



## 28th International Conference on Lightning Protection



# Topic I: Lightning Discharge

## I-C: Meteorology and Global Phenomena

### Moderator's Report

Chairman: E. P. Krider  
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#### I. INTRODUCTION

A total of 16 papers, coming from various countries (Japan, Sweden, Sri Lanka, Ukraine, Finland and USA) have been included in this session.

Seven papers have been selected for oral presentation; nine papers have been selected for the Poster Session.

The meteorology and global phenomena section covers two principal topics: the first related to lightning observations by means of HF-VHF radiation and the second related to various phenomena in the upper atmosphere (elves, sprites) usually associated with lightning discharges.

#### II. PAPERS FOR ORAL PRESENTATION

I-15 “*The lightning observation by LDAR II network in the summer and winter*” by M. Tatsumi, T. Idogawa, N. Honma

This paper describes comparisons between three-dimensional flash data derived from an LDAR II system and two-dimensional flash data derived from a LLS network. All data are analyzed by season. The LDAR II observations show the behavior of downward and upward discharges and the height difference for discharges generated in summer and in winter.

I-16 “*An operational VHF broadband digital interferometer and winter thunderstorm observations*” by T. Morimoto, M. Akita, T. Ushio, Z. Kawasaki

This paper presents a novel technique using a VHF broadband digital interferometer to detect and monitor

thunderstorm activity. Lightning observation in 2D or 3D are compared with video-camera observations. The authors claim the superiority of interferometry over the TOA (Time-of-Arrival) technique. The positive charge distribution inside thunderclouds is investigated and as well the total lightning activity, including high-speed phenomena (J- or K- processes).

I-17 “*Signatures of the lightning HF radiations at 10 MHz, 5 MHz and 3 MHz associated with leader and return stroke process*” by M. Edirisinghe, J. S. Mäkelä, R. Montanõ, M. Fernando, V. Cooray

The authors have analyzed 46 flashes with simultaneous records of HF radiations at 10 MHz, 5 MHz and 3 MHz. In most cases, the strongest HF radiation happens at the onset of the negative return stroke. After an initial burst, the HF radiation intensities increase again after several milliseconds. Authors believe that this is due to possible cloud discharge activity. The durations of the HF radiation during the return stroke are similar for the three frequency examined.

I-18 “*Characteristics of winter thunderclouds and possibility of nowcasting using a Doppler radar*” by F. Kobayashi, T. Shimura, H. Kawamoto, A. Wada, K. Shinjo

In this paper, the authors analyze the structures of Japanese winter thunderclouds and of the CG lightning activity using Doppler radar, video camera, wind profiler and other weather observations, together an UHF lightning interferometric detector. They study some cases of “superbolt” flashes in winter thunderclouds. It is suggested how to nowcast winter thunderclouds with the Doppler radar, using the maximum reflectivity, the vertical integrated reflectivity and horizontal convergence at lower level.

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I-19 “*Characteristics of ELF transients for the study of huge lightning in the world*” by K. Yamashita, T. Otsuyama, N. Sekiguchi, Y. Matsudo, Y. Ando, M. Hayakawa, K. Michimoto

In this paper, the authors compare the several types of the ELF direction findings with other reference systems (LIS and SAFIR), and confirm the validity of the ELF direction findings. It is shown that the Goniometer method is most accurate for the long-range events because the observed electric fields are easily affected by noise more than the observed magnetic fields.

I-20 “*Lightning activity observed by TRMM satellite*” by T. Morimoto, Z. Kawasaki, T. Ushio, S. Oita

This paper presents the observation results by TRMM/PR and LIS and the investigation of lightning activities by the results. The authors find that the correlation between lightning activities and the snow depth of convective clouds may follow the power-five law. They also investigate the influence of El Niño on lightning activity. From the comparison of the statistics between El Niño and non El Niño periods, the authors find that the lightning activity during El Niño period is higher than non El Niño period instead of less precipitation on the ground during El Niño period.

I-21 “*Characteristics of sprites and elves associated with Japanese winter lightning, as estimated by ELF transients*” by Y. Matsudo, T. Suzuki, K. Yamashita, Y. Ando, M. Hayakawa, K. Michimoto

This paper presents a view of particular atmospheric events like sprites and elves. These phenomena are defined as Transient Luminous Events (TLEs) and usually happen in the mesosphere, over large thunderstorms. The authors used optical measurements, an EM antenna and a lightning observation system (SAFIR system). They find that sprites happen not only with positive CGs but also with negative CGs and intra-cloud lightning. Furthermore, they measure the charge moment of the lightning that induces sprites and the total charge transfer.

