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

MIS026-01 Room:201B Time:May 24 08:30-08:45

A study of the morphology of winter sprites in the Hokuriku area of Japan in relation to cloud charge height

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Continuous observations of sprites in the Hokuriku area of Japan were performed from two optical sites during the three winter periods. The purpose of this observation is to study the major effect in appearance of sprites and in determining the morphology of sprites (columns or carrots). Detailed analysis is performed based on the estimation of the height of -10oC at the time of sprite occurrence. When the height of -10oC is lower than 1,800m, the occurrence of sprites is infrequent, and the dominant shape is column. Then while when it is increased (1,800 to 3,000m), a new situation takes place; that is, the occurrence of sprites is very enhanced and more spectacular shapes like carrots tend to be frequently observed in addition to column sprites. These sprite characteristics are first compared with those of parent lightning in the Hokuriku area and with our latest computer simulations on sprite initiation.

Keywords: sprites, winter lightning, Hokuriku area, cloud charge height

Japan Geoscience Union Meeting 2011
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MIS026-02 Room:201B Time:May 24 08:45-09:00

Energetic radiation associated with winter thunderstorm activity.

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Intense gamma rays likely associated with lightning and/or thunderstorm activities have been detected in recent years, at various altitudes ranging from the ground level to the ionosphere. However, neither the source of this radiation nor its nature has been clarified. We have identified a migrating source of gamma rays lasting for several minutes attributed to a winter thunderstorm in Japan. Our findings indicate that the gamma rays were emitted continuously from a downward hemispherical surface, the bottom of which was about 300 m above sea level, and this source of gamma rays moved from north to south above the observation site at a speed of about 7 m/s. The radiation source probably moved along with the charged region of the cloud at a height of around 1 km, because the estimated migration of the radiation source was consistent with the observed movement of atmospheric electric field variation between ground-based observation sites and with the wind speed and direction at about 1 km altitude. This movement implies that the intense electric field produced by the charged region in the thundercloud generated a radiation source beneath the charged region. The observation helps explain not only the relation between the locations of the charged region and the radiation source, but probably also the lightning initiation urged by the radiation.

Japan Geoscience Union Meeting 2011
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MIS026-03 Room:201B Time:May 24 09:00-09:15

Winter Thunderstorms in Hokuriku district, Japan

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Winter Thunderstorms in Hokuriku district, Japan are very particular phenomena. We have studied for over twenty years in Komatsu Airbase, by using weather radars, sferics direction finding systems, and field mills network.

In this presentaion, we will propose our results between meteorological conditions and electical activity of winter thunderclouds, furthermore will propose our latest analyses of winter thunderclouds and convective clouds in the area surrounding Komatsu Airbase.

Keywords: Winter Thunderstorm, The Sea of Japan, Lightning Activity, Atmospheric Meteorological Condition

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

MIS026-04 Room:201B Time:May 24 09:15-09:30

Recent progress of research on characteristics of winter lightning in Japan

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Regarding winter lightning in Japan, such characteristics as occurrence of frequent upward lightning or frequent occurrence of positive ground flashes have been known. On the engineering side, similar number of lightning damages on transmission lines or wind turbines to that in summer has been experienced in winter in the winter thunderstorm area of Japan, despite the number of lightning strokes observed by lightning location systems (LLS) is much less than that in summer. From this aspect, it is inferred that the characteristics of lightning strikes and of lightning currents in winter differ from those in summer. In recent years, damages on wind turbines by winter lightning have attracted attention in the research community, and there has been much progress in the research on characteristics of winter lightning in Japan through accumulation of observation data.

