NEWSLETTER ON ATMOSPHERIC ELECTRICITY

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AMS COMMITTEE ON ATMOSPHERIC ELECTRICITY

AGU COMMITTEE ON ATMOSPHERIC AND SPACE ELECTRICITY

INTERNATIONAL COMMISSION ON ATMOSPHERIC ELECTRICITY

Announcements

Contributions to the next edition of this Newsletter are welcome and should be submitted to Earle Williams, Secretary of the ICAE, by e-mail (preferably) (earlew@juliet.ll.mit.edu) or by fax (617-253-6208) any time before October 31, 1997. Mark your calendars!

In Memory of Bernard Vonnegut

1914-1997
Honorary President of the ICAE

"Just Lucky, I Guess"

In the Spring of 1975 John Willett, then my fellow graduate student at MIT, suggested that I travel to Albany to meet Bernard Vonnegut and further explore the issue of the gravitational energy of precipitation in thunderclouds. This meeting turned out to be a major event in my life. Within minutes of meeting Bernie, there seemed little doubt that we belonged to the same "karass" (*Cat's Cradle*). He asked me where I was from. When I replied "A small town in Indiana you've never heard of," it was immediately revealed to me that in this small town (Culver) many years earlier he and his younger brother Kurt had summered away from their winter home in Indianapolis. Bernie mentioned some years later that Kurt had identified the star Tralfamadore (*Slaughterhouse Five*) from the shore of Lake Maxinkuckee on the edge of that small town. I later learned that my father had known many of Bernie's relatives.

Several years after this first meeting, Bernie described to me his own experiences as a graduate student at MIT. To my great surprise, he confessed that he had not been much of a student. In graduate school he had signed up for Morse and Feshbach's Methods in Theoretical Physics and discovered in the same classroom the name Richard Feynman. Prof. Henry Houghton mentioned to me more than once and was evidently very proud of the fact that he had landed Bernie's first job dealing with smokes in the Chemical Engineering Department at MIT. Bernie later became interested in the problem of aircraft icing in the Meteorology Department. These experiences probably set an important stage for his later work on nucleation with Irving Langmuir and Vincent Schaefer in Project Cirrus at the General Electric Research Laboratory which began in the Fall of 1945.

Bernie's way in science was to go out and measure things, a trait in rather short supply in the meteorological community today. He overflowed with ideas. Many of his measurements were carried out in his laboratory, which was accurately depicted in brother Kurt's quotation of Bernie's own description: "If you think this is a mess, you should see what it's like up here," pointing to his head (*Wampeters, Foma and Granfalloons*). In his laboratory he discovered the efficacy of silver iodide for nucleating the ice phase, investigated droplet production from electrified wires, worked with oscillating anemometers of all shapes and sizes (with enthusiastic support from Haflidi Jonsson), constructed a toothpick air gun designed to infer maximum wind speeds in tornadoes, studied (with Andy Detwiler) repeated nucleation of water samples with the same silver iodide source, and demonstrated vortex intensification with a high voltage arc (with Bob Ryan). Larger scale experiments required the out-of-doors: space charge release studies with his inspiring and energetic scientific colleague Charlie Moore began in the 1950's at A.D. Little in West Cambridge and continued in the 1980's at Langmuir Laboratory, an ionospheric potential measurement by nulling method (that nearly hooked John Willett for a doctoral thesis and which Ralph Markson later pursued by aircraft methods for his own thesis with Bernie), a vertically pointing Doppler search for lightning-induced changes in particle fall speeds (which did hook Roger Lhermitte and me), the deployment of segmented wires by balloon for triggering lightning, and the installation of a corona wire "corral" around a field mill at Langmuir Lab.

Bernie is occasionally seen as some kind of nut in the eyes of some meteorologists, but they didn't know him well. For example, some will probably remember Bernie as the guy who believed that electricity powered all tornadoes, rather than the guy who first identified and called attention to the discrepancy between theory and observation in the maximum wind speeds of tornadoes. The meteorologists are still puzzling today about the thermodynamic limit, and improved wind measurements by Howie Bluestein and colleagues are still high by comparison. Bernie was not a crazed electrifier, but rather a fundamental and innovative thinker. His concepts were uncomplicated and free of equations, though he appreciated the complicated, as exemplified in his well known statement "What theorist would have predicted lightning?" For one of his many San Francisco AGU talks concerned with lightning and electrostatic energy, he drew crude circles with a crayon that looked (Bill Winn joked with him afterward) like a child's drawing. The comment was on target. Bernie later related his feelings about the space charge release experiments with Charlie Moore as feeling like a child with a rattle, and he wanted to keep shaking that rattle. Roger Lhermitte called him a dreamer; that description is appropriate too.

On another visit to Albany, a cooler-full of electron-charged blocks of dry-iced polymethylmethacrylate went along. (Bernie and Charlie had explored this phenomenon years earlier at A.D. Little and were nearly bounced from the fashionable Locke-Ober restaurant in Boston after one of Charlie's live demonstrations at their table.). In Albany, one of these blocks became the target of Bernie's toothpick air gun, and a successful discharge. Another block went to the arbor press for mechanical fracture, sending a shower of plastic fragments all over the lab. My later reassembly of all of these fragments showed that the fracture had also successfully triggered a discharge.

Bernie often mentioned Jim Hughes' name during my visits to Albany, thankful that Hughes at the Office of Naval Research had supported collaborative research work with Charlie Moore that was "180 degrees out of phase" with the ideas of Marx Brook on thunderstorm electrification. One of Bernie's admirable qualities was his remaining your friend despite significant differences of scientific opinion. Perhaps the best example of this quality was his long-standing friendship with Marx, with whom he shared great mutual respect.

Bernie, Anton Seimon and I had planned a winter trip to the summit of Mt. Washington a couple years ago. Bernie hoped to release liquid propane and seed the supercooled cloud frequently encountered on the summit and then look for a perturbation in the satellite pictures from space. As it turned out, Bernie did not feel strong enough to make this trip and Anton and I went alone. Unfortunately, no opportunity arose for the proposed experiment but the orange propane tank with "B. Vonnegut" scrawled on its side is on the summit, awaiting this trial. We shall do it for Bernie one of these days.

Bernie kept things churning and stayed in the arena till the last month of his life. He kept us thinking and (as his close friend Edmund Dewan recently remarked) kept us laughing too. He continued to challenge the concept that he gave name to: the paradigm of atmospheric electricity. He tried repeatedly to organize a chaff release experiment to determine where air parcels initially in the tops of thunderstorms would wind up. He knew of his cancer (few others did) when he gave his last AGU talk last December on the polarity of the global circuit, and bypassed chemotherapy because it would have interfered with his attending the meeting.

This Spring, I traveled to Albany again, three weeks before Bernie died. During our two hour conversation, he spoke of his desire to honor Joseph Henry on the anniversary of his 200th birthday. He spoke of James Espy and his ideas on weather modification with forest fires. He spoke of the need to study fair weather electricity toward understanding the behavior of thunderstorms. On other issues he was clearly concerned: that Langmuir's work on periodic seeding with silver iodide had not been properly followed up, that the results of the space charge release experiments had not been properly interpreted, that the occurrence of positive ground flashes had numerous interpretations. He referred to the still unresolved issue of the origin of thunderstorm electrification as "a magnificent problem."

Late in the discussion (I had overstayed my visit) he looked over and said: "I've been thinking about an epitaph: 'Just lucky, I guess.' You know the story, don't you?" I didn't know the story and what followed was one of those Hoosier-hilarious jokes that does not bear repeating here. But the underlying meaning was clear: Bernie attributed his success with scientific discovery to serendipity. The epitaph is characteristically modest. Bernie's special creativity would have carried him with or without serendipity. We shall miss him greatly.

-- Earle Williams

AGU CASE News (From Don MacGorman):

AGU/CASE has requested five special sessions for the fall AGU meeting in December. To help you prepare papers for these sessions, the title and the convener of each session are listed below:

- Thunderstorm Electrical Effects on the Middle and Upper Atmosphere and Ionosphere
  Convener: D. D. Sentman, Geophysical Institute, University of Alaska Fairbanks,

Fairbanks, AK 99775-7320, tel.: 907-474-6442, fax: 907-474-7290, e-mail: dsentman@gi.alaska.edu

- The Role of Runaway Air Breakdown in Atmospheric Electricity. Convener: Robert Roussel-Dupre, NIS-1, Mail Stop D466, Los Alamos National Laboratory, Los Alamos, New Mexico, 87545, tel: 505-667-9228, fax: 505-665-7395 or 505-665-3332, e-mail: roussel-dupre@lanl.gov

- Deep Convection and Atmospheric Chemistry: The STERAO-A Project Convener: James Dye, NCAR MMM/ATD, P.O. Box 3000, Boulder, CO 80301, tel.: 303-497-8944, fax: 303-497-8171, email: dye@ucar.edu

- Lightning and Thunderstorm Electrification Convener: Don MacGorman, CIMMS, 100 E. Boyd, Rm 1110, Norman, OK 73019, tel.: 405-325-5667, fax: 405-325-7614, e-mail: dmacgorm@hoth.gcn.ou.edu

- Global Electrical Circuit Convener: Earle Williams, MIT Parsons Laboratory, MIT 48-211, Cambridge, Ma 02139. tel.: 617-253-2459, fax: 617-253-6208, email: earlew@ll.mit.edu

To make room for a CASE article, we are omitting the usual list of names and addresses of CASE members. The list published last spring and fall is still valid. I think that a recent article (ASLA 97-3) by AGU staff is important to our community and so am including an edited version (with permission of AGU):

An increasingly important role of scientists is to influence the formulation of national science policy by educating their elected representatives in Congress. Congress and the President have agreed on the goal of balancing the federal budget by 2002. The necessary reductions in federal spending will come mainly from the 'discretionary' part of the budget-the part that includes support for science. It is inevitable that scientific research will be closely examined as a candidate for reductions.

A concern for the scientific community must be that many Members of Congress neither understand the importance of funding for research nor have the facts necessary to make informed voting decisions. If research funding is targeted for cuts, educating Congress on the importance of continued support may mean "the difference between slight reductions and wholesale slaughter" as one observer recently put it.

