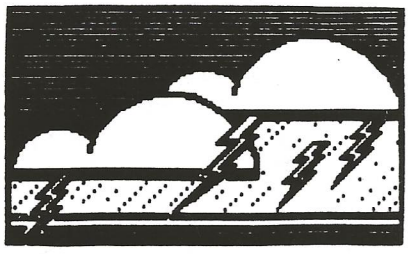
NEWSLETTER ON ATMOSPHERIC ELECTRICITY



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AMS COMMITTEE ON ATMOSPHERIC ELECTRICITY

AGU COMMITTEE ON ATMOSPHERIC AND SPACE ELECTRICITY

INTERNATIONAL COMMISSION ON ATMOS. ELECTRICITY

ANNOUNCEMENTS

FUTURE NEWSLETTER CONTRIBUTIONS: Two issues of this Newsletter are issued each year, in November and May. In efforts to save the expense of this mailing (now to approximately 440 recipients), we are requesting contributions for the fall Newsletter to be received by **October 31, 1994** (Halloween). If you missed the deadline for this issue, you are probably not reading the Newsletter Announcements. MARK YOUR CALENDARS NOW!

1994 INTERNATIONAL AEROSPACE AND GROUND CONFERENCE ON LIGHTNING AND STATIC ELECTRICITY (May 24-27, 1994, Mannheim, Germany; Conference Chairman, Prof. Dr. J. L. ter Haseborg)

CONFERENCE UPDATE (Richard T. Hasbrouck, P.E., Chairman, Lightning Safety Session, Lawrence Livermore National Laboratory, P.O. Box 808, L-154, Livermore, CA 94551)

Today, I spoke with Dominique Serafin - the EUROEM 94 chairman - who reported that planning and responses are going very well. Five, parallel, papers sessions will be required for presenting the 300 papers that have been accepted - approximately 100 are from the USA, 60 from Russia, 40 from Ukraine, plus others from Western and Eastern European countries, Japan and Australia. In addition, there will be poster sessions, and a number of major manufacturers will be exhibiting. Indications are that the number of attendees will be around 1,000. Additional information, including hotels, was to be mailed out in February. Please contact Richard Hasbrouck if you have any questions.

REQUEST FOR INPUT ON ATMOSPHERIC ELECTRODYNAMICS: Gar Bering requests input for a review article he is preparing on fair weather atmospheric electrodynamics (see University of Houston section below).

PROPOSED COLORADO FIELD STUDY: A field project is being planned for the summer of 1996 in the Greeley, CO region to investigate the electrical development of large, hail-bearing clouds. Preliminary plans call for measurements to be made by the CSU-CHILL radar, the SDSMT T-28, and possibly the NCAR Sailplane. One of the focuses of the proposed project will be to investigate the physics and meteorology behind the apparent tendency of hail-bearing storms to produce predominantly positive cloud-to-ground lightning. Many other aspects of thunderstorm electrification can be studied in such a project. John Helsdon and Andy Detwiler of the South Dakota School of Mines and Technology are working to organize this project and are seeking collaborators with additional instrumentation (balloons, interferometers, aircraft, radars, etc.) and ideas for investigation. If you would be interested in participating in such a project, please contact either John

(**jhelsdon@lightning.ias.sdsmt.edu**) or Andy (**andy@nimbus.ias.sdsmt.edu**) at **(605) 394-2291** or write to:

Institute of Atmospheric Sciences
South Dakota School of Mines & Technology
501 E. St. Joseph St.
Rapid City, SD 57701-3995

If sufficient interest exists, we will organize a preliminary planning meeting, possibly at the Fall AGU Meeting.

URSI MEETING: An open URSI Working Group Meeting on Extraterrestrial and Terrestrial Meteorological-Electrical Environment With Noise and Chaos, was be held on 13-14 May, 1994, in Tokyo, Japan. The workshop chairman was H. Kikuchi and the co-chairman was M. Hayakawa.

REQUESTS FOR LIGHTNING DATA SETS: Investigators at NASA Marshall Space Flight Center are interested in any lightning data sets that could contribute to a global lightning climatology (e.g., regional lightning detection networks, etc.). Any groups with such data sets are encouraged to contact S. Goodman (ph: 205-544-1683; fax: 205-544-5760; e-mail: hchristian@ nasamail.nasa.gov). The address for both is ES41, NASA/MSFC, Huntsville AL 35812.

AGU CASE NEWS: As you read last November, each issue of the Newsletter on Atmospheric Electricity (AE) now contains a section devoted to the AGU Committee on Atmospheric and Space Electricity (CASE). The mailing list has also been expanded to include scientists interested in the middle atmosphere and, more generally, in any electrical interactions between the lower and upper atmosphere. Consequently, the AGU has agreed to share the mailing costs. If you know of any interested individuals who are not currently receiving this newsletter, please send names and addresses to:

Earle R. Williams, Room 54-1818
Department of Earth, Atmospheric, and Planetary Sciences
Massachusetts Institute of Technology
Cambridge, MA 02139
Phone: 617-253-2459; Fax: 617-253-6208

In the next issue of this newsletter, to be distributed prior to the Fall Annual Meeting of the AGU, look for a tentative agenda of the upcoming CASE meeting. One topic has already been suggested: The nature of the above-thunderstorm electrical discharges of current AE research interest is unknown; they might have a major impact on upper-atmospheric chemistry and electromagnetics; thus they constitute an essential area of lower/upper atmospheric collaboration. Other topics for the CASE meeting are hereby solicited. You will also recall from the last issue that a listing of new AE and Middle-Atmosphere databases will be printed in these pages each Fall. Please send your input on both of these subjects **as soon as possible, but not later than September 30, 1994**, to:

John C. Willett, PL/GPAA
29 Randolph Rd
Hanscom AFB, MA 01731-3010
Phone: 617-377-5954; E-mail: willett@zircon.plh.af.mil

The Annual Case Database Listing is intended to be a concise directory to new atmospheric/space electricity data sets of general interest, organized by category rather than by

researcher, to facilitate interdisciplinary awareness of, and collaboration with, existing data. The idea is to devote two or three lines to each such data set, indicating at least the following:

(1) parameters measured,
(2) amount of data,
(3) periods covered,
(4) principal investigator, and
(5) a telephone number and/or E-mail address for more information.

Note that the usefulness of this listing depends on you! The responses received during the next four months will determine its viability. **Please send summaries of all new data sets to John Willett, preferably by E-mail, ASAP.**

The main function of this Spring edition of the AGU CASE News is to summarize the last Committee meeting, which was held at 8:00 PM on December 9, 1993, at the Cathedral Hill Hotel in San Francisco. At least 40 people attended (with some 24 from AS and 10 from SPA), including 8 of the 14 CASE members. The following topics were discussed:

1) Martin Uman reported on the prospects for future rocket-triggered-lightning experiments at Camp Blanding in Florida. Triggering now appears certain this summer and will likely continue in the future. There will probably be opportunities to piggy-back experiments. For more information contact Martin Uman (904-392-0913).