Electromagnetic field waveforms associated with lightning discharges simultaneously observed with faults of high voltage power transmission lines were investigated. The field waveforms observed in the frequency range of several to several hundreds of kHz showed different characteristics from those associated with lightning return strokes. The field waveforms observed in this frequency range closely relate to waveforms of lightning current. If the location of lightning striking point is known, the peak magnitude of lightning current can be estimated from the observed peak field strength. As a result, it was known that the lightning discharges resulted in outages of power transmission lines had peak currents in the order of 200 kA or higher, regardless of the polarity. They are inferred to be initiated by upward leaders from transmission towers. The lightning strokes of this kind were named as GC (Ground-to-cloud) lightning strokes [1]. Like return strokes, there is difference in the characteristics of negative GC and positive GC. The polarity is defined by the polarity of charge in cloud neutralized by GC strokes.

On the other hand, frequent lightning damages of plastic blades of wind turbines were experienced in winter after many wind turbines had been constructed on Honshu Island along the coast of the Sea of Japan. The cause of these damages is inferred to be large charge transfer associated with lightning strikes to wind turbine blades. According to observation by LLS, proportion of high current lightning flashes is also much higher than that in summer. The reason why comparable number of lightning damages on transmission lines or wind turbines in winter to that in summer is experienced is that upward lightning is generated even from structures of several tens of meters high. This characteristics result in high number of lightning strikes to tall structures even under low lightning ground flash density.

The peculiar characteristics of lightning discharges in winter is inferred to be related to the charge structure in clouds in winter, which was confirmed by location of VHF radiation sources and of neutralized charge in clouds. A model of charge structure in lightning cloud that charges of each polarity exists according to the temperature height in a similar way to that in summer, reported in the early 1980s, had long been believed. In this model, positive charges neutralized by positive ground flashes reside in the -30 degrees Celcius region; however, according to recent observations, charges neutralized by lightning ground flashes in winter reside around the -10 degrees Celcius region in most of the cases regardless of their polarities [2].

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Keywords: winter lightning, lightning current, lightning discharge

Japan Geoscience Union Meeting 2011
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MIS026-05 Room:201B Time:May 24 09:30-09:45

Development of the Broadband Radar Network at Ku-band

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A new high resolution Ku-band Doppler radar with fast scanning capability for meteorological applications has been developed. With the new system design, the radar can accurately measure the radar reflectivity factor with 4-m resolution at the lowest usable height of 60 m from short distance to 15 km (e.g., min. det. refl. at 15km is 20dBz) for 10 W power using a pulse compression technique. Concept of the system design, signal processing algorithm, and data acquisition procedures are described. This small radar system operates at Ku-band and can acquire the 3-D reflectivity image within 1 minute with less than 10m resolution in a short range (less than 15 km in radius).

Initial observation was carried out to demonstrate the potential capability of the system. In addition to the radar system, the equipments for lightning observations were also installed at the radar site. The results of the initial observation show that our radar system can successfully measure the precipitation structure within thunderstorm at high resolution. This comparison clearly shows that the observations by the Ku-band broad band radar reveal the rain structure in much more detail than the conventional C-band radar does. This small rain structure tends to be obscured in the C-band radar observation, indicating that the observation by the Ku-band broad band radar are well suited for fine scale measurements of precipitation from low altitude to the top of the cloud. During the field campaign, F0 scale tornado was also detected by the radar, the detail of the observation will be presented at the presentation.

Keywords: Thunderstorm, Lightning, Radar

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

MIS026-06 Room:201B Time:May 24 09:45-10:00

Ionosperic disturbances associated with TLEs:Modeling and observations

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This paper reports on the direct comparison between experimental and numerical results of the ionospheric disturbances associated with red sprites in the mesosphere. The ionospheric disturbances due to the sprite ionization column are observed by a continuous monitoring of the amplitude and phase of distant VLF transmitter signals at several locations in Japan, whilst the numerical computation to calculate the spatio-temporal dependence of the observed VLF waves is performed by using a two-dimensional finite-difference time-domain (FDTD) method. As a result, the observed maximum scattered amplitude and phase changes are in close agreement with the numerical results for both carrot and column sprites.The distance variation of the scattered amplitude from the numerical simulation is found to strongly depend on the spatial dimension of the sprite ionization column (practically the nearest sprite ionization column to the transmitter) due to the different scattering mechanisms. The forward scattering amplitude is significantly larger than that for back scattering for the carrot sprite indicating the nature of Mie scattering, while the amplitude of both backward and forward scatterings are comparable for a column sprite showing the nature of Rayleigh scattering.

