-1 The CAWSES Program and Indian Perspective

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Session: 3a. Geospace response to variability of the lower atmosphere

Type of presentation: oral

Key word: CAWSES India Space Weather interactions Atmospheric Coupling Processes

SCOSTEP' s programs are highly respected by the Indian space science community. The CAWSES-India was supported by the Indian Space Research Organization (ISRO), in line with the international programme of CAWSES. The programme provided a platform to the Indian scientific community to define common scientific objective(s) and make concerted and coordinated efforts for research on the Sun-Earth System. The CAWSES-India Phase-1 had also provided necessary support for moderate augmentation of the existing facilities and infrastructure at several universities in the country. The phase-1 of CAWSES-India spanned for four years (2005-2009), covering the declining phase of solar cycle. Recognizing the significant contributions made in CAWSES-India Phase-1, ISRO has approved CAWSES-India Phase-2 as a logical extension to cover the ascending phase of solar cycle until 2014. The CAWSES-India National Scientific Steering Committee had been reconstituted with three science themes to be pursued in phase-2, viz., (a) Solar Influence on Climate (0-100 km), (b) Space Weather & Climate: Science and Applications, and (c) Atmospheric coupling processes. 42 projects involving more than 15 organizations/institutions in India have been supported wherein more than 100 research publications have already appeared from the results obtained in CAWSES-India phase-2 in reputed national and international journals. Further, a JASTP Special issue on the CAWSES-India phase-2 is nearing completion. In this talk, in addition to highlighting some of the results obtained under the CAWSES program, the modalities in organizing the community to align with the VarSITI program will also be discussed.

-2 Dependence of the High-Latitude Lower Thermospheric Wind Vertical Vorticity and Horizontal Divergence on the Interplanetary Magnetic Field (IMF)

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Session: 1b. Origin, evolution, and Earth impact of high speed streams

Type of presentation: poster

Key word: high-latitude lower thermosphere wind vortices Interplanetary Magnetic Field

We analyze the vertical component of vorticity and the horizontal divergence of the high-latitude neutral wind field in the lower thermosphere during the southern summer time for different interplanetary magnetic field (IMF) conditions with the aid of the National Center for Atmospheric Research (NCAR) Thermosphere Ionosphere Electrodynamics General Circulation Model (TIE-GCM), with the following results. (1) The mean neutral wind pattern in the high-latitude lower thermosphere is dominated by rotational flow, imparted primarily through the ion drag force, rather than by horizontally divergent flow. Poleward of -60° magnetic latitude the magnitude of relative vertical vorticity often exceeds the magnitude of planetary vertical vorticity. (2) The vertical vorticity depends on the IMF. (3) The difference vertical vorticity, obtained by subtracting values with zero IMF from those with non-zero IMF, is much larger than the difference horizontal divergence for all IMF conditions. (4) The effects of IMF penetrate down to 106 km altitude. To determine the processes that are mainly responsible for causing strong rotational flow in the high-latitude lower thermospheric wind fields, a term analysis of the vorticity equation is also performed, with the following results. (1) The magnitude of forcing terms on vertical vorticity is significant poleward of -60° magnetic latitude. (2) The primary forcing term that determines variations of the vertical vorticity is ion drag. This forcing is closely related to the flow of field-aligned current between the ionosphere and magnetosphere. Significant contributions to variations of the vorticity, however, can be made by the horizontal advection term. (3) The effects of the IMF on the ion drag forcing are seen down to around 106 km altitude. (4) The continual forcing of magnetic-zonal-mean By-dependent vertical vorticity by ion drag can lead to strong polar vortices.

-3 Large scale atmospheric coupling processes and transport

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Session: 3c. Regional, hemispheric and inter-hemispheric couplings and transport in the atmosphere

Type of presentation: oral

Key word: Atmospheric coupling Waves

For the most part, the large scale zonal mean structure of the atmosphere is consistent with radiative equilibrium and geostrophic balance. Atmospheric waves (gravity waves, tides and planetary waves) and their dissipation are the primary mechanism for deviations from this structure. These waves transport momentum and energy between different heights and cause global meridional circulations which in turn transport constituents. In addition, the particle trajectories associated with these waves cause local variations in constituents especially where there are horizonal or vertical gradients in their mixing ratios.

We are currently at a point in the study of this coupling where short term and small scale aspects of this coupling are starting to be observed and modeled. In this talk, I will review recent developments in this field.

-4 Report from the MiniMax24 Working Group of VarSITI's ISEST/MiniMax24

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: Campaigns MiniMax24 VarSITI

MiniMax24 project coordinates international observations and conducts long-term campaigns providing daily updates on solar and geospace events through a network of international participants. It also serves as a "come-into-contact platform" with a broad range of experts in solar terrestrial physics. We give an overview on this initiative and report on the future plans of the MiniMax24 Working Group of VarSITI' s ISEST/MiniMax24 project.

-5 Polar summer mesosphere echoes correlated with high speed solar wind streams

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Session: 1b. Origin, evolution, and Earth impact of high speed streams

Type of presentation: poster

Key word: PMSE High speed solar wind streams

Periodic oscillations of polar mesospheric summer echoes (PMSE) are observed, correlated with high speed solar wind streams (HSS). The observation is made by 52MHz VHF radar measurements at Esrange, Sweden (67.8°N, 20.4°E). Correlations between PMSE volume reflectivity/counts, HSSs, and AE index are primarily found at 7-day, 9-day, and 13-day periodicities as well as 9-day and 13.5-day periodicities in 2006 and 2008, respectively. The observations show that the effects of HSSs appear in PMSEs. During corotating interaction region (CIR)-induced HSSs, the long-lasting enhancement of PMSEs, geomagnetic disturbances, and D-region ionization suggests that a favorable condition in generating PMSEs can be provided by the precipitating energetic electrons (>30 keV), which are frequently multiplied in the magnetosphere during HSSs.

-6 Using the lidar to observe and study the potassium layer over Beijing

Zelong Wang *(中科院空间中心)*

Session: 3c. Regional, hemispheric and inter-hemispheric couplings and transport in the atmosphere

Type of presentation: oral

Key word: the patassium layer seasonal variation modeling

We measured the density of the upper atmosphere potassium layer during 220 nights for two years, from November 2010 to October 2011 and from May 2013 to April 2014 respectively, at Beijing, china (40°N,116°E). The average properties of the nightly mean potassium layer are as follows: column density of 9.43×107 cm-2; peak density of 91 cm-3; layer centroid height of 89.7 km and RMS layer width of 4.49 km. Both the nightly mean column and peak density exhibit semiannual variations with maxima in winter and summer. The centroid height shows a semiannual variation, though, with maxima in spring and fall. The RMS layer width varies annually with a maximum width in winter. We also constructed a seasonal model of the potassium layer with the foregone neutral and ionic reactions of the metal. Although the model is able to reproduce some observed features of the K layer, the layer shape is quite different.

-7 Occurrence and climate effects of high-speed solar wind streams over the Grand Modern Maximum

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Session: 1b. Origin, evolution, and Earth impact of high speed streams

Type of presentation: oral

Key word: high-speed solar wind streams HSS effects on troposphere long-term evolution of coronal holes

In the declining phase of the solar cycle the polar coronal holes expand and form non-axisymmetric extensions toward lower latitudes. These extensions enhance the occurrence of high-speed solar wind streams (HSS) and related co-rotating interaction regions in the low-latitude heliosphere, and cause moderate, recurrent geomagnetic activity in the near-Earth space. Here, using new methods and definitions of geomagnetic activity, we calculate the effective annual occurrence of HSS over the whole Grand Modern Maximum (GMM). We find that a period of frequent occurrence of HSS occurs in the declining phase of each solar cycle. The most persistent HSS activity occurred in the declining phase of solar cycle 18. This suggests that cycle 19, which marks the sunspot maximum period of the GMM, was indeed preceded by exceptionally strong polar fields during the previous sunspot minimum. This gives interesting support for the validity of solar dynamo theory during this dramatic period of solar magnetism. We also study the winter surface temperatures and the occurrence of North Atlantic oscillation (NAO) during the different phases of the sunspot cycle (minimum, ascending, maximum and declining phase) and find a significant NAO pattern only during the declining phase, suggesting an intimate connection between the high-speed streams and the tropospheric climate patterns. We note that this connection is largely independent of the overall level of solar activity that varies dramatically over the GMM.

-8 The launched China-Brazil Joint Lab opens the long-term cooperation of space weather research

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Session: 5. Space Weather Meridian Session

Type of presentation: oral

Key word: China-Brazil Joint Lab Space Weather Joint ground-based detection Data sharing ISWMCP

Aiming to realize the East-West and South-North Semi-sphere' s joint monitoring and studies in the field of space weather research, the China-Brazil Space Weather Joint Lab was launched at August 6, 2014, which was held by the National Space Science Center (NSSC) of Chinese Academy of Science (CAS) and National Institute of Space Weather (INPE) of Brazil commonly. NSSC and INPE started an opening ceremony in Space Weather Headquarter of INPE. And besides, more than 30 delegates representing agencies as Bureau of International co-operation of CAS、Bureau of Major R&D Program of CAS, NSSC and INPE attend it. At the opening ceremony, Dr. Yin, the Deputy President of CAS and Dr. Perondi, the Director of INPE met the consistent to launch the extensive frontier cooperation in Space Weather Science and Detection, Meteorological Science, Remote-Sensing Detection, strengthening the bilateral communication and talent fostering et al. The Joint Lab could facilitate the regional space weather exploring and obtaining the global space weather information, and which is full of creativities and significant values in scientific research and application. Meanwhile, this Joint Lab is also a very important communication platform for China, Brazil and other surrounding nations to share the researching resources based on the ground-based detection. And most important, it is quite meaningful for pushing forward the major cooperation project in space weather –International Space Weather Meridian Circle Program (ISWMCP) which was lead by China. At present, the Joint Lab is located at the Space Weather Headquarter of INPE. At the premier stage, the Space Weather Joint Lab, South America Data Center, Santa Maria Observatory and those observation equipments such as Lidar、Digisonde、Ionosphere GPS - TEC and Fluxgate magnetometer are going to be installed in plan. This program has been launched in 2014 and will be accomplished at the end of 2016, when construction of the first period is finished and the project will run normally.

-9 Gravity wave parameters and their seasonal variations derived from Na lidar observations at 20oN Haikou, China

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Session: 5. Space Weather Meridian Session

Type of presentation: oral

Key word: Sodium Lidar Gravity wave parameters 20oN Seasonal distribution Wave Source

The nightly and seasonal variability of gravity wave activity and spectra in the mesopause region at Haikou are studied with 3 years of sodium lidar observations. From the linear layer density response to gravity wave forcing, the lidar data were analyzed to get the atmospheric density perturbations and their spectra. The atmospheric density perturbation, density variance for fluctuations with vertical scales between 2 and 10 km, and amplitudes of density perturbation spectra at m=2π/8 km 2π/4 km and ω=2π/60min, 2π/25min all exhibit large nightly variability as well as large seasonal variations, with the semiannual maxima occurring near the solstice. The mean RMS atmospheric density perturbation over Hainan are 6.5 %, which in summer are obviously larger than that in winter and the maxima occur near the solstice. The m spectra show power law shapes, and their range of variation is between-1.87 and-3.80 with an annual mean value of -3.02, and ω spectra is between-1.05 and-2.11 with an annual mean value of -1.89, respectively. Different from the mid-latitude observation as at Beijing or Urbana, the RMS perturbation is more active than those sites. It is concluded that the reaction of the Qinghai-Tibet plateau and the equatorial undercurrent may the main reason of the gravity wave behaviors at Haikou.

-10 Estimation of MSTID-related polarization electric field using coordinated radio and optical observations

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Session: 3a. Geospace response to variability of the lower atmosphere

Type of presentation: poster

Key word: MSTID airglow imager SuperDARN Hpkkaido HF radar

Medium-scale traveling ionospheric disturbances (MSTIDs), which typically have a horizontal scale of 100-500 km and a period of ~1 h, are observed in the F region ionosphere at midlatitudes. To date, quite a few observations of MSTIDs in nighttime have been carried out: they predominantly had a northwest-southeast frontal structure and propagated southwestward in the northern hemisphere. Recently, several numerical studies reported that the ionospheric E-F coupling processes through the polarization electric field play a key role for the generation and propagation of MSTIDs. However, observational evidence for the mechanisms is still limited.

In this study, we investigated nighttime MSTIDs by the Super Dual Auroral Radar Network (SuperDARN) HF radar in Hokkaido, Japan (43.5N, 143.6E), in combination with 630-nm all-sky imager located at Paratunka (53.0N, 158.2E), within the radar field of view. This configuration allows us to examine the associations between the HF echoes and airglow intensity variations spatially and temporally. Based on the measurements from January 2010 to June 2014, we found 6 conjugate events of MSTIDs: The Doppler velocities of field aligned irregularities (FAI) echoes observed by the SuperDARN showed systematic polarity changes which were consistent with airglow intensity variations. The MSTIDs propagated southwestward and had amplitudes in the airglow intensity of 10-15%, while the line-of-sight Doppler velocity amplitudes of 30-120 m/s were detected by the SuperDARN. Assuming that the polarization electric field is perpendicular to wavefronts of MSTIDs, these measurements yielded polarization electric fields of 3.5-9.0 mV/m. Our result suggests importance of the E-F coupling via MSTID-related polarization electric field, because the above estimation requires quite large effective field ($E_0+U\times B$) and seems to be improbable at midlatitudes considering the continuity of the electric current in the F region alone.

-11 MIT: A Future Chinese Space Mission

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: poster

Key word: Space Mission Magnetosphere-Ionoshpere Coupling

The Magnetosphere-Ionosphere-Thermosphere Coupling Small-Satellite Constellation Mission (MIT) is a Chinese mission targeting at the coupling processes of the earth' s magnetosphere-ionosphere-thermosphere system. The mission' s science objectives focus on the acceleration mechanism and the origin of outflow O+ ions and other related outstanding scientific questions. The mission plans a constellation composed of four satellites orbiting the earth at three different altitudes (see the Figure and table attached). The proposed payloads include particles detectors, field detectors, aurora and neutral imaging system. These payloads will measure the plasma compositions and the electromagnetic waves, therefore determine the key acceleration mechanisms for the oxygen ions. This mission is selected as a background model supported by the strategy pioneer program of Chinese Academy of Science. The proposed lunch date is between 2019 to 2020.

-12 An Overview of the Intra-atmospheric Chain in Sun-Earth Connections

Peter Pilewskie *(University of Colorado, Laboratory for Atmospheric and Space Physics)*

Session: 3b. Trends in the entire atmosphere, including anthropogenic aspects

Type of presentation: oral

Key word: Sun-climate connection atmospheric coupling

The mechanisms by which solar variability couples into the Earth’ s climate system have been subjects of vigorous research over the past several decades. The influence of the Sun occurs throughout the entire path from the topmost layers of Earth’ s atmosphere to the coupled systems of atmosphere, oceans, cryosphere, and landmasses that support human society. Although it is unlikely that the Sun has contributed in a significant way to the increase in global mean temperature of the Earth over past 50 years, on longer time scales such effects appear to exist. Moreover, correlations between solar activity and climate at the regional scale may exceed global trends. State-of-the art atmospheric models that couple all the layers of the Earth’ s extended atmosphere along with improved observations are providing new insight into how solar influences at high altitudes affect the lower atmosphere and conversely, how solar energy input into the ocean and land surface leads to changes in dynamics and temperature in the middle and upper atmosphere. This talk will focus on the outstanding questions and recent progress in understanding the role of the intra-atmospheric chain in the Sun-Earth connection, with an emphasis on the entire pathway through connection to the mass and electromagnetic chains.

-13 Coupling between Arctic and northern Europe climate, according to NCEP-CFSR and ERA-INT reanalyses

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Session: 3c. Regional, hemispheric and inter-hemispheric couplings and transport in the atmosphere

Type of presentation: oral

Key word: Arctic Teleconnection ERA-Interim NCEP-CFSR

Climate change is faster and more severe in the Arctic than in the rest of the world. Changes in the Arctic may be related to climate changes in northern Europe and may partly explain them. Usually, the climate analyses are focusing on certain regions, without evaluation of influences from neighbouring regions. Still, it is known that at adjoin regions weather and climate are strongly related to each other. We used NCEP-CFSR and ERA-INT reanalyses monthly mean values for 1979 – 2009 of temperature and specific humidity vertical profiles up to 300 hPa, sea level pressure, precipitable water and total cloud content. There were some differences between NCEP-CFSR and ERA-INT reanalyses results, but no fundamental disagreements in trends or correlation patterns. NAO and AO monthly means from NOAA-CPC database were also used.

Latest studies for the Arctic elucidate that climatic changes in the upper troposphere are even higher than near surface. Our results do not support them. Largest statistically significant trends in temperature and specific humidity were at 2 m and 1000 hPa, above that height trend strengths and also areas with significant trends decreased in both models. In northern Europe there was insignificant or less than 0.1 ºC/year trend in all seasons. Trends for 10 years (2000 – 2009) amplified more in temperature with even +0.5 ºC/year above Chukchi Sea and –0.5 ºC/year above Greenland and Alaska, but still, trends decreased with height.

Locally, there was high positive correlation between temperature, specific humidity and precipitable water. Correlation between temperature and sea level pressure was in summer mostly insignificant or positive, while in other seasons insignificant or negative. In northern Europe the correlations were significant in all seasons. Correlation between specific humidity and sea level pressure was mostly negative or insignificant, in northern Europe was stronger negative correlation in winter and autumn. Temperature in northern Europe had positive correlation with AO and NAO indexes, especially in winter and spring. For specific humidity, the correlation was strong (R > +0.5) only in winter.

A testing point (TP) was selected in southern Estonia (58N, 26E) for teleconnection patterns. As expected, TP has high mutual correlations (R > +0.5) between temperature, specific humidity and precipitable water with surrounding areas covering the whole northern Europe in all seasons. There were also vast areas far from TP with significant correlations. For example, TP temperature in spring had high positive correlation with sea level pressure over Pacific Ocean and Alaska. In summer, TP temperature has high positive correlation with seal level pressure over surrounding areas, but negative correlation over the entire Arctic Ocean and Greenland. Specific humidity in TP has high positive correlation with surrounding areas precipitable water in all seasons, but negative correlation with precipitable water over Greenland and Canada. In all seasons except summer, temperature at TP has high positive correlation with temperature in Siberia and negative correlation in southern Greenland. Temperature in TP has in summer and winter high negative correlation with cloudiness above surrounding areas, while there is positive correlation with Central Siberia cloudiness. To take into account several factors, more complicate statistical analyse will be carried out.

-14 Recent Progress in Long-Term Solar Activity

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Session: 2a. Long-term solar variability (magnetism, total irradiance, and spectral irradiance) and its impact on geospace and Earth

Type of presentation: oral

Key word: solar magnetic field solar variability

Over the past decade there has been significant progress in the study of solar variability on the time scale of centuries. New reconstructions of Sunspot Numbers, Far Ultraviolet and Microwave proxies, Solar Wind Physical Parameters, Total Solar Irradiance, and Cosmic Ray Modulation have provided a well-constrained and consistent image of solar variability over almost two centuries of the past. The new insights promise further progress in modeling solar activity much further back in time.

-15 Coronal, Interplanetary, and Terrestrial Radio Bursts

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Session: 2c. Coronal and Interplanetary radio bursts including auroral kilometric radiation

Type of presentation: oral

Key word: radio physics space missions

Nonthermal radio emission is pervasive in the solar system and is often an excellent diagnostic of remote processes such as shocks, reconnection, and double layers. In this talk, I'll give an overview of several of these processes, describe some phenomenology and outstanding problems, and outline some future initiatives and projects in low frequency radio physics.

-16 The Observation of Sporadic Sodium Layer at a low-latitude location (Haikou, China, 20.0o N, 110.3o E) by Lidar

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Session: 5. Space Weather Meridian Session

Type of presentation: oral

Key word: Na lidar observations low-latitude location

Na lidar observations of SSL at a low-latitude location (Haikou, China, 20.0o N, 110.3o E) from the year of 2010 to 2013 are reported in this paper. A Nd:YAG laser pumped dye laser is used to generate the probing beam. The wavelength of the dye laser is set to 589 nm by a sodium fluorescence cell. The energy and divergence of the beam are about 42 mJ and 1 mrad respectively. The repetition rate of Nd:YAG laser is 30 Hz. The backscattered fluorescence photons from the sodium layer are collected by a telescope with a Φ 1000mm primary mirror. From 222 SSL events detected in about 2759 h of observation, a SSL occurrence rate of 12.4 h at our location was obtained. The statistical analyses of main parameters for the 188 SSL events were made, and the results were compared with those of other location reported. By examining the corresponding data from about 160 km southwest ionosonde, it was found that there was well correlation between SSL and Es. Of 78 pairs of SSL and Es events checked, all SSLs were accompanied by Es within 5 km in altitude, and 64 pairs of them were correlated within 1 h in time.

-17 Lidar observations of the middle atmospheric thermal structure over North China

Chuan Yue, Guotao Yang, Jihong Wang, Sai Guan *(National Space Science Center, CAS, Beijing 100190, China)*

Session: 3b. Trends in the entire atmosphere, including anthropogenic aspects

Type of presentation: oral

Key word: Lidar Atmospheric temperature Seasonal variations stratospheric temperature enhancement Mesospheric temperature inversion

According to the observational data for over 120 nights of the Rayleigh lidar located in Beijing, China (40.5°N, 116.2°E), the middle atmospheric thermal structure (35-85 km) over North China was obtained. Lidar observation results show good agreements with SABER temperature data sets, which justify that both the two instruments are reliable. Lidar results show significant difference with the NRLMS-ISE-00 empirical model and lidar temperatures are usually colder than the model data during the observational time, which may be due to the associations of high level of solar activity, greenhouse gases and the frequent haze weather in North China. To characterize the seasonal variations of the atmospheric temperature structure over Beijing, the amplitude and phase profiles of the annual, semi-annual and 3-month sinusoidal oscillations were extracted by multi-parameter sinusoidal regression. A stratospheric temperature enhancement (STE) event and a long-term mesospheric temperature inversion layer (MIL) are observed in the early winter of 2012/2013. The observed STE event could be due to the enhancement of planetary wave activity while the long-term MIL could be due to gravity wave-planetary wave interactions in the masopause region.

-18 Origin and Long-term Evolution of the Sun’s Magnetism

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Session: 2a. Long-term solar variability (magnetism, total irradiance, and spectral irradiance) and its impact on geospace and Earth

Type of presentation: oral

Key word: Sun Magnetism

Solar magnetism is understood to be a product of a dynamo mechanism in the Sun’s interior which is sustained by small and large-scale plasma flows and their interactions with magnetic fields. The Sun’s activity, mediated by magnetic fields, has a wide ranging impact on planetary environments, including forcing of planetary climates and atmospheres. This activity evolves not only on solar cycle timescales but on longer timescales due to the evolution of the Sun as a star. In this talk I will review our current understanding of the origin of solar magnetism and discuss efforts to understand its long-term evolution and consequent impact on planets.

-19 Transient and long-term solar activity: Origin and impact on the Earth’ s atmosphere

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Session: 2b. Origin of solar flares and their impact on Earth’ s ionosphere/atmosphere

Type of presentation: oral

Key word: Solar Activity High-frequency, Radio, Infrared Earth's ionosphere

In this paper, we will review the last advances reported in order to better understand the explosive phenomena occurring in the solar atmosphere and known as solar flares. Special attention will be paid to the high-frequency observational diagnostic of sudden energy liberation showing up in the electromagnetic spectrum in the millimeter, sub-millimeter, terahertz (THz) and Infrared (IR) spectral domains. A better description of the solar phenomena in these spectral domains is essential to infer the physical mechanism at work. Enhanced radiation fluxes and energetic particles are sub products of the rapid energy dissipation in solar active regions, which reach the environment of the Earth in few minutes up to few hours. Similarly, on longer timescales the Earth’ s atmosphere is also under the constant influence of the long-term solar radiation in X-rays, UV and EUV. In this presentation, we will also show how to monitor both the long-term and transient solar activity phenomena using ground-based observational diagnostics of the lower neutral atmosphere, middle and lower ionosphere.

-20 Slipping Magnetic Reconnection Triggering an Eruption of a Triangle-flag flux rope

Li Ting *(National Astronomical Observatories, Chinese Academy of Sciences)*

Session: 2b. Origin of solar flares and their impact on Earth’ s ionosphere/atmosphere

Type of presentation: oral

Key word: magnetic reconnection flares

We firstly report the simultaneous activities of a slipping motion of flare loops and a slipping eruption of a flux rope in 131 {\AA} and 94 {\AA} channels on 2014 February 02. The east hook-like flare ribbon propagated slippingly at a speed of about 50 km s^{-1}, which lasted about 40 min and extended by more than 100 Mm, but the west flare ribbon moved in the opposite direction with a speed of 30 km s^{-1}. At the later phase of the flare activity, a ``bi-fan" system of flare loops was well developed. The east footpoints of the flux rope showed an apparent slipping motion along the hook of the ribbon, simultaneously the fine structures of the flux rope rose up rapidly at a speed of 130 km s^{-1}, much faster the whole flux rope. We infer that the east footpoints of the flux rope are successively heated by a slipping magnetic reconnection during the flare, which results in the apparent slippage of the flux rope. The slipping motion delineates a ``triangle-flag surface" of the flux rope, implying that the topology of a flux rope is more complex than anticipated.

-21 Mass transport in the heliosphere

Vladimir Obridko *(IZMIRAN)*

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: mass chain global field and heliosphere

The following key aspects of mass transport from the Sun will be discussed: the key role of the global magnetic field in long-term variations in the matter transport; modern ideas of the origin and acceleration of the solar wind; active longitudes and heliomagnetic coordinates; general structure of the heliosphere; physical conditions in coronal holes and solar wind characteristics; interaction of different streams (high-speed solar wind streams, coronal mass ejections); the total mass flux and its variation with the evolution of the Sun; transport of the magnetic field; geomagnetic disturbance data as an index of some characteristics of the solar dynamo; a possible role of mass flows in climate variations.

-23 Galactic Cosmic Ray Modulation near the Heliopause

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: Galactic Cosmic Ray Heliopause Voyager 1

We investigate modulation of galactic cosmic rays in the inner and outer heliosheaths using three-dimensional numerical simulations. The model is based on the Parker transport equation integrated using a stochastic phase space trajectory method. Integration is performed on a plasma background obtained from a global three-dimensional magnetohydrodynamic simulations. Our results predict a negligible amount of modulation in the outer heliosheath, because of weak scattering of cosmic ray ions owing to very low levels of magnetic fluctuation power at wavenumbers relevant to the transport of cosmic rays with MeV to GeV energies. This means that the heliopause may be treated as a Dirichlet-type boundary for the purpose of energetic particle modeling. We present models with and without drift velocity to facilitate comparison with papers published earlier. We also attempt to reproduce the sudden step-like increases of cosmic-ray intensity observed by Voyager 1 before its encounter with the heliopause. Our results indicate that very slow cross-field diffusion in the outer heliosheath could produce a large gradient of cosmic rays inside the heliospheric boundary. The resulting large gradient in cosmic-ray intensity near the heliopause qualitatively agrees with recent
Voyager 1 observations.

-24 Study of Daytime Pi2 Pulsations

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Session: 2b. Origin of solar flares and their impact on Earth’ s ionosphere/atmosphere

Type of presentation: oral

Key word: Daytime Pi2 Pi2's at LEO satellite

Pulsations with irregular waveforms in the frequency range 6.6 – 25 mHz called Pi2s, are short lived oscillations and are excited by sources in the night side magnetosphere. Substorms are one of the common energy sources for Pi2s. Although Pi2s are a night time phenomenon, they are often observed in the low latitude daytime ground stations. But at the same time there are reports which show that Pi2 oscillations are confined to midnight to dawn sector and could not identify their simultaneous occurrence during daytime. In this study, we investigate the occurrence of daytime Pi2s using low latitude ground stations from Indian, Japanese and American sector. Pi2s identified at daytime ground stations are then compared with observations from overhead Low Earth Orbiting (LEO) satellite. Observations from satellite and ground platforms may enable us in understanding the role of ionosphere in the propagation/modification of daytime Pi2 oscillations.

-25 Solar and anthropogenic impact on the middle atmosphere: an overview

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Session: 3a. Geospace response to variability of the lower atmosphere

Type of presentation: oral

Key word: middle atmosphere trends

The middle atmosphere/lower thermosphere (MALT) plays a multiplex role in climate change research. For example, it cools due to greenhouse gas increase, it absorbs most of the energetic part of solar radiation, it reacts very sensitive to dynamical coupling from lower altitudes, and it acts as a precursor for certain circulation patterns propagating down to the surface. The middle atmosphere/lower thermosphere is known to react substantially more sensitive to an increase of greenhouse gases (in particular carbon dioxide) compared to the troposphere. Therefore, temperature trends in the middle atmosphere are notoriously larger (and of opposite sign) compared to trends at the Earth's surface. Unfortunately, the mechanisms of greenhouse gas cooling are much more complicated that frequently addressed in models. For example, stratospheric ozone influences the MALT due to shrinking but also through radiative coupling affecting the mesosphere. Various processes involved in cooling lead to temperature trends which are not uniform in time. Measurements limited to a certain time period may therefore pretend a trend which is not in line with long term processes.

Apart from influence if greenhouse gases on trends in the MALT, there is also an affect from `above' to `below'. The energetic part of the solar spectrum is absorbed in the MALT. It transfers to lower altitudes by, for example, generation of photochemical active species propagating from the lower thermosphere to the stratosphere. Dynamical processes play a key role in coupling the MALT to the troposphere, and vice versa. For example, gravity waves generated at lower altitudes propagate to the MALT where they lead to a thermal structure which deviates from radiative equilibrium by up to hundred degrees. Tropospheric circulation changes induced by GHG increase will modify gravity wave generation which is expected to leave severe impacts in the MALT. Certain circulation patterns are first detectable in the MALT before they propagate into the troposphere. The strength of the polar vortex plays a key role in stratospheric impact on the troposphere. Such processes are key elements in transferring climate signals from the upper to the lower atmosphere. Science questions related to the topics mentioned above will be studied in the ROSMIC project (Role Of the Sun and the Middle atmosphere/thermosphere/ionosphere In Climate) which is part of SCOSTEPs new program VarSITI.

-26 Near-Sun CME Magnetic Field and its Variation Through the Inner Heliosphere: A Proposed Modus Operandi for VarSITI's ISEST-MiniMax24 Working Group 5

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Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: oral

Key word: CME Flux Rope

It is now well understood that the vast majority of solar coronal mass ejections (CMEs) have a magnetic structure resembling that of a flux rope. The axial magnetic field (Bz) of the rope, combined with the rope's axis orientation at geospace, will determine the strength of the southward magnetic field (Bs) of the interplanetary CME (ICME) that is a decisive factor of the ICME's geoeffectiveness. At Working Group 5 (WG5) of the VarSITI ISEST-MiniMax24 Program, dedicated to this Bs-challenge, we implement a modular systems approach to tackle this central problem: using novel calculations in the low solar atmosphere we first constrain the magnetic helicity of the CME that gives rise to a CME Bz-value under a force-free flux-rope working hypothesis. Using forward modeling on the CME observations at just a few solar radii we further infer the CME axis orientation that gives rise to a near-Sun estimate of Bs via an orientation projection of Bz. These Bz- and Bs-estimates, subjected to viable schemes of CME expansion and axis rotation, are to be tested at L1 via in-situ measurements and fits. Tested on a matrix of Program-selected eruption events, this approach is aimed to look for patterns that will provide educated assessments of the ICME geoeffectiveness potential spurred from near-Sun CME properties. A test-case example of this modus operandi for WG5 is provided for illustrative and feedback purposes.

-27 Solar Storm Impact on Earth Environment: A Data-Driven Three-Dimensional Magnetohydrodynamic Simulation of the Storm Initiation

Shitsan Wu *(The University of Alabama in Huntsville)*

Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: Solar Storm

A major challenge to the space weather forecasting community is accurate prediction of Bz vector at 1 AU. In order to achieve this goal, the internal magnetic structure of a CME will play an important role. Currently, there are so many studies of CME propagation, but only a few have included the magnetic structure of the CME. In this presentation, we briefly summarize the CME initiation process presently used. A total data-driven CME initiation model based on Active Evolution model will be discussed. To illustrate this process, we will use AR11283 as an example.