Members of Congress want to know what their constituents are thinking and what concerns them. Your representative and senators want to know how science, or your research, affects individuals and institutions in your district or state.

Last year Neal Lane, NSF Director, said in a speech to scientists, "...if you don't take it as one of your professional responsibilities to inform your fellow citizens about the importance of the science and technology enterprise, then that public support, critical to sustaining it, isn't going to be there...One thing that has been striking during this year of budget battles...is the perceived stony silence of the science and technology community...And I can assure you that this perceived lack of concern has not gone unnoticed in Washington."

Communicating with your elected representatives can appear intimidating if you have not done it before. Actually, it is easy. Remember, they are trying to represent you and WANT to know how YOU feel about the issues on which THEY must vote.

Writing To Congress

A personal letter is probably the easiest way to contact your legislators. The following are guidelines for writing:

1. Address the letter to YOUR senators or representative. You are his/her constituent and he/she is interested in your opinion. Address for senators: The Honorable _________, U.S. Senate, Washington, DC 20510; Salutation: Dear Senator __________: Address for representatives: The Honorable _________, U.S. House of Representatives, Washington, DC 20515; Salutation: Dear Congressman/Congresswoman________:

2. Immediately identify the subject you are writing about. Limit your letter to one topic. If it concerns a specific bill, identify the bill by name and number.

3. Tell the senator or representative why you are advocating your position. State facts; give examples. Tell how the legislation will affect you and your institution, company, group, state, district, etc. Do not generalize; be specific.

4. Repeat your reason for writing. Thank the senator or representative for his/her cooperation.

5. Keep the letter polite, positive, and constructive. Never threaten. Include your local address. Limit the letter to one or two pages. Type the letter or write neatly. Do not send a photocopy. Type/print your name underneath your signature.

Before you write, you might find it helpful to call your legislator's office and ask for the name of the staff member (also known as a staffer) responsible for the issue of interest to you. Then, when you address the letter to the legislator, send it to the attention of the staffer. The staffers are the issue experts, and the elected officials listen very carefully to what a staffer has to say about a particular topic.

Federal Employees

Some government employees have thought that they were prohibited from contacting congressional representatives, at least about issues affecting them as government employees or about matters involving their agency. To clarify the rules for federal employees communicating with Congress, we contacted the Office of Personnel Management, the Office of Government Ethics, and the Office of Special Counsel for information.

Federal employees DO have the right, as does any citizen, to communicate with their elected representatives. In addition to First Amendment rights, U.S. Code provides that the rights of federal employees to petition Congress or provide information to Congress may not be interfered with or denied. Communication can include expressing your opinion about a program involving your agency or with which you personally work.

However, there are guidelines for federal employees when writing or speaking to a Member of Congress:

1. When communicating with your senators or representative, be sure to indicate that you are doing so as a private citizen, not as an official of your agency. Do not write on

agency letterhead or use your official title, but you can say that you are employed by a particular federal agency.

2. You are not permitted to solicit a Member of Congress for a recommendation for a personnel action, such as a promotion.
3. To avoid a conflict of interest, you may not represent anyone other than yourself. For example, you could not endorse a company doing business with your agency.
4. If you have *any* questions about a particular action you want to take, you should contact the designated agency ethics official for your agency. Some rules may be unique to your agency.

Meeting With Your Elected Officials

Another excellent opportunity for scientists to communicate is when legislators are back in the home state or district. It is often easier to meet with an elected official in that setting. A call to the district or state office will tell you when the legislator will be in the state.

If you are planning a trip to Washington, you can set up a visit to your legislator's office. If the Member of Congress cannot meet with you, ask for a meeting with the staff member handling science issues.

Procedures for visits in either setting are as follows:

1. Make an appointment. State the subject to be discussed, the time needed (do not expect more than 15-20 minutes if meeting in Washington), and identify persons who will attend.
2. Be early for the appointment and be prepared to wait. Legislators' schedules change frequently, and you must be flexible with your time. Do not be disappointed if the legislator cannot meet with you and a staffer does. Staffers are extremely influential. Be prepared to make the same presentation to the staffer that you would have made to the legislator.
3. Select a spokesperson if others are going with you. Agree on your presentation in advance. Also, make sure that everyone in the group is in agreement on the issue to be discussed. You do not want to be surprised in the meeting.
4. Know the facts, both legislative and related to your position. If a bill is being discussed, know its number and title and the Member's position on it.
5. Present the facts in an orderly, concise, positive manner. Be prepared to discuss the arguments that are counter to your position. The Member or staffer may want to explore the issue from all sides when discussing it with you.
6. Relate the positive impact of legislation you support and the problems it corrects.
7. Relate the negative impact of legislation that you oppose and offer, where appropriate, a different approach.
8. Prepare a one-page fact sheet to leave at the end of your visit.

9. Ask for favorable consideration of your position, thank the legislator or staffer for his/her time and courtesy, and leave promptly.

We hear an increasing number of reports from AGU members who have begun communicating with their senators and representatives. Rather than being put off by the experience, they express satisfaction that they were able to raise the elected official's understanding of the importance of strong support for scientific research. Try it yourself.

We thank AGU for providing partial funding of this newsletter.

3rd International Workshop on the Physics of Lightning (IWPL)

As decided in Osaka in September 1995, the 3rd IWPL will take place from 15-20 September, 1997, in France (Saint Jean de Luz, near Bairritz). The IWPL spirit will be to emphasize scientific exchanges, discussions and collaborative projects. There will be a restricted number of invited participants (50), and much time allocated for discussions in general sessions and working groups. For more information contact: APERI, Attn: Gérard Berger, 28 résidence La Vallé, 91120 Palaiseau, France. Tel: 33-1-69-85-17-77; fax: 33-1-69-41-03-34.

RACES

The target dates for RACES have been changed since the last notice of early April. In response to V.N. Bringi's input on storm climatology in northeastern Colorado, and to interests of possible collaborators with interests in SPRITE studies, the target dates have been shifted to 1 June through 10 July 1998 (a 6-week period). Please check the anonymous ftp site on nimbus. ias.sdsmt.edu for further info. The contacts on the project are Andy Detwiler and John Helsdon.

IAGA Conference, Uppsala, Sweden, August 4-9, 1997

Dick Goldberg and Dave Sentman are convening Symposium (2.19), entitled "Electrodynamic Upward Coupling in the Middle Atmosphere and Ionosphere (Sprites, Jets, etc.)." Contact them at goldberg@nssdca.gsfc.nasa.gov and dsentman@gi.alaska.edu, respectively. Bob Holzworth will also chair a session on Middle Atmospheric Electrodynamics.

IAMAS Meeting
(International Association of Meteorology and Atmospheric Sciences)

This meeting is planned for July 1-9, 1997, in Melbourne, Australia. For further information contact mscarlet@peg.apc.org.

24th International Conference on Lightning Protection (ICLP)

The conference provides an excellent opportunity for scientists, engineers, designers and users of lightning protection systems, from a wide range of universities and industry, to present and discuss the latest scientific results and share their pracitcal experiences in the field of lightning protection technology. The meeting will be held in Birmingham, UK, September 14-18, 1998. For further info contact Caroline Lees (c.a.lees@soc.staffs.ac.uk).

International Scientific Meeting on Electromagnetics in Medicine

This is the third scientific meeting on Microwaves in Medicine, sponsored by the International Union of Radio Science (URSI) through its Commision on Electromagnetics in Biology and Medicine and the Institute of Electrical and Electronic Engineers (IEEE) through its Microwave Theory and Techniques Society. It will be held at the Congress Hotel in Chicago, Illinois, November 3-5, 1997. Authors are invited to submit papers on all topics of interest to electromagnetics in biology and medicine. This seems like a natural follow-up to some of the recent meetings on lightning and will build on the medical aspects of lightning injury, electromagnetic effects, and other bioengineering aspects. Please contact Mary Ann Cooper, MD, Room 618 College of Medicine West, 1819 West Polk St., Chicago, IL 61612-7354. Tel: (312) 413-7840, Fax: (312) 413-0289.

URSI (International Meeting of Radio Science)

Abstracts for a meeting in Boulder, Colorado (Jan. 5-9, 1998) are requested by Sept. 19, 1997. Sessions on natural and man-made noise (David Cohen) and on sprites and ionospheric effects of lightning (Umran Inan) are planned. Questions should be directed to Dr. Denise Thorsen (infoursi@cires.colorado.edu).

Next International Conference on Atmospheric Electricity

The Eleventh International Conference on Atmospheric Electricity, hosted by the NASA Marshall Space Flight Center, will be held June 6-11, 1999. Local arrangements will be handled by Dr. Hugh Christian (hugh.christian@msfc.nasa.gov). It will convene at the Gunthersville Lodge in Gunthersville State Park, Gunthersville, Alabama.

Job Opening

Airborne Research Associates, a small Boston area (Waltham) company doing basic atmospheric electrical and lightning research, has an unusual job opportunity for a scientist, experimental physicist or electronics engineer to participate in four ongoing projects. These programs, funded by NASA, NSF and NOAA, involve developing a new generation of lightning detection and mapping systems for ground and aircraft use, conducting atmospheric electrical balloon soundings to observe the global electrical circuit as part of a global warming study, and investigating the use of RF radiation from thunderstorms to identify storms with tornadoes. Much of the work involves the use of lightning as a diagnostic for aviation hazards. The person must be proficient at programming (preferably C and assembly language), PC computer technology, electronic experimentation and verbal communication. Experience with RF, digital engineering and product development would be ideal. Some of the work requires operating equipment on a twin engine research aircraft during data collection. An advanced degree is desirable but not required. The person must be self directed and able to work in several projects in parallel in a non-structured setting. Some field work and travel is required. The work is interesting, challenging, demanding and rewarding for someone interested in meteorology, aviation and developing new technology. Interested parties should send their full resume with references to: Dr. Ralph Markson, Airborne Research Associates, 46 Kendal Common Rd., Weston MA 02193.

