NEWSLETTER ON ATMOSPHERIC ELECTRICITY

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SPECIAL ISSUE

Celebrating Two Decades of ICAE Newsletter

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INTERNATIONAL COMMISSION ON ATMOSPHERIC ELECTRICITY (IAMAS/IUGG)

AMS COMMITTEE ON ATMOSPHERIC ELECTRICITY

AGU COMMITTEE ON ATMOSPHERIC AND SPACE ELECTRICITY

EUROPEAN GEOSCIENCES UNION

SOCIETY OF ATMOSPHERIC ELECTRICITY OF JAPAN

<u>Comment on the photo above</u>: Nowadays, it has become very easy to take a photo of lightning even during day time by using a high end of digital camera such as EX-F1 (CASIO). Indeed, these days many beautiful lightning photos can be viewed easily through internet! However, such kinds of photos can usually be just a kind of manifestation of return strokes. The photo shown here is one for the event just before a first return stroke, that is, a photo of a stepped leader. This photo was taken by Weitao Lu, Laboratory of Lightning Physics and Protection Engineering (LiP&P), Chinese Academy of Meteorological Sciences (CAMS) with a high-speed digital camera at 16:52:13 (local time) on July 14, 2008 in Conghua, Guangdong, China. The original photo is in white and black and the color is added by using Photoshop software.

SPECIAL SESSION OF ICAE NEWSLETTER

20th ANNIVERSARY

Recollections on the Origin of the Newsletter of Atmospheric Electricity

Earle Williams, MIT, earlew@ll.mit.edu

We dreamed up the Newsletter toward highlighting and publicizing research findings in our field on a time scale shorter than the annual trek to the AGU Meeting in San Francisco, and the 4-year interval between international conferences. And given that atmospheric electricity is a field program-oriented discipline, a second major goal was the announcement of field project plans to encourage collaborative work and coordinated observations. In the largely email-less era of Newsletter origin, solicitations for contributions were made by telephone, and were submitted to MIT by fax machine. These entries were then retyped to create the Newsletter document which was then photocopied, envelope-stuffed and hand-mailed. My wife, Kathy Bell, provided enormous assistance in this process, and came up with the first logos for the Newsletter. Through the interest and generosity of Dick Hallgren, then the Director of the American Meteorological Society, these burdensome responsibilities of Newsletter copying and distribution were later picked up by the very efficient Joyce Anise at AMS Headquarters, and twice a year I paid a visit to AMS on the other end of Beacon Street to initiate the distribution. Shortly thereafter, Monte Bateman launched the Newsletter into cyberspace, where it remains today.

Daohong Wang has an easier job today with Newsletter contributions by email and the cut-and-paste operation, but he is also a far more efficient Secretary of the ICAE. For those who doubt this claim, please note in the future the short delay between the closing date for Newsletter contributions and the release date of the finished document by email. The success of the Newsletter is proportional to the contributions it receives, so please continue your support!

What have we achieved in the past 20 years? And what can we expect in the next 20 years?

Daohong Wang, Gifu University, Japan
wang@gifu-u.ac.jp

In order to commemorate the 20th anniversary of ICAE newsletter, I really wished that many of our colleagues could comment about such as "What we have achieved in the past 20 years? And what we can expect in the next 20 years?" Unfortunately, due to various reasons, perhaps directly or indirectly related to either the current global financial crisis or the swine flu, at the time when I am going to distribute this newsletter, I have not received any comments. In order to trigger such comments for the next issue of our newsletter, in the following and based on my personal views I have listed a few most exciting achievements made by our colleagues in our community during the past 20 years as well as some expectations for the next 20 years.

Achievements:

- Global lightning observation from space
- Discovery and understanding of various luminous phenomena above thunderstorms
- Fine 3D mapping of lightning progression processes (even for a whole storm!)

- Further understanding of the properties of various lightning processes
- Wide installation of various lightning detection systems and their applications
- Revealing and characterization of inverted charge structure and other sophisticated charge structure thunderstorms
- And so on………………

Expectations:

- Real time observation (or monitoring) of global lightning from a network of geostationary satellites
- 3D location of positive leaders even in the presence of simultaneous negative leaders
- Efficient method for artificially triggering lightning discharges
- Comprehensive comparison between 3D lightning progression location and radar echo at a time resolution of several seconds
- Revealing of the role of atmospheric electricity in our global environment system
- A universal model of thunderstorm electrification and discharge
- Significant improvement in accuracy of various lightning detection systems and further applications
- And so on………….

Again, all these comments are my personal arbitrary views. I am sure that each of our colleagues has different views. Your comments are what I am looking for (for the next issue of our newsletter)!!!

ANNOUNCEMENTS

Awards

Dr. Richard E. Orville, Professor of Atmospheric Sciences, Texas A&M University, was elected a Fellow in the American Geophysical Union. Election to the Fellow category is an honor limited to 0.1% of AGU members each year. Orville made fundamental contributions to the spectroscopy of lightning in the 1960's and 70's and founded the National Lightning Detection Network (NLDN) in the 1980's, which is now operated by Vaisala, Inc. The lightning spectroscopy research included the discovery of the neutral oxygen emissions (OI) at 777.4 nm in the infrared that are now used by NASA satellites to map the worldwide distribution of lightning. Data from the NLDN is considered an atmospheric electricity resource and is used by many tens of colleagues to map the characteristics of lightning ground strikes with meteorological variables.

New Books

A monograph titled "Electromagnetic Phenomena Associated with Earthquakes"

Editor: M. Hayakawa

Contents: Ten chapters written by senior scientists (A.C. Fraser-Smith (USA), Y. Kopytenko (Russia), F. Freund (USA), P.F. Biagi (Italy), M. Hayakawa (Japan), M. Hayakawa (Japan), J.Y. Liu(Taiwan), M. Parrot(France), S. Pulinets (Russia), O.A. Molchanov (Russia)), 279 pages

Publisher: Transworld Research Network (India)

Date: To appear shortly (2009)

A special monograph on "Lightning: Principles, Instruments and Applications"

edited by Hans D. Betz, U. Schumann and P. Laroche, has been published in March 2008 by Springer (Dordrecht, NL). It contains 27 extended articles by more than 50 leading experts in atmospheric research. Book homepage: http://www.springer.com/978-1-4020-9078-3

Contents of the special monograph:

ANNOUNCEMENTS

CONFERENCES

IAMAS Assembly 2009 Montreal, Canada (MOCA-09)

IAMAS (The International Association of Meteorology and Atmospheric Sciences) assembly 2009 will be held in Montreal, Canada 19-29, July 2009. As one of the 10 commissions of IAMAS, ICAE is organizing the following two symposia. During these two symposia, nearly 60 papers by our colleagues as listed below are going to be presented. For detail, please visit:
http://www.moca-09.org/e/02-planner_e.shtml.

M16: Thunderstorms and their Manifestation on Local, Regional and Global Scales

Convenors: Earle Williams, Serge Soula, Colin Price

A New Method for Locating Lightning Strokes Based on Single-Station Observations

Mingli Chen - *Hong Kong Polytechnic University* - *CHINA*

Aviation Related Meteorological Changes of Thunderstorm in Southern Nigeria

Yemi Sikiru Onifade - *Crescent University* - *NIGERIA*

Case Study on the Relationship of Radar Echo and Lightning of Severe Thunderstorm in Beijing using VIPS Data

Jinli Liu - *Chinese Academy Of Sciences* - *CHINA*

Charge Structure Inside an Isolated Thunderstorm based on First Electric Field Soundings in Chinese Inland Plateau

Xiushu Qie - *LAGEO, Institute Of Atmospheric Physics* - *CHINA*

Estimation of Small ion Concentration Near the Earth Surface: Theoretical Approach

Sunil Pawar - *Indian Institute Of Tropical Meteorology* - *INDIA*

Features of Lightning Discharge Radiated Radio Wave Atmospherics/Tweeks Observed at Low Latitude Indian Station

Devendraa Siingh - *Indian Institute Of Tropical Meteorology* - *INDIA*

First Results of Sprites, Lightning Activities and Thunderstorms in Chinese Mainland

Jing Yang - *Chinese Academy of Sciences* - *CHINA*

Generation of Elementary Particles by Thunderclouds

Aleksandr Lidvansky - *Russian Academy of Sciences* - *RUSSIA*

Ground-Based Detection of Sprites and their Parent Lightning Flashes over Africa during the 2006 AMMA Campaign

Earle Williams - *Massachusetts Institute of Technology* - *USA*

Impact of Lightning-NO Emissions on North American Photochemistry as Determined Using the GMI Model

