Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS01-01 Room:202 Time:May 23 14:15-14:30

Magnetic distrubance resulted from typhoons in Pacific Ocean in September 2008

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Geomagnetic total intensity fields recorded by 3 stations are utilized to examine magnetic pulsations induced by 3 typhoons in the Pacific Ocean in September 2008. To determine whether magnetic variations resulted from space weather or typhoons, time-series data of magnetic total intensity fields recorded at 2 monitor and 1 remote stations are examined and cross-compared. The correlation coefficient is applied to determine the discrepancy of amplitudes at different frequency bands due to magnetic pulsations. It is found that magnetic pulsations at the anomalous frequency band of between 0.0025 and 0.007 Hz appear when typhoons with category 4 are closest to monitor stations. The anomalous frequency band is different with frequency characteristics of either ocean waves or swells reported in previous studies and consistent with magnetic pulsations triggered by acoustic gravity waves due to either gravity waves of swells or upward vertical motions of typhoons.

Keywords: Magnetic pulsations, Typhoons, Acoustic gravity waves

Japan Geoscience Union Meeting 2013
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MIS01-02 Room:202 Time:May 23 14:30-14:45

Changes of the geomagnetic field in Japan during the annular solar eclipse on May 20-21, 2012

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An annular solar eclipse passed along Japan islands morning on May 20-21, 2012. In addition to a number of public observatories of the 3-component geomagnetic fields in all parts of Japan, we have fluxgate magnetometers and a liquid nitrogen SQUID magnetometer in Northeastern and Central Japan. Most of our observation sites were within the path of this eclipse, and one was within the area of more than 90% magnitude of the eclipse. We checked the changes in the data of the geomagnetic field during the eclipse. Here, the change was defined as the difference from the average curve obtained from the geomagneticaly calm days in May 2012. As a result, we found that the amplitudes of the changes in the x, y, z-components and the total force were about +5, -20, -5, and +5 nT, respectively. They are almost within the average +/- of the standard deviation except the y-component. We can expect the currents relatively flowing northwards in the ionosphere over the Japan islands during the eclipse. Because the northern part of the shadow connected to the night hemisphere at that time, it would block the Sq currents flowing southwards.

Keywords: annular solar eclipse, geomagnetic field

Japan Geoscience Union Meeting 2013
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MIS01-03 Room:202 Time:May 23 14:45-15:00

Characteristics of global thunderstorm activities extracted from Schumann resonance observations at Agra, India

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Schumann resonance (SR) is one of the most exciting electromagnetic phenomena occurring in the earth-ionosphere cavity. It shows standing waves at ELF frequencies of 8, 14, 20, ...Hz as a result of resonance between direct and round-the-world ELF waves radiated from lightning discharges. Schumann resonance studies have found wide ranging applications recently in the fields of global thunderstorm activities, surface temperature, lower ionosphere, and forecast of mansoon etc.

In this paper Schumann resonance (SR) data obtained by employing a set of 3-component search coil magnetometer at tropical station Agra (geographic lat. 27.2oN, long. 78oE) are analysed for a period of 12 months between 01 March, 2011 and 29 February, 2012. By giving special attention to the study of first mode SR frequency corresponding to X-component (north-south) in general and to the Y-component (east-west) wherever necessary, various properties of global thunderstorm activities are deduced and interpreted. We show that global thunderstorm activities are concentrated in summer months with peak activity in August, 2011. This result is correlated with optical transient detector (OTD) data and a correlation coefficient of 0.67 is found. The peak activity occurring in the month of August, 2011 is supported by a study of monthly variation of frequency range dF (dF= fnmax ?fnmin) which shows a significant drop in the month of August. We further show that the general decrease in the first mode SR frequency observed at Agra and other Indian stations is due to minimum solar cycle period of 2008-09 (now increasing). We also study the diurnal variation of first mode frequency and interpret it in terms of variation in source-observer distance.