2) Dennis Buichler reported on the upcoming launch of the Optical Transient Detector, which will locate lightning discharges with 10 km spatial and 2 ms temporal resolution over most of the globe from a satellite. A typical site will receive about 40 visits per month at different local times, each visit having about a 3 minute dwell time. The launch is now planned for September, 1994. For more information contact Hugh Christian (205-544-1649).

3) John Willett presented an initial compilation of funding sources for the disciplines covered by the CASE. Noteworthy is the move of NSF from Washington, DC, to Arlington, VA, where the new main phone number is 703-306-1234. Many may be unaware of the Air Force Office of Scientific Research (AFOSR), which sponsors basic research in the troposphere (about $500K/yr outside the Air Force) and ionosphere ($600K/yr) through Maj. Jim Kroll (202-767-5021). **Please contribute any knowledge you have of other relevant funding sources to John Willett** (address above) so that it can be shared with the rest of the CASE constituency at the next meeting. The following information is solicited about each source:

a) Contact name, address, phone and/or E-mail
b) Annual total funding level for program
c) Application deadlines, if any.

4) Dave Rust contributed the news item that the Smithsonian Museum is organizing a touring exhibition on Storm Research (which may have been completed by now).

5) John Hallett raised the question of future conflicts between the international meetings on Atmospheric Electricity and on Cloud Physics, which have tended to occur in the same year but too many days apart to make a single trip cover both. Earle Williams will take up this matter with the ICAE.

6) Earle Williams reported that Jim Nicholson's retirement from NASA/KSC makes it necessary to find a new home for the TRIP data archive. (Roger Lhermitte also wants to unload some old data.) Is anyone interested?

7) Bill Beasley announced that, after the VORTEX experiment in 1995, the futures of the Mobile CLASS system and the Cimarron Radar at NOAA/NSSL are in jeopardy.

8) Phil Krider reported that the IMAS meeting in Boulder (June, 1995) has allotted three half-day sessions to CASE topics. These sessions are not yet fully organized, so there is still an opportunity to focus on one or more areas of special interest. The organizer of the atmospheric electricity session is Bob Holzworth (206-685-7401).

9) Bob Holzworth listed a number of upcoming balloon, rocket, and satellite experiments directed toward the middle atmosphere or ionosphere that should be of interest to the CASE constituency. Dave Sentman, Walt Lyons and Earle Williams also announced experiments. **Announcements of planned experiments that offer significant opportunities for collaboration are an important function of both the CASE meeting and this newsletter.** Any such input is encouraged.

10) John Willett described the Annual Case Database Listing (see above).

Finally, the term of the current CASE expires on June 30, 1994. **Nominations for new or continuing Committee members are requested** by the current Chairman, John Willett, at the above address.

Special Issue of the *Monthly Weather Review,* August 1994

(Special Issue Editor: Richard E. Orville, Texas A&M University)

Thunderstorm Electrification and Lightning

PREFACE

Thunderstorm electrification and lightning studies are today an integral part of meteorological research on storms and related phenomena. It has not always been this way. The recent interest in thunderstorm electrification and lightning studies is the direct results of the emergence of lightning location networks as a tool for studying the physical and meteorological characteristics of lightning. An unknown technology just 20 years ago, lightning networks now cover the contiguous United States and provide us with the location, polarity, peak current, and number of strokes in a flash to ground within seconds of the flash occurrence.

This special issue of the Monthly Weather Review recognizes the importance of thunderstorm electrification and lightning in current meteorological research. At the suggestion of the AMS Publications Commissioner Joanne Simpson and the Co-Chief Editor Peter Ray, it was initiated in late 1992. As a guest editor, I am pleased by the enthusiastic response of our community to collect manuscripts on the subject of thunderstorm electrification and lightning and to publish them in one issue of the Monthly Weather Review. Over half the papers in this issue use lightning network data. Three-quarters of the papers are by authors who reside in the southern plains of the United States, reflecting the strong interest in storm research that extends from South Dakota, to Colorado, to Oklahoma, and to Texas. The research reported in this issue will provide you with an overview of the most recent research on the observational aspects and numerical modeling of thunderstorms.

1. MacGorman and Burgess, "Positive cloud-to-ground lightning in tornadic storms and hailstorms."

2. Reap, "Analysis and prediction of lightning strike distributions associated with synoptic map types over Florida."

3. Watson, Holle, and Lopez, "Diurnal cloud-to-ground lightning patterns in Arizona during the Southwest Monsoon."

4. Watson, Holle, and Lopez, "Cloud-to-ground lightning and upper-air patterns during bursts and breaks in the Southwest Monsoon."

5. Stolzenburg, "Observations of high-ground-flash densities of positive lightning in summertime thunderstorms."

6. Zipser and Lutz, "The vertical profile of radar reflectivity of convective cells: a strong indicator of storm intensity and lightning probablility?"

7. Rutledge and Petersen, "Vertical radar reflectivity structure and cloud-to-ground lightning in the stratiform region of MCS's: further evidence for in-situ charging in the stratiform region."

8. Stolzenburg, Marshall, Rust, and Smull, "Horizontal distribution of electrical and meteorological conditions across the stratiform region of a mesoscale convective system."

9. Holle, Watson, Lopez, MacGorman, Ortiz, and Otto, "Life cycles of lightning and severe weather in 3-4 June 1985 PRE-STORM mesoscale convective systems."

10. Nielsen, Maddox, and Vasiloff, "The evolution of cloud-to-ground lightning within a portion of the 10-11 June 1985 squall line."

11. Hondl and Eilts, "Doppler radar signatures of developing thunderstorms and their potential to indicate the onset of CG lightning."

12. Zipser, "Deep cumulonimbus cloud systems in the tropics with and without lightning."

13. Randell, Rutledge, Farley, and Helsdon, " A modeling study on the electrical development of tropical convection: continental and ocean (monsoon) storms."

14. Solomon and Baker, "Electrification of New Mexico Thunderstorms."

15. Samsury and Orville, "Cloud-to-ground lightning in tropical cyclones: a study of hurricanes Hugo (1989) and Jerry (1989)."

16. Lyons and Keen, "Observations of lightning in convective supercells within tropical storms and hurricanes."

17. Williams, "Global circuit response to seasonal variations in surface air temperature."

18. Price and Rind, "Modeling global lightning distributions in a general circulation model."

19. Lyons, (Picture of the Month), "Low-light video observations of frequent luminous structures in the stratosphere above thunderstorms."

RESEARCH ACTIVITY BY ORGANIZATION

AIRBORNE RESEARCH ASSOCIATES (Weston, MA)

Ralph Markson reports that the Phase II SBIR proposal to continue his study of the use of ionospheric potential to monitor variations of tropical temperature has been approved and the 2 year study in which 173 ionospheric potential soundings will be made should commence around June 1994. Conductivity is being added to the electric field instrumentation in order to study variations in columnar resistance. Lothar Ruhnke will participate in the project with particular responsibility for the conductivity instrumentation and data. As part of the program, comparisons will be made with Earle Williams' and Dave Sentman's Schumann Resonance measurements as indicators of tropical temperature variation. One aspect of this will be to see if ionospheric potential may be an indicator of shower clouds (a large percentage of which are probably electrified but too weakly to produce lightning). While Schumann Resonance records only lightning variation and not contributions to the global circuit current from electrified shower clouds, it may be more sensitive to tropical temperature than ionospheric potential. Thus the difference between these records may provide a qualitative measure of the temporal variation of global shower clouds.

