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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

The Newsletter on Atmospheric Electricity being sent by e-mail, those colleagues needing a paper version should contact Serge Soula: (serge.soula@aero.obs-mip.fr) or Pierre Laroche: (Pierre.Laroche@onera.fr). They will receive the Newsletter by regular mail. Those knowing anybody who needs such a paper version are also welcome to contact us. On the other hand, the easiest way to communicate being electronic mail, we would be grateful to all of those who can help us complete the "atmospheric electricity" list of email addresses already available. All issues of this Newsletter are available on the website of the International Commission on Atmospheric Electricity:

http://www.atmospheric-electricity.org/

We remind all our colleagues that the Newsletter remains also available on the website:

http://ae.atmos.uah.edu

thanks to Monte Bateman's help.

Contributions to the next issue of this Newsletter (May 2005) will be welcome and should be submitted to Serge Soula or Pierre Laroche before April 30, 2005, preferably under word attached documents. A reminder will be sent to all colleagues whose e-mail addresses are presently listed.

ANNOUNCEMENTS

IN MEMORIAM PROFESSOR NGUYEN MANH DUC

Professor Nguyen Manh Duc, many years' coworker and member of the atmospheric electricity group at the Institute of Geophysics, Polish Academy of Sciences in Warsaw, passed away on June 25, 2004. He was born on February 5, 1935 in Vietnam. There he completed his university studies and started his professional work in the Vietnamese Institute of Atmospheric Physics. During the International Geophysical Year 1958-1959 (IGY) he worked in the framework of Polish-Vietnamese geophysical cooperation taking part from the Vietnamese side in foundation and maintenance of atmospheric electricity and radioactivity station at Sa-Pa in Vietnam. With his assistance, after lengthy and detailed preparation, the Vietnamese staff was able to carry on the measurements in this commonly established subtropical mountain station, later in Phu-Lien, for thirty years. He translated into Vietnamese language the book, Introduction in the Atmospheric Electricity Problems, written by Stanisław Michnowski during the IGY in Sa-Pa. The book was published in Hanoi, 1960..

In 1960-1963, Nguyen Manh Duc came to the Institute of Geophysics, Polish Academy of Sciences in Poland to process and analyze the IGY results of Sa-Pa atmospheric electricity station with Polish members of scientific staff of this station at the atmospheric electricity laboratory. The yearbook and several papers were prepared jointly and published in the special issue of Publications of the Institute of Geophysics (Mateiały i Prace Instytutu Geofizyki Pan) Warszawa, 1965. The cooperation has been kept after his return to Vietnam to carry on atmospheric electricity research in Sa-Pa and Phu-Lien.

In 1965-1969 he stayed again at the Institute of Geophysics and extended his studies in lightning research at the Warsaw University of Technology. In his PhD dissertation he gives the approximate temporal and spatial distribution of lightning c-g flashes in Poland obtained by means of a limited number of lightning counters constructed by him. He was the first to use climatic regions approach for this purpose. The results were published with Stanisław Michnowski in Acta Geoph. Pol. 1969. .

The gained experience allowed him to work at the Center of Atmospheric Research in Hai Phong in Vietnam as deputy director until 1972. Later, in 1980-1982 Professor Nguyen Manh Duc worked in the Vietnamese Academy of Science in Hanoi, being head of the Institute of Atmospheric Physics in this Academy in the years 1983-1988. Incessantly he continued his research work especially in lightning observation and lightning protection problems. In mountain tropical station Tham Dao he observed and recorded photographically some peculiar forms of unusual discharges in the cloud including cases of ball and bead lightning discharge.

In 1988-1999 he continued in Poland in the Institute of Geophysics his studies of the lightning discharge processes especially concerning the phenomena observed by him in Vietnam. He attempted at first to get a better understanding of little known processes of lightning initiation in the cloud. A new hypothesis of these phenomena, based on the discharges between cloud particles, was presented by him in Acta Geoph. Pol. and together with Stanisław Michnowski in Journal of Geophys. Res. 1996. Nguyen Manh Duc later extended his collective streamer

approach used in this hypothesis developing conceptual model of the whole lightning discharge in the cloud. He prepared a very interesting monograph on this subject with some precursor ideas of properties of lightning discharge development in clouds. The sudden stroke disrupted this very promissing work.

After many years of recovery Prof. Nguyen Manh Duc resumed his research in Vietnam. The abstract of his new paper on lightning initiation in the cloud was presented during the 10-th ICAE Conference in Versailles in 2003. He intended to come to Institute of Geophysis in Warsaw in 2004 to finish his habilitation work. Unfortunately, second stroke disrupted his life.

Nguyen Manh Duc was an author of about 70 scientific papers and two books. He was deeply engaged in atmospheric electricity, especially lightning, research. This quiet and modest man with patient force accompanied us to conquer various difficulties in undertaken new research tasks. Although he had at his disposal only very modest experimental facilities, his efforts with his deep interest in solving the puzzles of nature and gift of creative thinking had given the fruitful results.

I had the pleasure to work with him for forty five years. He was a key person in foundation and keeping the atmospheric electricity research in Vietnam in cooperation with the Institute of Geophysics in Poland. He was one of my best friends and one of the best coworkers in our atmospheric electricity group in Warsaw. His passing away is very great lost not only for his family and Vietnamese friends but also for all members of our atmospheric electricity group and many colleagues in the Institute of Geophysics in Warsaw. We believe that his work in the field of atmospheric electricity in Vietnam and Poland will be continued on the basis of up-to-day facilities.

Stanislaw Michnowski

ICAE 2003 SPECIAL ISSUE

Following the 12th International Conference on Atmospheric Electricity, held 9-13 June 2003 in Versailles, the publication of a special issue on this scientific event was decided. The reviewing procedure of papers submitted by authors, managed by guest editors Serge Chauzy and Pierre Laroche, is now completed. Atmospheric Research (Elsevier) will publish a selection of papers whose content was presented during the conference. 31 manuscripts were recommended and finally accepted by the editor in chief of Atmospheric Research and the ICAE 2003 Special Issue should be soon published. The guest editors are deeply grateful to all authors and reviewers for their contribution to this important special issue.

NEW BOOK

NLSI's new book *Lightning Protection for Engineers* is a 200+ page practical and illustrated manual describing lightning protection techniques in grounding, bonding, shielding and surge protection in accord with the most recent international codes and standards. Air Terminals, including designs unsupported by mainstream science, also are discussed. An extensive reference section is included. For more information see:

www.lightningsafety.com/nlsi_bus/lp_for_eng_book/html

INFORMATION

Jaan Salm would like to send you an information. He has carried out research in the field of air ions and aerosols since 1959. Most of his publications are in Russian. Recently he translated the non-English titles into English. The list of his publications is available through Internet as follows: http://ael.physic.ut.ee/ > English pages > People > > List of Academic Publications. A large number of the papers are related to atmospheric electricity. Everybody is welcome to ask questions.

CONFERENCES

2004 AGU FALL MEETING

The 2003 AGU Fall Meeting, sponsored by the American Geophysical Union, will be held from 13–17 December 2004 in San Francisco, California, U.S.A..
The website of this meeting: http://www.agu.org/meetings/fm04/
With the help of Dennis Boccippio, Chair of the Focus Group on Atmospheric and Space Electricity (http://www.agu.org/focus_group/ASE/index.html), 11 sessions for the section **Atmospheric and Space Electricity** have been proposed and will be held**,** from Tuesday 14th to Friday 17th:

- Thunderstorms, Lightning, and Atmospheric Chemistry
- The Physics of Lightning and Thunderstorm Electrification I (Posters)
- Franklin Lecture: Advances in Atmospheric Electricity and Lightning Research
- Modeling of High-Altitude Discharges and Comparison with Measurements I (Posters)
- Electrical Effects of Thunderstorms on the Middle and Upper Atmosphere I (Posters)
- Lightning: Detection, Meteorology, and Climate I (Posters)
- The Physics of Lightning and Thunderstorm Electrification II
- Lightning: Detection, Meteorology, and Climate II
- Electrical Effects of Thunderstorms on the Middle and Upper Atmosphere II
- Modeling of High-Altitude Discharges and Comparison with Measurements II
- Atmospheric and Space Electricity: From DC to Gamma

2005 EMC ZURICH

Special Session on Lightning and Its Effects at 2005 EMC ZURICH.

Following successful presentations in Montreux (1975, 1977), Rotterdam (1979), and the last twelve years in Zurich from 1981 to 2003, the **16th International Zurich Symposium on Electromagnetic Compatibility** is planned for **February 14-18, 2005** at the Swiss Federal Institute of Technology (ETZ) in Zurich, Switzerland.

Vlad Rakov is Chair of the EMC Zurich Technical Program Committee on Lightning. He has been invited to organize a Special Session on Lightning and Its Effects at EMC Zurich ’05. Papers for this Special Session may be submitted on the following topics.

