photo: Serge Soula, Marie-Galante, Guadeloupe, France.

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.nsstc.uah.edu/

thanks to Monte Bateman's help.

Contributions to the next issue of this Newsletter (November 2006) will be welcome and should be submitted to Serge Soula or Pierre Laroche before November 15, 2006, preferably under word attached documents. A reminder will be sent to all colleagues whose e-mail addresses are presently listed.

ANNOUNCEMENTS

AWARDS

At the January 2006 annual meeting of the AMS in Atlanta, **Richard Orville** (Texas A&M University) received the Award for Outstanding Contribution to the Advance of Applied Meteorology, American Meteorological Society, "For distinguished scientific contributions which have greatly improved our understanding of the phenomenology and climatology of the lightning discharge."

CONFERENCES

INTERNATIONAL LIS SCIENCE TEAM MEETING ANNOUNCEMENT

Last year the NASA Tropical Rainfall Measuring Mission (TRMM) was granted an extension of mission operations through 2009. Hence, the Lightning Imaging Sensor (LIS) on TRMM will continue collecting valuable lightning observations from space for several more years. Presently, the LIS science team proudly celebrates 11 years of successful data collecting (the 1st solar cycle!). This dataset is currently being reprocessed to continue providing LIS data users world-wide the best possible lightning data products. To celebrate the 11 years of data collection, to review and appreciate the benefits afforded by LIS science, and to actively discuss and facilitate future scientific collaborations involving LIS data, the LIS science team is hosting an international workshop on **September 11-14, 2006** at the National Space Science & Technology Center (NSSTC) in Huntsville, Alabama. The contact for this Workshop is the LIS Principal Investigator, Dr. Hugh Christian, at email: Hugh.Christian@nasa.gov.

2006 EPSC (EUROPEAN PLANETARY SCIENCE CONGRESS)

This Congress will be held at the ESTREL Convention Center in Berlin, Germany, on **18 – 22 September 2006**.

The website of the congress : http://meetings.copernicus.org/epsc2006/

This is the first European Planetary Science Congress. It is intended to provide an attractive platform to exchange and present results, develop new ideas and to network the planetary science community in Europe. It will have a distinctively interactive style, with a mix of talks, workshops, panels and posters, intended to provide a stimulating environment for the community to meet. The meeting will be particularly timely, and will allow the community to see the first Venus Express results, as well as to meet and discuss the many opportunities for upcoming missions, particularly in the Cosmic Vision context. There has been a strong response to the call for session proposals covering a broad area of science topics related to planetary science, and it is now clear that this will be a very well attended meeting. We anticipate very many high quality presentations, and the format should enable everyone to find a good audience. Presenters are now invited to submit their abstracts by 14 Jun 2006. The website will allow you to rioritise between oral, workshop, panel and poster presentations. Please note that we need abstracts whatever format of presentation you are proposing, in order to plan the sessions effectively.

This Congress includes sessions on Atmospheres and Oceans

Deadlines:

- Call for abstracts 4 May - 14. June

- Pre-registration TBD

NEXT GENERATION STORM PENETRATING AIRCRAFT WORKSHOP

The National Science Foundation and South Dakota School of Mines & Technology T-28, Storm Penetrating Aircraft retired from active service in 2005. Its last mission was to measure lightning-produced NO in the cores of Oklahoma thunderstorms in the summer of 2003. For the last 20 years, the T-28 was active in many field projects focusing on thunderstorm electrification. Its retirement leaves a significant hole in observational capabilities in this area.

Pending a positive funding decision, the NSF and SDSM&T will convene a workshop in Rapid City, SD to consider the Next-Generation Storm Penetrating Aircraft (NGSPA) to replace and expand the capabilities of the T-28. The tentative dates for the workshop are **23-25 October 2006**, with the workshop starting and ending at noon on the respective days. The most likely candidate for the NGSPA is the Fairchild A-10 twin engine jet. The A-10 would present much higher altitude capabilities,(~40 kft), payload capacity (~4000 lbs), and on-station time (3-4 hours depending on distance to target).

The purpose of the workshop will be to bring a diverse group of interests from many areas of the atmospheric and related sciences together to discuss the utility of the NGSPA to further research in these areas. The result of the workshop will be a report to NSF outlining uses, proposed experimental objectives, and necessary instrumentation for such experiments. This report will help the NSF decide whether to dedicate resources to support the acquisition and modification of an aircraft, such as the A-10, to function as the NGSPA.

Given the important role that the T-28 filled in the area of thunderstorm electrification, it is important for the Atmospheric Electricity community to support the development of the NGSPA. If you are interested in seeing the NGSPA come to fruition, please plan to attend the workshop and participate in developing the material for the report (pending a positive funding decision, partial travel support may be available). If you can not attend, but wish to contribute to the content of the report, please contact John Helsdon (john.helsdon@sdsmt.edu) with ideas related to how you would envision using the NGSPA for research in atmospheric science, in general, or atmospheric electricity, in particular. Once the workshop funding is decided, more details will be forthcoming.

2006 AGU FALL MEETING

The fall meeting of AGU will be held on **11-15 December 2006**, at the Moscone Center West, 800 Howard Street, San Francisco. (**http://www.agu.org/meetings/fm06/**)

The deadline to propose **sessions** for the section AE (Atmospheric and Space Electricity) is : **8 June, 2006**.