Other ongoing activities at ARA include development of new lightning detection instrumentation. David Proctor has come from South Africa to work with Markson on lightning projects. There may be a new position for a scientist with strength in electronics and programming to participate in ARA's atmospheric electrical work and interested parties should contact Ralph Markson at (617) 899-1834.

ASTeR (Fort Collins, CO)

The first of two NASA-funded summer field programs to collect additional information on the "cloud-to-stratosphere" luminous discharge phenomena above massive thunderstorm systems will be conducted during June and July at the Yucca Ridge site northeast of Ft. Collins, CO. Walt Lyons is the program PI. The field program is scheduled to begin 25 June 1994 and continue at least through the month of July. Observations will be taken on nights when large mesoscale convective systems develop over the high plains to the east of the Rockies. Multispectral and image intensified optical data on these huge luminous features will be collected for distances out to at least 700 km in an arc form the north through east through southwest. When possible, measurements will be coordinated with jet aircraft reconnaissance flights conducted for NASA by the University of Alaska (Dave Sentman). Additional cooperative measurements will be made by Jack Winckler (University of Minnesota), Earle Williams (MIT), Perry Malcom (USAF Academy), Russ Armstrong and Vince Eccles (Mission Research Corporation) and (potentially) personnel from one or more national laboratories. Preliminary plans call for repeating many of the measurements in east central Florida in summer, 1995. Other investigators interested in taking complimentary measurements should contact Walt Lyons (phone/fax 303-568-7664)

UNIVERSITY OF FLORIDA (Gainesville, FL)

Yuri Villaneuva, Vlad Rakov, Martin Uman, in collaboration with Marx Brook (NMIMT), have analyzed microsecond-scale pulses in different stages of cloud flashes in Florida and New Mexico. The larger pulses tend to occur early in the flash, confirming the results of Bils et al. (1988) and in contrast with the three-stage representation of cloud-discharge electric fields suggested by Kitagawa and Brook (1960). The tendency for the larger pulses to occur early in the cloud flash suggests that they are related to the initial in-cloud channel formation

processes and contradicts the common view found in the atmospheric radio-noise literature that the main sources of VLF/LF electromagnetic radiation in cloud flashes are the K processes which occur in the final, or J-type, part of the cloud discharge. A paper containing these results has been accepted for publication in the JGR.

Vlad Rakov and Martin Uman have examined lightning events showing two electric field waveforms characteristic of return strokes but separated by the relatively short time interval of typically some tens to some hundreds of microseconds. Such double field waveforms (14 total), were observed in about 20% of all flashes analyzed. Eight of the 14 double field waveforms were associated with lightning channels having double terminations on ground. The remaining six double field waveforms were associated with channels showing single ground attachments. The latter observation suggests that double field waveforms can be due to two return strokes, each initiated by its own leader process, occurring in the same channel within a millisecond or less of each other. Such short interstroke intervals imply that the minimum time for the lightning channel to decay to the point that a new leader-return stroke sequence can occur is significantly shorter than previously thought and that the distribution of interstroke intervals should be extended to the submillisecond range. A paper containing these results has been accepted for publication in the JGR.

Vlad Rakov, Martin Uman, Glen Hoffman, and Michael Master, in collaboration with Marx Brook (NMIMT), are analyzing so-called regular pulse trains in lightning electric fields. These pulse trains were first described by Krider et al. (1975) who attributed them to some in-cloud processes in previously-formed channels, similar to dart-stepped leaders of a cloud-to-ground discharge. However, because they used a triggered measuring system and a 200-ms oscilloscope sweep, Krider et al. (1975) could not reliably determine the position of those trains within the overall flash record and their possible relation to any presently known in-cloud lightning processes. Our preliminary results show that the regular pulse trains occur in both cloud and ground flashes and are sometimes associated with K changes and M components. It appears that the regular pulse trains are the manifestation of some basic in-cloud discharge process which have escaped registration in most previous lightning studies due to insufficient measuring system gain and time resolution.

Martin Uman, Vlad Rakov, Rajeev Thottappillil, and Joe Versaggi, in collaboration with Andre Eybert-Berard, Louis Barret, and Jean-Pierre Berlandis (CENG, France), continue analyzing electric and magnetic field measurements 30, 50, and 110 m from the lightning channel acquired during the 1993 triggered-lightning experiment at Camp Blanding, Florida. Among interesting observations are the variation of the leader and return stroke field waveforms with range (providing some new inferences on the charge distribution, speed, and current in the bottom portion of the lightning channel) and the first simultaneous electric and magnetic field waveforms due to individual leader-steps. The UF lightning research group plans to participate in the triggered-lightning experiments at Camp Blanding during the summer of 1994.

Rajeev Thottappillil, Vlad Rakov, and Martin Uman, in collaboration with Dick Fisher and George Schnestzer (Sandia), are analyzing the triggered-lightning data, including the step voltages, electric and magnetic fields at 10 and 20 m, channel-base currents, and video and cinematic images, acquired by Sandia National Laboratories in Fort McClellan, Alabama. The results will be compared to those from Camp Blanding, Florida.

Rajeev Thottappillil and Martin Uman have proposed a lightning return-stroke model with a single height-variable discharge time constant. The new model is both more general and more physically reasonable than the Diendorfer-Uman model (Diendorfer and Uman, 1990) and its modification by Thottappillil et al. (1991). A paper containing a description of this model and discussion of its potential application has been submitted to the JGR.

HIGH VOLTAGE RESEARCH INSTITUTE

(Tomsk Polytechnical University, Tomsk, Russia)

Alfred Dulson et al. have submitted a paper to JGR. In the paper the meteorological problem associated with the coordination of routine meteorological observations of thunderstorm activity at weather stations and lightning flash counter registration are being discussed.

In June 1993 Valentina Gorbatenko has been awarded the Ph.D. in meteorological science in the Russian State Hydrometeorological Institute (St. Petersburg). In her dissertation "Elaboration of the models of spatial distribution of the thunderstorm activity" the influence of various factors of the atmosphere - lithosphere system on thunderstorm activity was analyzed. The modeling of thunderstorm activity was carried out for regions with different physical-geographical and climatic conditions. Received results are being prepared for publication in the reviewed literature and for presentation at a conference.

Fagim Gindullin has also submitted a paper to JGR. In this paper statistical models for intensity of thunderstorm action, such as thunderstorm duration (Th) expressed in hours and number of thunderstorm days (Nd), were defined for regions with different climatic elements. These models have been used for creating regional maps of Th and Nd and the study of the effects of geographical climate factors on thunderstorm action.

Dmitry Shelukhin is finishing an autonomous electronic recorder, a memory device for the time registration in the course of a half year of accidental events, such as the markings of lightning flash counters.