1. Properties of the lightning discharge important for EMC
2. Lightning return-stroke models
3. Lightning EMP
4. Coupling of lightning electromagnetic fields to overhead and buried conductors

5. Lightning locating systems
6. Atmospherics
7. Lightning effects in the middle and upper atmosphere
8. Lightning protection
9. Lightning testing standards

Original, not previously published or elsewhere submitted **preliminary manuscript** (not exceeding four pages) shall be submitted electronically (in PDF format only) via the EMC Zurich website http://www.emc-zurich.ch. The submission deadline is **July 2, 2004**.

All contributions will be reviewed by the Technical Program Committee. Authors will be notified by **September 17, 2004**. Final paper (not to exceed four pages) submission deadline is **November 26, 2004**. If you decide to contribute, please send a copy of your paper to rakov@ece.ufl.edu.

2005 EGU GENERAL ASSEMBLY

European Geosciences Union

General Assembly 2005
Vienna, Austria, 24 - 29 April 2005

http://www.copernicus.org/EGU/ga/egu05/index.htm

We hereby would like to draw your attention to the General Assembly of the European Geosciences Union (EGU):
In "Natural Hazard Programme":
Lightning Section: NH1.04
http://www.cosis.net/members/meetings/programme/view.php?p_id=129

Deadline for receipt of abstracts : 21 January 2005
Deadline for pre-registration : 8 April 2005

9TH SCIENTIFIC ASSEMBLY OF IAMAS

The 2005 IAMAS General Assembly will be held from 2-11 August 2005 in Beijing, China (http://www.iamas2005.com/). As part of this assembly, IAMAS and its Commissions (http://www.iamas.org/) organize a wide range of scientific meetings that are open to all scientists. Based on discussions following the meetings in Sapporo (2003), "The Fascinating Atmosphere: Changeable and Changing" has been agreed to as the scientific theme for IAMAS 2005. ICAE participates to the organization of 4 symposia :

- One symposium in the session A: GASES, AEROSOLS TO CLOUDS (NO RAIN)
"NOx from Lightning and Anthropogenic production with its transport and chemical transformation by deep convection" (ICAE, ICACGP, IOC).
Conveners:
James E. Dye, National Center for Atmospheric Research, PO Box 3000;
Boulder CO 80307, USA; Phone: 303-497-8944; FAX: 303-497-8171; dye@ucar.edu
Pierre Laroche, Atmospheric Environment Research Unit,
ONERA, 92322 Chatillon Cedex France;
Tel +33 1 46734723; Fax +33 1 46734148; laroche@onera.fr
Prof. Xiaoyan Tang at Peking University
Hajime Akimoto, President ICCl 1998-2002, Institute for Global Change Research,
Frontier Research System for Global Change, 3173-25 Showa-machi, Kanazawa-ku,
Yokohama 236-0001, Japan;
TEL: +81-45-778-5710; FAX: +81-45-778-2292; akimoto@jamstec.go.jp

- Three symposia in the session J: ELECTRICAL
"Precipitation and Electrification in Convective Clouds" (ICAE-ICCP)
Conveners:
Clive Saunders UMIST Physics Department, Sackville Street M60 1QD Manchester, UK.
Tel +441 612 003 909 Fax +441 612 003 941 e-mail: clive.saunders@umist.ac.uk
Tsutomu Takahashi, Obirin University, Core-Education Center, Obirin Univ. 3758 Tokiwa-cho, Machida-shi, Tokyo 194-0294, Japan
tel +81-427-97-0017 fax +81-427-97-0017 e-mail: t2@obirin.ac.jp

"Middle Atmosphere Electrical Events Associated With Tropospheric Storms"
(IAMAS/ICAE, ICMA, IOC-IAGA).
Conveners:
Colin Price Department of Geophysics and Planetary Science, Tel Aviv University
Ramat Aviv, 69978 Israel tel: 972-3-6406029 fax: 972-3-6409282 e-mail: cprice@flash.tau.ac.il
Yoav Yair The Open University of Israel 16, Klauzner Street Ramat-Aviv 61392 Tel-aviv
Tel: 972-3-6465579 fax: 972-3-6465410 e-mail: yoavya@openu.ac.il

"Global Lightning and Climate" (ICAE-ICCL).
Convenors:
E.(Earle) R. Williams, MIT 48-21118, Parsens Laboratory Cambridge, Ma 02181, USA

Tel: (+1) 617 253 2459, Fax: (+1) 617 253 6208, earlew@juliet.ll.mit.edu
Xiushu QIE, Cold and Arid Regions Environmental and Engineering Research Institute,
Chinese Academy of Sciences, W. 260 Donggang Road, Lanzhou, Gansu 730000,
P. R. China, Tel: +86-931-4967686, Fax: +86-931-8274863, Email:qiex@ns.lzb.ac.cn

VIII SIPDA - International Symposium on Lightning Protection

21st - 25th November 2005
São Paulo, Brazil

Organised by

UNIVERSITY OF SÃO PAULO
Inst. of Electrotechnics and Energy

IEEE
Networking the World
South Brazil Section

- *Honour President:* Prof. Duílio M. Leite, BRAZIL
- *Chairman:* Prof. Alexandre Piantini, BRAZIL

International Steering Committee

- Prof. Maria Teresa C. Barros, PORTUGAL
- Dr. Gérard Berger, FRANCE
- Prof. William A. Chisholm, CANADA
- Prof. Mat Darveniza, AUSTRALIA
- Prof. Zdobyslaw Flisowski, POLAND
- Prof. Masaru Ishii, JAPAN
- Prof. Duílio M. Leite, BRAZIL
- Prof. Carlo Mazzetti, ITALY
- Prof. Carlo A. Nucci, ITALY
- Prof. Alexandre Piantini, BRAZIL
- Prof. Vladimir A. Rakov, USA
- Prof. Shigeru Yokoyama, JAPAN

Scope

The aim of the Symposium is to present and discuss recent developments concerning lightning modelling and measurement techniques, as well as grounding and lightning protection. Prospective authors are invited to submit abstracts, preferably by e-mail (sipda@iee.usp.br), on the following topics:

1) Lightning phenomena
2) Lightning detection and location systems
3) Electromagnetic compatibility and lightning induced effects
4) Modelling
5) Lightning protection of transmission and distribution systems
6) Surge protective devices
7) Lightning protection of electronics and telecommunication systems

8) Lightning protection of structures and installations
9) Grounding
10) Testing and standardisation
11) Lightning-caused deaths, injuries and damages

Deadlines

Abstract submission (min. 400 and max. 600 words): **1st March 2005**
Notification of provisional acceptance: **30th April 2005**
Full paper submission: **15th July 2005**
Notification of final acceptance: **1st September 2005**

Registration/Information:

VIII SIPDA Secretariat
E-mail: sipda@iee.usp.br
Web site: www.iee.usp.br/sipda

RESEARCH ACTIVITY BY INSTITUTION

ATMOSPHERIC ELECTRICITY GROUP (ELAT) – BRAZILIAN INSTITUTE OF SPACE RESEARCH (Sao José dos Campos – Brazil)

At this period the main activities were: ELAT team participate in the ILDC Conference in Helsinki, organized by Vaisala; new sensors are being integrated and installing as part of the expansion of the Brazilian Integrated Lightning Detection Network (RINDAT), which at middle of 2005 should be covering 70% of the country; two lightning detection efficiency models to study the performance of the RINDAT were developed; the First International Conference on Lightning Physics and Effects will be held in Belo Horizonte in November 07-11, simultaneously with three other events; the next triggered campaign in Brazil will start in November 13; the lightning observations made in the last summer with a high speed camera showed very interesting results that should be published in a near future.

COLORADO STATE UNIVERSITY - RADAR METEOROLOGY GROUP

Timothy Lang, Steve Rutledge, and Kyle Wiens have been studying the kinematic, microphysical, and lightning evolution of the 11 June 2000 mesoscale convective system (MCS) observed during the STEPS project. Earlier this year they published a manuscript in GRL detailing how most positive cloud-to-ground (CG) lightning in the stratiform region of this storm originated within the convective line. Further analysis reveals that this is true of most of the stratiform lightning, including intracloud and negative CGs. Within the convective line it was observed that the height of maximum VHF source density from lightning flashes gradually shifted from approximately 9 km MSL (indicating a normal polarity dipole) to 5-6 km MSL (indicating a potential inverted dipole) during this storm's lifetime. This shift was coincident with the development of significant quantities of polarimetric-radar-inferred graupel at this lower altitude, suggesting that this graupel was acquiring net positive charge. Interestingly, this lower positive charge development did not lead to a significant increase in positive CG lightning in the convective line; indeed, the opposite occurred with positive CG flash rates declining late in this storm's lifetime.

