Room:103 Time:May 26 10:00-10:15

Development of 0.1-100eV ion energy mass spectrometer

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Measurements of ions with energies lower than several eV are not easy in the terrestrial magnetosphere, since spacecraft potential is positive in many cases. However, it is indicated that there are significant amount of ions in this energy range, based on, for example, ion observations under eclipse.

On the other hand, applied voltages on electrodes in an electrostatic analyzer should not be so low (i.e., near zero), since it becomes difficult to keep stable enough. This is one of problems on the ion measurements with energies lower than several eV. In order to avoid this, we have tried following points: (1) to apply wider gap between curved electrodes, (2) to apply small inlet and exit, and (3) adjustment of inlet and exit positions. Using numerical calculations, we got a sensor design with energy, angle, and mass resolving capability. Noise level due to EUV photons can be reduced to low enough. Note that an active control of spacecraft potential will be necessary, especially in a low-density region.

The sensor can be used for observations of ions upflowing from the polar ionosphere.

Keywords: suprathermal ion, ion upflow, magnetosphere, instrument

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PEM031-08 Room:103 Time:May 26 10:15-10:30

Multiple enhancements of the electron density in the cusp for brief southward excursions of IMF

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A brief southward excursion of IMF is thought to cause a short-period enhancement of the magnetosheath plasma precipitation along the reconnected magnetic field lines, and of the electron density at F2 peak altitudes in the cusp. Our survey for the high time resolution data from EISCAT Svalbard Radar found events in which multiple enhancements of the electron density in the cusp were detected during a brief southward excursion of IMF. One of the clear events shows that three enhancements occurred within about 2 minutes of each other. This time interval is much shorter than the mean time between successive auroral events in the cusp, i.e., 6 min. Simultaneous observations of the plasma precipitation by DMSP spacecraft show that the cusp electron precipitation region has a few spatial boundaries in terms of the energy and energy flux of the precipitating electrons. We consider how these spatial boundaries can be incorporated in the multiple enhancements of the electron density detected by the radar, and present a picture for the phenomenon triggered in the ionospheric cusp by a brief southward excursion of IMF.

Keywords: cusp, electron density, plasma flow, IMF

Japan Geoscience Union Meeting 2011
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PEM031-09 Room:103 Time:May 26 10:45-11:00

A comparative study on the types and dynamics of auroras and the fine properties of auroral particles using Reimei

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The dynamic variations and numerous types of spatial distributions found in the auroral emissions have been well-known as one of the most remarkable and exciting phenomena in the Earth's polar magnetosphere. The Reimei satellite mission, starting the scientific observations at 650-km altitudes in the late 2005, has been providing us with the high-time/spatial resolution auroral data with the novel observation function realizing simultaneous conjunction measurements of the auroral emissions at the ionospheric altitudes and the auroral plasma particles in the topside ionosphere. The multi-spectral auroral camera (MAC) with 1.1-km resolution over a 70-km x 70-km area at the auroral altitudes (110 km) are imaging a number of spatial distributions and time variations of auroras simultaneously with energy spectra of the energetic (10 eV - 12 keV) plasma over the full-pitch angle range by auroral electron/ion energy spectrum analyzers (ESA/ISA). The geomagnetic field data are also investigated for elucidating the correlation of the transversely accelerated ions (TAIs) with the field-aligned currents carried by invisible thermal electron flows which could not be detected by the electrostatic plasma analyzer on Reimei due to the lowermost energy limitation. These features of the Reimei mission imply that the satellite observation dataset could reveal the closed correlation between the structures and variations of auroral arcs/bands and the precipitating electron components accelerated mainly by quasi-static field-aligned potential structures and kinetic (dispersive) Alfven waves above the Reimei orbit. We could also investigate the fine-scale relations among the auroral electron signatures, field-aligned current properties, and TAIs, by being mapped on the auroral emissions. The detailed comparisons based on these high-quality auroral image/particle data would derive the newest comprehensive knowledge which has not been obtained for several decades. For instance, Reimei firstly showed that rapidly varying inverted-V electron components are highly correlated with small-size active auroras like rotating auroral vortices, high-speed streaming shear-type arcs, flushing ray-type auroras, etc. It is also common that the downward electron conics and the associated upward wide-energy electron bursts are observed in association with dynamically changing auroras at the lower energy range than the inverted-V electrons. In this paper, we report several characteristic observational results from the comparative study on the types and dynamics of auroras and the fine properties of auroral particles using Reimei.