UNIVERSITY OF HOUSTON

(Houston, TX)

Gar Bering writes: I have recently been drafted to prepare a review article on fair weather "Atmospheric Electrodynamics" for inclusion into the U.S. National Report to the IUGG (1991-1994). The complete list of topics I am to cover has not yet arrived, but I know that it will include both the global circuit and its upward extension into space, incorporating upper atmospheric electrodynamics. As you have probably already deduced, this letter is requesting all of your relevant reprints from 1991 to 1994 (include 1990 papers if they appeared after your reply to Bob Holzworth's letter on this same topic).

In selecting reprints to send, please be aware that I have been instructed to include sections on applied science (i.e. mission oriented research) and implementation (i.e. commercial and operational application), in addition to the familiar presentation on fundamental process science.

I would also like to take this opportunity to solicit your advice and input. This year, there is an effort being made to improve the quadrennial report by seeking to make the components into review articles as opposed to compendia of references. This objective makes my job much more difficult in that it requires very careful judgment as to the selection of the topics to be emphasized. To this end, I would very much appreciate your advice regarding what you consider to be the major advances and debates of the last four years. What paradigms have died? Which old tired paradigms have been reborn? What new paradigms have arisen? Which unresolved controversies have been the most important and fruitful?

INSTITUT FÜR GEOPHYSIK DER UNIVERSITÄT GÖTTINGEN

(Göttingen, Germany)

Martin Füllekrug has developed facilities to record the magnetic field components in the lower ELF range from 0.1 to 20 Hz. The measurements are carried out with induction coils showing a noise level of 55 fT $Hz^{-1/2}$ at 1 Hz (fT = 10^{-12} Tesla). Thus the recording instrument is well suited for scientific research in view of its possibility to record time-series continuously at high resolution in amplitude and frequency, needed for the detection of the weak Schumann-resonances with amplitudes around 1 pT. The robust estimation of the amplitude, damping and frequency of the first two Schumann-resonances allows monitoring of excitation and propagation

conditions and will be extended to all observable Schumann-resonances and to time intervals of one minute in length. These parameters provide global integrated information, modified by disturbances of local origin that can be removed by connecting the measurements from at least three observation sites at middle latitude locations around the world.

One of the objectives of this work is to set up a Geoelectric Index, characterizing the electromagnetic balance in the troposphere. A second objective is a continuous observation of the solar activity coupling into the lower ionosphere. The improved understanding of the lower ELF range will also help to build up magnetotelluric transfer functions, completing the conductivity profile of the upper earth's crust.

UNIVERSITY OF KALYANI (West Bengal, India)

A.B. Bhattacharya, B.K. Dutta and R. Bhattacharya have investigated "some distinct effects of tropical monsoon clouds as derived from atmospherics". In this work the electrical effects due to monsoon clouds in conjunction with VLF atmospherics data have been extensively analyzed. The cloud distribution and rainfall pattern during the SW monsoon period generally occurs in the afternoon hours between 13 to 18 IST. The coefficient of variation (CV) of monsoon rainfall plotted against rainfall amount reveals that CV decreases with increasing rainfall amounts up to about 40 inches of rainfall. The differences in the mean dry bulb temperature as well as mean relative humidity values at the standard levels between strong and weak monsoon are studied. The monthly median of the hourly average together with the respective upper and lower decile values of atmospherics have been considered. Also the frequency dependence of afternoon maximum (or late afternoon minimum) to morning minimum in the sferics level is taken into account to determine the seasonal variation. During monsoon months the sferics level with higher cloud amount (>4 okta) increases considerably but the width of the sferics is reduced. The results are interpreted by considering the activity of the sources involved at such times.

The present observations will be supplemented by radar and satellite data with an emphasis on monsoon/break period classification as suggested by Earle Williams. The work is in progress and S.K. Kar is now actively engaged in this exciting problem.

LAWRENCE LIVERMORE NATIONAL LABORATORY (Livermore, CA)

As part of his postdoctoral research Colin Price is working with Joyce Penner of LLNL and Michael Prather of UC Irvine to better quantify the contribution of lightning to the global NO_x budget ($NO_x = NO+NO_2$). NO_x distributions and concentrations are of great importance to ozone chemistry. In addition, NO_x can form nitrates in precipitation, leading to the deposition of nitrates on the earth's surface. NO_x also contributes to the formation of acidic precipitation. We have developed two methods to improve the estimates of lightning-produced NO_x. The first involves looking at the detailed microphysics of lightning channels, while the second involves the global electric circuit. Although these two methods take completely different approaches to attacking the problem, both methods provide similar results, thereby reducing the uncertainties by nearly an order of magnitude. Work continues in this area.

Colin Price and John Molitoris of LLNL plan to participate in this summer's field measurements of stratospheric "lightning" organized by Walt Lyons in Ft. Collins. If the funding is available, we plan to bring a high resolution (spatial and temporal) CCD imager, that would allow us to observe these phenomena at 1 microsec intervals. It is possible that we may also be able to bring a photospectrometer to Ft. Collins to study the spectral signature of these discharges. We hope to continue participating in these field measurements during the next few years.

Colin Price is also working on developing an empirical model of the global electric circuit. The empirical model uses global satellite derived cloud data to predict ionospheric potential. Extensive work has been done with the International Satellite Cloud Climatology

Project (ISCCP) data sets to look at diurnal fluctuations in global cloud cover. The clouds can be separated into different types of clouds, e.g. deep convective, stratiform, cumulus, etc. By looking at specific cloud types the Carnegie curve is well reproduced. Low, stratiform clouds also seem to indicate a good correlation with the Carnegie Curve implying that point discharge under non-thunderstorm clouds is significant to the global currents in the fair-weather circuit.

Finally, Colin Price is working with lightning data supplied by Dick Orville (Texas A&M) to investigate the idea that peak currents in CG return strokes have a latitudinal dependence (Orville, *Nature*, January 1990). Since cloud volumes appear to be larger in low latitudes than in high latitudes, as a result of the height of the tropopause, it is possible that peak currents in thunderstorms may be related to cloud parameters. If this is true, satellite cloud data could be used to provide a global climatology of peak currents in CG flashes.

LIGHTNING DATA CENTER (Denver, CO)

A couple of years ago, a number of interested persons in the Denver–Boulder area formed a loose association called the Lightning Data Center (LDC), located at St. Anthony's Hospital in Denver. Since then, its membership and mission have evolved and solidified, though still encompassing a broad range of interests and expertise. Members come from the medical and meteorological communities, industry, product marketing, and the private sector. Currently, the missions of LDC are to: "a) Gather and study lightning casualty data for Colorado from various sources; b) Investigate the problem of under reporting lightning deaths and injuries and its consequences in terms of public awareness and policy making at the state and national levels; c) Assist others in obtaining and using lightning data sets that are as complete as possible for medical, meteorological, community protection, and planning purposes; and d) Educate health care workers and the public on the dangers of lightning, to more accurately identify lightning victims, on proper medical treatment of victims, and on measures to reduce the risks of lightning injury." The papers in the proceedings of the AMS Conference on Atmospheric Electricity by Lopez et al. and Holle et al. demonstrate results stimulated by the work of the LDC.