Active Region 11283 is a very productive source region which produced several flares and CMEs. We use a three-dimensional time-dependent MHD analyses of an observed Sigmoid (flux-rope) from its birth to eruption and propagation to initiate a CME at 2011 September 6. To carry out this investigation, a very well developed data-driven active region evolution model (Wu et al. 2006, 2013, Jiang et al. 2013) together with a global propagation model (Feng, Zhou and Wu, 2007) is used. By inputting SDO/HMI vector magnetograms at the lower boundary to drive the model, we simulated an observed Sigmoid (flux-rope) feature which is identical to the images obtained by SDO/AIA and Hinode/XRT. We have found that this Sigmoid is not stable due to twist instability (TI) by computing the decay index. Then, we used this solution as the inputs to the three-dimensional global magnetohydrodynamic propagation model. It shows the Sigmoid (flux-rope) is lifted up and forms a CME as seen by the High Altitude Observatory/Mauna Loa Coronagraph. This simulation also showed that a new flux-rope is formed after the first eruption due to magnetic reconnection.

-28 Numerical Analysis of Earth-affecting CMEs: A Report from the ISEST/Minimax24 Simulation Working Group

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Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: oral

Key word: Coronal Mass Ejection Simulation

We report the progress and the future plan of the Simulation Working Group of the ISEST/MiniMax24 project. The scientific goals of this working group are to (1) provide global context for the ICMEs investigated by the ISEST team (e.g. WG1, WG4); (2) investigate processes of the CME initiation, heliospheric propagation, and CMEs interaction; (3) develop tools to assist collaboration of numerical modelers, theoreticians, and observers. The working group will use existing 3D MHD models including ENLIL, COIN-TVD, CESE, H3DMHD and SWMF.

-29 Two kinematical classes of ISEST Event List of CMEs observed by SDO/AIA, PROBA2/SWAP, and coronographs on board SOHO and STEREO

Ewa Chmielewska, Michal Tomczak, Sylwester Kolomanski *(Astronomical Institute, University of Wroclaw)*

Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: poster

Key word: CME, solar flares,

Statistical characteristics of two distinct kinematical CME classes associated with eruptive prominences (EP) or flares were widely reported in many papers e.g. Gosling et al. (1976), Moon et al. (2002), Vrsnak et al. (2005), Chen et al. (2005a). Simultaneous observations taken by SDO, PROBA2, SOHO, and STEREO satellites provide perfect opportunity to study solar eruptive phenomena in many EUV channels (AIA, EUVI), with high temporal and spatial resolutions and large field of view. In order to verify this two-classes concept we examined the height-time profiles of ISEST Event List of CMEs associated with flares and associated with eruptive prominences. We confirm that CMEs associated with flares show the impulsive acceleration that coincides very well with the impulsive phase of flares and have higher speeds than CMEs associated with eruptive prominences.

-30 Solar Data Mining Using Automated Feature Detection: First Scientific Results

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Session: 2a. Long-term solar variability (magnetism, total irradiance, and spectral irradiance) and its impact on geospace and Earth

Type of presentation: oral

Key word: Solar Feature Detection Solar Data Mining

The Solar Dynamics Observatory Feature Finding Team (FFT), led by the author, has produced 16 automated feature tracking modules for data from SDO, LASCO, and ground-based H-alpha observatories (see Martens et al. 2012, Solar Physics, 275, 79). The metadata produced by those modules and others are available from the Heliophysics Events Knowledgebase (HEK) and the Virtual Solar Observatory (VSO). The feature finding modules have the ability to digest far larger amounts of data than can ever be analyzed by human observers. Having metadata available for large amounts of events and phenomena, obtained with consistent detection criteria -- unlike catalogs produced by human observers -- allows researchers to effectively search solar data for patterns.

I will show a number of first science results recently obtained by data mining these metadata. Not surprisingly several of the patterns are well known (e.g. flares occur mostly in active regions), but some really surprising new trends have been discovered as well, in at least one case upending scientific consensus. These results show the power and promise that systematic feature recognition and data mining holds for solar physics.

FFT website: http://solar.physics.montana.edu/sol_phys/fft/

-31 Two Solar Cycles of Relativistic Electrons, ULF waves, and High Speed Solar Wind Streams

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Session: 1b. Origin, evolution, and Earth impact of high speed streams

Type of presentation: poster

Key word: relativistic electrons ULF waves

Relativistic electrons (>2 MeV) as measured by GOES geostationary satellites from 1987 to 2009 encompassing Solar Cycles 22 and 23, and Pc5 ULF waves as observed by ground magnetic observatories located in the auroral zone of Canada, as well as solar wind speeds are used in a statistical study. The relationships among energetic electrons in the near-Earth environment, magnetic variations in Pc5 frequency band on the ground, and high speed streams in the solar wind are determined. Results are presented in the poster.

-32 Role of plasmoids in energy cascade in magnetic reconnection in solar flares: Modelling and relation to observations

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Session: 2b. Origin of solar flares and their impact on Earth' s ionosphere/atmosphere

Type of presentation: oral

Key word: Magnetic reconnection MHD

Magnetic reconnection is nowadays commonly accepted mechanism for energy dissipation in solar flares. Nevertheless, really efficient reconnection, in a such collision-less plasma as the solar flaring corona is, works at very small scales: The width of the dissipative current layer typically reaches ion skin depth or electron Larmor radius. Under solar conditions such scales are of the order of meters while the macroscopic flare current layers, believed to be formed behind the ejected filament/CME, are some six orders of magnitude thicker. Hence, some mechanism of cascading from large to small scales is required.

Starting from 90's continuously more evidence is collected that formation and interaction of magnetic islands/plasmoids - which are helical magnetic fluxropes in the 3D reality - can provide such mechanism. There is a quite close analogy with the helical vortex tubes, whose formation and mutual interaction play this role in classical fluid dynamics.

Furthermore, namely recent observations demonstrate that formation and interaction of plasmoids is indeed involved in the real solar flares: Extension of MHD simulations providing simulated observations in optical, UV/EUV and radio domains and their comparison with the data really observed during the solar flares bring strong indication of the role of plasmoids in the solar flares.

The contribution aims at reviewing and summarizing recent development in the MHD and PIC simulations of plasmoid-dominated reconnection as well as related observations.

-33 Distinguishing writhe from twist using multi-spacecraft measurements and numerical simulations.

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: CMEs Magnetic field

The magnetic field configuration in coronal mass ejections (CMEs) has been the subject of a number of recent studies that aimed to understand its morphology through various methods: with different magnetic field fitting and reconstruction codes using in situ measurements at 1 AU, with numerical simulations and with remote-sensing observations by STEREO and SDO. With most of these methods, it is assumed that CMEs consist of a twisted magnetic flux rope. We have previously shown how sheared magnetic field lines in a CME may be mistaken for a twisted flux rope when observed in situ by a single spacecraft, due to the limitation of reconstruction methods. Here, we present our most recent study on this subject. We study the ability of multi-spacecraft measurements to distinguish between different structures of the CME magnetic field. We do so by comparing reconstructions obtained using measurements of a simulated writhed CME to that obtained using measurements of a twisted flux rope for different spacecraft location with respect to the CME direction of propagation. We also discuss how these two types of structures may evolve as they propagate in the inner heliosphere and whether sheared or writhed field lines have been detected before.

-34 INSTANT: an innovative, small mission concept for solar and heliospheric science from the L5 location

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Session: 5. Space Weather Meridian Session

Type of presentation: oral

Key word: Space Weather Mission Concept

We will present both the science objectives and related instrumentation of a small solar and heliospheric mission concept, INSTANT: INvestigation of Solar-Terrestrial Activity aNd Transients. It will be submitted as an opportunity to the upcoming ESA-China S-class mission call later this year. This concept was conceived to allow innovative measurements and unprecedented, early determination of key properties of Earthbound CMEs from the L5 vantage point. Innovative measurements will include magnetic field determination in the corona thanks to Hanle measurement in Lyman-α and polarized heliospheric imaging for accurate determination of CME trajectories. With complementary in situ measurements, it will uniquely permit solar storm science, solar storm surveillance, and synergy with Solar Orbiter and Solar Probe Plus (the ESA-China S2 mission launch is planned in 2021).

-35 Modeling the geoeffective Coronal Mass Ejections

[1]Alexis Rouillard, [1]Lavraud Benoit, [1]Anthony Bourdelle, [2]Valbona Kunkel, [3]Dusan Odstrcil *([1]IRAP, [2]GMU/HelioMagnetics, [3]GMU)*

Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: oral

Key word: Coronal Mass Ejections Space Weather

The geo-effectiveness of coronal mass ejections (CME) is determined by a complex chain of processes. This paper highlights this fact by first discussing the importance of CMEs intrinsic properties set at the Sun (e.g., trajectory, eruption process, orientation, etc.). We then review other key processes that may occur during propagation (e.g., shocks, compressions, magnetic flux erosion) and in the specific interaction with Earth's magnetosphere (e.g., magnetic properties, preconditioning mechanisms). These processes sequentially have a significant influence on the final geo-effectiveness of CMEs. Their relative importance is discussed. While the CME's trajectory, magnetic field orientation, velocity and their duration as set at the Sun certainly are key ingredients to geo-effectiveness, other processes and properties, that at first appear secondary, often may be as important.

-36 Spatiotemporal Behavior of ULF waves excited by interplanetary shock and solar wind dynamic pressure impulses in the magnetosphere

Qiugang Zong *(Peking University)*

Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: IP shock Waves

When an interplanetary shock or a solar wind dynamic pressure impulse impinges on the magnetophere, ultra low-frequency (ULF) waves can be excited in the magnetosphere and the solar wind energy can be transported from interplanetary space into the inner magnetosphere. In this study, we have systematically studied ULF waves excited at in the magnetosphere by interplanetary shock or solar wind dynamic pressure impulse. We have found that the poloidal and toroidal waves excited by positive and negative pressure pulses oscillate in a similar manner of phase near 06:00 local time (MLT) and 18:00 M LT, but in antiphase near 12:00 M LT and 0:00 MLT. ULF waves generated by IP shock impact is much stronger than that to negative pressure pulses. Furthermore, it is shown that excited ULF oscillations are in general stronger around local noon than those in the dawn and dusk flanks. It is demonstrated that the poloidal wave amplitudes are stronger than the toroidal wave amplitudes except in the magnetotail.

In the energetic particle point of view that the magnitude of IP shock generated ULF waves (energetic particle flux oscillations) are much larger around 12:00 LT than at dawn and dusk and oscillate in an opposite phase near local noon and midnight。 A frequency preference in the oscillations in between 2.2 mHz and 3.3 mHz. The oscillations are stronger under southward IMF condition than that under northward IMF condition. Plasmapause /PBL would modify the generated ULF waves.

-37 COMPARISON OF FORMOSAT-3/COSMIC ELECTRON DENSITY PROFILES WITH IRI DURING DISTURBED CONDITIONS

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: poster

Key word: occultation electron density profile

In this study we examine the impact of space weather effects registered in the current solar cycle on electron density profiles obtained by FORMOSAT-3/COSMIC radio occultation (RO) measurements. We also attempt to compare these profiles with those predicted by the International Reference Ionosphere (IRI-2012) model under the same conditions. We therefore perform a comparison between measured and predicted electron density profiles and discuss any systematic features in the differences that we observe.

-38 Coupling of the polar stratosphere and mesosphere during stratospheric sudden warmings

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Session: 3c. Regional, hemispheric and inter-hemispheric couplings and transport in the atmosphere

Type of presentation: oral

Key word: energetic particle precipitation stratosphere-mesosphere coupling

Stratospheric sudden warmings (SSWs) play a key role in coupling the stratosphere and the mesosphere in the northern hemisphere. The occurrences of strong SSWs accompanied by elevated stratopause events (ESEs) strongly modulate the inter-annual variability of the transport into the polar stratosphere of nitrogen oxides (NOx) produced in the MLT region by energetic particle precipitation (EPP). Such ESEs hence play an important role in conveying the impact of EPP into the lower atmosphere. During ESEs, the polar stratopause reforms at mesospheric altitudes before being brought down to its climatological position by a downward mean meridional circulation driven by planetary and gravity waves.

We characterise the dynamics of ESEs that occurred in recent years with the NCAR whole-atmosphere WACCM_SD model with specified dynamics, and in particular the ESE of January 2013. We examine their impact on the downward transport of EPP-induced NOx, as well as of other mesospheric trace species like carbon monoxide, and compare model results with observed NOx variability. We further investigate the model and observed variability in mesospheric ozone during ESEs and, in particular, their modulation of the ozone secondary maximum near 100 km.

-39 Impact of the Lower Atmosphere on Variability and Mixing in the Thermosphere and Ionosphere

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Session: 3a. Geospace response to variability of the lower atmosphere

Type of presentation: oral

Key word: thermosphere ionosphere variability lower atmosphere forcing

Recent development of whole atmosphere models has opened a window into the degree to which the lower atmosphere induces variability in the thermosphere and ionosphere system. Processes associated with tropospheric weather systems, wind flow over topography, and geostrophic adjustment in the lower atmosphere generates a spectrum of waves that propagate upward. The amplification of these model-resolved waves drives strong winds and shear near the turbopause and lower thermosphere region. The modeled vertical structure and shear is similar to wind observations in the lower thermosphere enabling their impact to be assessed. The rich spectrum of short-period (1 to 3 hours) waves manifest in the thermosphere also has a clear ionospheric signature, which is apparent in incoherent scatter observations, ionosondes, and lidar measurements. The lower thermosphere is also the region where a whole spectrum of migrating and non-migrating tides reaches a peak as they propagate from their sources in the lower atmosphere. The spectrum of tides drives circulation patterns on a range of scales from global to regional, which act as a mixing agent. The model can be used to quantify the role of mixing by tides, and the impact on the ratio of light atomic (oxygen) to heavier molecular (nitrogen) species, which has a direct impact on ionospheric recombination rates. The seasonal/latitudinal variation of tides can induce variations in mixing and O/N2 ratio. The new whole atmosphere models can be used to determine the contribution to mixing by the spectrum of atmospheric tides and larger-scale model-resolved waves.

-40 Particle Acceleration at a Pair of Parallel Shocks near the Sun using a test particle simulation

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: CME particle acceleration Shock waves

A "twin-CME" scenario [Li et al., 2012a] has been proposed recently to account for extreme Solar Energetic Particle (SEP) events. In this scenario, two CMEs erupt from the same active region and drive two shocks in a short period of time and the presence of the first CME leads to a more efficient acceleration process at the second shock. In a subset of these events the two CMEs are separately by only a few minutes and particle acceleration process is further enhanced due to particle reflecting between the two shocks. Here we examine particle acceleration at a parallel shock pair using a test particle approach. We follow single particle trajectories using two methods: close to the shock we follow particle's motion by solving the Lorentz equation directly; beyond certain distances, we ignore the gyration degree of freedom of particle and approximate particle's motion by its guiding center motion and pitch angle scattering. We do not consider the wave generation due to the streaming protons at both shocks. Instead, we assume the background turbulence upstream the first shock is given, and follow its transmission to the downstream of the
second shock. Our results show that the intensity of accelerated particles in the shock pair case is significantly enhanced over a single shock case and the
maximum energy obtained in a shock pair system can be a few to 10 times that of a single shock case.

-41 Study of the TEC fluctuations in the high latitude ionosphere by GNSS measurements

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Session: 5. Space Weather Meridian Session

Type of presentation: poster

Key word: Ionosphere TEC Space Weather High Latitudes

In the paper there are presented occurrence of TEC fluctuations in high latitudes ionosphere during September 9, 2011 storm. The simultaneously GNSS observations from more than 30 Greenland network stations provided to obtain similarly auroral oval, irregularity oval. It is shown that irregularity oval very sensitive to changes of solar-geomagnetic activity and can use as indicator space weather conditions.

The scintillations of trans-ionospheric radio signals are very well known indicator space weather condition. The electron density irregularities presented in high latitude ionosphere may experience phase and amplitude fluctuations of GPS signals. The small irregularities with scale less than 1 km cause fast fluctuations it is usually called scintillations. The medium and large scale ionospheric irregularities are responsible for slow fluctuations. The low frequency GPS phase fluctuations may be directly due to electron density changes along the radio ray path or the total electron content (TEC) changes. The GPS observations of Greenland network were used for diurnal TEC variations in the high latitude ionosphere to represent. This network provides unique opportunity to monitor TEC variability in polar ionosphere on a regular base. GPS stations are arranged along the latitude over the range 60-83° N (65-87° Corrected Geomagnetic Latitude) near of 25-50° W longitudes. It covers subauroral, auroral and polar ionosphere. In the report occurrence of phase fluctuations (TEC changes) in the high latitude ionosphere during September 9, 2011 storm is presented. Dual-frequency GPS measurements for individual satellite passes served as raw data. As a measure of fluctuation activity the rate of TEC (ROT, in the unit of TECU/min, 1 TECU=1016 electron/m2) at 1 min. interval was used, as the measure of TEC fluctuations intensity do index ROTI.

Analyses showed that fluctuation activity of GPS signals in the high latitude ionosphere is depended on geomagnetic conditions. Intensity of fluctuations essentially increases during geomagnetic storm. Similarly to the auroral oval the spatial distribution of the fluctuations demonstrate the irregularity oval images. The occurrence of GPS-TEC fluctuations is very sensitive to solar-geomagnetic changes and can use to evaluate space weather conditions. The study showed that the operating high-latitudes GNSS stations can provide to monitor in near real-time of the space weather.

Work was partially supported by of RFBR 14-05-98820/

-42 The Great Indian Power Failure: Need of GIC Study

Abhijeet Khandagale *(Albedo Informatics)*

Session: 2a. Long-term solar variability (magnetism, total irradiance, and spectral irradiance) and its impact on geospace and Earth

Type of presentation: oral

Key word: SEP GIC D-RAP

Given the essential role electricity plays in society today, it is crucial to understand how natural hazards impact the reliability of the grid. The hazard posed by geomagnetic storms is one of the most concerning due to the potential for long-term, widespread power outage. And as the electric infrastructure ages and we become more and more dependent on electricity, the risk of a catastrophic outage increases with each peak of the solar cycle. India faced a huge power outage on 31st July 2012 which is termed to be the biggest in the history. It has attracted the need to monitor such interconnected grids for possible GIC effects. Following the model set up by Heliophysicist Antti Pulkkinen in Virginia, this paper asserts the necessity for implementation of such projects worldwide, esp India. While the probability of an extreme storm occurring is relatively low at any given time, one will occur eventually.

-43 Study of the Ionospheric Mid-latitude Summer Nighttime Anomaly

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Session: 3c. Regional, hemispheric and inter-hemispheric couplings and transport in the atmosphere

Type of presentation: oral

Key word: Ionospheric Mid-Latitude Summer Nighttime Anomaly FORMOSAT-3/COSMIC

The ionospheric mid-latitude summer nighttime anomaly (MSNA) is a recent discovered electron density structure featured by a greater nighttime electron density than daytime. It consists of the previously known anomaly in the southern hemisphere around South America-Antarctica region, i. e. Weddell Sea anomaly (WSA), and the recent observed anomaly in the northern hemisphere spanning in wider longitudes. The global three-dimensional observations taken by radio occultation soundings of FORMOSAT-3/COSMIC have provided the altitude-latitude electron density structure of the phenomenon. Based on the observed electron density structure, the MSNA is reproduced by the theoretical model indicating the importance of equatorward wind effect in production of the phenomenon before midnight hour. In later hours, the ionization structure is maintained by downward diffusion of ionization at higher altitude (plasmasphere) and could be sustained until 04:00 LT. In this presentation, we review the developments on studies of MSNA as well as the latest progress which indicates the zonal propagation of the phenomenon that was not originally expected.

-44 Overview about the Meridian Project

Chi Wang *(National Space Science Center, Chinese Academy of Scienc)*

Session: 5. Space Weather Meridian Session

Type of presentation: oral

Key word: Meridian Project space weather

To develop an understanding of near-Earth space’ s response to solar activities and the coupling among different layers in geospace, China has initiated a ground base program to monitor China’ s geospace environment. Called the Meridian Space Weather Monitoring Project (or Chinese Meridian Project), the effort consists of a chain of 15 ground-based observatories located roughly along 120°E longitude and 30°N latitude. Each observatory is equipped with multiple instruments to measure key parameters such as the baseline and time-varying geomagnetic field, as well as the middle and upper atmosphere and ionosphere from about 20 to 1000 kilometers. This project started collecting data in 2012. We will give a brief overview and recent advance of the Meridian Project. In order to promote international collaboration in space weather and enhance the ability of space environment monitoring worldwide, we propose the International Meridian Circle Program (IMCP) to connect 120ºE and 60ºW meridian chains of ground based monitors all over the world.

-45 Combining Models, Theory and Observations to Reconstruct CME and Shock Morphology

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Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: oral

Key word: Space Weather Coronal Mass Ejection

We present a full study of the four VarSITI campaign events of both the shock and CME driver. The events are measured in white-light images using a Graduated Cylindrical Shell (GCS) model for the ejecta and a spheroid shock model. The height measurements are combined with in-situ signatures and fit with an aerodynamic-drag model to determine the kinematics of each distinct front. These kinematic profiles are also compared to results derived from numerical models to test their accuracy and attempt to create an accurate empriical prediction model that captures the unique dynamics of each of event as well as the ambient medium that each CME is propagating through.

-46 Effects of major storm events of the current solar cycle over Europe

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: poster

Key word: ionosphere geomagnetic storm

The interaction between the Sun and upper atmosphere intensifies during space weather events such as CMEs (Coronal Mass Ejections) which significantly modify the spatial and temporal ionospheric structure. This is reflected on ionospheric characteristics which exhibit excursions from their median behaviour and therefore have to be studied in detail. During the present solar cycle, that is currently undergoing its maximum activity phase, a relatively limited number of such intense events was registered over Europe and is presented along with a quantitative demonstration of their effects on ionospheric characteristics such as peak ionospheric characteristics derived from ionosondes and LEO satellites through occultation measurements as well as GPS derived total electron content.

-47 Interplanetary shock characteristics and their geoeffectiveness

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: poster

Key word: Interplanetary shock Fast forward shock sudden impulse substorm onset

A statistical study of Interplanetary (IP) shock parameters is performed during the period of Jan 1998 to Jun 2013 in this work. Fast forward shocks are the most common type of shocks observed near 1 AU (about 70% of all analyzed 303 shocks). The amplitude of sudden impulses (SI, quantified by SYM-H index) and the substorm onset intensity (approximately represented by the decreasing of SML index) are analyzed to find their relation with each parameter of fast forward shocks. The square root dynamic pressure variation is showed the best correlation with SI (r=0.80). The orientation of IMF prior to IP shock may play a major role in triggering substorm by shocks. Further study is in progress to investigate the association between shocks and storms, and detailed analysis will be taken to find which physical mechanisms are taking effect in the geoeffectiveness of shocks.

-48 The Solar Wind in the Recent Solar Cycle

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Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: oral

Key word: solar wind solar cycle

The recent solar minimum was unusually long and unusually deep. This paper discusses the solar wind conditions during this solar minimum and in the ascending phase of the solar cycle and how they relate to solar wind observations over the past 50 years. The solar wind magnetic field was 20% less than observed during any previous solar cycle. The solar wind flux was lower than recent data but not as low as in the 1969 solar minimum. What is unusual is that the flux has not recovered as the solar cycle has progressed. The minimum in dynamic pressure is likewise not as low as in 1969, but the very low pressures have persisted much longer than during other solar cycles. We discuss the effects these low pressures have on the outer heliosphere as well for the solar wind interaction with Earth's magnetosphere.

-49 Global features of Kelvin-Helmholtz wave at the magnetopause for northward IMF

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Session: 1b. Origin, evolution, and Earth impact of high speed streams

Type of presentation: poster

Key word: Kelvin-Helmholtz wave magnetopause simulation

We investigate the global features of Kelvin-Helmholtz waves (KHW) at the low-latitude magnetopause for constant northward interplanetary magnetic field conditions, using global magnetohydrodynamic simulations. The root-integrated power (RIP) of X component of bulk velocity is employed to analyze the magnetopause mode of KHW along the boundary layer. The RIP distribution of the outer KHW is much broader than that of the inner one, and the maximum amplitude of global KHW occurs near the dawn/dusk terminator regions. In the dayside magnetopause, the phase of the waveform at middle latitudes leads to that at low latitudes, while the situation reversed in the nightside. The global evolution of KHW phases is a representation of an interesting feature that the axis of the Kelvin-Helmholtz vortex aligns with the geomagnetic field lines. We suggest that the reported features may also exist in other KHW active regions with flow-sheared plasma.

-50 3D morphological reconstruction of CMEs and CME-driven shocks from SECCHI COR and HI1 observations

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Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: oral

Key word: Coronal Mass Ejections 3D reconstructions

We have developed a mask fitting technique to derive the 3D morphology of a CME from the observations taken by SECCHI/COR and SOHO/LASCO. It allows us to derive the 3D CME without any a-priori shape assumption. This technique is now extended to the SECCHI/HI1 observations for not only CMEs but also the CME-driven shocks. The developed technique will be applied to one or two Sun-to-Earth MiniMax24 Events. The derived 3D morphology will be used to
study the dynamics and mass evolution of CMEs. The 3D shock morphology will be compared to the 3D shock reconstruction based on a bow-shock model. The relation between the CME and the CME-driven shock will be investigated.

-51 Responses of midlatitude ionosphere to the June 2013 geomagnetic storm

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Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: poster

Key word: ionosphere disturbanses geomagnetic storms

The ionospheric response in the midlatitude [43.25N, 76.92E] are investigated on the basis of observations from an groundbased iono-sonde during the June 2013 geomagnetic storm.

-52 A SOLAR TYPE II RADIO BURST FROM CME–CORONAL RAY INTERACTION: SIMULTANEOUS RADIO AND EXTREME ULTRAVIOLET IMAGING

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Session: 2c. Coronal and Interplanetary radio bursts including auroral kilometric radiation

Type of presentation: oral

Key word: solar radio burst CMEs

Simultaneous radio and extreme ultraviolet (EUV)/white-light imaging data are examined for a solar type II radio burst occurring on 2010 March 18 to deduce its source location. Using a bow-shock model, we reconstruct the three-dimensional EUV wave front (presumably the type-II-emitting shock) based on the imaging data of the two Solar TErrestrial RElations Observatory spacecraft. It is then combined with the Nan¸cay radio imaging data to infer the three-dimensional position of the type II source. It is found that the type II source coincides with the interface between the coronal mass ejection (CME) EUV wave front and a nearby coronal ray structure, providing evidence that the type II emission is physically related to the CME–ray interaction. This result, consistent with those of previous studies, is based on simultaneous radio and EUV imaging data for the first time.

-53 Measurements of 350 – 440 nm fluxes in solar flares

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Session: 2b. Origin of solar flares and their impact on Earth' s ionosphere/atmosphere

Type of presentation: poster

Key word: solar flares blue continuum

For a broad-band diagnostics of chromospheric flare plasma is highly desirable to analyze EUV spectra routinely provided by spectrometer EVE onboard of SDO as well as to get complementary spectra covering many spectral lines and various continuum features in the optical range. While the flare spectra are well detected on the background of the solar disk, the detection of flare line emission from the Sun-as-a-star in optical is much more difficult due to a strong background radiation. Supposing the flare/background radiation contrast is strong enough to be detected, we developed a device for measuring the flux from a selected part of the flaring region. Here we present a description of the post-focus instrument installed at the horizontal solar telescope of the Ondrejov observatory. It consists of a system of diaphragms, imaging H-alpha telescope and a spectrometer with dispersion of 3 px per Angstroem but with cadency reaching up to 50 frames per second. First data from solar flares observed recently are presented and analyzed. We discuss possibilities to use the measurements for short-time prediction of flares.

-54 Features and Shock Type of the Front Boundary Layers in Three Categories of ICMEs

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: poster

Key word: Interplanetary Coronal Mass Ejection Magnetic Cloud Complex Ejecta Boundary layer

Through analyzing boundary layer characteristics of interplanetary coronal mass ejections (ICME), this work investigates the physical features of the interaction between interplanetary coronal mass ejections and the adjacent solar wind. This work selects several ICME events observed by Wind at 1 AU, including five events of Single Interplanetary Coronal Mass Ejection (SICME), three events of Multi Interplanetary Coronal Mass Ejection (MICME) and four events of Complex Ejecta (CE). Having analyzed plasma beta (β), Magnetic field magnitude (B), proton density (Np), velocity of protons (V), proton temperature (Tp), total pressure (Ptotal), thermal pressure (Pth) and magnetic pressure (Pb), we can obtain the results that Ptotal, Pth, Pb, Np and V within the boundary layer of ICME conspicuously increases, with β greater than one and Tp almost isotropic in the boundary layer. The ratio (Tratio) of proton perpendicular temperature and parallel temperature is nearly 1 in the front boundary layers. And most of the proton temperature anisotropy trend is changed across the shock in front of the ICMEs. Among the 13 ICMEs boundary layers the temperature anisotropy varying across the shock, 9 shocks are parallel shocks and only 4 are perpendicular shocks. Thus the variation of the temperature anisotropy is corresponding to the parallel shocks, it satisfies the reported features that the parallel shocks tend to heat the solar wind.

-55 VarSITI: SCOSTEP’s new scientific program (2014-2018)

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Session: 2a. Long-term solar variability (magnetism, total irradiance, and spectral irradiance) and its impact on geospace and Earth

Type of presentation: oral

Key word: scientific program solar-terrestrial VarSITI

Previous SCOSTEP programs, namely CAWSES I and II, were devoted to elucidating the physical processes that connect changes in the Sun with features in the interplanetary space and geospace environment, down to the Earth’s atmosphere. Great progress was achieved towards this end, and towards the possibility of the worldwide research community being able to access international data sets, distributed sensor networks, virtual observatories, advanced computational and visualization facilities, the most sophisticated Sun-to-Earth community models available, and communication across disciplines and national boundaries.

During the last solar minimum, solar activity was extremely low for an extended period, and the present maximum of sunspot cycle 24 is the lowest in the last 100 years. It is not clear what long-term solar activity variations we can expect in the future: whether this is just the end of the recent 80 years of high solar activity, or whether Sun is entering a Maunder-type minimum. Moreover, it is not clear to what extent our present understanding of how the Sun influences the geospace -- which is based on instrumental observations taken during only the period of high solar activity in the second half of the 20th century -- will hold during periods of more moderate to low solar activity that may follow. And it is still more unclear how all this would affect global climate change, or the role played by various inputs penetrating from the Earth’s lower atmosphere to the ionosphere and plasmasphere.

The new SCOSTEP program “Variability of the Sun and Its Terrestrial Impact” (VarSITI) (2014-2018) will focus on the recent and expected future solar activity and its consequences for the Earth, for various times scales from the order of thousands of years to milliseconds, and for various locations and their connections from the solar interior to the Earth’s atmosphere. In order to elucidate these various Sun-Earth connections, much closer communications are needed between solar scientists (solar interior, atmosphere, and heliosphere) and geospace scientists (magnetosphere, ionosphere, and atmosphere).

Four scientific projects are carried out in the framework of the new SCOSTEP’s VarSITI program: (1) Solar Evolution and Extrema (SEE), (2) International Study of Earth-Affecting Solar Transients (ISEST/MiniMax24), (3) Specification and Prediction of the Coupled Inner-Magnetospheric Environment (SPeCIMEN), and (4) Role Of the Sun and the Middle atmosphere/thermosphere/ionosphere In Climate (ROSMIC). Details of these four projects will be presented, along with web pages, mailing lists and newsletters, campaign observations for particular intervals in collaboration with relevant satellite and ground-based missions as well as modeling efforts to facilitate the implementation of these projects. We will also discuss the collaboration with other on-going projects like the UN-based International Space Weather Initiative (ISWI), particularly for promoting VarSITI-related science in developing countries.

-56 Atomic oxygen in the mesopause region as derived from SCIAMACHY O(1S) green line measurements

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Session: 2a. Long-term solar variability (magnetism, total irradiance, and spectral irradiance) and its impact on geospace and Earth

Type of presentation: oral

Key word: atomic oxygen mesopause

A new dataset of atomic oxygen abundance in the upper mesosphere and lower thermosphere is presented. The data is derived from the nighttime atomic oxygen green line limb emission measurements of the SCIAMACHY (Scanning Imaging Absorption Spectrometer for Atmospheric CHartographY) instrument on the European Environmental Satellite (Envisat). The temporal coverage is October 2002 until April 2012 and the latitudinal extent is 50S to 60N at 10pm local time. This dataset is compared to other satellite datasets, in particular to recently published data of SABER (Sounding of
the Atmosphere using Broadband Emission Radiometry) and the Mass Spetrometer and Incoherent Scatter (MSIS) model. SCIAMACHY atomic oxygen peak abundances are typically 3–6 1e11 mol/cm3 at the atomic oxygen maximum region, depending on latitude and season. These values are similar to previous values based on chemiluminescence measurements of the atomic
oxygen three body recombination reaction, but at least 30% lower than SABER.
Annual mean differences of atomic oxygen densities between the maximum (2002) and minimum (2008) of the
23rd solar cycle reveal altitude-dependent variations of 5-25% being in phase with the solar flux.