Sarah Tessendorf, Kyle Wiens and Steve Rutledge are continuing their analyses of convective storms from STEPS: For storms producing +CGs, the +CG production resulted from one of two modes (1) Older cells with normal tripole charge structure decayed with a large-scale subsidence of the entire charge structure, resulting in a mid-level positive (and overall inverted tripolar structure) that was tapped for the +CGs. (2) New, vigorous cells (including 29 June supercell) form an inverted dipole or tripole right away, followed by +CGs.

In all cases, +CGs originated from 5-9 km altitude and generally clustered on the downwind side of the main precipitation/hail shaft. In all cases, the parent charge structure for

+CGs was an inverted tripole, which highlights the importance of the lower negative charge in the initiation of +CGs, and also somewhat discounts various other explanations for +CG production (e.g., tilted dipole). Negative CG-dominated cells were generally weaker than +CG-dominated cells and always initiated as normal polarity dipoles. Then the lower positive formed (completing the normal tripole) and -CGs ensued--again, highlighting the importance of a lower charge region (positive in this case) in CG initiation.

STEPS Cases: 3 June/29 June comparison

Two case studies (3 June 2000 and 29 June 2000) have been analyzed in detail and compared. The early kinematic and microphysical evolution of 29 June was similar to 3 June and both exhibited inverted dipole structure from the start. After about an hour, 29 June intensified into a kinematically and microphysically stronger storm than 3 June, with updrafts near 50 m s^{-1} and substantial quantities of large hail being produced. Flash rates in the 29 June storm were an order of magnitude larger than 3 June, and 29 June produced copious +CG lightning, while 3 June didn't produce any CG lightning of either polarity. Though both exhibited inverted dipoles, the 29 June storm developed an additional negative charge region, and the +CGs only began after this lower negative developed. In contrast, the 3 June case did not develop any apparent lower negative charge and, consequently, produced no CGs of either polarity.

A two part paper has been submitted to J. Atmos. Sci. describing the 29 June STEPS supercell in detail.

FMA RESEARCH, INC./YUCCA RIDGE FIELD STATION, (Fort Collins, Colorado, USA)

Sprite monitoring activity using low light television systems continued during the summer of 2004. The main purpose was obtaining optical confirmation of sprite, halo and elve events in conjunction with the ongoing development of ELF/VLF transient analysis techniques yielding charge moment changes (CMC) by Steve Cummer (Duke University). Our main activity, under NSF support, is the development of a database characterizing transient luminous events (TLEs) and their parent lightning and storm systems, focusing primarily on data collected during the Summer, 2000 Severe Thunderstorm Electrification and Precipitation Study (STEPS). Our goal is to document as thoroughly as possible between 750 and 1000 TLEs (mostly sprites and haloes) above the U.S. High Plains. The project was greatly assisted by Laura Andersen, an intern from the meteorology program of the University of Northern Colorado. UNC Professor Gary Huffines also worked with FMA in preparing an extensive climatology of NLDN flash data for the greater Houston, TX area (1995-2003) in support of a joint proposal to investigate urban impacts on lightning during the planned Houston Environmental Aerosol Thunderstorm (HEAT) Project (FMA, Duke, and UNC).

In addition to sprite research, Tom Nelson has assisted in Duke/FMA's systematic investigation of temporal and spatial patterns of CMC estimates, using both impulsive (2 ms) and longer duration values extracted by Steve Cummer from his ELF/VLF system. An intense supercell produced a U.S. record hailstone in Nebraska on 23 June 2003 during the BAMEX experiment. In the past, many hailstorms have been associated with large numbers of high peak current positive CGs. This supercell began as a positive CG dominated storm, but within an hour,

and as the record hail fell, overall CG rates dropped dramatically with almost all strokes being negative and peak currents being 10 kA or less. Impulse CMCs were also very small, the vast majority not exceeding the sensor threshold of a mere 5 C km, and the largest being less than 200 C km. Low peak current CGs during hailstorms have recently also been observed in France.

Walt Lyons continues to interact with Earle Williams (MIT) and Steve Cummer (Duke) to investigate the sprite "polarity paradox." This refers to the fact that while >99.9% of all confirmed sprites are associated with positive CGs, global ELF transient analysis suggest that at least 1 in 10 of the CMCs large enough to induce conventional dielectric mesospheric breakdown are from negative CGs. Case studies conducted using CMC data from the Duke system have found little evidence of large negative CMC values in U.S. High Plains summer storms. Does this suggest that the large negative events may occur elsewhere, perhaps over oceanic regions?

We have compared the brightness of lightning channels to ground containing extended (>300 ms) continuing currents using 1000 fps high speed imagers to ULF-derived estimates of current amplitudes (Arthri Swaminathan and Steven Cummer, Duke). A strong, though not yet quantitative, relationship exists.

Yucca Ridge continues to host an all-sky OH image system for mesospheric gravity wave studies for the Kyoto University (Takuji Nakamura). This imager is one leg of a stereo-pair, with the second located to the south of Yucca Ridge near Platteville, CO.

Walt Lyons made a variety of presentations on lightning and STEPS-related research at various conferences including URSI (Boulder), AGU (San Francisco) and the AMS Annual Meeting (Seattle). He also served as a lecturer for the NATO Advanced Study Institute on Sprites, Elves and Intense Lightning Discharges held in Corte, Corsica in July, 2004. A presentation, co-authored by Russ Armstrong (MRC), on potential thunderstorm-induced electrodynamic and hydrodynamic disturbances in the lower stratosphere as related to proposed high altitude airship operations was presented at both the AMS Space Weather Symposium and NOAA'S Space Weather Week (Boulder).

FMA's subsidiary, Sky Fire Productions, Inc., under NSF educational outreach funding, produced a planetarium program entitled, "*The Hundred Year Hunt for the Red Sprite*." The DVD/VHS video version, designed for classroom use, has won several major video production awards (Telly, Aurora, Videographer). It may be ordered on the companion educational outreach site, www.Sky-Fire.TV. This site allows for self-directed learning by students of all ages interested in sprites, lightning, clouds and severe weather. Students can take an on-line Red Sprite Quiz, and receive a graded certificate of completion. The project was greatly facilitated by Mickey Schmidt, director of the U.S. Air Force Academy Planetarium.

Walt Lyons will serve as the President of the American Meteorological Society during 2005. He is pleased that the Conference on Meteorological Applications of Lightning Data, organized by Walt Petersen (University of Alabama, Hunstville), will be part of the AMS Annual Meetings in San Diego (2005) and Atlanta (2006), and hopefully will become an annual event.

GEODETIC AND GEOPHYSICAL RESEARCH INSTITUTE OF THE HUNGARIAN ACADEMY OF SCIENCES, DEPARTMENT OF AERONOMY, (Sopron, Hungary)

Background Schumann resonances (SR) have been measured for more than one decade in the Széchenyi István Geophysical Observatory at Nagycenk, Hungary. Recording SR transients

started about five years ago in the frame of a cooperation with Earle Williams' SR group supported by the US-Hungarian Joint Found.

This SR data set made possible numerous international cooperative works. Gabriella Sátori (satori@ggki.hu) and his PhD student, József Bór (jbor@ggki.hu) joined the surface ELF campaign during the Columbia (STS -107) mission to locate the intense lightnings producing TLEs. The results of the ELF campaign with participation of Israel, Japan and Hungary were published in GRL VOL. 31, L20107, doi:10.1029/2004GL020711, 2004. The Hungary SR group also joined the Conjugate Eurosprite Campaign in 2003. Vertical charge moment changes of sprite producing lightnings were deduced from the ELF transients recorded at Nagycenk, Hungary.

Additional works were based on the observation of background Schumann resonances at two distant SR stations. The lightning activity of the two main tropical chimney regions (Amazon and Congo Basins) were compared by using SR data recored at Nagycenk, Hungary and in Rhode Island, USA as well as OTD/LIS satellite observations. Earle Williams' and Gabriella Sátori's work: "Lightning, Thermodynamic and Hydrological Comparison of the Two Tropical Continental Chimneys" was published in the Journal of Atmospheric and Solar Terrestrial Physics, Vol. 66 (2004) 1213-1231.

Influence of solar terminator passages on Schumann resonance parameters were studied based on SR observations at three distant SR stations (Israel, USA, Hungary) and published by A Melnikov, C Price, G Sátori, M Füllekrug in J. Atm. Sol. Terr. Phys. Vol. 66 (2004) 1187-1194.

A new Schumann resonance recording system was installed at the Polish Polar Station (77º N, 15.5º E), Hornsund in Spitsbergen, August 2004 in the frame of the project titled „Lightning Induced Wave Observations at Spitsbergen" supported by NATO Collaborative Linkage Grant for Poland (Institute of Geophysics - Mariusz Neska) and Hungary (Geodetic and Geophysical Research Institute -Gabriella Sátori).

