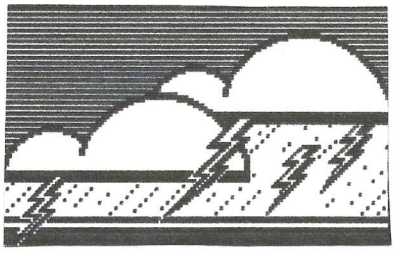
NEWSLETTER ON ATMOSPHERIC ELECTRICITY

Vol. 3, No. 2
NOVEMBER 25, 1992



AMS COMMITTEE ON ATMOSPHERIC ELECTRICITY

AGU COMMITTEE ON ATMOSPHERIC AND SPACE ELECTRICITY

INTERNATIONAL COMMISSION ON ATMOS. ELECTRICITY

ANNOUNCEMENTS

Expansion of Newsletter Representation

This Newsletter has now been expanded to represent the CASE and the ICAE, in addition to the AMS Committee on Atmospheric Electricity. The current members of all three Committees are shown below.

AMS Committee on Atmospheric Electricity	AGU Committee on Atmospheric & Space Electricity	International Commission on Atmospheric Electricity
John Hallett, Chair	John Willett, Chair	E. Philip Krider, President
Rob Black	Jim Dye	Earle Williams, Secretary
Steve Goodman	Dick Goldberg	Bernard Vonnegut
John Helsdon	Bob Holzworth	Hans Dolezalek
Vlad Mazar	Vince Idone	James Hughes
Dave Rust	Umran Inan	John Latham
Ewen Thomson	Mike Kelley	Marcia Baker
Mark Weber	Phil Krider	Serge Chauzy
William Winn	Don MacGorman	Hugh Christian
	Doug Mach	Guo Chang-Ming
	Tom Marshall	Sven Israelsson
	Nelson Maynard	Zen-Ichiro Kawasaki
	Earle Williams	N. Kitagawa
	Conrad Ziegler	Stan Michnowski
		Lothar Ruhnke
		Clive Saunders
		M. Ishii
		M. Takagi
		H. Tammet
		William Winn
		Ya M. Shvarts

Future Newsletter Contributions

In efforts to save the expense of this mailing (now to approximately 380 recipients), we are requesting contributions for the next Newsletter now to be received by April 30, 1993. If you missed the deadline for this issue, you're probably not reading the Newsletter Announcements. MARK YOUR CALENDARS NOW!

Future Meetings

John Willett has scheduled a joint meeting of the Committee of Atmospheric and Space Electricity (CASE) and the AMS Committee on Atmospheric Electricity at the Fall AGU meeting for Thursday evening, December 10 in the Twin Peaks Room of the Cathedral Hill Hotel. Issues now on the agenda are (1) lightning triggering by EPRE, (2) AE space-launch constraints at Kennedy Space Center (3) the NWS Lightning Detection Network (4) new editorship of JGR for atmospheric electricity, and (5) AE contributions to the upcoming AMS Conference on Severe Local Storms. All are welcome to attend. Please bring additional agenda items to the attention of John Willett or John Hallett.

Abstracts for the 26th International Conference on Radar Meteorology (to be held 24-28 May in Norman, Oklahoma) are due November 10, 1992. Program Co-chairmen are Ed Brandes and Tzvi Gal-Chen.

An International Workshop on Physics of Lightning will be held March 15-19, 1993 in le Domaine de Rochebois in Vitrac, France. The Scientific Committee is co-chaired by Prof. T. Kawamura and Prof. M. Goldman.

The next International Aerospace and Ground Conference on Lightning and Static Electricity is to be held in late May, 1994 in Mannheim, Germany. Abstracts should be submitted to the conference coordinator: Heinrich Busse, Bundesakademie für Wehrtechnik, Seckenheimer Landstr. 8-10, 6800 Mannheim 1, Germany.

A special session devoted to the application of synoptic scale observations of lightning, deep convection and the global electrical circuit to problems of global change will be held at the 1994 Annual Meeting (Jan. 24-28) of the AMS in Nashville, Tennessee. Interested participants should contact Earle Williams or Richard Orville.

Mark your calendars for October 1993 in St. Louis. A Storm Electricity meeting will be held in association with the Severe Storms Conference, sponsored by the American Meteorological Society. The announcement will appear in the Bulletin shortly.
Call John Hallett for further information **(702) 677-3116.**

In Memoriam

The National Commission on Atmospheric Electricity (Drs. Stepanenko and Shvarts in Russia) informs ICAE that Dr. Victor Petrovich Kolokolov, a former chairman of NCAE and a former member of ICAE, passed away September 20, 1992 at the age of 78. He was a well-wishing man and a good scientist. We mourn for his death.