The chairman of the section AE is Victor Pasko :

Victor P. Pasko, Department of Electrical Engineering, Communications and Space Sciences Laboratory, Pennsylvania State University, 211B Electrical Engineering East, University Park, PA 16802-2706, USA; Phone: +1-814-865-3467; Fax: +1-814-865-7065; E-mail: vpasko@psu.edu

2ND CONFERENCE ON THE METEOROLOGICAL APPLICATIONS OF LIGHTNING DATA

UAH (Walt Petersen) served as Chair of the 2nd Conference on Meteorological Applications of Lightning Data which was held earlier this year during the American Meteorological Society (AMS) Annual Meeting in Atlanta January 29 – February 2. The 2nd conference proved to be a great success, and had more attendees than the 1st conference held last year in San Diego. The next conference will be held during the 2008 AMS Annual Meeting in New Orleans.

ICLP 2006

The 28th ICLP (International Conference on Lightning Protection) will be held in Kanazawa, Japan, 18-22 September 2006.

The program is available on the website : http://www.iclp2006.net/
It includes presentations on the following topics :
1. Lightning Discharge 2. Lightning Occurrence Characteristics 3. Lightning Electromagnetic Impulse (LEMP) and Lightning-Induced Effects 4. Lightning Attachment 5. Lightning Downconductors and Earthing 6. Lightning Protection of Power Systems 7. Lightning Protection of Electronic Systems 8. Lightning Deleterious Effects 9. Practical and Specific Lightning Protection Problems 10. Lightning Protection and Lightning Testing Standards 11. Lightning protection of Wind Mills

13TH INTERNATIONAL CONFERENCE ON ATMOSPHERIC ELECTRICITY

We would like to remind you that the abstract submitting for ICAE2007 will start from **July 1 until November 1, 2006**. For more information, please visit the Web of ICAE2007 : (http://www.casnw.net/icae2007/).
Here is the announcement of the Conference :

August 13-17, 2007 in Beijing, China

On behalf of the International Commission on Atmospheric Electricity (ICAE), we are honored to announce that the 13th International Conference on Atmospheric Electricity (13th ICAE) will be held in Beijing, China on August 13-17, 2007. Your interest and participation in the conference are extremely appreciated.

The Conference will be a unique opportunity to present and discuss the newest results and to assess the most relevant issues in atmospheric electricity and lightning physics. Young scientists are especially encouraged to attend the meeting and present the results of their research. The registration fee may be reduced for students and young scientists.

Most of the topics related to electricity in the atmosphere will be covered:

- Global circuit
- Ion and fair weather electricity
- Thunderstorm electrification
- Lightning physics
- Lightning and Meteorology - operational application and basic research
- Lightning and climate change
- Lightning discharge and atmospheric chemistry
- Electrical effects of thunderstorms on the middle and upper atmosphere
- Lightning detection technology
- Lightning protection and safety

Abstract submission will start on 1st July 2006. The overall information on the Conference will be available on the website of International Commission on Atmospheric Electricity (http://www.atmospheric-electricity.org) in December 2005.

Xiushu Qie — President of 13th ICAE
Pierre Laroche — President of ICAE

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INTERNATIONAL CONFERENCE ON LIGHTNING AND STATIC ELECTRICITY 2007 - (ICOLSE 2007)

The **ICOLSE 2007** will be held at Université Pierre et Marie Curie in Paris, France, from **28-31 August 2007**.
This Conference will be concerned with all aspects of lightning interaction with ground, air and sea systems and human beings.
The website of the conference is: http://www.icolse.org/

The deadline for the receipt of Abstracts by the Technical Secretariat is **31 July 2006**

IX INTERNATIONAL SYMPOSIUM ON LIGHTNING PROTECTION (SIPDA)

Prof. Alexandre Piantini, Chairman of the IX SIPDA is very pleased to announce the **Call for Papers** of the IX International Symposium on Lightning Protection - IX SIPDA – which will be held in Foz do Iguaçu, Brazil, from 26th to 30th November, 2007.

The event is organized by the Institute of Electrotechnics and Energy of the University of São Paulo - IEE/USP - with the support of the Institute of Electrical and Electronics Engineers - South Brazil Section - IEEE.

The aim of the Symposium is to present and discuss recent developments concerning lightning modeling and measurement techniques, as well as grounding and lightning protection. The main topics of the Symposium are:

1) Lightning Physics, Characteristics and Measurements
2) Lightning Detection and Location Systems
3) Lightning Protection of Substations and Transmission Lines
4) Lightning Protection of Medium and Low Voltage Distribution Lines
5) Lightning Protection of Structures and Installations
6) Lightning Protection of Electronics and Telecommunication Systems
7) Grounding
8) Lightning Electromagnetic Fields and Electromagnetic Compatibility
9) Equipment
10) Testing and Standardisation
11) Lightning-caused Accidents and Injuries

Authors are invited to submit unpublished papers in the topics listed through the website (www.iee.usp.br/sipda), according to the following time schedule:

- **Abstract submission (min. 400 and max. 600 words): 1st March 2007**
- **Notification of provisional acceptance: 30th April 2007**
- **Full paper submission: 1st July 2007**

- **Notification of final acceptance: 1st September 2007**

For further information about the Symposium, please visit the web site at: http://www.iee.usp.br/sipda or contact us through the e-mail: sipda@iee.usp.br.