Current efforts include extending the data base and results of the paper, "Under reporting of Lightning Injuries and Deaths in Colorado," by Lopez et al. in the AMS Bulletin (Nov. 1993). Also, the LDC would like to establish communication links with other groups or individuals of similar interests for the purpose of exchanging ideas and data on common problems. If you would like to receive the "informal" minutes of our meetings, or have any comments or questions, please contact Dan Breed via e-mail (internet: breed@ncar.ucar.edu) or Dr. Michael Cherington, Lightning Data Center/Provenant St. Anthony's, 4231 W. 16th Avenue, Denver, CO 80204-1374; Phone: 303-629-5600, Fax: 303-623-5151.

UNIV. OF MANCHESTER INSTITUTE OF SCIENCE AND TECHNOLOGY (Manchester, England)

Laboratory studies are continuing at UMIST following Ian Brooks's discovery that continuous seeding to produce ice crystals, as used by Takahashi, leads to an overestimate of the liquid water content in the laboratory cloud. Takahashi's subsequent revelation that he used spray to produce his high liquid water content values (in direct contradiction to his 1978 paper) is now the focus of attention. Liquid water contents exceeding the value needed for wet growth are available using a droplet spray gun. Su Ling Peck is finding that at speeds between 3 and 9 m/s, the liquid water can readily build up on the riming target and is swept away in the airstream leading to positive charging of the target even without the presence of ice crystals.

Clive Saunders visited John Helsdon and Dick Farley recently to discuss their model results obtained with the UMIST laboratory data. High electric fields are easily generated by crystal/graupel interactions but the sign is highly dependent on using the correct value of EW, the effective liquid water on the rimer. EW itself depends on graupel size, fall speed and droplet

size distribution. The model results are feeding back to the lab where specific tests will be made to improve the details of the parameterization scheme.

Visitors to UMIST this summer include Rohan Jayaratne and later on, Eldo Avila from Jorge Caranti's lab in Cordoba. With Su Ling, they will be working on resolution of current problem areas between the various laboratory results. Anyone interested is welcome to come along. (e-mail address: **clive.saunders@umist.ac.uk**)

MARSHALL SPACE FLIGHT CENTER (Huntsville, AL)

Excellent progress is being made with the TOGA COARE aircraft data analysis (R. Blakeslee, J. Bailey, K. Driscoll and H. Christian). In January and February 1993 electrical properties of tropical maritime convection were investigated during the international TOGA COARE field program using NASA's ER-2 and DC-8 aircraft. Ground-based lightning observations were also obtained during TOGA COARE and continued to be made until January 1994. Analysis of that data is under way by several groups (R. Orville, and E. Zipser, TAMU; H. Christian, R. Blakeslee, and S. Goodman, MSFC; P. Krider, and C. Weidman, U. of Arizona; and M. Brook, New Mexico Tech).

The NASA Lightning Imaging Sensor (LIS) engineering flight model was delivered to Orbital Sciences Corporation (OSC) in early March for launch on a Micro Lab-1 small satellite later this year. The LIS engineering model, called the Optical Transient Detector, will be launched on an OSC Pegasus rocket into a 785 km, 70° inclination orbit with a planned lifetime of 2 years. Calibration of OTD was conducted by H. Christian, W. Koshak, and J. Bergstrom. Software for producing the initial OTD and LIS data products is nearly completed (D. Mach) and testing has begun (W. Boeck, Niagara University). An algorithm Theoretical Basis Document (ATBD) detailing LIS data processing and products has been prepared.

MSFC is also participating in joint research programs with DOE Los Alamos Laboratory/Sandia Laboratory (D. Holden and C. Rhodes) on the 1995 flight of the Optical Lightning Subsystem (OLS) for the Fast On-Orbit Recording of Transient Events (FORTE) satellite that will measure VHF and optical radiation from lightning. FORTE will be launched by a Pegasus rocket into a nearly identical orbit as the OTD. OLS uses a copy of the LIS optical imaging system with Sandia designed electronics and even processing. FORTE is a follow-on to last year's launch of the Los Alamos Blackbeard (D. Holden) satellite, capable of detecting lightning with RF and optical detectors.

A ground truth campaign (R. Blakeslee, H. Christian and S. Goodman) involving MSFC, New Mexico Tech, DOE, and DOD will take place this summer at Kennedy Space Center, Florida, and again in Nov.-Dec. 1995 in Darwin, Australia to coincide with the Maritime Continent Thunderstorm Experiment (MCTEX) planned for Melville Island. During MCTEX, in collaboration with many groups (e.g., NSF, NSSL, NOAA, several universities), MSFC will provide and deploy a 7-9 station field mill network, wideband E-field sensors, optical pulse detectors, spectrometers, and rf receivers. In addition, a 3 station Advanced Lightning Direction Finder (ALDF) will be installed in Darwin to support long term Tropical Rainfall Measurement Mission (TRMM) ground truth studies.

A paper is to appear in *Science* by Fishman et al. (co-authored by S. Goodman and H. Christian and others) describing the discovery of gamma-ray burst associated with thunderstorms on earth. The Burst and Transient Source Experiments (BATSE) aboard the Compton Gamma Ray Observatory has detected 18 such events since 1992. The long range ARSI National Lightning Network provided independent confirmation of a thunderstorm for one of these burst events on May 20, 1993.

A paper detailing preliminary work on rainfall estimation using lightning data is being presented at the AMS sponsored Seventh Conference on Satellite Meteorology and Oceanography (D. Buechler, H. Christian, and S. Goodman). The spatial rain rate patterns based on the radar were better reproduced by an approach using lightning observations and a simple relation than by using IR satellite imagery. This technique is now being applied to other locations and days to determine its robustness.

UNIVERSITY OF MISSISSIPPI (Oxford, MS)

Tom Marshall (Univ. of Mississippi), Jim Dye, Dan Breed and 4 undergraduates are analyzing the charge, size and type of precipitation particles observed in CaPE thunderstorms (Florida, 1991); the data were collected with an instrument mounted on the NCAR Sailplane.

Tom will collaborate with Dave Rust (NSSL), Maribeth Stolzenburg (OU/CIMMS/NOAA), and Monte Bateman (Langmuir Laboratory) to fly balloon-borne electric field meters and particle charge-and-size measuring instruments into the updrafts of severe and tornadic storms this spring as part of Verification of the Origins of Rotation in Tornadoes Experiment (VORTEX) and into mesoscale convective systems (MCS's). The MCS flights will be in close proximity to NSSL's multiparameter Doppler radar to compare the electrical structure with radar-derived microphysics. On some flights in both storm situations, Bill Beasley (OU) and Ken Eack (OU) will fly an X-ray detector with the electric field meter.

MIT LINCOLN LABORATORY (Lexington, MA)

Under FAA sponsorship, MIT Lincoln Laboratory is conducting operational evaluations of an Integrated Terminal Weather System (ITWS) at the airport in Memphis, TN, and Orlando, FL, reports Mark Weber. Products provided for use by air traffic control supervisors and traffic management specialists include detections and short term forecasts for low altitude wind shear, hail, mesocyclones, tornadoes, lightning and other storm impacts on flight routes.

Measurements associated with development of an advanced Weather Surveillance Processor for the FAA's Airport Surveillance Radar (ASR-9) continue at Albuquerque's International Airport. The MIT C-band radar will be operated in support of this program and scientific studies related to the characteristics of thundercloud electrical activity in New Mexico. ONERA will operate its interferometric lightning mapping system at Albuquerque, if suitable sites for the VHF receiving statings can be found.