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS01-04 Room:202 Time:May 23 15:00-15:15

Development of Nueral Network Tomography for Water Vapar Distribution

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Many meteorological disasters such as flood and landslide with torrential rain have been reported, and the mechanism of the precipitation system has been studied. Grasp of the situation of the local precipitation is important and the portable radar is one of the advances tools. Practical studies based on the radar are now going on. However, in the developing countries such as Indonesia and Philippines, the observation with the radars has difficulties due to the cost and the maintenance. The water vapor tomography using a GPS and/or broadband satellite is thought to be effective as a situation of the precipitation monitoring system in above-mentioned countries. When the development of a rain cloud to bring the disasters, there is an inflow of the water vapor from the neighborhood. Therefore, we try to develop water vapor tomography, which provides the three-dimensional water vapor distribution, from GPS data and AMeDAS using algorithm of residual minimization learning neural network (RMTNN). The numerical simulation demonstrates that three-dimensional water vapor distribution can be estimated from GPS data. The details will be shown at our presentation.

Keywords: water vapor tomography, GPS

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MIS01-05 Room:202 Time:May 23 15:15-15:30

Observation of thunderstorms producing lightning narrow bipolar events with phased array radar

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Phased array radar (PAR) with unprecedented high temporal and spatial resolution is used for the first time to analyze structures of thunderstorms producing narrow bipolar events (NBEs), which are located with low frequency (LF) lightning location system comprising nine stations in Osaka region of Japan. The PAR has a temporal resolution of 30 seconds and a spatial resolution of 100 m in radial direction, 1.2? in azimuthal direction and 0.9? in elevation direction. Such resolutions are much better than traditional parabolic weather radar. During the summer of 2012, 232 positive NBEs and 22 negative NBEs were detected and located by the LF lightning location system. Thunderstorms producing these NBEs were observed by the PAR, and locations of NBEs are compared with thunderstorm structures.

It is found that NBEs usually correspond well with the deepest convection. However, in some thunderstorms with intense updraft extending above 15 km, positive NBEs are produced at the periphery, instead of the center, of the deepest convection. This may be because of decrease of electric field due to elevation of the upper positive charge layer or formation of screening negative charge layer in the region of the deepest convection.

Negative NBEs are generally higher than positive NBEs and are almost exclusively located at the cloud top of thunderstorm. Positive NBEs, on the other hand, are always located well inside thundercloud. Another important feature of negative NBEs is that they can only be produced in thunderstorms with cloud top higher than about 14 km, which is quite rare in Osaka region, resulting in rare occurrences of negative NBE. Numerous thunderstorms with lower height did not produce any negative NBE, indicating a height threshold for NBE production.

Such special features of negative NBE make it a perfect target for monitoring severe thunderstorms. If we can detect negative NBE and determine its height, we can estimate the thunderstorm top height right from the negative NBE height. Even if we cannot determine NBE height, we can roughly decide the severity of thunderstorm by the presence of negative NBE. As long as negative NBE is produced, the thunderstorm has probably developed above at least 14 km, which is quite severe. In this way, severe thunderstorms can be conveniently monitored by detecting negative NBEs.

Keywords: narrow bipolar event, phased arrya radar, severe thunderstorm

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS01-06 Room:202 Time:May 23 15:30-15:45

Observation and Study on Lightning Processes Using Continuous VHF Broadband Digital Interferometer in New Mexico