RESEARCH ACTIVITY BY INSTITUTION

European COoperation in the field of Scientific and Technical Research

The COST action P18 is about the **Physic of Lightning and Its Effects**. P18 consists in 5 working group

WG1. Measurement of properties of various types of lightning discharges
WG2. Phenomenology and modelling of the processes in the lightning flash
WG3. Physics and models for the lightning attachment to objects
WG4. Inverse source problems in lightning
WG5. Mesospheric transient luminous events associated with lightning

COST P18 had held its first workshop 2-3 April 2006 in Vienna.
http://www.costp18-lightning.org

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

The last recent activities of ELAT includes: the first data of the Brazilian Lightning Network in the South of Brazil – the results were presented during the ILDC Conference in Tucson in April; the beginning of the expansion of the Brazilian Lightning Network to cover the North region of the country; the campaign to observe sprites and e-fields on balloon altitudes in the South of Brazil in January/February 2006 – evidence were found of large number of sprites associated with mesoscale convective systems over South of Brazil, Paraguai and North of Argentine; and finally the evidence that the smoke from fires in the Amazon may change the lightning characteristics in the Southeast.

COLORADO STATE UNIVERSITY - RADAR METEOROLOGY GROUP

Timothy Lang and Steve Rutledge are studying the observed 5-h evolution of an asymmetric bow-echo mesoscale convective system (MCS). Data sources include polarimetric and Doppler radars, a VHF lightning mapper, and the National Lightning Detection Network. Approximately 99% of VHF lightning sources occurred within 10 km of the convective line (CL). Charge identification within the CL revealed evolution during the first 3 h from a normal dipole (upper positive charge, UPC, near 9 km MSL/-30 °C over mid-level negative charge near 7 km/-15 °C) to a normal-polarity tripole with lower positive charge (LPC) near 6 km (-10 °C). The development of this LPC apparently was associated with graupel gaining positive charge. During the final 2 h, the UPC disappeared, leaving an inverted charge structure which was dominated by negative cloud-to-ground (CG) lightning. When the bow-echo occurred during hour 2, the cell associated with severe winds developed an inverted tripole structure and produced predominantly positive CG lightning.

Stratiform lightning was infrequent, and normally initiated in the CL and propagated rearward along two pathways: a downward-sloping upper pathway near 9 km, and a constant-altitude lower pathway near 6 km. During the final 2 h, the lower pathway was dominant. Some flashes initiated within the stratiform region during this time, when the stratiform vertical reflectivity structure was well developed. These flashes initiated near the bright band at 4 km within recently decayed convection, and revealed negative charge above and positive charge below.

INDIAN INSTITUTE OF TROPICAL METEOROLOGY (Pune-411008, India)

A study about a rain gush phenomenon observed following overhead lightning stroke at Mumbai on 26 July 2005 has been made by S.S. Kandalgaonkar, M.I.R. Tinmaker and M.K. Kulkarni.

Summary: A minute interval data of stroke density and the rainfall collected on an exceptionally heavy rainfall day at Mumbai are analyzed to examine the possibility of the occurrence of rain gush phenomenon. The study revealed that on this day the rain gush phenomenon is observed partially in accordance with the definition of the phenomenon. The phenomenon is called as partial as the second part of the phenomenon i.e. the reduction in the rainfall intensity should be noticed within few seconds from its peak intensity time, which is not observed on this day. The normal behavior of the rainfall intensity during the heavy spells is the maximum intensity remains for a short duration (i.e. minute or two) and then immediately after it decreases exponentially. The distribution observed in the present study is linear which the characteristics feature of the rainfall intensity observed on this day. Thus the behavior of the rainfall on this day started with the rain gush phenomenon but it is not ended immediately. Hence in the present study the phenomenon can be called as a prolonged rain gush phenomenon.

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)

The spatial distribution and temporal evolution of lightning flashes and precipitation structure for 10 severe hailstorms have been studied by using the ground-based CG lightning location data, Doppler radar data and standard orbit data of PR, TMI and LIS on TRMM satellite, cooperated with Institute of Atmospheric Physics, Chinese Academy of Sciences, and Shandong Research Institute of Meteorology. The results show that the percentage of +CG lightning in these hailstorms is high with an average value of 45.5%. There is a distinct increase in CG lightning rate during the rapid development stage of hailstorms. The hailstone falling corresponds to an active positive flash period, and the increase of +CG flash rate is generally accompanied with a decrease of –CG flash rate. The flash rate declines rapidly during the dissipating stage of hailstorms. The precipitation structure and lightning activity in two typical hailstorms are studied in detail. It is found that strong convective cells with reflectivity greater than 30dBZ mainly are situated in the front region of hailstorms, whereas the trailing stratiform region is in the rear part of the hailstorms. Their maximum echo top height is higher than 14 km. Convective rain contributes much more rainfall to the total than stratiform rain, and the convective rain takes about 85% and 97% of the total in the two cases, respectively. Total lightning activity in the hailstorms is very active with the flash rate up to 183 fl/min and 55 fl/min, respectively. The result also shows that most lightning flashes occurred in the echo region greater than 30dBZ and its immediate periphery. The probability of lightning occurrence is 20 times higher in convective region than in stratiform region. The result suggests that the lightning information is helpful to the identification of convective rain region. The linear relationship between flash rate and ice water content is disclosed primarily.