MIT WEATHER RADAR LABORATORY (Cambridge, MA)

Studies continue on the global circuit response to surface air temperature. Dennis Boccippio has worked out a scheme to calibrate wet bulb potential temperature θ_w from surface temperature, pressure and dew point for all reporting meteorological stations on the international grid. Mean θ_w values for the tropics on the seasonal time scale are being compared with published DMSP data sets on midnight lightning (Orville, Henderson, Goodman, Christian) and archived data sets on Schumann resonance, the latter in collaboration with Dave Sentman, Masashi Hayakawa, Bob Aiksnoras and Bob Wood. On the diurnal time scale, time of maximum Schumann resonance amplitude for each of three major zones of tropical convection lags the maximum θ_w values by about 3 hours, consistent with independent results by Ralph Markson and Colin Price.

Kyle Blasch has completed a Master's thesis on analysis of the earth's Schumann resonances. Emphasis was placed on the use of the power ratio method (suggested earlier by Charles Polk) and direct inversion methods to determine source characteristics (strength and location) from power spectral measurements of the electric and magnetic fields. Archived data from Schumann resonance sites in California and Australia were generously provided by Dave Sentman as tests for the theoretical framework.

Thunderstorm studies will continue in Albuquerque this summer with Lincoln Laboratory (Mark Weber, Bob Boldi) and ONERA (Pierre LaRoche). In light of the excellent viewing conditions in the desert environment and the puzzling results on the behavior of the cloud/ground flash ratio communicated by Rohan Jayaratne in Botswana and Dave Mackerras in Australia, new attention will be given to comparisons of RHI cloud structure and dominant lightning type

in the New Mexico storms. The MIT radar will also be used to look for reflections from stratospheric discharges ('sprites') in coordination with Walt Lyons.

Nilton Renno's investigation of shallow convection in Orlando and Albuquerque with a model sailplane (equipped with Vaisala radiosonde) has shown that rising air is drawn from the surface sublayer (below 10 meter depth). These results have important implications for how Convective Available Potential Energy (CAPE) is evaluated form thermodyanmic soundings.

Earle Williams is working with G.S. Kent and others on a paper concerned with variations in upper level cirrus cloud for the tropics which appear to be related to surface temperature variations on the diurnal, seasonal and El Niño time scales. These same time scales have been shown to dominate the behavior of the global electrical circuit.

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH (Boulder, CO)

Dan Breed reports that the NCAR sailplane will be flown this summer in the vicinity of Boulder (for instrumentation test flights) and in the vicinity of the CSU CHILL radar near Greeley, Colorado (combining extensive test flights with research). The primary scientific objectives are: to determine the electrical structure ad particle charges during the initial electrification of cumulus congestus; and to relate the cloud's electrical evolution with its microphysical evolution through multiparameter radar measurements, particularly in relation to cloud glaciation processes. The research flights are scheduled to begin the week of June 6th, with 8–10 flights planned during June and July. The sailplane flights and data collection will also be coordinated with a summer Research Experience for Undergraduates (REU) program run by Prof. Chandrasekar of CSU.

Dan Breed has also been collaborating with Andy Detwiler of the South Dakota School of Mines and Technology on electric field intercomparisons done during the CAPE project between the T-28, the NCAR King Air, and the sailplane. A modicum of support has been given to Tom Marshall, University of Mississippi, and his students regarding particle charge measurements made by the sailplane during CAPE. A renewed emphasis in analyzing these and complementary data is planned.

NATIONAL SEVERE STORMS LABORATORY (Norman, OK)

Dave Rust (NSSL), Maribeth Stolzenburg (University of Oklahoma/NOAA), Tom Marshall (University of Mississippi), and Monte Bateman (Langmuir Laboratory, Socorro, New Mexico) will use mobile ballooning to fly electric field meters and particle charge-and-size measuring instruments into the updrafts of severe and tornadic storms this spring in the Oklahoma region as part of the Verification of the Origins of Rotation in Tornadoes Experiment (VORTEX). In addition, we plan on a few flights in mesoscale convective systems (MCSs) with the same instrumentation. The MCS flights will be in close proximity to NSSL's multiparameter Doppler radar to compare the electrical structure with radar-derived microphysics. On some flights in both storm situations, Bill Beasley (OU) and Ken Eack (OU) will fly an X-ray detector with the electric field meter.

Ron Holle and Raúl López of NSSL published two overview reports on real-time lightning detection networks over large regions. The publications describe the methods of operation of detection networks, and applications of lightning network data by meteorologists and others. They also have a list of all known references involving real-time lightning detection networks in any way. One report was published as a NOAA Technical Memorandum, and the other by the World Meteorological Organization.

NSSL has developed an algorithm to tabulate lightning ground flash rates for individual cells and storms in real time on a Sun workstation. The algorithm uses WSR-88D radar reflectivity data to identify storm cells and determine cell tracks. Lightning strike data are ingested from the National Lightning Detection Network. After each radar volume scan, lightning flashes that occurred during the volume scan are assigned to cells identified from the

radar data and are tabulated and stored. Five minute ground flash counts (total, negative and positive) are saved for up to an hour for each cell and can be displayed as histograms in real time in windows on the NSSL Real-time Algorithm Display System (RADS). Besides tabulating lightning, the algorithm tabulates radar-derived products such as maximum reflectivity, height of maximum reflectivity, storm height, and VIL for each cell. During May and early June, Don MacGorman and Ron Holle will use this algorithm in real time to evaluate applications of lightning data for National Weather Service operations. They will work at the NWS/NSSL Experimental Forecast Facility in Norman to monitor lightning strike behavior in storms throughout Oklahoma and to evaluate algorithm performance for future refinements. In July and August, the algorithm will be used during the SWAMP project in Arizona.

Raúl López and Ron Holle (NSSL) prepared an NSSL Technical Memorandum summarizing all lightning deaths, injuries, and property damage reports contained in the NOAA publication Storm Data for Colorado from 1951-1991. More than half of the deaths and injuries occurred during recreational activities; a higher ratio than elsewhere. The most frequent locations of victims were at or near mountain tops, the direct vicinity of trees, and in the open. Compared to the population trend of Colorado, there were fewer lightning casualties and damage reports in the 1970s and early 1980s than before and after that time period. Outdoor recreation, urban, and work cases have increased with population growth. Sports casualties have had a substantially higher rate of increase than the population growth would indicate. But ranch and farm casualties are now very infrequent after being significant through the early 1960s. The statewide year-to-year fluctuation in numbers of lightning victims correlates well with corresponding statewide summertime temperature changes, but not with precipitation. Long-term changes in casualties and damage reports in adjacent states are similar to those in Colorado.

Ron Holle and Irv Watson of NSSL studied two cases in January 1994 of cloud-to-ground lightning detected by the GDS network during subfreezing surface conditions on the central U.S. plains. Hourly surface National Weather Service stations showed the existence of lightning at two stations for a total of 4 hours, although over 1000 ground strikes occurred. Temperatures at 1 or 2 upper-air stations were warmer than freezing in the layer from 900 to 800 mb at one or two sounding times. Lightning data were not used by the NWS during the storms, although significant frozen precipitation was associated with times and places of flashes.