-57 An overview on PRIC’ s UAP observation in the polar regions

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Session: 5. Space Weather Meridian Session

Type of presentation: oral

Key word: Polar Ionosphere Aurora

Chinese Zhongshan Station in Antarctica and Yellow River Station in Svalbard, conjugately located at cusp latitudes, are very ideal platforms for upper atmospheric physics (UAP) observation. Since 1995, PRIC has established an UAP observational system at Zhongshan station, under international cooperation with Nation Institute of Polar Research in Japan and with Newcastle University in Australia. With supports from Chinese Meridian Project and Polar Capability Project, UAP observational capability at Zhongshan Station has been greatly upgrade since 2010. Several new facilities, such as a SuperDARN radar, a multiple wavelength auroral imager system, a meridian auroral spectrograph and so on, were developed there. Since Yellow River station was set up in 2004, an auroral observational system has been established there. In this talk, we will present our progresses on UAP observations and related researches at above stations. And we will also introduce our new auroral observatory in Iceland and prospect our future opportunities on polar UAP observation.

-58 Response of the ionosphere and thermosphere to gravity waves from the lower atmosphere – Observations by the Optical Mesosphere-Thermosphere Imagers (OMTIs)

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Session: 3a. Geospace response to variability of the lower atmosphere

Type of presentation: poster

Key word: gravity wave mesosphere thermosphere ionosphere airglow

We show recent results about the response of the ionosphere and thermosphere to the gravity waves from the lower atmosphere, based on the observations of nocturnal airglow by the Optical Mesosphere Thermosphere Imagers (OMTIs). The OMTIs consist of thirteen all-sky cooled-CCD imagers, five Fabry-Perot interferometers (FPIs), three meridian scanning photometers, and four airglow temperature photometers. They measure two-dimensional pattern, Doppler wind, and temperature through airglow emissions from oxygen (wavelength: 557.7 nm) and OH (near infrared band) in the mesopause region (80-100 km) and from oxygen (630.0 nm) in the thermosphere/ionosphere (200-300 km). They are in automatic operation at 13 stations at Australia, Indonesia, Thailand, far-east Russia, Japan, Canada, Hawaii, and Norway. Station information and quick look plots are available at http://stdb2.stelab.nagoya-u.ac.jp/omti/. In this presentation we show recent results obtained by OMTIs particularly related to the gravity-wave penetration to the mesosphere, thermosphere, and ionosphere, and interaction of ionospheric plasma structures, such as medium-scale traveling ionospheric distuebances and plasma bubbles, with gravity waves.

-59 Microwave signatures in the pre-impulsive phase of a solar flare

[1]Zhao Wu, [1]Yao Chen, [2]Guangli Huang, [3]Gang Li *([1]Shandong University, [2]Purple Mountain Observatory, [3]University of Alabama in Huntsville)*

Session: 2c. Coronal and Interplanetary radio bursts including auroral kilometric radiation

Type of presentation: poster

Key word: microwave dimming magnetic null microwave islands

In this study we focus on the microwave signatures at the pre-impulsive phase of solar flares, by examining simultaneous radio-EUV imaging data obtained with Nobeyama Radioheliogragh (NORH) and Atmospheric Imaging Assembly / Solar Dynamics Observatory (AIA/SDO) for the M7.7 flare on 2012 July 19. The corresponding thermal bremsstrahlung emission was deduced on the basis of the temperature and column density values given by the SDO Differential Emission Messure (DEM) method. Then we obtained the non-thermal gyrosynchrotron emission profile by removing the thermal contribution from the NORH data at 17/34 GHz. We find that there was a dimming region at the cusp of the flare loop, corresponding to a maximum of hard X-ray emission observed by RHESSI, possibly caused by the presence of a magnetic null at the loop cusp. In addition, we also discovered several local maximum of microwave emission (termed as microwave islands) in the corona, possibly emitted by energetic electrons accelerated and confined within magnetically-closed structures (e.g., magnetic islands formed by magnetic reconnections). This is the first time such microwave features was reported.

-60 QUASI-PERIODIC VARIATIONS OF LOW ENERGY COSMIC RAYS.

Karel Kudela *(IEP SAS, Kosice, Slovakia)*

Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: cosmic rays quasi-periodicities

Temporal changes of the cosmic ray (CR) flux on Earth are measured and analyzed since the discovery of CR. Along with irregular strong changes as Forbush decreases and SEP/GLE events are, the CR time series show also quasi-periodic (QP) variations. We present a review on selected results on QP variations of CR mainly according to some papers published on the topic in the past few years. Power spectrum density (PSD) of the CR time series at a single ground based CR station has rather complicated character. Shape of PSD and QPs occurring there, important for modulation and for checking links of CR to space weather/space climate effects, are discussed. Earth’ s and solar rotation along with solar activity, IMF, solar wind and status of the magnetosphere and atmosphere above the detector, are behind formation of QP observed in secondary CR on the Earth’ s surface. Wavelet spectra are useful tool for checking the fine strucure of QPs and their temporal evolution. Neutron monitors and muon telescopes provide the informations about QPs in CR. In addition, in recent years there are new installations on the ground from which the unique information about CR variability can be deduced (higher statistical accuracy, different response function to primaries). We attempt to summarize the current knowledge on selected QPs in CR flux in the energy range of primaries above that of atmospheric threshold (e.g. diurnal variation and its harmonics, ~ 27 day QP ; Rieger periodicity; quasi-biennal oscillations; QPs on longer time scales observed from direct measurements) and to discuss the consequences. Few open questions and some tasks for future studies are listed too.

-61 TIDAL WIND MAPPING FROM OBSERVATIONS OF A METEOR RADAR CHAIN

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Session: 5. Space Weather Meridian Session

Type of presentation: oral

Key word: Meteor Radar MLT wind observation upper atmospheric tides Hough mode

This article proposes a technique to map the tidal winds in the mesosphere and lower ther-mosphere (MLT) region from the observations of a four-station meteor radar chain located at middle- and low-latitudes along the 120 °E meridian in the Northern Hemisphere. A 3 year dataset of the horizontal winds in the altitude range of 80 - 100 km is observed during 2011 - 2013. We _rst decompose the tidal winds into mean, diurnal, semidiurnal, and terdiurnal components for each station. It is found that the diurnal/semidiurnal components dominate at the low-latitude/midlatitude stations. Their amplitudes increase at lower altitudes and then decrease at higher altitudes after reaching a peak in the MLT region. Hough functions of the classical tidal theory are then used to _t the latitudinal distribution of each decomposed com- ponent. The diurnal component is found to be dominated by the _rst symmetric (1, 1) mode. Yet for the semidiurnal and terdiurnal components, the corresponding dominant modes are the second symmetric modes (2, 4) and (3, 5), and considerable contributions are also from the _rst antisymmetric modes (2, 3), (3, 4) and second antisymmetric modes (2, 5), (3, 6). Based on the decomposed results, we further map the horizontal winds in the domains of latitude, altitude and local time. The mapped horizontal winds successfully reproduce the local time versus altitudinal distributions of the original observations at the four stations. Thus, we conclude that the meteor radar chain is useful to monitor and study the regional characteristics of the tidal winds in the MLT region.

-62 Mild Space Weather during Solar Cycle 24

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: Space weather Coronal Mass Ejections Geomagnetic Storms Solar Energetic Particle Events

Solar Cycle 24 is very weak as indicated by the lowest sunspot number in the space age. In particular, the sunspot number has declined by ~40% compared to cycle 23. On the other hand, the CME and flare rate did not drop that much. The number of high energy (>500 MeV), large solar energetic particle (SEP) events and large geomagnetic storms (Dst ≤-100 nT) have also been the lowest in the space age. Since CMEs are responsible for these two space weather events, we explore CME properties that might explain the mild space weather in cycle 24. By examining the properties of CMEs originating close to the limb, we found that the CMEs of cycle 24 show anomalous expansion compared to the cycle-23 CMEs. The CME expansion can be explained by the altered properties of CMEs in cycle 24. In particular the total pressure decreased significantly in cycle 24, making the CMEs attain a larger size for pressure balance. In-situ heliospheric data from Sun-Earth L1 confirm the unusually low heliospheric total pressure during solar cycle 24. The expansion leads to a reduced magnetic content of CMEs observed at 1 AU resulting in weaker and less frequent geomagnetic storms. The magnetic field strength in the heliosphere and the ambient Alfven speed also decreased significantly in cycle 24. The drop in Alfven speed makes it easy to form shocks and explains why the frequency of large solar energetic particle events in cycle 24 is similar to that in cycle 23. The reduced ambient magnetic field reduces the efficiency of particle acceleration by shocks, explaining the lack of higher energy particle events. Finally, the reduced heliospheric magnetic field also reduces the field strength in shock sheaths and CIRs explaining the weaker CME sheath storms and CIR storms.

-63 Optical and ULF/ELF/VLF wave measurements at longitudinally-distributed stations at subauroral latitudes

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: poster

Key word: subauroral latitudes EMIC wave chorus wave radiation belts

The keV-MeV-energy particles in the inner magnetosphere drift around the Earth due to gradient and curvature of the magnetic field with time scales from tens of minutes to hours. In order to understand the acceleration and loss of these particles in the inner magnetosphere, it is important to monitor particle and wave activities using longitudinally-distributed ground stations. For this purpose, we install all-sky aurora/airglow imagers with cooled-CCD detectors, 64-Hz sampling induction magnetometers, and 20-100 kHz sampling loop antennas at subauroral latitudes. These instruments monitor aurora/airglow and ULF/ELF/VLF wave activities. Some instruments have been in automatic operation at Athabasca (54.7N 246.7E, L=4.4) in Canada and Paratunka (53.0N, 158.2E L=2.1) and Magadan (60.1N, 50.7E, L=2.6) in Far-eastern Russia. New instruments will be installed at Fredericton (46.4N, 292.6E, L=3.2) in Canada and at Zhigansk (66.8N, 123.4E, L=3.4) in Siberian Russia in 2014-2015. These longitudinal chain stations at subauroral latitudes give a great opportunity to monitor particle dynamics and ULF/ELF/VLF waves in the inner magnetosphere on a global scale. In this presentation we report several initial results on waves and auroras observed by these instruments to show their measurement capability at subauroral latitudes.

-64 Middle-latitude auroras observed at Kamchatka during the three geomagnetic storms of March 9, 2012 and March 17 and June 1, 2013

[1]Kazuo Shiokawa, [1]Yuichi Otsuka, [1]Shin Suzuki, [2]Sergey Smirnov, [2]Boris M. Shevtsov *([1]Solar-Terrestrial Environment Laboratory, Nagoya University, [2]Institute of Cosmophysical Research and Radiowaves Propagation (IKIR))*

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Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: oral

Key word: campaign data analysis middle-latitude aurora

We report three events of red auroras observed at Paratunka (53.0N, 158.2E, dipole magnetic latitude: 45.8) in the Kamchatka region in far-eastern Russia. The auroras were observed at 08 UT (17 LT) on March 9, 2012, 15-18 UT (00-03 LT) on March 17, 2013, and at 11-13 UT (20-22 LT) on June 1, 2013. These auroras were observed in the northern sky of Paratunka mainly in the 630-nm airglow images during the main and recovery phase of geomagnetic storms. This fact suggests that they are the Stable Auroral Red arcs occurring through interaction between plasmaspheric low energy electrons and ring-current hot ions. For the event of March 17, 2013, some ray-like longitudinal structures are recognized in the auroral images, indicating there are some fine-scale structures in the interaction in the inner magnetosphere.

-65 Global thermospheric disturbances during a solar flare: Modeling study

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Session: 2b. Origin of solar flares and their impact on Earth’ s ionosphere/atmosphere

Type of presentation: oral

Key word: solar flare thermospheric disturbance theoretical model

This study focuses on the global thermosphere disturbances during a solar flare by a theoretical model of thermosphere and ionosphere. The simulated results show significant enhancements in thermospheric density and temperature in dayside hemisphere. The greatest thermospheric response occurs at sub-solar point, which shows the important effect of solar zenith angle. The results show that there are also significant enhancements in nightside hemisphere. There is significant latitude dependence for nightside thermospheric response. It almost synchronizes with dayside in polar region and high latitudes, but is later at lower latitudes. The greatest nightside response occurs around anti-solar point about 4 hours after solar flare onset. The nightside thermosphere disturbance is induced by the change of global circulation of thermosphere gas. The disturbances of global thermosphere circulation transfer the mass and energy at dayside hemisphere to nightside hemisphere. Thermospheric response to a solar flare mainly depends on the total integrated energy into the thermosphere, not the peak value of EUV flux.

-66 Geomagnetic Activity Effect on the Global Ionosphere during 2007–2009 Deep Solar Minimum

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Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: oral

Key word: Geomagnetic activity effect Ionosphere Deep solar minimum

In this paper the significant effect of weaker geomagnetic activity during 2007–2009 deep solar minimum on ionospheric variability on the shorter-term timescales of several days was highlighted via investigating the response of daily-mean global electron content (GEC, the global area integral of TEC derived from ground-based GPS measurements) to geomagnetic activity index Ap. Based on a case during the deep solar minimum, the effect of the recurrent weaker geomagnetic disturbances on the ionosphere was evident. Statistical analyses indicate that the effect of weaker geomagnetic activity on GEC variations on shorter-term timescales was significant during 2007–2009 even under relatively quiet geomagnetic activity condition; daily-mean GEC was positively correlated with geomagnetic activity. However, GEC variations on shorter-term timescales were poorly correlated with geomagnetic activity during the solar cycle descending phase of 2003–2005 except under strong geomagnetic disturbance condition. Statistically the effects of solar EUV irradiance, geomagnetic activity, and other factors (e.g., meteorological sources) on GEC variations on shorter-term timescales were basically equivalent during 2007–2009 solar minimum.

-67 Simulated equinoctial asymmetry of the ionospheric vertical plasma drifts

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Session: 3a. Geospace response to variability of the lower atmosphere

Type of presentation: oral

Key word: equinoctial asymmetry plasma drift

This paper studies the influence of the lower thermospheric tidal winds below 105 km on the equinoctial asymmetry of the equatorial vertical E×B plasma drifts (V) using TIDM-IGGCAS-II model and tidal winds below 105 km from TIMED/TIDI observations. Although a series of other non-migrating tides also affect the V asymmetry, the simulated equinoctial asymmetry in V are mainly driven by the migrating diurnal tide (DW1), migrating semidiurnal tide (SW2), DE3, and DW2 non-migrating tides. The asymmetry in daytime V⊥ varies with local time and longitude, and mainly shows three features. First, the simulated daytime V⊥ during March Equinox is larger than that during September Equinox in most of longitudinal sectors. This asymmetry is mainly driven by the semiannual oscillation (SAO) of the migrating diurnal tide in the tropical MLT region, and the equinoctial asymmetry of the migrating semidiurnal tide also play an important role in the generation of this asymmetry. Second, the daytime V⊥ asymmetry in Eastern Hemisphere is more significant than that in Western Hemisphere. Our simulation suggests that the longitudinal variation of the geomagnetic fields and DW2 tides play important roles in the generation of this hemisphere difference. Thirdly, there is an obvious wavenumber-4 longitudinal structure in the V asymmetry. Our simulation suggests that this wavenumber-4 structure is mainly driven by the equinoctial asymmetry of the DE3 tide.

-68 DIRECT OBSERVATIONS OF MAGNETIC FLUX ROPE FORMATION DURING A SOLAR CORONAL MASS EJECTION

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: poster

Key word: Coronal Mass Ejection Magnetic Reconnection Flare

Coronal mass ejections (CMEs) are the most spectacular eruptive phenomena in the solar atmosphere. It is generally accepted that CMEs are results of eruptions of magnetic flux ropes (MFRs). However, a heated debate is on whether MFRs pre-exist before the eruptions or they are formed during the eruptions. Several coronal signatures, e.g., filaments, coronal cavities, sigmoid structures and hot channels (or hot blobs), are proposed as MFRs and observed before the eruption, which support the pre existing MFR scenario. There is almost no reported observation about MFR formation during the eruption. In this presentation, we present an intriguing observation of a solar eruptive event with the Atmospheric Imaging Assembly on board the Solar Dynamic Observatory, which shows a detailed formation process of the MFR during the eruption. The process started with the expansion of a low lying coronal arcade, possibly caused by the flare magnetic reconnection underneath. The newly-formed ascending loops from below further pushed the arcade upward, stretching the surrounding magnetic field. The arcade and stretched magnetic field lines then curved-in just below the arcade vertex, forming an X-point. The field lines near the X-point continued to approach each other and a second magnetic reconnection was induced. It is this high-lying magnetic reconnection that led to the formation and eruption of a hot blob (~ 10 MK), presumably a MFR, producing a CME. We suggest that two spatially-separated magnetic reconnections occurred in this event, responsible for producing the flare and the hot blob (CME), respectively.

-69 Coronal Type Ⅱ Radio Bursts Associated with Helmet Streamers and Electron Acceleration in a Streamer-Shock System

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Session: 2c. Coronal and Interplanetary radio bursts including auroral kilometric radiation

Type of presentation: oral

Key word: Type Ⅱ radio bursts Shock electron acceleration

Solar type Ⅱ radio bursts are excited by energetic electrons accelerated at coronal eruption-driven shocks. Streamers are quasi-steady and dense, and magnetically-closed structures in the corona, where the Alfven speed is much lower and plasma outflow is much slower than that of the surroundings, therefore are expected to facilitate the formation/enhancement of shocks. In recent studies, streamers have been suspected to be important on the generation of type Ⅱ radio bursts and the morphology of radio dynamic spectra. In this study, we first present two type Ⅱ burst events in which the type Ⅱ ends at the time of the CME front (shock) passing by the streamer tip (cusp). We conjecture that the large-scale closed magnetic field of the streamer may be important to electron acceleration at coronal shocks and excitation of type Ⅱ bursts. To validate this physical insight, we develop a streamer-shock model consisting of a streamer and an outward-propagating shock, and perform a test particle simulation. It show that only those electrons that are injected within the closed field regions can be accelerated efficiently, and the trapping effect via closed field lines allows the trapped electrons to return to the shock front multiple times and be repetitively accelerated. We suggest that the scenario may be potentially important to the generation of more metric type Ⅱs considering the fact that most solar eruptions originate from closed field regions.

-70 Temporal Spectral Shift of Band-splitting Type Ⅱ Solar Radio Bursts

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Session: 2c. Coronal and Interplanetary radio bursts including auroral kilometric radiation

Type of presentation: poster

Key word: Type Ⅱ Solar Radio Bursts Band-splitting

It is well known that the fundamental and\or harmonic branches of type Ⅱ solar radio bursts may get split into two almost-parallel bands with similar spectral shape and frequency drift. Mechanisms accounting for this intriguing phenomenon remain unknown. In this study, we report a novel observational finding of temporal spectral shift of type Ⅱ splitting bands, providing further observational constraint on the underlying physics. The temporal spectral shift can be defined when correlated spectral features such as intensity variations and shape changes appear systematically at an earlier or later time in one band than the other. Two events were examined to reveal/define this observational finding. An overall temporal shift of several to more than ten seconds is observed. The temporal shift directions are opposite for the two events of study. Physical implications of this finding are discussed

-71 How "stealthy" can be Earth-affecting eruptions?

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Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: oral

Key word: Coronal Mass Ejections EUV Observations

During the extended solar minimum preceding Cycle 24, the Solar and Terrestrial Relations Observatory (STEREO) revealed CMEs that left no low coronal signatures as viewed against the solar disk. These events are called stealth CMEs, although this name can be loosely used as is often the case with solar physics research. The lack of low coronal signatures may have resulted from the limited capability of the EUV imager. Now with the improved sensitivity, cadence and temperature coverage of the Atmospheric Imaging Assembly (AIA) on board the Solar Dynamics Observatory, combined with additional view angles by STEREO, we may be able to rescue some of the CMEs from the stealthy category. We showcase the 2012 October 5 CME (a VARSITI/ISEST campaign event) and discuss how stealthy Earth-affecting CMEs can be.

-72 ST radar in Kunming and its gravity wave observation results

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Session: 3c. Regional, hemispheric and inter-hemispheric couplings and transport in the atmosphere

Type of presentation: poster

Key word: ST radar Gravity wave

The stratosphere is the most stable region of the Earth’ s atmosphere. Many observational techniques have been applied to investigate gravity waves in this region including balloon soundings, rocket studies, lidar studies, and aircraft-based instruments and so on. But in the troposphere there has deep convection processes by different forms of motion in the atmosphere which are governed by the fundamental physical laws of conservation of mass, momentum and energy. Due to the restriction of observation instrument, the studies about gravity waves in the troposphere are less than other regions. The VHF radar measurements can be divided into the ST (Stratosphere-troposphere) radar and MST (Mesosphere-stratosphere- troposphere) radar according to the height.

In attempt to study the dynamics of the MLT region in lower latitude over China, the Kunming atmosphere radar facility (KARF) consisting of a MF radar, an all-sky meteor radar and a ST Doppler radar with meteor radar capability was installed at Kunming Radio Observatory (25.6N, 103.8E), 130 km north-east of Kunming, which is the capital city of Yunnan Province. So far, ST radar, working on the frequency of VHF, plays an important role of study on wind, waves and atmosphere turbulence in the area of 5-22.1 km.

Because the gravity wave has its origin in Stratosphere-troposphere region, it is the most wave motion in this area. The data of September 2011 observed by ST radar DBS technique with time and vertical resolution of 5 seconds and 300 meters, respectively, were used in this work to investigate the gravity wave. The data analysis methods involve wavelet analysis, which was applied at every height and day. We have found a few events with the wavelength of about 3.5 km and period of about 1 hour

-73 Study of the Geo-effectiveness and GCR-effectiveness of ISEST/MiniMax ICMEs of March 17 and June 01, 2013

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Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: poster

Key word: ISEST/MiniMax ICMEs Geo-effectiveness GCR-effectiveness

We study the geomagnetic and galactic cosmic ray (GCR) response of ISEST/MiniMax ICMEs of 2013. In this study we use the high time resolution interplanetary plasma/field data of solar wind velocity, IMF strength, its north-south component, field variance, electric field, solar plasma density, and temperature and plasma beta during the passage of these ICMEs. Using time variations/fluctuations in these parameters, we identify distinct features of ICMEs during their passage. To study the geo-effectiveness and GCR-effectiveness of these structures, we analyze the high time resolution data of geomagnetic indices and neutron monitors with the simultaneous and same time resolution data of interplanetary plasma and field. From these analyses we attempt to identify features of ICMEs and solar wind parameters during their passage when geo-effectiveness is at its maximum and minimum level. Similarly we identify the features of ICMEs and solar wind parameters during their passage when GCR intensity is affected to its maximum and minimum level. We discuss the similarities and distinctions in the geo-effectiveness and GCR-effectiveness of the same ICME structure in the light of plasma/field variations and physical mechanism(s) playing important role in influencing the geomagnetic activity and GCR intensity. We search for the role, if any, particularly of field fluctuations, plasma beta, and density in influencing solar wing-magnetosphere coupling leading to the geo-effectiveness of ICMEs. The role of field variance (turbulence) in GCR-effectiveness is specially investigated during these events. These results are utilized to identify the model(s) that best explain the geo-effectiveness and GCR-effectiveness.

-74 On solar-cycle variation of subsurface kinetic helicity

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Session: 2a. Long-term solar variability (magnetism, total irradiance, and spectral irradiance) and its impact on geospace and Earth

Type of presentation: oral

Key word: subsurface kinetic helicity solar cycle variation hemispheric helicity sign rule time-distance helioseismology 3D MHD dynamo model

This study investigates the solar-cycle variation of subsurface kinetic helicity. Previous observations on current helicity have shown that hemispheric helicity sign rule is observed on the photosphere and shows solar-cycle variation. This is in contradiction with the sigma-effect model that predicts no solar-cycle variation of hemispheric helicity sign rule. To save this model, here we check one fundamental assumption of this model, that is, there is no solar-cycle variation of subsurface kinetic helicity. We use flow maps either obtained through 3D MHD dynamo models or inverted using local helioseismology time-distance method. We show that both in the dynamo model and by helioseismology observation indeed no solar-cycle variation of kinetic helicity is present.

-75 The effect of non-radial magnetic field on measuring helicity transfer rate

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: solar activity magnetic field magnetic helicity measurement

It is generally believed that the evolution of relative magnetic helicity has a close relationship with solar activities. Before the launch of SDO, when calculating relative magnetic helicity transport rate using photospheric magnetograms, previous studies have mostly used MDI/SOHO line-of-sight magnetic field data and supposed that the magnetic field is radial. However, this hypothesis is not strictly true. Here we use vector magnetic field and line-of-sight magnetic field data, both taken by HMI/SDO, to estimate the effect of non-radial magnetic field on measuring helicity transfer rate. Three active regions, namely NOAA 11072, 11084 and 11158, are studied. The main results are as follows: 1) The effect of non-radial magnetic field on estimating transverse velocity is relatively small. 2) On estimating the magnetic helicity transfer rate, the effect of non-radial magnetic field is strong when active regions are observed near the limb and is relatively small when active regions are close to disk center. 3) The effect of non-radial magnetic field becomes minor if the accumulated amount of magnetic helicity is the only concern. This removes (at least partially) the concerns on results of previous studies that had used MDI/SOHO data and assumed that the magnetic field is radial.

-76 Fine Structures of Microwave Bursts on 15 February 2011 Event in AR 11158

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Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: oral

Key word: solar flare solar radio burst

The GOES X2.2 flare on 15 February 2011 occurred in the active region NOAA 11158 at 01:56:50 UT. We study two groups of microwave type U and reverse-slope (RS) bursts during the decay phase of the X2.2 flare. We extrapolated the non-linear force-free magnetic field in AR NOAA 11158 and found that these bursts can be interpreted as the result of a new reconnection process between the two similar-scaled loops.

-77 On Chinese Spectral Radioheliograph for Space Weather Studies

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Session: 2c. Coronal and Interplanetary radio bursts including auroral kilometric radiation

Type of presentation: oral

Key word: solar radio radioheliograph

Radio imaging spectroscopy over wide range wavelength in dm/cm-bands will open new windows on solar flares and coronal mass ejections by tracing the radio emissions from accelerated electrons. The Chinese Spectral Radioheliograph (CSRH) with two arrays in 400MHz-2GHz /2-15GHz ranges with 64/532 frequency channels have just been established to reach this goal. We will introduce the progress and current status of CSRH. Some preliminary results of CSRH will be presented.

-78 Energetics Characteristics of the Super Magnetic Storm on November 20, 2003: Based on 3D Global MHD Simulation

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Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: poster

Key word: energy budget super storm

The three-dimensional global magnetohydrodynamic model (PPM-LR MHD) is employed to investi-gate the energy budget in the solar wind – magnetosphere system during the super magnetic storm on November 20, 2003, one of the biggest storms during last decade with the Dst ~ -500 nT. During this event, about 23% solar wind kinetic energy is transferred into the magnetosphere. The total energy input is estimated to be about 9.50×1017 J, about 14 times of a moderate storm. The energy dissipation via the inner magnetosphere is less than the energy input with the coupling efficiency of ~63.3%. The energy dissipated via ring current injection is less than that via high-latitude ionosphere at the initial stage of the super storm. Furthermore, both the simulation results and the empirical results indic-ate that the ratio of ring current injection to the total energy output increases with the enhancement of the magnetospheric activity level. These are consistent with the statistical results we have got before. The empirical equations underestimate the solar wind kinetic energy, the energy input, and the energy dissipation via high-latitude ionosphere compared with the simulation results, however, the coupling efficiency of the high-latitude ionosphere (23.4%) is close to the simulation result (23.1%) during the entire storm time period.

-79 Atmospheric studies with the O+ 732.0 and 733.0 nm airglow emissions as observed with the Wind Imaging Interferometer (WINDII) on the Upper Atmosphere Research Satellite

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Session: 3c. Regional, hemispheric and inter-hemispheric couplings and transport in the atmosphere

Type of presentation: oral

Key word: ionized atomic oxygen airglow emission

This presentation is of newly analyzed observations of ionized atomic oxygen dayglow emission as observed with the Wind Imaging Interferometer (WINDII) on the Upper Atmosphere Research Satellite, launched in 1991. Remote sensing of airglow emission has proven to be a powerful tool for atmospheric studies, yielding derived quantities such as constituent concentrations, temperatures and winds. The available airglow wavelengths are limited and most have been exploited over past decades. One of those identified early on were the O+ (2P – 2D) doublets at 732.0 and 733.0 nm (among other O+ emissions). An attractive feature of the emission is that it is produced dominantly by photoionization from the ground state of neutral atomic oxygen. Since the solar flux is known, and the quenching rate can be calculated, the atomic oxygen concentration can be determined in a strictly unambiguous way. This is not so for many airglow emissions, where more than one process is involved. However the use to date of this O+ emission for this purpose has yet to match its full potential and this presentation reports on some initial progress in that direction. WINDII had incorporated a filter primarily intended for observations of the hydroxyl P1(2) line that also transmitted the O+ 732.0 and 733.0 nm emissions. The original processing implementation for extracting the latter emissions produced invalid results. The first corrected results are presented here, and compared with simulations by the Canadian Ionosphere and Atmosphere Model (C-IAM). Reasonable agreement is obtained, in terms of vertical profiles, solar flux and solar zenith angle variations. Observations presented demonstrate that conjugate photoelectrons do not contribute to the excitation of this emission. This paves the way for the determination of atomic oxygen concentrations. It is expected that it will be possible to determine ion winds from these data.

-80 Different Electron and Proton Onset Times of SEP Events

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: Solar Energetic Particles Electron and Proton Onset Times

We study large solar energetic particle (SEP) events with >10 MeV proton flux observed by GOES during solar cycle 24. Using multi-spacecraft observations from STEREO A, B and SOHO, we are able to determine accurately the solar release time (SRT) of SEP electrons and protons. We first compute connection angles (CA) between the solar events and foot-points of spiral magnetic field lines for each spacecraft. By choosing the smallest CA, we derive the electron and proton SRTs using electron fluxes from the SOHO Electron Proton and Helium Instrument (EPHIN) in three high-energy channels (0.25 – 0.70 MeV, 0.67 – 3.00 MeV, and 2.64 – 10.4 MeV), proton fluxes from the SOHO Energetic and Relativistic Nuclei and Electron instrument (ERNE) in (25 – 32 MeV, 50 – 67 MeV, 64 – 80 MeV, 80 – 101 MeV), and from the High Energy Telescope (HET) on STEREO in similar high-energy channels. We find that the proton SRTs inferred from high-energy channels (> 50 MeV) are similar to electron SRTs; the proton SRTs inferred from low energy channel (25 – 32 MeV) can be delayed from the electron SRTs from tens of minutes to hours, especially for SEPs with large pre-event flux levels, suggesting that low-energy protons might be trapped for a long time or suffer more scattering than high-energy protons. We also find that for large SEP events (most GLE events), the observed EPHIN electron fluxes have a double-peak feature whose onsets correspond well to the associated metric Type II and DH Type II onsets respectively.

-81 Study of Earth-affecting Solar CMEs: A Report from ISEST/Minimax24 Working Group 4 on Campaign Events

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Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: oral

Key word: Coronal Mass Ejections Corona Space Weather

We report on the progress and future plans of the ISEST/Minimax24 WG4 dedicated to the study of campaign events. The participants attempt to integrate theory, simulations and observations to understand the chain of cause-effect activities from the Sun to Earth for a small number of carefully selected events. Textbook cases (standard events) from the Sun to Earth are provided to the other ISEST Working Groups and to the community at large. WG4 will also examine controversial events, such as stealth CMEs and problem ICMEs, to better understand the propagation of such events. WG4 will also interact with other VarSITI projects, especially the VarSITI-wide campaign studies.

-82 Effects of High-Speed Solar Wind Streams on the Magnetosphere and Ionosphere/Thermosphere: Similarities and Differences

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Session: 1b. Origin, evolution, and Earth impact of high speed streams

Type of presentation: oral

Key word: High speed solar wind stream solar wind-magnetosphere-ionosphere coupling

High-speed solar wind stream (HSS) has been well recognized as one of the leading causes of geomagnetic disturbances. There is ample observational evidence showing the effects of HSS on thermospheric density and composition as well as on magnetospheric energetic particles. However, it is yet to be understood how exactly energies are being transferred from the solar wind and dissipated into the magnetosphere and ionosphere/thermosphere during HSS events. The paper will discuss the similarities and differences between the magnetosphere and the ionosphere in response to HSSs. It will also address the important issue concerning the energy coupling efficiency between the solar wind and magnetosphere/ionosphere during HSSs, which will be compared to those CME-driven events to shed new lights on the coupling processes between the solar wind and magnetosphere-ionosphere under the different solar wind conditions.