Studying long term trends of potential gradient is continued in cooperation between Giles Harrison (University of Reading, UK) and Ferenc Märcz (Gedetic and Geophysical Research Institute, Hungary).

INDIAN INSTITUTE OF TROPICAL METEOROLOGY – PHYSICAL METEOROLOGY AND AEROLOGY DIVISION (Pune, India)

Abstract about a study on "Lightning and Rainfall Activity over Gangetic West Bengal" by S.S. Kandalgaonkar, M.I.R. Tinmaker, M.K. Kulkarni and Asha Nath:

Satellite (LIS) based lightning flash grid (0.5^o x 0.5^o) data for 6-year period (1998-2003) over Gangetic West Bengal (20^oN to 26^oN and 85^oE to 89^oE) excluding the oceanic region were analyzed to study their annual, seasonal and diurnal variations. These data have further compared with the rainfall data of the same period to study their possible linkage between the two parameters. The results of this study revealed that during the annual course lightning activity exhibit a bimodal. The interseasonal comparison of the lightning activity indicates that during the premonsoon season it is nearly 1.5 / 9 times higher than the monsoon / postmonsoon season, while the rainfall activity in monsoon season is nearly 7.7 / 9.9 times higher than the premonsoon/postmonsoon. The diurnal variation of the lightning activity shows prominent peak at 1331-1500 UTC. The lower / higher RLR values in premonsoon / monsoon season thus

suggests that the rainfall yield and cloud electrification in convective and maritime regimes is differently associated.

INSTITUTE OF GEOPHYSICS OF THE POLISH ACADEMY OF SCIENCES, DEPARTMENT OF GEOMAGNETISM, (Warsaw, Poland)

A new Schumann resonance (SR) recording system has been installed at the Polish Polar Station in Hornsund at Spitsbergen in the frame of the project titled "Lightning Induced Wave Observations at Spitsbergen". The project is supported by NATO Collaborative Linkage Grant for Hungary (Geodetic and Geophysical Research Institute of the Hungarian Academy of Sciences – Gabriella Sátori) and Poland (Institute of Geophysics of the Polish Academy of Sciences – Mariusz Neska).

The Spitsbergen SR station is located almost at the same longitude as Nagycenk, Hungary, and both stations are situated in the longitudinal range of Africa which has the most intense lightning activity in the world. There is an SR station in the Negev desert, too. Fine variations of the African source can be monitored from these three sites.

The Schumann resonance recording system at Spitsbergen has a rather good view to the two other tropical regions (South America and The Maritime Continent) and it is far enough from the Northern American and Eurasian lightning activity during the Northern hemisphere summer yielding reliable Schumann resonance parameters from these source regions, too. A high latitude SR station is also important from the point of view of extraterrestrial influences (space weather).

LABORATORY OF LIGHTNING AND SEVERE STORM, COLD AND ARID REGIONS ENVIRONMENTAL AND ENGINEERING RESEARCH INSTITUTE, CHINESE ACADEMY OF SCIENCES, (Lanzhou, Gansu 730000, P. R. China)

Observation on lightning discharges has been continuously conducted in the summer of 2004 on the central Tibetan Plateau (31°27’47”, 92°03’39.8”, 4508m asl) by using field mill, slow and fast antenna system, wide-band interferometer and high-speed digital camera. Artificially triggering lightning experiment using the rocket-and-wire technique was tried by the first time in the high elevation region, and one lighting discharge was successfully triggered with the altitude-triggering method under a condition of positive charge overhead.

A tripole charge structure was deduced for most of the thunderstorms during their mature stage, but with a larger-than-usual lower positive charge region which seems to be correlated to the solid particles. The IC discharges between the lower dipole dominated all the flashes during the tripole structure stage. It is interesting to note that no positive CG and only a few negative CG flashes occurred during the tripole stage. The thunderstorm could change to normal charge structure in its late stage as the precipitation falling down to the ground, and negative CG flashes dominated as a result.

The response of lightning activity on the environmental thermodynamics has been checked on the Tibetan Plateau by using both the in-situ data, and the satellite data and NCEP data. It has been found that very large CAPE may not correspond to lightning activity, but more

lightning activity do corresponds to larger CAPE. Bowen ratio may play a role in the conversion efficiency of the potential energy to the convection kinetic energy

MASSACHUSETTS INSTITUTE OF TECHNOLOGY (Parsons Laboratory, Cambridge, Massachusetts 02139, USA)

Eric Downes and Earle Williams have been studying the archive of large lightning transients recorded in the lower ELF frequency band in West Greenwich, Rhode Island, beginning in 1994. The vertical charge moments for a large population of these superlative lightning flashes have been calculated by electromagnetic methods. The puzzle at present is that roughly 10% of all charge moments above the threshold for sprite initiation (400-800 C-km) are negative in polarity, leaving roughly 90% with positive polarity. Yet less than 0.1 % of sprites have been documented with ground flashes of negative polarity. A reexamination of earlier comparisons between video records of sprites (courtesy of Walt Lyons) and NLDN records show that roughly 10% of video-documented sprites lack a clear positive ground flash 'parent'. Steve Cummer is checking these events against the Stanford VLF data toward understanding their physical origins.

Earle Williams gave a talk in Michael Rycroft's session at COSPAR in Paris in July on the comparison of the Amazon and Congo River basin areas to the global circuit, and to global lightning. These two contributions are distinct. These ideas have recently been published (E. Williams and G. Satori, Lightning, thermodynamic and hydrological comparison of the two tropical continental chimneys, JASTP, 66, 1213-1231, 2004).

MIT participated in the Sprite Summer School in Corsica, France, with lectures on the meteorological and microphysical setting for sprites, and the use of calibrated radiance measurements in a large air-filled glow discharge tube in estimating the current flow in sprites.

A suggested explanation for the inverted electrical polarity of thunderstorms (now well documented in STEPS 2000) has been presented at the AMS Conference on Severe Local Storms. The explanation is based on a threshold in liquid water content, exceeded in two possible ways by an elevated cloud base height. Broader, less dilute updrafts are expected with deeper subcloud reservoirs of unstable air, and less diminishment of cloud water by precipitation in the 'warm rain' process is expected with a shallower warm rain region. LP supercells are frequent sites of inverted polarity electrification, and these high cloud storms exhibit a minimum of precipitation efficiency (i.e., 'Low Precipitation) for similar reasons.

A paper exploring lightning on islands (with the NASA Lightning Imaging Sensor on the TRMM satellite) as a means to distinguish hypotheses about the physical origin of the large land-ocean lightning contrast has been published recently:

MASSACHUSETTS INSTITUTE OF TECHNOLOGY (Lincoln Laboratory, Lexington, Massachusetts, USA)

Further exploration of the possible role of water substance in the electrification of volcanic eruptions has been undertaken. Literature results have been collected (including an unpublished manuscript on Mt St Helens by Peter Hobbs) on the gross dipole polarity of eruption clouds. The majority of these results are in agreement with the gross polarity of ordinary thunderstorms. The prevailing view on the electrification process in deep eruption clouds is one

involving interactions of dry silicate minerals (tephra and ash). Desert dust devils are electrified by the interaction of dry silicate minerals, but exhibit gross dipoles with a polarity opposite to ordinary thunderstorms.

As a further test of applicability of the relaxation radius to explosive volcanism (Williams and McNutt, 2004), the literature results on fireball radii with conventional explosives have been explored. Good agreement has been found, both in the magnitude and the scaling behavior with explosive energy. Fireball durations are also observed to increase systematically with total energy, and this observation may find use in estimating the energy of explosive eruptions with space-based infrared sensors.

NATIONAL LIGHTNING SAFETY INSTITUTE (NLSI) (Louisville, Colorado, USA)

(A non-profit, non-product organization providing objective information about lightning safety issues. More information at: www.lightningsafety.com)

The USA-Russian Hazardous Environment Workshop meeting was conducted in Albuquerque NM during Sept. 27-Oct 1, 2004. It was sponsored by the US Dept. Energy under the non-proliferation treaty between the two countries. USA Team members presenting lightning protection papers included: Richard Kithil Jr, NLSI President *The Role of Lightning Detection in Weapons Safety* and *21st Lightning Safety for Environments Containing Sensitive Electronics, Explosives and Volatile Substances;* Jake Struck US Army Picatinny Arsenal *Faraday Shield Lightning Protection Effect in Reinforced Concrete Shelters;* Douglas Loescher Sandia Labs *MultiLayer Patches for Lightning Protection;* Steve Eisenhawer LANL *Performance Analysis of the Lightning Warning and Protection System at LANL*; and Michelle Caldwell Sandia Labs *Electromagnetic Hazards and the Sandia Lightning Simulator.* Russian lightning papers included: Eduard Moiseenko VNIITF *Method of Protection of Ground Buildings and Constructions Against Direct Lightning Strokes and its Hazardous Effects*; Alexander Kushnerov VNIIA *Hazardous Item Transportation Safety in Lightning Conditions*; and Vladimir Terenkin VNIIEF *Investigation of Spark Discharge in the Ground on Reproduction of a Lightning Current Pulse by Means of EMG.*

NLSI work in applied lightning safety projects in recent time has included studies for: Dallas-Forth Worth Airport (people safety); and NASA's Wallops Island Flight Center (launch site). NLSI investigations also have included lightning insults to 911 emergency call centers for a major insurer having high claims histories. Not previously publicized, such lightning outages result in personal injuries, equipment losses and interruption of critical public services. NLSI has expanded its consulting and teaching capabilities to focus on the public communications sector. To this end, Richard Cohen, PhD EE has joined NLSI as Senior Technical Director.