JGR Special Issue

Now that the 9th International Conference on Atmospheric Electricity is behind us, it is important to publish without delay conference presentations of quality in a profesional journal. The Journal of Geophysical Research has agreed to publish a Special Issue on Atmospheric Electricity to save the conference papers for posterity. All accepted papers will have to pass the referee process. All participants of the 9th conference are encouraged to submit their papers for publication. We want to print the Special Issue not later than one year after the conference. It is therefore necessary to submit the papers without delay. All manuscripts should reach the editorial office before December 31, 1992. Manuscripts should be mailed to:

JGR-Atmospheres
NCAR Acd
P.O. Box 3000
Boulder, CO 80307

OR:

Lothar H. Ruhnke
Guest Editor
11208 Wedge Drive
Reston, VA 22090

MWR Special Issue

A special issue of Monthly Weather Review devoted to Thunderstorm Electrification and Lightning is planned for sometime in 1993. Manuscripts should be submitted to Guest Editor Richard Orville.

Journals Contributions

Marcia Baker has called attention to an important need at the International Conference in St. Petersburg in June: Don't throw away your old journals and books!! Because of the economic crisis in the C.I.S. (the former Soviet Union), many libraries and scientific organizations there have cancelled their subscriptions to scientific journals. Moreover, in many of those scientific institutions the collections of Western journals and books were quite incomplete to start with. This situation makes it extremely difficult for our colleagues in the C.I.S. to continue to do research.

There are several ways in which American scientists can help. One is for all of us, as individuals, to add C.I.S. scientists to our reprint and preprint mailing lists. Another is for individuals and institutions to send new and used scientific books and journals to C.I.S. scientists. We encourage everyone to consider this when cleaning out shelves and during library reorganization. We are searching for organizational help in mailing and distributing donated scientific material and request from our members suggested names of C.I.S. colleagues, institutions who would be the most appropriate recipients.

RESEARCH ACTIVITIES BY ORGANIZATION

AIRBORNE RESEARCH (Weston, MA)

Ralph Markson and Derek Lane-Smith have been working under an SBIR award to Airborne Research Associates to investigate the possibility of monitoring global temperature change through measurements of ionospheric potential (V_I). To obtain the data a modern balloon borne electric field radiosonde that mated with a standard commercial (VIZ) radiosonde was developed along with a relatively inexpensive computer controlled ground station/analysis system. This was accomplished successfully and 31 V_I soundings were made during August and September 1992. One set of 8 was made over a 24 hour period (3 hr intervals) to measure the diurnal (Carnegie curve) variation. Correlation analysis with global tropical temperature data showed positive correlations exceeding the 95% to as much as 99% confidence level when a 2 hour time lag from temperature to V_I was employed. Future plans are to expand the program, if possible, so that measurements could be made, sometims simultaneously, in different parts of the world. Conductivity will be added to the package in order to investigate aerosols and radioactivity on a global scale. Research groups in othe countries as well as in the U.S. who would like to participate in the future are encouraged to contact Ralph Markson at ARA, 46 Kendall Common Rd., Weston, MA 02193.

ATMOSPHERIC RESEARCH SYSTEMS, INC. (Palm Bay, FL)

The USA National Oceanic and Atmospheric Administration (NOAA) and the National Weather Service (NWS) are the latest customers to contract for realtime national lightning data from Atmospheric Research Systems, Inc. (ARSI) of Palm Bay, Florida. It has taken two years to finalize this contract, which is officially in place as of September 1, 1992. This contract allows for the supply of national realtime data to NWS offices and to the NOAA research centers, such as NSSFC and NSSL for the next five years.

Dr. Jack Jalickee, the project manager with the NWS office of systems development in Silver Spring, Maryland said the lightning data will give the agency an important new tool in alerting people to severe storms. Right now, the service can track thunderstorms but can't always tell if the storms include a lot of electrical activity.

The lightning detection network which is the largest in the world, is privately-owned and operated by ARSI of Palm Bay, Florida and Zephyr Weather Information Service, Inc. of Westborough, Massachusetts. The network consists of 66 sensors installed throughout the 48 contiguous United States communicating by satellite with ARSI headquarters in Florida. After processing the data, it is re-distributed to customers by a number of satellite channels as well as all major weather re-distributors throughout the USA. This is the first time that the NWS has brought realtime weather data, which has been generated by sensors privately-owned and operated. In the past, and typically worldwide, all weather information is generated from Government-owned systems. This is a significant first between commercial enterprise and the U.S. Government.