### III. PAPERS FOR POSTER SESSION

I-47 “*Development of a zone based thunderstorm classification system using a neural network*” by J. Singye, K. Masugata, T. Murai, I. Kitamura

This paper describes a prototype algorithm to track thunderstorms, using a number of field mills and a neural network, trained with data from dynamic simulations, these based on the field mill measurements.

I-48 “*Relationship between thunderstorm echoes and lightning discharges*” by T. Suzuki, T. Miyazaki, M. Hayakawa, K. Michimoto, Y. Ohhigashi

Radar echoes, SAFIR lightning data, field mills, camera system, satellite data are used to study the generation of sprites by thunderstorms in Japanese winter. Fifteen sprites are detected and eleven of them show long linear lightning

channels. A possible mechanism for winter lightning inducing sprites, with positive charge transfer, is suggested and the structure of parent thundercloud systems is analyzed as well.

I-49 “*Winter sprites and associated phenomena in the Hokuriku area, Japan*” by M. Hayakawa, T. Nakamura, Y. Matsudo, K. Yamashita, D. Iudine, T. Suzuki, K. Michimoto

In this paper, the authors study the parent lightning and the morphological characteristics of sprites in the wintertime in Japan and compare them to sprites in other nations. Sprite occurrence criteria are linked to positive CG discharges and a vertical charge moment exceeding 300 C·km.

I-50 “*Details of lightning channels associated with sprites in winter around the Hokuriku coast*” by T. Suzuki, Y. Matsudo, M. Hayakawa, K. Michimoto, T. Shimura, T. Hanada

This paper describes an investigation of sprites and the parent thunderclouds using a SAFIR system, CCD cameras, and satellite IR-imagery. The authors analyze a case study and suggest that sprite-parent winter thunderclouds, probably in a common mesoscale system, are connected with each other and share the same cloud shield. The sprite-inducing lightning discharge had a long, linear lightning channel.

I-51 “*Chaotic nature of research on induction field fluctuations by lightning discharge*” by T. Miyazaki, T. Okada, T. Suzuki

The authors of this paper detect atmospheric, generated by lightning discharges, with an orthogonal loop antenna, in the band 10-500 kHz, and they use the chaos theory to analyze the induction field components. They find that a chaotic characteristic exists in the induction field components.

I-52 “*Evidence on a link between the intensity of Schumann resonance and global surface temperature*” by M. Sekiguchi, M. Hayakawa, A. P. Nikolaenko, E. Williams, Y. Hobara

This paper presents a correlation study between the Schumann resonance intensity and the global surface temperature. Variations in the global land temperature are characterized by two patterns associated with different latitude intervals. The semi-annual variation is dominant in the equatorial belt and the annual component prevails from the middle to high latitudes.

I-53 “*Lightning discharge mapping system using time differences of broadband arrival pulses technique*” by T. Tantisattayakul, K. Masugata, K. Kitamura, H. Shimaki, T. Kawauchi, H. Ito

This paper describes a broadband VHF detection system for mapping the lightning discharge process in 3D. A time-domain signal analysis is applied to evaluate the time

differences of the broadband VHF pulses.

I-54 “*Lightning HF radiation at 10 MHz during dart leader and subsequent return stroke processes*” by J. Mäkelä, M. Edirisinghe, M. Fernando, R. Montanõ, V. Cooray

The authors measure both the broadband electric field and the HF radiation at 10 MHz in close tropical lightning. They show examples of different leader processes associated with the subsequent return strokes in CG flashes. The behavior of different dart leaders are studied and the chaotic processes are shown to be higher in HF emission.

I-55 “*The lightning HF radiation at 10 MHz, 5 MHz and 3 MHz associated with cloud flashes*” by V. Jeyanthiran, M. Edirisinghe, M. Fernando, V. Cooray.

This paper is based on HF radiation generated by cloud flashes at 10 MHz, 5 MHz and 3 MHz. The authors find that cloud flashes undergo microsecond scale discharges, the majority of them being at 5 MHz.