Keywords: TLE, VLF, Ionospheric disturbances

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

MIS026-07 Room:201B Time:May 24 10:00-10:15

Research on location method based on VLF/LF bands EM source associated with lightning discharges

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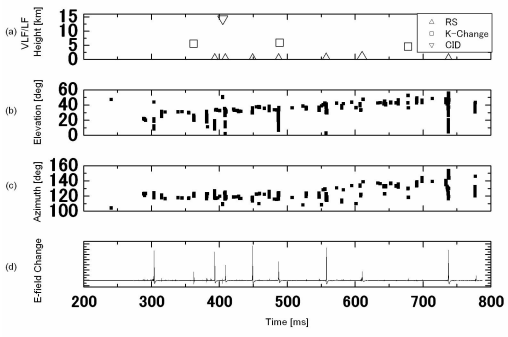
We have been designing and developing a new type of a 3D lightning location system based on broadband digital interferometry in VLF/LF bands. The VLF/LF interferometer consists of four or more observation stations which detect electromagnetic (EM) waves in a wide frequency range from 1kHz to 150 kHz associated with lightning discharges. Since EM waves in VLF/LF radiated by lightning discharges propagate a long distance, the VLF/LF interferometer locates lightning discharges a few hundred kilometers away from the VLF/LF interferometer. During the summer season in 2009, we had conducted lightning observation campaign with a use of a prototype of the VLF/LF interferometer, which consisted of four stations in Darwin, Australia, to validate the system.

The observation results are compared with the observations of VHF interferometers which enable us to visualize leader developments associated with lightning discharges. The VLF/LF interferometer mainly located EM waves associated with return strokes, K events, and compact intracloud lightning discharges (CIDs), which are energetic breakdowns within thunderclouds. The upper figure shows the time series variation of lightning discharges in 3D location, (a) heights obtained from the VLF/LF band interferometer, (b), (c) 2D mapping which coordinate system uses elevation and azimuth obtained from VHF band interferometer, and (d) E-field change.

The VLF/LF radiation sources associated with the return strokes are located near the ground surface. The recoil streamers in K-events and the CID are located near the 5-8 km and 13-16 km in altitudes, respectively. The clear difference of VLF/LF radiation source altitudes is applicable to decide effective criterion whether cloud to ground discharges or cloud discharges. In addition, we succeed in locating K-events that involved pulse bursts, although it was difficult for other VLF/LF location system to locate them.



Keywords: Broadband Interferometry, EM Source Location, Lightning Discharge

Japan Geoscience Union Meeting 2011
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MIS026-08 Room:201B Time:May 24 10:15-10:30

TGF producing lightning properties deduced from ELF transient

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Recent finding of terrestrial gamma ray flashes (TGF) suggests the generation of the strong electric field from thunderstorm activity, leading to the energization of electrons till 20MeV range. However characteristics of the causative lightning of TGF have not been well understood yet. In this paper, the electrical properties such as a polarity, peak amplitude and charge moment change of TGF producing lightning are studied by using ELF transients observed in Moshiri, Hokkaido, Japan. Lightning properties associated with TGF are compared with other lightning that do not accompany TGF identified by World Wide Lightning Network (WWLLN).