Dale Allen - *University of Maryland* - *USA*

Lightning Activity and Electric Structure in a Rainstorm System

Dong Zheng - *Chinese Academy Of Meteorological Sciences* - *CHINA*

Lightning Activity and NOx Production (LNOx) in a Hector Blow-Up: First Observations During SCOUT-O3/ACTIVE

Heidi Huntrieser – Institut of Physik der Atmosphe - *GERMANY*

Lightning Activity in the 50 Years as Inferred from Thunderstorm Day Data

Iara Pinto - *Brazilian Institute of Space Research* - *BRAZIL*

Lightning Effect on Intensity of Secondary Cosmic Rays during Thunderstorms

CONFERENCES

Aleksandr Lidvansky - Russian Academy Of Sciences - RUSSIA

Lightning NOx Production in the Tropics

Kenneth Pickering - NASA / Goddard Space Flight Center - USA

Lightning Observations from Tornado-spawning Storm Complexes in the State of Sao Paulo, Brazil

Gerhard Held - UNESP - BRAZIL

Long Continuing Luminosity in Observations of Cloud-to-Ground Flashes in an Urban Area of Brazil

Rosangela Gin - - BRAZIL

Micro-Structure of Thundercloud and Lightning Discharge

Zen Kawasaki - Osaka University - JAPAN

Model Study of Effects of Relative Humidity in Low Level and Vertical Wind to Lightning Activity in Cloud

Wang Fei - Chinese Academy of Meteorological Sciences - CHINA

Numerical Simulation of Tornadogenesis in a Realistic Condition: Importance of Near-Surface Conditions

Ken-Ichi Shimose - Dep. Of Earth And Planetary Sciences, Kyushu Univ. - JAPAN

Observation of Tornadic Thunderstorms Occurred over Japan

Fumiaki Kobayashi - National Defense Academy - JAPAN

Observations of Lightning and Radar Characteristics of Thunderstorms in the South of Brazil During the Warm Season - Preliminary Results

Cesar Beneti - SIMEPAR Technological Institute - BRAZIL

On the Spatial-Temporal Monitoring of the Global Lightning Charge Production from Schumann Resonance Observations

Vadim Mushtak - Massachusetts Institute of Technology - USA

Propagation of ELF Waves from Lightning in the Earth-ionosphere Cavity

Jagdish Rai - Indian Institute of Technology - INDIA

Role of Drop Distortion in Enhancing the Lightning Activity in Clouds Formed over Cities

A.K. Kamra - Indian Institute of Tropical Meteorology - INDIA

Runaway Electron Production inside Thunderclouds

Joseph Dwyer - Florida Tech - USA

The Optical TLE Observations with Satellite and Radar Data Support in Poland

Rafal Iwanski - Institute Of Meteorology and Water Management - POLAND

The Regional Distribution of Tropospheric NO2 Column Density over Northern China

Pucai Wang - Chinese Academy of Sciences - CHINA

Thunderstorm Observation in the Metropolitan Area of Sau Paulo: Warm Season 2004-2008

Rosangela Gin - - BRAZIL

Thunderstorms, Lightning, Transient Luminous Events and Whistler-mode Radio Waves

Devendraa Siingh - Indian Institute of Tropical Meteorology - INDIA

To the Numerical Simulation of Transient Electric Fields from 2D current Sources in the Atmosphere: Equivalent Electrical Circuit and the Current Budget

Andrei Sorokin - Institute of Applied Physics, RAS - RUSSIA

Urban Effects on Lightning Flash Density in Two Metropolitan Areas in Israel

Colin Price - Tel Aviv University - ISRAEL

M17: Lightning: Characteristics, Physics, and Hazard Mitigation

Convenors: Vladimir Rakov, Christian Bouquegneau, Daohong Wang

A MoM-AOM Approach for Frequency Domain Analysis of Indirect Lightning Strike Effects on Transmission Lines Terminated by Lightning Arresters

Valiollah Mashayekhi - Amirkabir University of Technology - IRAN

A New VLF-VHF Dual Band Lightning Detection and Location System in China and the Preliminary Results

Wansheng Dong - Chinese Academy Of Meteorological Sciences - CHINA

An Evaluation of Cloud-to-Ground (CG) Lightning Warnings based on LF/VLF Cloud-to-Ground and VHF Total Lightning Mapping Network Data

Nick Demetriades - Vaisala Inc. - USA

An Improved Antenna Theory Model for the Evaluation of Radiated Electromagnetic Fields due to Lightning Strikes to Tall Towers

Rouzbeh Moini - Department Of Electrical Engineering, Amirkabir University Of Technology, Tehran - IRAN

Broadband Electric Field Measurements and Mapping of 3-D Lightning Radiation Sources and their Associated Radar Echos

Yajun Li - Cold & Arid Regions Environmental & Engineering Research - CHINA

Calculation of Electric and Magnetic Fields at the CN Tower in Cartesian Coordinates

Ivan Boev - University of Toronto - CANADA

Channel Characteristics of NBE as Inferred From Narrow Bipolar Radiation Field

Baoyou Zhu - University Of Science and Technology of China - CHINA

Characteristics of Initial Stage of a Rocket-triggered Lightning Flash

Yang Zhao - Chinese Academy of Sciences - CHINA

Characteristics of Multiple-ground Terminations Lightning Flash Discharges

Yang Zhao - Chinese Academy of Sciences - CHINA

Characteristics of Negative Cloud-To-Ground Lightning Flashes From VLF/LF Bandwidth Field Observation

Baoyou Zhu - University Of Science and Technology Of China - CHINA

Correlation between Electrical Current and Light Intensity of a Rocket-triggered Lightning Flash

Weitao Lu - Chinese Academy of Meteorological Sciences - CHINA

Current and Close Electromagnetic Fields of Triggered Lightning during SHATLE, China

Xiushu Qie - LAGEO, Institute of Atmospheric Physics - CHINA

Experience on Thunderstorm Tracking and Cloud-to-ground Lightning Warning for Human Life Protection in Brazil

Kleber Naccarato - INPE - BRAZIL

Geographical Variations of Lightning Characteristics

Osmar Pinto Jr. - Brazilian Institute of Space Research - BRAZIL

High-Speed Video Observations of Positive Lightning in Brazil, USA and Austria

Marcelo M.F. Saba - INPE - BRAZIL

M-components Parameters in Natural Negative Cloud-to-Ground Lightning from Electric Fields and High-Speed Videos

Leandro Campos - - BRAZIL

On the Lightning Protection of High Structures

Daohong Wang - Gifu University - JAPAN

On the Measurement and Calculation Methods of Lightning Horizontal Electric Fields

Farhad Rachidi - Swiss Federal Institute Of Technology (EPFL) - SWITZERLAND

Parameters of Compact Intracloud Discharges Inferred From Their Electromagnetic Signatures

Vladimir Rakov - University of Florida - USA

Positive Charge Region in Lower Part of Thunderstorm and Preliminary Breakdown Process of Negative Cloud-to-ground Lightning

Yijun Zhang - Chinese Academy of Meteorological Sciences - CHINA

Small Negative Cloud-To-Ground Lightning Reports at the KSC-ER

Jennifer Wilson - NASA Kennedy Space Center - USA

The Relationship between Narrow Bipolar Pulse Events and Lightning Discharges in Thunderstorm

Yanhui Wang - Chinese Academy of Sciences - CHINA

The Surface Electric Field-Recovery Curves of the Lightning Discharges Occurring in the Dissipation Stage of Thunderstorms

Sunil Pawar - Indian Institute of Tropical Meteorology - INDIA

The Use of High-speed Video Records to Distinguish between Leader/Return Stroke and M-component Modes of Charge Transfer in Upward Lightning

Fridolin Heidler - University of The Federal Armed Forces Munich - GERMANY

VLF-VHF Dual Band Lightning Detection and Location Network (LDLN): Find Where the Lightning Radiation Events Occurred

Tao Wang - USA

2009 AGU Fall Meeting

The fall meeting of AGU will be held on 14-18 December 2009, at the Moscone Center West, 800 Howard Street, San Francisco. For detail, please visit http://www.agu.org/meetings/fm09/.

First Announcement of 14th ICAE

On behalf of the International Commission on Atmospheric Electricity (ICAE), we would like to announce that the 14th International Conference on Atmospheric Electricity (14th ICAE) will be held in Rio de Janeiro, Brazil on August 08-12, 2011. The Conference will provide a unique opportunity to present and discuss the newest results and to assess the most relevant issues in atmospheric electricity and lightning research. Your participation in the conference is much appreciated. A reduced registration fee will be available for students.