Keywords: auroral emission, auroral particle, fine structure, satellite observation, particle acceleration, auroral dyanamics

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

PEM031-10 Room:103 Time:May 26 11:00-11:15

High-speed imaging of auroral microstructures

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We have been conducting high-speed (100 Hz) imaging observations of auroral microstructures since January 2010 at Poker Flat Research Range (PFRR), Alaska. For example, from the observations in the last winter season, we showed evidence that auroral folds were periodically formed in a breakup arc and the luminosity is exponentially increased for about 10 sec before an auroral breakup onset. The evolution of turbulent microstructures and the formation of folds may be interpreted by the nonlinear evolution of inertial Alfven wave (IAW) turbulence in the thin current sheet. In this presentation we report the development and initial results of a new optical instrument system installed at PFRR since November 2010. Using a Hamamatsu EMCCD camera, we are conducting 180 Hz and 250 Hz imaging of the breakup aurora for the first time to search unexpectedly fast auroral phenomena, and to understand the electron acceleration mechanisms associated with dispersive Alfven waves in collaborations with Tohoku University and University of Alaska, Fairbanks. We use a telephoto lens of 300mm/F2.8 to resolve the finest scale of aurora with attaching a BG3 filter to see only the prompt emissions from molecular nitrogen.

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PEM031-11 Room:103 Time:May 26 11:15-11:30

Fine-scale structure of aurora in the sub-auroral region

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Auroras sometimes appear in the equatorward of the main auroral oval. The ”sub-auroral” aurora has been observed since 1970’s, and known to consist of faint patches. The Reimei satellite revealed its complicated, fine-scale structures of the sub-auroral aurora. The observation was made by optical and particle instruments on board the Reimei satellite near the equatorward edge of the main auroral oval. The aurora has the following characteristics: (1) A full width at half maximum (FWHM) value is as low as only ˜1.8 km from optical measurements, and ˜0.6 km from particle measurements at the ionospheric altitude, which is much smaller than previously determined. (2) Using the IGRF model, the FWHM value of 0.6 km corresponds to 9 km in the equatorial plane (L˜5), which is ˜10 times smaller than the gyroradius of typical protons in the inner magnetosphere. (3) The velocity distribution function of precipitating electrons is comparable to that of the trapped ones and does not demonstrate any plateau or positive gradient in the distribution at high energies greater than ˜1 keV. (4) The aurora was observed in geomagnetically quiet condition. (5) A geosynchronous satellite observed a significant increase in the plasma pressure of hot electrons in comparison with that of hot ions. The structuring of the aurora may be attributed to scattering processes of hot electrons as was previously suggested. If the structured aurora is a visual manifestation of the cold plasma that determines the growth of the waves scattering the hot electrons, an issue will be the extremely small scale of the cold plasma. Possible mechanisms leading to the extremely small scale structure of the cold plasma will be discussed.