Keywords: Terrestrial gamma ray flashes, ELF transient, Charge moment change, Current moment, RHESSI

Japan Geoscience Union Meeting 2011
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MIS026-09 Room:201B Time:May 24 10:45-11:00

Aerosol formation by positive and negative ion recombination

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It has been pointed out that the recombination of atmospheric positive and negative cluster ions could form ultrafine particles. However, few experiments have been conducted to see the possibility of particle formation by ion-ion recombination. In this study, we measured particles formed by positive and negative corona discharges in SO2/H2O/Air mixtures. When positive and negative discharges were operated simultaneously, the formed particles were much more than the sum of the particles formed by individual positive and negative discharge. This result indicated that the recombination of positive and negative ions led to the particle formation. The particle formation was enhanced by the addition of NH3. Therefore, the formation rate of particles was shown to be affected by chemical compositions of positive and negative ions.

Keywords: atmospheric ion, atmospheric aerosol, ion-ion recombination

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

MIS026-10 Room:201B Time:May 24 11:00-11:15

Report of atmospheric electric field observation in Shonai area and calibrations for the observations

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1. Introduction

The Electric Field Mill (EFM) measures atmospheric electric field of local area which is disturbed by landform, structures or the instrument itself. Furthermore each EFM has different sensitivity respectively.

We installed EFM at five observation sites in Shonai area in order to for analyses and study of atmospheric electricity concerning to thunderclouds. In order to compare multi-point observation data, calibrations of EFMs are required. We report the method of the calibrations to enable the comparison in this presentation.

2. Sensitivity calibration

We made large size parallel flat condenser which can install EFM in Kakioka magnetic observatory. We calculated out reduction factor from given voltage of electricity to the instrument by the parallel flat condenser and output of the FEM.

3. In situ calibration

To correct difference of output due to environment around observation point, we took in situ calibration at each site. We installed the EFM in a pit near by the continuous observation point and adjusted the position of electrodes to ground level. Reduction factor at the point is calculated from output of the EFM in the pit and output of the continuous observation.

4. Conclusion

Reduction factors for comparison among multi-point observation data are induced. However, we afraid that variations of atmospheric electric field at some points were too small to derive feasible reduction factors. Because changes of atmospheric electric field during thunder clouds passing, and reduction factors obtained under sharp fluctuating atmospheric electric field are more reliable than that obtained under calm conditions. We will inspect the adequacy of those reduction factors.

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MIS026-11 Room:201B Time:May 24 11:15-11:30

Atmospheric electrical conductivity measured at the summit of Mt. Fuji and in Tokyo

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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 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, aerosol size distributions, radon concentrations, and intensity of cosmic rays at the summit of Mt. Fui simultaneously. We also observed the similar elements at Kagurazaka in Tokyo. We compared these results with the passed values.

Observation periods were from 29th July to 25th August 2100 at the summit and from 30th October to 31st December 2010 at Kagurazaka, respectively. Small ions were measured with the Gerdien type meter (COM-3400). The critical mobility was set 0.7 $cm^2/V/s$ and we measured positive and negative ions alternately. Size distributions from 4.4 nm 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 KC01C). Radon concentration was obtained radioactive aerosols collected on a filter.

Small ions are generated with ionization of air by cosmic rays or radiation from radon. Small ions are lost by various mechanisms such as ion-ion recombination and ion-aerosol attachment.

$dn/dt = q - an^2 - bnN$

where n : small ion concentration, N : aerosol concentration, q : ion pair production (ionization rate), a : recombination coefficient, b : attachment coefficient. As the second term can be neglected because of small n compared with N in large city, dn/dt goes to q - bnN. Under the equilibrium conditions, the left-hand side is zero, q = bnN. If q is constant, n is inversely proportional to N. However, aerosol concentration is low and the ionization rate by cosmic ray is high in mountain atmosphere. Conductivity L is obtained by the equation:

$L = enk$ with $k = 1.3\ cm^2/V/s$.

The average value of conductivity at the summit was a third of the value measured by Sekikawa (1960), on the other hand, the average value at Kagurazaka showed nearly same value as the value measured by Tuge (1996). Hourly averaged values showed often the diurnal pattern, high in the early morning and low in the evening. There was inversely good correlation between conductivity and particle concentration at Kagurazaka and also weak correlation at the summit. There was no correlation between conductivity and radon concentration. The possibility of ion induced nucleation was observed once.