NATIONAL UNIVERSITY OF COLOMBIA (Bogotá, Colombia)

Horatio Torres reports that the general objective of his research work at the National University of Colombia is the spatial-temporal, and statistical and probabilistic characterization of electromagnetic disturbances (lightning, transients) in electrical and electronic systems and equipment by means of acquisition, estimation and modeling of disturbances and system response.

For more than 10 years, research has been carried out in Colombia on the spatial-temporal characterization of atmospheric electrical discharges. This research arises from the fact that accentuated lightning activity (caused by the geographical location of the country in the vicinity of the Intertropical Confluence Zone (ITCZ)), affects operation of electrical and electronic systems and equipment.

There are two bid processes in motion for the procurement and installation of two lightning detection systems in Colombia; one for the EPM Power Utility (5 antennas) and another for the ISA Power Utility (8 antennas). The first bid was adjudicated to LLP Inc. in February/94. The second bid will not be canceled, but will be a direct buy (direct contract) with LLP or LPATS.

The Colombian Network for Lightning Location and Measurement (RECMA Project) is a joint effort between our research at the National University and the Colombian Power utilities and we will analyze the data through the research project entitled "Acquisition and Analysis of Electromagnetic Signals" sponsored by the Colombian Science and Technology Foundation (Colciencias).

PENNSYLVANIA STATE UNIVERSITY (State College, PA)

Les Hale of Penn State is planning to continue a study of the generation of "slow tails" from lightning, which he believes will be important to the coupling of energy to the ionosphere and global circuit. This will commence in collaboration with rocket experiments and "upward lightning" measurements this summer and will continue next winter with an attempt to observe the antipodal reconvergence of sferics in the Schumann resonance band. He is aware of the Ukrainian calculations (Bliokh and Nickolaenko, 1980) which show a "split" antipode but believes this should be checked with a realistic ionosphere, namely the real one.

He would like to suggest a definitive laboratory experiment for which he does not have the funding or equipment. The advent of ten picosecond pulsers and tens of GHz oscilloscopes means that lightning return strokes could be meaningfully simulated on a laboratory scale. A fast leading edge, properly terminated to prevent excessive ringing, is applied to a shot "monopole" above a plane conducting table. A similar receiving monopole is placed as far as possible away without interference from reflections from the edge of the table. A planar "ionosphere" is then lowered from "infinity" (the ceiling) and changes in the received signal are noted. One recent paper implies that the received signal will not get any stronger {GRL 19, 665, subsequent Comment GRL 20, 761, and Reply GRL 20, 763). Hale contends that the presence of the "ionosphere" alone should also give rise to a "slow tail", whose width is related to the round trip propagation time to the ionosphere, which showed up in a computer simulation {Nature, 329, 814), but is not predicted by other theoretical treatments. The results would also have important implications for EMI and EMP.

This would be a good way to settle several matters, and Hale would be glad to collaborate, but other experimenters are invited to go at it, if they wish.

PHILLIPS LABORATORY (Bedford, MA)

John Willett has organized an experiment to gather information on the conditions for triggered lightning and on the electrostatic field distributions inside thunderstorms. The experiment will run from mid-July to mid-August at the Langmuir Laboratory (LL) in New Mexico, in collaboration with Bill Winn of NMIMT. Three electric-field sounding rockets will be launched, immediately followed by triggering rockets, to document the ambient-field profiles associated with triggering attempts. Stan Heckman, currently at PL/GPAA, will measure the currents in the triggering wires, and the resulting field changes, during the initial development of any discharges that occur. Vince Idone of SUNYA will arrange for streak photography of the upward leaders. Radar coverage of the storms will be provided by both the LL radar and Paul Krehbiel's dual-polarization radar.

SOUTH DAKOTA SCHOOL OF MINES & TECHNOLOGY (Rapid City, SD)

Analysis and simulation of thunderstorm cases from CAPE continues. Rahul Ramachandran completed his MS thesis with Andy Detwiler, briefly discussing thunderstorms penetrated by the SDSM&T T-28 on 28 and 31 July and 13 August, and discussing in more detail a storm penetrated by the T-28 on 29 July with good coverage by the CP-2 radar. Jeff French is finishing his MS thesis with John Helsdon involving a comparison of observations and storm-electrification model simulations of a storm penetrated by the T-28 on 9 August.

Bill Wojcik is completing his MS thesis with John Helsdon involving a comparison between non-inductive charging mechanisms as presented by Takahashi and Saunders et al. using the 19 July CCOPE thunderstorm simulation as a test bed. John Helsdon and Dick Farley have collaborated with Steve Rutledge and Scot Randell of CSU on an electrical modeling study of continental and monsoon storms in the Darwin, Australia area. The study, which involves the relationship between CAPE and the electrical development of these storms, will appear in the forthcoming special issue of Monthly Weather Review.

ST. PETERSBURG STATE UNIVERSITY (St. Petersburg, Russia)

Vadim Mushtak and Pavel Furman continue on experimental studies of mid-latitudinal ELF (30-200 Hz) fields in European Russia: recently the Schumann resonances frequency band has been included in the investigation program.

Vitaly Kirillov, Vadim Mushtak and Juri Galyuck are developing ELF propagation theory (the two-dimensional telegraph equation method) for application to real time interpretation of experimental data as an indicator of the global thunderstorm activity.

Kirill Kostvgov continues investigations the theory of nonlinear processes and shock waves associated with lightnings and other electrical discharges.

Yu. V. Shtennikov continues the computer simulation of the spatial and temporal distribution of atmospheric radio noise in VLF band.

TEXAS A&M UNIVERSITY (College Station, TX)

The mesoscale group composed of Ed Zipser, Dick Orville, Mike Biggerstaff, Lou Wicker, and John Nielsen-Gammon continues to work on a broad set of problems combining electrification with other meteorological processes. Approximately 30 graduate students are working in mesoscale meteorology; half of these are involved in studies related to electrification and lightning. This research has resulted in the following papers, either published or in press.

Samsury and Orville, "Cloud-to-ground lightning in tropical cyclones: a study of hurricanes Hugo (1989) and Jerry (1989)" to be published in the *Monthly Weather Review*, August 1994. This paper reports on the lightning characteristics of two land-falling hurricanes and their distinctive differences in lightning activity.

Zipser, "Deep cumulonimbus cloud systems in the tropics with and without lightning", in press, *Monthly Weather Review*, August 1994.

Zipser and Lutz, "The vertical profile of radar reflectivity of convective cells: a strong indicator of storm intensity and lightning probability?", in press, *Monthly Weather Review*, August 1994.

Orville, "Cloud-to-ground lightning flash characteristics in the contiguous United States: 1989-1991" in press, *J. Geophys. Res.*

The following papers were presented at the Annual Meeting of the American Meteorological Society, Nashville, Tennessee, January 23-28, 1994. Reprints are available from the authors.