RESEARCH ACTIVITY BY ORGANIZATION

Airborne Research Associates (Waltham, MA)

ARA is continuing its projects to develop new lightning mapping technology with particular application toward aviation safety. One project involves a ground based multistation time-of-arrival system and another is to develop the first single-station aircraft system that can determine the distance to lightning accurately. The availability of an accurate total lightning mapping system on an aircraft enhances the capability for studying RF discharges from thunderstorms producing tornadoes compared to non-tornado thunderstorms in a project beginning this summer. Another study involves investigation of new ways to observe global temperature variation through balloon soundings of ionospheric potential and columnar resistance. These projects are led by Ralph Markson and Lothar Ruhnke.

Colorado State University (Ft. Collins, CO)

Larry Carey and Steve Rutledge are investigating the relationship between mixed phase microphysics and lightning in tropical convection by utilizing the first coincident electrical and polarimetric radar observations of tropical storms obtained during the Maritime Continent Thunderstorm Experiment (MCTEX). Analysis of BMRC C-pol radar data has allowed the investigators to distinguish between rain and ice throughout the entire storm volume. Polarimetric radar observations have been compared to total lightning flash rates from a flat plate antenna, the surface electric field as measured by a NASA/MSFC field mill, and the cloud-to-ground (CG) lightning flash rate and location as determined by a network of Advanced Lightning Direction Finders (ALDF) provided by NASA/MSFC. Preliminary results suggest a strong correlation between mixed phase ice mass, initial storm electrification, and lightning.

In addition, Larry Carey and Steve Rutledge continue their research on positive CG producing severe hailstorms in northeastern Colorado. Detailed analysis of CSU-CHILL polarimetric radar and NLDN (National Lightning Detection Network) observations of two severe hailstorms (7 June 95 and 31 July 96) occurring along the Front Range has revealed a consistent pattern between precipitation structure and positive CG lightning. Clusters of positive ground discharges appear to be correlated with convective cell collapse and the fallout of large hail. Large hail typically falls out of these storms 20-30 minutes prior to the peak in positive CG lightning. Rapid increases in the surface rain and hail mass flux associated with echo descent occur simultaneously with the maximum positive CG flash rate. Several more case studies have been identified in the 1995 and 1996 warm season data and will be analyzed in the near future.

Walt Petersen and Steve Rutledge have been conducting sensitivity studies using a 1-D dynamical cloud-model (Ferrier-Houze model) with a four-ice category bulk microphysical scheme and parameterized non-inductive charging processes to investigate the coupling between the large scale thermodynamic environment and cloud kinematic, microphysical and electrical development. Specifically, recent analyses have focused on diagnosed convective heating profiles associated with the modeled convection as a function of convective/electrical intensity. The simulations suggest that deep tropical lightning (non-lightning) producing convective clouds are associated with more pronounced upper (lower) level diabatic heating peaks and an increased (decreased) contribution by ice processes (relative to warm-rain coalescence) to the total convective rainfall. On-going work seeks to assess the contribution made by lightning-producing convection to the total "cloud ensemble" heating profile.

Work is also underway with Earle Williams concerning the analysis of surface wet-bulb temperature and lightning data collected in French Guyana during 1989. Analysis has focused on the diurnal cycles partitioned by season and ITCZ location. The data suggest consistent variations between surface wet-bulb temperature and lightning flash density as a function of season. Months associated with more rainfall, less lightning and a stronger maritime influence exhibit a lower amplitude diurnal cycle (broad early afternoon peak) in both wet-bulb and flash frequency (but more pronounced than that observed over the western Pacific during COARE). During the electrically-active summer and early Fall, the airmass in French Guyana experiences a more continental influence, accompanied by higher amplitude diurnal cycles in both lightning and wet-bulb temperature. Spectral analyses will be performed on both the lightning and wet-bulb data-sets to examine intra-seasonal variations in the two variables and the role that tropical wave disturbances play in modulating electrical activity over tropical South America.

Timothy Lang and Steve Rutledge are currently analyzing lightning data gathered during Phase A of the Stratosphere-Troposphere Experiments: Radiation, Aerosols, and Ozone (STERAO-A) field project, which took place during the summer of 1996 in northeastern Colorado. STERAO-A was designed to study the chemical impacts of deep, isolated convection, and included the use of a three-dimensional VHF lightning interferometer (ITF) designed by the Office National d'Etudes et deRecherches Aerospatiales (ONERA). Also being examined are data from the National Lightning Detection Network (NLDN) and a network of three field change meters. To date, ITF data for two storms have been studied and compared to the other lightning data sets. Cloud-to-ground (CG) flash rates from the NLDN and ITF do not agree well, with ITF typically detecting far more CGs than the NLDN. The likely reason is that, due to unforeseen problems in its vertical resolution, ITF is classifying spider discharges-which resemble CG leader processes in the VHF band-as CG leaders, because it is locating them at altitudes lower than their true positions. The NLDN is probably closer to truth, as it detects and classifies based on emissions from the return stroke (which emits only weakly in VHF), thus avoiding any ambiguity involved in classifying based on leader radiation. However, the NLDN may have detection efficiency issues of its own, and could play a small role in causing the disagreement. ITF also appears to be detecting a multitude of short duration (<1 ms) intra-cloud (IC) flashes. Some of these flashes may be parts of other, longer flashes and are probably being mistakenly classified as separate flashes by ITF's classification algorithm. However, there are many isolated flashes which may be positive bipolar discharges-short (~10-20 microsecond) discharges that propagate upward from the main negative charge region, but fall short of connecting to the main positive region near the top of the thunderstorm. This possibility is currently being examined. Because of its better detection efficiency and temporal resolution (2 3 microseconds vs. 1 ms for the field change meters), ITF detects many more flashes than the field change meters used in the experiment. However, based on data from one storm, flash rates calculated from the field change meters trend ITF-derived flash rates quite well.

Bard Zajac and Steve Rutledge are developing a climatology of cloud-to-ground (CG) lightning in the contiguous United States using observations from the National Lightning Detection Network (NLDN). This climatology is being developed within the framework of the WSR-88D NEXRAD radar network so that the lightning data can be placed within meteorological context. Due to its anomalous nature, strong emphasis is given to understanding the temporal and spatial distributions (absolute and percent of total) of positive polarity CG lightning. We attempt to explain two steady, large-scale spatial features shown in previous studies of this type (Orville and others): 1) annual maxima of positive polarity CG flash density in the Central and Southern Plains, and 2) annual maxima of percent positive polarity CG flashes in the High Plains and Upper Midwest. We speculate that positive polarity CGs are produced primarily by 1) stratiform regions of squall lines and mesoscale convective systems (MCSs); 2) severe local storms; and 3) decaying convective activity. Further, observations (1) and (2) may be explained by the high frequency of occurrence of squall lines and MCSs over the Central and Southern Plains and severe local storms over the High Plains and Upper Midwest relative to other types of convective activity. We are testing this hypothesis by examining the spectral characteristics of positive polarity CGs over these and other regions in the contiguous United States in the context of the radar-identified precipitation structures. This analysis is being done by applying a clustering algorithm (low-pass filter) to the NLDN data. We expect that the temporal and spatial characteristics of positive polarity CG clusters will be related to the convective regimes endemic to specific regions in the U.S. (e.g., long-lived, expansive clusters in the Southern Plains versus more impulsive, isolated clusters in the High Plains).

University of Electrocommunications (Chofu, Tokyo, Japan)

M. Hayakawa reports on the International Workshop on Seismo Electromagnetics, March 3-5, 1997 in Tokyo:

After the disastrous Kobe earthquake in January 1995, STA of Japan called for an "Earthquake Integrated Frontier Research" project, which began last fiscal year and will be continued for the coming four years. The Earthquake Integrated Frontier Research consists of five projects, and NASDA has decided to conduct an "Earthquake Remote Sensing Frontier Research (ERSFR)" as one of the five projects. The ERSFR project has two subsets; one is the application of SAR interferometry technique to earth studies, while the second is concerned with the coordinated study of electromagnetic and other related phenomena associated with earthquakes. This workshop was dedicated to the latter aspect, whose aim was to perform extensive and coordinated studies of phenomena taking place in the atmosphere and ionosphere/magnetosphere, and then to study the feasibility of using these phenomena for earthquake prediction.

The aim of this workshop sponsored by NASDA was to have an open forum to highlight the seismo-phenomena taking place in the atmosphere and ionosphere/magnetosphere and their related phenomena. The workshop was planned to evaluate previously observed phenomena, to collect significant new data and then to discuss the physical underlying mechanisms. The final goal of NASDA's ERSFR project isa comprehensive view on the seismo-phenomena taking place in the atmosphere and ionosphere/magnetosphere, and and understanding of the energy transfer from the lithosphere to the atmosphere and ionosphere/magnetosphere, etc. The subjects discussed in this workshop included,

1. Seismo-electric and -magnetic signals (SEMS) observed by geophysical methods on the ground surface;
2. Seismogenic electromagnetic emissions (ULF, ELF/VLF/LF, MF, HF frequency range) observed on the ground;

3. Seismogenic electromagnetic emissions in the ionosphere;
4. Electromagnetic sounding of the atmosphere in relation to earthquakes (modification of radio signals, atmospheric noise, optical emission, lightning activity, etc.) and associated phenomena;
5. Electromagnetic sounding of the Earth's environment in relation to earthquakes (modification of radio signals, atmospheric noise, optical emission, lightning activity, etc.) and associated phenomena;
6. Modeling of seismo-phenomena in the atmosphere and ionosphere/magnetosphere and energy transfer from the lithosphere to upper atmosphere.

This workshop was attended by approximately 150 scientists, including about 50 foreign scientists. About 60 papers were presented orally, and about 70 papers as poster papers. There was extensive discussion on new results on seismo-electromagnetic emissions in the atmosphere and on wave and plasma phenomena in the ionosphere, associated with earthquakes, and on their physical mechanisms. Future satellite missions were also discussed. Abstracts are available on request. Please contact M. Hayakawa, Dept. of Electronic Engineering, The Univ. of Electro-Communications, 1-5-1 Chofugaoka, Chofu Tokyo 182. A monograph on "Seismo Electromagnetics" is scheduled to be published at the end of this year or early next year, which will include the papers presented in this workshop.