Acknowledgments

This study was partly supported by the Grants-in-Aid for Scientific Research, Category C (Grant No. 22510019), from Japan Society for the Promotion of Science and the Sumitomo Foundation. This work was performed during the period in which the NPO ”Valid Utilization of Mt. Fuji Weather Station” maintained the facilities.

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Keywords: ion, ion induced nucleation, background aerosol, radon, cosmic ray

Japan Geoscience Union Meeting 2011
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MIS026-12 Room:201B Time:May 24 11:30-11:45

A statistical study on the AGW modulations in subionospheric VLF/LF propagation data

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Though there have been several papers suggesting the important role of atmospheric gravity waves (AGWs) in the generation mechanism of seismo-ionospheric perturbations, no reports have appeared on the statistical study of the AGW effect. Based on the data over nine years and for many propagation paths in and around Japan, this paper presents the first statistical result on the role of AGW in seismo-ionospheric effects. The conclusion by means of superimposed epoch analysis is that the AGW modulation (fluctuation) is rather enhanced about 10 days only for shallow (depth $<$ 40km) earthquakes, but its significance level is just close to the conventional 2sigma (sigma: standard deviation) level. So that, we can conceive that the AGW channel is the most dominant hypothesis for seismo- ionospheric perturbations, but an alternative channel such as chemical (+ electric field) channel is also operative either simultaneously for an EQ or may be dominant for a small number of earthquakes.

Keywords: VLF/LF subionospheric propagation, earthquakes, seismo-ionospheric perturbation, AGW modulation

Japan Geoscience Union Meeting 2011
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MIS026-13 Room:201B Time:May 24 11:45-12:00

Ionospheric anomalies possibly associated with M > 6.0 Earthquakes in Japan area

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Recent studies have shown that there were precursory electromagnetic signals observed on the ground and in space associated with large earthquakes. The major question, still widely debated in the scientific community is whether such signals systematically precede major earthquakes. To address this problem we have started to validate the anomalous ionospheric signals during the occurrence of large earthquakes. In this paper, we examine pre-earthquake ionospheric anomalies in time series and perform a statistical test by using total electron content (TEC) derived from global ionosphere maps (GIM) around the Japan area for the first time. The normalized GIM-TEC (GIM-TEC∗), which is computed based on 15 days backward running mean of GIM-TEC, have been investigated for minimizing possible confounding effects of consecutive earthquakes and identify the abnormal signals. Meanwhile, to reduce the effect of strong geomagnetic activities such as geomagnetic storms, a criterion for removing the GIM-TEC data have been adapted; that is Dst index exceeds -60nT. Temporal variations of GIM-TEC∗ for large and destructive earthquakes in Japan have been studied; which are the 2004 mid-Niigata Prefecture Earthquake (M6.8), the 2007 offshore mid-Niigata Earthquake (M6.8), and so on. Although there are some positive and negative TEC anomalies before and after the four earthquakes, there is a tendency that positive TEC anomalies appear 1-5 days before all the above earthquakes even in the quiet geomagnetic condition. Superposed epoch analysis has been performed for statistical analysis of TEC anomalies associated with M ? 6.0 Earthquakes during the 12-year period of May 1998 ? May 2010. The statistical result indicates the significance of the positive TEC anomalies 1?5 days before earthquakes within 1000 km from the epicenter around Japan.

Keywords: Ionospheric anomalies, Earthquake, GIM-TEC, Statistical analysis, case study

Japan Geoscience Union Meeting 2011
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MIS026-14 Room:201B Time:May 24 12:00-12:15

Statistical analysis of the ULF magnetic field data linked to Izu Island earthquake swarm.

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[1]The Univ. of Electro-Comms., Japan.