-83 Solar cycle and seasonal variability of CO and CO2 in the mesosphere and lower thermosphere: MIPAS and ACE-FTS observations and WACCM simulations

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Session: 3b. Trends in the entire atmosphere, including anthropogenic aspects

Type of presentation: oral

Key word: CO CO2 Solar cycle Mesosphere Lower Thermosphere MIPAS ACE-FTS WACCM

In a recent paper (Garcia et al., J. Geophys. Res., doi:10.1002/2013JD021208, 2014) we used the Whole Atmosphere Community Climate Model (WACCM) to calculate the distribution of CO2 and CO in the mesosphere and lower thermosphere (MLT), and compared the results with observations from the ACE-FTS and MIPAS satellite-borne instruments taken during the solar minimum of 2007-2009. Here we will focus on the analysis of the solar cycle and seasonal variability of the CO and CO2 measurements in the mesosphere and lower thermosphere taken by MIPAS (2002-2012) and ACE-FTS (2004-2013), and WACCM simulations performed for the last three solar cycles. Discussions of the secular trends in that period will also be briefly presented.

-84 The measurement results of O2(0-1) airglow at 94km altitude by GBAII

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Session: 2b. Origin of solar flares and their impact on Earth' s ionosphere/atmosphere

Type of presentation: oral

Key word: Airglow upper atmospheric wind velocity temperature volume emission rate

A ground-based airglow imaging interferometer (GBAII) is proposed to measure simultaneously the temperature and wind in the mesopause region by using airglow emissions of the O2(0–1)band in our group. Since it employs a wide angle Michelson interferometer with a large air gap, combined with the rotational temperature measurement, both the phase and spectral information can be obtained from the imaging results. Based on the optimization and calibrations for the optical system in the laboratory, we developed and assembled a prototype of a GBAII, and carried out many times observation at the observatory of Xi' an University of Technology teaching buildings. For example, the observed temperatures fall mainly on the range of 167–196 K on 12 June 2012, while both the zonal and meridional winds faintly show the feature of half-day oscillation. The consistent trends between the observation results and the standard atmospheric models suggest that the GBAII has achieved our basic design goals.

The volume emission rate (VER) of O2(0-1) night airglow is studied according to the Barth mechanism in this work: The VER O2(0-1) airglow is calculated to be 4041 photons cm-3.s-1 at altitude of 94km above sea level. The airglow emission can be decayed from radiation position to ground-based instrument and its transmittance of O2(0-1) airglow is calculated to be 0.24, so that the theoretical value of VER O2(0-1) airglow is 970 photons cm-3.s-1 before into the detector. The VERs of O2 (0-1) airglow are detected to be 887 and 928 photons cm-3.s-1 by GBAII two times test on 12 June 2012 and 6 Dec 2013. The relative errors are 8.5% and 4.3% respectively.

-85 The Height of Coronal Mass Ejections at the Onset of Metric Type II Bursts

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Session: 2c. Coronal and Interplanetary radio bursts including auroral kilometric radiation

Type of presentation: oral

Key word: Coronal Mass Ejections Metric Type II Radio Burst Solar Corona

The onset of metric type II bursts, which can be observed remotely by radio instruments, provides us the first indication of a shock front propagating in the solar corona. Coronal mass ejections (CMEs) have been suggested to be the driver of the coronal shocks. Therefore, the height of the CME at the onset of the metric type II radio burst can be used to estimate the formation height of the shock. We estimate the CME height by assuming that CMEs accelerate from rest to its final speed (the projection corrected speed of the CME) during a period starting at the flare onset time and ending at the flare peak time, after which they propagate with a final speed. Using this flare-onset method Gopalswamy et al. (2012) found the CME height at metric type II burst onset with mean and median values of 1.53 Rs and 1.47 Rs for the cycle 23 ground level enhancement (GLE) events. We have expanded this study to include all major non-GLE solar energetic particle (SEP) events. We found that the average and median height of non-GLE associated CMEs at the onset of the metric type II to be 1.73 Rs and 1.61 Rs, respectively. For cycle 24 SEP events we compared the heights from the flare-onset method to that obtained by fitting a 3-D spherical shock model to EUV and white-light images provided by the imaging instruments on the STEREO, SOHO and SDO spacecraft. The correlation coefficient (CC) between the heights of the flare-onset method and the spherical shock method was reasonably good, CC=0.68. We also compared the average and median shock heights during cycle 23 and cycle 24. The average height during cycle 23 (cycle 24) was 1.78 Rs (1.59 Rs) and the median height 1.61 Rs (1.45 Rs), respectively. The lower formation height of the shocks during cycle 24 suggests a change in the Alfven speed profile because (a) the solar magnetic fields are weaker; (b) the plasma density levels are closer to the surface during cycle 24.

Reference: Gopalswamy, N. et al. 2012, Space Sci. Rev. 171, 23.

-86 Superflares on Solar type Stars and Their Implications on the Possibility of Superflares on the Sun

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Session: 2b. Origin of solar flares and their impact on Earth’ s ionosphere/atmosphere

Type of presentation: oral

Key word: solar flares extreme events

Using Kepler data, Maehara et al. (2012) have discovered 365 superflares (10^34-10^36 erg) on 148 solar type stars (G type dwarfs). They revealed that the occurrence frequency of superflares of 10^34 erg is once in 800 years, and that of 10^35 erg is once in 5000 years on Sun-like stars whose surface temperature and rotation are similar to those of the Sun. It was also found that these superflare stars show quasi-periodic brightness variation, which can be interpreted as a result of rotation of stars with large star spots (Notsu Y. et al. 2013). This interpretation is consistent with standard theory of solar flares and dynamo (Shibata et al. 2013), and has partly been confirmed by spectroscopic observations of some of these stars using Subaru telescope (Notsu S. et al., 2013; Nogami et al. 2014). Furthermore, there were no evidence of hot Jupiters around these superflare stars, suggesting the possibility that superflares may occur on the Sun (Nogami et al. 2014). Shibayama et al. (2013) extended Maehara et al.’ s work to find 1547 superflares on 279 solar type stars from 500 days Kepler data. They basically confirmed the results of Maehara et al., but found that in some Sun-like stars the occurrence rate of superflares was very high, 5 superflares in 500 days (i.e., once in 100 days). We shall discuss what would happen on the civilization and environment of the Earth if such superflares would occur on the Sun.

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Nogami, D. et al. (2014) PASJ 66, L4

-87 Recent progress in the studies of Polar Cap Ionization Patches

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: Polar Ionosphere-magnetosphere coupling Polar cap patches Magetic reconnection

Patches of ionization are common in the polar ionosphere where their motion and associated density gradients give variable disturbances to High Frequency (HF) radio communications, over-the-horizon radar location errors, and disruption and errors to satellite navigation and communication. Their formation and evolution are poorly understood, particularly under disturbed space weather conditions. We report direct observations of the full evolution of patches during a geomagnetic storm, including formation, polar cap entry, transpolar evolution, polar cap exit, and sunward return flow. Our observations show that modulation of nightside reconnection in the substorm cycle of the magnetosphere helps form the gaps between patches where steady convection would give a "tongue" of ionization (TOI).

We also report the first direct and continuous monitoring of a complicated evolution of a newly created patch during a geomagnetic storm. The observations reveal that the patch was segmented from the high density "tongue" of ionization (TOI) by a subauroral polarization stream (SAPS) near the polar cap boundary associated with a substorm . The patch did not follow the expected route across the polar cap from dayside to nightside, but instead was halted by a local disturbance in the polar cap due to a rapidly changing in interplanetary magnetic field (IMF) condition and evolved in a particular way with quickly fading associated with the high-latitude lobe reconnection.

-88 Long-term variability of electromagnetic characteristics in solar wind streams and its connection with 22-year solar magnetic cycle and geomagnetic activity for measurement period 1964-2014 at near-Earth orbit

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Session: 2a. Long-term solar variability (magnetism, total irradiance, and spectral irradiance) and its impact on geospace and Earth

Type of presentation: oral

Key word: Long-term solar wind variability Long-term geomagnetic activity variability 22-year solar magnetic cycle Electromagnetic Chain

Solar wind streams form a spiral with a different longitude angle U: fast-moving streams moving more directly and slow-moving streams wrapping more around Sun. The azimuthal component of spiral corresponds to east-west component By (GSE c.s.) of interplanetary magnetic field (IMF), which plays important role in reconnection on magnetopause and evolution of geomagnetic activity (GA). We put as our aim to find connection between electromagnetic parameters of solar wind (IMF B; electric field E=[VxB], where V is solar wind velocity; Poyting vector of electromagnetic flux density P=[ExB]) and spiral angle U for period of solar cycles N20-24. Such approach allows to describe dynamics of quasi-stationary streams for period of about two magnetic solar cycles and the stream influence on GA. We take as our data base IMF B, solar wind velocity V, density N, temperature T measured at 1 a.u. near ecliptic plane for interval of 1963-2014 (omni base). We show that maxima of values E and P for each solar cycle are at U~80 deg. (By>0) and U~260 d. (By<0). Besides, the peaks of E and P at U~80 d. are considerably larger for odd cycles (21, 23) than for even ones (20, 22) and does not follow by maximal sunspot numbers of the cycles Wm. We argue that the result can be interpreted as influence of 22-yr magnetic cycle on parameters of the streams. The maxima of E and P near U~80 d. belong to stream with maxima of N, B and minima of V, T. These parameters of slow stream of cold dense plasma and the fact that Bx changes its sign near boundary point to internal edge of HCS. We also obtained new characteristics of the 23d cycle. In particular, we show that absolute maximum of P(U) occurred during cycle 23. As the P is connected with rate of the e/m flux transmission to magnetosphere, the P maximum should have its manifestation in GA. Really, dependence of Dst on U demonstrates absolute maximum in Dst near U~80 d. for cycle 23. In addition, Dst -index increased with time (number of cycle) almost at all U that can be regarded as long-term change in GA for period of cycles 20-24 with maximum at 23 cycle, in agreement with the absolute maximum of P, E for cycle 23. Incomplete cycle 24 shows decrease in the long-term change of Dst. At last PC-index of polar cap derived on basis of magnetic data at Thule as function of U demonstrates absolute maximum of P for cycle 23 near the same U~80 d. The result clearly shows that weakness of sunspot maximum Wm=121 of the 23d cycle does not determine efficiency of the solar wind stream for the cycle. Our analysis allows to conclude that odd solar cycles with low Wm have the largest E and P in similar solar wind streams near U~80 d, By>0 and consequently high GA. Despite the fact that all the solar wind parameters discussed here show long-term decrease in their values for cycle 24, we see constant rise of V in HSS from coronal holes (N and T are lower than average) with By<0 at present. The latter is typical feature of streams for even cycles (20, 22). We discuss in closing application of our results to some problems of solar-terrestrial physics. In particular, we explain annual distribution of occurrence frequency of large geomagnetic disturbances, when additional peaks appear for the 2nd half of year under IMF with By>0 together with well-known peaks near equinoxes. The study was supported by P-22 grant of RAS.

-89 The spatial distribution of R2 FACs relative to SAPS

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Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: poster

Key word: field-aligned currents subauroral polarization streams

To test the current-generation model of subauroral
polarization stream (SAPS), we have investigated the relativive positions of field-aligned currents (FACs) with respect to SAPS in a statistical way by using CHAMP and DMSP satellite observations as well as model simulations. Comparative studies have been performed for consecutive CHAMP observations in different magnetic local time (MLT) sectors with respect to SAPS. The latitude of the peak westward zonal wind deduced from CHAMP measurements has been used to represent the location of the
SAPS peak. Both the density and the sheet current strength
of R2 (region 2) FACs are enhanced when SAPS occur. Subsequently R2 FACs decay in intensity and correspondingly the centers retreat poleward. The latitudes of the center of the R2 FAC, small- and medium-scale FACs, and SAPS shift equatorward with increasing MLT. The SAPS peaks are located between R2 and R1 (region 1) FAC peaks in all MLT bins under study. The SAPS peaks are closer to R2 centers in the later MLT sectors. The peaks of small- and mediumscale FACs are located poleward of SAPS, mainly in the upward R1 FACs region. The upward R1 FACs are partly closed by the downward R1 FACs in the dawn–morning sector. Based on model simulation, when R2 shifts equatorward to the subauroral region, the plasma flow also shifts equatorward with its peak located poleward of that of R2 FACs. Both the model and observations provide evidence that SAPS behave as caused by a magnetospheric current source.

-90 Geo-effectiveness of CMEs with DH-type II radio bursts

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Session: 2c. Coronal and Interplanetary radio bursts including auroral kilometric radiation

Type of presentation: oral

Key word: Coronal Mass Ejections (CMEs) DH-type-II radio bursts geomagnetic storms

We statistically study the geo-effectiveness of CMEs with DH-type-II radio bursts in the 23rd solar cycle during 1997 - 2008. About 109 events (47 %) [109/232] are found to be geo-effective (i.e., with a Dst value < -50 nT). Out of the 109 events, 59 % (64/109) are with moderate geomagnetic storms (Dst from -50 to -100 nT), 29 % (32/109) are with intense (Dst from -100 to -200 nT), and 12 % (13/109) are with severe (Dst < -200 nT) geomagnetic storms. On average, the DH-CMEs are found to be associated with a Dst value of - 116 nT. We also find that the type-II bursts end frequency is an important parameter strongly associated with the level of geomagnetic storms, lower the end frequency higher the storms level. For example, if the end frequency is lower than 100 kHz (28/109), the possibilities of intense and severe storms are 38 % and 62%, respectively. Therefore the occurrence of DH-type-II bursts and associated spectral parameters can be used as a good indicator of geomagnetic storms.

-91 On the Photospheric Magnetism-Related Clues to Solar Violent Eruptions

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Session: 2a. Long-term solar variability (magnetism, total irradiance, and spectral irradiance) and its impact on geospace and Earth

Type of presentation: poster

Key word: Photospheric Magnetic Field Solar Eruption Solar Weather Prediction

The coronal flux loops, where solar violent eruptions may originate, take root on the solar photosphere. The magnetic fields in the photosphere reflect and confine the physical environment of the higher atmosphere above to some extent. The energy released during solar eruptions is provided by accumulation of free magnetic energy. The observations of vector magnetic fields in solar photosphere develop well and systematically, and a large amount of observed data is accumulating. Scientists already have the ability to more accurately mine the relations between evolution of magnetism-related parameters and eruptions with different magnitude. These could provide more clues to the prognostication of solar eruptions according to the evolution of observed magnetic fields. We try to drive forward the studies on the prediction of solar eruptions employing vector magnetic field data (independently).

-92 Cluster Observations of energetic O+ ions correlated with ULF waves in the night-side high-latitude magnetosheath during a storm initial phase

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Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: oral

Key word: energetic O+ ions Magnetosheath ULF waves

Measurements from Cluster spacecraft C4 are used to investigate the energization of singly charged oxygen ions, O+, by Ultra-Low Frequency (ULF) waves in the night-side high-latitude magnetosheath during the initial phase of an intense storm on 24 October 2011. The number density of O+ ions was ~0.1 cm-3 detected by Cluster C4 within the night-side high-latitude magnetosheath. The observed energetic O+ ion flux was periodic in the ULF wave Pc 5 range, ~ 3 min. The fluctuations of O+ number density, dNO+ were closely correlated with the pulsations of magnetic field, dBx. The phase difference between the dNO+ and dBx is ~ 1800 or ~ 900, which corresponding to the O+ pitch angle distribution mainly in the direction parallel or perpendicular to the magnetic field, respectively. These results indicate that the O+ ions can be energized by Pc 5 waves both in the parallel and perpendicular to the magnetic field in the night-side high-latitude magnetosheath during the storm initial phase. Our observation investigation presents a new source of the abundant energetic O+ in the plasma sheet during the storm main phase, which is from the night-side high-latitude magnetosheath throughout the magnetopause/mantle/lobe region. These energetic ions are likely one of the major sources of O+ filling into the near-Earth plasma sheet and ring current during the storm main phase.

-93 Observations of interplanetary coronal mass ejections and its geoeffectiveness during 1996-2013

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: poster

Key word: CME geoeffectiveness

A solar coronal mass ejection (CME) is a large-scale eruption of plasma and magnetic fields from the Sun. It is believed to be the main source of strong interplanetary disturbances that may cause intense geomagnetic storms. We use observations from WIND spacecraft to study solar wind conditions from 1996 to 2012, corresponding to complete cycle 23 and the increasing and maximum phases of solar cycle 24, and summarize their basic properties. We identified 444 ICMEs in the near-Earth solar wind during this period. The ICME occurrence rate increases (from 49 in 2001 to 7 in 2008) with solar activity. We compare the properties (magnetic, velocity, southward magnetic field Bs, proton temperature, plasma thermal pressures) of the ICME in increasing phases of solar cycle 23 to those in increasing phase of solar cycle 24. We can see clearly that the properties of ICME in solar cycle 24 is weaker than those in solar cycle 23. We also analyse the ICME’ s geoeffectiveness. The number of strong geomagnetic storms has the difference of order of magnitude between solar cycle 23 and solar cycle 24. There are only 7 strong geomagnetic storms in solar cycle 24. This may caused by the weaker ICME properties.

-94 Solar coronal structure in late 2013 obtained with the time-relaxation MHD simulation and potential field model

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Session: 1b. Origin, evolution, and Earth impact of high speed streams

Type of presentation: oral

Key word: MHD simulation solar corona

The solar photospheric magnetic field at the unipolar magnetic regions (UMRs; global-scale structures) was significantly weak relative to those at the solar active regions (ARs) or bipolar magnetic regions (BMRs; local, small-scale structures) in late 2013, which makes it a challenge to determine realistic global structures of the solar corona at that time. In this work, by means of our MHD simulation model and the PFSS model using the magnetic field data from Huairou Solar Observing Station, GONG and HMI for CR2144, we conduct the model calculations and compare the outputs with other observations, such as the AIA coronal image data, for better theoretical determination of the global coronal structures at the solar-activity maximum period with weak global solar magnetic field and compact strong bipolar regions. We will report the results of the model calculations of the coronal magnetic field, characterize the differences among the results, and propose pre-processes for more robust determination of the coronal structures

-95 Magnetic flux-rope structure of (I)CMEs characterized by the field-line twist and length distributions

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: magnetic flux rope magnetic flux magnetic reconnection Coronal Mass Ejections Flare Filament

We will report on the detailed and systematic study of field-line twist and length distributions within magnetic flux ropes embedded in Interplanetary Coronal Mass Ejections (ICMEs). The Grad-Shafranov reconstruction method will be utilized together with a constant-twist nonlinear force-free (Gold-Hoyle) flux rope model and the commonly known Lundquist model to reveal the close relation between the field-line twist and length in cylindrical flux ropes, based on in-situ spacecraft measurements. In particular we will utilize energetic electron burst observations at 1 AU together with associated type III radio emissions detected by the Wind spacecraft to provide unique measurements of magnetic field-line lengths within selected ICME events. These direct measurements will be compared with our model calculations to help assess the fidelity of different flux-rope models. We will also discuss the implications of our analysis of flux-rope structures on the origination and evolution processes in their corresponding solar source regions.

-96 The distribution and formation of the small scale pressure-balanced structures in the fast solar wind

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Session: 1b. Origin, evolution, and Earth impact of high speed streams

Type of presentation: poster

Key word: pressure-balanced structures solar wind

This work studies the dependence of the pressure-balanced structures (PBSs)' distribution on the background magnetic field direction in the fast solar wind. And it is suggested that the small PBSs could be formed by the compressive MHD waves in the high speed stream of the solar wind. The plasma and magnetic field data obtained by WIND in quiet solar wind at 1 AU have been analyzed. Firstly, a developed moving-average method is applied to get the background magnetic field for every temporal scale at each time moment . Through the wavelet cross coherence spectrum analysis, we obtain the correlation coefficients between plasma thermal pressure Pth and magnetic pressure PB distributing against the temporal scale and the angle between the background magnetic field and GSE-x. We notice that the angle coverage of a PBS decreases with shorter temporal scale, but the occurrence of the PBS is independent of the angle between the mean field and the GSE-x. Suspecting the isolated small PBSs formed by compressive waves in situ, we continue this study on testing the wave modes forming a small PBS with B0 quasi-parallel and quasi-perpendicular to GSE-x. As a result, we identify that the cross helicity and the compressibility attain values for slow-mode and mirror-mode from the theoretical calculation. And the wave vector is derived by Minimum Variance Analysis. Besides, the proton temperatures obey temperature anisotropy derived from the velocity distribution functions, satisfying the requirements for slow-mode and mirror-mode, respectively. Thus, a small-scale PBS is proved to be driven by compressive MHD waves in the fast stream of the solar wind.

-97 The chain response of the magnetospheric - and - ground magnetic field to interplanetary shocks

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: interplanetary shock magnetic field variation

In response to interplanetary (IP) shocks, magnetic field may decrease/increase (negative/positive response) in nightside magnetosphere, while at high latitudes on the ground it has two phase bipolar variations: preliminary impulse(PI) and main impulse (MI). Based on global MHD simulation, this paper investigates the linkage between the MI phase variation on the ground and the magnetospheric negative response to an IP shock. It is revealed that although the two phenomena occur at separated locations, they are actually two aspects of a unified response process. Velocity disturbances near the flanks of the magnetopause cause the magnetic field to decrease in this region, which forms a dynamo powering the transient field-aligned currents (FAC). These FAC further generates a pair of ionospheric current vortex, leading to MI variations on the ground. Moreover, time evolution of the negative response region inside the flank magnetopause and the transient MI-FAC, as well as the MLT dependence of minimum ground H well consist with each other.

-98 IMF By-controlled FACs in the magnetotail during northward IMF

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: field-aligned currents magnetotail interplanetary magnetic field

The influence of the interplanetary magnetic field (IMF) By component on the field-aligned currents (FACs) in the plasma sheet boundary layer (PSBL) in the magnetotail during the northward IMF were investigated using the data from Cluster. There are 748 FACs cases selected to do analysis. We present that the IMF By component plays a very important role in controlling the flow direction of the FACs in the PSBL in the magnetotail. In the northern hemisphere, the influence of the positive (negative) IMF By is an earthward (tailward) FACs. To the contrary, in the southern hemisphere, the effect of the positive (negative) IMF By is a tailward (earthward) FACs. The FAC density is controlled by IMF By only when |IMF By| is large. When |IMF By| is more than 10 nT the absolute FAC density in the PSBL has an obvious positive correlation with the |IMF By|. There is a clear dusk-dawn asymmetry in the current densities for the FACs in the PSBL, with the dawn currents appearing larger than the dusk currents.

-99 Early Evolution of An Energetic Coronal Mass Ejection

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: CME Flare Wave

We study a coronal mass ejection (CME) associated with an X-class flare, whose initiation is clearly observed in low corona with high-cadence, high-resolution EUV images, providing us a rare opportunity to witness the early evolution of an energetic CME in detail. The eruption starts with a slow expansion of cool overlying loops ($\sim\,$1 MK), below which a reverse S-shaped dimming is seen immediately above the brightening active region in hot EUV passbands. The dimming is associated with a rising hot arch ($\sim\,$6 MK), which we interpret as a preexistent, high-lying flux rope. This is followed by the arising of a double hot channel (DHC; $\sim\,$10 MK) from the core of the active region. The higher structures rise earlier and faster than lower ones, with the leading front undergoing extremely rapid acceleration up to 35 km~s^{-2}. This suggests that the torus instability is the major triggering mechanism and that it is the high-lying flux rope rather than the DHC that drives the eruption. A global EUV wave, which is closely associated with a metric type II radio burst, initiates as the laterally under-expanding loop system pushes down neighboring coronal loops that subsequently oscillate vertically. Polar plumes oscillate horizontally with the wave passing through at $\sim\,$400 km~s^{-1}. A local EUV wave bounded by the expanding loop system propagates first sunward and then outward at $\sim\,$200 km~s^{-1}.

-100 Meridian Circle International Observation (MERINO): Results from the 2014 campaigns

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Session: 5. Space Weather Meridian Session

Type of presentation: oral

Key word: space weather ground-based observation

MERINO, Meridian Circle International Observation, is a network of space weather monitoring along the meridian 120E/60W longitudes. The meridian circle spans across America and Asia longitude sectors which are of particular geophysical interests arising from the fact of distinctive and opposite offsets associated with geomagnetic field configuration. Space weather and climate along the circle have demonstrated various
important aspects regarding dynamics and coupling processes in the geospace system of the magnetosphere, ionosphere and thermosphere. Further understanding the underlying sciences driving vertical coupling from low to upper atmosphere layers under the influence of solar-terrestrial processes and horizontal (latiduinal and longitudinal) variability requires dedicated and coordinated observations.

A series of observational campaigns have been proposed to collect data along the meridian circle, including two for the year 2014. The first campaign was conducted between March 24 - April 6, 2014 with a range of radio and optical instruments at facilities from the Chinese Meridian Project, the World Incoherent Scatter Radar netwrok, the Global Ionosphere Radio Observatory (GIRO), as well as from individual research institutions and regional networks in Asia and America areas. The second campaign will be taking place between September 16 and October 1, 2014. In this presentation, we will provide an ovewiew of the MERINO initiative, its sceintific goals, the observational network, and initial results from the 2014 campaigns.

-101 Chromospheric Evaporation in an X1.0 Flare Observed with IRIS and EIS

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Session: 2b. Origin of solar flares and their impact on Earth’ s ionosphere/atmosphere

Type of presentation: oral

Key word: line: profiles methods: data analysis Sun: corona Sun: flares Sun: UV radiation

Chromospheric evaporation refers to dynamic mass motions in solar flaring loops as a result of rapid energy deposit around chromospheric layers. Although it has been studied for many years, there still exist some unresolved problems, such as a dominant stationary velocity in high temperature (10 MK) emission lines. The recently launched Interface Region Imaging Spectrograph (IRIS) provides high resolution imaging and spectroscopic observations that focus on the chromosphere and transition region in the UV passband. Using the new IRIS observations, in particular, its coordinate observations with the Extreme-ultraviolet Imaging Spectrometer (EIS), we study the chromospheric evaporation process from the lower atmosphere to high corona during an X1.0 flare. We obtain dominant upward mass motions in high temperature lines (e.g., Fe XXI and Fe XXIII, >10 MK) at two ribbons of the flare, which are consistent with the chromospheric evaporation model. In addition, we find a separation pattern of the two blueshifted ribbons, which indicates that the evaporation process is proceeding into the decay phase with magnetic reconnection still underway. We also study the dependence of Doppler velocities in multiple spectral lines on time as well as the line formation temperature. Finally, we discuss the energy process in the X1.0 flare based on our measurements.

-102 Full-halo coronalmass ejections: Arrival at the Earth

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Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: oral

Key word: Full halo CME Arrival at the Earth

A geomagnetic storm is mainly caused by a frontside coronal mass ejection (CME) hitting the Earth and then interacting with the magnetosphere. However, not all frontside CMEs can hit the Earth. Thus, which CMEs hit the Earth and when they do so are important issues in the study and forecasting of space weather. In our previous work, the deprojected parameters of the full-halo coronal mass ejections (FHCMEs) that occurred from1March 2007 to 31May 2012 were estimated, and there are 39 frontside events that could be fitted by the Graduated Cylindrical Shell model. In this work, we continue to study whether and when these frontside FHCMEs (FFHCMEs) hit the Earth. It is found that 59% of these FFHCMEs hit the Earth, and for central events, whose deviation angles, which are the angles between the propagation direction and the Sun-Earth line, are smaller than 45◦, the fraction increases to 75%. After checking the deprojected angular widths of the CMEs, we found that all of the Earth-encountered CMEs satisfy a simple criterion that the angular width is larger than twice the deviation angle. This result suggests that some simple criteria can be used to forecast whether a CME could hit the Earth. Furthermore, for Earth-encountered CMEs, the transit time is found to be roughly anticorrelated with the deprojected velocity, but some events significantly deviate from the linearity. For CMEs with similar velocities, the differences of their transit times can be up to several days. Such deviation is further demonstrated to be mainly caused by the CME geometry and propagation direction, which are essential in the forecasting of CME arrival.

-103 Annual variations of the critical frequency foF2 at Vanimo station during the two last solar minima

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Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: oral

Key word: Solar minimum Annual variation Equatorial ionosphere

Behavior of the ionosphere during the prolonged solar cycle minimum 23-24 is one of the interesting phenomena. Many authors concluded that the annual means of the critical ionospheric frequency foF2 and the global TEC (total electron content) were reduced due to EUV variations (extreme ultraviolet), while other investigations found no essential variations compared to the previous solar minimum. To resolve these doubts we have examined the factors which can change the annual ionospheric variations of the critical frequency foF2 at the equatorial ionization anomaly stations Vanimo during the two last solar minima. With that end in view the annual variations of foF2 at Vanimo station have been calculated and compared with variations of Dst-index and of the solar wind parameters. Annual means of foF2 during solar minimum 23-24 at Vanimo station is lower with respect to the previous solar minimum 21-22, but this difference (is about ~ 1,5 MHz) is not unusual. We show that in addition to low level of the EUV during the last solar minima, the geomagnetic variations effect, associated with the solar coronal holes, has to be included as the influencing factor on the equatorial ionosphere. It is shown that together with other solar and interplanetary parameters, the long-term variations of the Dst-index, as measure of solar-terrestrial relationships can be used for study geomagnetic and solar wind effects on ionosphere. This is important under such conditions when percent of coverage of the solar wind data is less than 50% to calculate their long-term variations.

-104 Cosmic rays, geomagnetic activity and global temperature variations during solar cycles 20-23

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Session: 2a. Long-term solar variability (magnetism, total irradiance, and spectral irradiance) and its impact on geospace and Earth

Type of presentation: oral

Key word: Cosmic Ray Climate change

We have studied conditions in interplanetary space, which can have an influence on galactic cosmic rays and climate change. In this connection the long-term of the solar wind and interplanetary magnetic field parameters and cosmic ray variations have been compared with geomagnetic activity represented by the equatorial Dst index from the beginning 1965 to the end 2012. Dst index is commonly used as the solar wind-magnetosphere-ionosphere interaction characteristic. The important drivers in interplanetary medium which have effect on cosmic rays as CMEs (coronal mass ejections) and CIRs (corotating interaction regions) undergo very strong changes during their propagation to the Earth. Because of the sunspot numbers and long-term variations of cosmic rays do not adequately reflect peculiarities concerned with the solar wind arrival to 1 AU. Therefore, the geomagnetic indices have some inestimable advantage as continuous series other the solar wind measurements. We have compared the yearly average variations of Dst index and the solar wind parameters with cosmic ray data from Moscow, Climax, Haleakala and Oulu neutron monitors during the solar cycles 20-23. During the descending phases of these solar cycles the long-lasting solar wind high speed streams occurred frequently and were the primary contributors to the recurrent Dst variations. They also had effects on cosmic rays variations. Climate change in connection with evolution of Dst index and CR variations is analyzed. We demonstrate that the detrended annual means of global surface air temperature in 1965-2012 show the maxima during cosmic rays and Dst index minima. It proves that cosmic rays play essential role in climate change and main part of climate variations can be explained by Pudovkin and Raspopov′ s (1992) mechanism of action cosmic rays modulated by the solar activity on the state of lower atmosphere and meteorological parameters.

-105 The Temperature Structure of Some Typical Flare Loop Systems

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Session: 2b. Origin of solar flares and their impact on Earth’ s ionosphere/atmosphere

Type of presentation: poster

Key word: flares coronal mass ejections

Solar flares and coronal mass ejections (CMEs) are the main drivers of disastrous space weather. To understand the physical processes behind solar eruptions is the important base and prerequisite for reliable space weather prediction. Studying thermodynamic properties of flare structures will help understand the flare energy release and CME acceleration mechanism. Here we show some flares which occur at the solar limb or near the limb and are all with typical flare loop systems. With high-resolution data provided by six EUV channels of the AIA instrument on board SDO, we utilize the differential emission measure (DEM) method to study the temperature structure and some other physical properties of the flare loop systems, and they are compared with earlier results.

-106 Nonmigrating tidal modulation of the equatorial thermosphere and ionosphere anomaly

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Session: 3a. Geospace response to variability of the lower atmosphere

Type of presentation: oral

Key word: equatorial thermosphere anomaly nonmigrating tides

The modulation of nonmigrating tides on both the ionospheric equatorial ionization anomaly (EIA) and the equatorial thermosphere anomaly (ETA) is investigated on the basis of simulations from the Thermosphere-Ionosphere-Mesosphere-Electrodynamics General Circulation Model (TIME-GCM). Our simulations demonstrate the distinct features of the EIA and ETA seen in observations after the inclusion of field-aligned ion drag in the model. Both the EIA and ETA in the constant local time frame display an obvious zonal wave-4 structure associated with the modulation of nonmigrating tides. However, the modeled EIA and ETA show a primary zonal wave-1 structure when only the migrating tides are specified at the model lower boundary. Our simulations reveal that the zonal wave-4 structure of the ETA under both low and high solar activity conditions is mainly caused by the direct response of the upper thermosphere to the diurnal eastward wave number 3 (DE3) and semidiurnal eastward wave number 2 (SE2) nonmigrating tides from the lower atmosphere. There is minor contribution from the ion-neutral coupling. The longitudinal variations of the EIA are also caused by these nonmigrating tides, but through the modulation of the neutral wind dynamo.