University of Florida (Gainesville, FL)

Vlad Rakov reports: Triggered-lightning experiments will continue in Summer 1997 (for the fifth year) at Camp Blanding, Florida. Researchers interested in participating in the program should contact Martin Uman (muman@admin.ee.ufl.edu).

Martin Uman, Vlad Rakov, Keith Rambo, Tim Vaught, Mark Fernandez, Dan Cordier, Bob Chandler (Florida Museum of Natural History), Ralph Bernstein (EPRI), and Charlie Golden (Camp Blanding Florida Army National Guard Base) authored a paper titled "Triggered-Lightning Experiments at Camp Blanding, Florida (1993-1995)." The paper is scheduled for publication in the April issue of the *Transactions of the IEEE of Japan.*

Dan Cordier, Mike Stapleton, Keith Rambo, and Martin Uman have excavated and are preparing for display in the Florida Museum of Natural History in Gainesville, Florida, the fulgurite that has two long branches extending downward from the ground strike point. One branch is 17 feet (5.2 m) in length and the other 16 feet (4.9 m) in length. The fulgurite was produced on July 15, 1996 by a Camp Blanding triggered-lightning flash that did not attach to the rocket launcher but terminated on the ground instead. The longest fulgurite we have been able to find in a museum is about 13 feet (4.0 m). Does anyone know of a longer one?

Daohong Wang of Gifu University, Japan has joined the University of Florida lightning research group for the period April 1997 through January 1998.

FMA Research Inc. (formerly ASTeR, Inc.) (Ft. Collins, CO)

Walt Lyons and Tom Nelson are continuing to analyze results from the SPRITES'96 field program which was conducted at the Yucca Ridge Field Station last summer. Well over 1000 sprites and elves were imaged. A complete description of the experiment, measurement systems deployed, and some preliminary results can be found in our new sprite Web site: http://www.FMA-research.com.

An extensive video summary of the sprite efforts at Yucca Ridge during the 1993-1996 seasons was prepared by FMA Research for NASA. This 75 minute narrated tape includes numerous "highlights" of sprite and elve storms. We would be happy to make duplicate copies of the tape. Please send either VHS or S-VHS tape (120 minutes) along with a stamped return mail envelop to Walt Lyons, Yucca Ridge Field Station, 46050 Weld County Road 13, Ft. Collins, CO 80524. We will dupe your copy as quickly as possible.

SPIRTES'97 will be conducted at Yucca Ridge from 1 July through 10 August 1997. While plans are still being finalized, measurements will be made by several teams including those from FMA Resreach, MIT/Lincoln Lab, Penn State and Tohoku University. STAR Lab will continue its broad band VLF measurements. Multispectral (blue and red) low-light video images will be made in conjunction with blue and red photometer measurements.

An extensive climatology of large peak current CG events, from 14 summer months of NLDN data, has been completed by Walt Lyons, Marek Uliasz and Tom Nelson. The results are being submitted to the Monthly Weather Reveiw. A summary, along with some color maps, will be posted on the FMA web site shortly.

GemM Laboratory of Shmidt's Earth Physics Institute, Russian Academy of Sciences (Borok, Russia)

For experimental investigations of the Earth's electrical environment, aeroelectrical, geophysical and radiophysical measurements will be continued at the experimental complex of the Geoelectromagnetic Monitoring Laboratory (58N, 38E).

The experimental complex is equipped for field digital recording of a wide class of geoelectromagnetic, aeroelectrical and meteorological signals. It is composed of a set of sensors, amplifiers, analog filters, and acquisition systems for observation of the following geophysical fields:

a) vertical electric current by a current collector with effective area 2500 m^2;

b) atmospheric electric field with help of electrostatic fluxmeters ("field mills");

c) 3-component geomagnetic field;

d) riometric observations of cosmic radio noise absorption at the frequency 32 MHz;

e) Doppler frequency shift of radio waves;

f) atmospheric pressure by a liquid microbarograph and other meteorological parameters.

Data recording is performed with the use of a data-logging system based on an IBM PC with an analog-digital converter, magneto-optical disks and a CD for data storage.

The local, regional and global aeroelectrical effects will be studied toward the construction of the aeroelectrical structure's hierarchy in the global electrical circuit. The research of ionosphere-atmosphere coupling will be continued for magnetic disturbed conditions.

The problem of the electrical boundary layer will be considered by means of computer modeling of turbulent convection. Altitude profiles are shaped for different values of some atmosphere parameters. The electric current variations caused by temporal modification of the conductivity profile will be analyzed by means of a computer modeling method.

The research team of GemM Laboratory gratefully thank Dr. Lothar Ruhnke for technical support in the data-logging system.

University of Illinois (Chicago, Illinois)

Mary Ann Cooper, MD, Associate Professor of Emergency Medicine and Director of the Lightning and Electrical Shock Injury Evaluation Program at the University of Illinois, has provided education and clinical care for hundreds of survivors of lightning and electrical injury and their families. She has come to realize that the only way to address the questions that need to be answered in lightning injury is to develop an animal model. Although Kitigawa, Ishikawa, and Ohashi and Andrews have done the foundation work in these areas, none of them have continued in the basic science, animal model work. In an effort to better understand lightning, she has attended international atmospheric electricity and lightning meetings for years, interfacing and becoming acquainted with professionals from cloud physics, electrical engineering, meteorology and many other disciplines concerned with lightning. Because of her international reputation as an expert in these injuries, she can command good fees for expert testimony and has used these monies to self-fund her research hoping to develop the model to the point where it will be fundable by other sources. In the next few years she will be attempting to answer the questions of the pathway and cellular effects of the lightning energy in addition to using the model to potentially test lightning protection clothing and perhaps eventually drugs that can be administered acutely to mitigate the long term complications of lightning injury in its survivors. (If anyone has sources for potential grant, contract, or gift funding, please let her know.) She also welcomes discussion on these topics and is maintaining a list of those interested in the medical effects of lightning. If anyone would like to be added to the list, please contact her at macooper@uic.edu.

Indian Institute of Tropical Meteorology (Pune, India)

The following abstracts describe work done at the Institute over the past couple of years:

A. Mary Selvam, et al.: Diurnal and seasonal variations of space charge, electric field and cloud condensation nuclei in the lowest layer of the atmosphere (*Tellus,* **32,** 1980, 232-244).

Diurnal and seasonal variations of space charge, vertical electric field and cloud condensation nuclei in the lower layers of the atmosphere during winter, pre-monsoon, monsoon and post-monsoon seasons were studied.

The curve showing the diurnal variation of space charge exhibited a double oscillation corresponding to that of the electric field during winter and pre-monsoon seasons. Similar features are absent during monsoon and post-monsoon seasons. During pre-monsoon the semi-diurnal components of space charge and electric field are in phase, while in winter the semi-diurnal component of space charge occurs 1 h ahead of the electric field component.

The mean values and diurnal ranges of both space charge and electric field are high during winter/pre-monsoon and are low during monsoon/post-monsoon seasons. The diurnal range of temperature and concentration of cloud condensation nuclei are positively correlated with space charge and the electric field.

The pre-sunrise minimum in the electric field is associated with the characteristics of the F-region of the ionosphere rather than with the ground sunrise time. The variations in the F2 layer critical frequency (foF2) are reflected in the diurnal and inter-diurnal components of the surface electric field. The results of the present study support the hypothesis that the increase in the electrosphere potential could be the source of the atmospheric electric sunrise effect (Muir, 1975).

G.K. Manohar et.al.: Effects of thermal power plant emissions on atmospheric electrical parameters (*Atmospheric Environments,* **23,** 1989, 843-850).

Emissions from industrial stacks may not only cause environmental and health problems but also cause substantial deviation in the fair weather atmospheric electric parameters.

Observations of the surface atmospheric electric field, point discharge current and wind in the vicinity of a thermal power plant were made during three field observational programmes. Results of these observations are presented and they are used for determining the minimum distance from the source point for expecting normal fair weather surface atmospheric electric field. Measurements of surface atmospheric electric field may be considered as one of the aids for the detection of pollution caused by industrial processes.

G.K. Manohar, et al.: Some characteristics of point discharge current during two pre-monsoon season thunderstorms at Pune (*Current Science,* **59,** 1990, 367-370).

Measurements of point discharge current were made at Pune during two pre-monsoon season thunderstorms of 1987 and 1988. The monthly distribution of the number of days of thunderstorms in the pre-monsoon months of 1987 was seen to vary from that of 1988 though the total number of seasonal thunderstorm days on both occasions were equal. The daywise features of point discharge current on the days of thunderstorm during 1987 and 1988 are presented. Normalized frequency distribution of spells and diurnal time duration of point discharge current and the values of charge received by the earth are also presented.

G.K. Manohar, et al.: Off-shore sea surface electric field investigations around the Indian Sub-continent during 9-20 May 1983 (*Advances in Atmospheric Sciences,* **7,** 1990, 451-462).

Sea surface electric field observations off the coast from Goa (15° 25'N, 73° 47'E) to Madras (13° 04'N, 80° 15'E) around Sri Lanka, in a distance range 25-135 km from coast, during 9-20 May 1983 were taken. In this paper we have examined the diurnal variation of electric field in the Arabian sea, Indian Ocean and Bay of Bengal regions covered during the cruise of the research ship ORV Gaveshani. An aspect of electric field dependence on coastal distance and Aitken Nuclei concentration has also been studied. An attempt to examine the latitude dependence of the field was also made. Results obtained in the above studies are presented and compared with those obtained elsewhere.

S.S. Kandalgaonkar: Variations in the Atmospheric Electric field at a Tropical Station during 1930-1987 (*Advances in Atmospheric Sciences,* **8,** 1991, 99-106).