The following topics related to electricity in the atmosphere will be covered:

- Global circuit
- Fair weather electricity and atmospheric ions
- Thunderstorm electrification

CONFERENCES

- Lightning physics
- Lightning and meteorology
- Lightning and climate change
- Lightning and atmospheric chemistry
- Electrical effects of thunderstorms on the middle and upper atmosphere
- Lightning detection technologies and their applications
- Application of lightning data
- Lightning hazard and mitigation

Abstract submission will start on March 1st, 2010. The overall information on the conference will be available on the website of the conference (http://www.icae2011.net) and on the website of the International Commission on Atmospheric Electricity (http://icae.jp) in December 2009. In order to make our meeting successful, hopefully, your consideration for participation of this conference will start now!

Zen Kawasaki President of ICAE (zen@comm.eng.osaka-u.ac.jp)
Daohong Wang Secretary of ICAE (wang@gifu-u.ac.jp)
Osmar Pinto Junior President of 14^{th} ICAE (osmar@dge.inpe.br)

Airborne Research Associates

Weston, Massachusetts (Ralph Markson, rmarkson@comcast.net)

ARA has focused on two activities in recent years: a) measurement of the global circuit intensity from ionospheric potential (Vi) soundings and b) development of a national total lightning network that now is operational.

The Vi measurements were made with electric field soundings using a meteorological research aircraft as well as with free balloons. A summary of a half-century of such measurements by ARA and other groups was published: The Global Circuit Intensity: It's Measurement and Variation Over the Last 50 Years, Bull. Amer. Meteor. Soc., 88, 223-241 (Feb. 2007). The data showed that contrary to some reports of a 4-decade secular decrease in Vi there has been no significant variation of Vi. The reported decrease was due to variations in the measured electric field values due to environmental factors caused by cleaning up the aerosol laden air in England and the growth of trees near the electric field sensors in Hungary. Another contributing factor was the up to 40% increase in Vi in the period 1960-1964 due to greatly enhanced nuclear testing in the late 1950s prior to the scheduled 1963 ban on atmospheric testing; this enhanced Vi period created the impression of a secular decrease in Vi. By 1966 both atmospheric radiation and Vi dropped back to their baseline values and since then Vi has remained within +/-10% of its mean value of 240 kV.

An important finding of the nuclear effect on Vi is that enhanced ionization in the lower stratosphere/upper troposphere is correlated with an increase in the global circuit intensity. This finding is consistent with an earlier hypothesis (Markson, 1978: "Atmospheric Electricity and Sun-Weather Relationships", Nature, 273, 103-109) and findings that cosmic radiation modulates the global circuit intensity (Markson and Muir, 1980: "Solar Wind Control of the Earth's Electric Field", Science 208, 979-990; Markson, 1981: "Modulation of the Earth's Electric Field by Cosmic Radiation", Nature 291, 304-308) presumably by enhancing the conduction current over electrified clouds and possibly through intensification of thunderstorm activity. The enhanced ionization from atmospheric nuclear debris would provide the same effect as ionization from increased cosmic radiation.

The second major activity at ARA was further development and eventual implementation of technology for mapping total lightning through broadband rf detection. This work was started at ARA in the late 1990s under two NASA STTR technology transfer awards including a ground based time-of-arrival (TOA) system at Orlando and a single sensor aircraft system. Starting in 2002 Ralph Markson working with Stan Heckman developed and demonstrated a TOA total lightning mapping system for southern New England. For detection of intracloud lightning (IC) a high density of sensors is required. In order to obtain the necessary sensor density with internet

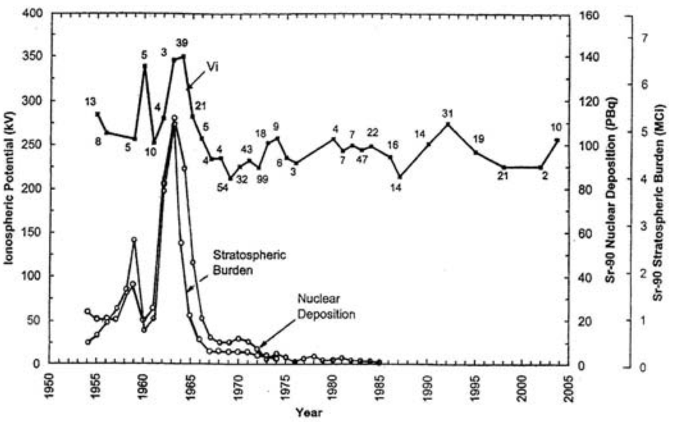

Fig. 1. Variation of Vi from 1955 through 2004. The number of soundings each year are given. Also shown is nuclear deposition indicating radioactive Sr-90 fallout on the ground while the stratospheric burden is a measure of Sr-90 in the stratosphere. (From Markson 2007).

connection, an arrangement was made with the WeatherBug company, operators of 8000 internet connected sensors nationwide, for transfer of technology and implementation. Final development of the lightning sensors and mating them with the WeatherBug weather sensor array and communications, mostly due to Heckman's efforts, required another 2.5 years. The national system was announced in January 2009 at the American Meteorological Society Convention in Phoenix. Currently there are about 150 sensors deployed across the U.S. and while all cloud-to-ground flashes are detected not all IC discharges are yet detected; plans call for 1000 or more sensors eventually and then we expect almost all intracloud flashes will be detected. Markson is particularly concerned with use of IC for aviation because of the early thunderstorm and microburst warning capability and quantification of convective velocity through IC rate.

Atmospheric Electricity Group (ELAT), Brazilian Institute of Space Research

Sao José dos Campos, Brazil

The main activities developed by ELAT in the last semester were:

- An innovative methodology for CG lightning forecast with advance of about one hour for regions with less than 1.000 km^2 was developed using real-time CG lightning data provided by the Brazilian lightning detection network (BrasilDAT) together with IR satellite and weather radar images. A project carried on at Paraíba Valley (located throughout São Paulo and Rio de Janeiro States) using the methodology from Jan/2006 to Mar/2009 presented very good results. It was also performed a preliminary analysis comparing automatic warnings generated only by electric field-mill (EFM) triggers and warnings based only on occurrence of CG lightning strokes. The results show that, as expected, the EFM alone produced a high percentage of false warnings compared to the warnings based on CG lightning information only.
- High-speed video recordings of two lightning flashes confirm that positive cloud-to-ground (CG) strokes can be produced by extensive horizontal intracloud (IC) discharges within and near the cloud base. These recordings constitute the first observations of CG leaders emanating from IC discharges of either polarity. In one case, the discharge began with a negative leader that propagated horizontally, went upward and produced an IC discharge. After the beginning of the IC discharge, a positive leader emanated from the lowest portion of the IC discharge, and initiated a positive return stroke. In the other case, the IC discharge began with a positive leader and then initiated a downward-propagating positive leader that contained recoil processes and produced a bright return stroke followed by a long continuing luminosity. These observations help to understand the complex genesis of positive CG flashes, why IC lightning commonly precedes them and why extensive horizontal channels are often involved. The results are submitted for publication.
- The results of the observations of the similarities and differences in lightning characteristics in two distinct regions (Arizona, U. S. and São Paulo, Brazil) using the same high-speed camera instrumentation, supported by lightning location system data, was submitted to publication. The use of these techniques allowed us to precisely measure the number of strokes in a flash, their polarity, the interstroke time interval, the number of ground contacts, and the durations

of continuing currents in negative CG flashes. Statistical analyses did not show any significant differences in the lightning characteristics during the summer season in both locations, and these characteristics were very similar to the well-accepted parameters for negative CG lightning. However, it was found there were large clear storm-to-storm variations that are also presented and discussed.

➢ The first measurements of the intensity of the continuing current in Brazil were done. The study presents 81 CC intensity measurements obtained from electric field capacitive antenna. All variations observed in the electric field were simultaneously observed by high-speed cameras. Through GPS time stamping of each image recorded by the high-speed camera, it was possible to determine the distance of the stroke preceding the CC event to the antenna, comparing with the time provided by the Brazilian lightning location system. The arithmetic mean value of the CC intensities was 321 A. Maximum and minimum values are respectively 1400 A and 22 A.

➢ Some important results were achieved by comparing flash rates in Brazil gathered by two different detection techniques: BrasilDAT LF network and LIS. Some differences in the lightning activity throughout the country revealed by the two different techniques, however, cannot be attributed only to dataset limitations and are probably related to regional behaviors associated with different types of meteorological conditions.

➢ A book about tropical lightning was in press in an American publisher.