Five lightning discharges have been artificially triggered with the rocket-wire technique during the passage of two severe thunderstorms in the summer of 2005. The five triggered lightning discharges include 1-10 return strokes, and the average return stroke current is 11.9kA with a maximum of 21.0kA and a minimum of 6.6kA, similar to the subsequent return stroke in natural lightning. The half peak width of the current waveform is 39μs, and the rise time from 30% to 90% peak is less than 0.8μs. The return stroke current i_r(kA) and the neutralized Charge Q(C) has the relation of $I_P=18.5Q^{0.65}$. The radiation field of return stroke is 6.89kV/m and 0.39kV/m at 60m and 550m, respectively. The radiation field is decreased as $r^{-1.189}$ with the increase of horizontal distance r from the discharge channel. According to the well accepted transmission line model, the speed of return stroke is estimated to be 1.6×10^8m/s, with a variation range of $1.3\text{-}1.9\times10^8$m/s.

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

MIT has been funded by NASA hydrology to deploy the portable C-band Doppler radar in Niger, Africa for participation in the AMMA (African Monsoon and Multidisciplinary Activities). The radar has been upgraded with a new solid-state transmitter, equipped with current SIGMET software, tested at MIT Lincoln Laboratory and packed for shipment by sea. Expected arrival in Africa is the end of May.

During an exploratory trip to Niamey, Niger in April, Williams found an excellent location for the radar near the international airport. The control tower there will be used to operate a video camera (provided by Walt Lyons and Tom Nelson of FMA Research) on 'spider' lightning flashes and sprites in the large mesoscale convective systems there. Plans are also underway with Bob Boldi to have the Schumann resonance observations from Rhode Island on the internet (via a fiber optic link recently established through the woods) so that energetic transient events can be paired with lightning in Africa observed with the video camera there.

Also in preparation for AMMA and the NASA-sponsored research on tropical cyclogenesis in Africa, collaborative studies have underway with Manos Anagnostou and Themis Chronis of the University of Connecticut. The ZEUS VLF lightning network over Africa has been used to study the evolution of easterly wave disturbances (MCSs) as they cross the West African coast during the 2004 Atlantic hurricane season. We are eager to continue these observations during AMMA.

Three papers have been submitted to the Special Issue on Schumann Resonances in Radio Science, initiated and edited by Victor Pasko. One is concerned with the puzzlement about the strong lightning polarity asymmetry of sprites, one with the documentation of sprite-producing lightning in Australia from the Schumann resonance station in Rhode Island, and the third with changes in the height of the ionosphere on different time scales. Williams is also a coauthor with Gabriella Satori on a paper focused on the day-night ionosphere asymmetry, and with Phyllis Greifinger and Vadim Mushtak on refinements in the modeling of the lower dissipation height in the ionosphere in the ELF range.

Steve McNutt and Earle Williams are collaborating on an NSF-sponsored study of volcanic lightning. The working hypothesis in this study is that water substance from exploding magma is the main player in volcanic lightning, with volcanic ash playing only a secondary role. The latitudinal dependence of volcanic lightning is being explored as a test of this idea. Volcanic lightning has now been documented in about 70 volcanoes worldwide. During a recent visit to Fairbanks, AK, the recent episodes of lightning (Jan 13 and 28) in the Augustine volcano, documented on the 28th in the VHF by Paul Krehbiel, Ron Thomas and Bill Rison at New Mexico Tech, were examined in some detail. These same Augustine eruptions were detected with DoD satellite assets.

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

(a) Geostationary Lightning Mapper

NASA-MSFC (Rich Blakeslee, Dennis Boccippio, Steve Goodman, William Koshak) is providing technical consultation and support for the Geostationary Operational Environmental Satellite (GOES) Project Office for the Geostationary Lightning Mapper (GLM) baselined on GOES-R (2012). The GOES-R program recently awarded 1-year formulation study contracts to Ball Aerospace, ITT Industries and Lockheed Martin for GLM trade studies and concept design.

(b) DC Metro Area Lightning Mapping Array Demonstration Project

A next generation portable lightning mapping array (LMA) developed by New Mexico Tech (NMT) recently became available to other projects due to the cancellation of the VORTEX-II Experiment in 2007. At the Southern Thunder Alliance (LMA researcher/data/product producers and end user forecaster/decision making consumers) workshop in Fort Worth July 2005 there was a consesus that a demonstration network in the DC Metropolitan area would be of great interest and benefit, with the Sterling, Va Weather Forecast Office, the National Weather Service (NWS) Office of Science and Technology, and NOAA NESDIS serving as sponsors. The first four stations were installed in early May with three additional sites planned between May and July. Among the benefits and opportunities for a DC LMA demonstration are: a) LMA would provide coverage of 3 major heavily used airports, b) complex terrain to the west provides an opportunity to evaluate gaps in the radar network that can be augmented by total lightning measurements, and c) experimental lightning forecasts and warnings can be developed and evaluated to determine the benefit for a major metropolitan region.