Many other countries around the world have operational systems from ARSI, and various Government bodies are listed as purchasers of data from these networks. The networks are known as Lightning Position and Tracking Systems (LPATS), and are on five continents with a major concentration of systems in Europe. Siemens of Germany have recently procured another LPATS for use in Austria. Their objective is to create a European data service similar to the USA network.

The USA NOAA contract is a major milestone in the business aspirations of ARSI as well as setting a formidable precedent for supplying similar services to the Government. Typical users of lightning data are utilities, mines, forestry, airports and TV stations.

For further information, please contact Mr. Bill Cook at **(407) 725-8001**, or Fax **(407) 725-7918.**

DESERT RESEARCH INSTITUTE (Reno, NV)

Bob Black, Paul Willis from the Hurricane Research Division, NOAA, Miami and John Hallett from DRI, Reno flew on the NOAA P3 aircraft through Hurricane Tina in the Pacific, 400 miles off Mexico in late September to measure electrical characteristics (E_z, E_y, particle charge, visual lightning) along with cloud and precipitation. The most spectacular mission was a night flight 21/22 September, which showed moderate electrical activity (2 per minute) in association with a 45 Dbz radar echo in the SE quadrant of the eyewall which waxed and waned over a period of an hour or so. The aircraft flight track was a series of figure 4's through the eyewall between +10 and -2°C. Measurements were also made in Andrew prior to its passage over Florida.

LIGHTNING LOCATION AND PROTECTION, INC. (Tucson, AZ)

LLP and its sister company GeoMet Data Services (GDS) have both characterized and improved the National Lightning Detection Network (NLDN), now operated by GDS. A detailed summary of findings was presented at the ICLP meeting in St. Petersburg, Russia. With enhancements by LLP and GDS, this network was shown to provide an average location accuracy of 2-4 km and a flash detection efficeiency ranging from 70-90 percent. In addition, th Florida region of the network has undergone significant renovation which was designed to provide locational accuracies between 0.5 and 1.0 km. This improvement is currently being evaluated through the use of ground truth observations and network comparisons in the Orlando and KSC regions. A technical report is expected within the next 6 months.

During the last summer, GDS and the Electric Power Reearch Institute (owner of the NLDN) held a workshop focussed on quality assurance and performance monitoring for the NLDN. One of the key changes in the realtime NLDN data stream which was precipitated by

this meeting was the inclusion of statistical and geometric measures of location accuracy for each lightning flash. These parameters will be available in December of this year when the new national control center in Tucson assumes operational responsibility for the network.

The omnidirectional electrical storm identification device (ESID) introduced by LLP last year is currently under evaluation by the FAA and LLP (Orlando) and the Air Force (KSC). In both locations, this sensor is being compared with lightning detection systems capable of identifying and tracking cloud discharges. The results of these evaluations should provide the necessary data to further quantify the cloud discharge detection capabilities of the ESID.

The three Advanced Lightning Direction Finders provided for use in the TOGA-COARE project--each equipped with GPS clocks and configured for long-range (>1000 km) lightning detection--are in route to their destinations in the South Pacific. Based on information and data provided by Marx Brook, waveform discrimination criteria were modified to allow distant lightning (>600 km) corrupted by ionospheric reflections to be detected and processed by the sensors. Over the next several months, 37 similarly configured sensors are being used to densify the NLDN and to cover the western U.S.

For further details, please contact Ken Cummins or Burt Pifer.

MIT WEATHER RADAR LABORATORY (Cambridge, MA)

Dennis Boccippio and Earle Williams worked in Orlando, Florida with Lincoln Laboratory (Mark Weber and Bob Boldi), ONERA (Pierre LaRoche, Anne Bondiou and Clive-Marne), NMIMT (Paul Krehbiel) and NSSL (Vlad Mazur) on the end-of-storm oscillation (EOSO) and spider lightning. Particular attention has been given to meteorological conditions associated with the late-stage transition from foul-fo-fair field polarity, the occurrence of large positive field changes, and the subsequent recovery to foul polarity. Doppler EVAD (Extended Velocity Azimuth Display) calculations by Dennis indicate that the 'inverted' storm phase is characterized by downward air motion throughout the cloud region ordinarily classified as 'mixed phase'. A recovery of the mesoscale updraft is associated with the return to foul weather field. Possible microphysical growth states of particles are now being evaluated.