NATIONAL SEVERE STORMS LABORATORY – NOAA (Norman, Oklahoma, USA)

The field phase of the Thunderstorm Electrification and Lightning Experiment (TELEX) is now complete. The scientific purpose of TELEX is to test and revise hypotheses concerning

the inter-relationships among the wind field, microphysical characteristics, electrical structure, and lightning of isolated nonsevere and severe storms and mesoscale convective systems (MCSs). We conducted the field program of TELEX in central Oklahoma, 9 May–20 June 2004. Institutions (principal investigators) involved in the TELEX 2004 field program were the NOAA/National Severe Storms Laboratory (Don MacGorman, Dave Rust, Conrad Ziegler), New Mexico Institute of Mining and Technology (Ken Eack, Paul Krehbiel, Bill Rison), the University of Oklahoma (Mike Biggerstaff, Terry Schuur, Jerry Straka, Bill Beasley), Texas A&M University (Larry Carey), and the University of Washington (Bob Holzworth). Observing systems included the Oklahoma three-dimensional] Lightning Mapping Array (OK-LMA), an 11-cm wavelength polarimetric Doppler radar (KOUN), and a mobile laboratory for storm intercept to fly as many as four balloon soundings simultaneously inside storms. Furthermore, the balloon-borne electric field meter was substantially upgraded to provide higher resolution data, including more accurate determination of instrument orientation to increase the resolution of three-dimensional electric field vectors. Other sensors were sometimes added to the instrument train by visiting researchers (listed above). Thirty-six flights were made during 13 ballooning missions. Soundings were made through nonsevere and severe storms and mesoscale convective systems. Several flights recorded data on both ascent and descent through the storms. Processing and initial analyses of the data from all the sensors are in progress. Our portion of this research was supported in part by the National Science Foundation ATM 0233268 and the National Severe Storms Laboratory.

NATIONAL SPACE SCIENCE TECHNOLOGY CENTER'S (NSSTC) - NASA/MARSHALL SPACE FLIGHT CENTER (MSFC) AND NSSTC/UNIVERSITY OF ALABAMA IN HUNTSVILLE (UAH) (Huntsville, USA)

The NASA Lightning Imaging Sensor (LIS) is still operating without degradation on the Tropical Rainfall Measuring Mission (TRMM) satellite, which was launched in November 1997 for a planned 3-year mission lifetime. TRMM is currently providing data for both research and operations. On November 8 the National Research Council (NRC), at the request of NASA, held a review to examine the merits for continuing TRMM operations. As a result of the NRC study, TRMM operations could continue through 2005 or longer, or TRMM could end science data collection at the end of 2004. A decision is expected in the coming months. The LIS team is reviewing final data disposition for the TRMM end-of-mission, including dataset reprocessing and/or generation of new products. Inputs from the user community are welcome and should be directed to **Dennis.Boccippio@nasa.gov**. LIS and Optical Transient Detector (OTD) data are freely accessible to the public at http://thunder.nsstc.nasa.gov/data.html.

The NSSTC lightning group continues to support atmospheric electricity and lightning research through conference planning activities. **Dennis Boccippio** (MSFC) reports that the Atmospheric and Space Electricity Focus Group in AGU has seen a 68% increase in ASE abstracts at the Fall Meeting in the last two years (with 114 submitted this year). The Focus Group is also now awarding its own Outstanding Student Paper awards, and has submitted one Fellow nomination and one Fleming Medal nomination this year. It has also arranged an ASE Named Lecture (the Franklin Lecture) at the meeting; the inaugural Franklin Lecture will be give

by **Philip Krider** (U. of Ariz.). **Walt Petersen** (UAH) reports that the first *AMS Conference on Meteorological Applications of Lightning Data* is to be held on 10-11 January 2005 during the AMS Annual Meeting in San Diego, California, Jan. 9-13, 2005. Approximately 75 papers were submitted to the lightning conference covering a variety of topics ranging from assimilation of lightning information into the forecast and warning decision making process, use of space and ground-based lightning information in atmospheric and climate science, and aspects of lightning information as it relates to public safety. The AMS conference committee is composed of **W. Petersen** (Chair), **Richard Blakeslee** (MSFC), **Lawrence Carey** (TAMU), **Chris Darden** (NWS Huntsville) and **Martin Murphy** (Vaisala). Plans call for the next conference to be held during the 2006 AMS Annual Meeting in Atlanta- look for the initial call for papers in the January issue of BAMS.

A paper entitled "The Tropical Convective Spectrum: 1. Archetypal Vertical Profiles" by **D. Boccippio, W. Petersen** and **Dan Cecil** (UAH) has been accepted for publication in the Journal of Climate. This establishes, through cluster analysis of TRMM Precipitation Radar data, a 25-category classification scheme for radar reflectivity vertical profiles. Recent results include application of the scheme to examine the evolution of deep convection in the Amazon and Indian premonsoon-to-monsoon transitions.

D. Boccippio, W. Petersen and **D. Cecil** have also completed a neural network-based "virtual radar" retrieval from passive microwave (and optionally lightning) observations, using TRMM TMI, LIS and PR observations as training/validation data. The retrieval predicts reflectivity products at the pixel-level for use in data assimilation or decision support system applications. Retrieved continuous parameters include: Echo Tops, VIL, Ice Water Content, Probability of Hail, Severe Hail Index, Rainfall, and vertical reflectivity profile. Retrieved classifiers include convective/stratiform, bright band, anvil, and profile type using the classification scheme described above. Inclusion of lightning inputs helps resolve deep convective cell structure and enhance convective/stratiform discrimination for midlevel (echo near the mixed phase region) profiles, which are highly important for global rainfall yet difficult to discriminate using passive microwave observations alone. The group is investigating applying the retrievals to current Aqua/AMSR-E passive microwave data.

W. Petersen, Hugh Christian (MSFC) **and D. Boccippio** have been examining ice water path and lightning flash rate statistics using TRMM LIS and PR data. Preliminary results suggest that relationships between ice water path and lightning flash density are approximately constant (in contrast to lightning-rainfall relationships) when averaged over all land, ocean and coastal regimes- emphasizing the global validity of hydrometeor based charging theory and the importance of ice.

A Total Lightning Applications, Transition, Evaluation, Science and Technology (LATEST) Workshop was held in Huntsville AL on April 1 and 2, 2004 bringing together approximately 65 participants from government, university, and private industry. A key motivating factor for the workshop is the fact that a series of systems measuring total lightning are beginning to produce “real-time” data across portions of the southern United States. The workshop fostered insightful discussions among technicians, scientists, and end-users that would otherwise be impossible. Technical discussions provided insight into data reliability. Scientific presentations focused on interpretations of lightning-storm relationships. Participants from

National Weather Service (NWS) Forecast Offices in Melbourne and Huntsville provided a unique perspective on how integration of total lightning data into the decision support system and process may lead to increase warning lead times for severe weather warnings. Abstracts, presentations, and the list of attendees can be found on the Short-term Prediction Research and Transition (SPoRT) center Web page at http://weather.msfc.nasa.gov/sport/sport_meeting.html. An outcome of the workshop is the formation of the LATEST project guided by a steering group tasked with reviewing the science and applications of the project. The project seeks improve the basic science understanding and end-user applications of total lightning products in routine operations.

The C-band Advanced Radar for Meteorological and Operational Research (**ARMOR**) in Huntsville is scheduled for completion of its dual-polarimetric upgrade and SIGMET software integration during the week of Nov. 8-12. Located at the Huntsville International Airport, the ARMOR was originally deployed as a National Weather Service WSR-74C local-warning radar and donated to UAH in late 2002. The ARMOR upgrade is a joint project between NSSTC partners UAH and NASA, and a private partner WHNT-TV (owned by the New York Times Inc.). The radar will provide continuous real-time surveillance and volumetric sampling of convection, precipitation, and tropospheric winds in northern Alabama. Advanced algorithms will be implemented to diagnose hydrometeor types, rainfall rates, and full three-dimensional wind flow in real time. These data will support fundamental research topics related to cloud microphysical and electrification processes (using the NASA MSFC Lightning Mapping Array), cloud dynamics, multi-parameter rainfall measurement, and boundary layer wind flow. The National Weather Service and WHNT-TV, in conjunction with the NASA SPoRT facility, will also use the data operationally for weather warning decision support. NSSTC Scientists leading the upgrade include Dr.'s **W. Petersen** (facility lead scientist) and **Kevin Knupp** (co-lead scientist) from UAH, and **R. Blakeslee** of NASA. The facility would also like to acknowledge the contributions made by **Prof. Steven Rutledge**, **Prof. Chandrasekar**, and **Ms. Brenda Dolan** (CSU), and **Dr. Tom Keenan** (BMRC).