(c) Personnel Announcements

Themis Chronis (University of Connecticut-Storrs) will be arriving in Huntsville this June for 1-2 years under the NASA Postdoctoral Program. NSSTC/UAH Lightning Group Ph.D. students Major Michael Gauthier and Ms. Wiebke Deierling (Walt Petersen, UAH Thesis Advisor) will be defending their Ph.D. Dissertations at the end of May and early June, respectively. Ms. Deierling has been examining the ice-flux hypothesis of Baker, Latham and Christian, and Major Gauthier has been examining physical causes for the cloud-to-ground lightning anomaly near Houston, Texas. Several publications from both dissertations will be forthcoming. Additionally, Ms. Deierling was awarded an NCAR Advanced Studies Program Post-Doc and will begin her new position at NCAR in October.

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

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

The RAL group have increased their involvement with planetary atmospheric electricity experiments. Karen Aplin is a co-investigator on the French-led ARES (Atmospheric Relaxation and Electricity Sensor) experiment which is building a relaxation probe for the first ever atmospheric electrical measurements on Mars. She is also coordinating a Venus Entry Probe mission which is likely to include lightning and fair-weather field sensors.

Nicholas Owen and Peter Stevens from Birmingham University have now successfully completed their project work at RAL, and have predicted both positive and negative ion mobility spectra in Titan's atmosphere.

TEL AVIV UNIVERSITY (TAU), DEPARTMENT OF GEOPHYSICS AND PLANETARY SCIENCES - THE OPEN UNIVERSITY OF ISRAEL (OUI), DEPARTMENT OF LIFE AND NATURAL SCIENCES - (Tel Aviv, Israël)

The team led by **Yoav Yair** (The Open University of Israel) and **Colin Price** (Tel-Aviv University) successfully completed the 2005/6 winter-sprite campaign and detected, for the first time, sprites and ELVES near Israel. Observations were carried out either from the Tel-Aviv University campus or from the Wise Observatory near Mizpe-Ramon in southern Israel, based on the storm range and the meteorological conditions. The viewing geometry and location was decided based on satellite imagery, cloud radar and weather forecasts by **Brauch Ziv** (OUI). The observing system was based on 2 WATEC cameras (N-902 and 940), mounted on a PTU and commanded via the Internet. A real-time event detection software (UFO-Capture) enabled saving only transient optical events in un-compressed video format, to be later analyzed. The optical campaign was accompanied by measurements in the ELF and VLF range from both stations in the Negev desert (Price et al., GRL, 2004). A total of more than 30 events were detected in 6 separate storms, above thunderstorms in the eastern Mediterranean, between the Israeli coastline and Cyprus. All sprite events were associated with positive cloud-to-ground flashes, and occurred between 50 and 85 km altitude. Some of the parent flashes were located by the Israeli Electrical Company LPATS system, with the help of engineer **Evgeny Katz**. System set-up and calibration were performed by **Adam Devir** (OUI) and **David Shtivelman** (TAU). The ILAN team (Imaging of Lightning And Nocturnal flashes, open website URL: http://geophysics.tau.ac.il/personal/Ilan/) included students **Michal Ganot, Yosi Sherez, Eran Greenberg** (TAU) and **Roy Yaniv** (OUI).

Continuing analysis of space shuttle lightning data from the MEIDEX campaign (Yair et al., JGR, 2004) is being conducted by **Yoav Yair**, **Reuven Aviv**, **Baruch Ziv**, **Roy Yaniv** (OUI), **Colin Price** (TAU) and **Gilad Ravid** (BGU). Video footage of 6 storm systems with varying flash rates, over Africa, South America, Australia and the Pacific Ocean were analyzed. It is found that when the storm flash rate was high, lightning activity in horizontally remote electrically active cells became clustered, with bursts of nearly simultaneous activity separated by quiet periods. The recurrence time was ~2.5 seconds, close to the previously reported time delay between consecutive ELF transient signals in the Schumann resonance range (Füllekrug, 1995). We show that this behavior is similar to the collective dynamics of a network of weakly coupled limit-cycle oscillators (Strogatz, 2000). Thunderstorm cells embedded within a mesoscale convective system (MCS) constitute such a network, and their lightning frequency is best described in terms of phase-locking of a globally coupled array (Kourtchatov et al., 1995). Comparison of basic parameters of the lightning networks with predictions of random-graph models reveals that the networks are compatible with generalized random-graphs with a prescribed degree distribution (Newman et al., 2001) that exhibit a high clustering coefficient and small average path lengths. Such networks are capable of supporting fast response, synchronization and coherent oscillations. Several physical mechanisms are being investigated to explain the observed phenomenon.

TEXAS A&M UNIVERSITY (TAMU), DEPARTMENT OF ATMOSPHERIC SCIENCES (TEXAS, USA)

The NSF-sponsored **Texas A&M University (Richard Orville (PI) and Larry Carey (co-PI), along with Brandon Ely, Jerry Guynes, and Shane Motley)** Lightning Detection and Ranging (LDAR II) network over Houston has been operational since mid-July 2005 with at least seven sensors. By mid-August, data archival began and the number of sensors increased to the current configuration with ten operational sensors. There are two remaining sensors that will be online by the end of June 2006. Since August 2005 we have recorded lightning data from over 30 thunderstorm days and from a wide variety of convective modes (MCSs, sea-breeze storms, supercells, etc).