The variations noticed in the atmospheric electric field recorded at Pune (18° 32'N, 73° 51'E, 559 m ASL), a tropical inland station located in Deccan Plateau, India, during the period 1930-1987, have been examined in relation to the variations observed in the Angstrom turbidity coefficient (B) and selected meteorological parameters. The monthly and annual mean values of the atmospheric electric field, Angstrom turbidity coefficient (B), rainfall, temperature and relative humidity for the years 1930-1938, 1957-58, 1964-65, 1973-74 and 1987 were considered in the study.

The results of the above study indicated gradual increases in the atmospheric electric field over the period of study (1930-1987) which is statistically significant at less than 5% level. The increases noticed during different periods varied from 30 to 109%. The increase noticed during the period (1930-1938) and (1973-1974) was maximum (109%). The Angstrom turbidity coefficient also showed systematic increases during the period of study, which is consistent. The diurnal curve of the atmospheric electric field at the station by and large, showed a double oscillation, which is generally observed in the continental environments.

G.K. Manohar, et al.: Point-discharge-current observations in the thunderstorm environment of the years 1987 and 1988 at Pune (*Monthly Weather Review,* **119,** 1991, 3104-3107).

Observations of point-discharge current through an artificially erected single point in the thunderstorm environment at Pune during the years 1987 and 1988 were made and studied for the monthly net charge received by the earth through this process. Curiously, the net charge received by the earth at the station through point-discharge current, during six thunderstorm days in May and five in June 1987, was noticed as positive and amounted to 9 and 3 mC respectively, whereas during the rest of 1987 and most of the time throughout 1988 the net-charge values were negative.

A possible explanation of this observed feature is sought in an examination of the upper-atmospheric meteorological and electrical conditions that are reported responsible elsewhere and perhaps also in the present case.

A. Mary Selvam, et al.: Electrical, microphysical and dynamical observations in summer monsoon clouds (*Atmospheric Research,* **26,** 1991, 19-32).

Electrical, microphysical and dynamical conditions in ground-based clouds were studied using the observations carried out at Mahabaleshwar (17° 56'N, 73° 40'E; 1382 m ASL), a hill station, during the summer monsoon season of 1977.

There is a significant correlation between the rain intensity and the corresponding atmospheric electric potential gradient. The diurnal curves of rainfall and negative electric potential gradient exhibited two peaks. The peak in rainfall during the morning hours and the afternoon peak in electric potential gradient were statistically significant. The early morning peak in rainfall was attributed to the enhanced convergence caused by the radiational imbalance in the cloud and cloud-free regions during active monsoon conditions. The afternoon peak in the electric potential gradient was attributed to the cloud formation due to convection.

The atmospheric electric potential gradient showed sign reversal from its normal fair weather positive to negative at the time of the onset of rain. The reversal of the electric potential gradient and the incidence of positively charged raindrops at the surface were almost simultaneous. Positive raindrop charges were recorded 1-2 minutes prior to the occurrence of negative electric potential gradient showing a steep increase during heavy rain spells. The raindrop charges were predominantly positive. The possible physical mechanisms for electrification of monsoon clouds have been discussed.

The cloud condensation nuclei and surface temperature also showed peaks during the morning hours. The microphysical observations suggest that the rain formation takes place in monsoon clouds both by the collision-coalescence and ice crystal processes.

A simple 1-D model was used to compute different cloud physical parameters. For a cloud with its top at 9 km the precipitation efficiency is in the range 60-70% of the adiabatic liquid water content. It has an average rainfall rate of 15 mm hr-1, vertical velocity of 3-5 m s-1 and average life time of 30 minutes.

Institute of Geophysics, Polish Academy of Sciences (Warsaw, Poland)

Results of recent work carried out by Nguyen Manh Duc and S. Michnowski on the initiation processes of lightning discharges in a thundercloud have been published in two articles in *J. Geophys. Res.* (vol. 101; No. D 21; 22,669-26,680; 1996).

Experimental and observational work connected with electric charge transport to the Earth's surface by precipitation particles in downdrafts from nearby thunderstorms is continued by Peter Baranski. Preliminary results of those investigations have been presented in a paper published in *Acta Geophys. Pol.* (vol. XLIV, No. 4, 1-7, 1996). Peter Baranski and Tomasz Kuraszkiewicz are preparing a new digital data acquisition system with a fast electric field antenna for obtaining waveforms of characteristic stages of atmospheric discharges and studying their frequency spectra (i.e., PSD) up to 10 MHz. An application of this processing to satellite detection of lightning discharges is also considered.

Further examination of the magnetospheric-ionospheric effects on the ground electric field and air-earth current in the polar regions is continued (S. Michnowski, M. Kubicki, N. Nikiforowa).

The recordings of the atmospheric electric field in both Swider and polar station Hornsund are continued.

In the spring-summer season of 1997, experimental investigations of Maxwellian current by long antenna at Jozefoslaw Station near Warsaw will be continued (it will be the last year of operation). The global component of this current should most accurately map the ionospheric potential (theoretical work on the electric signal transmission through the lower atmosphere is under way). The main task of the experiment is to find whether this component, masked by horizontal space charge advection, is noticeable at ground level. In a uniform conducting fluid, the displacement current caused by charge redistribution connected to the current flowing in this fluid compensates the latter.

P.N. Lebedev Physical Institute, Russian Academy of Sciences (Moscow, Russia)

Following is a report on the project "Role of high energy cosmic rays in lightning production," prepared by the Russian scientist group:

Every day about 4400 thunderstorms and about 8 million lightnings occur on Earth. The thunderstorms and lightnings do damage and every year the losses amount to hundreds of millions of dollars.

Despite the success of the lightning production study, the nature of these phenomena and the physical mechanisms responsible for them are far from completely understood. No theory exists for explaining lightning production and lightning protection.

A central issue of the problem mentioned above is leader lightning leader production. A tentative scenario for lightning initiation includes free electrons - electron avalanche - streamer - leader - main stroke. The leader production requires a great quantity of free electrons to cause enough streamers in the volume 0.1-0.3 km^3 of the thunderstorm cloud. These electrons could be generated by high energy cosmic ray particles with $E > 10^{14}$ eV. When the cosmic ray passes through the atmosphere it interacts with nuclei of atmospheric atoms and produces secondaries. In such events more than 10^5 relativistic charged particles pass through the thundercloud simultaneously. These secondaries produce air ionization and give an abundance of free electrons (> 10^{12} electrons). These electrons could be accelerated by strong electric fields inside the thundercloud and produce avalanches.

To investigate the role of high energy cosmic rays in the lightning production and phenomena in thunderstorms, several groups of Russian scientists (Lebedev Physical Institute, Moscow, Russian Academy of Sciences; Central Aerological Observatory, Moscow, Committee on Hydrometeorology; Research Institute of Pulse Technique, Moscow, Ministry of Atomic Energy; Russian Federal Center - All Russian Research Institute of Experimental Physics, Sarov, Ministry of Atomic Energy) are preparing a project. We shall apply to the International Scientific and Technology Center to apply for financial support. Those interested in this problem are invited to participate. Contact Dr. Yuri Stozhkov, Laboratory of Solar and Cosmic Ray Physics, P.N. Lebedev Physical Institute, Russian Academy of Sciences, Leninsky Prospect, 53, 117924, Moscow, Russia; fax: 7095 408-61-02; e-mail: stozhkov@fiand.msc.su.

Los Alamos National Laboratory (Los Alamos, NM)

The Blackbeard instrument on the ALEXIS satellite has completed three and a half years of operation and continues to acquire TransIonospheric Pulse Pair (TIPP) events under the direction of Dan Holden, Dave Smith, and Dot DeLapp. Two TIPPs, which were recorded by Blackbeard in September of 1996, were also recorded by a LANL ground-based broadband HF receiver. One of the events appears to have originated from tropical cyclone Fausto at a height of 18 km. FORTE, a new satellite with improved sensors for detecting optical and VHF emissions from Earth, is nearly ready to go under the direction of Steve Knox and may launch as early as the summer of 1997.

Dave Smith and Xuan-Min Shao are completing analysis of multiple-station field change and broadband HF data acquired from New Mexico thunderstorms last summer by LANL and New Mexico Tech (NMT). The data indicate that the source which produces TIPP events also produces Narrow Positive Bipolar Pulses (NPBPs), distinct field change events which have been associated with the strongest sources of RF radiation from thunderstorms. Source locations were derived from differential times of arrival and show that the events occurred in the active regions of thunderstorms at altitudes between 5 and 9 km AGL. The source is very short in duration, very powerful, and is not associated with normal intracloud lightning. The events will be studied further this summer.

Dave Suszcynsky and Bob Roussel-Dupre are preparing for the first year of a three year study which involves launching balloons through thunderstorms. The balloons will be launched from Langmuir Laboratory and will be equipped with field change meters and gamma ray detectors. The study is being carried out in conjunction with the National Severe Storms Lab and NMT.

M.I.T. Lincoln Laboratory (Lexington, MA)

Lincoln Laboratory and Marshall Space Flight Center are conducting a study for the GOES Program Office of NESDIS to assess the operational benefits that would be accrued through deployment of a total Lightning Mapping Sensor (LMS) on a future GOES platform. In broad outline, the effort seeks to: (i) identify specific operational forecast and decision-making responsibilities where availability of LMS data would be of value; (ii) estimate the frequency with which each such benefit category is realized; and (iii) estimate the economic value of the benefit when realized, for example through the aversion of property damage, loss of life or economic disruption. The results of this effort will be used by NOAA management in articulating operational requirements for LMS and defending associated budgetary needs.

Newsletter readers with information on data, contacts or previous studies that might assist in this effort should contact Mark Weber (617 981-7434, email: markw@ll.mit.edu). The study will be completed by the end of September, 1997.

Collaborative work continues among Lincoln Laboratory (Bob Boldi, Anne Matlin and Earle Williams), the NASA Marshall Space Flight Center (Steve Goodman, Ravi Raghavan) and the NWS Office in Melbourne, Florida (Steve Hodanish, Dave Sharp). LISDAD (Lightning Imaging Sensor Data Acquisition and Display) documents total lightning activity in radar-identified Florida storms with the LDAR (Lightning Detection and Ranging) system. Recent emphasis has been placed on severe weather events. Results thus far indicate that high flash rates (>1 flash per second) are a necessary but not sufficient condition for severe weather (with specific NWS thresholds). The storm on April 23, 1997 which exhibited 21 tornadoes is currently being examined.