-107 A new classification of SPEs based on the multi-energy channel

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: solar proton event proton acceleration

We have investigated characteristics of solar proton events (SPEs) and their association with other types of solar eruption using 42 SPEs observed with SOHO/ERNE
detector from 1997 to 2012. A velocity dispersion analysis was performed to correctly estimate the onset times of proton flux increase at the solar vicinity. These SPE onset
times were compared with those of associated flares, coronal mass ejections (CMEs) and interplanetary (IP) type II radio bursts. We found: (i) the proton flux of 13 SPEs (31%) increase during the flare X-ray intensity is increasing, and the rest 29 SPEs (69%) show onsets well coincident with the first appearance of CMEs in LASCO field-of-view. (ii) All flare-associated SPEs show the flux enhancements starting from the lower energy, while the CME-associated SPEs show the flux enhancements starting from either the higher or the lower energies. In the other events the flux enhancement occurs simultaneously
at all energies within 10 minutes. (iii) For the former, large
flux enhancements occur in a short time, while the latter tend to show relatively weak and slow flux enhancements.
Our classification uses two criteria, SPE onset timing relative to flares and energy-dependent flux enhancement, unlike the conventional classification of SPEs based on whether the flux time profile is impulsive or gradual. Nevertheless our classification scheme recovers the distinction between the flare-associated SPEs and the CME-associated SPEs in terms of the onset timing. Additional information on the proton acceleration as implied by the energy dependent patterns of flux enhancement is briefly discussed.

-108 The Effect of Solar Wind Corotation Interaction Regions on Earth’s Thermosphere and Ionosphere

Wenbin Wang *(High Altitude Observatory, National Center for Atmospheric Rsearch)*

Session: 1b. Origin, evolution, and Earth impact of high speed streams

Type of presentation: oral

Key word: Storm response Thermosphere and ionosphere

Solar wind corotating interaction regions (CIRs) occur when high-speed solar wind streams originating from solar coronal holes interact with slow-speed solar winds. These CIRs occur periodically and frequently during the declining phase of a solar cycle and result in recurrent geomagnetic activity with a long duration of several days, which perturbs the ionosphere and thermosphere on a global scale as a result of energy and momentum deposition at high latitudes. In this study we employ the thermosphere ionosphere electrodynamics global circulation model (TIEGCM) to elucidate the changes of thermospheric temperature, winds and composition and ionospheric electron densities during CIR-induced geomagnetically activity periods. The model results show globally enhanced neutral winds that are more equatorward and westward. Neutral temperature becomes higher during the course of a CIR-storm as energy is continuously deposited into the thermosphere-ionosphere system, which leads to a long and sustained change to neutral composition and an enhancement of neutral density. At different latitudes, the ionospheric electron densities during CIR storms show different response, which is the combination effect of changes in neutral winds, composition and ionospheric penetration electric fields. Diagnostic analysis on TIEGCM simulations has also been carried out to determine the main drivers of these storm-time thermosphere and ionosphere changes.

-109 Statistical Survey of Type III Radio Bursts Observed by the STEREO/Waves Instruments

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Session: 2c. Coronal and Interplanetary radio bursts including auroral kilometric radiation

Type of presentation: oral

Key word: Plasma radiation Solar radio emissions

Type III radio bursts represent a clear evidence of far-reaching effects of solar eruptions injecting energetic electrons into the interplanetary medium. We performed statistical analysis of a large number of Type III radio bursts measured by STEREO between May 2007 and February 2013. Only intense, simple, and isolated cases have been included in our data set. The STEREO/Waves instrument allows tracking radio sources and investigating their polarization properties between 125 kHz and 2 MHz. As it was already reported by other authors, we observe that the maximum flux density occurs at 1 MHz on both spacecraft. Estimated apparent source sizes expand linearly with a radial distance from the Sun. Triangulated radio sources are statistically located further from the Sun with a factor of 5 and 3 for the fundamental and harmonic components, respectively. We suggest that scattering of the primary beam pattern plays an important role in the propagation of Type III radio bursts and that we observe only scatter images of real sources.

-110 Thermospheric planetary wave-type oscillations observed by FPIs over Xinglong and Millstone Hill

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Session: 5. Space Weather Meridian Session

Type of presentation: oral

Key word: Thermospheric wind Planetary waves

Three-year (2010-2013) observations of thermospheric winds (at ~250 km) by Fabry-Perot Interferometers (FPIs) at Xinglong (XL, 40.2°N, 117.4°E) and Millstone Hill (MH, 42.6°N, 71.5°W) are used to study the climatology of atmospheric Planetary Wave Type Oscillations (PWTOs) with periods of 4-19 days. We find that (1) these PWTOs occur more frequently in the months from May to October. They are consistent with the summertime preference of middle latitude ionospheric electron density oscillations noted in other studies. (2) The month-to-month variations in PWTOs show phase changes between MH and XL, switching from anti-phase to in-phase when PWTO periods vary from short to long. (3) Typical PWTOs show annual and semiannual variations. The relative intensity of annual over semiannual components for PWTOs is different between XL and MH. (4) Magnetic storms and substorms have little influences on the annual and semiannual variations of the typical PWTOs amplitudes. (5) Meridional wind PWTOs with typical periodicity bands around 5-, 8-, and 16-days appear to be correlated to both solar wind speed and Kp oscillations, suggesting a possible influence of the solar wind Co-rotation Interaction Regions (CIR) on neutral wind dynamics.

-111 Study of Geoeffectiveness, and Relative Importance, of Different Structures/Features in ICME and CIRs

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: ICME CIR Geoeffectiveness

The ICMEs and the CIRs are two most important structures of the interplanetary medium affecting the Earth and the near-earth space environment. We study the geoeffectiveness and relative importance of various structures/features identified during the passage of ICMEs and CIRs observed during solar cycle 23 and 24. We utilize the timings of different features of these structures, their arrival and duration. The ICME structures identified for the analysis are shock front, sheath, and flux rope/magnetic cloud. We isolate shock arrival time, passage of sheath region, arrival of flux rope/magnetic cloud and the end time of its passage. Similarly, we isolate the CIR arrival, forward shock arrival, stream interface and the reverse shock during the passage of CIR. As geomagnetic parameter we utilize high time resolution data of Dst index. In addition to this geomagnetic index, we utilize the simultaneous and similar time resolution data of interplanetary plasma and field, namely, solar wind velocity, interplanetary magnetic field, its north-south component, plasma temperature and density. Further, we also utilize some other interplanetary parameters, such as duskward interplanetary magnetic field, field variance, solar plasma pressure and plasma beta. We apply the method of superposed analysis first. As the plasma and field properties are different during the passage of different structures, both in ICMEs and CIRs, we systematically vary epoch time in our superposed analysis one by one, e.g., (i) arrival time of shock front, (ii) arrival time of flux rope/magnetic cloud and (iii) passage time of rear part of this structure. Similarly we systematically change the epoch time in the superposed epoch analysis one after the other, e.g., (i) arrival time of CIR, (ii) arrival time of forward shock, (iii) arrival of stream interface and, (iv) the time of reverse shock passage. In this way we analyze the role and effects, one by one, of each identified individual structures during the passage of ICMEs and CIRs. Utilizing the properties of various structures during the passage of ICMEs and CIRs, and variations observed in plasma and field parameters during their passage, along with the simultaneous changes observed in geomagnetic parameters, we identify the interplanetary conditions, plasma/field parameters and their relative importance in their geoeffectiveness. We also study the additional role, if any, of the solar wind parameters such as plasma density, field fluctuations (variance) and plasma beta conditions in influencing their geoeffectiveness. In addition to superposed analysis using large data-base of solar cycle 23 and 24, we study some individual selected events especially those observed in recent years, with special emphasis on varSITI/ISEST campaign ICME events of 2012 and 2013. The results of this detailed study are discussed in the light of existing models. Implications of these results to solar wind- magnetosphere coupling during the passage of solar transients of different properties are also discussed.

-112 Large winds and wind shears caused by the interaction between gravity waves and tides in the mesosphere and lower thermosphere

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Session: 5. Space Weather Meridian Session

Type of presentation: oral

Key word: Mesosphere and Lower thermosphere Gravity wave Tides Large wind and wind shear

A two-dimensional nonlinear numerical model was used to simulate large winds (≥ 100 ms-1) and wind shears (≥ 40 ms-1km-1) in the mesosphere and lower thermosphere (MLT) that are caused by the interaction between gravity waves (GWs) and migrating tides. By varying the wavelengths of GWs and the phases of diurnal and semidiurnal tides, sixty-four numerical experiments were performed. Our numerical experiments indicate that both migrating diurnal and semidiurnal tides strongly modulate the occurrence of GW breaking, and the associated larger winds and wind shears. The large winds and wind shears in our simulations are in good agreement with that from the chemical release measurements from sounding rockets. Moreover, the occurrence of large wind shears is highly related to the phases of migrating tides in local time; the occurrence of large wind shears is also in agreement with the lidar observations. The local time dependency of large wind shears is mainly attributed to the filtering and/or hindering effects of diurnal and semidiurnal tidal winds on GWs. Our simulation study reveals that the nonlinear interactions between GWs and the migrating diurnal and semidiurnal tides play an important role in driving the large winds and wind shears in the MLT region.

-113 STUDY OF IONOSPHERIC DYNAMICS WITH IRKUTSK INCOHEREN SCATTER RADAR

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Session: 5. Space Weather Meridian Session

Type of presentation: oral

Key word: ionosphere incoherent scatter NEUTRAL WIND space weather

The ionosphere is a part of the Sun-Earth system, the physical processes taking place in it are complex. They are caused by the absorption and transformation of energy that comes to us from various sources in the external and internal geosphere, such as solar radiation, solar wind, magnetosphere, human impact, etc. The main purpose of this work is the experimental study of the ionospheric plasma dynamics: neutral and ionized components interaction, neutral wind and plasma drift speeds calculation, their impact on the ionospheric parameters variation during solar activity growth phase, 2012-2013. Due to the high solar activity, and thus a higher electron density, we can cover a larger range of heights in our research, and more accurately measure the drift velocity of the plasma along the line of sight radar, and calculate diffusion and neutral winds velocities with greater precision.

Work funds by RFBR, grant №12-05-31019_мол_а

-114 Evolution of Coronal Mass Ejections through the Heliosphere

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Session: 2c. Coronal and Interplanetary radio bursts including auroral kilometric radiation

Type of presentation: oral

Key word: coronal mass ejections shock waves solar-terrestrial relations radio radiation solar wind

It has been almost 8 years since the launch of the STEREO spacecraft. A primary objective of STEREO is to characterize interplanetary propagation of coronal mass ejections (CMEs), the most spectacular eruptions in the solar corona and drivers of major space weather effects. This talk will focus on some progresses in understating CME propagation in the heliosphere based on merged STEREO remote-sensing and in situ observations, specifically: (1) predicting CME arrival and speed at the Earth; (2) CME interaction with the heliosphere; and (3) CME-CME interactions. Event studies together with implications for instrumentation will be presented to demonstrate the capabilities with which the impact of a solar storm on the Earth can be predicted with small ambiguities.

-115 Data Analysis of Earth-affecting CMEs: A Report from the ISEST/Minimax24 Data Working Group

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Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: oral

Key word: Coronal Mass Ejections Corona

We report the progress and the future plan of the Data Analysis Working Group of the ISEST/MiniMax24 project. The scientific goals of this working group are to (1) identify all Earth-affecting ICMEs during the STEREO era (2007– to – date) and their solar sources, (2) track these events from the Sun to the Earth, and fully measure, characterize and quantify their properties and evolution from the Sun to the Earth and (3) provide a comprehensive event database for other working groups, other projects, and the entire community. The working group is also tasked to identify and characterize other Earth-affecting transients, including solar flares, SEPs and CIR.

-116 An Overview on The Origin, Evolution and Earth Impact of Coronal Mass Ejections

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: Coronal Mass Ejections Corona

Earth-impact coronal mass ejections (CMEs) are the main source of severe space weather that affects life and society. In this talk, I will provide an overview of the current understanding of the origin, evolution and geo-effectiveness of CMEs, and the challenging questions associated with these studies. I will utilize the state-of-the-art observations and analysis of the July 12-15, 2012 event to illustrate the complete Sun-to-Earth processes. The program of the International Study of Earth-Affecting Solar Transients will be introduced.

-117 The possible trigger mechanism of the solar eruption in 2012 July 12

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Session: 2b. Origin of solar flares and their impact on Earth’ s ionosphere/atmosphere

Type of presentation: oral

Key word: activity flares magnetic fields reconnection

We examine flare eruptions (X1.4) on 2012 July 7 in the NOAA active region 11520. Using an advanced non-linear force-free field (NLFFF) extrapolation method based on the SDO/HMI vector magnetograms, we investigate the evolution of the magnetic field during the eruption. Also, based on the extrapolated field we determine the rough positions of the separatrix surface, where might be the magnetic reconnection site in this active region. Moreover, compared with EUV images, the nullpoint position has good alignment with the EUV bright point. In addition, the sunspot rotation may lead the magnetic reconnection.

-118 Extremely Large EUV Late Phase of Solar Flares

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Session: 2b. Origin of solar flares and their impact on Earth’ s ionosphere/atmosphere

Type of presentation: oral

Key word: Solar Flares EUV Late Phase Hot Channel

The Extreme Ultra-Violet (EUV) late phase was a new observation feature other than impulsive or gradual phase during solar flares. It was observed as a second peak in EUV irradiance profile, especially in the line of warm temperature (~2.5MK, Fe XVI 33.5 nm). Previous works indicates that long loop arcades near the flare region would be heated during the main phase occasionally, then they went through a slow cooling process, and emitted series of EUV emissions , which formed the late phase. In this paper, a strong long-duration flare event (LDE) with extremely large late phase was observed by multiple instruments and proved to be confined. Detailed analysis were given to investigate this extraordinary event.

-119 Nonlinear Structures Produced by the Solar Wind Interaction with Earth’s Bow Shock

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: Shock Solar wind current sheet

Observations and PIC simulation models have shown that understanding the physics of collisionless shock requires that we include the dynamics of nonlinear structures observed in the upstream region. We present results of a two-dimensional simulation of the interaction of a current sheet and a perpendicular shock. Simulation results reproduce Cluster observations fairly well, such as (1) the solar wind (SW) mean flow slows down, (2) the temperature and number density of the plasma increases and decreases respectively in the structure, and (3) the energy flux spectrogram shows the SW beam was present throughout the structure. Local velocity distributions and acceleration mechanisms of the SW ions at the nonlinear structure are also will be discussed.

-120 Sun-to-Earth Kinematics of the 2012 July 12 Coronal Mass Ejection

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: poster

Key word: coronal mass ejections solar wind

A large coronal mass ejection (CME) occurred on July 12, 2012, and was associated with an X1.4 flare from NOAA AR 11520 (S17W08). The CME was propagating toward the Earth, and the whole process was recorded by the two STEREO spacecraft. We use the STEREO wide-angle imaging observations and a geometric triangulation technique to determine the CME Sun-to-Earth kinematics, which are then compared with the associated type II radio burst and in situ solar wind signatures near the Earth. Solar source characteristics and the in situ flux rope structure are also investigated, in order to understand the underlying mechanism that controls the whole Sun-to-Earth propagation of the CME.

-121 The mechanisms for the onset and explosive eruptions of three flare associated CMEs

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: poster

Key word: cme dimming

Magnetic reconnection is the main energy release process during a solar eruption. We try to investigate the relationship between CMEs and magnetic reconnection by analyzing three flare associated CMEs observed by STEREO and SDO. We focus on tracking CMEs from surface and comparing them with associated flare evolutions. We also compare our results with the numerical work.

-122 Research on heliospsheric current sheet

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Session: 2a. Long-term solar variability (magnetism, total irradiance, and spectral irradiance) and its impact on geospace and Earth

Type of presentation: oral

Key word: heliospheric current sheet heliospheric plasma sheet sector boundary mismatch

Heliospheric current sheet (HCS) is an important structure in slow solar wind, research on it may deepen our understanding of how the slow solar wind origins. From our latest research, we find that heliospheric plasma sheets (HPS) have different location relationship with HCS, and HPS are most likely to be quasi-stationary structure. We also find sector boundary (SB) sometimes will mismatch with HCS, which is unusual and may caused by interchange reconnection, this is also worth to make further investigation.

-123 Relationship between Metric Type II Solar Radio Bursts and Coronal Mass Ejections

Kyungsuk Cho *(KASI)*

Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: Type II radio burst CME

Metric type II solar radio bursts are known radio signatures of coronal shocks. Since the first discovery of the metric type II burst by Payne-Scott, Yabsley, and Bolton (1947), the debate on the origin (solar flare and/or coronal mass ejection) of the type II bursts has continued. By comparing kinematics of m-type II shocks with those of CMEs observed by SOHO/LASCO C1 & C2, MLSO/MK4, STEREO/COR1, and SDO/AIA, I have investigated the relationship between the type II shocks and CMEs. I found that CMEs could be main source of type II bursts, and suggested that type II bursts are generated in two sites: either at the CME nose or at the CME-streamer interaction site. I will review my studies on the relationship between CMEs and metric type II radio bursts.

-124 North/South asymmetry in the ionosphere and seismic activity over the land and sea

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Session: 3c. Regional, hemispheric and inter-hemispheric couplings and transport in the atmosphere

Type of presentation: oral

Key word: Sea/land differences in ionosphere Earthquake occurrence

A North-South asymmetry over the sea and land is investigated with the GPS-derived Global Ionospheric Maps, GIM, of total electron content, TEC, provided by Jet Propulson Laboratory, JPL, for a period of 1999-2013. Accuracy of model TEC based on electron density profile using the International Reference Ionosphere-Plasmasphere model, IRI-Plas, depends on the F2 layer peak density and height supplied by the foF2 critical frequency and M3000F2 ITU-R (former CCIR) maps. The GIM-TEC and ITU-R ionosphere maps may be less reliable over the oceans in view of rare GPS receivers and ionosonde networks only on seashores and islands which involve more assumptions or interpolations imposed on mapping techniques. Using measurements onboard ISIS1,2 and IK19 satellites during 1969-1982 the sea-dominant global land/sea asymmetry in the F2 layer peak electron density, NmF2 (foF2 critical frequency) and peak height, hmF2, has been established which exhibits tilted ionosphere along the seashores with denser electron population at greater peak heights over the sea [1,2]. The recent investigation of the Northern and Southern components of the annual asymmetry in the ionosphere has confirmed contribution of seismic activity in the North-South asymmetry of nighttime ionosphere [2]. In the present study the Earthquake Occurrence (EO) of magnitude M5+ for 1964-2013 is investigated over the land and sea in the Northern and Southern magnetic hemispheres. The appreciable sea/land differences in EO are obtained comprising near 70% (sea) against 30% (land) of the global events. These characteristics tend to receive less public awareness and are sometimes overlooked due to their location on the uninhabited ocean territory. The sea/land differences of earthquake occurrence in the Northern and Southern hemispheres and their possible contribution to the asymmetry in the ionosphere/plasmasphere total electron content are discussed in the paper.

1. Gulyaeva, T.L. Calibration of IRI–ITU-R peak density and height over the oceans with topside sounding data. Adv. Space Res., 45, 276-283, doi:10.1016/j.asr.2009.09.002, 2010.

2. Gulyaeva, T.L., F. Arikan, M. Hernández-Pajares, and I.S. Veselovsky. North-South components of the annual asymmetry in the ionosphere. Radio Sci., 49, doi:10.1002/2014RS005401, 2014.

-125 Solar Energetic Particle Event Associated with the 2012 July 23 Extreme Storm

Zhu Bei, Liu Ying *(Centor for Space Science and Applied Research Chinese Academy of Sciences)*

Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: oral

Key word: solar energetic particle (SEP) event extreme storm longitudinal distribution

We study the solar energetic particle (SEP) event associated with the 2012 July 23 extreme storm, for which the Solar Terrestrial Relations Observatory (STEREO) and the spacecraft at L1 provide multi-point remote sensing and energetic particle observations. The extreme storm, with a superfast shock and extremely enhanced ejecta magnetic field observed near 1 AU at STEREO A, is caused by the combination of successive coronal mass ejections (CMEs). Meanwhile, energetic electrons and ions are observed by the two STEREO spacecraft and the Advanced Composition Explorer (ACE), suggestive of a wide longitudinal spread of the particles at 1 AU. We examine the particle flux, spectra, compositions and anisotropy, in association with the CME properties. Connection between the spacecraft and CME/shock via magnetic field lines is also investigated to understand the cause of the wide longitudinal distribution of the SEP event.

-126 Anomalous Cosmic Rays Acceleration by the Termination Shock

zhang lihua, Qin Gang *(NSSC)*

Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: Anomalous Cosmic Rays (ACRs) spectra termination shock (TS) Acceleration

When crossing the termination shock (TS), Voyager 1 and 2 observed Anomalous Cosmic Rays (ACRs) different as expected by diffusive shock acceleration. In this work, we study the ACRs acceleration by analyzing test particles rajectories from numerical solution of Newton-Lorentz quation. As a preliminary work, simple toy models of plasma, magnetic field, and TS are assumed. In addition, our modeling results of ACRs spectra will be compared with Voyager 1 and 2 observations.

-127 Study of geomagnetic cutoff rigidity of cosmic ray in higher latitudes

Chu Wei, Qin Gang *(NSSC)*

Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: geomagnetic cutoff rigidity cosmic ray

Numerical simulation has been used to study the geomagnetic cutoff rigidity of cosmic ray in middle and high latitudes during the periods of quiet and disturbance. In our work we can show that an observer can see a sudden decrease of the geomagnetic cutoff rigidity from tens of MV to several MV in higher latitudes. So we define a "magnetic hole" in which the geomagnetic cutoff rigidity of cosmic ray is smaller than a threshold value, e.g., 10 MV. It is found that the area of the "magnetic hole" is related to the conditions of interplanetary space. In this work, we will show the relationship in detail between the area of the "magnetic hole" and IMF, solar wind speed, SYM_H, and so on, in the periods of both quiet and disturbance.

-128 The cross-relations of sunspots and solar mean magnetic field during solar cycle 21-23

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Session: 2a. Long-term solar variability (magnetism, total irradiance, and spectral irradiance) and its impact on geospace and Earth

Type of presentation: poster

Key word: sunspots solar mean magnetic field

Solar variation has a profound impact on not only the space but also the earth climate related to human being. Solar magnetic evolutions are the fundamental fields for solar activity and space weather. The solar mean magnetic field (SMMF) is the average field as observed over the entire visible disk. Large-scale solar magnetic fields have been measured at Wilcox Solar Observatory since 1975 till now. The different patterns for short-term periodicities of SMMF of solar cycles was discussed (Yin Z.Q. et al, 2014).

Sunspots are caused by intense magnetic activity, and they are associated with strong magnetic fields in active region, while SMMF describe the large-scale manifestations of solar magnetism. Their daily observations are described and analyzed by using cross-wavelet transforms. The time-variable characteristics of periods of SMMF and sunspots and their cross-relations are investigated and discussed during the different phase of solar cycles. It will also contribute further related researches.

-129 Plasma motion of magnetic clouds at 1 AU

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: Plasma motion Magnetic clouds

Magnetic clouds (MCs) are the interplanetary counterparts
of coronal mass ejections (CMEs). Due to the very low value of beta in MCs, they are believed to be in a nearly force-free state and therefore are able to be modeled by a cylindrical force-free flux rope. However, the force-free state only describes the magnetic field topology without any information of the plasma motion of a MC. For a MC propagating in interplanetary space, the plasma motion has three possible components: global propagating motion of a MC away from the Sun, expanding motion and circular motion with respect to the axis of the MC. By assuming the quasi-steady evolution and self-similar expansion, we introduced the three-component motion into the cylindrical force-free flux rope model, and developed a velocity-modified new model. Then we applied the model to 73 MCs observed by Wind spacecraft to investigate the properties of the plasma motion of MCs. It is found that (1)
some MCs did not propagate along the Sun-Earth line, suggesting the direct evidence of the CME' s deflected propagation and/or rotation in interplanetary space, (2) the expansion speed is correlated with the radial propagation speed and 62%/17% of MCs underwent a under/over-expansion at 1 AU, and (3) the cicular motion does exists though it is only on the order of 10 km s−1. These findings advance our understanding of the MC' s properties at 1 AU as well as the dynamic evlotion of CMEs from the Sun to interplanetary space.

-130 Coupled Observations of Space Weather Storms in the Geospace System

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Session: 5. Space Weather Meridian Session

Type of presentation: oral

Key word: storms ionosphere radiation belts

The spheres of Geospace from the lower neutral atmosphere and ionosphere, through the plasmasphere and magnetosphere, and to the magnetopause are coupled by electro-magnetic fields and currents, by particle transport and dynamics, and by the exchange of energy and momentum among these interconnected regions. Driven by the variable and sometimes intense forcing of the solar wind, strong disturbances – storms – propagate throughout the Geospace system producing considerable space weather effects. Distributed ground-based and space based instruments monitor the drivers, processes, and effects associated with Geospace storms across the expanse of the system from the solar wind to the Earth' s surface. We examine stormtime space weather effects in both the ionosphere and magnetosphere using currently available observational systems. We demonstrate that adopting a system perspective that combines and interconnects individual measurements and phenomena can lead to a better understanding of stormtime processes and effects. We describe two examples of this approach as applied to stormtime space weather phenomena – total electron content (TEC) perturbations in the mid and high latitude ionosphere, and radiation belt enhancement and energization in the magnetosphere. Not surprisingly, we find that these two phenomena are interrelated on the system level. They constitute parts of a repeatable stepwise chain of stormtime processes which lead from the cold (fraction of an eV) electrons of the ionosphere to the multi-MeV electrons of the Van Allen radiation belts. We make use of the extensive in situ observational capabilities of the Van Allen (radiation belt) Probes and Themis spacecraft missions and the ground based instrumentation of the world-wide space weather observing networks.

-131 Shocks inside CMEs: Properties and Geo-effectiveness

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: coronal mass ejection

Fast magnetosonic shocks are often measured propagating through coronal mass ejections (CMEs) by ACE or Wind at 1 AU. There, the upstream conditions are different from that in the typical solar wind: low plasma beta, low density and sometimes, high speeds. We first discuss the properties of such shocks based on numerical simulations as well as a study of 49 such shocks during solar cycle 23. We then discuss the geo-effectiveness of such compressed CMEs.

-132 Synergy between SCOSTEP and NSF's GEM, CEDAR, and SHINE Programs

ILIA ROUSSEV *(NATIONAL SCIENCE FOUNDATION)*

Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: solar physics space sciences

This talk summarizes the GEM, CEDAR, and SHINE programs at the USA's National Science Foundation, and it discusses future synergistic activities with SCOSTEP.

-133 Evolution of the solar polar field

Jie Jiang *(NAOC)*

Session: 2a. Long-term solar variability (magnetism, total irradiance, and spectral irradiance) and its impact on geospace and Earth

Type of presentation: oral

Key word: polar field nonlinear effects

The evolution of the solar polar field has close relation with the geospace and Earth. The effects of the systematic and the random flows on the emergent sunspot groups at the solar surface cause the decay of the sunspot groups and the evolution of the solar polar field. The nonlinearities in the polar field source parameters and in the transport parameters play important roles in the modulation of the polar field, and also in the modulation of the total and the spectral irradiance. The nonlinearities in the source parameters include the cycle dependence of the latitudes and the tilt angles of the emergent sunspot groups. These nonlinearities have solid observational supports, but have not received enough attention during the past. In the talk, I will mainly present the effects of the nonlinearities in the source parameters on the polar field generation. The randomness in the source parameters and the possible cause of the peculiar cycle 23 minimum will also be presented.

-134 Study of Correlations between the Galactic Cosmic Rays (GCRs) and the Earth Cloud Properties

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: Galactic Cosmic Rays (GCRs) Earth cloud properties

Galactic Cosmic Rays (GCRs) ionize the atmosphere and increase the concentration of ions.
Ions are good cloud condensation nuclei. But it is not agreed that the GCRs has an influence on the Earth cloud properties.
In this work, we study this topic using the Neutron Monitor GCRs observation
data and cloud dataset from the International Satellite Cloud Climatology Project (ISCCP).

-135 60-year Database of Cosmic-Ray Neutron Fluxes held by WDC for Cosmic Rays

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Session: 2a. Long-term solar variability (magnetism, total irradiance, and spectral irradiance) and its impact on geospace and Earth

Type of presentation: poster

Key word: Cosmic Ray Neutron Database World Data Center

The World Data center (WDC) for Cosmic Rays was established in 1957 in RIKEN, Tokyo, as a C2 center of the ICSU WDC. This WDC has been moved to the Solar-Terrestrial Environment Laboratory, Nagoya University in 1991. The principal data held by the WDC are pressure-corrected and scale-adjusted one-hour counts of cosmic-ray neutron data which are provided by ground-based stations (about 50 at present) distributed in a wide range of the longitude and the latitude. Quality controlled data are opened through the Web page given below. This database will be useful for studies of variations of cosmic-lay flux with time scales ranging from hours to years. A long-term trend of the time variations of cosmic-ray flux in current 60 years is discussed. Beside of well-known 11-year variations of the flux, in the opposite sense of the sunspot cycle, a general increasing trend can be seen since the Cycle 23.

http://center.stelab.nagoya-u.ac.jp/WDCCR/.

-136 Mesosphere-stratosphere coupling via energetic particle precipitation

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: energetic particle precipitation (EPP) EPP-NOy stratosphere mesosphere

Polar winter descent of odd nitrogen produced by energetic particle precipitation (EPP-NOy) represents an important vertical coupling mechanism transferring the solar signal from the mesosphere and lower thermosphere down to the polar stratosphere and possibly below. While production mechanisms of EPP-NOy and dynamical processes affecting its downward transport are qualitatively well understood, uncertainties remain, however, with respect to their quantitative assessment. This talk summarizes recent progress in constraining these processes by observational data with particular emphasis on the analysis of the 10-years record of global NOy obtained from MIPAS-Envisat during 2002-2012.

-137 A study of cosmic ray flux based on the noise in raw CCD data from solar images

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: Cosmic ray flux CCD solar images Poincare map thresholding method

Usually, raw solar images of CCDs are contaminated with single-pixel noise which is considered made by cosmic ray hits. Recently, Oh et al. studied signals of solar cosmic ray flux variations by counting the number of cosmic ray traces in raw CCD solar images taken by SOHO/EIT with the method suggested by Chae and Yun. And Qin et al. studied galactic cosmic rays by despiking spacecraft energetic proton data with a robust automatic algorithm based on the Poincare map thresholding method developed by Goring and Nikora. In this work, we will use the Poincare map thresholding method to despike the raw CCD solar iamges of SOHO/EIT, then we will get cosmic ray flux by counting the number of single-pixel traces. This way, we will have a new way to get cosmic ray flux data.

-138 Response of mid-latitude ionosphere to extreme surface conditions

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Session: 3a. Geospace response to variability of the lower atmosphere

Type of presentation: oral

Key word: seeding Spread-F co-seismic effects on ionosphere

Ionospheric perturbations are dynamically forced from both above and below, the latter is more important in mid- and low latitudes. It is well known that most of the wave-like disturbances originate from the lower atmosphere and spread-F can be triggered (seeded) by such disturbances. Observational examples are shown in this report that there are indeed signatures of couplings between ionospheric spread-F and some extreme ground conditions such as typhoon landing, volcano eruption and great earthquakes. Particularly some very short lived spread-F-like phenomena often appeared after great earthquakes, which is actually a infrasonic wave package.

After the 2011 Tohoku earthquake, Anomalous magnetic variations were observed by ground magnetometers in East Asia area. Observations show that the variations can be notable at stations 2000–4000 km away from epicenter, and we define it as teleseismic magnetic disturbances (TMDs). The common morphology and time sequence at different stations are analyzed and based on the results, a possible mechanism is suggested. The mechanism for TMDs, in brief, is that Rayleigh waves after quake arrive at teleseismic sites; atmospheric disturbances (in the form of subsonic wave) are caused locally and propagate upwards into the ionosphere overhead, and then variations of ionospheric electron density induced electric current influence the magnetic field disturbances beneath. The observed time sequence of phenomena indicates that this cause-effect chain is reasonable.