A real-time Houston LDAR II website has been operational for several months. The site displays the last 40 minutes of lighting activity detected by the LDAR II network on an overview map of SE Texas and also allows the user to zoom around each LDAR II sensor site. In addition we are testing a lightning advisory system that will alert customers through e-mail that lightning is approaching their area of interest. A data feed of LDAR II source density and Flash Extent Density through the LDM server should be running by June 1 giving access to the NASA Space Flight Meteorology Group at the Johnson Space Center and the League City NOAA NWS Forecast Office.

Now that the network has been operational approaching a year and accumulated an extensive amount of total lightning data, **Brandon Ely, Richard Orville and Larry Carey** in collaboration with **Martin Murphy (Vaisala)** are analyzing network performance and comparing it to other LDAR II type networks. As part of his PhD Dissertation, **Brandon Ely** plans to 1) verify that the distribution of location errors are Gaussian, 2) refine the estimate of RMS timing error, and 3) analyze the LDAR II source power distribution to verify that the distribution is similar to the Vaisala LDAR II network over Dallas, and 4) estimate the relative VHF source and flash detection efficiency of the network. Also as part of his PhD, **Brandon Ely** along with **Larry Carey,** and **Richard Orville** are conducting dual-Doppler (KHGX WSR-88D and Shared Mobile Atmospheric Research and Teaching [SMART]) radar case study analyses of many sea-breeze and air-mass convective events collected during the summer of 2005 along with the corresponding LDAR II and NLDN lightning data. Statistical analyses of relationships between the kinematic properties (e.g., updraft strength and size) and the onset of total lightning will be conducted.

Scott Steiger (Suny Oswego, TAMU) has recently submitted a two-part manuscript to Monthly Weather Review with co-authors **Richard Orville and Larry Carey**. The majority of the results came from his PhD dissertation, which he successfully defended in July 2005 at TAMU. The first manuscript is entitled "Total Lightning Signatures of Thunderstorm Intensity, Part I: Supercells" and the second, "Part II: Mesoscale Convective Systems." These studies involved total lightning data from the Dallas-Fort Worth LDAR II system and the NLDN, and WSR-88D radar data. Significant relationships between storm dynamics and lightning characteristics were found for several of the storm cell lifetimes examined. Lightning altitude (e.g., 95th percentile source height/lightning "top") was well correlated to radar measures of updraft strength (VIL, radar top) in supercells. A distinct lightning bow/comma-shape in the plan view source density was associated with severe wind reports in two squall lines that propagated over the Dallas-Fort Worth region.

Under the advisement of **Larry Carey** and **Richard Orville**, **Shane Motley** has examined the relationship between total lightning flash characteristics and the radar inferred microphysical and kinematic properties of ordinary convective cells. In collaboration with **Martin Murphy**, twenty-two ordinary thunderstorm cases were examined, with nine cases occurring within range of Vaisala's Dallas Ft-Worth LDAR II and thirteen cases occurring within range of the TAMU LDAR II network over Houston. The analyses reveal strong correlations between the vertical integral of ice water content and total flash rate suggesting rapid electrification occurs once a sufficient quantity of graupel becomes available for non-inductive charging. Cloud-to-ground (CG) flash rates displayed weaker correlations to vertically integrated ice mass suggesting that total is preferred over CG lightning observations for accurate inferences of cell intensity.

Using Vaisala's NLDN CG lightning data and severe storm reports (NOAA Storm Data), **Douglas Butts (NOAA NWS, TAMU)** and **Larry Carey** are investigating the characteristics of cloud-to-ground (CG) lightning in cool season (October thru March) tornadic events in the central and eastern (especially southeastern) United States from 1989 – 2003. As with prior analyses of warm season tornado reports, preliminary results indicate that positive CG dominant (i.e., > 50% +CG) tornadic storms do occasionally occur in the southeastern United States but still represent an overwhelming minority of total tornado events there (< 10%). A north-to-south oriented region in the central United States (i.e., western Oklahoma to Nebraska) is characterized by a high percentage (20-70%) of cool season tornadic events associated with dominant +CG lightning.

THE UNIVERSITY OF READING (Reading, UK)

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

Modern instrumentation for atmospheric electrical measurements continues to be developed at the University of Reading, including sensors for the air-earth conduction current density (Alec Bennett). A simple and inexpensive instrument for measuring the Potential Gradient and the air-earth current has been developed, based on the Wilson plate sensor. A poster on this device – the EPAC sensor - was presented in at the EGU meeting in Vienna. There is interest in its use in schools for demonstrating electrostatic phenomena, as it is easily and cheaply constructed.

Conductivity and Potential Gradient measurements at Reading are being studied in terms of local aerosol measurements (Madhavi Latha), using methods already developed to study past smoke pollution. A reconstruction of smoke pollution changes 1898-2004 has been produced using atmospheric electricity data from Kew (Giles Harrison), which shows the effects of the Clean Air legislation in the UK in the 1950s.

THE UNIVERSITY OF TEXAS (Dallas, TX, USA)

(Brian A. Tinsley)

We have made a new 3-D model of the global electric circuit for steady-state conditions, but with the cosmic ray global ionization rate distribution variable with solar activity. A detailed distribution of near-surface ion production by radioactive gases and minerals is included. The model incorporates a global 3-D distribution of several kinds of tropospheric aerosols with seasonal variations, and a stratospheric distribution of ultrafine aerosol particles near 40 km. The ultrafine particles are from sulphuric acid vapor that is downwelling in the Brewer-Dobson circulation. Very large concentrations following explosive volcanic eruptions can produce a stratospheric column resistance at higher latitudes which, under certain circumstances, can be comparable with the tropospheric column resistance.