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We observed lightning discharges using the upgraded VHF broadband digital interferometer (DITF) at Langmuir Laboratory in New Mexico. The digitizer of the original VHF DITF has been upgraded to record the waveforms at 180 MS/s for 2 seconds continuously. In this study, we use the standard deviation of the distribution of slopes of phase difference versus frequency as the criteria to identify whether the signals are related to lightning processes. The signals that have slopes near the mode of the distribution are assumed to be coherent, have originated a single source, and have propagated directly to the antennas. Then we used the slopes to locate the radiation sources. As a result, both positive breakdown and negative breakdown are located, and recoil leaders are visualized in great detail. As recoil leaders cross the area of initiation, their development was slowed and their emissions were reduced. There are also recoil leaders that seems to start from one negative charge region and propagate to an adjacent negative charge region. Negative leaders and recoil leaders have emissions that can be 20-30 dB higher than the emissions from positive leaders, however the intensity of radiation is the same for the majority of emissions. We also identified the difference of frequency characteristics between lightning processes. The calculation method shown in this paper is a useful technique for locating all radiation types from lightning processes regardless of radiation amplitude using broadband interferometry, and is expected to clarify lightning processes with very low power signals that have not been discussed in the past.

Keywords: lightning discharge, interferometer

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MIS01-07 Room:202 Time:May 23 15:45-16:00

Properties of lightning in Eastern Mediterranean thunderstorms

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We present an analysis of thunderstorm and lighting properties in Israel and in the Eastern Mediterranean region based on data obtained by the Israel Lightning Location System (ILLS) during one year (1.8.2009-31.7.2010). We computed the multiplicity, the percentage of single stroke flashes and the land-sea distribution of single vs. multiple-stroke flashes and the stroke current distribution. Results show that for the commonly used North American Lightning Detection Network (NALDN) thresholds (e.g. 0.5 seconds and 10 km range between strokes), the percentage of single stroke flashes above Israel was 37% and the average multiplicity was 1.7. When using modified thresholds of 0.2 s and 2.5 km (based on the average time interval between successive return strokes being several tens of milliseconds, and a mean range of less than 2.5 km between two ground terminations of strokes in the same flash), we find a mean multiplicity of 1.4 for negative CGs and a percentage of 58% of single stroke flashes. Case-study analysis of a unique storm in 30.10.2009, which had 20696 strokes in 24 hours, shows that most positive CGs (93.2%) are single stroke flashes, while for negative CGs this value is 41.3%. In multiple-stroke negative flashes, the average current is always larger and wider distributed in the first stroke (-37 kA) and decreases and narrows in subsequent strokes, the final one being the weakest. The average inter-stroke time is 0.078 seconds, which seems to justify the use of the new threshold for calculating the multiplicity. We suggest that present values used for clustering strokes into flashes seem to be too large and can potentially misclassify independent flashes as subsequent strokes of a single flash. This may lead to lower values of flash densities than occur in reality.

Keywords: Lightning detection system, Flash multiplicity, Thunderstorms, Eastern Mediterranean

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS01-08 Room:202 Time:May 23 16:15-16:30

High resolution experiment for thunderstorm and lightning

Tomoo Ushio[1*], Shigeharu Shimamura[1], Hiroshi Kikuchi[1], Ting Wu[1], Yoshitaka Nakamura[2], Satoru Yoshida[1], Takeshi Morimoto[3], Zen-Ichiro Kawasaki[1]

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A new phased array radar system and high resolution lightning location system have been developed for thunderstorm and lightning studies. It is now well known that rapidly evolving severe weather phenomena (e.g., microbursts, severe thunderstorms, tornadoes, and lightning) are a threat to our lives particularly in a densely populated area. Over the past decade, mechanically rotating radar systems at the C-band or S-band have been proved to be effective for weather surveillance especially in a wide area more than 100 km in range. However, rapidly evolving weather phenomena have temporal and spatial scales comparable to the resolution limit (-10 min. and -500m) of typical S-band or C-band radar systems, and cannot be fully resolved with these radar systems. In order to understand the fundamental process and dynamics of such fast changing weather phenomena, volumetric observations with both high temporal and spatial resolution are required. The phased array radar system developed has the unique capability of scanning the whole sky with 100m and 10 second resolution up to 30 km in a cost effective manner. The system adopts the digital beam forming technique for elevation scanning and mechanically rotates the array antenna in azimuth direction within 10 seconds. The radar transmits a broad beam of several degrees with 24 antenna elements and receives the back scattered signal with 128 elements digitizing at each elements. Then by digitally forming the beam in the signal processor, the fast scanning is realized. Additionally, electrical aspect of thunderstorm can be obtained by detecting the lightning flash rate. In Osaka University, a new lightning location system which covers the area of phased array radar was developed and locates the sources of the impulses from lightning in 3 dimensions. In this presentation, the new phased array radar and lightning location system for high resolution thunderstorm studies are introduced.