-139 Waiting Times of Quasi-homologous Coronal Mass Ejections from Super Active Regions

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: poster

Key word: Coronal Mass Ejections Instabilities of Sun

Why and how do some active regions (ARs) frequently produce coronal mass ejections (CMEs)? These are key questions for deepening our understanding of the mechanisms and processes of energy accumulation and sudden release in ARs and for improving our space weather prediction capability. Although some case studies have been performed, these questions are still far from fully answered. These issues are now being addressed statistically through an investigation of the waiting times of quasi-homologous CMEs from super ARs in solar cycle 23. It is found that the waiting times of quasi-homologous CMEs have a two-component distribution with a separation at about 18 hr. The first component is a Gaussian-like distribution with a peak at about 7 hr, which indicates a tight physical connection between these quasi-homologous CMEs. The likelihood of two or more occurrences of CMEs faster than 1200 km s−1 from the same AR within 18 hr is about 20%. Furthermore, the correlation analysis among CME waiting times, CME speeds, and CME occurrence rates reveals that these quantities are independent of each other, suggesting that the perturbation by preceding CMEs rather than free energy input is the direct cause of quasi-homologous CMEs. The peak waiting time of 7 hr probably characterizes the timescale of the growth of the instabilities triggered by preceding CMEs. This study uncovers some clues from a statistical perspective for us to understand quasi-homologous CMEs as well as CME-rich ARs.

-140 Proton acceleration by interplanetary shock waves with test particle simulations

Fanjing Kong, Gang Qin, Lihua Zhang *(National Space Science Center, CAS)*

Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: proton acceleration interplanetary shock

Energetic particles enhancements at 1 AU is often associated with interplanetary shocks, which can accelerate particle's energy up to a few MeV. However, the shock acceleration mechanisms remain a puzzle. In the present work, we study protons' shock acceleration by calculating a large number of test charged particles' trajectories with a model shock. We adopt time-backward calculation to get particle energy spectrum. Furthermore, we compare our simulation results with spacecraft observations. Therefore, this work will help us to investigate the details of protons' interplanetary shock acceleration process.

-141 A Prominence Eruption Driven by Flux Feeding from Chromospheric Fibrils

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: poster

Key word: Sun:prominences Sun: filaments Sun: coronal mass ejections Sun: chromosphere Sun: corona

We present multi-wavelength observations of a prominence eruption originating from a quadrupolar field configuration, in which the prominence was embedded in a side-arcade. Within a two-day period before its eruption on 2012 October 22, the prominence was perturbed three times by chromospheric fibrils underneath, which rose upward, became brightened, and merge into the prominence, resulting in horizontal flows along the prominence axis, suggesting that the fluxes carried by the fibrils were incorporated into the magnetic field of the prominence. These perturbations caused the prominence to oscillate, slowly ascend, and finally erupt. The height-time evolution of the prominence followed an exponential increase. In the absence of intense heating, this indicates that ideal instability played a crucial role. The eruption involved interactions with the other side-arcade, leading up to a twin coronal mass ejection, which was accompanied by transient surface brightenings in the central arcade, followed by transient dimmings and brightenings in the two side-arcades. We suggest that flux feeding from chromospheric fibrils might be an important mechanism to trigger coronal eruptions.

-142 Study of solar energetic particle event timescales associated with ICMEs with numerical simulations

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: Sun: coronal mass ejections(CMEs) Sun: heliosphere

Recently, S.W. Kahler (2013) did a research on the solar energetic particle (SEP) event timescales associated with ICMEs from spacecraft data analysis. They obtained different timescales of SEP events, such as the onset time from CME launch to SEP onset, the rise time from onset to half the peak intensity (0.5Ip), and the duration of the SEP intensity above 0.5Ip. In this work, we solve SEPs transport equation considering ICME shocks as energetic particles sources. From the numerical simulations, we can also get the timescales of SEP events in different conditions. To compare our simulation results with Kahler's data analysis, we can better understand the mechanisms of SEP's transport in heliosphere.

-143 Multiple-spacecraft observation of current sheets in the solar wind

Dawei Guo, Bin Miao *(University of Science and Technology of China)*

Session: 2a. Long-term solar variability (magnetism, total irradiance, and spectral irradiance) and its impact on geospace and Earth

Type of presentation: oral

Key word: solar wind current sheet

Solar wind is a natural laboratory to study Magnetohydrodynamics (MHD) turbulency. Intermittency primarily composed of current sheet is a central topic in the solar wind. Whether it is the border of flux-tube with a “spaghetti-like” structure evolved from the solar or caused by non-linear interactions of MHD turbulence is still an open question. Interplanetary magnetic field is ‘frozen in’ into the radially expanding solar wind plasma and form so-called Parker spiral because of the solar rotation. ACE and STEREO spacecraft move in the Earth's orbit, ACE locate in L1 point and STEREO slowly drift away from the Earth in opposite directions. We can use these observers to detect directional discontinuity of the heliospheric magnetic field that have the same footpoints in the solar atmosphere successively. Current sheets identified by the three spacecraft have a similar distribution except for a time delay. So we conjecture that most of the current sheets are intrinsic in the solar wind, having a solar origin.

-144 Coupling between the lower and upper atmosphere via the convectively generated gravity waves ------From severe weather to space weather

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Session: 3a. Geospace response to variability of the lower atmosphere

Type of presentation: oral

Key word: gravity waves coupling

Atmospheric gravity waves or buoyancy waves have restoring force of gravity or buoyancy. Gravity waves are excited when an air parcel is displaced to a region with a different density. In the Earth' s atmosphere, gravity waves are one mechanism for the transfer of momentum from the troposphere to the stratosphere and up. In this talk, we combine various techniques to reveal a more complete picture of concentric convectively-excited gravity waves simultaneously in the stratosphere and mesosphere. The ground-based instrument used is an OH all-sky imager in Colorado. Three nadir-viewing instruments on NASA satellites are the Atmospheric Infrared Sounder (AIRS) on Aqua, Cloud Imaging and Particle Size (CIPS) on the Aeronomy of Ice in the Mesosphere (AIM) and the Visible Infrared Imaging Radiometer Suite (VIIRS) on Suomi NPP satellites. The third instrument, the Day/Night Band Imager on VIIRS, measures the broadband airglow emissions directly or reflected back by clouds. We will present the observations of gravity waves observed in the upper atmosphere over various severe weather systems, such as devastating tornados, hurricanes, tropical cyclones, thunderstorms, Super Typhoon Haiyan, etc. The modulation of the ionospheric electron density by upward propagating concentric gravity waves will also be introduced.

-145 Postmidnight bubbles and scintillations in the quiet-time June solstice: possible forcing from lower atmosphere

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Session: 3a. Geospace response to variability of the lower atmosphere

Type of presentation: oral

Key word: Postmidnight Equatorial bubbles

While the mechanism for producing plasma irregularities in the dusk sector is believed to be fairly well understood, the cause of the formation of irregularities and bubbles during the postmidnight sector is still unknown, especially for magnetically quiet periods. This paper presents a case study of the strong postmidnight bubbles that often occur during magnetically quiet periods primarily in June solstice, along with a 4 year (2009–2012) statistical study that shows strong occurrence peak during June solstice predominantly in the African sector. We also confirm, for the first time, the presence of Rayleigh-Taylor (RT) instability during postmidnight hours by using the physics-based model for plasma densities and RT growth rates. Finally, we consider several possible sources of the eastward electric fields that permit the RT instability to develop and form bubbles in the postmidnight local time sector. This includes the upwelling of charged dust particles from the Sahara desert (the largest desert in the world) that could contribute to the abundance of sporadic E-layer in the June sector which may explain the cause for the predominance occurrence of strong postmidnight plasma density irregularities in the African sector.

-146 Longitudinal Variability of Equatorial Electrodynamics and Ionospheric Density Irregularities

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Session: 3c. Regional, hemispheric and inter-hemispheric couplings and transport in the atmosphere

Type of presentation: oral

Key word: Ionospheric irregularities Electrodynamics

With the increasing reliance on technology, the impact of space weather will certainly increase unless suitable protective measures are taken. Understanding the physics behind each space weather impacts and improving the forecasting is a major objective of the space science community. While the formation of equatorial electrojet (EEJ) and its temporal variation is believed to be fairly well understood, the longitudinal variability at all local times is still unknown. This paper presents a case and statistical study of the longitudinal variability of dayside EEJ for all local times using ground-based observations. We found EEJ is stronger in the west-American sector and decreases from west to east longitudinal sectors. We also confirm the presence of significant longitudinal difference in the dusk sector pre-reversal drift, using the ion velocity meter (IVM) instrument onboard the C/NOFS satellite, with stronger pre-reversal drift in the west-American sector compared to the African sector. Both satellite and recently deployed ground-based instruments observations have shown that the African sector is home to stronger and year-round ionospheric bubbles/irregularities and scintillations compared to the American and Asian sectors. This study' s results raises the question if the vertical drift, which is believed to be the main cause for the enhancement of Rayleigh-Taylor (RT) instability growth rate, is stronger in the American sector and weaker in the African sector – why are the occurrence and amplitude of equatorial irregularities stronger in African sector?

-147 The Automatic Recognition and Trace of Coronal Mass Ejections Based on Images

Zhuang Bin, Wang Yuming, Shen Chenglong, Li Huimin, Pan Zonghao *(USTC)*

Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: poster

Key word: Coronal mass ejections J-map Hough transform Ice-Cream Cone model

CMEs (Coronal Mass Ejections) is one of the most violent eruptive activities in the solar atmosphere, they have a great impact on the space environment and human activities. Therefore, the prediction of CMEs with more extensive human activities seems more important, while

the recognition of CMEs can provide a lot of convenience for its forecast. At present, there are some automatic recognition methods like SEEDS (Solar Eruptive Event Detection System, Olmedo et al., 2008) and CACTus (Computer Aided CME Tracking Software package, E.Robbrecht et al., 2004). These provide some good ideas for the automatic recognition of CMEs, but there also exists recognition mistakes: for example, a Halo-CME always be seemed as multiple CMEs in SEEDS. Therefore, it is necessary to improve the accuracy of recognition, especially for Halo-CME.

The main work of this paper consists of two parts:First, the use of observational data from LASCO C2 and C3 can generate each azimuth Jmap (time, height) array. We use Hough transform method to identify the presence of CMEs in J-map and work out the velocity in the projection plane and start propagation time of one CME by linear fitting; Second, by finding out each azimuth CME and its propagation parameters, we achieve the tracking process in coronagraph, and the use of Ice-Cream Cone model(Xue et al., 2005) is proposed to work out the CME propagation parameters in real space, which provides further detailed data for CME forecast.

On this basis, we get the following significant results:

1. In our recognition process, someone only need to enter a period of time to automatically obtain the LASCO C2 and C3 data and generate Jmap array. Besides, the recognition can be achieved easily by Hough transform.
2. We achieve the CME tracking while using Ice-Cream Cone model based on the recognized CME velocity in the projection plane to fit the CME propagation parameters in the real space, which can provide more basic data for the CME forecast.
3.After working out the recognition of the CME on 2013/12/26 and comparing the results with SEEDS, we find that ours and SEEDS both can recognite the CME accurately, but the tracing of CME of ours is better. Besides, we find that our method can give the accurate recognition of a CME in 2012/10/05 which SEEDS identifies it as multiple CMEs.

-148 Terrestrial radio emission: From the ground into "outer space"

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Session: 2c. Coronal and Interplanetary radio bursts including auroral kilometric radiation

Type of presentation: oral

Key word: Whistlers VLF whistler mode waves Manmade VLF transmitters Impact on radiation belts

Radio waves occur naturally in space, as well as propagating into space from the ground. Electromagnetic waves in the VLF range play an important role in the acceleration and loss of energetic electrons in both the inner and outer Van Allen radiation belts. Whistler mode waves known as chorus and plasmaspheric hiss are believed to be the dominant drivers of electron acceleration and loss in the outer radiation belt. They act as a mechanism through which energy coupling can occur, whereby comparatively low energy particles with eV to keV energies are accelerated to vastly higher energies (hundreds of keV to MeV). The most effective of these VLF waves are naturally generated from processes occurring in space. However, there are also VLF electromagnetic waves propagating into space from the ground which play significant roles in the inner magnetosphere. Such waves are believed to be important drivers of loss in the inner radiation belt and slot region. In this talk I will focus on lightning-generated whistlers, and transmissions from manmade VLF transmitters, both of which propagate into space.

Whistlers occur as the result of dispersion of the broadband electromagnetic radiation pulse from lightning. The dispersion results from the wave propagating through a magnetoactive plasma. Whistlers (from lightning) are the "prototype" wave for the entire class of whistler mode waves. Whistlers pitch angle scatter inner belt electrons into the bounce loss cone, causing their precipitation into the atmosphere, and are thus believed to be an important driver of inner belt electron loss. As such, whistlers provide a coupling between near-ground lightning discharges, the inner Van Allen radiation belt ~10,000 km above, and the upper atmosphere/ionospheric D-region. As the dispersion of whistlers is strongly dependent upon the cold plasma density they have long been used to remote sense the plasmasphere, and indeed were used to first identify the plasmapause. Recent advances mean that near real-time plasmasphere density measurements are now possible from automatic identification and analysis of whistlers.

The inner radiation belt and slot region are also affected by broadcasts from manmade VLF transmitters. For some time it has been suggested these transmitters might be significant drivers of inner belt electron losses. More recent analysis has identified that although manmade VLF transmitters do produce clear but weak scattering of electrons into the drift loss cone, they are not important as a major loss process. However, these transmissions do provide a good test bed for our overall understanding of propagation, absorption and interactions in the plasmasphere and the radiation belts.

-149 Long Term Determination of Variations in Energetic Electron Precipitation into the Atmosphere using AARDDVARK

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: Energetic Electron Precipitation Radiation Belt Losses Earth Impact Remote Sensing by AARDDVARK

Energetic electron precipitation (EEP) is an important loss mechanism in the dynamic radiation belts. Obtaining accurate precipitating flux measurements is necessary for the understanding, modeling, and analysis of the spatial and temporal belt dynamics, their impact on the atmosphere, and ultimately climate. Recent studies have demonstrated that EEP commonly drives significant HOx increases and subsequent ozone depletions in the mesosphere.

In this study we analyze observations of subionospherically propagating very low frequency (VLF) radio waves to determine EEP flux magnitudes from the outer radiation belt through their influence on the lower ionosphere. We analyze data from a radio wave receiver located in Sodankyl, Finland (SGO), part of the Antarctic-Arctic Radiation-belt Dynamic Deposition VLF Atmospheric Research Konsortia (AARDDVARK), which observes VLF radio signals from the US high-power narrow-band communication transmitter with call sign NAA located in Culter, Maine. We use a near-continuous dataset of NAA-SGO observations spanning from November 2004 until December 2013 to determine the long time period variation of EEP into the atmosphere. This propagation path covers 3<L<8, i.e., the footprint of the outer radiation belts.

We determine quiet day curves (QDC) over the entire time period and use these to identify amplitude perturbations due to the ionospheric disturbances caused by EEP. Modeling of VLF radio wave propagation is used to estimate the electron fluxes precipitating into the atmosphere from the observed amplitude perturbations. We find that using a dynamically varying energy spectral gradient for the precipitating fluxes in the modeling gives improvements in the extracted EEP flux magnitudes compared to the fixed gradient approach used in previous studies. Our method performs well during the summer months when the day-lit ionosphere is the most stable. However, our approach is currently unusable during the winter-time. During the summer months only we have obtained more than 650 days worth of "reasonable" NAA-SGO fluxes over the 2004-2013 period. These fluxes agree well with POES bounce loss cone measurements made during large EEP events. Our method of EEP detection is more sensitive than possible with the existing POES satellite instruments, measuring flux magnitudes below the noise floor of the POES instruments.

-150 Differences among ozone lamina characteristics expressed in partial pressure and mixing ratio.

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Session: 3b. Trends in the entire atmosphere, including anthropogenic aspects

Type of presentation: poster

Key word: ozone laminae partial pressure, mixing ratio

In the study of ozone laminae many authors use partial pressure as a measure of abundance in layers during ascent of ozone sonde. In this case the occurrence of strong ozone laminae (>40 nbar) has strong seasonal cycle with maximum in spring and minimum in fall. Laminae have also sharp area of their vertical occurrence which is situated in the lower stratosphere up to ozone maximum in vertical profile. In this poster we express the ozone laminae in mixing ratio which has maximum in its vertical profile above the heights of balloon bursting. We search for differences in heights of occurrence of maxima in positive ozone laminae and its annual cycle.

-151 Registration of the atmospheric background and burst gamma radiation on board the Russian Segment of the International Space Station

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Session: 3b. Trends in the entire atmosphere, including anthropogenic aspects

Type of presentation: poster

Key word: atmosphere gamma bursts

The report describes data on the energy spectra of gamma radiation in the range of 0.3-1.0 MeV recorded continuously in 2011 on board the Russian Segment of the International Space Station. About 500 thousand energy spectra with a time resolution of 16 μs characterized by a large variety of time profiles and amplitudes were obtained for 232 full days of measurements. The data obtained allow us to study the spectrum of background gamma radiation and its latitude and longitude distribution, to identify gamma-ray bursts (Terrestrial Gamma Flashes - TGF), and to study their sources and their relation to thunderstorm activity and other high-energy atmospheric phenomena.

-152 Thermosphere response to stratospheric sudden warmings

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Session: 3a. Geospace response to variability of the lower atmosphere

Type of presentation: oral

Key word: thermosphere dynamics stratosphere sudden warming

Stratospheric sudden warming (SSW) is a dramatic meteorological event in the winter polar stratosphere. SSW impact on the upper atmosphere has been discovered in recent years, owing to rapidly growing satellite and ground observations. The ionosphere electrodynamical changes during SSWs are pronounced and widely reported. In contrast, the thermosphere changes are less prominent and hence difficult to observe due to its large background mass and heat capacity. However, it has an important impact on the ionosphere via its compositional change and global circulation.

This talk will summarize recent advances on the thermosphere response to SSWs by reviewing observations and model simulations. This includes the thermosphere response to SSW using observations and its possible contribution to ionospheric responses (GRL doi:10.1029/2011GL047898). The local time variation of the thermosphere response and the global mean cooling revealed by the GAIA model (doi:10.1002/grl.50146) and the zonal mean effect of the SSW on thermosphere and the physical mechanisms for the global mean cooling (doi:10.1002/2014JA020222). These results provide an urgently needed global context to order and synthesize ground and satellite observations.

-153 Estimation of the release time of solar energetic particles near the Sun

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: Solar Energetic Particle Velocity Dispersion Analysis

This paper investigates the onset time of Solar Energetic Particle (SEP) events with numerical simulations based on solving a focused transport equation in the three- dimensional Parker Interplanetary Magnetic Field (IMF), and analyses the accuracy of the Velocity Dispersion Analysis (VDA) method. We calculate the fluxes of protons observed at 1 AU equatorial plane in energy range between 10 MeV and 80 MeV. Three models are used to
describe different SEP sources produced by flare or oronal shock, and the effects of particle perpendicular diffusion
in the interplanetary space are also studied. We have the following findings: (1) When the observer is connected to the source by IMF, the effects of particles propagating
in the solar atmosphere and perpendicular diffusion in the
interplanetary space have little influence on the VDA results; (2) If SEPs are accelerated by a flare,
the VDA method is invalid when the observer is far from SEP source, because particles must spend some time on leaving the source to the observer' s field line with the effect of propagating in the solar atmosphere or
perpendicular diffusion in the interplanetary space; and (3) If SEPs are accelerated by a large coronal shock,
the VDA results would change with observer' s location unless the time profile of SEP source is the same at different point of the shock front.

-154 A NUMERICAL SIMULATION OF SOLAR ENERGETIC PARTICLE DROPOUTS DURING IMPULSIVE EVENTS

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: Solar Energetic Particle (SEP) Heliosphere

This paper investigates the rapid ariations of solar energetic particle (SEP) intensity,
a process known as "dropouts." In particular, we use numerical model
simulations based on solving the focused transport equation in the three-dimensional Parker interplanetary magnetic field. In order to reproduce the phenomenon of SEP dropouts, our calculations of the temporal intensity profile of 0.5 and 5 MeV protons at the Earth show that the perpendicular diffusion must be small while the parallel mean free path is long. When the observer is located at 1 AU, the perpendicular to parallel diffusion ratio must be below 10^(-5) if we want to see the particle flux
dropping by at least several times within 3 hr. When the observer is located at a larger solar radial distance, the perpendicular to parallel diffusion ratio for reproducing the dropouts should be even lower than that in the case of 1 AU distance. A shorter parallel mean free path or a larger radial distance from the source to observer will cause the particles to arrive later, making the effects of perpendicular diffusion more prominent and SEP dropouts disappear. All of these effects require the magnetic turbulence that resonates with the particles to be low
everywhere in the inner heliosphere.

-155 Observational study of solar vector magnetic field and helicity

Hongqi Zhang *(National Astronomical Observatories of China)*

Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: Vector magnetic field Solar flare-CMEs Helicity

I would like to discuss the observational study of vector magnetic fields in solar active regions. The observation of photospheric vector magnetic fields provides the important message of the non-potential field and the relationship with solar flare-CMEs. The helicity is an important key parameter to present the basic topological configuration of magnetic field in solar atmosphere.
The relationship between the non-potentiality of magnetic field and solar flare-CMEs, and the different scale of magnetic helicity and helcity time evolution with solar activities have been presented in the talk by means of the observational solar vector magnetograms. The questions on the study of observational vector magnetic field and helicity have been discussed also.

-156 Solar activity impact on ionosphere-atmosphere coupling in the East Asian region

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Session: 3c. Regional, hemispheric and inter-hemispheric couplings and transport in the atmosphere

Type of presentation: oral

Key word: ionosphere-atmosphere coupling geomagnetic storms stratospheric warming

The paper presents studying ionospheric effects of geomagnetic storms and stratospheric warming events in the East Asian region.
Irkutsk incoherent scatter radar allowed us to study both positive and negative effects of geomagnetic storms in electron density and electron temperature as well as coherent echo phenomena that were observed during main and recovery storm phases on the background of both positive and negative electron density disturbances.
Using the numerical model of ionosphere-plasmasphere interaction (developed in the Institute of Solar-Terrestrial Physics) we performed modeling ionospheric responses to geomagnetic storms observed with ionosondes in the East Asian region. The model results showed that the mid-latitude response is mainly caused by changes in neutral composition of the atmosphere, whereas the auroral and subauroral response is attributed to the joint action of the convection and energetic electron precipitations. The special simulation allowed us to estimate the role of the thermospheric wind and the electromagnetic drift in the formation of low-latitude ionospheric response.
Using the data of ionosondes in the East Asian region and the meteorological NCEP/NCAR and UK Met Office reanalysis data we have studied the impact of the neutral atmosphere dynamical processes on the ionosphere during sudden stratospheric warming events. The analysis showed that ionospheric response depends on the ionosonde position relatively to the stratospheric circulation pattern. A negative effect in the critical frequency and a positive effect in the peak height were observed above the border of stratospheric cyclone and anticyclone with northward flow direction, and an opposite pattern was observed above the centre of stratospheric cyclone.
Using spectrometric measurements of the OH and O2 upper atmospheric emissions, the Aura MLS satellite temperature data, and the data of Irkutsk incoherent scatter radar we carried out a comprehensive analysis of sudden stratospheric warming manifestations in a large height range. The analysis showed that stratospheric temperature disturbances were accompanied by increase in the intensities of the OH and O2 emissions (MLT heights), decrease in the daytime meridional wind velocity, and significant disturbances of the electron density, electron and ion temperatures (thermospheric heights). Revealed results may indicate a coupling between the lower and upper atmosphere.

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-157 The Successful Beginning of Chinese Meridian Project

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Session: 5. Space Weather Meridian Session

Type of presentation: oral

Key word: Space weather Ground-based observation Merdian Project

The Meridian Project is a ground-based network program to monitor Solar-Terrestrial space environment, which was designed to run 11 years and consists of a chain of ground-based observatories with multiple instruments including magnetometers, ionosondes, HF and VHF radars, Lidars, IPS monitors, sounding rockets etc. Instruments are approximately arranged along 120◦E meridian and 30◦N latitude circle. As a result of 4 years effort, the Meridian Project has been successfully established. So far, about 1800 gigabyte monitoring data were obtained during its partial test run from 2010 and later plenary science operation after completion of its construction in October of 2012. The data set is made available to public via a dedicated data center, and has been used widely by scientists from various fields, especially those Chinese space scientists. According to an incomplete statistic, totally 155 papers were published and 5 patents were registered till the end of 2013, that use the data set or facilities of the Meridian Project. Among them, some brilliant achievements have contributed substantially to the science knowledge base, such as observation of ionosphere response to the great Tohoku earthquake, evidence for double sodium layers, direct observation of evolution of polar cap ionization patches, and so on. The Meridian Project has also been providing monitoring data to space weather forecasting service, including that of two forecasting platforms funded by the project itself. This talk presents an overall introduction of the Meridian Project, and focuses on selected scientific and technology achievements has been made taking advantage of the project.

-158 The Sonmiani geomagnetic field effects due to high speed solar wind stream emanating from coronal holes during 2010

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Session: 1b. Origin, evolution, and Earth impact of high speed streams

Type of presentation: oral

Key word: Coronal Hole High Speed Streams Sonmiani geomagnetic observatory solar minimum K index

The enhancement of geomagnetic field activity at Sonmiani Geomagnetic Observatory (25.20° N, 66.75° E) in Pakistan as a result of high speed solar wind stream speed emanating from coronal holes is studied here. 06 Coronal Hole High Speed Stream (CHHSS) events were identified in the solar minimum period of 2010. The events were selected lying within the solar wind speed range of 600-750 km/s. In three of the events, the local K index rose to 5 causing geomagnetic field variations of up to 195 nT while the Kp indices went up to 6. The Dst indices reached a value of -85 nT. 42.86% of the events had K indices as 5 and 57.14% of the events had K-indices as 4.

-159 Natural forcings of NAO long-term changes

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Session: 3b. Trends in the entire atmosphere, including anthropogenic aspects

Type of presentation: poster

Key word: North Atlantic Oscillation - NAO long-term variations geomagnetic activity climatic change

Long-term variations in the North Atlantic Oscillation (NAO) have been linked by several authors to natural external forcings, such as geomagnetic activity. In fact, the NAO is an internal mode of variability of the atmosphere which may be modulated by several external forcings such as aerosols due to volcanic eruptions, anthropogenic influences on the atmospheric composition, and also solar activity variations through the effects of geomagnetic storms over the atmosphere. In this work we analyze the correlation between the NAO and the geomagnetic aa index in long-term time scales. We obtain significant correlations which may be explained through upper atmosphere processes induced by geomagnetic storms and followed by coupling mechanisms among the different atmosphere regions, reaching finally the troposphere. Understanding and interpreting the causes of atmospheric variability, such as the NAO in this case, requires a fundamental understanding of the atmosphere response to solar variations. This is an essential focus of climate science, which is seeking to determine the extent to which human activities are altering the planetary energy balance through the emission of greenhouse gases and pollutants.

-160 Predicting the magnetic vectors within coronal mass ejections arriving at Earth

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: Coronal Mass Ejections Bz forecast

The process by which the Sun affects the terrestrial environment on short timescales is predominately driven by the amount of magnetic reconnection between the solar wind and Earth' s magnetosphere. Reconnection occurs most efficiently when the solar wind magnetic field has a southward component. The most severe impacts are during the arrival of a coronal mass ejection (CME), when the magnetosphere is both compressed and magnetically connected to the heliospheric environment, leading to disruptions to, for example, power grids and satellite navigation. Unfortunately, forecasting magnetic vectors within coronal mass ejections remains elusive. Here we report how, by combining a statistically robust helicity rule for a CME' s solar origin with a simplified flux rope topology the magnetic vectors within the Earth-directed segment of a CME can be predicted. These magnetic vectors can be incorporated into forecasting procedures to predict the global response measured by the Kp index more reliably. In particular, false predictions of strong geomagnetic events made without magnetic field information are considerably reduced. As an example, the forecast strength of a geomagnetic storm following a CME on 7 January 2014, is reduced from G3 (strong) to G1 (minor) on the NOAA scale when magnetic vectors are taken into account.

-161 COMPARISONS OF CHARACTERISTICS OF MAGNETIC CLOUD AND CLOUD-LIKE STRUCTURES DURING 1995-2012

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: Magnetic cloud Sunspot number Interplanetary magnetic field Geomagnetic activity Magnetic cloud-like structure

Using eighteen years (1995-2012) of solar wind plasma and magnetic field data (observed by Wind spacecraft), solar activity (e.g., sunspot number: SSN), and geomagnetic activity index (Dst), we have identified 168 magnetic clouds (MCs) and 197 magnetic cloud-like structures (MCLs). The following features are found during seven different periods (PT: whole period during 1995-2012, P1 and P2: first and second half period during 1995-2003 and 2004-2012, Q1 and Q2: quiet periods during 1995-1997 and 2007-2009, A1 and A2: active periods during 1998-2006 and 2010-2012). (1) During 1995-2012 the yearly occurrence frequency is 9.3 for MCs (<NMCs>PT = 9.3) and 10.9 for MCLs (<NMCLs>PT =10.9). (2) In the quiet periods, <NMCs>Q1,Q2 is higher than <NMCLs> Q1,Q2 (i.e., <NMCs>Q1 > <NMCLs>Q1 and <NMCs>Q2 > <NMCLs>Q2), but <NMCs> Q1,Q2 is lower than <NMCLs> during the active periods (i.e., <NMCs>A1 < <NMCLs>A1 and <NMCs>A2 < <NMCLs>A2). This is probably due to the lower interaction rate between MCs/MCLs and the quiet background solar wind during lower solar active periods (in Q1,Q2), and higher interaction rate and highly disturbed background solar wind during the active periods (in A1 and A2). (3) The minimum Bz (Bzmin) inside of a MC is well correlated with the intensity of geomagnetic activity, Dstmin (minimum Dst found within a storm event) for MCs (correlation coefficient, c.c. = 0.75 and the fitting function is Dstmin = -1.74+ 7.23 Bzmin), but Bzmin is not well correlated with MCLs (c.c. = 0.57 and the fitting function is Dstmin = -9.88+ 4.53 Bzmin). (4) MCs play a major role in producing geomagnetic storms: the absolute value of the average Dstmin for MCs (<Dstmin>MC = -70 nT) associated geomagnetic storms is almost 2 times stronger than MCLs (<Dstmin>MCL = -35 nT) due to the difference in the IMF (interplanetary magnetic field) strength. (5) The SSN is not correlated with <NMCs>PT (c.c. = 0.27), but is well associated with <NMCLs>PT (c.c. = 0.85). Note that the c.c. for SSN vs. <NMCs>P2 is better than that for SSN vs. <NMCLs>P2. (6) Averages of IMF, solar wind speed, and density inside of the MCs are larger than those are inside of the MCLs. (7) Average of MC duration (~18.82 hours) is ~20% longer than the average of MCL duration (~15.69 hours).

-162 Detecting geomagnetic activity effects on precipitation and circulation patterns

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Session: 3b. Trends in the entire atmosphere, including anthropogenic aspects

Type of presentation: oral

Key word: precipitation geomagnetic activity long-term variability climatic change

A plausible natural mechanism explaining an association between precipitation and geomagnetic activity consists of a link of processes which begins in the upper atmosphere and ends in alterations of atmospheric circulation patterns in the troposphere. In the present work we analyze this mechanism to explain precipitation trends in different regions associated to long-term variability of geomagnetic activity. Due to the nature of the processes that lead to precipitation, the discernment between natural and anthropogenic effects, which certainly affect precipitation worldwide, and the link between precipitation and geomagnetic activity are highly complex and hard to detect. A theoretical and a statistical analysis are made using monthly mean precipitation time series together with solar and geomagnetic activity indices. The aim of this work is to convey the importance of recognizing and quantifying the different forcings determining precipitation long-term variations.

-163 What determines properties of the solar wind ?

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Session: 1b. Origin, evolution, and Earth impact of high speed streams

Type of presentation: oral

Key word: solar wind MHD simulation Alfven wave coronal heating surface convection

We investigate how properties of the solar wind are determined by the convection and the magnetic field on the solar surface.
We performed forward-type self-consistent MHD numerical experiments for Alfvén wave-driven solar winds with a wide range of input Poynting flux from the photosphere, aiming at extreme conditions of the heliosphere.
The mass flux of the solar wind sensitively depends on the magnetic field strength and the turbulent velocity at the stellar photosphere, because the reflection and the nonlinear dissipation of Alfvén waves are affected largely by the background properties of the solar winds.
Based on these findings, we discuss how the properties of the solar wind change according to varying magnetic field and surface convection of the Sun and applications to space weather forecast.