Recent observations of vertical electric field (Ez) from Vostok, Antarctica, have been analyzed with Gary Burns of the Australian Antarctic Division. The penetration of the north-south solar wind electric field (Es) into the atmosphere in the magnetic polar cap is apparent, with a predominantly 27-day period. (Es is the product VxBy, where Vx is the radial solar wind velocity and By is the east-west interplanetary magnetic field.) The correlation of high magnetic latitude surface pressure with IMF direction (and thus Es), that was found by Mansurov et al. in 1974 and Page in 1989 for both the Arctic and Antarctic, is confirmed. A new result is that of the correlation of Vostok surface pressure with the larger amplitude day-to-day changes in the daily average Ez. (Actually, this is to be expected for consistency with the Mansurov effect). These results are consistent with a mechanism of cloud cover changes due to electrical current density effects on CCN and IFN scavenging in clouds. The day-to-day changes in Ez are presumably due to day-to day changes in thunderstorm activity in the tropical ‘chimney’ locations. The results can be thought of as the expression of a global electrical climate coupling mechanism.

We are continuing our work on modeling the effects of the current density in the global electric circuit on cloud microphysics.

UNIVERSITY OF FLORIDA (Gainesville, Florida, USA)

Experiments will continue in Summer 2006 (for the 13th 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 in conjunction with optical observations and continued studies of the energetic radiation (X-rays, gamma-rays) during natural lightning discharges using the new Thunderstorm Energetic Radiation Array (TERA), in collaboration with the Florida Institute of Technology. Additionally, measurements of electric field pulses associated with the initial breakdown in both cloud and ground discharges and coordinated photoelectric and image-converter-camera observations of various lightning processes will be performed at the University of Florida Campus in Gainesville. No major triggered-lightning experiment is planned for this summer.

Brian DeCarlo defended his Masters thesis titled “Triggered-lightning testing of the performance of grounding systems in Florida sandy soil”.

Vinod Jayakumar, Vladimir Rakov, Megumu Miki (CRIEPI, Japan), Martin Uman, George Schnetzer, and Keith Rambo authored a paper titled “Estimation of input energy in rocket-triggered lightning". Electric fields in the immediate vicinity (within 0.1 to 1.6 m) of the triggered-lightning channel were measured with Pockels sensors at the ICLRT in 2000. These fields and the associated currents measured at the base of a 2-m strike object were used to compute the input power and energy, each per unit channel length and as a function of time, associated with return strokes in rocket-triggered lightning. In doing so, the authors assumed that the vertical component of the electric field at horizontal distances of 0.1 to 1.6 m from the lightning attachment point is not much different from the longitudinal electric field inside the channel (Borovsky, 1995). The estimated mean input energy over the first 50 μs or so is between 10^3 and 10^4 J/m, consistent with predictions of gas dynamic models, but one to two orders of magnitude smaller than Krider et al.'s (1968) estimate for a natural-lightning first stroke based on the conversion of measured optical energy to total energy using energy ratios observed in laboratory long-spark experiments. The channel radius and resistance per unit channel length at the instance of peak power are estimated to be 0.32 cm and 7.5 Ω/m, respectively. The paper is published in the GRL.

Vlad Rakov authored a paper titled "Lightning Flashes Transporting Both Negative and Positive Charges to Ground". Bipolar lightning is a poorly understood and often unrecognized phenomenon. However, bipolar events constitute 6 to 14% of summer lightning flashes observed on tall objects in USA, Switzerland, and Russia and 5 to 33% of winter lightning flashes in Japan. Bipolar flashes were also reported from triggered-lightning experiments in France, Japan, New Mexico, Florida, and China. Bipolar lightning flashes can be grouped in three categories: (1) type 1 is associated with a polarity reversal during a millisecond-scale current component (such as the initial-stage current), type 2 is characterized by different polarities of the initial-stage current and of the following return stroke or strokes, and type 3 involves return strokes of opposite polarity. Bipolar flashes of types 1 and 2 are initiated from tall objects (or triggered using the rocket-and-wire technique), whereas type 3 can be either upward (type 3a) or downward (type 3b) flash. Miki et al. (2004) obtained both optical (high-speed video) and current records for types 1, 2, and 3a in their studies of winter lightning at the 200-m Fukui stack in Japan. All three types were also observed in the Gaisberg-tower studies in Austria (Schulz and Diendorfer, 2003). Jerauld et al. (2003), from observations in Florida, presented the first documented bipolar flash of type 3b (natural downward). The occurrence of bipolar lightning suggests that the cloud charged structure cannot always be described by a simple, vertically stacked charge model. It is likely that positively and negatively charged regions can exist at about the same height in the cloud, as observed by Imyanitov et al. (1971).