Keywords: Lightning, Thunderstorm, RADAR

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS01-09 Room:202 Time:May 23 16:30-16:45

A lightning observation network in Kansai using a LF broadband digital interferometer

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[1]Osaka University

We have been designing and developing a LF broadband digital interferometer (DITF) that detect electromagnetic (EM) waves associated with cloud-to-ground and intracloud discharges, and locate the EM wave sources. We have been building up a lightning observation network consisting of a LF DITF around Osaka. The observation network covers the areas from Kobe to Nara. In this presentation we compare the results with radar data and discuss the initiation of lightning discharges.

Keywords: lightning, monitoring, remote sensing

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS01-10 Room:202 Time:May 23 16:45-17:00

Electrodynamic model of the atmosphere ionosphere coupling

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The numerous powerful natural and artificial phenomena influence to the ionosphere and stimulate an appearance of plasma and electromagnetic disturbances. The ionosphere is disturbed from below by earthquakes, volcanic eruptions, typhoons, thunderstorms, explosions. Disturbing factors of these processes are the atmospheric perturbations, electric currents, electromagnetic radiations, and increase of radioactivity level, charge aerosols transport. Numerous observations of anomalous plasma and electromagnetic phenomena in the ionosphere above the regions of seismic and meteorological activity are evidence that intense processes in these regions influence the state of the ionosphere during periods of from several hours to several dozens of days. An analysis of satellite data showed the presence of electromagnetic perturbations over a broad spectral interval, electron density fluctuations in the ionosphere, changes in the ionic composition and temperature of the plasma in the upper ionosphere, the anomalous IR radiation flux and the increase of DC electric field. These perturbations are localized within a magnetic field tube conjugated with the epicenter of an impending earthquake and typhoon. Simultaneously with electromagnetic and plasma phenomena in the ionosphere, an increase in the concentration of soil gases and aerosols, an increase in atmospheric radioactivity heating of the lower atmosphere, sharp changes in its electrophysical parameters were observed.

The key role in atmosphere-ionosphere interaction belongs to electromotive force (EMF) in the lower atmosphere. The external current of EMF is excited in a process of vertical atmospheric convection and gravitational sedimentation of charged aerosols over seismic and typhoon region. Aerosols are injected into the atmosphere due to intensified soil gas elevation in the lithosphere during the enhancement of seismic activity. As a basis for the theoretical modeling it will be used a mechanism of the electric field generation in the ionosphere by the EMF excited in closed global atmosphere-ionosphere electric circuit due to emission of charged aerosols, radioactive substances into the atmosphere and their transport by atmospheric convection during enhancement of seismic activity. Calculations show that the electric field of the current that flows in the ionosphere can reach values of several tens of mV/m observed on satellites. As a result the instability of acoustic-gravitational waves in the lower ionosphere is developed. This results in the formation of horizontal conductivity inhomogeneities, the generation of field ? aligned currents into the magnetosphere, and the formation of plasma layers in it. The interaction of conductivity inhomogeneities with electromagnetic field of lightning discharges results in the emission of extremely low-frequency radiation into the magnetosphere observed on satellites and magnetic field oscillations in the ultra-low-frequency range. Electric field strengthening in the ionosphere modifies vertical profile of its E, F and D layers related to plasma drift and ionosphere heating by electric current. At definite conditions the seismic related DC electric field can reach the breakdown value in some region of the atmosphere at altitudes over epicenter of seismic activity. Atmospheric turbulence leads to appearance of the random electric discharges. Comparison of the calculation results performed by above mentioned theory and the satellite observation data confirm above mentioned mechanism. One can consider that disturbed region is a source of other phenomena. Namely, there are scattering of the electromagnetic waves on the conducting canal of discharges, the glow of discharges region, the growth of ozone number density and the atmosphere heating of disturbed region.