-164 Long-term trends in ionospheric currents as a response to natural and anthropogenic forcings

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Session: 3b. Trends in the entire atmosphere, including anthropogenic aspects

Type of presentation: oral

Key word: ionospheric currents long-term trends Earth's magnetic field upper atmosphere

Ionospheric currents, specifically solar-quiet current systems (Sq) and the equatorial electrojet (EEJ), are a complex and highly dynamic system. These currents depend on ionospheric conductivities and other parameters which vary with the Earth' s main magnetic field and greenhouse gases concentration, among other long-term trend forcings. The response of Sq and EEJ to a natural forcing, such as secular changes in the Earth' s magnetic field, and to the anthropogenic forcing that is the increasing greenhouse gases concentration, is studied in the present work. A theoretical as well as an experimental analysis is carried out in order to determine to which extent each forcing mechanism is responsible for the observed trends in the context of other trend sources. The quantification of natural and anthropogenic effects on trends is an important contribution to one of the present focus of climate science that is the determination of the extent to which human activities are altering the planetary energy balance.

-165 Helicity Observation with Vector Magnetograph and Flare

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Session: 2b. Origin of solar flares and their impact on Earth’ s ionosphere/atmosphere

Type of presentation: oral

Key word: vector magnetic field helicity flare

The distribution and evolution of helicity observed with long-term vector magnetograms are reviewed. Consequently, some recent relevant observation of net current in active region with opposite polarity will be reported as well as the relationship of a relevant parameter to the flare will be introduced.

-166 High-speed streams evolution and corresponding instabilities in the surrounding heliospheric plasma

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Session: 1b. Origin, evolution, and Earth impact of high speed streams

Type of presentation: oral

Key word: High-speed streams instabilities

High-speed streams in the inner heliosphere are investigated for many years. However, peculiarities of their propagation are still poor-known because of lack of observations above the ecliptic plane. This leads to necessity of combination both theoretical and experimental investigations of evolution of such structures in order to understand their impact on the surrounding plasma. There are many questions remaining unanswered, regarding the process of their propagation. Both ICMEs and quasi-stable high-speed streams like coronal holes-related flows significantly disturb the media and result into excitation of numerous instabilities and turbulence, which are often associated with corotating interaction regions, framing the way of those flows. Areas involved in these processes may be very large, and their dimension depends on the combination of properties of both the propagating flows and surrounding solar wind. We discuss the theoretical interpretation of observational results in the framework of collisionless MHD approach, which may be applied to the description of Kelvin-Helmholtz large-scale instability and instabilities of temperature-anisotropic plasma at edges of high-speed streams at different latitudes and distances from the Sun. The Ulysses spacecraft, near-Earth spacecraft like STEREO, WIND and ACE data will be combined with SMEI-STEL observations, giving a possibility to analyze a 3-D picture of the investigated processes.

-167 Thermospheric wind observations and simulations

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Session: 5. Space Weather Meridian Session

Type of presentation: oral

Key word: Thermospheric Winds Fabry-Perot interferometer TIEGCM

Thermospheric winds are an important parameter for understanding space weather and its effect on the ionosphere. Over the years NCAR has accumulate ground based Fabry-Perot interferometer (FPI) observations from high latitudes to mid latitudes to study the thermospheric dynamics. At the same time, modeling effort for the thermosphere and ionosphere is also progressing. NCAR has a long history developing the first principle upper atmosphere model the NCAR Thermosphere Ionosphere Electrodynamics General Circulation Model (TIEGCM), which is a widely used community model. Because the thermosphere and ionosphere are greatly affected by the geomagnetic and solar activities, the TIEGCM model uses geomagnetic index or solar wind inter-planetary parameters based high latitude ion convection model as a driver. In general the TIEGCM can describe the average behavior of the thermosphere and ionosphere very well. There are large discrepancies between observations and simulations, particularly during geomagnetically active periods. In this report, we report our effort to improve the TIEGCM to better simulate the thermospheric winds from high to mid latitudes. The simulation results will be validated with FPI observations.

-168 The Influence of Very Large Solar Proton Events on the Mesosphere and Stratosphere

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: solar proton event mesosphere stratosphere ozone

Solar proton events (SPEs) can cause changes in constituents in the Earth' s polar mesosphere and stratosphere. A number of large SPEs have occurred over the past 50 years and tend to happen most frequently near solar maximum. The protons in extremely large SPEs occurring in 1972, 1989, 2000, 2001, and 2003 initiated long-lasting atmospheric changes. The highly energetic protons caused ionizations, excitations, dissociations, and dissociative ionizations of the background constituents. Complicated ion chemistry leads to HOx (H, OH, HO2) production and dissociation of N2 leads to NOy (N, NO, NO2, NO3, N2O5, HNO3, HO2NO2, ClONO2, BrONO2) production. Both the HOx and NOy increases can result in changes to ozone in the stratosphere and mesosphere. The HOx increases lead to short-lived (~days) ozone decreases in the mesosphere and upper stratosphere. The NOy increases lead to long-lived (~several months) stratospheric ozone changes because of the long lifetime of NOy constituents in this region. The very large July 2000 SPE occurred fairly recently, is well-studied, and was the third largest in the past fifty years, when comparing NOy production. This SPE led to observations and computations of short-lived HOx-caused polar mesospheric ozone decreases >70% as well as calculations of long-lived NOy-caused polar upper stratospheric ozone decreases >20%. Intriguingly, our global model also simulated SPE-caused polar lower stratospheric ozone increases >10% in the Southern Hemisphere due to the July 2000 SPE. These impacts were due to interference by enhanced NOy constituents with the chlorine and bromine catalytic cycles for ozone, leading to a long-lived increase in ozone several months after the very large event. Other very large SPEs in 1972 (August), 1989 (August, October), 2000 (November), 2001 (September, November), and 2003 (October, November) led to similar polar atmospheric effects. Polar total ozone depletions up to 3% were simulated in both hemispheres for extended periods of time (several months) as a result of the NOy enhancements due to the very large SPEs in 1972, 1989, 2000, 2001, and 2003. Although such changes are small and are not observable in the total ozone record, they need to be understood and quantified in order to calculate the magnitude of the ongoing anthropogenically-caused ozone changes due to chlorine and bromine.

-169 Compound Effect of Alfvén Waves and Ion-cyclotron Waves on Heating/Acceleration of Minor Ions via the Pick-up Process

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: Alfven waves nonresonant pick up

A scenario is proposed to explain the preferential heating of minor ions and differential streaming velocity between minor ions and protons observed in the solar corona and in the solar wind. It is demonstrated by test particle simulations that minor ions can be nearly fully picked up by intrinsic Alfvén-cyclotron waves observed in the solar wind based on the observed wave energy density. Both high frequency ion-cyclotron waves and low frequency Alfvén waves play crucial roles in the pick-up process. A minor ion can first gain a high magnetic moment through the resonant wave-particle interaction with ion-cyclotron waves, and then this ion with a large magnetic moment can be trapped by magnetic mirror-like field structures in the presence of the lower-frequency Alfvén waves. As a result, the ion is picked up by these Alfvén-cyclotron waves. However, minor ions can only be partially picked up in the corona due to low wave energy density and low plasma beta. During the pick-up process, minor ions are stochastically heated and accelerated by Alfvén-cyclotron waves so that they are hotter and flow faster than protons. The compound effect of Alfvén waves and ion-cyclotron waves is important on the heating and acceleration of minor ions. The kinetic properties of minor ions from simulation results are generally consistent with in situ and remote features observed in the solar wind and solar corona.

-170 High Speed Streams and their Impact on Earth

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Session: 1b. Origin, evolution, and Earth impact of high speed streams

Type of presentation: oral

Key word: magnetic storms radiation belts

Episodes of southward interplanetary magnetic field (IMF) that lead to disturbed geomagnetic conditions are associated with either (i) coronal mass ejections (CMEs) that possess long and continuous negative IMF Bz excursions, or (ii) with high speed solar wind streams (HSS) whose geoeffectiveness is due to Bz profiles fluctuating about zero with various amplitudes and duration. HSS have their origins in the outflow from coronal holes and dominate the interplanetary medium during the declining phase of the solar cycle and solar minimum. HSS interact with upstream slower solar wind to form magnetic compression regions called corotating interaction regions (CIRs). These CIRs cause recurrent magnetic storms at Earth. Such storms exhibit exceptionally long recovery phases lasting from many days to weeks. Due to the extended period of geomagnetic activity, it is estimated that the energy input to the magnetosphere during HSS is comparable to the energy input during CMEs. Although HSS cause relatively weak to moderate magnetic storms, their effect on the radiation belts is surprisingly strong. Why high speed streams cause this response is not well understood and this is one of the science objectives of the recently launched Van Allen Probes mission. HSS deliver a superdense plasma from the solar wind that is observable in the magnetosphere shortly after magnetospheric convection onset. This plasma sheet population is convected earthward in a period of few hours and its energization leads to the formation of an enhanced ring current. The occurrence of this superdense plasma is strongly correlated with a dropout in the outer electron radiation belt flux, as measured at geosynchronous orbit, and with the occurrence of a plasmaspheric drainage plume. Recently, the enhancement of radiation belt fluxes during some HSS has also been associated with acceleration of relativistic electrons by whistler mode waves. Study of these physical processes is an active and on-going area of research.

-171 Wavelength dependence of solar irradiance enhancement during flares and its influence on the upper atmosphere

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Session: 2b. Origin of solar flares and their impact on Earth’ s ionosphere/atmosphere

Type of presentation: oral

Key word: flares Energy distribution NO cooling

The wavelength dependence of solar irradiance enhancement during flare events is one of the important factors in determining how the Thermosphere–Ionosphere (T–I) system responds to flares. To investigate the wavelength dependence of flare enhancement, the Flare Irradiance Spectral Model (FISM) was run for 61 X-class flares. While X-ray irradiance energy increases much more than EUV, the impact of solar irradiance enhancement on the thermosphere at 400 km is largest for the EUV band, which is due the difference of the energy distribution and influence on the Nitroxide (NO).

-172 Storm-time variations of thermospheric O/N2 and NO

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Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: oral

Key word: geomagnetic storm thermospheric composition FUV observation

Storm-time intense particle precipitation and Joule heating cause enhanced nitric oxide (NO) production and significant reduction in O/N2 ratio in the thermosphere. Simultaneous NO column density and O/N2 column density ratio from measurements by Global Ultra-violet Imager (GUVI) on TIMED satellite reveal two important features: (1) Storm-time O/N2 depletion and NO enhancement extend from high to mid and low latitudes. They are anti-correlated on a global scale; (2) The NO enhancement covers a wider longitude and latitude region than O/N2 depletion on a local scale. The similarity between O/N2 depletion and NO enhancement on global scale is due to storm-time equatorward meridional wind that brings both O/N2 depleted and NO enhanced air from high to low latitudes. The altitude dependence of the storm-time meridional wind, different peaks altitudes of the local O/N2 and NO variations, and long life time of NO may explain the different behaviors of O/N2 and NO on a local scale.

-173 Role of the Earth's bow shock in the interaction of coronal mass ejections with the Earth's environment

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: magnetic clouds, CME terrestrial bow shock geoeffectivity

Coronal mass ejections (CME) are known as geoeffective events, responsible for geomagnetic storms in the magnetosphere. We first review statistics on their geoeffectivity as a function of their orientation, the state of preceding or following solar winds, ... Indeed, before reaching the Earth' s magnetosphere, coronal mass ejections first interact with the terrestrial bow shock. We then briefly recall the role of the bow shock which contributes to decelerate the solar wind from supersonic to sub-sonic, sub-Alfvenic velocities, so that it can flow around the obstacle: incident kinetic energy is converted into downstream thermal and magnetic energy. Finally, the interaction of CMEs with the magnetosphere depends on the interaction with the magnetosphere of this decelerated and modified plasma flowing downstream of the shock (in the so-called magnetosheath region). Among CMEs, we concentrate on magnetic clouds, well identified in the solar wind by their magnetic structure. Cluster observations in the magnetosheath and at bow shock crossings reveal different downstream behaviours: the orientation of the clouds' magnetic field could be quasi-unchanged, rotated or strongly modified relative to the upstream magnetic field. The magnetic field orientation is of primary importance for the interaction with the magnetosphere and the development of magnetic activity inside the magnetospheric activity. Therefore, we examine the configurations where the terrestrial bow shock is responsible for a modification of the magnetic field orientation and discuss their possible consequences for the magnetospheric magnetic activity.

-174 STATISTICAL DETECTION OF SLOW-MODE WAVES IN SOLAR POLAR REGIONS WITH SDO/AIA

Jiangtao Su *(National Astronomical Observatories, Chinese Academy of Sciences)*

Session: 2b. Origin of solar flares and their impact on Earth’ s ionosphere/atmosphere

Type of presentation: oral

Key word: solar activities Coronal oscillations

Observations from the SDO/AIA telescope are utilized to statistically investigate the propagating quasi-periodic oscillations in the solar polar plume and inter-plume regions. On average, the periods are found nearly equal in the three coronal channels of AIA 171, 193 and 211 \AA, and the wavelengths increase with temperature from 171 \AA, 193 \AA, to 211 \AA. The phase speeds may be inferred from the above obtained parameters. Further, the speed ratios of v193 /v171 and v211 /v171 are derived, e.g. 1.4±0.8 and 1.8±1.6 in the plume regions, respectively, which are equivalent to the theoretical expected ones for acoustic waves. We find that there are no significant differences for the detected parameters between the plume and inter-plume regions. To our knowledge, this is the first time that we simultaneously obtained the phase speeds of slow-mode waves in the three channels in the open coronal magnetic structures due to the method adopted in the present work, which is able to minimize influences of the jets or eruptions on wave signals.

-175 Fluctuations in solar dynamos

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Session: 2a. Long-term solar variability (magnetism, total irradiance, and spectral irradiance) and its impact on geospace and Earth

Type of presentation: oral

Key word: Solar activity Solar dynamo

Solar cyclic magnetic activity is far to be just a cycle. Amplitude of solar cycles vary from cycle to cycle, from time to time more substantial deviation from cyclic behaviour like famous Maunder minimum occurs. We argue that the origin of such phenomenae can be assisiated with random variations with dynamo governing parameters.

-176 High-flux-electron disturbance caused by solar wind in the cusp region: Cluster observations

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: Cusp region High flux electron disturbance Temporal and spatial scales

Using the Cluster multi-spacecraft observations, we analyze a long duration field aligned high flux electron disturbance in the cusp region on 30 September 2001. All four Cluster spacecraft observed the same disturbance in which both the upward and downward electrons are observed and the electron flux was one order of magnitude higher than usual in the cusp. The temporal scale of the field aligned electron disturbance was at least 36 minutes. The spatial scale was about 540 km in the direction along the orbit and at least 1800 km in local time extent in the mid-altitude cusp region. It was the longest duration and the largest spatial scale of any field aligned electron disturbance observed in the polar region up to date, and it shows a advantage of the Cluster multi observation. Both upward and downward electrons are the main contributors to the field aligned currents in the electron disturbance. During this electron disturbance, the solar wind dynamic pressure increased and the IMF kept being southward. It is likely that the field aligned high flux electron disturbance with its long temporal and large spatial scales was caused by high dynamic pressure of the solar wind during a permanently southward IMF. This enables us to learn more about electron disturbances in the cusp and is important to understand the physical mechanism, especially for the solar wind- magnetosphere- ionosphere coupling.

-177 Motions in the MLT polar regions induced by energetic particles (3D simulations)

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: energetic particles atmospheric response 3D simulations

Energetic particles (precipitating electrons and solar protons) transform photochemical system in polar regions during geomagnetic storms and solar proton events (SPE) due to the additional production of NOx and HOx chemical compounds. Then it leads to ozone destruction in the stratosphere and mesosphere and, as a consequence, to the changes in temperature and dynamics. Such dynamical response after SPE of July 2000 was simulated with two 3D models: CHARM (CHemical Atmospheric Research Model) and ARM (Atmospheric Research Model) –Ttroposphere-Middle Atmosphere-Lower Thermosphere GCM. The results of simulations of the dynamical and temperature response caused by ozone depletion initiated by precipitating electrons and solar protons during famous period of October-November 2003 are presented. The response of atmospheric chemical composition was calculated with CHARM 3D photochemical-transport model. ARM was used to investigate changes in circulation and temperature caused by particle-induced ozone variations. In order to calculate ionization rates induced by relativistic electrons and solar protons during late October-November, corresponding proton and electron fluxes in different energetic channels from GOES-10and POES-15/16 have been used. The Atmospheric Ionization Module Osnabrück - AIMOS (Wissing and Kallenrode, 2009) was used to calculate 3D fields of ionization rates separately from electrons and protons. The results of simulations showed that Northern and Southern polar regions have different response in dynamics to energetic particles during the period of geomagnetic storms in October-November 2003. Such difference is the result of several reasons: different polar cap expansion during the geomagnetic storm, different sunlit over N. and S. polar regions, and different magnitude and structure of induced ozone destruction. As was found in model runs the dynamical response is more over Southern polar region, where solar radiation exists in this period.

-178 Solar cycle forcing on the lower inosphere: 3D simulations with CHARM-I model

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Session: 2a. Long-term solar variability (magnetism, total irradiance, and spectral irradiance) and its impact on geospace and Earth

Type of presentation: oral

Key word: solar irradiance variations lower inosphere 3D global simulations

The response other ionized chemical species in the lower ionosphere (D-region) of the Earth’ s atmosphere to solar cycle have been simulated with new three-dimentional photochemical global transport model CHARM-I (CHemical Atmospheric Research Model with Ions), developed at the Laboratory for Atmospheric Chemistry and Dynamics of Central Aerological Observatory. Model describes the interaction between 70 neutral and ionized chemical species involved in 200 photochemical reactions. “Family” technique is used for solving kinetic part of the model equations and Prather’ s scheme used to describe advection. 3D global wind components and temperature field (daily averaged) calculated by GCM ARM (Atmospheric Research Model) were used in simulations. Solar cycle signal in UV solar irradiance variations measured from space (SIM and other instruments) has been introduced in the model. External forcing used in numerical scenario described unusual features of 23rd solar cycle: long and deep its minima. So that, the amplitude of external signal (max-min) was really more than in previous cycles. Ionization was induced by Lα and GCRs. The results for mean solar irradiance for electron concentration profiles and its global picture gave good correspondence with observations. Global fields of neutral species (O3, NOy etc.) obtained with interactions with ions also has such correspondence.

-179 Euler potentials for two layers with non-constant current densities in the ambient field aligned to the layers

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: poster

Key word: particle trapping Birkeland currents Euler potentials

Birkeland currents are currents flowing in the Earth's ionosphere along the magnetic field. Here we model them by two current layers aligned to an ambient homogeneous field. The direction of the currents can be parallel or anti-parallel. Our previous result on the layers assumed constant current density (Romashets and Vandas, 2012) but magnetic field has singularities at the edges. New approach eliminates this inconsistency by introducing an inhomogeneous current density. Euler potentials are constructed semi-analytically for such a system and charged particle motion and trapping in it are examined.

-180 Linear force-free toroidal magnetic fields with axial symmetry

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: poster

Key word: CME magnetic flux rope

An exact toroidal linear force-free magnetic field distribution
was proposed by Romashets and Vandas (2009).
It was a superposition of force-free fields in cylinders, rotated around
the axis of a toroid. The cylinders contained the Lundquist (1950) axially
symmetric field. Here we include into the cylindrical solution
non-symmetric (harmonic) parts. Due to the construction, the resulting
toroidal field is a linear force-free field with axial symmetry but it contains
coefficients (at harmonics) as free parameters. By their variation one can
get a desired shape of the flux-rope cross section, e.g., circular or elliptic
one. The described solution can be used for interpretation of magnetic cloud
observations.

-181 Observations of an Eruptive Flux Rope, CME Formation, and Associated Blast Wave

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: Filament Eruptions Coronal Mass Ejections Shock Waves

A new in-depth analysis of a well-known eruptive event observed by SDO/AIA on 13 June 2010 has revealed important features in the genesis of a CME and associated MHD wave. (1) A hot 11 MK flux rope developed from the structures initially associated with a compact prominence system. The flux rope appeared as a bundle of intertwisted loops. It sharply erupted with an impulsive acceleration of up to 3-4 km/s^2 one minute before the hard X-ray burst and earlier than any other structures, reached a velocity of 450 km/s, and then decelerated to about 70 km/s. (2) The CME development was driven by the expanding flux rope. Closed coronal structures above the rope a) were sequentially involved into the expansion from below upwards, b) approached each other, and c) apparently merged, constituting the visible rim. The flux rope rotated inside the rim, which has become an outer boundary of the cavity. The rim was probably associated to a separatrix surface. (3) The formation of the rim was associated with a successive compression of the structures in the upper magnetosphere of the active region into the CME frontal structure (FS). When the rim was formed completely, it looked like a piston. (4) The disturbance responsible for the consecutive CME formation episodes was excited by the flux rope inside the rim, and then propagated outward. EUV structures arranged at different heights started to accelerate when their trajectories in the distance-time diagram were crossed by the trajectory of the fast front of this disturbance. (5) Outside the rim and FS, the disturbance propagated like a blast wave. Its signatures were a type II radio burst and a leading portion of the EUV wave. The main, trailing part of the EUV transient was the FS, which consisted of 1.8 MK coronal loops on top of the expanding rim. The blast wave strongly decelerated and decayed into a weak disturbance soon afterwards, being not driven by the trailing piston, which considerably slowed down.

-182 Kinematic Evolution of the 2012 July 12 CME from the Sun to the Earth: Observation-Constrained Three-Dimensional MHD Simulations

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Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: poster

Key word: kinematic evolution CME propagation

Dynamic process of coronal mass ejections (CMEs) in the heliosphere is the key information for us to evaluate the CMEs' geo-effectiveness and to improve the accurate prediction of CME induced Shock Arrival Time (SAT) at Earth' s environment. We present an observation-constrained three-dimensional (3D) magnetohydrodynamic (MHD) simulation of the evolution of the CME in a realistic ambient solar wind for the July 12-16, 2012 event by using the 3D COIN-TVD MHD code. A detailed comparison between the observations and the observation-constrained simulation results from our model is made, including time-elongation maps for the positions of Stereo A and Stereo B. In the validation study, we find that our 3D COIN-TVD MHD model, with the magnetized plasma blob as the CME driver, is able to re-produce relatively well the real 3D nature of the CME and their evolution in the inner heliosphere; and also provide a relatively satisfactory comparison with the Wind spacecraft observations at 1 AU.

-183 Global long-term temperature and wind response of the Earth's atmosphere to UV variability induced by solar cycle (3D simulation with ARM model)

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Session: 2a. Long-term solar variability (magnetism, total irradiance, and spectral irradiance) and its impact on geospace and Earth

Type of presentation: oral

Key word: UV variations planetary waves global temperature

The response in ozone and other chemical species of the Earth’ s atmosphere have been simulated with new version of three-dimentional photochemical global transport model CHARM (CHemical Atmospheric Research Model), developed at the Laboratory for Atmospheric Chemistry and Dynamics of Central Aerological Observatory. Model describes the interaction between 40 chemical species involved in 140 photochemical reactions. “Family” technique is used for solving kinetic part of the model equations and Prather’ s scheme used to describe advection. 3D global wind components and temperature field (daily averaged) calculated by GCM ARM (Atmospheric Research Model) were used in simulations. Solar cycle signal in UV solar irradiance variations measured from space (SIM and other instruments) has been introduced in the model. External forcing used in numerical scenario described unusual features of 23rd solar cycle: long and deep its minima. So that, the amplitude of external signal (max-min) was really more than in previous cycles. The results of simulations showed global structure of ozone response, which is mostly positive. At the same time the regions of negative ozone changes at high latitudes exist. The response of tropospheric ozone was also found around the equator. NOy global changes responsible for negative ozone response is also presented.

This work was supported by Russian Science Foundation for Basic Research (grant N 13-05-0105213).

-184 Investigating the Onset of Two Successive Flux Rope Eruptions in the Same Solar Active Region

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: CME Flux rope

Coronal mass ejections (CMEs) are the most spectacular eruptive phenomena in our solar system. Up to now, although many initiation models have been proposed theoretically, the work of validating and distinguishing these models observationally is rare. In this presentation, we investigate two successive flux rope (FR1 and FR2) eruptions resulting in two coronal mass ejections (CMEs) on 2012 January 23. Both flux ropes (FRs) appeared as an EUV channel structure in the images of high temperature passbands of the Atmospheric Imaging Assembly prior to the CME eruption. We determine the onset time of the FR impulsive acceleration with high temporal accuracy for the first time. We find that at the onset of the impulsive acceleration phase, FR1 (FR2) reaches the critical height of 84.4 ± 11.2 Mm (86.2 ± 13.0 Mm) where the decline of the overlying field with height is fast enough to trigger the torus instability. After a very short interval (~2 minutes), the flare emission began to enhance quickly. These results reveal the compound activity involving multiple magnetic FRs and further suggest that the ideal torus instability probably plays the essential role of initiating the impulsive acceleration of CMEs.

-185 Formation of a Double-decker Magnetic Flux Rope in Solar Active Region 11520

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Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: oral

Key word: CME Flux rope

Magnetic flux rope (MFR) is a magnetic structure with all of field lines wrapping around a central axis inside. It has been supposed to exist in various celestial circumstances like the magnetotail of the Earth, the ionosphere of Venus, the Nebula, and the black hole system. In the solar atmosphere, the MFR is even believed to be a fundamental structure of coronal mass ejections, existing prior to and driving the solar eruptions. Recent SDO observations reveal that the MFR pre-exists in the corona as a high temperature channel structure often imaged by AIA 131 and 94 passbands. In this talk, I will present a case study to address the formation of the channel structure through analyzing the long-term evolution of NOAA active region 11520. We find that the twisted field of an MFR is built up from two groups of sheared arcades near the main polarity inversion line half day before the eruption. The temperature within the twisted field and sheared arcades is higher than that of the ambient volume, suggesting that magnetic reconnection most likely works there. The driver behind the reconnection is attributed to shearing and converging motions at magnetic footpoints. Extrapolated three-dimensional non-linear force-free field structures further reveal the locations of the reconnection to be in a bald-patch region and in a hyperbolic flux tube. About two hours before the eruption, indications for a second MFR in the form of an S-shaped hot channel are seen. It lies above the original MFR that continuously exists and includes a filament. The whole structure thus makes up a stable double-decker MFR system for hours prior to the eruption.

-186 SEASONAL VARIATION OF IONOSPHERIC COMPLEXES OVER THE EQUATORIAL IONIZATION ANOMALY REGION

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: ionospheric complexes internal dynamics phase transition

The ionosphere which can be termed as a complex system due to several variations in its internal dynamics, and it requires a continuous study to understand its reactions to the influence of its external environment. The complexes of the ionosphere were studied by computing some chaoticity and dynamical complexity quantifiers like Lyapunov exponent, correlation dimension, Tsallis entropy from the detrended TEC data from along the three Global Positioning System (GPS) Total Electron Content (TEC) receiver stations with equatorial ionization anomaly region of Nigeria. To study these seasonal variations, the day to day values of these quantifiers were evaluated and plotted to view the seasonal variation throughout the year. The values of the five most quiet and five most disturbed days were plotted as contour to show the monthly/ seasonal variation of these parameters. The observation shows a wavelike pattern for the day to day plot with values dropping to lower values during the equinox months. A similar drop in the values of the chaoticity and dynamical complexity parameters were also recorded for the equinoxial months from the contour plots. These show a phase transition from higher values of chaoticity and dynamical complexity during the solstice months to lower values during the equinoxes in the ionosphere. These may be due to the self reorganization of the internal dynamics of the ionospheric system in response to the external influx of stochastic drivers like higher solar wind as a result of the higher proximity of the earth to the sun during the equinoxial months. Further discussions were done on the response of the chaoticity and dynamical complexity of the ionosphere to solar activities in this work.

-187 Sunspot activity and reversal of polar fields in the current cycle 24

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Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of presentation: oral

Key word: solar magnetic fields activity complexes

We analyzed the evolution of Sun’ s magnetic field leading to the polar field reversals in the current cycle 24. Zonal distribution of magnetic fields indicates a close relation between the remnants of large activity complexes and the high-latitude Unipolar Magnetic Regions (UMRs). At the beginning of cycle 24, large activity complexes were prevalent in the northern hemisphere. As the complexes decayed, their trailing polarity magnetic fields formed UMRs of positive polarity. The UMRs were then transported poleward and had established a predominantly positive polarity field near the North Pole since May 2013. In the southern hemisphere, large activity complexes appeared later, and developed in highly concentrated magnetic clusters. The UMRs of negative polarity were formed as the result of decay of these complexes. These UMRs are now reaching the high latitudes and will lead to the reversal of magnetic field at the South Pole in the near future. The global rearrangement of Sun’ s magnetic field is also apparent in the distribution of the coronal holes. Our results demonstrate that the north-south asymmetry in formation of solar activity complexes led to the asymmetry in high-latitude UMRs, and thus, is responsible for the lack of synchronicity of polar-field reversals in opposite hemispheres.

-188 Global and seasonal extent of the thermospheric midnight temperature maximum as seen in O(1D) nightglow by the Wind Imaging Interferometer (WINDII)

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Session: 3a. Geospace response to variability of the lower atmosphere

Type of presentation: oral

Key word: atomic oxygen airglow thermosphere midnight temperature maximum

Manifestations of thermospheric dynamics are observed in the variations of upper atmosphere neutral winds, temperature, density and F-region plasma over a wide time range. These fields are influenced by perturbations propagating vertically from the lower and middle atmosphere (e.g. tides) and from above through variations in the solar and geomagnetic activity. The midnight temperature maximum (MTM) is a large scale neutral temperature anomaly with wide spread influence on the low-latitude thermosphere and ionosphere. Variations in the low latitudes' nighttime neutral density, termed midnight density maximum (MDM) have also been observed and modeled. Although there is a large body of work on the characteristics of the MTM (& MDM) there are still a few questions which remain to be answered concerning the global scale distribution of the MTM (MDM), their spatial extent and longitudinal variations, their global seasonal occurrence pattern and amplitude.

The Wind Imaging Interferometer (WINDII) flown on the Upper Atmosphere Research Satellite (UARS) provides among other parameters multiyear observations of O(1D) nightglow volume emission rates (VER) and Doppler temperatures over the altitude range from 150 to 300 km, together with neutral winds with continuous latitude coverage from 42°N to 42°S and to 72° in one hemisphere every 36 days. These correlative in time and space data are employed in the study of the MTM/MDM examining the dynamical source of signatures as the wave 4 observed in the nighttime O(1D) VER and Doppler temperatures, as well as their coupling with neutral winds and effects from the mesosphere/lower thermosphere and above through the variations of the solar and geomagnetic activity from solar maximum to solar minimum.

-189 On Seasonal/longitudinal Distributions of Post-midnight Quiettime Equatorial Ionospheric Irregularities

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Session: 3a. Geospace response to variability of the lower atmosphere

Type of presentation: poster

Key word: post-midnight irregularity occurrences electrodynamic perturbations in density and vertical drifts

The seasonal/longitudinal (s/l) distributions of post-midnight quiettime equatorial ionospheric irregularity occurrences are studied for a better understanding of seeding mechanism of the Rayleigh-Taylor (RT) instability process. The s/l distributions of irregularity occurrences are found to have high occurrences around the prime meridian in every season. These high occurrence longitude sectors are all located at longitudes of negative magnetic declination with the dip equator in the northern hemisphere. The density and vertical drifts in these longitude sectors are higher than that in other longitude regions indicating an ionospheric condition that is susceptible to the RT instability process. In addition, large variations in the density and vertical drifts also imply the possible existence of electrodynamic perturbations that can serve as seeds for the RT instability in the post-midnight ionosphere.

-190 Current Helicity and Twist from Hinode Spectro-Polarimeter Data: the Brink of Solar Cycles 23 and 24

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Session: 2a. Long-term solar variability (magnetism, total irradiance, and spectral irradiance) and its impact on geospace and Earth

Type of presentation: poster

Key word: magnetic helicity solar astive region vector magnetic fields solar dynamo

Current helicity and twist of solar magnetic fields have been studies from vector magnetograms of solar surface obtained by ground based instruments for a number of years. These observations have revealed an important regularity in distribution of helical properties of solar magnetic fields, the so-called hemispheric sign rule of domination of negative/positive sign of helicity in the Northern/Southern hemispheres. This rule has been established over the most of the solar cycles 22 and 23.

In this study, using the vector magnetograms of solar active regions observed with the Spectro-Polarimeter (SP) of Hinode Solar Optical Telescope (SOT) in 2006-2012, we have statistically analysed the distribution of the current helicity and twist.

We have also divided the data points into weak and strong field ranges. For relatively weak fields in the quiet Sun and penumbras we have generally confirmed the earlier established regularities of the hemispheric sign rule for the period under investigation (cycles 23 and 24).