There have been many reports on ULF magnetic anomalies in relation with local powerful seismic activities. Most previous works have been dealt with seismo-ULF signatures based on the physical principle such as fractal and polarization analyses, whilst there are only few works based on the statistical analysis. In this paper, we aim at extracting the properties of seismo-ULF signatures and to address their physical mechanisms by using the statistical analysis. The statistical properties (i.e. cumulative probability distribution function) are calculated by using each half-hour period in a number of frequency band ranging from 1mHz to 2Hz for the time period of about three years around Izu Island earthquake swarm (the year of the quake, one year before and after the quake). As a result, the remarkable change in the shape of cumulative probability distribution starts about one month before the swarm particularly at the frequency band of 6.7mHz to 0.01Hz. After the swarm, the distribution returns to the original distribution, For other two years (before and after the swarm), the cumulative probability distribution does not show systematic dependence as is seen for the year of the swarm, which indicates that the observed changes of the distribution is due to the swarm.

Keywords: ULF, earthquake, statistical analysis, seismo electromagnetics

Japan Geoscience Union Meeting 2011
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MIS026-15 Room:201B Time:May 24 12:15-12:30

Statistical study of the ionospheric perturbation observed by low-altitude satellite

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Using electric field power observed on board DEMETER satellite, we have performed the statistical analysis of the local ELF electric field enhancement located at the side of the equatorial anomaly crest for the time period of one year (Jan.1 to Dec. 31, 2005). Among 7576 half orbits during a year, 363 half orbits contain the local electric field bursts corresponding to the ionospheric perturbation and their peak electric field intensity are obtained. As a result distribution of the peak intensity is symmetrical about the magnetic equator and increases with increasing the magnetic latitude. This latitudinal dependence of the peak intensity is much clearer in daytime than nighttime. Then we study the connection between ionospheric perturbation and powerful seismic events (M>6) occurred over the orbits (within 15 deg in longitude) and before 10 days from the perturbed orbits. Although the statistical error is relatively large, the median value of the peak intensity of the ionospheric burst events above land earthquakes is much larger than those for ocean earthquakes, which implies the lithosphere-atmosphere-ionosphere coupling due to the powerful earthquakes.

Keywords: ionospheric pertubation, DEMETER, equatorial anomaly, earthquake

Japan Geoscience Union Meeting 2011
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MIS026-P01 Room:Convention Hall Time:May 24 14:00-16:30

A Year-round Observation of Size Distribution of Aerosol Particles at the Cape Ochiishi, Japan

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New particle formation by nucleation of gas-phase compounds emitted from marine biogenic sources is very important for climate change. To clarify the mechanism of the formation, size distribution of submicron aerosols was measured at the Cape Ochiishi, facing the North Western Pacific Ocean where primary productivity is high. To perform an automatic year-round observation, a test observation was done from 22nd May to 18th June 2008 and a year-round observation was performed from 16th October 2009 to 7th September 2010.

The size distribution from 10 nm to 487 nm and from 300 nm to 5000 nm in diameter was measured with a scanning mobility particle sizer (SMPS, TSI 3034) and optical particle counters (OPC, RION KC01D, KC01E, KR12A), respectively. Sample air was dried to lower than 40% with a ribbon heater. Transport of sulfate, organic carbon (OC), and black carbon (BC) was estimated with Chemical weather FORecasting System (CFORS). CFORS was developed by Prof. Itsushi Uno and Mr. Koji Ishihara in Research Institute for Applied Mechanics (RIAM), Kyushu University, Japan. The system migrated to National Institute for Environmental Studies (NIES) with financial support by Center for Global Environmental Research (CGER) in June 2002. (http://www-cfors. nies.go.jp/ ˜cfors/research/). Outline of RIAM-CFORS (by Prof. Uno, RIAM, Kyushu Univ.) is shown in the web (http://www-cfors.nies.go.jp/˜cfors/ outline.html). Existence of inversion layer was estimated with temperature profile measured at surface, 10m, 30m, and 50m in altitude.