Keywords: atmosphere, ionosphere, global electric circuit, electromotive force

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS01-11 Room:202 Time:May 23 17:00-17:15

An Analysis of Atmospheric Electricity at Syowa Station, Antarctica

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Minamoto and Kadokura(2011) shows criteria for extracting fair-weather data in atmospheric electricity at Syowa Station, Antarctica by using meteorological factors. We extracted fair-weather atmospheric electricity periods from data between February 2009 and January 2012, with that criteria. Amount of the fair-weather periods is 2765 hours, 10 % of the three years. In the fair-weather periods, 171 hours were during geomagnetically active period, which is defined as follows: K-index is more than four.

In order to discuss fluctuations of atmospheric electricity when auroral particles precipitate over Antarctic region, we will show relationship between the data of fair-weather atmospheric electricity, geomagnetic field and Cosmic Noise Absorption which is known to occur when high energy electrons penetrate into the ionosphere.

Keywords: atmospheric electricity, Antarctica, Aurora, Cosmic noise

Japan Geoscience Union Meeting 2013
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MIS01-12 Room:202 Time:May 23 17:15-17:30

Ionospheric Perturbation Caused by Solar flares as determined from VLF subionospheric propagation Studies at Agra, India

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Studies of very low frequency (VLF) subionospheric propagation of fixed frequency VLF transmitter signals [NWC, (19.8 kHz), NPM (21.4 kHz) and NAA (24 kHz)] have been in progress at Agra (geograph. lat. 27.2oN, longi. 78oE) India since the year, 2002. Earlier we used absolute phase and amplitude data logger (Abs PAL) purchased from LF EM Low Frequency Electromagnetic Research Ltd, Australia which was later replaced by Soft PAL system. The observations have been taken at Bichpuri Campus, located in rural area about 12 Km west of Agra city where local disturbances due to electrical malfunctioning are low.While earlier studies were intended to monitor the effects of lightening and earthquakes, recently we have oriented our studies to examine the effects of solar flares on a moderate path (GCP 6600 Km, Agra-NWC, Australia). We have analysed the data for a period of one year between 01 January, 2011 and 31 December, 2011 and found 47 cases of solar flare induced perturbations which are correlated linearly with X-ray fluxes of varying intensities. The amplitude perturbations appear as enhancements (dA) which lie in the range of 0.6 dB to 5.36 dB. Assuming unperturbed ionospheric height of reflection H'= 71 Km and sharpness factor Beta = 0.43 Km-1, we have calculated the flare induced ionospheric height H' = 66 Km and Beta = 0.48 Km-1. The electron density at this height of reflection is found to be 801.61 cm-3. This is consistent with IRI-2007 model electron density with an error ˜10 percent.

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS01-13 Room:202 Time:May 23 17:30-17:45

Simultaneous observations of subionospheric VLF perturbations and surface displacements for major earthquakes over Japan

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Ionospheric anomalies at the low latitude were reported before major seismic activities by using VLF transmitter signals. Although possible generation mechanisms of the precursory perturbations have been proposed such as anomalous electric field and atmospheric waves originated from the ground, the experimental evidence indicating the coupling between the lithospheric activities and overlaying ionosphere before seismic events were rare. In this paper we analyze the VLF transmitter amplitude data from our VLF observation network to identify the ionospheric perturbations together with frequency dependent filtered surface displacement data from GPS network for different earthquakes in Japan. As a result, both ionospheric perturbations and surface displacements are observed about one week before for some of the shallow earthquakes, which may indicate the coupling between the precursory ground movement and relevant ionospheric perturbations.