Furthermore, we note that the stronger the magnetic fields are taken into account, the more the pattern of current helicity fluctuates and violates the hemispheric sign rule. That in particular concerns with strong vertical fields in sunspots. We hope to use the found regularities for better understanding the solar dynamo as well as the mechanism of formation and evolution of solar active regions.

-191 MAGNETIC HELICITY TRACED BY SWIRLS IN SUNSPOTS: results from high cadence multi-wavelength observations on board SDO

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Session: 2a. Long-term solar variability (magnetism, total irradiance, and spectral irradiance) and its impact on geospace and Earth

Type of presentation: oral

Key word: magnetic helicity sunspot rotation multi-wavelength observations

Magnetic helicity, the scalar product of the magnetic field and the magnetic potential vectors, is a very important quantity in magneto-hydrodynamics as it is invariant in the non-dissipative limit. In the hydromagnetic dynamo theory one can use the helicity for nonlinear feedback from the mechanism of magnetic field generation to the motion of the highly conductive plasmas. Helical properties of solar magnetic fields have been studied by means of vector magnetograms of solar active regions; and the proxy of magnetic helicity, the electric current helicity (projection of the magnetic field to the electric current) has been computed. The problem of helicity injection from the solar convective zone through the photosphere into the corona and further onto the heliosphere is important for understanding the space weather as well as construction of models for the solar dynamo.

The phenomenon of sunspot oscillations is known for many years. The recent SDO/AIA/HMI multi-wavelength data with high cadence and high spatial resolution allow us to study in detail the phenomenon of sunspot oscillation, and detect swirls in rotating structures. Using broad temperature-wavelength range we can resolve not only horizontal structure of the slow magneto-acoustic wave fronts but also obtain height distribution of this phenomenon.

We used the PWF (Pixelized Wavelet Filtration) method (Sych et al., 2008) to extract the narrowband frequency structure of swirl-like waveguides inside sunspots and trace its spiraling nature. By using the Local Correlation Tracking Technique (LCT) we compute the phase velocities of magneto-acoustic waves at several levels in and above the photosphere and quantify its swirling dynamics. Superposing various multi-wavelength data enable us to analyse vertical structure of the swirl above the sunspot. Thus, we can see how helical structures expand from the level of solar photosphere into the chromosphere and up to the corona. We use the vector magnetogram data from SDO/HMI to track the electric current helicity simultaneously with the wave structures.

In the present study, we investigate the case of active region NOAA 11131 on December 8, 2010. We show that the helical properties of phase velocities of slow magneto-acoustic waves have close similarity with helicity of magnetic field in solar active regions. The future aim is to study the three-dimensional dynamics of sunspot swirling oscillations in detail, and shedding a light on the problem of helicity transfer from the solar interior to the heliosphere.

-192 Energetic particles near the heliospheric current sheet

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: energetic particles magnetic reconnection current sheets

The heliospheric current sheet crossings are known by sharp changes of plasma characteristics in the low-energy range. This is a result of many processes, including both a simple crossing of tangential/rotational discontinuity and a magnetic reconnection at multiple X-points along large regions at the heliospheric current HCS. At the same time, suprathermal ions in the keV-MeV energy range are sometimes observed close to the heliospheric current sheet, which was shown for the first time by Murphy et al. in 1993. Murphy and co-authors suggested that this is a consequence of the magnetic reconnection. However, electric fields generated during the reconnection at current sheets in the solar wind seem to be too small in comparison with the same process in the solar corona to accelerate particles up to MeV energies. It is important, too, to notice that not every crossing of the reconnecting HCS is associated with energetic particles events, which militates against an idea that the magnetic reconnection occurring directly at the HCS can be responsible for significant particle energization. We discuss alternative hypothesis, explaining observations of energetic particles in the vicinity of the heliospheric current sheet, and present both statistical and case studies of the effect examined at different time scales and in different energy ranges on the basis of data obtained by ACE (LEMS30 and DE) and STEREO.

-193 A proof of coincidence of the equatorward edge of the polarization jet and energetic ion injection boundary during substorms.

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Session: 1b. Origin, evolution, and Earth impact of high speed streams

Type of presentation: poster

Key word: polarization jet ion injection boundary substorm activity

Case studies of polarization jet recorded by ground-based stations and energetic ions measured by AMPTE/CCE evidence that these phenomena appears simultaneously and on the same L-shells. Then the data from different satellites were considered. For isolated magnetic disturbances of different intensity, the latitudinal dynamics of the inner boundary of energetic ion (up to 50 keV) penetration into the magnetosphere was analyzed using the AMPTE/CCE data, and variations of the equatorward edge of the polarization jet (PJ) measured by DMSP satellites were examined. It is shown that the invariant latitude of the inner boundary of energetic ions injected into the magnetosphere depends on the AE values. It turned out also that the invariant latitude of the PJ equatorward boundary well correlates with the AE-index values. The coincidence of these dependencies in a large range of AE, evidences that these boundaries are physically interconnected and are formed on the same L-shells during the development of substorms in the magnetosphere.
The work is partially supported by the RAS program P22.

-194 Interplanetary magnetic field pressure and magnetic field line stress contribution into the geomagnetopause stagnation point pressure

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Session: 1b. Origin, evolution, and Earth impact of high speed streams

Type of presentation: oral

Key word: magnetopause stagnation pressure IMF impact

It is generally valid that the supersonic and superalfvenic solar wind ram pressure is the main factor contributing into the geomagnetopause stagnation. Influence of solar wind plasma thermal pressure (sonic Mach number Ms) can be taken into account by well-known Landau & Lifshitz (1959) expression. Two complementary factors were also recently revealed in observations. These are the magnetotail magnetic field line tension and pressure. Magnetic field line tension results in the clock angle dependency of the geomagnetotail terminator cross-section in the reference frame rotating with IMF transversal component (Verigin et al., Geomagn. & Aeron., 2009). While the magnetic field pressure leads to magnetopause movement towards the Earth when the IMF cone angle approaching 90 degree (Dušík et al., J. Geophys. Res., 2010).

Different approaches to the description of magnetic field lines stress and pressure at the magnetopause are discussed in the talk based on theoretical limitations, analytic solutions in Lagrangian variables, and 3-D MHD modeling. It is shown that the influence of the curved magnetic field line stress on the magnetosheath plasma flow is ~2d/R times less than the influence of the magnetic field line pressure, where d is the magnetosheath thickness and R is the magnetic field lines curvature radius.

New analytic proxy for magnetosheath stagnation pressure is proposed in the talk which take into account an impact of magnetic field line pressure (Alfvenic Mach number Ma) the angle between solar wind and IMF directions. Geomagnetopause model based on the measurements of Prognoz' /Intrerball' orbiters is updated taking into account the new stagnation pressure proxy.

The talk is partially supported by P22 program of RAS.

-195 Formation, kinematics and nature of shocks associated with CMEs

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: Shock Coronal mass ejection

By using SDO data, we have studied occurrence, kinematics and nature of shocks associated with several CMEs. Occurrence and motion of these shocks were analysed in different spectral channels. We showed that kinematics of CME body and its related shock in the SDO/AIA fields of view differs considerably. We established that the time dependence of shock position and velocity obtained from SDO data is in agreement with theoretical dependences of variation in these motion parameters with time in the context of self-similar motion of an explosive shock. We concluded that the shocks are not piston-like with the CME body acting as a piston. We put forward a method for determining spatial distribution of electron density in the corona with the use of integrated information on spatial positions of a shock at various instants of time and on the frequency-time dependence of type II radio bursts.

-196 3D modeling of the density distribution in the plasmasphere using the Interball-1 data base.

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Session: 1b. Origin, evolution, and Earth impact of high speed streams

Type of presentation: oral

Key word: plasmasphere physical modeling solar wind geomagnetic activity

A data base of all the cold plasma measurements aboard INTERBALL 1 obtained in 1995 – 2000 was collected which includes plasmaspheric density and temperature, spacecraft potential, orbital information, indices of geomagnetic activity, and average solar wind parameters. This data base was used for 3D modeling of plasma distribution inside the plasmasphere. 2D model describing density distribution in meridional plane is based on equations describing the plasma distribution in the plasmasphere for the cases of thermal equilibrium and collisionless initial partial filling of plasmaspheric shells. This 2D model is then expanded into 3D one using a simple equation for plasmapause position. Impact of solar wind and geomagnetic activity on the plasmasphere state is discussed.
The work is partially supported by the RAS program P22.

-197 HOW DO FAST PULSE CMEs RELATED TO POWERFUL FLARES BUT UNRELATED TO ERUPTIVE FILAMENTS APPEAR AND MOVE?

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: oral

Key word: Sun solar corona coronal mass ejection

GOES-12/SXI and SDO/AIA data were used to examine the formation and initial stage of movement for several fast pulse "halo"-type coronal mass ejections (HCME) that were related to GOES M and X class flares but unrelated to solar filament eruptions. According to their formation, the HCMEs under study can be subdivided into three groups: i) Most of the HCMEs studied resulted from broken equilibrium - presumably, due to an emerging new magnetic flux - of solitary wide loop-like emission structures identified with the future ejection observable in the 195 Angstrom channel a few hours before the mass ejection starts moving or before the relevant flare onset; ii) a CME can form from several individual loop-like structures or, possibly, a loop arcade; iii) for some HCMEs, their formation starts with a group of coronal loops moving upwards as first observed in the "hot" 131 Angstrom channel. A few minutes later, loops start to move observable in images taken with the "colder" 211 Angstrom channel, still later in the 193 Angstrom channel, and finally, in 171 Angstrom channel images. The moving loop-like structures affect the overlying coronal areas in such a way that a frontal HCME structure forms, its brightness increasing from the "hottest" to the 'coldest' line. Moreover, loops are observed moving sunwards, towards the CME origin, resulting in an area of lower brightness forming behind the frontal structure. All the coronal mass ejections we studied started to move before the related solar flares appeared. The kinematics of the HCME's under examination has been studied along, generally, curvilinear trajectories in the plane-of-sky. It has been concluded that two types of coronal mass ejections exist differing in their time speed profile determined by the area and magnetic configuration of the active area where the mass ejection originated. Homologous HCMEs - i.e. appearing in the same active area at different times - have the same speed profile.

-198 Comparison of impacts of CIR/HSS, Sheath and ICME on magnetic storm generation

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Session: 1b. Origin, evolution, and Earth impact of high speed streams

Type of presentation: oral

Key word: magnetic storm interplanetary driver MC ICME Stheath CIR/HSS

One of the most important results of recent researches is the experimental fact that the development of magnetic storms depends on the type of interplanetary drivers. On the basis of OMNI data for the period 1976-2000 we compare the reaction of magnetosphere on the corotating interaction regions (CIR) before the high speed streams (HSS) of solar wind, the interplanetary coronal mass ejection (ICME) separately for magnetic cloud (MC) and Ejecta, and on the Sheath before ICME (see site ftp://ftp.iki.rssi.ru/omni/). We present empirical relations between temporal variations of Dst index during magnetic storms and interplanetary parameters (southward component of magnetic field, electric field, dynamic pressure and others). The highest geoeffectiveness (probability to generation of magnetic storm) is observed for MC while the highest efficiency (solar wind-magnetosphere coupling coefficients) is observed for Sheath and CIR.

This work was supported by the RFBR, project 13-02-00158a, and by the Program 22 of Presidium of Russian Academy of Sciences.

-199 Long-Term Trends in the Upper Atmosphere-Ionosphere – Roles of Different Trend Drivers

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Session: 3b. Trends in the entire atmosphere, including anthropogenic aspects

Type of presentation: oral

Key word: long-term trends upper atmosphere-ionosphere system

Long-term trends in the mesosphere-thermosphere-ionosphere system are driven by a couple of agents. Most important general trend driver is continuously increasing concentration of greenhouse gases, namely of CO2. However, there are also other drivers of trend at these altitudes. In the ionosphere and thermosphere, these are mainly long-term changes of geomagnetic activity (impact of long-term changes of solar activity is largely removed when correcting for the solar cycle effect during trend calculations) and the secular variation of the Earth' s magnetic field. In the mesosphere, lower thermosphere and related part of the ionosphere, the stratospheric ozone depletion and its recovery, and to some extent changes in water vapor content play a role. The whole upper atmosphere-ionosphere is probably affected by long-term changes of atmospheric wave activity (gravity, tidal and planetary waves), which are known very poorly. Some of these drivers are efficient only regionally (e.g., secular variation of Earth' s magnetic field), others reverse trend with time (ozone, geomagnetic activity). Consequently, we can hardly expect spatially homogeneous and temporally stable trends in the upper atmosphere and ionosphere, which explains some contradictions between observational trend results.

-200 Hurricanes over Atlantic Region during 1851-2010 and Solar influence on them

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Session: 2a. Long-term solar variability (magnetism, total irradiance, and spectral irradiance) and its impact on geospace and Earth

Type of presentation: poster

Key word: Sun spot number solar maxima and minima

The analysis of hurricane frequency during 1851-2010 reveals (1)it increases monotonically from1851upto1910,then it begins to decrease slowly (2)Monthly variation also exists namely

The frequency is much more during august to October, September being the month of maximum Hurricane. The reverse is the situation during December to June. The 30 years variation study shows that in 1941 -70& 1971-2000 total hurricane were maximum. The analyse of the rates of change of frequency shows that the rate monotonically increases since 1851 the max. Being during1971-2000. (1.22 per yr. approx) .But after that it began to decrease. Another very interesting aspect is that the frequency of hurricane is found to decrease .When Solar activities are increased i.e. when Sun' s Spot Number increases calculate the decadal frequency study shows that from it was less than10 before 1991but more than 10 after 1991 and during 2001-10 it was 13.3.A very striking feature is that the average frequency over the time of Solar maxima is 8.3 which is less than the normal average(8.8) but average over solar minima years is (9.53).Evidently, these suggest adverse effect of solar activities on hurricane formation. This is similar to the resistance found in cyclone formation. Possibly the solar hot material produces this resistance to the formation of hurricane/cyclone.

-201 The polarization degree of the original solar radio emission

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Session: 2c. Coronal and Interplanetary radio bursts including auroral kilometric radiation

Type of presentation: poster

Key word: CSRH polarization degree

The Chinese Spectral Radioheliograph (CSRH) observes the Sun in radio wavelength on the ground. CSRH-I array is comprised of 40 reflector antennas with 4.5-m dishes from 0.4-2GHz and CSRH-II array is comprised of 60 reflector antennas with 2-m dishes from 2-15GHz. All the 100 antennas are mounted equatorially and spread in 3×3km2 quiet RF zone surrounded by hills. The key science of project CSRH are studies of fine structures, particle acceleration, solar radio bursts with different types, solar magnetic field and solar flares, etc. Many phenomena happen in decimetric and centimetric bandwidth. The polarization of solar radio signal is one of the most important solar features in solar The polarization degree of solar radio emission could be detected from CSRH project.

-202 On the Acceleration of Solar Energetic Particles During Halloween Storms

Ahmed Abdel Hady *(Cairo University)*

Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: oral

Key word: Solar energetic particles solar particle event Particle acceleration Solar electromagnetic field

The solar energetic particles (SEP’ s) could be accelerated to higher energies of order of MeV per nucleon. A modified model for SEP’ s acceleration has been given and applied for Halloween storms event during the decline phase of solar cycle 23. The estimated values of the solar magnetic field during the solar particle event were introduced. The solar magnetic field describes a sophisticated feature of discrete sectors/regions over the period that starts from 28 October 2003 to 4 November 2003. The applications of the suggested model on the solar particle event show that a homogeneous structure is in agreement with the observations. The acceleration time is calculated, where the energy losses due to the different physical processes are entirely neglected. The combination of the direct acceleration and the well-known Fermi mechanisms verifies the observed spectrum.

-203 Properties of tilt of bipolar solar regions

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Session: 2a. Long-term solar variability (magnetism, total irradiance, and spectral irradiance) and its impact on geospace and Earth

Type of presentation: oral

Key word: Solar activity Surface magnetism

Bipolar solar regions are one of the crucial elements for understanding of solar dynamo. Some of its properties are known from the beginning of the last century, e.g. Joy's law, that correlates angular inclination of bipole (tilt) with the latitude, or Hale's law, that describes a preferred orientation of bipoles. More detailed description of bipole's behavior found difficulties because of the insufficient statistical material and lay for a long time mostly within the theoretical conceptions. However, recently obtained results of observational data processing provide a rich sample and give some evidences that tilt properties can substantially differ for small and large bipoles. Here we proceed to investigate a relationship between tilt and different parameters of bipoles and find certain statistical correlations.

-204 Anomalous compression of the magnetosphere and its effects in the radiation belts and ionosphere

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of presentation: poster

Key words: erupting filaments magnetosphere-ionosphere coupling radiation belts

Extreme compression of the magnetosphere was found during magnetic storm on 21 January 2005, which was produced by a CME preceding very dense and fast plasma originated from a chromospheric erupted filament. From 1712 to 2400 UT, the dayside magnetosphere was continuously located inside geosynchronous orbit due to very high solar wind dynamic pressure (Pd). The compression was found to be extremely strong from 1846 to 2035 UT when Pd peaked up to almost 200 nPa such that the subsolar bow shock moved inside the geosynchronous orbit. The minimal size of the dayside magnetosphere was estimated to be less than 3 RE. Under the extreme compression, the outer magnetosphere at L > 5 was pushed inward such that particles from the radiation belts suffered fast radial transport toward the Earth at very low L-shells, accelerated and populated the forbidden zones at low latitudes. The polar cap expanded dramatically that allowed penetrating auroral precipitation and solar energetic particles to middle latitudes (<50°). Ionization by intense fluxes of quasitrapped and precipitating particles and electrodynamic process disturbed whole the ionosphere and resulted in development of a great positive ionospheric storm from equator to middle latitudes both on the day and night sides.

-205 High-speed solar wind streams and positive dayside ionospheric storms

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Session: 1b. Origin, evolution, and Earth impact of high speed streams

Type of presentation: oral

Key words: Ionospheric storms recurrent magnetic storms

An analysis of case events and statistics of positive ionospheric storms was performed in the dayside region of the equatorial ionization anomaly during high-speed solar wind streams and related recurrent geomagnetic storms (RGSs). RGSs dominate in geomagnetic and ionospheric conditions on the declining phase and minimum of solar activity in 2004 to 2008. It is shown that total electron content (TEC) peaks on 3 to 4 day after the RGS onset, i.e. on the recovery phase, during high-intensity long-duration continuous auroral activity produced by high-speed solar wind streams. The response of positive ionospheric storms to solar, heliospheric and geomagnetic drivers reveals a prominent longitudinal variation. Most intense TEC enhancements were found in the longitudinal ranges from 90° to 180° and from –180° to –120°. The highest correlations of the TEC enhancements exhibit a prominent annual asymmetry with maximum during the winter season. An analysis of electron content vertical profiles, derived from two independent methods using ionosondes and COSMIC/FORMOSAT-3 radio occultation, shows that in the maximum of RGS-related positive ionospheric storm, the F2 layer is thickening, NmF2 increases by ~50% and hmF2 elevates by a few tens of kilometers. We speculate that this dynamics might result from storm-time effects of thermospheric O/N2 enhancements and penetrating electric fields of interplanetary and magnetospheric origin.

-206 The non-migrating tidal components from the wavenumber spectra of SABER/TIMED observations

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Session: 3a. Geospace response to variability of the lower atmosphere

Type of presentation: poster

Key word: non-migrating tidal component SABER

The longitudinal wavenumber spectra at the MLT altitudes (70-120 km) and in the latitude range between 50 were estimated from the temperature data observed by the SABER instrument on board the TIMED satellite during the interval from 2002 to 2008. From these wavenumber spectra we proposed a new approach to obtain the once a day resolution components of the diurnal and semi-diurnal non-migrating tides. The dominant component DE3 was then analyzed in detail to reveal its spatial and temporal variations. We found that the properties of the spatial distribution and the large time scale variation are similar to the previous works which used 2-months resolution data. These properties are that the DE3 component occurs mainly in the lower latitudes within 20 and peaks at the altitude of about 106 km; the tidal amplitude is larger during boreal summer and early autumn, smaller in spring and smallest in winter; the component is slightly stronger during the eastward wind phase of the quasi-biennial oscillation (QBO) than the westward phase. The higher-resolution data were used to retrieve the monthly deviations of the DE3 component which reveal the day-to-day variability of the tide. It is found that (1) the variability occurs mainly at the altitude range from 100 to 115km with two peaks respectively at 106 and 100 km; (2) it is stronger at the low-latitudes and peaks around the equator; (3) it is larger around solstitial months than equinox months; (4) It would not experience obvious inter-annual variation.

-207 Comparative climatological study of large-scale traveling ionospheric disturbances over North America and China in 2011–2012

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Session: 3a. Geospace response to variability of the lower atmosphere

Type of presentation: poster

Key word: Traveling ionospheric disturbance, GPS network

This paper describes a comparative study of the climatology of large-scale traveling ionospheric disturbances (LSTIDs) over North America and China based on observations obtained in 2011–2012 using two GPS networks characterized by dense regional coverage. We identified a total of 390 LSTIDs in China and 363 events in North America. These can be categorized into three types, namely south, north-, and westward-propagating LSTIDs. The southward-moving LSTIDs over North America show similar diurnal and seasonal variations to those of geomagnetic disturbances, but the southward LSTIDs over China do not show such variations. The occurrence of southward-propagating LSTIDs over China increases at ~1–2 hours after the time of geomagnetic activity maximum; this increase lasts several hours until the geomagnetic activity minimum, which happens during the local evening. The southward-moving LSTIDs over North America show a weak semiannual variation, with two major peaks in March and October, while the southward-propagating LSTIDs over China show a major peak in January. Northward-propagating LSTIDs occur much less frequently than their southward-moving counterparts, and they are mainly observed in China. They mostly occur during geomagnetic activity maximum, indicating a possible relation with the degree of geomagnetic activity. Westward-traveling LSTIDs are seen in both regions during local sunrise and may be excited by the moving solar terminator. No relationship was found between these latter LSTIDs and the geomagnetic disturbances. The propagation direction of westward-moving events changed from northwestward during winter solstice to southwestward at summer solstice. This is consistent with the seasonal orientation of the solar terminator.

-208 EUV imaging of the Earth's magnetosheath: global hybrid simulation

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of presentation: poster

Key word: EUV imaging Magnetosheath solar wind charge exchange

Charge exchange between solar wind alpha particles and neutral hydrogens in the magnetosheath and magnetosphere produces a unique extreme ultraviolet emission at 30.4 nm. In order to understand the relationship between the dynamics of the magnetosheath and the 30.4 nm emissions by solar wind charge exchange (SWCX) in lunar perspective, the intensity distributions and the variations of such emission under different solar wind and interplanetary magnetic field (IMF) conditions are systematically investigated using a three-dimensional global hybrid simulation code. It is found from the simulations that the emission intensity and the intensity distribution patterns change dramatically with the conditions of solar wind and IMF. The maximum emission intensity by SWCX may change from several mR during quiet solar wind conditions to more than 1000 mR during disturbed conditions. The emission intensity increases with the solar wind speed, density, temperature, and the He2+/H+ density ratio in the solar wind. The emission intensity also increases when the IMF turns from northward to southward under the same solar wind conditions. As the increase of IMF magnitude, the intensities in dayside magnetosheath decrease while the intensities in the cusp region and in the nightside magnetosphere increase. The locations of the bow shock and magnetopause are also evident in these images. It is expected that this investigation provide us with an overall understanding on EUV emissions in the magnetosheath by SWCX and the 30.4 nm emission can potentially be used to remotely sense the global configuration of the magnetosheath in future.

-209 A Study of CME-driven shocks with remote sensing data: recent results and prospects from future solar missions

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Session: 2c. Coronal, Interplanetary and Terrestrial radio bursts
Type of contribution: oral

Over the last 20 years, thanks to continuous monitoring of the Sun, space based observatories provided us with a new view of solar storms (or Coronal Mass Ejections - CMEs), the main drivers (together with solar wind and solar energetic particles – SEPs) of geomagnetic storms on our planet. The development of CMEs in the outer corona has been studied with remote sensing instruments like radio antennas, white light coronagraphs and UV/EUV spectrometers. In particular, UV spectra observed during solar eruptions allowed us to study for the first time their 3D expansion velocities, their thermal energies, the evolution of post-CME current sheets and small scale eruptions, and to characterize CME-driven shocks. At the same time, coronagraphic white light images and radio dynamic spectra provided not only an estimates of the CME kinetic energies, masses and densities, but (as more recently shown) can also be used to infer the velocity, geometry, and compression ratios of CME-driven shocks, together with an estimate of coronal magnetic fields crossed by the shock itself, whose measurements are usually quite challenging. This talk will be aimed at reviewing these results focusing on CME-driven shocks and discussing the new possibilities that will be offered by the Solar Orbiter mission, in coordination with other future missions/observatories.

-210 Solar irradiance variability and the Earth's climate

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Session: 2a. Long-term solar variability (magnetism, total irradiance, and spectral irradiance) and its impact on geospace and Earth

Type of contribution: oral

There is growing evidence of the influence of solar irradiance on the Earth's climate through variability in the total flux and its spectral distribution. Both total and spectral solar irradiance have been monitored through a succession of space instrumentation since 1978, revealing correlations with solar activity. This led to the development of models aimed at reconstructing solar irradiance over the satellite era. Now, such models extend back in time over the past few centuries (that is, the telescope era) and even over the entire Holocene using various indicators of solar activity. The reconstructed solar irradiance forms an important input to climate models. While considerable progress has been made in the calibration and collation of the available body of direct observations, significant uncertainty hangs over the cycle-to-cycle variation and the wavelength-dependence of the amplitude of the variation over the solar cycle. These uncertainties impact the modelling of solar irradiance variability and its influence on the climate. Here, we present the results of recent efforts to resolve these open issues in our understanding of solar irradiance variability**.**

-211 Severe Space Weather: Solar Wind Coupling and Radiation Belt Response

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Session: 1a. Origin, evolutions, and Earth impact of coronal mass ejections

Type of contribution: oral

Long-term observations from both operational and scientific spacecraft have shown quite conclusively that high-energy radiation belt particles can cause significant problems for Earth-orbiting satellites. A prevalent cause of operational anomalies is the phenomenon of deep-dielectric charging due to highly energetic electrons. However, moderate-energy electrons and very energetic ions (protons) can also cause disruptions, respectively, due to surface charging and single-event upsets. The NASA Radiation Belt Storm Probes (now renamed the Van Allen Probes) were designed to study the Earth's radiation environment and, ultimately, to provide improved physical understanding and modeling capability for the radiation belt regions. The Relativistic Electron-Proton Telescope (REPT) instruments on the dual Van Allen Probes provide information about energetic electrons (E>1.5 MeV) and energetic protons (E>17 MeV). We show the REPT observations made since the 30 August 2012 launch of the Van Allen Probes spacecraft and we discuss how real-time and near real-time space weather beacon data from the mission can be used for better space situational awareness. In particular, we characterize various solar wind driving conditions and document directly the fascinating radiation belt responses.

-212 Energetic Particles, Atmosphere and Regional Climate

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of contribution: oral

This presentation we will give an introductory overview of the energetic particle precipitation (EPP) impact on the polar atmosphere and discuss the potential effects of EPP on regional winter climate. In addition to solar storms the nearly continuous precipitation of energetic particles from the magnetosphere affects ionisation levels in the polar atmosphere. In the atmosphere this ionisation peaks in the middle atmosphere (20-100 km), where it leads to enhanced production of NOx and HOx gases. These are gases, which participate in catalytic ozone destruction. Dynamical (e.g. temperature, winds) coupling mechanisms in the atmosphere can further provide coupling between space weather in the form of particle precipitation and the lower atmosphere and thus have indirect implications to polar climate: the analysis of meteorological data and atmospheric chemistry-climate model results has shown that during the winter season temperatures and winds from about 80 km altitude down to the surface show variability depending on the level of EPP. However, the characteristics of the energy spectrum and the precipitating fluxes of precipitating electrons are not known well enough for straightforward inclusion of this important particle precipitation process in atmospheric models.

-213 Variability of the Sun and Its Impact on the ITM System

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The SABER Science Team

Session: 2b. Origin of solar flares and their impact on Earth's ionosphere/atmosphere

Type of contribution: oral

For nearly 13 years the TIMED and SORCE satellites have been observing key elements of the energy budget of the ionosphere-thermosphere-mesosphere (ITM) system. These datasets now provide an in-depth view of the natural variability of the atmosphere as forced by variation in the solar ultraviolet and in particle precipitation. We review these observations and examine time series of multiple parameters in the stratosphere, mesosphere, and thermosphere. Variability is evident on timescales ranging from days to the 11-year solar cycle. While there is in general a positive correlation between most parameters (e.g., temperature, atomic oxygen) and the 11-year solar cycle, other parameters (e.g., atomic hydrogen) exhibit strong anti-correlations with the 11-year cycle. There is also evidence for solar cycle influence in atmospheric tides. These measurements and results will be reviewed, as will our search for the first telltale signs of the progression to the next solar minimum that will be most readily evident in the radiative cooling of the thermosphere.

-214 New Measurements of Solar flare spectra from SDO/EVE and their impact on planetary Ionosphere and Thermosphere systems.

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Session: 2b. Origin of solar flares and their impact on Earth's ionosphere/atmosphere

Type of contribution: oral

SDO has now been observing the Sun for almost five years, and the continuous observations between all instruments has revealed new insights into Solar Eruptive Events. SDO's EUV Variability Experiment (EVE) has had a profound impact on Space Weather and Aeronomy studies due to its high spectral resolution and nearly continuous coverage from two of its channels, providing full Extreme Ultraviolet (EUV) spectral and temporal coverage of solar flare irradiance changes for the first time. Not only does this improve our understand of the origin and evolution of solar flares, but also accurately measure how these solar irradiance drivers influence the atmosphere of Earth and other planets.

-215 Energetic particles during solar flares

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Session: 1c. Origin, evolution, and Earth impact of energetic particles from solar, magnetospheric and galactic sources

Type of contribution: oral

During periods of sporadic solar activity, the Sun effectively converts magnetic energy into kinetic energy of accelerated particles in solar flares. Understanding particle propagation and acceleration is an important element of Space Weather. These energetic particles are particular well observed via bright microwave radio and hard X-ray emissions. In the talk, I will highlight recent success in X-ray observations with RHESSI. New observational results are surprising and demonstrate that we are still far from even a general scenario for flares. The physics of energetic electrons and comparison between models in the view of recent observations will be presented.

-216 Survey of the 23rd and 24th solar cycle minor-to-moderate magnetic storm effects on ionosphere

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Session: 4. Workshop to analyze Sun-to-Earth MiniMax24 Events

Type of contribution: poster

The paper is focused on ionospheric reaction to occasional minor-to-moderate magnetic storms above selected ionospheric stations located across the Northern and Southern Hemisphere. Most of the storms analysed occurred under low or extremely low solar activity conditions of the 23rd and 24th solar cycles. We analysed variability of the *F2* layer critical frequency *foF2* and the *F2* layer peak height *hmF2* obtained for different latitudinal and longitudinal sectors of both hemispheres for within the entire period of selected magnetic storms. Observations were compared with the effects of strong magnetic storms and with the IRI2000 outputs when STORM model option is activated. Our analysis showed that the effects on the middle latitude ionosphere of weak-to-moderate CIR-related magnetic storms, which mostly occur around solar minimum period, could be comparable with the effects of strong magnetic storms. In general, both positive and negative deviations of *foF2* and *hmF2* have been observed independent on season and location. However positive effects on *foF2* prevailed and were more significant. Observations of stormy ionosphere also showed large departures from the climatology within storm recovery phase, which are comparable with those usually observed during the storm main phase. The IRI STORM model gave no reliable corrections of *foF2* for analysed events.

-217 Evaluating the diffusive equilibrium models: Comparison with the IMAGE RPI field-aligned electron density measurements

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The diffusive equilibrium models that are widely used by the space physics community to describe the plasma densities in the plasmasphere are evaluated with field-aligned electron density measurements from the radio plasma imager (RPI) instrument onboard the IMAGE satellite. The original mathematical form of the diffusive equilibrium model was based on the hydrostatic equilibrium along the magnetic field line with the centrifugal force and the field-aligned electrostatic force as well as a large number of simplifying approximations. Six free parameters in the mathematical form have been conventionally determined from observations. We evaluate four sets of the parameters that have been reported in the literature. The evaluation is made according to the equatorial radial distance dependence, latitudinal dependence at a given radial distance, and the combined radial and latitudinal dependences. We find that the mathematical form given in the diffusive equilibrium model is intrinsically incompatible with the measurements unless another large number of free parameters are artificially introduced, which essentially changes the nature of a theoretical model to an empirical model.