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Keywords: Inner magnetosphere, aurora, fine-scale structure, Reimei satellite, precipitating electrons

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

PEM031-12 Room:103 Time:May 26 11:30-11:45

Relation between drift oscillations of auroral patches in the morning sector and ULF pulsations

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In this study, we investigate a relation amang oscillations in drift of auroral patches, ULF pulsations, and propagating auroral arcs simultaneously observed in the morning sector and discuss the physical processes of these phenomena. We have studied Quasi-Stationary Auroral Patches (QSAPs) observed at the South Pole Station (-74.3CGLAT) in the interval 9-14 MLT on July 8, 2004, that were characterized as stable auroral form, location, and luminosity for up to several hours (Ebihara et al., 2007). In this interval, the QSAPs showed oscillations in their eastward drift velocity and the oscillations were accompanied by Poleward Moving Auroral Arcs (PMAAs) and Pc 5 pulsations. It was further demonstrated from the detailed anaysis that all the three phenomena had the same period as Pc 5 pulsations and regular phase relation among them.

There are a few previous studies on the correlation between the drift oscillations of the auroral patches and ULF pulsations, in which the oscillations were deduced to be the ionospheric perturbations due to the coupling between the propagating compressional waves and the shear Alfven waves in the magnetosphere. Furthermore, we calculated the magnetosphere-ionopshere coupling process by the numerical simulation assuming that the field-line resonance (FLR) occurred in the magnetosphere. As a result, the oscillations of QSAPs, PMAAs, and Pc 5 pulsations can be interpreted as the various aspects of the FLR phenomena.

Such drift oscillations of auroral patches can be observed occasionally by the color digital camera at Tromso (66.7CGLAT), Norway, in the early morning and are coincident with ULF pulsations. In the presentation, we will also report the characteristics of the auroral patches observed at Tromso comparing with ULF pulsations from the IMAGE magnetometer network.

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Oguti T., R. Nakamura, and T. Yamamoto, Oscillations in drifts of auroral patches, J. Geomagn. Geoelectr., 39, 609-624, 1987.

Keywords: auroral patches, ULF pulsations, poleward moving auroral arcs, field line resonance, magnetosphere-ionosphere coupling

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

PEM031-13 Room:103 Time:May 26 11:45-12:00

Nonlinear simulation of ionospheric feedback instability with nonuniform Alfven velocity distribution

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The ionospheric feedback instability has been presented for the model that describes the dynamics of auroral arcs developed in convection electric fields [e.g. Sato, 1978; Lysak, 1991]. Destabilization of shear Alfven waves, propagating along the ambient magnetic field, is induced by the resonant coupling with the electric drift propagating on the ionosphere. Recently, formations of small-scale arc dynamics and ionospheric cavity modes were investigated by numerical simulations including non-uniformity in the background plasma density and the two-fluid effects in dipole magnetic field geometry [Streltsov and Lotko, 2004; Lu et al., 2008]. However, these simulations were performed only in a two-dimensional coordinate (along the magnetic field and perpendicular to the auroral arcs) and did not necessarily treat the nonlinear terms in a sufficient manner. Watanabe [2010] performed a three-dimensional simulation in slab magnetic field geometry with the reduced-MHD model that treats the nonlinear terms appropriately. The nonlinear behaviors indicate that the Kelvin-Helmholtz type vortex structures are spontaneously excited in the magnetosphere. We make a linear eigenmode analysis of shear Alfven waves in dipole field geometry to understand the characteristics of the cavity modes excited by non-uniformity in the Alfven velocity [Hiraki and Watanabe, 2011]. A realistic Alfven velocity profile is known such that it increases with height from the ionosphere, peaks around 1 Re, and decreases toward the magnetic equator. We find that the growth rate of cavity modes is considerably reduced by a large gradient of the Alfven velocity in the magnetospheric side, without any collisional effects at the ionosphere. For a realistic velocity distribution, the growth rate is a factor of 10 or much smaller than the rate for fundamental field-line resonances. It means that the field fine resonances are well developed when the cavity modes begin to grow up. Based on these results, we start to perform a nonlinear simulation considering non-uniformity in the Alfven velocity in dipole field geometry. We will present some new results of the analysis on the dynamics of arcs and cavity modes.