In light of evidence that the global circuit responds in a sensitive way to variations in surface temperature (Science, May, 1992) on the El Niño time scale, we have returned to the issue of the seasonal variation of global circuit. Insolation and consequently surface temperature for the tropics exhibit a well-defined semi-annual signal (i.e., two maxima per year). Both WMO global statistics on thunder days and a large number of annual records of air-earth current support a substantial global response to the approximate 1°C semi-annual temperature variation. Furthermore, the large collection of atmospheric potential measurements by Ralph Markson show the semi-annual component when averaged by month.

Work is underway to record Schumann resonance spectra from the radome on the Green Building (which formerly housed the Doppler radar now in use in Toga Coare by Steve Rutledge of CSU). Even in electromagnetically noisy Cambridge, well defined Schumann spectra are frequently obtained. Renewed efforts to secure continuous measurements on wet bulb temperature in zones of deep tropical convection (Brazil, central Africa, southeast Asia) are also in progress for comparison with SR data.

Stan Heckman, now working with John Willett at the Phillips Laboratory, recently received the Rossby Award for best PhD thesis in the Center for Meteorology and Physical Oceanography. His thesis is concerned with an explanation for the origin of discrete strokes in lightning.

Peter Vonnegut (Albany, New York)

SCIENCE FLASHES

What's New in the Research World

October 28, 1992 Volume 3 Issue 6

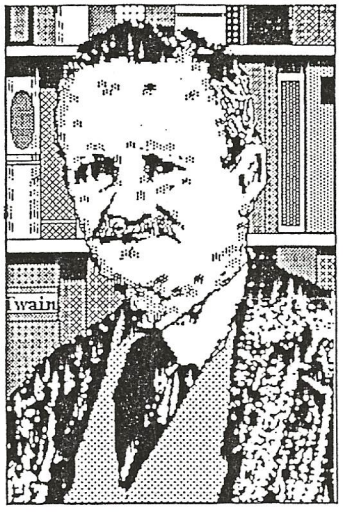
VONNEGUT RIGHT, SAYS NORSE GOD

In an electrifying statement, the ancient Norse god Thor explained, at a recent news conference held at Asgard, that Dr. Bernard Vonnegut was completely right in his theories on thunderstorm electrification and in his associated theories on tornado formation.

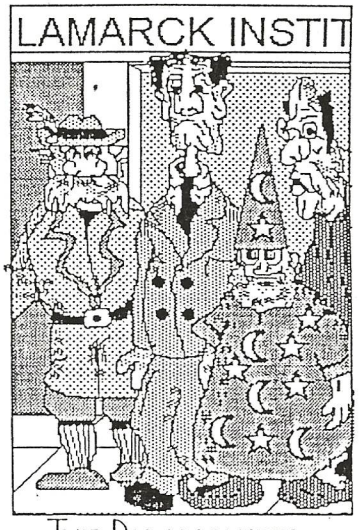
Mr. Thor told the gathered reporters that he had had a lot of time on his hands after northern Europe had been seized by the bloody frenzy of what is commonly called "Christianity."

"Nobody paid any attention to me, "he related," so I had to find something to do to keep myself busy for the rest of my eternal life. Since I am the Thunder God, I thought it would be logical to see what I had really been doing since creation, and learn more about myself."

"Over the next centuries, I read and investigated what the mortals had been saying about me. Some, such as that guy Franklin, made some good observations, but it wasn't until the mid nineteen fifties that Vonnegut really got it all together. I just can't understand why other scientists couldn't, and still can't, see that Vonnegut put it all together in a nice neat package."



DR. BERNARD VONNEGUT



THE PARADIGMISTS

"Part of the problem here I think, "Thor went on," are those damn mental log jams called paradigms. Scientists who are guided by paradigms glorify and institutionalize stale thinking. and award self-fullfilling research. Reinventing crap and rediscovering it are all they are doing, in most cases. The paradigm people can't accept Vonnegut's ideas because there's not one paradigm behind them."

"A paradigm ain't worth a dime", he sneeringly noted. as he pitched a thunderbolt casually out the (See p 3)

UNIVERSITY OF FLORIDA (Gainesville, FL)

Ewen Thomson, Rick Gaudio, and Yosef Yariv (University of Florida) joined Pedro Medelius (Boeing Aerospace/INET) at Kennedy Space Center this past summer to measure five station wideband electric field and dE/dt from lightning. Data from several overhead storms were obtained and are presently being analyzed in terms of the location, orientation, current and velocity of formation of the large-current processes that cause wideband radiation fields.

In a related venture, Ewen Thomson and Bill Hager (University of Florida) are studying an isolated storm that produced only five lightnings to test how well Hager's electrification generator model predicts the formation and characteristics of lightning.