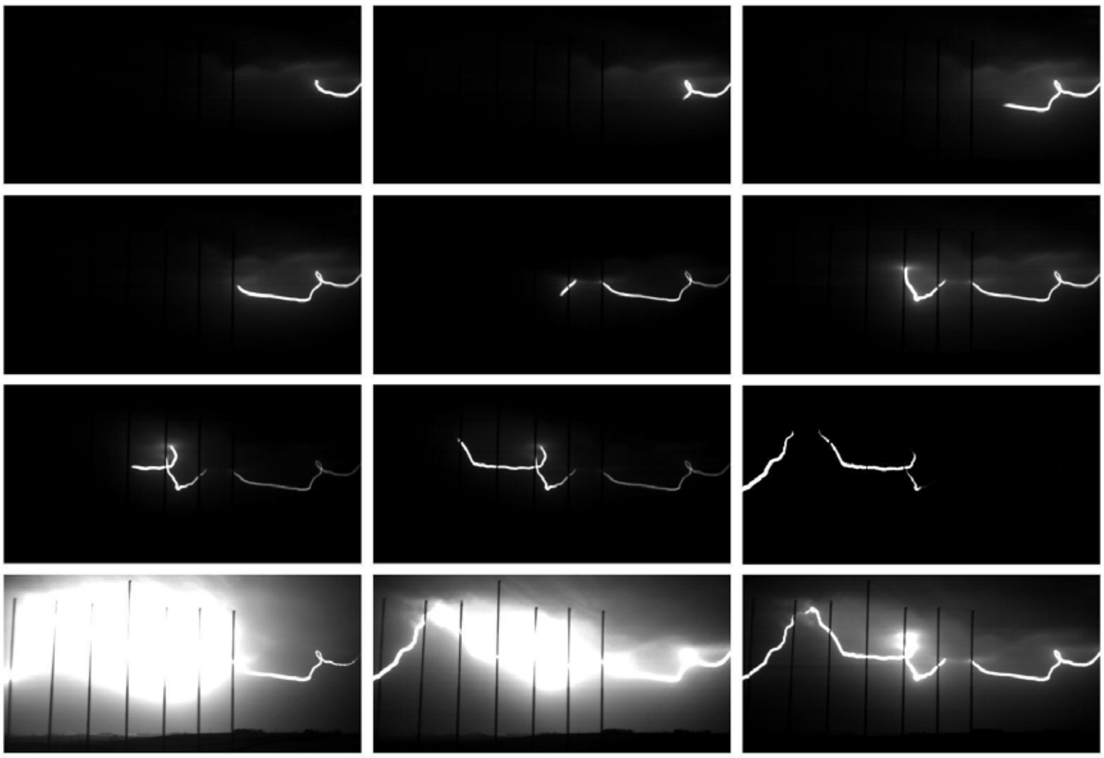

Fig. 1 Images of the leader and of the return stroke of a positive CG. The +CG struck 7 km from the camera, had an estimated peak current of 30 kA and a continuing current that lasted 460 ms.

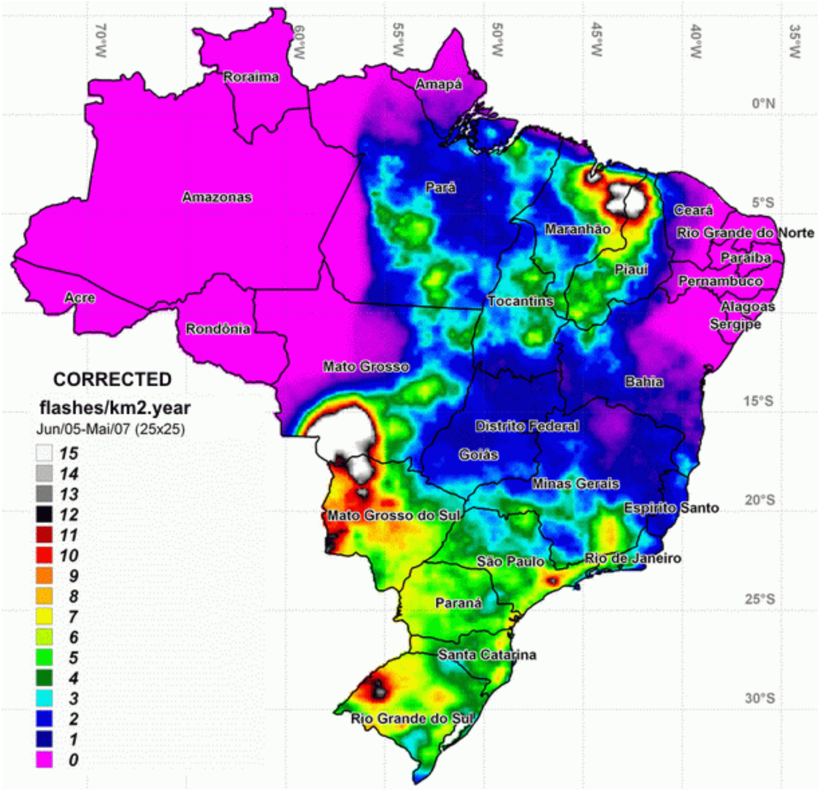

Fig. 2 Cloud-to-ground flash density values (flashes/km2.year) for a 2-year BrasilDAT dataset (Jun/2005 to May/2007) corrected for the variations of the network relative flash detection efficiency for a grid resolution is 25 x 25km.

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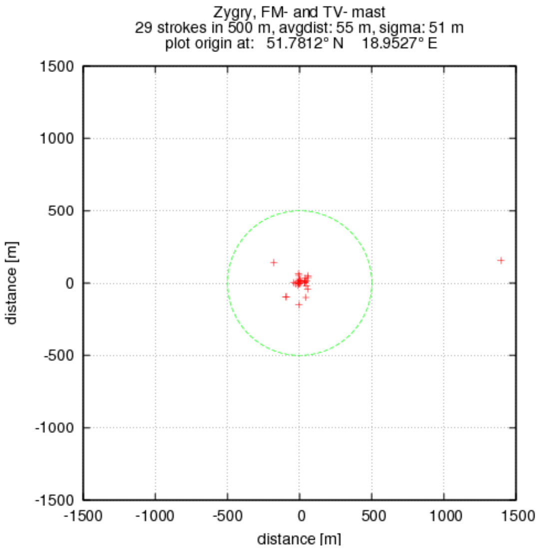
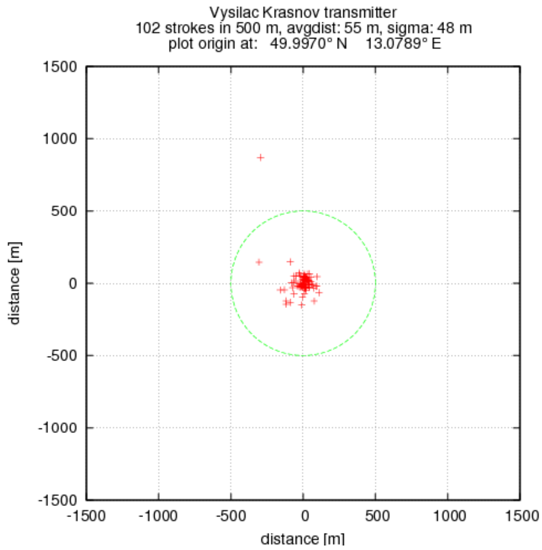
The international Lightning Detection Network LINET was extended further and now comprises more than 100 sensors in 19 European countries. Among others, the locating accuracy is constantly checked and improved. It is well known that statistical errors can be mathematically calculated from the locating algorithm; however, the resulting error ellipse does not comprise systematic errors, which can be small or large, depending on various circumstances. Thus, independent ground truth must be searched. This has been accomplished by inspecting strikes into towers of known position. Of course, most suited are instrumented towers, which allow detailed identification of the strikes involved, but the observation of prominent stroke clusters that occur during different storms at different times serve the purpose equally well and have the advantage that they can be found at many places in Europe. Two examples for towers in Czech Republic and Poland are shown in the following figures.

It becomes evident that the average scatter of statistical deviations is below ~100 m, but the systematic error may be larger. Fortunately, the systematic errors are independent of the individual strokes and can be corrected for a large area around the observed tower. For example, when the error observed for a particular tower in Slovenia was corrected, it turned out that all other towers in Slovenia could be located with similar accuracy.





Atmospheric Electricity Group, Departments of Physics University of Shkodra and Tirana (Albania)

The major activities consist on the measurement campaigns on the principal factors of atmospheric electricity, organized in several parts of Albania. There are done continuous measurements on atmospheric ion concentration; aerosol concentration by number and by mass; radon in the air, atmospheric ion concentrations, etc. The measurements of aerosol and concentrations are realized in major cities of Albania, in the perimeter of Shkodra Lake, and in the Adriatic seashore (Velipoja beach). The measurements of radon concentration in the air are situated mainly in the perimeter of Shkodra Lake. Meanwhile the measurements of atmospheric ion concentration are continuous and are realized in all of the above mentioned locations.