In another collaborative study led by Ralph Markson (the ATLAS Project), Lincoln Lab is examining how lightning may influence pilot's decisions in the terminal area. Movies of aircraft tracks with respect to radar imagery and lightning locations in the vicinity of Orlando, Florida are being used to determine whether pilots' decisions to penetrate intense precipitation is affected by the presence or absence of lightning. Comparisons between daytime and nighttime storms are planned.

M.I.T. Parsons Laboratory (Cambridge, MA)

Global maps of energetic lightning events have been assembled for one year (1996) by Everest Huang, Bob Boldi and Earle Williams, based on ELF measurements in West Greenwich, Rhode Island. Site error corrections using thousands of NLDN events as 'truth' for great circle bearings (supplied by Ken Cummins) have produced satellite maps with notable concentrations over continents, consistent with maps for the deeper mesoscale convective systems by Karen Devlin and Ed Zipser. Further refinement is still needed in the impedance-based range finding algorithms, as the most prevalent South American events (south from Rhode Island) are sometimes located incorrectly in Asia (north from Rhode Island). The seasonal migration of the sources in latitude and the consistent diurnal lags in regional activity from traditional afternoon lightning maxima are consistent features of these data. The positive events which are likely sprite-producers, dominate the global population. Validation of the single-station observations have been helped by Dick Dowden (Australia) and Rohan Jayaratne (Africa). Rohan reported spider lightning ground flashes in Botswana in March which was accurately located from Rhode Island.

Dan Stevenson is examining distributions of lightning properties from the NASA MSFC Optical Transient Detector. One goal of these studies is to determine how the population of ordinary lightning is coupled to the energetic 'tail' of the distribution, so as to better interpret the ELF maps.

Earle Williams had very productive and enjoyable visits with Colin Price, Yoav Yair and Zev Levin in Israel and with Gabriella Satori, Francis Marcz and Bertsi Zieger in Hungary in February. The prospects for high quality Schumann resonance (SR) measurements in the Negev Desert look very good. Analyses underway with ongoing measurements in Sopron are showing clear signs of a semi annual signal in both SR and DC potential gradient data.

Vadim Mushtak from St. Petersburg, Russia, met with Stan Heckman and Earle Williams in March. He brought with him on a laptop computer a model for the Earth-ionospheric cavity with day-night asymmetry, a valuable tool for quantifying departures form the traditional normal mode analysis.

Ebby Anyamba (NASA Goddard Space Flight Center) and Earle Williams have identified the Madden-Julian oscillation in TOVS satellite data and simultaneously acquired Schumann resonance observations from Arrival Heights, Antarctica of Tony Fraser-Smith and Martin Fullekrug. These observations point to the importance of convection in Africa and South America in sustaining this eastward-propagating wave phenomena.

NASA / Marshall Space Flight Center (Huntsville, AL)

NASA has completed the second year of on-orbit operations of a lightning sensor in low earth orbit called the Optical Transient Detector (OTD). As one of the first NASA 'faster, better, cheaper' projects, the OTD, launched in April 1995, was developed in-house at MSFC as an early prototype of the Lightning Imaging Sensor (LIS). The OTD detects, locates, and measures the radiant energy produced by total lightning (intracloud and cloud-to-ground flashes, day and night) from an inclination orbit at 735 km altitude with storm scale (5-10 km) spatial and 2 ms temporal resolution.

The OTD has contributed to the production of the most complete and detailed maps of the global lightning distribution, the discovery that the global lightning flash rate is less than half of the widely accepted earlier estimates dating back to 1925, the use of lightning as a proxy for detecting intense atmospheric convection, the discovery of potential lightning indicators for application to more timely hazardous weather and tornado warnings, and forest fire and wild-land fire operations. The OTD provided field experiment support to the recent NASA PEM-TROPICS chemistry mission. Two Ph.D. degrees have been completed making use of OTD data, and a total of 10 M.S. and Ph.D. degrees are now underway which incorporate OTD observations into experimental and theoretical studies. The OTD data and the associated scientific research have confirmed the value of space-based lightning observations in contributing to the understanding of atmospheric and precipitation processes.

Global lightning data observations from the OTD experiment have now been released to the general science community and are available from the Global Hydrology Resource Center (GHRC). You can learn more about these data from http://ghrc.msfc.nasa.gov/.

The LIS is scheduled for a November, 1997 launch as a scientific payload on the Tropical Rainfall Measuring Mission (TRMM-1). The LIS has been integrated on the TRMM satellite and the testing continues. More information about both OTD and LIS can be found on the NASA homepage http://www.ghcc.msfc.nasa.gov/lightning. Other information about the MSFC electricity program can be found at this site.

We continue to have an interest in lightning data sets that could contribute to a global lightning climatology and to on-going ground truth activities for OTD (e.g. regional lightning detection networks, etc.) and LIS. Any individual or group interested in such a collaboration is encouraged to contact S. Goodman (e-mail: steven.goodman@msfc.nasa.gov) or H. Christian (hugh.christian@msfc.nasa.gov).

On March 11-12, NASA convened a workshop in Guntersville, Alabama to discuss the contributions of lightning research to the science goals of the NASA Mission To Planet Earth (MTPE) program and the U. S. Weather Research Program (USWRP). A small group of distinguished scientists with diverse interests in lightning research and its applications participated in the workshop. One of their recommendations was the desire for continuous lightning observations from geosynchronous orbit. The performance design for such an instrument, referred to as the Lightning Mapper Sensor (LMS), would be similar to the OTD and LIS. This instrument is presently under consideration for a possible flight on GOES N-P. The instrument would detect, locate, and measure the radiant energy of lightning discharges continuously with a detection efficiency of 90%. The real-time data would be quality assured, corrected, geolocated, and provided to the user in less than 30 seconds. From the GOES-E position, the total area of coverage would be from the U. S. west coast to the mid-Atlantic Ocean and from the Canadian border south to the Amazon.

A study begun last summer (S. Goodman, R. Raghavan, E. Williams) to determine how future geostationary orbit lightning measurements might assist a forecaster in the determination and identification of severe thunderstorms in real-time is continuing. The demonstration is based on the Integrated Terminal Weather System (ITWS) and currently displays a suite of products in real-time that includes data from the Melbourne WSR-88D radar, Lightning Detection and Ranging (LDAR) network at NASA/Kennedy Space Center, and the National Lightning Detection Network (NLDN). The results from this experiment will be used to derive a quantitative estimate of the benefits that would be possible on a national basis from the use of data from an operational geostationary lightning sensor. Furthermore, the integrated database acquired through this experiment will be used to validate and calibrate total lightning measurements acquired from OTD and LIS.

Dr. Dennis Boccippio joined the MSFC lightning group in February. In addition, Dr. William Boeck (Niagara University) will be spending a sabbatical year at the MSFC beginning June 1 to support LIS launch activities and data analysis.

National Comission on Atmospheric Electricity (St. Petersburg, Russia)

It is with deep sorrow that we report the death of two colleagues. Mr. Lev Gordeevich Makhotkin (1915-1996) passed away on December 8, 1996. Professor Lev Grigor'evich Kachurin (1920-1997) passed away on February 15, 1997. Their work and personalities have contributed so much to the national science.

National Lightning Safety Institute (NLSI) (Louisville, CO)

1. NLSI is preparing a Lightning Risk Assessment for NASA's Johnson Space Center, Houston, TX at the Neutral Buoyancy Laboratory (NBL). This 5 million gallon tank, housed in a massive steel and concrete-rebar structure, is used to simulate astronaut space walks in an underwater environment. Lightning is a common threat to this area of Texas. What is the risk to personnel in the NBL tank and elsewhere at the site? NLSI's Richard Kithil and Richard Hasbrouck will characterize the lightning risk for NASA.

2. NLSI has provided "best available technology" consulting design studies for the Great Stupa of Dharmakaya at the Rocky Mountain Dharma Center. The 100 ft. high Buddhist structure lies in a lightning-prone area west of Fort Collins, Colorado near Red Feather Lakes.

3. North Carolina Outward Bound has contracted with NLSI to conduct several tutorial workshops on lightning safety issues for outdoor recreation leaders in Ashville, NC.

4. NLSI attended the annual Department of Energy fire safety meeting in Pleasanton, CA. About 150 fire safety and risk management officials were present. "An Overview of Lightning Safety" tutorial was given, followed by a two hour workshop heard by a smaller group.

5. About 20% of all lightning fatalities and injuries occur in some form of outdoor recreation, whether team or individual sports or pursuit of personal activities.

National Severe Storms Laboratory (Norman, OK)

The distribution of cloud-to-ground lightning over Arizona from the perspective of a power utility will be published in the June issue of the Journal of Applied Meteorology. The study is by Raúl López, Ron Holle, and Irv Watson (now at NWS Tallahassee) of NSSL, and Jon Skindlov of SRP in Phoenix, Arizona. Several color figures show substantial variability in spatial and temporal distributions of lightning over the state among months and years. The figures also show how the lightning maxima are closely related to the state's topography.

These variations in time and space must be taken into account when assessing the costs and values of changes to the lightning protection of transmission and distribution lines.

The impacts of an isolated cloud-to-ground flash during winter in Connecticut are described in the March issue of the AMS Bulletin. The paper by Ron Holle, Raúl López, and Ken Howard of NSSL, Ken Cummins and Mark Malone of Global Atmospherics, Inc., and Phil Krider of the University of Arizona, describes a positive flash that was detected by the National Lightning Detection Network, destroyed a house, and seriously injured an occupant.

The Electrical Nature of Storms, a book authored by Don MacGorman and Dave Rust and being published by Oxford University Press, is proceeding on schedule to become available for purchase late this summer. This book is intended as a graduate level text and a reference for professionals.