Using dE/dt data recorded in 1990 at Kennedy Space Center in a 50 Hz to 150 MHz bandwidth, Ewen Thomson and Steve Davis (University of Florida) are simulating the effect of a propagating source on the narrowband VHF waveshapes obtained using long-baseline TOA systems. Their results relating to the origin of VHF radiation will be discussed at AGU this Fall.

UNIVERSITY OF FLORIDA (Dept. of Electrical Engineering)

Ewen Thomson (contribution will be sent later)

Marcos Rubinstein presented a survey paper at the 21st International Conference on Lightning Protection (Berlin, September 22-25, 1992) on the lightning-power line interaction research done by the UF group. On October 1, 1992, he will move to Switzerland to participate in a lightning research project with the Ecole Polytechnique Federal de Lausanne and the Swiss PTT.

Yuri Villanueva, Vlad Rakov, and Martin Uman, in collaboration with Marx Brook (New Mexico Tech) continue the analysis of microsecond-scale electric field pulses in different stages of cloud flashes at KSC, in Gainesville, Florida, and in Socorro, New Mexico. The preliminary results of this study will be presented at the 10th International Zurich Symposium & Technical Exhibition on EMC (March 9-11, 1993).

Rajeev Thottappillil has been awarded the Ph.D. in electrical engineering in August 1992. He is currently a Postdoctoral Fellow in the Department of Electrical Engineering. The new results found in his dissertation "Cloud-to-ground lightning processes with emphasis on data analysis and modelling of the return stroke" are being prepared for publication in the reviewed literature.

STORM ELECTRICITY AND CLOUD PHYSICS RESEARCH GROUP
NOAA/ERL/NATIONAL SEVERE STORMS LABORATORY (Norman, Oklahoma)

Personnel changes: We have consolidated our group in Norman with the recent arrival of Ron Holle (405) 366-0516, Raul Lopez (405) 366-0416, and Bob Ortiz (406) 366-0451. Irv Watson will remain in Boulder until after TOGA-COARE and will join us next spring.

Scientists from NOAA/ERL/National Severe Storms Laboratory conducted tests at the Langmuir Laboratory for Atmospheric Research in the mountains of New Mexico. The team consisted of Dave Rust and students Megan Madox, Tom Shepherd, and Maribeth Stolzenburg from the School of Meteorology (SOM) and Ken Eack, physics student, at Oklahoma University. We were there primarily to work with and support research being conducted by John Willett of Phillips Laboratory and Tom Marshall of the University of Mississippi. During the two-week project, we released balloons instrumented with sondes and electric field meters to provide base data for comparison with a new prototype rocket-borne electric field sounding system being tested by John Willett.

A second project included testing of all our balloon-borne instruments in a high-electric-field system to simulate fields inside clouds and thunderstorms. The system, which included a

field mill flush mounted in the lower parallel-plate electrode, was made available by Bill Winn and Charlie Moore. The test system provided controllable and quantitative electric fields. The sonde that we tested (Vaisala RL80) is used extensively by NCAR, NOAA, and others. The sonde uses Loran-C navigation signals to calculate winds and is susceptible to high E, where it can lose wind and tracking data. We have developed a different Loran receiving antenna so the sonde function more reliably during soundings in high E. The data show that the modified sondes function in fields of at least 100 kV/m (kilovolts/meter), the limit of the test setup for the sonde. The results of the test were also corroborated in flights through thunderstorms over Langmuir Laboratory in which the electric field reached 100 kV/m and the sonde continued to receive high-resolution wind information.

We also tested the particle charge and size (q-d) instrument flown by physics Ph.D. candidate Monte Bateman of NSSL/CIMMS. Those tests indicate the q-d instrument does not emit point-discharge until 100 kV/m at an atmospheric pressure of about 700 mb. Particle charges should not have any possible contamination by point-discharge from the instrument below this threshold value of E, which can be adjusted for the pressure where measurements were made. The ability to detect point-discharge from the instrument was also verified.

Calibration of the balloon-borne electric field meter confirmed the calibration calculation technique in use since the instrument's inception by Bill Winn to be correct. The data show no evidence of point-discharge at the maximum E magnitude we could apply of 190 kV/m.

Irv Watson, Ron Holle, and Raul Lopez have recently completed two lightning-related papers concentrating on the Southwest U.S. Monsoon. These papers will be submitted to *Monthly Weather Review*. One paper identifies convective bursts and breaks using Bureau of Land Management (BLM) lightning information. Composited upper-air analyses for 12 bursts and 10 breaks are examined to determine the synoptic-scale differences between these regimes. This investigation shows the synoptic-scale differences between these regimes. This investigation shows the importance of moisture, the location of the subtropical ridge axis, and the high plateau thermal low. The other study examines the diurnal CG lightning patterns in Arizona during the summer. On most days, flash activity develops along the Mogollon Rim, and moves south and westward down the topography gradient, and enters the lower desert by early evening. At the same time, lightning activity develops in the highlands of southeast Arizona and moves west-northwestward, also reaching the lower desert by late afternoon and early evening.