William Koshak (MSFC) continues to develop and test a lightning charge retrieval algorithm using NASA KSC ground-based field mill data. The algorithm is based on a technique called "Dimensional Reduction," and preliminary results of the method shall be provided at the Fall AGU meeting in San Francisco in cooperation with U. of Arizona collaborators (**P. Krider**, and **Natalie Murray**).

ONERA- ATMOSPHERIC ENVIRONMENT RESEARCH GROUP (Chatillon, France)

The group is currently continuing its activities on lightning physic, lightning observations and storm electrification.

Alain Delannoy (alain.delannoy@onera.fr) is developing an enhanced parameterization of electrostatic effect of lightning flash in THOR. THOR is a 1.5D model of dynamic macrophysics and electrification of convective clouds which applies explicit microphysic description. THOR is tuned with the sophisticated 3D description of the convective cloud delivered by MESO-NH model (Laboratoire d'Aérologie and Meteo-France).

PhD student Isabelle L'Helgoualc'h (helgoual@onera.fr) has developed a 3D model describing the propagation of lightning leader based on the 3D description of the electrical field in the storm cloud. This model based on the physical behavior of the discharge will serve in the future as a tool to investigate the instability driving the recoil streamer process. Isabelle is currently performing a detailed simulation of the negative stepped leader development, with as objective to compute the HF and VHF radiation from this type of discharge. Local wide band measurement of lightning radiation (blanchet@onera.fr) are compared to very long range lightning flash detection from the ZEUS VLF lightning mapper of the National Observatory of Athens provided by Eric Defer (defer@meteo.noa.gr).

Development of the scientific VHF lightning mapper PROFEO is now in an active construction phase after design and preparation by Philippe Lalande (lalande@onera.fr) and Patrice Blanchet (blanchet@onera.fr). PROFEO will be installed end of 2005 and will survey the 3D lightning activity over Paris Area. Electric field variation at ground is studied in French Polynesia within collaboration with Pascal Ortega at UPF- Laboratoire Terre-Océan (pascal.ortega@upf.pf).

Based on geographical position and type of an aircraft, Alain Broc (alain.broc@onera.fr) and Philippe Lalande are developing a probabilistic definition of the lightning threat to aircraft.

OSAKA UNIVERSITY - LIGHTING RESEARCH GROUP(LRGOU) (OSAKA, JAPAN)

The first one is the field campaign in Darwin, Australia. LRGOU has been conducting campaigns in Darwin these ten years. The VHF digital interferometer (BDITF) is one of the noticeable results. VHF BDITF is realized to be an operational system from the aspects of 2D and monitoring of thunderstorm evolutions. LRGOU operates two VHF BDITF systems with about 20 km base line to have 3D image of lightning discharge development. Superimposition of VHF sources on CAPPI radar cross sections shows an excellent agreement. The post processing for 3D is nearly suppressible. LRGOU equipped VHF BDITF for TROCCINOX 2004 project in Brazil. LRGOU is considering the participation in TROCCINOX 2005. LRGOU is expected participate inTWP ICE, which is the international project in January/February 2006 in Darwin.

The second issue is the satellite observation of lightning discharges by means of VHF BDITF. This project is on going as the cooperation among SOHLA, Tokyo University, Osaka Prefecture University and LRGOU. The possible satellite should be a small one like micro lab satellite. LRGOU is assigned to be the mission design of this satellite, and VHF BDITF on the satellite is approved. In the fiscal year of 2005 they launch an experimental satellite for their final goal. LRGOU is manufacturing the VHF broadband receiver, and design a broadband antenna in VHF range. A satellite with VHF BDITF will be launched in the fiscal year of 2007. (contact: zen@comm.eng.osaka-u.ac.jp)

POLISH ACADEMY OF SCIENCES (Warsaw, Poland)

The atmospheric electricity research group at the Institute of Geophysics P. A. Sci. is focusing its current research investigations on: 1) observations and studies of thunderstorm

lightning activity in the 100×100 km area surrounding Warsaw (Piotr Baranski: baranski@igf.edu.pl) and 2) continuous measurements of electrical and meteorological elements during fair weather periods at Swider Geophysical Observatory and polar station Hornsund, Spitsbergen, and examination of possible response of measured atmospheric electric field to solar activity, magnetosphere and ionosphere changes (Marek Kubicki: swider@igf.edu.pl).

We performed together with the Institute of Meteorology and Water Management in Warsaw (Pawel Bodzak) a preliminary assessment of the quality of lightning detection data delivered by the SAFIR network system, which is now in operational usage by the Polish meteorological service. The partial validation procedure of lightning detection data is based on using simultaneous and independent electric field and Maxwell current measurements carried out at a the single reference station. The measurement material gathered during several thunderstorms near Warsaw in 2002 and 2004 enabled us to state that the mean detection efficiency of cloud-to-ground (c-g) discharges together with intracloud (ic) ones obtained by the SAFIR system was on the level of 67% of those which were indicated by $\pm\Delta I_M$ from the Maxwell current antenna records and on the level of 22% in the not often occurred complex discharges, i. e., the joint events of c-g and ic discharge from the same thundercloud, which are separated by the time interval less than 1s. Some discrepancies between lightning polarity given by the SAFIR system and that one which is shown by the reference measurements ranged in 2002 from 3% to 13% for c-g discriminations. For the multiple c-g discharges, with more than one return stroke (RS), the number of RS indicated by the SAFIR system and LF antenna control sensor (PAD 04) was sometimes different. In the most critical case of one flash with 7 RS during thunderstorm on 28-th May, 2002 the SAFIR system recognized it as a c-g discharge with only 1 RS. It seems that for purpose of achieving the lightning detection efficiency better than 95% by the SAFIR system some of its LF algorithm discrimination procedures should be checked and modified to provide more reliable lightning detection results.

At Swider Geophysical Observatory the electric field and vertical air–earth current and electrical conductivity recording are continued witch simultaneous observations of meteorology, radioactivity and pollution parameters (M. Kubicki, W. Kozłowski, B. Laurikainen). The concentration of the aerosol particles is now measured by the ultrafine condensation particle counter 3025A TSI co.

At the polar station Hornsund , Spitsbergen, the electric field and air earth-earth current density recordings are going on with simultaneous magnetometer, riometer and meteorological and radioactivity pollution measurements (M.Kubicki, S. Michnowski, B. Laurikainen). New sensor for electric field measurements is preliminary applied (J.Berlinski). The new air-earth current density sensor is still in a design stage (J.Drzewiecki).

The influences of solar wind on electrical element variations at the ground level at Hornsund and Swider are examined with the use of geophysical data from Hornsund and Swider, IMAGE net of magnetometer and riometer stations, and satellite data on interplanetary magnetic field of solar wind (S. Michnowski, M. Kubicki, N. Kleimeneva, S. Israelsson, N. Nikiforova).

The atmospheric electric field response to cosmic ray events of galactic and solar origin is examined (Z. Kobylinski, S. Michnowski, M. Kubicki, R. Balcer). Effects of giant magnetic storms on the Hornsund and Swider electric field recordings is analyzed (N. Nikiforova, N. Kleimenova, O. Kozyreva, M.Kubicki, S. Michnowski).

SPACE SCIENCE AND TECHNOLOGY DEPARTMENT – RUTHERFORD APPLETON LABORATORY (Oxfordshire, UK)

Karen Aplin (k.l.aplin@rl.ac.uk)

The infra-red properties of atmospheric small ions may have a role in the energy balance of the atmosphere. To investigate this, infra-red absorption of atmospheric small ions is being studied at the UK Natural Environment Research Council (NERC) Molecular Spectroscopy Facility, located at RAL. A corona source is being employed to enhance background ion concentrations: these are measured with a Programmable Ion Mobility Spectrometer (PIMS), operated simultaneously with a Fourier transform infra-red spectrometer. Helen Brown has written software in Labview which both controls the PIMS and plots the ion concentrations found in real-time. Dr Robert McPheat's Fourier transform spectrometer measurements and analysis have indicated the presence of two infra-red absorption bands between 9-13 μm, in the presence of enhanced ion concentrations. In a forthcoming paper, (J. Atmos. Solar-Terrestrial Physics), the magnitude of and possible mechanisms for the observed absorption are discussed. Further laboratory work is underway to quantify the sensitivity of the absorption to the ion concentration and mobility spectrum.