UNIVERSITY OF ULM, MATERIALS DIVISION, (Ulm, Germany)

Nanoparticles play today an important role in the arena of biomedical engineering and environmental sciences. In models of atmospheric electricity they play only a marginal role. Nevertheless, solid nanoscale aerosols deserve our attention here too: depending on polarity, they could participate in lightning processes, directly and indirectly. Triboelectric and contact charging between hydrophobic aerosols (e.g., fresh soot) and hydrometeors could contribute to the separation of charge in convective systems directly. Possible indirect effects consist in nucleating ice crystals that become charged, e.g., by collision with graupel pellets. One route by which solid hydrophilic nanoscale aerosols could become charged is via nucleation of ice crystals that subsequently sublimate (leaving INs charged). In a model based on laboratory experiments we simulated the triboelectric component for soot and water, and predicted the transport of charged solid aerosols to stratospheric altitudes, and even higher, by the electric fields related to transient luminous events (Sommer A.P. Electrification vs. Crystallization: Principles to Monitor Nanoaerosols in Clouds. Crystal Growth & Design 6, 749-754, 2006). The implication of charged aerosols in modeling atmospheric electrification processes seems important because of three reasons: 1. at high concentrations in clouds they may contribute to lightning, 2. attached to ice crystals they may alter collision probabilities, and 3. attached to cloud droplets they may have an impact on their coalescence probabilities. Solid nanoaerosols attached to ice particles were predicted to enhance the transfer of charge between ice particles – prior to contact (Sommer A.P. Langmuir, 18, 5040-5042, 2002 and Sommer A.P. and Levin Z. Atmospheric Research 58, 129-139, 2001). Aerosol charging in the lower atmosphere, in combination with transport by the fields generating transient luminous events, provides one explanation for the presence of a variety of viable microorganisms in the upper atmosphere, and is the simplest explanation for the presence of nanobacteria at 41 km altitude (Journal of Proteome Research 2005, 4, 180-184), indicating their terrestrial provenance. Because of the multidisciplinary nature of the research involving nanoparticles, it occurs progressively that results, which could be of interest to the atmospheric electricity community, are published in journals, which are remote from the traditional atmospheric electricity literature. C&EN, the flag journal of the American Chemical Society, has just dedicated a *Hot Article* to transient luminous events – and that they could trigger chemical processes in the atmosphere (Amato I. Chemical & Engineering News, 2006, 84, 40-41). (Andrei P. Sommer, samoan@gmx.net)

Sommer A.P. Electrification vs. Crystallization: Principles to Monitor Nanoaerosols in Clouds. Crystal Growth & Design 6, 749-754, 2006. *Hot Article* in May 2006, selected by the ACS → http://pubs3.acs.org/acs/journals/hot_article.page?in_manuscript_number=cg050427n

VAISALA, THUNDERSTORM DATA AND THUNDERSTORM SYSTEMS BUSINESS UNITS (TUCSON, AZ, USA)

From 24 to 27 April 2006, Vaisala hosted the 19th International Lightning Detection Conference (ILDC) for two days, and the 1st International Lightning Meteorology Conference (ILMC) for one and a half days in Tucson, Arizona. A total of 165 attendees were at the conference from 27 countries. There were 46 presentations at the ILDC and 28 at the ILMC. ILDC sessions focused on lightning detection network performance and validation, and their applications to utilities, human safety, protection and risk, and related atmospheric physics. ILMC topics included nowcasting with LF and total lightning data, winter and tropical lightning, climatologies and forecasting of lightning, as well as case studies and lightning data assimilation into numerical weather prediction models. The next ILDC and ILMC meetings are scheduled to be held in Beijing, China in spring 2008.

As part of Vaisala's technology and applications test bed in the Dallas-Fort Worth area in Texas, Vaisala has been operating two overlapping total lightning detection networks. The first is based on the VHF Interferometry principle and the second is based on the VHF Time-Of-Arrival principle. For the first time, these two technologies can be compared and contrasted in a common region where they both exhibit good performance. Results from an ongoing study to evaluate the performance of both of these networks for total lightning mapping was recently presented at the 19th ILDC in Tucson, AZ USA. Another paper will be presented on this topic at the upcoming International Conference on Lightning Protection in Japan in September 2006.

For additional information concerning Vaisala's lightning research activities, contact Nick.Demetriades@vaisala.com.

VERY LOW FREQUENCY RESEARCH GROUP OF THE SPACE, TELECOMMUNICATIONS AND RADIOSCIENCE (STAR) LABORATORY OF STANFORD UNIVERSITY (Stanford, CA, USA)

William Peter is modeling lightning-induced electron precipitation (LEP) events, and comparing the modeling results to experimental data acquired from the Holographic Array for Ionospheric/Lightning research (HAIL). The model simulates whistler wave propagation in the magnetosphere, the scattering of energetic particles into the loss cone, and the resulting impact of the electron precipitation on the lower atmosphere. The model can be applied to multiple types of precipitation events (i.e., transmitter-induced, lightning-induced) and is directly comparable to VLF remote sensing measurements. Hardware and software upgrades were completed on five HAIL sites within the last six months, with seven sites across the continental United States currently in operation.

In the summer of 2005, Robert Marshall conducted sprite observations at Langmuir Laboratory, New Mexico, using a high-speed intensified telescopic imaging system with frames rates up to 10,000 frames-per-second, improving on the 1000 fps system used in 2004. At the same time, the 2004 measurements of streamers and beads at 1000 and 2000 fps have been analyzed in greater detail and statistics have been established.

Stanford's VLF receivers at Nancay, France and Heraklion, Crete continue to be productive. Data from these sites has been used to establish the relationship between elves and early/fast events (Mika et al, in press). Furthermore, our VLF receiver at South Pole Station has recently been upgraded and is now continuously recording.

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