NSSL has begun planning a field program focussed on tornadic storms in Oklahoma, north Texas, and south Kansas to begin during the spring of 1994. Tentative plans for instrumentation include balloon-borne electric field soundings from a mobile laboratory, single and dual-Dopple radar coverage, an airborne Doppler radar, a lightning ground strike mapping system, and atmospheric soundings near and inside tornadic storms. For more information, contact Dave Rust at (405) 366-0404 or Don MacGorman at (405) 366-0405.

During the past few months Don MacGorman has been wrapping up a study of severe storms whose cloud-to-ground activity is dominated by positive ground flashes, instead of the more common negative flashes. He also has begun a new study of clusters of positive cloud-to-ground lightning in stratiform precipitation regions. In two cases, one during spring and one during winter, infrequent positive ground flashes continued to occur for a few hours in the stratiform region after it became detached from the convective line.

On August 31, the National Weather Service (NWS) awarded a contract to Atmospheric Research Systems, Inc., (ARSI) to provide national lightning strike data to government agencies from networks of LPATS stations. A September protest of the contract award was dismissed. NSSL is helping the NWS and FAA to perform preliminary acceptance testing of the performance of this national system.

National hazard policy, protection strategies, and community education efforts are based principally on statistics on lightning deaths and injuries obtained from the monthly NOAA publication *Storm Data*. Cursory checking of this data source against newspaper, anecdotal information, and medical/hospital experiences indicate that many more lightning-caused injuries occur than are in *Storm Data*. If this can be verified and quantified, lightning

should be considered a much more dangerous natural hazard than presently believed, so community awareness should be raised, and the attention of hazard protection policy agencies aroused to the importance of this phenomenon. A study is in progress by Raul Lopez and Ron Holle of NSSL, together with Michael Cherington and other staff members of St. Anthony Hospital in Denver, Todd Heightkamp of the Denver NWS, and Ken Langford and Steve Clark from the Denver area to compare *Storm Data* statistics to death certificate and hospitalization records from Colorado. Preliminary results indicate that *Storm Data* may underreport deaths by 20% and injuries (serious enough to require hospitalization or be reported by newspapers) by at least 30%. Also, only 50% of all injuries required hospitalization of at least one day, while the other 50% were treated in emergency rooms and released by themselves. Most deaths occurred at the strike location or while being taken to the hospital.

The first phase of a study concerning lightning-related human casualties in central Florida was completed by Ron Holle, Raul Lopez, Bob Ortiz, and Irv Watson, with assistance from NWS staff Charles Paxton and Dennis Decker in Florida and Dan Smith in Fort Worth. For the 90 deaths and injuries and 43 property-damage cases due to lightning in central Florida during eight years of *Storm Data*, it was found that people were struck more often at the end of storms than at the start, and least often at the storm's maximum. However, property is struck quite often at the maximum. People are hit often when there are rather few flashes, e.g., less than one flash per 4 minutes.

Raul Lopez, Ron Holle, Bob Ortiz and Irv Watson, studied the variation of flash density and signal strength during the lifetime of a mesoscale convective system observed during 3-4 June 1985 in the PRESTORM area. As the system moved through the Oklahoma/Kansas lightning detection network, flash density and minimum and median signal strength varied considerably with time in a regular way. The changes resulted from effects of the network configuration and signal strength attenuation with distance, and did not necessarily represent physical changes of the storm. Changes in flash signal strength distribution during a storm's life cycle could be an important indication of microphysical and dynamical changes, but before using lightning direction-finder (DF) data for such studies, one has to consider the instrumental limitations of the network, or wrong physical conclusions could be drawn.

A study by Raul Lopez, Ron Holle, and Irv Watson is in progress to study the effects of network configuration, attenuation with distance, and sensor detection thresholds on the losses of detection efficiency in the BLM network covering the western U.S. The goal is to obtain maps of detection efficiency losses due to these factors to correct the eight years of available CG lightning data from this large region so they can be used in climatological and meteorological studies.