Coincidence detectors to measure cosmic ray ionisation rates are under development jointly with The University of Reading. A solar powered, coincidence-based cosmic ray detection system using two Geiger counters, with a coincidence circuit developed by John Firth, will soon be installed at the Snowdon Summit Weather Station to measure ionisation rates there continuously. In conjunction with the existing radiative instrumentation, this will provide more information on the absorption properties of atmospheric ions at 8-50 μm in the cloud-free atmosphere.

In a separate study, atmospheric cosmic ray ionisation rates have been found to be closely linked to meteorological and dynamical processes. Work currently underway in collaboration with the University of Reading's Department of Meteorology, and presented at the Paris COSPAR meeting, has illustrated that the pressure correction usually applied to surface neutron count rates is not always adequate.

THE UNIVERSITY OF MANCHESTER (Manchester, UK)

The Atmospheric Physics Research Group in UMIST, Manchester, UK has transferred to the School of Earth, Atmospheric and Environmental Sciences in The University of Manchester. This follows the dissolution of both UMIST and The Victoria University of Manchester to form a new University. Extensive new laboratories are under construction and will include a new temperature controlled cloud chamber facility to replace the four cold rooms we have at present.

Meanwhile research continues in the existing laboratories into the electrification of thunderstorms via the graupel/ice-crystal collisional charging process.

Our results presented at the ICAE Conference in Versailles in 2003 showed that the sign of graupel charging is sensitive to the details of the mixing process between a cloud of ice crystals and a separate supercooled droplet cloud just before the particles collide with a rimed

target simulating a soft hail stone. The exact position of the "charge-sign reversal" line on a plot of Effective Liquid Water Content (EW) versus Temperature has long been a contentious issue. It is now possible, by careful control of the cloud particle growth conditions to obtain graupel charge sign reversal, at say -15°C, at specific values of EW in the range 0.5 to 3.5 g m^{-3}. The cloud conditions and experimental details responsible for a particular result simulate the equivalent situation in clouds. We now need even more detailed information concerning the supersaturation in clouds and the growth conditions of the ice particles involved in cloud particle collisions in order to best relate the laboratory work to the natural environment. A paper on this research is in preparation.

Collaboration with Rumjana Mitzeva of Sofia University continues - her model of the surface growth conditions on a riming graupel pellet is crucial to our understanding of the reasons why graupel may charge positively or negatively depending on ice crystal conditions, droplet accretion rates and temperature. Our paper on this topic presented at Versailles is to appear in the conference issue of Atmospheric Research.

Following the visits of Eldo Avila and Negui Castellano to UMIST and of Clive Saunders to Cordoba, Argentina, analysis of charge transfer data obtained in joint experiments in the UMIST cold room has led to the possibility that there is a new size dependent factor in ice/ice charge transfer. Graupel colliding with large ice particles or aggregates may tend to charge the graupel positively - a paper on this work is about to appear in Geophysical Research Letters. However, more work is needed to understand the cloud conditions and the processes involved.

Aircraft observations of ice crystal size and habit distributions in cirrus outflow from deep convection at several geographic locations are reported from the Emerald Project. In situ measurements were made in the outflow from maritime thunderstorms near Kwajalein, in the Marshall Islands and of more continental aerosol type thunderstorms both in the United States and near Darwin, Australia over the Tiwi Islands. The Cloud Particle Imager showed chain aggregates of small ice crystals in the outflow regions of continental storms that were typically highly electrified, displaying lightning, but not in the outflow regions of less electrically active maritime storms. There is a striking similarity between these images and those obtained in the UMIST cloud chamber in laboratory measurements of ice aggregation in electric fields. Chain aggregates of ice crystals may be common in fully glaciated regions of continental thunderstorms where ice particle number densities are high and the electric field promotes aggregation. It is not confirmed where in the storm the aggregates were typically formed, however in the Darwin thunderstorms they were noted to occur with the highest frequency towards the cirrus outflow base when the cirrus base was high, and generally decreased in frequency with increasing distance from the storm. A paper is to come out shortly in the Quarterly Journal.

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THE UNIVERSITY OF READING (Reading, UK)

Giles Harrison (r.g.harrison@reading.ac.uk)

Experimental studies of surface ion-aerosol physics undertaken as part of the Natural Environment Research Council's Polluted Troposphere project are continuing (Anna Willson and Dr Richard Wilding). Measurements of background ion production and small ion concentrations have been made at field sites in the UK, using a combination of Geiger-Müller tubes and the University of Reading's Programmable Ion Mobility Spectrometers (PIMS), including an instrument deployment in the UK's Tropospheric Organic Chemistry Experiment (TORCH) consortium.

Alec Bennett has begun work on the global circuit, initially studying the classical data on the global thunderstorm climatology. This variation is being compared with the Carnegie curve, to assess non-thunderstorm sources of diurnal variation in the atmospheric potential gradient.

Work continues on long term (century) timescale changes in the surface atmospheric electrical data: this is now being extended to examine early European electrical studies in the lower troposphere.

An inexpensive digital data acquisition system has been developed to allow atmospheric electrical sensors to be carried on Vaisala RS80 meteorological radiosondes.

UNIVERSITE PAUL SABATIER - LABORATOIRE D'AEROLOGIE, (Toulouse, France)

The group "Atmospheric Electricity" is involved in the Research Training Network "Coupling of Atmospheric Layers" project (http://www.dsri.dk/cal/) and especially in the Working Program "Cloud Electrification and Meteorology" (WP5). During the 2003 campaign, a large number of Sprites were observed. During the event of 23 July, 13 TLEs were observed between 2111 UT and 0033 UT in the area covered by the Safir system located in the South-East of France. Furthermore, the convective system have been analysed with the meteorological radar data, Meteosat satellite observations, and Cloud to Ground (CG) lightning activity detected by the French network Météorage. All of these sprites, except one, could be associated to a positive cloud-to-ground flash, which confirms the results of other studies, i.e. the vast majority of sprites seem to be triggered by +CGs. They occurred in two storm systems and in a relatively small portion of them. The sprite-associated +CGs tended to form tight clusters in a small area. The sprite-associated +CGs were located outside the dissipating high-reflectivity core in the stratiform region of the storm system (often several tens of km from the center of the storm). The satellite images showed that sprites seem to occur only in regions with cold (high) cloud tops, cloud tops in the vicinity of the tropopause. The associated +CGs had also a clear tendency to be found within or close to this region. The temporal repartition of the sprites does not appear to be random. Once the sprite production started, sprites had a tendency to occur fairly regularly with a few minutes interval, as if, at certain precise moments of the storm, favourable conditions for the sprite process were present. On the other hand, the sprite production started in a late stage of the

two storm areas distinguished for this event, when the –CG activity as well as the IC activity was rapidly falling, but when the +CG activity remained stable or even increased slightly. This observation corresponds also with previous works. The intracloud detecting system SAFIR shows in most cases the presence of intense intra-cloud (IC) activity either in the second before or the second after the sprite, or both. For one case of sprite, no CG flash was detected at that moment. This study is developed with more cases studies by Oscar Van der Velde (vdvo@aero.obs-mip.fr) and Serge Soula (sous@aero.obs-mip.fr).

A systematic study of total lightning activity of several hailstorms cases has been conducted to better establish the feature of this type of storms (Marie-Pierre Boussaton (boum@aero.obs-mip.fr) Serge Soula and Sylvain Coquillat (coqs@aero.obs-mip.fr)). This study is thus devoted to cases of storms with a specific care for the microphysics. It comprises two parts, one with complete analysis of severe storms occurring in South Western France and the other with a statistical study about hailstorms observed in Ile de France region during the 2000 summer. In each case the total lightning can be considered thanks to both systems of detection Météorage and Safir operating in both areas. In the case study, the location and the rates of lightning flashes can be described in relation with a 10-cm radar and IR images from the Meteosat satellite. In the statistical study, the lightning rates are considered versus the proportion of hail in the cloud system. The main statistical result is the higher proportion of hail the lower lightning flash rates. Numerical simulations from MESO-NH are performed in order to analyze the microphysics associated with some cases of thunderstorms (Jean-Pierre Pinty pinjp@aero.obs-mip.fr).

UNIVERSITE DE LA POLYNESIE FRANÇAISE – LABORATOIRE TERRE-OCEAN (French Polynesia)

Tahiti is a circular mountainous island with a 30km diameter and culminating at 2200m and roughly located at 17°30S and 210°W. For 7 years the lightning activity has been evaluated by means of 3 CIGRE counters in an area surrounding the island. These counters detect the lightning discharges with a 2-10kHz bandwidth filter. A mean value of 84 thunder days per year has been detected. This relative high lightning activity added to the particular topology of the island (high relief inside a large ocean area) makes an investigation on lightning interesting for my laboratory. Furthermore, despite elaborated protections, the local electric company *Electricité De Tahiti* (EDT) has serious troubles with lightning strikes inside the island. That is why they have offered a financial support to improve the study of the local lightning activity.