Keywords: feedback instability, Alfven wave, ionospheric cavity, nonlinear simulation, magnetosphere-ionosphere coupling

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(May 22-27 2011 at Makuhari, Chiba, Japan)

PEM031-14 Room:103 Time:May 26 12:00-12:15

Auroral conductance estimated from Polar and FAST satellites

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We estimated auroral conductance using Polar satellite global auroral images. We then compared the estimated conductance with FAST satellite observations of electrons at 3500 km altitude. Polar satellite observed a westward traveling surge at 21 MLT at 0301UT on February 23, 1997, when FAST satellite travelled across the northern auroral oval to the north at 20 MLT from 0255-0305 UT. Intense auroras concentrated in the poleward half (65-68 deg LAT) of the oval, where FAST observed the inverted-V signatures. In the inverted-V regions, the average energy of precipitating electrons was estimated as 7 and 8 keV from Polar auroral images and from FAST particle observations, respectively. The ionospheric conductance was estimated as Pedersen=12 and 15 (Z) and Hall=30 and 35 (Z) from images and particles, respectively. These results indicate that the estimation of conductance from auroral images agreed with particle observations better than the typical instrumental ambiguity (30 %) in spatial scales larger than 3 degree in latitudes. On the other hand, FAST observed localized (0.5 deg in LAT) enhancements in the conductance at the both edges of the inverted-V structure. These localized enhancements were not reproduced from auroral images, presumably because of the wider spatial resolution of images (0.5-2 deg in LAT).

Keywords: aurora, substorm, conductance, conductivity, geomagnetic field

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

PEM031-15 Room:103 Time:May 26 12:15-12:30

A statistical study of auroral upward field-aligned current using THEMIS electron data

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Using plasma sheet electron density and temperature obtained from the electrostatic analyzer (ESA) onboard the THEMIS-D satellite from Nov. 2007 to Jan. 2010, we have statistically investigated thermal current and conductivity to find where and when the field-aligned potential difference is formed. The thermal current (j_{th}) represents the field-aligned current carried by magnetospheric electrons without field-aligned potential difference, and can be estimated from the field-aligned current ($j_{||}$) which was introduced by Knight (Planet. Space Sci., 1973). The Knight relation for the field-aligned current assumes a Maxwellian distribution of magnetospheric electrons in the plasma sheet, while the THEMIS electron data do not show a single Maxwellian. Therefore, we have also examined thermal current by integrating the downward electron flux without the Maxwellian assumption. Through a comparison of the thermal current with the typical auroral current, which is shown by Iijima and Potemra (JGR, 1976), we can roughly estimate the magnitude of the field-aligned potential difference. We found that in the dawn side inner magnetosphere (source of the region 2 upward field-aligned current), both of the thermal currents with/without the Maxwellian assumption are comparable to or higher than the typical auroral current, particularly during active time (AE $>$ 100 nT). On the other hand, in the dusk side outer magnetosphere (source of the region 1 upward field-aligned current), both thermal currents are smaller than or comparable to the typical auroral current. It means that the potential difference may be necessary in the dusk region 1 current. In case of the field-aligned potential difference is formed, the field-aligned current is on the relation $j_{||}=KV_{||}$, where K is the conductivity that represents the efficiency of the upward field-aligned current. This relation was shown by Lyons (JGR, 1980). From the relation between the typical auroral current and the conductivity estimated by our study with Maxwellian assumption, we conclude that 1-10 kV of the filed-aligned potential difference is necessary on the dusk side region 1 upward field-aligned current.

Keywords: Field-Aligned Current, Plasma Sheet, Field-Aligned Potential Difference

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

PEM031-16 Room:103 Time:May 26 12:30-12:45

Study of temporal / spatial changes of SAID/SAPS structures by the SuperDARN Hokkaido radar

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Possible causes of variations of SAID / SAPS structures, both external and internal, will be discussed using the 4-year data from the SuperDARN Hokkaido radar.

Keywords: SuperDARN, Hokkaido HF radar, SAPS/SAID, inner magnetosphere, sub-auroral ionosphere, plasma instability