A study by Raul Lopez compared the performance charcteristics of the low- and medium-gain DF networks in the Kennedy Space Center area. Aspects included were site errors, detection efficiency, sensor performance, single detections, mixed polarity detections, saturations, and positive flash statistics. These results were published in a final report from NSSL to NASA's Office of Space Flight. In this same region, a preliminary study was made using 8 years of CG lightning data from the medium-gain DF network. Each day was stratified according to the prevailing low-level wind regime, then composite hourly maps were produced for each of the regimes. Areal and temporal patterns showed considerable differences from one low-level flow regime to the other, confirming previous studies using a much more limited data set. These climatological patterns, stratified by different typical synoptic situations, can be useful for the monitoring and forecasting of lightning activity in the region.

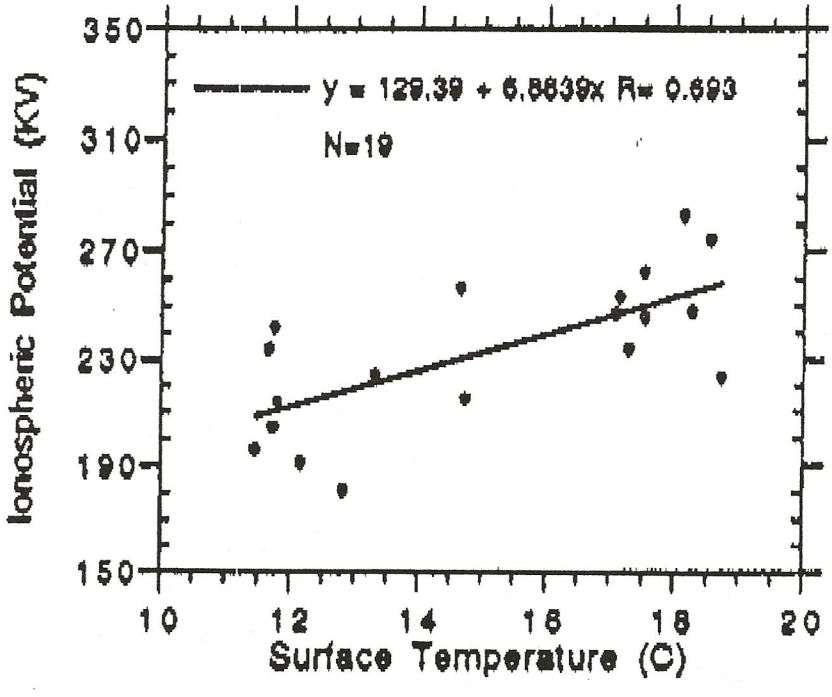
Vlad Mazur and OU SOM student John Ensworth conducted video recording of all-sky lightning images viewed in a parabolic mirror at two sites separated by 4 km in the vicinity of the Orlando airport, as a part of 1992 Orlando FAA-MIT/Lincoln Lab field program. One site was collocated with an interferometric site of New Mexico Institute of Mining and Technology. The video system at this site included a high-speed video camera with an image intensifier operating at 1,000 frames/s. A deep red filter was used to enable recording of lightning channels in daylight conditions. In addition to video images, electric and magnetic field

changes, lightning radiation at 300 MHz, and light transients were recorded. The second site was equipped with a regular speed video camera. The objective of observation was to obtain images of positive leaders and negative streamers in highly branched and extensive intracloud discharges and positive cloud-to-ground flashes in the late and stratiform stage of thunderstorms. Slow propagating leaders progressing with an estimated speed of 10^4 m/s, whose motion was well-resolved by the video system, have been observed during the cloud flashes and positive ground flashes. Faster moving streamers were also observed, but their speed was unresolved by the video system. The objective of data analysis will be to:
(1) identify leaders and streamers with the two-dimensional interferometric and other supporting measurements, and (2) reconstruct the three dimensional structure of lightning discharges observed.

NASA GODDARD INSTITUTE FOR SPACE STUDIES/COLUMBIA UNIVERSITY
(New York, NY)

Colin Price and David Rind recently published a paper in JGR titled "A simple lightning parameterization for calculating global lightning distributions", (JGR, 97, 9919-9933, June 20, 1992). Work has continued on the ratio of IC/CG flashes in thunderstorms. Previously it had been thought that the IC/CG ratio was determined by the freezing level height. Our studies show that the proportion of CG flashes in a particular thunderstorm is related to the thickness of the mixed-phase region in thunderstorms, and not to the freezing level height. Our results can also explain the variation of the ratio IC/CG with latitude.

More recently, Colin Price and Ralph Markson have been working on the relationship between ionospheric potential and global/tropical surface temperatures. Significant positive correlations have been found between both mean global/tropical surface temperatures and ionospheric potential (see figure). The results may imply that ionospheric potential may be a useful parameter for monitoring any future global climate change.