Our group is taking part in a project financed by our Government and NATO, to monitor air quality in all the Shkodra Region (North of Albania). This is a research program including aerosol, radon and electromagnetic field pollution in this region.

The results of the Velipoja campaign are published in the Journal of Electrostatics, presented in the 11th International Conference on Electrostatics. The radon measurements are presented in the International Conference on Lakes and Nutrient Loads. The measurement results of the aerosol concentration will be published in the 7th Balkan Physical Union Conference.

Indian Institute of Tropical Meteorology, Climatology of lightning activity over Peninsular India

M.I.R. Tinmaker (iqbal@tropmet.res.in), Kaushar Ali (kaushar@tropmet.res.in)
Indian Institute of Tropical Meteorology, Pune, 411 008, India

Lightning discharges in thunderstorms are an indication of the intensity of atmospheric convection. Atmospheric convection occurs under unstable atmospheric conditions, either due to the heating of the boundary layer by solar radiation during the day, or by the mixing of air masses of different densities. Lightning frequencies are therefore related to the regions of greatest instability in the Earth's atmosphere. These regions of instability do not occur randomly around the planet, but have an organized pattern related to the climate of the Earth which is driven by the differential heating of the Earth's surface by the Sun. If we change the climate we will change the regions of convection, their intensity, and hence will likely change the lightning patterns around the globe.

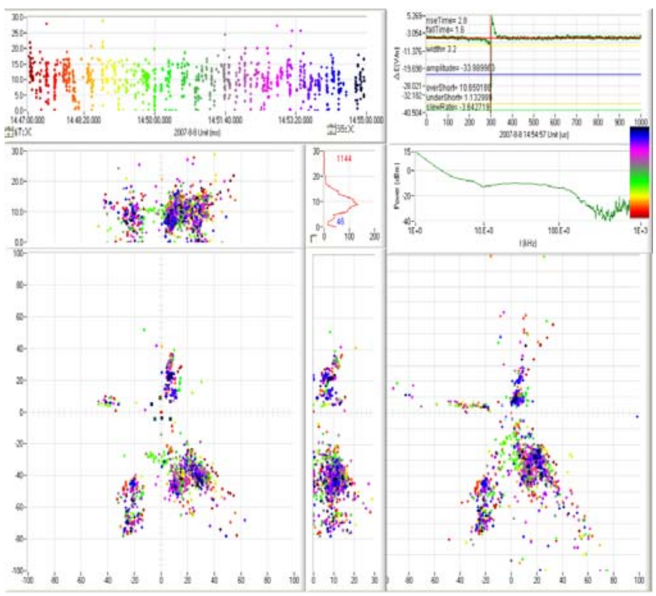
The Indian peninsula splits the north Indian Ocean into two basins, the Arabian sea in the west and the Bay of Bengal in the east. There exist geographical similarities between the two basins: both are located in the same latitude band and are semi-enclosed basins that open into the equatorial Indian Ocean in the south. There are also meteorological similarities: both are forced by the changing monsoon winds and receive similar amounts of solar radiation at the top of the troposphere. In spite of this, there are striking dissimilarities between the two basins. First, the wind over the two basins is different, this difference being most striking during the summer monsoon. This is a consequence of the Arabian sea being bounded on its west by the highlands of East Africa. These highlands sever at the western boundary for the low-level atmospheric flow, leading to the formation of an atmospheric western boundary current just like in the ocean (Anderson, 1976). The resulting low-level jet, called the Findlater Jet (Findlater, 1969), makes the winds over the Arabian sea more than twice as strong as those over the bay, which does not experience a similar western boundary effect.

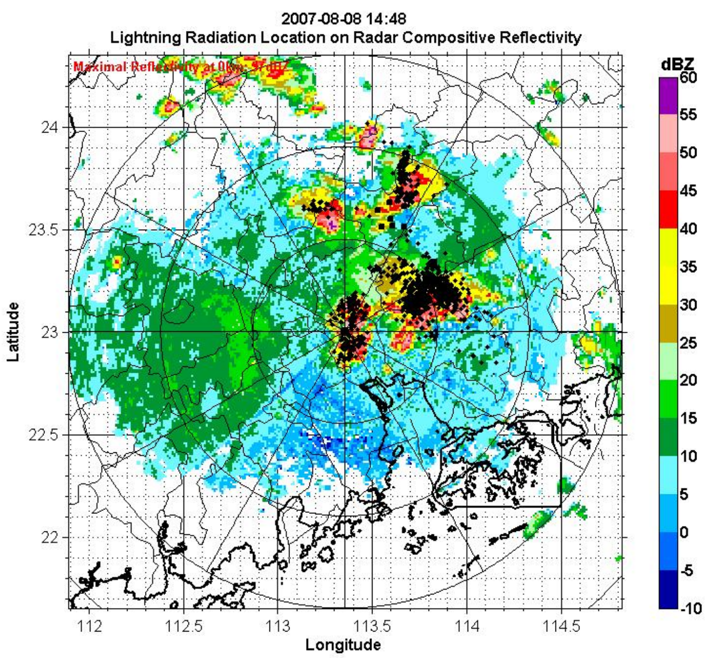
The main objective of this work is to study the climatology of lightning activity over Peninsular India. This article presents a study of spatio-temporal variation of lightning activity over Peninsular India (8oN-20oN, 73oE-86oE) by using satellite based lightning flash grid (1ox1o) data for 10 year (1998-2007) period. It is found that there is large spatial variation of lightning activity over south peninsular India and eastern India. On annual timescale, the lightning activity shows two maxima- first in the month of May and second in the month of September. The peaks of thunderstorm activity i.e. lightning over the south peninsular of India occur between mid-April to the first week of May about 4-6 weeks prior to the onset of the monsoon. The trigger for release of convective latent instability is provided by the day time heating, orographic features, and sea breeze penetration. The lightning activity during monsoon is noticed to be controlled mainly by low level jet, break and revival of monsoon. During post-monsoon, the activity is mainly influenced by the convective nature of the disturbed weather during the northeast monsoon season over most parts of the east coast of south peninsular India.

Laboratory of Lightning Physics and Protection Engineering, Chinese Academy of Meteorological Sciences (Beijing, China)

Collaborating with Guangzhou Meteorological Bureau, Laboratory of Lightning Physics and Protection Engineering (LiP&P) has performed Guangdong Comprehensive Observation Experiment on Lightning Discharge (GCOELD) at Guangzhou Field Experiment Site for Lightning Research and Testing every summer since 2006. A total of 23 lightning have been triggered with rocket-wire techniques. Among those triggered events, 19 are classical ones and 4 are altitude ones. Except for the integrated simultaneous observation about the acoustics, optics, electromagnetics and current of the triggered and natural lightning events, a lighting location system comprised of multi-stations and combining VLF and VHF location technologies were set up and tested in the experiment field in 2007. Furthermore, the experiment about the lightning protection of the automatic weather station (AWS) was carried out in 2008. This experiment included detecting the induced volt and current in the power cables and signal cables in different parts of the AWS, measuring the induced volt in the cables under the ground surface, observing the earth potential lifting at the stroke point and obtaining the current dissipation of grounded network in natural or triggered lightning environment. In the oncoming experiment of this year, the fore-mentioned observations will be performed persistently after some further improvements and a new project concerning the lightning occurring on high buildings will also be implemented.

On the other hand, with the support of Chongqing Meteorological Bureau, LiP&P is setting up a total lightning detection network in Chongqing area (in the southwest of China). This system contains a central station and 11 substations. The substations' preprocessed data are transmitted to the central station via internet. Combining the respective advantages of VLF and VHF technology in detecting lighting discharge process, the finally adopted system can be used to locate both the large-scale current process and small-scale breakdown process with the time of arrival (TOA) technology. The location of the





lightning process events will be calculated in real time. This network is being accomplished and to be tested. As a preliminary work for this network, LiP&P had completed plenty of related works mainly including hardware test, method study of identifying the type of the lightning, development and test of the location algorithm, simulation research of the location accuracy and the system test in field experiment. The distribution of the lightning process events observed by VLF/LF system in a thunderstorm during a period of 6 minutes in the 2007 field experiment is shown in the figures.