The burst of the particles smaller than 20nm in diameter continuing longer than 3 hrs was observed 36 times during these observation periods. Seven events were observed in early summer and the other was in autumn and winter. Banana shape was faintly observed 21 times. Transport of sulfate, OC, and BC was observed 11, 26, 30 times, respectively. Source of air mass was estimated with these elements, weather map, surface wind direction and backward trajectory analysis. The air mass of 26 events was estimated to continental. It suggests that the maritime nucleation is observed during a year, however clearly nucleation related to marine sources was not observed.

Acknowledgments
This study was partly supported by the Grant-in-Aids for Scientific Research on Priority Areas from the Ministry of Education, Culture, Sports, Science and Technology, Japan (18067005). The observation was performed at the monitoring station of the National Institute for Environmental Studies.

Keywords: size distribution, new particle formation, CFORS

Japan Geoscience Union Meeting 2011
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MIS026-P02 Room:Convention Hall Time:May 24 14:00-16:30

Lightning observations by the satellite and the characteristics of the electromagnetic waveforms

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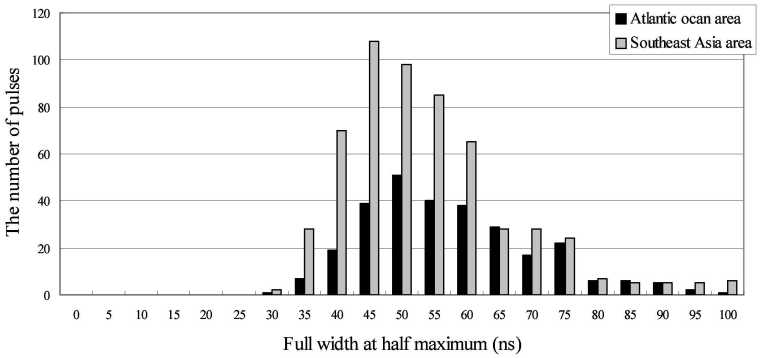
The well-developed thundercloud causes local downpours and tornadoes accompanied with the lightning discharge. These climatic phenomena in a short period of time are difficult to monitor in real time with an existing system. The monitoring of the thunderstorm activities is useful to prevent the weather disasters. The present study aims to monitor the thunderstorm activities from space. In our research group, the Broadband Digital Interferometer (DITF) has been already used to observe the lightning activities above ground. The DITF is a system to locate the sources of impulsive VHF radiation based on the digital interferometric technique. In other words, the DITF is a equipment to visualize lightning channel by VHF radio observations. The remarkable feature of the DITF is its bandwidth (from 25 MHz to 100 MHz) and implicit redundancy for the direction-of-arrival (DOA) estimation. The fairly high resolution and the compactness of the system are great advantage to be the spaceborne system. The goal of this study is to realize the spaceborne DITF and to monitor constantly the thunderstorm activities with the satellites. The Maido-1 observed the lightning discharges from February to October 2009. We indicated the recorded data with the Maido-1 above Southeast Asia area and the Atlantic Ocean area. The pulse width and the number of the pulses are thought to be highly affected by the propagation length through the ionosphere and the lightning activity level, respectively.

We calculated the change of the pulse width with the electromagnetic wave propagation in the ionosphere. The pulse width grows wider in the medium because the short duration VHF pulse with lightning activity has the wide band frequency characteristic. We conducted the propagation simulation in order to understand the change of the waveform. The ionospheric model was developed to calculate the change of the pulse width in the ionosphere. It was divided into the multi-layered media to consider the altitude distribution of the electron density. The model assumes that the ionosphere and the earth are the spherical shape with their origin at the center of the earth. The each layer has the thickness at 10 km. The values of the electron density are used the international reference ionosphere 2007 (IRI-2007) model. In the each layer, the value of the electron density and the refractive index stay constant. The full width at half maximum (FWHM) changed about the tens of nanoseconds. Next we compared to the pulse width of the received pulses by the Maido-1 satellite at the two observation areas. The results in the Atlantic Ocean area had the greater FWHM than those in the Southeast Asia area. The deference of the FWHM was about 5ns. The results had a similar finding for the ground-based observations.