Osaka University (Osaka, Japan)

Zen Kawasaki reports: The Lightning Research Group of Osaka University (LRGOU) has been conducting three International Cooperative Projects to investigate the mechanism of lightning discharges by means of field observations. The first project is in Darwin, Australia during the build-up stage of the rainy season there. Darwin is situated in the Inter Tropical Convergence Zone (ITCZ), and thunderstorm activity in the ITCZ is believed to be related to global warming. That is one of the reasons LRGOU has been giving attention to the lightning activity in Darwin. LRGOU operated two systems of the Interferometer systems to obtain three dimensional images of lightning progression in the suburb of Darwin. They performed a field campaign in November, 1996, where they captured more than one hundred data sets for UHF imaging. The project will be continued in 1997. This work is a collaboration among Otago University, Global Lightning Technologies Pty Ltd., University of Electro-Communications, Gifu University and LRGOU, and is expected to contribute to the TRMM International Project.

The second Project in Lanzhou, China, is a cooperation among Lanzhou Institute of Plateau Atmospheric Physics, Shanghai Meteorological Bureau, Gifu University, Nagoya Institute of Technology, Toyota College of Technology, and LRGOU. The main objective is to understand Mesoscale Convective Systems over a plateau through field observations. According to previous statistics they frequently observe positive cloud-to-ground strikes, (positive CG) and further confirmation is required. Since we occasionally experience positive CGs during winter at Hokuriku in Japan, the study of similarities and differences in the physics between these two areas is interesting scientifically. In this project LRGOU operated six wide band slow antennas which were synchronized with GPS. The characteristic pulses, which occur at the initiation of lightning discharges were observed and studied.

The third project is a cooperation among Toronto University, McMaster University, Suzuka College of Technology and LRGOU. Lightning strikes to the CN tower is the target for their investigation. Suzuka College of Technology and LRGOU operate the ALPS (Automatic Lightning Progression velocity measurement System) to measure the velocity of lightning strikes.

Concerning domestic projects, LRGOU joined the Rocket Triggered Lightning Experiment during winter at Hokuriku, Japan. LRGOU operated a wide band Interferometer to investigate the upward progression of leaders. The wide band Interferometer was designed and manufactured by them, and could observe upward leaders of both negative and positive polarities. Two dimensional mappings were obtained.

LRGOU has been conducting Laser Triggered Lightning Field Experiment for four years. At 23 hour 11 minute 50 second (JST) on February 11 the first Laser Triggered Lightning in history was achieved by firing a carbon dioxide pulse power laser of one kilo joule with two Gigawatts peak. The triggered lightning showed three-strokes, one with -35 kilo amperes current peak amplitude. An upward progressing positive leader, with weak intensity was observed by the narrow band Interferometer. LRGOU will contribute to the TRMM project as one of the Japanese Institutes.

More information on the LRGOU group and the Society of Atmospheric Electricity of Japan (SAEJ) can be found at the following home pages:

LRGOU URL http://lightning.pwr.eng.osaka-u.ac.jp/lrg/
SAEJ URL http://lightning.pwr.eng.osaka-u.ac.jp/saej/e_index.html

Russia State Hydro-Meteorological Institute (St. Petersburg, Russia)

The detection of electrically active areas in clouds is pursued by specialists at the Atmosphere Experimental Physics Department (RSHMI) together with the specialists at A.I.Voeikov MGO and A.I.Voeikov MGO RC ARS. Electrically active areas are the areas in clouds in which a strong accumulation of electric charge occurs and atmospheric electric discharges are possible at a particular stage of development. Up to now the detection of the electrically active areas has not been resolved, especially for nonthunderstorm clouds or for the prethunderstorm stage of clouds. With the purpose of discussing these issues, the RSHMI held the first scientific and technical seminar, "Detection of Electrically Active Clouds which Bring a Potential Lightning Threat to Aircraft" in December, 1996, with assistance from the subsection "Electromagnetic fields in the atmosphere" of the Russian Academy of Sciences. (Contact persons for the subsection are Prof. Vladimir Stepanenko and Dr. Yakov Shvarts). The following reports were presented.

M.S. Aleksandrov, V.A. Epanechnikov, B.A. Khaji (Inst. of Radio Electronics, Russia Ac. Sci.). The remote observation of an isolated thunderstorm.

V.I. Bannikov, S.M. Galperin, V.I. Frolov, G.G. Shchukin (A.I.Voeikov MGO RC ARS). The detection of electrically active areas in clouds by the use of radio facilities.

A.V. Belotserkovskiy (RSHMI). The short-range forecast of radar echoes and thunderstorm cloudiness.

T.E. Briedis, L.I. Divinskiy, A.D. Kuznetsov, A.D. Simakin (RSHMI). Electrically active areas in clouds: the dynamics and short-range forecast of their evolution.

L.I. Divinskiy (RSHMI). Temporal and spectral features of nonlightning radioemission from evidence derived from measurements with a high-performance ADC.

L.I. Divinskiy (RSHMI). A detection of regions with a potential lightning threat to aircraft from the nonlightning emission of clouds: the principle of operation of airborne and ground-based apparatus designed for this detection.

E.I. Dubovoi (A.L.Mints Radiotechnical Inst., Russia Ac.Sci.). A remote determination of energy released by lightning with the use of a radar.

V.I. Ermakov (Central Aerological Observatory). The role of cosmic rays in thunderstorm formation.

V.I. Ermakov (CAO). Triggering "aircraft-atmosphere" discharges by supercosmic rays.

L.V. Kashleva, Yu. P. Mikhailovskiy (A. I. Voeikov MGO RC ARS). Aspects of the formation of a cloud electrical structure at the prethunderstorm stage.

A.V. Kochin (CAO). The formation of electric charges in the melting layer.

Yu. P. Mikhailovskiy (A. I. Voeikov MGO RC ARS). On the possibility of detection of electrically hazardous areas by use of radar.

Yu. G. Osipov (RSHMI). Radioemission from corona discharges under natural and artificial electric fields.

N.E. Veremey (A. I. Voeikov MGO). The role of precipitation in the electrification of warm clouds.

N.E. Veremey, Yu. A. Dovgalyuk, Yu. F. Ponomarev, A.A. Sinkevich, V.D. Stepanenko (A. I. Voeikov MGO). The dynamical electric field structure of convective clouds based on aircraft measurements and numerical simulation.

B.M. Vorob'ev (RSHMI). A contribution to the calculation of some characteristics of air-mass convective clouds and hazardous weather phenomena (hail, heavy showers, thunderstorms).

N.V. Zudinov (RSHMI). An optimal estimate of the temporal position of signals picked up by a radio receiver while atmospheric electric discharges are in progress.

The second scientific and technical seminar "Detection of Electrically Active Clouds which Bring a Potential Lightning Threat to Aircraft" will be held in St. Petersburg, November 12-14, 1997, and will coincide with the International Specialized Exhibition "Gidrometeorology to Humanity", November 11-15, 1997, St. Petersburg. Contact person: Prof. Leonid I. Divinskiy, Russia State Hydro-Meteorological Institute, Malookhtinskiy 98, St.Petersburg, 195196. RUSSIA. Tel.: (812) 2218155, Fax: (812) 2216090, E-mail: divinskiy@rgmi.spb.su.

St. Petersburg State Technical University (St.Petersburg, Russia)

Mikhail Kostenko completed analysis of a lightning model and a simulation of wave processes in overhead lines. The paper on this analysis will be presented at the XII International Conference on Gas Discharges and their Applications 8th-12th September 1997, in Greifswald, Germany. A system of two quasi-linear partial differential equations is solved by the method of Characteristics. Waves in the leader and in the return stroke with nonlinear parameters as well as waves in power lines struck by lightning are treated in the modelling. This solution is more precise as compared with the solution published in *J. Geophys. Res.,* **100,** D2, 2739-2747, 1995.

Tel Aviv University Dept. of Geophysics and Planetary Sciences (Tel Aviv, Israel)

The results of a continuing survey of lightning characteristics in the Tel-Aviv area for the period 1989-1996, based on daily registrations of a CGR3-SN5 lightning flash counter, were compiled recently by Yoav Yair and Zev Levin. The long term average of the annual flash density in the Tel-Aviv area was found to be 5.0 ± 2.5 km^{-2} $year^{-1}$. The mean intracloud/cloud-to-ground flash ratio was found to be 2.3 ± 1.15, with maxima in the autumn months. This may be attributed to the higher altitude of the -10°C and -25°C isotherms (which signify the locations of charge centers), and to the weaker wind shears that occur in these months. The average fraction of positive ground flashes in Tel-Aviv thunderstorms was R=0.16 ± 0.8. Storms that exhibited larger than average PGF fraction were found to be subjected to a strong shear of the horizontal wind. The observed empirical relation between the PGF fraction and the intensity of the wind shear W was: $R = 10^{(0.0305*W+0.073)}$. The results were submitted to *J. Geophys. Res.*

A new CGR3-SN5 lightning detector, built and sent courtesy of Dave Mackarras (U. of Queensland) has been installed on the roof of the Geophysics building, next to the existing detector. We have added time-resolving capacity to both systems, which enables us to correlate close-range lightning registrations with those obtained by the LPATS (operated by the Israeli Electrical Company). After completing the technical procedures and correlating the two CGR3 detectors, the new one will be put near Mt. Carmel, to allow coverage of the northern Israeli coastline.

Analysis of radar images and LPATS strike locations is being continued by Orit Altaratz, an M.Sc. student under supervision of Zev Levin with assistance of Yoav Yair. Following a visit by Earle Williams, and ensuing discussions, close attention is especially being paid to very strong positive ground flashes occurring in the stratiform regions of winter precipitation systems. Early analysis of positive ground flashes stronger than 75 kA showed that they are separated in space and time from the main radar reflectivity core and the negative- and cloud flash activity. Further study of those strong PGFs will focus on possible detection of the accompanying Schumann Resonance radiation by stations in the US.