Laboratory of Middle Atmosphere and Global Environment Observation (LAGEO), Institute of Atmospheric Physics, Chinese Academy of Sciences (CAS) (Beijing 100029, China)

Thunderstorm electric field in situ sounding:

A strong electric field sounding system has been designed to acquire the vertical component of electric field, temperature, relative humidity and GPS data along the sounding path. The observation in 2008 gave the first results of thunderstorm electric field instu measurements in Chinese inland plateau. The results indicated that there are four charge layers：A negative screening layer lies between 4.3 and 4.5 km; the lower positive charge region 4.5-5.3 with the temperature between 3 and -2 ℃; the main negative charge area between 5.4-6.6 km with temperature from -3 to -10 ℃; the upper positive charge layer is between 6.7 and 7.2 km and the temperature from -11 to -14℃.

Lighting activities in super typhoons over Northwest Pacific:

Seven super typhoons during 2005-2008 were analyzed by using the WWLLN data. The results showed that there are three distinct average flash density regions in mature typhoon: a weak maximum in the eyewall regions (20~80 km from the centre), a minimum 80~200 km outside the eyewall, and a strong maximum in the outer rainbands (>200 km radius). Each typhoon produced eyewall lightning outbreak during the periods of intensification and before the maximum intensity.

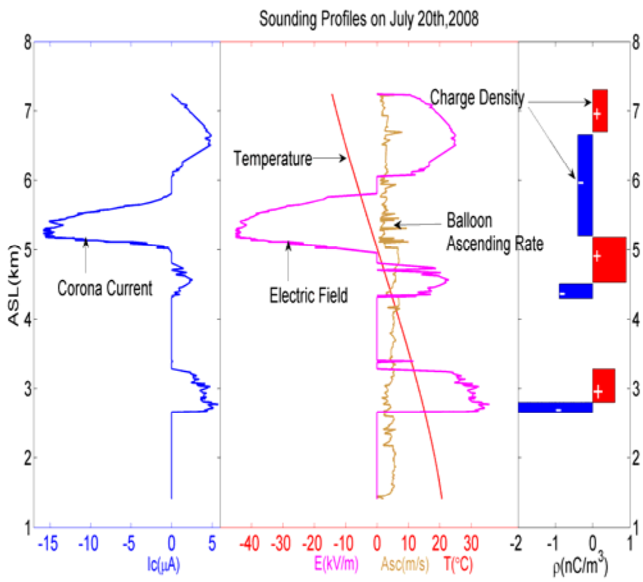


Fig.1 Vertical profiles of corona current (Ic), electric field (E), Temperature (T), and inferred charge (red box for positive, blue box for negative), acquired on July 20, 2008. The sounding duration was from 17:42 to 18:10.

Lightning characteristics and dynamical structure in a mesoscale convective system over north China:

Analysis of a mesoscale convective system in the north of Shandong province showed that the –CG is predominant during the thunderstorm whole lifetime. When the electrical field changed greatly, the lightning happened frequently. The –CG usually cluster in region with high reflectivity(>40dBz),while +CG usually in weak echo（30dBz-40dBz）. In addition, the flashes usually located in the convergent region or wind shear area.

Lightning research group of Gifu University (Gifu, Japan)

During the last winter, we continued observation on the lightning that strike on a windmill and its lightning protection tower. We have recorded the electric currents and the corresponding optical signals with ALPS for ten lightning events that hit on the windmill and the tower. Among these ten events, 4 are positive, 5 negative and 1 bipolar. Compared to the results we obtained before, the percentage of positive lightning are apparently high. Right now, we are trying to make a detailed comparison between the upward negative leaders in the positive lightning and the upward positive leaders in the negative lightning. As a preliminary result, negative leaders appear to have more regular pulses than positive leaders as shown in the following figure.

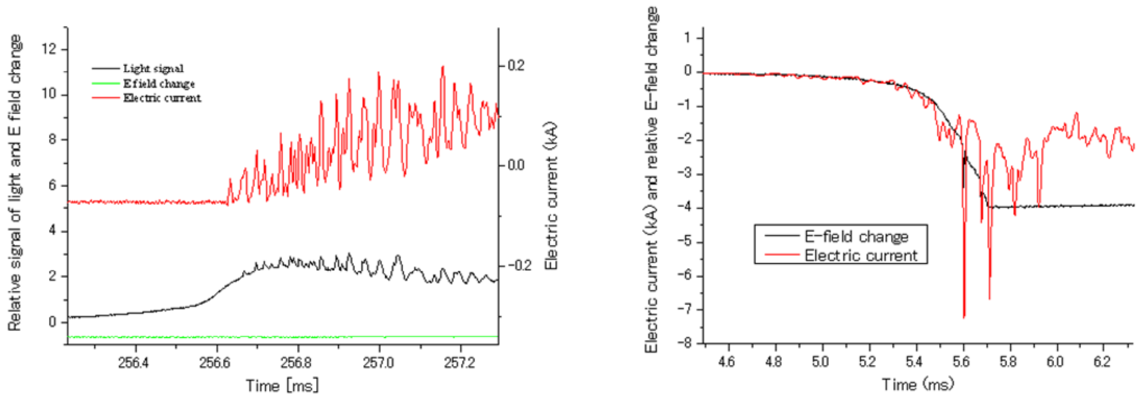


Fig.1 Example waveform of a negative upward leader (left) and a positive leader (right).

Massachusetts Institute of Technology, Parsons Laboratory Cambridge, Massachusetts 02139, USA

Vadim Mushtak and Earle Williams participated in the recent Chapman Conference at the Pennsylvania State University, concerned with transient luminous events and the coupling of lightning to the ionosphere. Mushtak presented the latest results simulating the inversion of multi-station measurements of Schumann resonances to infer lightning source properties of the three tropical ‘chimneys’. A realistic forward model that includes the day-night asymmetry of the ionosphere is used for the inversion calculations. In simulations with two chimneys and four receiver sites, the locations and source strengths are well replicated in this iterative inversion procedure, in less than ten iterations. We are now prepared to test the procedure on real observations, simultaneously recorded. Contributions are most welcome from other Schumann resonance stations worldwide.

Williams and a host of co-authors (C.-L. Kuo, E. Downes, R. Boldi, J. Bor, G. Satori, T. Adachi, W. Lyons, A.B. Chen, R.-R. Hsu, and H.-T. Su) revisited the so-called sprite polarity paradox in a poster presentation at the Chapman Conference. ISUAL satellite observations show evidence for as many halos as sprites worldwide. ELF observations from Nagycenk Observatory in Hungary by Jozsef Bor and Gabriella Satori show a large majority of negative polarity lightning parents for more than 100 halos. These diffuse optical events appear to resolve the sprite polarity paradox, with a physical origin that is traceable to the polarity asymmetry in lightning flashes to ground. Further work is underway, aimed at distinguishing the peak lightning brightnesses parent to pure halos and pure sprites in the ISUAL observations.

C.T.R. Wilson's foundations to the research work of the Chapman Conference were presented in an invited talk. Further study of Wilson's publications and 50 research notebooks indicates an organized pattern of research, alternating between field work (on thunderstorms and the global circuit) and laboratory work (the expansion cloud chamber) with a decadal periodicity. Though Wilson received the Nobel Prize in Physics in 1927, nearly everything he did (including the cloud chamber work) was aimed at problems in atmospheric electricity.

Yasu Hobara summarized the results on African sprite observations in Niger during the African Monsoon and Multidisciplinary Analysis (AMMA) at the recent European Geophysical Union (EGU) meeting. These findings will appear in the AMMA Special Issue of the Quarterly Journal.

Further discussions were held at the EGU on the integration of VLF receivers in Europe, Africa and the Americas toward improving West African lightning maps with ZEUS/STARNET during AMMA (2006) and in the following year (2007). Vasso Kotroni (National Observatory of Athens) and Carlos Morales (University of Sao Paulo) are making excellent progress in producing greatly improved lightning data sets for these two years.

Performance of Lightning Imaging Sensor (LIS) and Optical Transient Detector (OTD) Using Window Based Analysis

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Lightning is one of the most beautiful displays in the nature and at the same time, it is the most dangerous phenomena of the nature. Hence, the intensity of lightning is of much importance. The intensity of lightning is measured in terms of its flashes, which are the atmospheric discharges of electricity that typically occur during the thunderstorm activity. Earlier lightning flashes were measured by the abrupt changes in the electric field. Recently satellites have occupied the platform for investigating the lightning over large regions, since their inception. Satellites observe lightning flashes with various optical sensors. Results of the studies using the techniques such as Lightning Location Protection (LLP), Lightning Positioning And Tracking System (LPATS) etc hampered since the measurements were not quantified accurately in the form of frequency and distribution. Then Optical Transient Detector (OTD) came into existence, which was launched in April 1995 with special designing to detect the lightning. Following OTD, in Nov 1997 another Lightning Imaging Sensor (LIS) was launched. OTD stopped working in May 2000 and therefore, both OTD and LIS were in operation in 1998 and 99. OTD used to take 55 days to complete one revolution where as LIS is taking 49 days. In addition, there is difference in their configuration. Therefore, OTD formed 14 windows and LIS formed 15 windows. Based on the windows the performances of these two sensors have been compared over the

Indian land region.