Then we discussed the relationship between the number of the received pulses and the lightning activity. The relationship was calculated by using the observation results of the Maido-1 and the WWLLN. As the first step, the lightning activity factor is defined as the lightning detected number of the WWLLN. The lightning detected number indicates the number which the WWLLN detected the lighting activity in the satellite observation range and in five minutes around the time of the satellite observation. Second, the received pulse number by the Maido-1 was counted using the fitted pulses with the LogisticCum function. Then, we compared the detected number by the WWLLN with the received pulse number by the Maido-1. This result indicated the clear link between the number of the received pulses by the Maido-1 and the detected number by the WWLLN.

We concluded that the pulse width and the received pulse number with the VHF lightning satellite observation indicated the probability of the reference indexes for monitoring the lightning activities.



Keywords: Electromagnetic wave, Radio propagation, Lightning discharges, Satellite observation

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

MIS026-P03 Room:Convention Hall Time:May 24 14:00-16:30

Seasonal variability of lightning activity in the Mediterranean using the World Wide Lightning Location Network

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The Mediterranean Climate is the dominant climate in the Mediterranean region, and there are typically dry summers and wet winters. For this feature, the intensity of lightning activity in winter is stronger than one in summer in the Mediterranean region. In particular, winter thunderstorms are different from summer thunderstorms in terms of charge distributions for low altitudes of the tropopause. Thus, it is thought that the frequency of upward cloud-to-ground (CG) lightning flashes and the positive CG lightning flashes, transferring the large charge to ground, is high in winter than in summer. To fully understand lightning discharges in the Mediterranean region, we must recognize characteristics of their lightning activities. The World Wide Lightning Location Network (WWLLN) operated by the University of Washington has more than 50 sensors in the world and locates lightning discharges on the globe in real-time. In this study, we estimate monthly lightning distribution maps in the Mediterranean from 2007 to 2010 using the WWLLN. The lightning activity observed over the Mediterranean Sea in March moves to the European Continent from April to June. In July and August, we detect lightning flashes over inlands of the northern Mediterranean and Algeria. Meanwhile, there is no lightning activity over the greater part of the Mediterranean Sea. The lightning distribution on the European Continent moves south from September to October. From November to March, we detect lightning flashes over the Mediterranean Sea. Meanwhile, there is no lightning activity on the greater part of the inland south European Continent and inland North Africa. In this presentation, we will show some case examples in winter, and compare them with winter lightning in Japan and sea surface temperatures of the Mediterranean Sea.

Keywords: winter lightning

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Long-term trend of global geomagnetic Sq field

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Long-term variation, including seasonal and local time variations, of the atmospheric potential gradient (PG) at Kakioka (KAK) and Memambetsu (MMB) in Japan was investigated for the period 1958-2008. PG was observed in all seasons to have decreased steadily at KAK since 1980, but the decrease was accelerated after 1997. This pattern suggests that the height profile of the conductivity above KAK was modified, especially after 1997. The decrease in PG was also observed at MMB after 1997. More details together with seasola and local time variations will be shown in the presentaion.

Keywords: atmospheric electricity, potential gradient, long term trend, seasonal dependence, local time variation

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Development of small-size field mill for balloon measurement

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We developed a small-size field mill equipped with a data logger for balloon measurement. Purpose of this system is to monitor atmospheric electric field variation generated by thunderstorm and non-thunderstorm. The system is operated not only by battery without a commercial electric power but also in low temperature. In the presentation, we introduce a performance of our system and preliminary observation results.

Keywords: Atmospheric electric field, Field mill, Ion-aerosol