28th International Conference on Lightning Protection

Topic II: Lightning Occurrence Characteristics Moderator's Report

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I. General

A total of 14 papers (from Austria, Brazil, China, France, Japan, Norway, Poland and Spain) were selected for presentation at this session. Oral and poster sessions are devoted to lightning occurrence characteristics, each comprising 7 contributions. The focus of the session is on discussion of lightning characteristics obtained from modern lightning location systems (LLS), which are based on electromagnetic fields signatures associated with lightning discharges to detect and locate the source and infer its parameters. Twelve papers are dealing with different aspects of lightning data analyses obtained in different countries from lightning location systems based on different modern lightning detection technologies, while one of other papers refers to meteorological thunderstorm data and the second one deals with the lower ionospheric perturbations associated with sprites events.

In general the papers can be divided in three groups of common topics:

A. Lightning regional statistical data from LLS based on different technologies: Paper II-1, II-2, II-6, II-7, II-8, II-9, II-10, II-11and II-12.

B. Discussion on multiple flashes terminations, intervals and densities: Paper II-3, II-4 and II-5.

C. Analysis of lightning data from other than LLS sources: Papers II-13 and II-14.

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II. Brief Overview of the Papers

A. Papers selected for oral presentation (in order of presentation)

1. In **paper II-1** are described results of ten-years lightning data study in Japan collected from different LLS operated by electric power companies in years 1992-2001. The data from two systems LPATS and LLP have been analyzed and presented as statistical variations in different forms including annual numbers of strokes and flashes detected, seasonal and regional variations of flashes, flash densities, current distributions and others.

2. The **paper II-2** deals with comparison of performance of two overlapping total lightning detection networks in area of Texas, USA. One is based on VHF Interferometry principle (SAFIR sensors) while the second on VHF Time of Arrival principle (LDAR –II sensors). Results from observations in region of Dallas-Forth Worth during summer 2005 are analyzed and concluded that nature of two VHF technologies is clearly reflected in detailed spatial and temporal evolution of individual flashes.

3. **Paper II-3** describes results of observation of multiple termination lightning ground flashes using data by Japanese Lightning Detection Network (JLDN) and simultaneously by local VHF antennas in Fukui Plain region in summer 2000 and 2001. Subsequent strokes creating new termination points were identified and was proposed criterion to distinguish them from the LLS data. It was found that 83% of subsequent strokes having the same termination point on ground were located within 1,5 km from preceding strokes.

4. Flash multiplicity and Interstroke Intervals of 92 analyzed negative multi stroke flashes detected by ALDIS in Bad Voeslau in Austria on 11th July 2005 was analyzed in **paper II-4**. The specific Field Measuring-system was using

for those analysis digitizing continuously electric field to evaluate how good the Austrian LLS detects and classifies the lightning data. The statistics show that LLS detected 57% of all negative multistroke flashes correctly and 91% from 351 strokes of negative multistroke flashes were detected and classified correctly.

5. Discussion about lightning flash and stroke density data obtained from LLS in Brazil is described in **paper II-5**. The analyzes were done using stroke and flash density maps from five year observations (1999-2003) in region of Minas Gerais State provided by southeast Brazilian lightning location network RINDAT. It was observed that flash density increased in the studied region (in macro and micro scale) due to adjustment of spatial and temporal parameters and modifying them in the original criteria recommended by LLS manufacturer.

6. In **paper II-6** are analyzed lightning statistical data from SAFIR system in Poland in years 2002-2005. The data provide information ratio of CG and CC discharges strokes density, monthly stroke distributions, number of thunderstorm days and strokes current distribution in subsequent years. The quality of analyzed data strongly depends on SAFIR system performance and configuration and should be verified from different systems detecting lightning over Poland.

7. The problem of registration, LLS sensor data and manual meteorological observation of lightning in Norway in winter seasons 2001-2003 is described in **paper II-7**. It was found that only few of Norwegian lightning detection network consisting of 14 sensors are involved in detecting winter lightning along Norwegian cost. 26 % of observed 27 lightning events by meteorological services in winter were not coincided with registrations by LLS. It was no patterns in the data that LLS has missed large thunderstorms and this problem will be investigated covering more than one winter season in Norway.

B. Papers selected for oral presentation

8. **Paper II-8** deals with differences of lightning characteristics observed in Hokuriku district in Japan after replacing the old LLS system (1^{st}) by new one with IMPACT sensors (2^{nd}) operated by power utility HEPCO and after improvement of another old LLS system with ALDF sensors (3^{rd}) by IMPACT sensors (4^{th}) , which is operated by the second power utility KEPCO. The details of statistical lightning data from old and new systems are analyzed indicating the comparison of their lightning detection efficiency and location accuracy.

9. **Paper II-9** describes the lightning stroke data recorded by Japanese Lightning Detection Network in years 2000-2004. The means annual number of CG strokes was 2,86 million while 15,8 % of them was positive. Some influences of topography was indicated from year to year in different regions of Japan varying

10. The authors of **paper II-10** present experimental evaluation of the Catalan Lightning Detection Network (Spain) consisting of 3 VHF interferometer stations SAFIR. For this evaluation were measured electromagnetic field parameters and video records of lightning over Catalonia for two years. The comparison of different aspect of measurements and records are summarized.

11. **Paper II-11** presents results of lightning generated VLF sferics observed by single station installed at Kanazawa University in Japan. The station is able to locate CG strokes within distance of several hundred km with fairly good accuracy (app. 10%).

12. Another study of winter thunderstorms, this time in vicinity of Komatsu airport (Hokuriku coastal area) in Japan from about 20 years are presented in **paper II-12**. Authors used radar data, VHF sferics and field mills data. Case study of lightning strikes to aircrafts are described and seasonal variation of lightning direct strikes to aircraft around Komatsu airport in years 1981-2000 are also given.

13. Analysis of lower ionospheric perturbations induced by transient luminous events such as sprites and elves are by means of VLF Trimpi are described in **paper II-13**. Parameters of two VLF-sprites events observed in winter 2001/2002 in Hokuriku area in Japan were discussed and summarized, such as nose part (up to 5 sec after sprite occurrence) and tail part (5 to 60 sec after sprite occurrence).

14. In **paper II-14** is described the statistical method based on Principal Component Analysis and Canonical Correlation and its application for interpolation of lightning meteorological data. Five Principal Components were selected and applied for extension of thunderstorm data obtained from lightning localizer.