Keywords: VLF transmitter signals, ionospheric perturbation, surface displacement, GPS, earthquake

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(May 19-24 2013 at Makuhari, Chiba, Japan)

MIS01-P01 Room:Convention Hall Time:May 23 18:15-19:30

Concentration of small ions measured over the Pacific Ocean

Nobuyori Nagaoka[1*], Kazuhiko Miura[1], Sayako Ueda[1], Akihiko Fukawa[1], Katsuhiro Nagano[1], Kazuaki Yajima[2], Ryo Kawata[3], Hiroshi Furutani[3], Mitsuo Uematsu[3]

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It has been proposed that climate could be affected by changes in cloudiness caused by variations in the intensity of galactic cosmic rays in the atmosphere. The cause of it is considered as a new particle formation with an ion induced nucleation. The ion-induced nucleation is occurred under the low concentration of particles and high concentration of ions, but there are a few reports. Then we observed small ions and aerosol size distributions over the Pacific Ocean.

Observations were performed from December 1, 2011 to March 6, 2012 on the R/V Hakuho Maru KH-11-10 and KH-12-1 (EqPOS) cruises over the Pacific Ocean. Small ions were measured with the Gerdien type meter (COM-3400). The critical mobility was set 0.7 cm2/V/s and we measured positive and negative ions alternately. Size distributions from 4.4 to 5000 nm in diameter were measured with a scanning mobility particle sizer (SMPS, TSI 3936N25 or 3936L22) and an optical particle counter (OPC, RION KR12 or KC01D). Small ions are generated with ionization of air by cosmic rays or radiation from radioactive substances. Small ions are lost by various mechanisms such as ion-ion recombination and ion-aerosol attachment. In order to estimate the contribution of the lost by ion-aerosol attachment, a coagulation sink was calculated. The coagulation sink can be deter-mined from CoagS = SUM [KijNj]. Here Kij is the coagulation coefficient and Nj is the number concentration in size class j (Kulmala et al., 2001) .

Main results are as follows:
1. There is a negative relation between ion concentration and coagulation sink over the Pacific Ocean. This suggests that concentration of small ions decreases by ion-aerosol attachment.
2. There is a positive relation between ion concentration and wind speed over the Pacific Ocean. This suggests that small ions are generated by bubble bursts of sea water.

References
Kulmala et al., Tellus, 53B, 479-490, 2001

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Keywords: small ion, aerosol, cosmic ray, radon

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MIS01-P02 Room:Convention Hall Time:May 23 18:15-19:30

Deducing Locations and Charge Moment Changes of Lightning Discharges by ELF/LF Network Observations in Japan

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The electromagnetic radiations from lightning discharges have been intensively studied for a long time in different frequency ranges. Recent observations of electromagnetic radiations from lightning in the ELF (extremely low frequency) frequency range so-called ELF transients are recognized as a powerful tool to obtain one of the most important properties of lightning discharges ; the charge moment changes (Qds). In this paper we demonstrate the spatio-temporal distributions of lightning discharges together with their a charge moment change (CMC) around Japan by using our newly developed domestic ELF observation network. This is the first time to obtain such type of distribution by using only ELF observations in the spatial scale of Japan (a few thousands km). We found that the obtained lightning source distributions both over the Pacific Ocean and the Sea of Japan are originated from the thunderstorm active regions confirmed by other measurements such as WWLLN and LF (JLDN). Statistical properties of the charge moment changes indicate that both number and CMC of positive CGs are superior to those of negative CGs. Moreover, considerably large CMC with both polarities are identified for the CGs over the Pacific Ocean as well as those with positive polarity over the Sea of Japan.

Keywords: Lightning, ELF, LF, Charge moment change