In Fig. 1, the average lightning flashes against each window of OTD and LIS show a clear LIS curve overlying the OTD curve. LIS has registered three peaks of lightning flashes at window nos.3, 6 and 11 where as OTD has registered four peaks at second, 5th, 10th and 12th windows. The peaks documented by LIS are higher in magnitude than OTD. LIS has recorded least number of flashes at window number 8 while OTD shows least flash record at window number 7. Window number 15 for LIS and window number 14 for OTD have not observed a single flash. Average number of flashes has been shown against the latitudes in fig.2. It is seen that most of the lightning activity is confined to 15 – 33° N latitude. The average lightning flashes are increasing as the latitude advances. Again, the LIS curve is overlying the OTD curve supporting the finding of the fig. 1. The LIS curve shows the bimodal distribution of lightning flashes while OTD does not show the same. LIS records two peaks of maximum of average lightning flashes at 26.5°N (1405) and 33.5°N (606.82) respectively. The first peak at 26.5°N is higher than that at 33.5° N. The minimum of average flashes recorded by LIS was at 36.5° N. However, no distinct peak of average of lightning flashes is seen with OTD, the highest of average flashes recorded is at the same latitude (226.57 at 26.5° N). The lightning activity was least at 36.5° N (1.57).

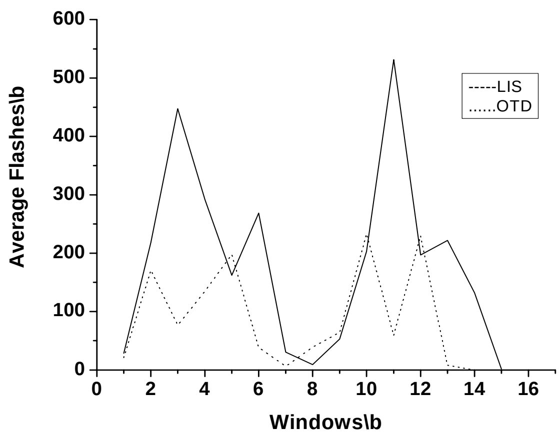

Fig 1.Variation of flashes through windows.

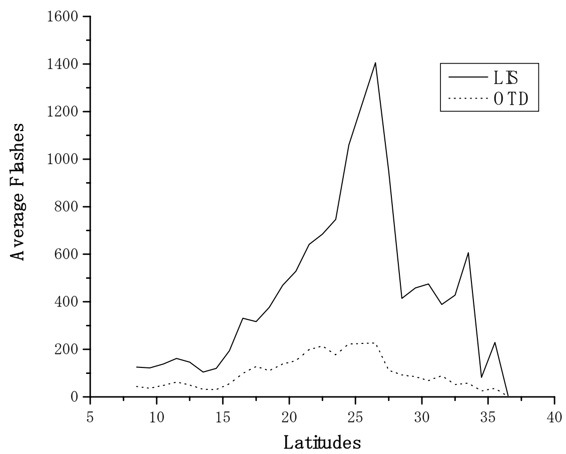

Fig.2. Variation of flashes along the latitudes.

The UK Met Office, Observation R&D Group – VLF Arrival Time Difference Lightning Location Network (ATDnet)

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The UK Met Office long range lightning location network (ATDnet) team attended the EUMETNET task force on lightning detection, held in Ljubljana, Slovenia in April. This is a European task force designed to compare the lightning detection networks and user requirements of several European countries. A recent comparison between ATDnet and the Brazilian lightning detection network (BrasilDAT) over southern Brazil was presented at the meeting (BrasilDAT data provided by Kleber Naccarato, INPE). The lightning strike location algorithms of

ATDnet were modified during February 2009 and have produced a significant improvement in location accuracy and detection efficiency, by reducing the assumed waveform group velocity and analysing the waveform shape adjacent to the maximum amplitude. These algorithm improvements significantly reduced the median ATDnet location error over southern Brazil from 89km to 21km, producing a more coherent distribution of lightning events (figure 1). Improvements in the detection efficiency over Europe have also been observed since the algorithm modification, although this will not be quantified until re-analysis of previous comparative data over France between ATDnet and Météo-France, as well as Austria with the Austrian ALDIS network. ATDnet continues its network expansion, with two more out-stations planned to be installed in Croatia and Namibia this year.

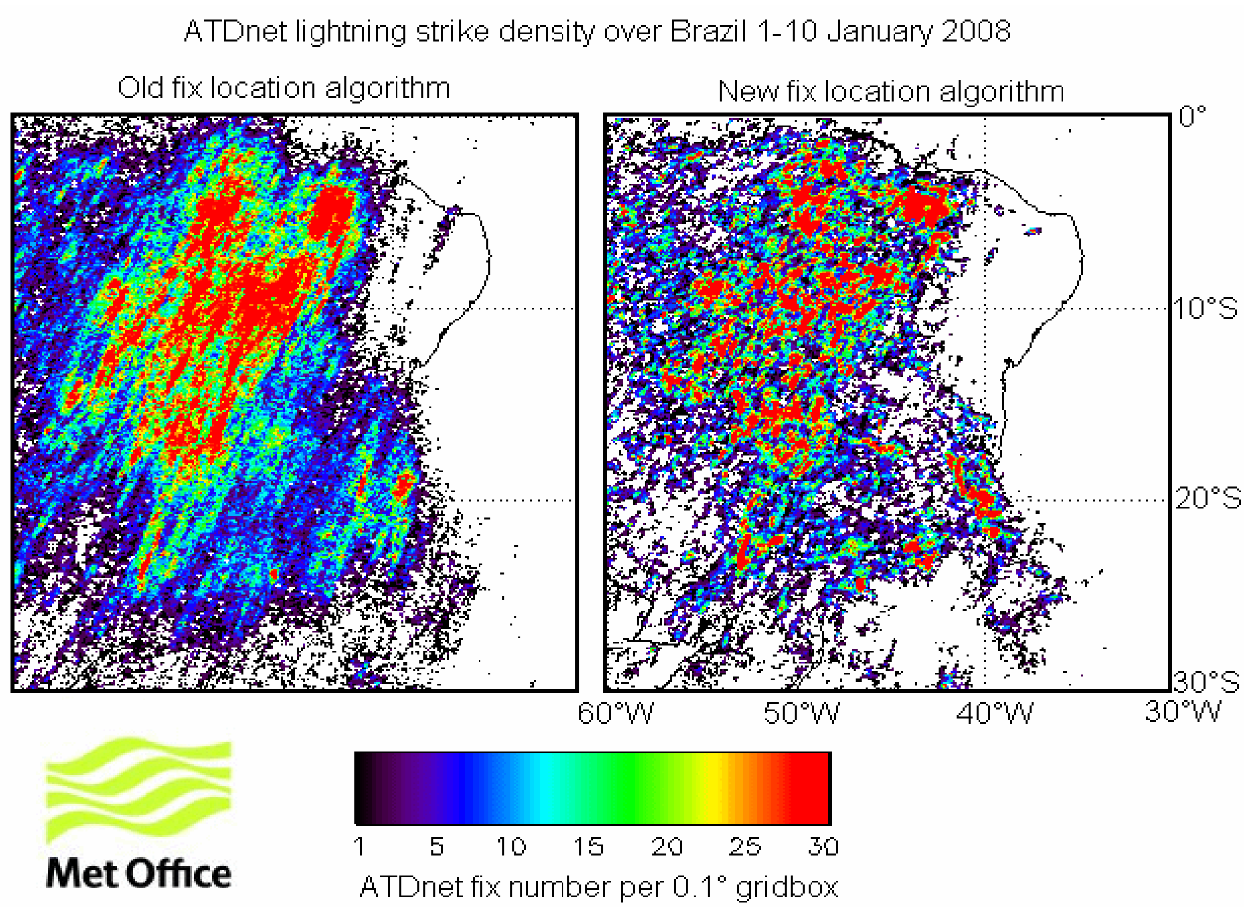

Fig. 1: Comparison between the UK Met Office ATDnet lightning strike density over the Brazilian region using the old and new fix location algorithms during the same ten days in January 2008.