In 2001, a detector using a direction finding antenna (Boltek Storm Tracker) was installed at the university. It was first chosen for its low cost and its easy installation. Connected to a PC, the system provides the azimuth of the lightning discharge and evaluates the distance of the event detected. A software plots the data on a selected map. The efficacy of the system has been tested for one season and, globally, the detection is coherent with visual observations and satellite images. Coherent but not accurate enough to make the study more precise. The second advantage of the Storm tracker is that the drivers of the PC card are available on the Boltek website. Thus, the data recorded by the detector can be read on the PC card. The exploitable data consist in the azimuth and the date which can be on the PC card every 10 ms. The idea was to connect three detectors through a network and to proceed to a triangulation. EDT has put at our disposal its own communication network and the triangulation is now achieved in real time. The global

system is called LIFT (Localisation des Impacts Foudre à Tahiti). We expect to have an area of correct detection of about 200 km in diameter.

To check the effect of these corrections we compare the LIFT data to the LIS data and to the WWLL data. The WWLL network is an international network of lightning location sensors at VLF (3-30 kHz). Among the large amount of data recorded by the 3 Boltek detectors very few have led to a coherent triangulation. Nevertheless, various corrections have been applied to the original data and some of them lead to a satisfying result. The comparison of the localization of each event allows to correct the azimuth given by each Boltek detector. A constant correction factor is not suitable enough but a correction function depending upon the azimuth seems to be more adapted. Another kind of correction has been applied by considering a tortuous trajectory of the lightning channel. This last correction considerably increases the amount of triangulating data and leads to a clear improvement of the localization too. At last, we think that a mixed correction function will be the best solution.

From a physical point of view we expect a fine investigation to be led in the lightning contrast between ocean and land, clarifying the effect of the relief. From a practical point of view, LIFT with corrected data has allowed an alarm criterion to be established in order to foresee heavy storms which are a hazard for exposed high voltage line transmissions (90kV). From February to July, about 20 severe storms were electrically active in the critical area and the power transmission was interrupted twice. The alarm tested a posteriori should have been activated three times including the two real cases with 20 and 10 minutes anticipations. At last, a calibrated capacitive probe provided by ONERA (Office National des Etudes et Recherches de l'Aérospatial) has been recently installed. The integrated signal and the localization of the CG flashes allow the current characteristics to be studied.

UNIVERSITY OF FLORIDA (Gainesville, Florida, USA)

A total of 5 lightning flashes were initiated from June 23 to July 24, 2004 in a hurricane-shortened season at the International Center for Lightning Research and Testing (ICLRT) at Camp Blanding, Florida. Of these 5, 3 contained leader/return stroke sequences (a total of 13) and 2 were composed of the initial stage only. All five flashes were triggered using the tower launcher and effectively transported negative charge to ground. Return-stroke peak currents ranged from approximately 3 kA to approximately 17 kA. One of the flashes without leader/return stroke sequences exhibited a current pulse (superimposed on the initial-stage current) whose peak was about 9 kA and whose half-peak width was of the order of 100 microseconds. Additionally, 9 natural negative lightning discharges that terminated on site or in its immediate vicinity were recorded by the multiple-station electric and magnetic field measuring network and by the Florida Institute of Technology x-ray detection array.

Vinod Jayakumar defended his Masters thesis titled “Estimation of Power, Energy, and Action Integral in Rocket-Triggered Lightning”.

Rob Olsen, Doug Jordan, Vlad Rakov, Martin Uman, and Nicky Grimes authored a paper titled “Observed one-dimensional return stroke propagation speeds in the bottom 170 m of a rocket-triggered lightning channel”. The return-stroke propagation speeds of five strokes from a seven-stroke triggered lightning flash are measured, with a 2-ns sampling interval, using a vertical array of photodiodes. Various methods for determining the reference point to be tracked are explored, and the speed is seen to vary over nearly an order of magnitude depending on which

method is chosen. The speeds are generally in agreement with the values found in the literature. The return-stroke speed appears to first increase with height and then to decrease with height in four of the five strokes examined. The paper is published in the GRL.

Vlad Rakov authored a review paper titled "Initiation of Lightning in Thunderclouds". The maximum electric fields typically measured in thunderclouds are reviewed, and implications these measurements have for lightning initiation are discussed. Initial breakdown processes in both cloud-to-ground and cloud discharges are considered, and characteristics of associated electric and magnetic field pulses are given. Narrow bipolar pulses attributed to the so-called compact intracloud discharges and the role of runaway electrons in lightning initiation are discussed. The paper is published in the Recent Res. Devel. Geophysics.

UNIVERSITY OF NEW YORK, DEPARTMENT OF EARTH AND ATMOSPHERIC SCIENCES (ALBANY, USA)

For several years we have done studies of tropical cyclones using cloud-to-ground lightning location data from the NLDN. The nearly continuous time and space coverage of ground flashes from the NLDN is a tremendous advantage for such studies. We use the lightning data in two ways: to make composites that give us insight into the convective structure of tropical cyclones as a function of various parameters; and in a case study mode as a means of identifying intense outbreaks of convection in forming tropical cyclones.

An example of the former is by Corbosiero and Molinari (Corbosiero, K., and J. Molinari, 2003: The relationship between storm motion, vertical wind shear, and convective asymmetries in tropical cyclones. *Journal of the Atmospheric Sciences*, **60**, 366-376). We composited lightning locations with respect to tropical cyclone centers, oriented with respect to the tropospheric vertical wind shear vector. These results showed that the azimuthal distribution of lightning-producing convection in tropical cyclones was enormously influenced by the vertical wind shear, and much less so by asymmetries associated with storm motion. These results held over land and over water, and for all intensities of storm from depression to hurricane.

An example of the latter is the paper by Molinari et al. (2004 Journal of the Atmospheric Sciences). In this we showed the influence of an intense downshear cell in a tropical depression. The cell was identified by its lightning signature, which was stronger than any we have found over water in 16 years of flash data. We provided evidence that the downshear cell became the new center of the storm, which became a hurricane shortly afterward. Because hurricanes form over water where little conventional data are available, the lightning data provide an outstanding tool to identify intense cells in developing storms. In future studies we will be trying to understand the mechanisms of formation with the help of the ground flash data. A second paper on this topic has been accepted by Journal of the Atmospheric Sciences (Molinari et al. 2005).

UNIVERSITY OF ULM, DEPARTMENT OF BIOMATERIALS, CENTRAL INSTITUTE OF BIOMEDICAL ENGINEERING (Ulm, Germany)

The analysis of the prior-to-contact charge transfer between ice crystal and graupel pellet, a model based on a curvature asymmetry between the ascending ice crystal and falling graupel pellet and on nanoscale water layers as charge reservoirs (Sommer A. P. and Levin Z. Atmos.

Res. 58, 129, 2001) was developed further. One year after its introduction, the model was extended and applied to analyze the effect of solid nanoscale aerosols on the transfer of charge (Aerosol Induced Lightning Activation in Thunderclouds, Sommer, A. P. Langmuir, 18, 5040, 2002). Our model was mentioned in two sources (Nelson J. and Baker M. Atmos. Chem. Phys. 3, 1237, 2003; Jungwirth P., Rosenfeld D. and Buch V., ICAE 2003). At present I am working on models targeting to kill bacteria by the use of laser light (using intensities of the order of the solar constant). I am also involved in projects exploiting the effect of laser light intensities of the same order on water layers contained in nanoscale cavities. These areas are some central parts of my field of work and have a significant crossover with thundercloud electrification processes. I discovered that whenever we go down to the nanoscale, knowledge from the cloud physics side can considerably enrich our understanding of processes affecting nanoparticles circulating in the blood – and vice versa. I have published results of laboratory experiments with relevance to cloud physics in journals which get only a marginal attention in the atmospheric electricity community, e.g., Journal of Proteome Research, Crystal Growth & Design, or NanoLetters. In two recent papers (Sommer A. P. and Franke R. P. Modulating the Profile of Nanoscopic Water Films with Low Level Laser Light, NanoLetters, 3, 19, 2003; and Sommer, A. P. Controlling Arrangement of 60 nm Nanospheres in Evaporating Sessile Drops with Low Level Laser Light, Crystal Growth & Design, in print), I showed that light intensities of the order of solar constant can cause a transient depletion of nanoscopic water layers attached to surfaces, and delay of the evaporation of a water drop from a hydrophobic substrate. Both results are supposed to have an immediate impact on the cloud electrification models, in particular when they are seen in a combination with the transfer of charge between hydrometeors differing in curvature. (Andrei P. Sommer, samoan@gmx.net).

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