Gilmore, Perez, Orville, and Wicker, "XLIGHT: An interactive lightning analysis and display system"

Orville, Zipser, and Weidman, "TOGA COARE: Results from a lightning direction finder network in the remote western Pacific Ocean"

Lucas and Orville, "TOGA COARE: Oceanic lightning"

Billingsley and Biggerstaff, "Evolution of cloud-to-ground lightning characteristics in the convective region of a mesoscale convective system"

UKRAINIAN INSTITUTE OF RADIO ASTRONOMY (Kharkov, Ukraine)

Alexander Nickolaenko's group has recently been awarded a grant from the newly established International Science Foundation to continue their theoretical and experimental studies of Schumann Resonance.

UPPSALA UNIVERSITY (Uppsala, Sweden)

In January 1994 Caje Jacobsson successfully defended her Licentiate dissertation "A study of a complex summer storm in Sweden" in which she treated the occurrence of lightning discharges in different parts of frontal systems by using data from lightning location systems, Doppler radars, satellites and the weather observation net.

Sven Israelsson, Edgar Knudsen and Hannes Tammet from Tartu University in Estonia have in the Uppsala area tested a long-wire antenna system for measuring the Ruhnke-Tammet effect. We will make more detailed studies of the global currents in northern Sweden (the aerora area). The project will be arranged in cooperation with Tapio Tuomi, Institute of Meteorology, Helsinki, Finland, Sergej Anisimow, Moscow Institute of Atmospheric Physics and Eugene Mareev, Institute of Applied Physics, Nizhnynovgorod, Russia.

Sven Israelsson continues to study the effects of the radioactive fallout after the Chernobyl accident on the occurrence of lightning discharges. We also try to use meteorological data such as the wet-bulb temperature, which has been used by E.R. Williams in his studies of the global thermometer and the Schumann resonance.

Edgar Knudsen and Sven Israelsson have developed an aparatus for measuring the aging of small-ions. The ion spectra will be more stable than by using the Gerdian method and with the new method it is possible to obtain a very good time resolution. We have also measured the electrode effect above different surfaces and in different weather conditions. The changes of the space charge density profiles take place in less than 7 seconds, which depends on the turbulent eddies. Similar results have been obtained by measuring the conductivity profiles.

Sven Israelsson has during the last three years studied the effect of increasing wind speed on the formation of space charges at ground level. Above very dry and wet ground surfaces very different charge formations appear. In the former case there is a formation of negative space charges and in the latter case positive charges.

A.I. VOEIKOV MAIN GEOPHYSICAL OBSERVATORY (St. Petersburg, Russia)

Yakov Shvarts reports that the subsection "Atmospheric Electricity" (Vladimir D. Stepanenko, Chairman) was chartered by the Fourth section of the RAN council on the complex "Scientific fundamentals of electrical engineering physics and electrical power engineering". The first meeting was held on March 11, 1994 at the Arctic and Antarctic Institute. The theme was: An effect of the magnetic-ionospheric disturbances on an operation of facilities and on biological systems. The second meeting will be held in the last decade of May 1994. The theme is: The remote measurement of lightning discharge characteristics.

Yakov Shvarts reports that Oleg P. Rulenko (the RAN Far-Eastern Branch Volcanology Institute, Petropavlovsk-Kamchatsky) has finished his master's thesis entitled "Experimental study of the volcanic cloud electrification". This thesis was presented to the MGO special academic board for defense in May, 1994.

Valery Gordyuk reminds the community that all atmospheric electric stations can send their data on 3.5" or 5.25" diskettes to the World Data Center at MGO. The Aarau station (Dr. R. Fisher, Switzerland) only sends its data in this form now. For information concerning a data presentation format you can communicate to Valery Gordyuk, MGO, WDC/AE, Karbysheva 7, St. Petersburg, 194018 Russia, FAX **(812) 2478661**. E-mail: **VMELESHKO@SOVAM.COM**.

Vladimir N. Morozov explores mathematical problems of a calculation of the electric field which is produced by thunderstorm current sources. He found this analytical solution of the nonstationary problem for the point-charge sources in an atmosphere with an exponential conductivity.

Vladimir D. Stepanenko investigated a thunderstorm re-emission profile of a nearby thunderstorm's lightning radio emission. He calculated the re-emission radio signal intensity. He found that this intensity may be more than the radar receiver noise level. This finding should be taken into account if a pre-thunderstorm or post-thunderstorm radio emission is studied.

Vladimir D. Stepanenko and his colleagues are continuing their researches in the MGO cloud chamber (see AEN, 1993, no. 2). Experiments are being carried out under subfreezing temperature.

Yulie A. Dovgalyuk (from Stepanenko's department) and her colleagues continue the numerical simulation of convective cloud electrification (see AEN, 1993, no. 2).

Simon M. Galperin and Vladimir D. Stepanenko continue to study the contributions of hydrometeors, corona and brush discharges as well as other factors to the echo signal from the thunderstorm center.

Simon Galperin, Valery Frolov, Valery Stasenko and Georgiy Shchukin continue to investigate thunderstorm clouds using a multi-wavelength radar and radiometric system. The main objectives of the 1994 experimental season are: investigation of cloud thermal emission and radar reflectivity evolution with respect to lightning activity (growth and decay); further investigation of thunderstorms with unusually high lightning activity for our latitudes (continued reflection on two meter wavelength accompanies these events regularly); determination of specific characteristics of lightning activity in Ns; application of radiometers for detection of the cloud area producing lightning activity.

UNIVERSITY OF WASHINGTON (Seattle, WA)

ELBBO update: The Extended Life Balloon Borne Observatories program successfully completed the observation phase last spring. In total we acquired 410 payload-days of data including periods of 2 months with 4 simultaneous balloons aloft. The balloons sampled all longitudes and latitudes from 28 degrees South to the South Pole. A new empirical conductivity model for the stratosphere has been developed by Dr. Hua Hu (now at JPL) as part of her PhD thesis. We are working on vector field comparisons with satellites, other balloon data (with E. Bering) and ground based data at the South Pole.

THUNDERSTORM III update: This experiment involves the launch of two rockets and a balloon for simultaneous electrodynamic observations in the stratosphere and mesosphere over a thunderstorm. We are now scheduled for a window to open May 23 at Wallops Island, Virginia. Scientists involved include: C. Croskey, J. Mitchell, and L. Hale (Penn State University) and R. Holzworth and B. Barnum (University of Washington, Seattle).

Blackbeard update: The Alexis/Blackbeard satellite has settled down into a more or less regular operating mode in which UW is receiving about 1 MB of data/day or more from the Photodiode Detectors. Dan Holden is the Principle Investigator on the Blackbeard experiment for which the primary instrument is the electric field sensor that is digitized at 150 Ms/s. Due to operation compromises associated with the early launch related problems, we are not getting as much coverage as we would like, but targeted, coordinated experiments are possible.

Thunderstorm '94 is to be a single rocket shot from Wallops Island to study the plasma waves in the ionosphere due to lightning. The launch window opens in late June, 1994. Part of our instrumentation has been delivered and final integration begins June 6. For information contact the PI: M. Kelley, Cornell University, Ithaca, NY or R.H. Holzworth, University of Washington, Seattle, WA.