Terrestrial Electromagnetic Environmental Studies Group, University of Electro - Communications

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The study of winter lightning in the Hokuriku area of Japan and its associated phenomena is still going on by means of coordinated measurements (lightning measurement (SAFIR), optical observation, ELF observation, satellite (DEMETER) observation etc.). Our recent finding based on a comparison of sprite observation with the corresponding height of -10°C, indicates that when the height of -10°C is lower than 1800m, the sprites are infrequent and the dominant shape is column, while when it is higher than 1800m, the occurrence of sprites is very enhanced and more spectacular shapes like carrots tend to be frequently observed in addition to columns (Myokei et al., 2008, 2009).

Also, Matsudo et al. (2008, 2009) have compared winter sprites in the Hokuriku area and in the Pacific Ocean, who have found a significant long-delay (average～90ms) for sprites in the Hokuriku area, but a much shorter delay (～43ms) for the Pacific Ocean. These informations would be of significant importance in the study of generation mechanism of sprites. Asano et al. (2008, 2009) have continued the computer simulations on sprites, and a recent paper by Asano et al. (2009) has suggested an important role of higher frequency components (like M components) in the continuing current in order to explain the long-delay effect of sprites. Also, the general lateral shift of sprites from their parent lightning has been interpreted in terms of the presence of an additional horizontal channel (Asano et al., 2009, accepted). Ionospheric perturbations associated with sprites have been observed by means of subionospheric VLF/LF propagation data observed at several stations in Japan, which are being analyzed.

In addition to the study of winter lightning and sprites, we have just started the similar campaign for summer lightning and the associated phenomena in the north of Tokyo area (Maebashi area famous for its high summer activity of lightning) together with the measurement by a Doppler radar, and the data will be presented and will be extensively compared with winter lightning results.

The ELF observation is continued at Moshiri (Hokkaido) with the measurements of two horizontal magnetic field components and one vertical electric field (with the sampling frequency of 4kHz). The diurnal and seasonal variations of Schumann resonance parameters at Moshiri have been studied (Sekiguchi et al., 2008), to be compared with the theoretical modeling. We have already developed an algorithm (with the objective judgment) to deduce the snapshot global lightning activity by using the simultaneous use of Schumann resonance data at a few stations in the world (Ando and Hayakawa, 2007). This inversion technique has been applied, for the first time, to the real data but only for a few days at three stations (Moshiri, Rhode Island and Lekhta), and the results will appear shortly (Shvets et al., 2009) with a lot of prospect. A huge amount of data (e.g., one year) will be an alyzed. ELF transients observed at Moshiri are used to obtain the global mapping of intense lightning activity (Yamashit a et al., 2009).

Lightning modeling is also continued. The first one is the cellular automation modeling of VHF radio emissions during the initial phase of lightning (Hayakawa et al., 2008) and the second is the use of cellular automaton in modeling sprites (especially with respect to sprite morphology) in terms of percolation theory.

Electromagnetic phenomena associated with earthquakes, are one of the main topics of our interest. A special monograph was edited by M. Hayakawa and will appear shortly (2009), which contains ten chapters written by qualified authors in different aspects of seismo-electromagnetics and provides us with updated information. Then, a special issue entitled "Electromagnetic Phenomena Associated with Earthquakes and Volcanoes" has just appeared in Physics and Chemistry of the Earth, with Guest Editors of M. Hayakawa, J. Y. Liu, K. Hattori and L. Telesca. This issue collects about 25 papers after the peer evaluation of those presented at a few relevant international meetings. The seismogenic ULF emission has been monitored in the Tokyo area by means of our Tokyo ULF network, and the subionospheric VLF/LF perturbations associated with earthquakes have been continued by Japanese VLF/LF network (Molchanov and Hayakawa, 2008). Especially the latter VLF/LF observations have yielded a lot of results on the presence and characteristics of seismo-ionospheric perturbations (case studies and statistical results). Furthermore, seismo-atmospheric effects have been studied as well by means of over-horizon VHF signals and an interferometer was developed to locate the perturbation (Yasuda et al., Radio Science, 2009, in press).

University of Florida (Gainesville, Florida, USA)

Experiments will continue in summer 2009 (for the 16th year) at the International Center for Lightning Research and Testing (ICLRT) at Camp Blanding, Florida. These include continued studies of the properties of natural lightning using multiple-station measurements of electric and magnetic fields and continued studies of the energetic radiation (X-rays, gamma-rays) during both natural and triggered lightning discharges using the upgraded Thunderstorm Energetic Radiation Array (TERA), in collaboration with the Florida Institute of Technology (FIT). Observations will also continue at the Lightning Observatory in Gainesville (LOG), located at a distance of about 45 km from Camp Blanding and linked to the Camp Blanding facility by a dedicated phone line. The LOG presently includes electric field, dE/dt, and VHF (36 MHz) systems, and an x-ray detector (provided by FIT) and will be operated in either stand-alone mode or two-station mode with the Camp Blanding facility. Dr. Satoru Yoshida of Osaka University, who is presently at UF as a visiting scholar, will operate a 3D broadband VHF interferometer.

A. Nag and V.A. Rakov authored a paper titled “Some Inferences on the Role of Lower Positive Charge Region in Facilitating Different Types of Lightning”. It is generally thought that the lower positive charge region (LPCR) serves to enhance the electric field at the bottom of the main negative charge region and thereby facilitate the launching of a negatively-charged leader toward ground. On the other hand, the presence of excessive lower positive charge region may prevent the occurrence of negative cloud-to-ground discharges by "blocking" the progression of descending negative leader from reaching ground and thus "converting" the potential cloud-to-ground flash to an intra-cloud (or cloud-to-air) one. They examined variations in occurrence of preliminary breakdown (PB) pulse trains in CG flashes. Assuming that the PB pulse train is a manifestation of interaction of a downward extending negative leader channel with the LPCR, they qualitatively examined the inferred dependence of lightning type on the magnitude of this charge region. The result is a set of conceptual scenarios that can be tested by future observations. The paper is published in the GRL.

J. Schoene, M.A. Uman, V.A. Rakov, K.J. Rambo, J. Jerauld, C.T. Mata, A.G. Mata, D.M. Jordan, and G.H. Schnetzer authored a paper titled "Characterization of return-stroke currents in rocket-triggered lightning". They presented a statistical analysis of the salient characteristics of current waveforms for 206 return strokes in 46 rocket-triggered lightning flashes. The flashes were triggered during a variety of experiments related to the interaction of lightning with power lines that were conducted from 1999 through 2004 at the International Center for Lightning Research and Testing at Camp Blanding, Florida. The return-stroke current, after measurement, was injected into either one of two test power lines or into the Earth near a power line via a grounding system of the rocket launcher. Statistical information is presented for return-stroke peak current, charge transfer, half-peak width, and 10%–90% risetime. Their return-stroke peak current statistics are generally consistent with those reported from other triggered-lightning studies and appear to be independent of electrical properties of the strike object, as previously found in another study. The means of the 10%–90% current risetimes for strikes to the power line (geometric mean 1.2 us) and for strikes to the Earth (geometric mean 0.4 us) are significantly different which indicates that the electrical properties of the strike object affect the risetime. This effect is likely related to the impedance seen by lightning at the strike point and/or to reflections at impedance discontinuities within the strike object, larger effective impedances apparently resulting in larger risetimes. A dependence of the return-stroke current half-peak width on the electrical properties of the strike object was not observed. The paper is published in JGR.

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Reminder

Newsletter on Atmospheric Electricity presents twice a year (May and November) to the members of our community with the following information:

- ✧ announcements concerning people from atmospheric electricity community, especially awards, new books...,
- ✧ announcements about conferences, meetings, symposia, workshops in our field of interest,
- ✧ brief synthetic reports about the research activities conducted by the various organizations working in atmospheric electricity throughout the world, and presented by the groups where this research is performed, and
- ✧ a list of recent publications. In this last item will be listed the references of the papers published in our field of interest during the past six months by the research groups, or to be published very soon, that wish to release this information, but we do not include the contributions in the proceedings of the Conferences.

No publication of scientific paper is done in this Newsletter. We urge all the groups interested to submit a short text (one page maximum with photos eventually) on their research, their results or their projects, along with a list of references of their papers published during the past six months. This list will appear in the last item. Any information about meetings, conferences or others which we would not be aware of will be welcome.

Newsletter on Atmospheric Electricity is now routinely provided on the web site of ICAE (http://www.icae.jp), and on the web site maintained by Monte Bateman http://ae.nsstc.uah.edu/.

In order to make our news letter more attractive and informative, it will be appreciated if you could include up to two photos or figures in your contribution!

Call for contributions to the newsletter

All issues of this newsletter are open for general contributions. If you would like to contribute any science highlight or workshop report, please contact Daohong Wang (wang@gifu-u.ac.jp) preferably by e-mail as an attached word document.

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