Colin Price continues work toward the establishment of a Schumann Resonance monitoring station in the Negev Desert of Israel. During the past 6 months Earle Williams of MIT visited to help with this project. In addition to work at the Mitzpe Ramon observatory, we also managed to check the effect of salinity on swimmer buoyancy in the Dead Sea. We are presently building the calibration coils for the magnetic field sensors, as well as the electric field sensor to measure the vertical electric field.

In related work, it has been shown that in addition to the SR amplitudes being well connected to global temperatures, these resonant modes also seem to be well correlated with global water vapor content of the atmosphere. It is therefore likely that SR may also be a useful way of monitoring changes in the atmopsheric water vapor content.

Two papers were recently published in *J. Geophys. Res.* (March, 1997) dealing with lightning-generated NOx. Global climatologies of these NOx sources can be obtained from Colin Price via e-mail: cprice@flash.tau.ac.il.

UMIST (Manchester, England)

Clive Saunders visited Giorgio Caranti, Eldo Avila and Nesvit Castellano in Cordoba, Argentina for 3 weeks at Easter 1997 to continue collaborative work on thunderstorm charging processes. Analysis of experiments carried out in the UMIST laboratory when the Cordoba scientists visited UMIST in the summer of 1996 has continued jointly and a paper has been completed on the effect of changing the supercooled droplet spectrum in the laboratory cloud. The sign of the charge transferred during ice crystal collisions and separations from a riming graupel pellet were shown in earlier work in UMIST, reported at the Osaka Conference in 1996, to be dependent on droplet size; smaller droplets, 6 µm diameter, favor negative rimers. The latest results with a broader droplet spectrum out to 60 µm, have now shown that larger droplets can also lead to more negative charging. These results can be accounted for by current thinking on the charging mechanism, which relies on the diffusional growth of the ice surfaces involved. More importantly the results mean that further laboratory simulations need to pay even closer attention to the details of the cloud droplet spectrum used in the experiments. In this connection, there is a need for more detailed information concerning cloud droplet spectra in thunderstorms, particularly in regions where the electric charge separations due to particle collisions are taking place. Information on these details would be very welcome from past and future airborne measurements.

University of Toronto, Canadian National Tower Lightning Studies Group (Toronto, Canada)

The Group is continuing studies of lightning at the Canadian National Tower in Toronto and its worldwide cooperation. During the 1996 lightning season, on initiative from Zen Kawasaki of Osaka University, an ALPS instrument was lent to the Group to measure the two-dimensional velocity of return strokes. Kanji Yamamoto of Suzuku College of Technology and Masakazu Wada of Osaka University visited the University of Toronto for about ten days at the beginning of August 1996. Results of the few strokes to the CN Tower recorded at that time have been reported in Japan.

From September 23 to 27, 1996 Wasyl Janischewskyj of the University of Toronto and Volodymyr Shostak of the State University Kyiv Polytechnik in Ukraine represented the Group at the 23rd International Conference on Lightning Protection in Florence, Italy. They presented three papers:

> "Comparison of Measured and Computed Electromagnetic Fields Radiated from Lightning Strikes to the Toronto CN Tower" by R. Rusan, W. Janischewskyj, A.M. Hussein and J.-S. Chang,
>
> "Collection and Use of Lightning Return Stroke parameters taking into Account Characteristics of the Struck Object" by W. Janischewskyj, V. Shostak, J. Barratt, A.M. Hussein, R. Rusan and J.-S. Chang, and
>
> "Estimation of Lightning Location System Accuracy Using CN Tower Lightning Data" by W. Janischewskyj, V. Shostak, A.M. Hussein and W. Chisholm.

As a member of the Group and a graduate student at the Ryerson Polytechnic University and the University of Western Ontario, Ileana Rusan successfully defended her Master's

Degree thesis entitled "CN Tower Lightning Parameters" in June 1996. The thesis provided a summary on visual observations of lightning flashes to the CN Tower made by two perpendicularly located TV cameras and on current waveforms measured by a Rogowski Coil installed on the CN Tower. Information collected by video cameras and documented in the thesis was used as the basis for an *IEEE Transactions* paper 96 SM 422-6 PWRD "Statistics of Lightning Strikes to the Toronto Canadian National Tower (1978-1995)" by W. Janischewskyj, A.M. Hussein, V. Shostak, I. Rusan, J.-X. Li and J.-S. Chang.

In January 1997, Radu Rusan completed his M.Sc. thesis at the University of Toronto on "Computation of Electromagnetic Fields Radiated by Lightning Strikes to the Toronto CN Tower". The thesis explored the factors that affect computation accuracy of the electromagnetic field surrounding a tall structure during lightning strikes. In the progress of his work Radu Rusan explained, in particular, the influence of different models upon reflections of the lightning current within the CN Tower and upon the computation of the resultant magnetic field.

As a result of the 1995 visit of Hideki Motoyama in Toronto, a paper entitled "Electromagnetic Field Radiation Model for Lightning Strokes to Tall Structures" and authored by H. Motoyama, W. Janischewskyj, A.M. Hussein, R. Rusan, W.A. Chisholm and J.-S. Chang, has appeared in Vol. 11, No. 3, on pages 1624-1631 of the July 1996 issue of *IEEE Transactions on Power Delivery.*

A.I. Voeikov Main Geophysical Observatory (St.Petersburg, Russia)

Prof. Vladimir D. Stepanenko reports that the dynamics of the electric field structure of convective clouds was investigated, using theoretical and experimental methods. The first method is based on application of the MGO thundercloud numerical models and the second is based on observations in flight. The analysis shows that electric field parameters are very convenient for estimation of seeding effects using ice nucleation reagents. The above-mentioned results were obtained in the MGO cloud physics, weather modification and radiation study.

Prof. Evgeniy P.Borisenkov, Dr. Yakov M.Shvarts (A.I. Voeikov MGO RC ARS) and Mrs. Irina A. Krushanina (the climatological station of the help center) study the behavior of the atmospheric electric field during barometric depressions. They try to learn the reasons for the poor general condition of people with heart problems, during such intervals. The authors seek to improve the prediction of these intervals with some meteorological parameters supplemented with certain atmospheric electric field characteristics.

A.I. Voeikov MGO Research Center for Atmospheric Remote Sensing (Russia, Leingradskaya oblast)

Dr. Simon Galperin reports that the Turgosh field experiment will be continued in the summer of 1997. Thunderstorms will be investigated extensively with meter-wavelength radars. These radars are capable of detecting both lightning and regions of relatively constant reflection. The record of electromagnetic emission will be paid special attention in the course of the region's life-span. The study of electrically active areas in clouds will be continued. This work will be performed over the passive-active stages of cloud development. According to our present concept, the passive stage begins with indicators of well-organized cloud electrification. This stage terminates with the first lightning discharge. The active stage of the cloud is characterized by different types of lightning discharges. For further detailes, please contact S. Galperin, G.Shchukin and V.Stasenko at Fax: 812-7075135, E-mail: georgiy@rcars.spb.su.

University of the Witwatersrand (Witwatersrand, South Africa)

The Lightning/EMC Research Programme has two main and complementary thrusts: (1) the effects of lightning on transmission systems; (2) the effects of lightning on industrial systems. Several research projects are under way toward investigation of these thrusts.

a) Laboratory verification of theoretical models of coupling of surges to distribution lines: Dr. J.M. Van Coller, with Mr. A. Bhowal (MTech student), is initiating a project where a scaled down model of an LV line will be used in the laboratory to measure induced surges due to a simulated lightning channel. This is a collaborative project with the Vaal Technikon.

b) Coupling of lightning transients from MV to LV systems via the transformer: Dr. J.M. Van Coller, with Mr. R. Kelly (MSc student), has developed and completed the validation of relevant transformer models as well as aerial bundle conductor (ABC) transmission line models relevant to the work. Testing of various circuit components and configurations is not in the planning phase.

c) Insulation co-ordination studies on HV transmission lines: Dr. J.M. Van Coller, with Mr. C. Mulongoti (MSc student), is investigating various operational aspects of using shield wires for MV distribution. This involves both insulation co-ordination issues and compensation issues.

d) The automation of a surge protective device testing facility: Dr. A.J. Phillips, with Mr. G. Kwasnik (MTech student), is completing a project to fully automate a laboratory test facility. This is a collaborative project with the Technikon Witwatersrand.

e) Design and optimisation of Rogowski coils for the measurement of high transient currents: This work by Dr. A.J. Phillips, with Dr. I.R. Jandrell and Mr. G.B. Grobbelaar, has been necessitated by the need for simple and rugged measuring circuits for use on the EPRG's high current impulse generator.

f) A consideration of lightning coupling models for transmission lines: Dr. I.R. Jandrell, with Mr. P.X. Gruber (MSc student), has investigated numerous lightning coupling models for transmission lines, and has developed and implemented MATLAB models for Bruce-Gould, travelling current source, transmission lines and modified transmission line models. Experimental verification commences during the 1996/97 lightning season.

g) A consideration of risk assessment techniques for the effects of lightning on industrial sites: Dr. I.R. Jandrell and Mr. C. Waner (MSc student) are focusing in three areas: lightning electromagnetics, lightning strike modelling and statistical modelling. This work will assist in identifying risk reduction techniques for use by industry.

h) Investigation of meaningful flash sorting parameters for LPATS data to be used in the optimisation of transmission lines: Dr. I.R. Jandrell and Mrs. M.G. Redelinhuys

(MSc student) have identified flash grouping as a key to the extraction of useful information from the lightning position and tracking system (LPATS). Flash sorting parameters have been identified and possible values for the criteria are being investigated.

York University (Toronto, Ontario, Canada)

Stephen Clodman is now an Adjunct Professor at the Centre for Research in Earth and Space Science (CRESS) of York University. He recently retired from the Atmospheric Environment Service of Canada (AES) in Toronto. He intends to continue the research on positive and negative lightning, and the research on lightning as a severe storm indicator, which he was doing at the AES with the participation of Earle Williams at M.I.T. (see entries under the AES in previous newsletters). He is now beginning a project with Dr. Gordon Shepherd, head of CRESS. They will try to use the WINDII imaging interferometer on the Upper Air Research Satellite to search for sprites and other phenomena in the upper atmosphere around thunderstorms.