NASA MARSHALL SPACE FLIGHT CENTER (Huntsville, AL)

All four planned data collection deployments (2 summer, 2 winter) for the joint NASA/Air Force Airborne Field Mill (ABFM) program conducted at Kennedy Space Center (KSC) have now been completed. D. Mach, J. Bailey, W. Koshak, H. Christian, have completed the operational analyses, the aircraft calibration report, and are currently finishing the review of summer-time launch commit criteria (LCC) rules. The installing of upgraded field mills at KSC which began this summer is proceeding on schedule.

Participation will occur this fall and winter during the TOGA-COARE field program involving aircraft (ER-2 and DC-8) electrical measurements and ground-based lightning detection. The ground-based observations are a cooperative effort involving MSFC (H. Christian, R. Blakeslee, and S. Goodman, U. of Ariz. (P. Krider and C. Weidman), TAME (R. Orville and E. Zipser), NMIMT (M. Brook) and LLP. LLP has kindly loaned three specially modified advanced lightning detection systems (ADLF) for this experiment.

A global lightning climatology continues to be assembled from digitized DMSP/OLS data sets. Persons who have ground-based lightning data sets (e.g., LLP, SAFIR, LPATS, VHF, other) that could contribute to a global lightning climatology (e.g., regional lightning detection networks, etc.) are encouraged to contact S. Goodman (ph.: 205-544-1683, fax: -5760, e-mail: SGOODMAN@nasamail.nasa.gov) or H. Christian (ph.: 205-544-1649, fax: -5760, e-mail: HCHRISTIAN@nasamail.nasa.gov). The address for both is ES43, NASA/MSFC, Huntsville, AL 35812.

NASA Technical Memorandum 4350 by H. Christian, R. Blakeslee, and S. Goodman, "Lightning Imaging Sensor (LIS) for the Earth Observing System", is available upon request. LIS has been selected to fly on the Tropical Rainfall Measuring Mission (TRMM) satellite.

A functional demonstration of a Lightning Simulator (LSIM) for LIS calibration is scheduled at NASA/MSFC in late March, 1993. Such a simulator will generate a realistic lightning scene using acousto-spinel modulation and scanning of a diode laser output (W. Koshak, NASA/MSFC; J.Bergstrom, Sverdrup Corp.).

STATE UNIVERSITY OF NEW YORK AT ALBANY (Albany, NY)

Anton Seimon is continuing his work on the CG lightning characteristics of thunderstorms spawning violent intensity tornadoes (F4-F5 intensity; estimated windspeeds of 92-142 m/s). Only 2% of United States tornadoes achieve this intensity, however almost 70% of tornado-related fatalities are attributed to these storms. A study detailing electrical activity in the 28 August 1990 Plainfield tornado, a case featuring the remarkable reversal of flash polarity at tornadogenesis, will be published in the February 1993 Bulletin of the AMS. Current work includes construction of an analog of 20 other violent tornado cases, and a detailed case study on the 10 July 1989 New York-Connecticut supercell which spawned three F4 and numerous lesser intensity tornadoes. This giant thunderstorm produced the highest flash rate for any single storm I have yet observed on the National Lightning Detection Network, as many as 100 per minute. A reliable eyewitness account describes a single farm building being hit by lightning at least 60-80 times in a few minutes! Preliminary findings from both this case and the analog study will be presented at the 1992 AGU meeting in San Francisco.

During this past summer, Vince Idone and Henry Jurenka have continued several analyses of the time-resolved photographic imagery of the last several campaigns of triggered lightning at the Kennedy Space Center. We are particularly interested in the relation of dart and dart-stepped leaders to the ensuing return stroke peak current. In addition, we are examining the correlation of the electric-field records obtained by Prof. Marx Brook in '91 with optical records of the same triggered events. We have been able to put together several pulse sequences of initiating leaders as observed simultaneously on film and in the electric field record. In addition, Vince is actively analyzing the highly time-resolved records of lightning channel cross-sections also obtained in '91. These will provide temporal resolution of 3 μsec

and a spatial resolution of at least 0.5 cm. Further, these images have been converted to relative intensity and may allow an examination of the relative luminosity variation across an individual return stroke channel. Variations of these spatial profiles with time could provide insight on the convective cooling of lightning channels. Some of this work will be presented at the upcoming AGU Meeting.

Ron Henderson, Vince Idone, Arsalan Saljoughy, and Anton Seimon have carried out a lightning field study during this past summer to evaluate various aspects of the performance of the NLDN in the local area of Albany, New York. Video records of over five hundred flashes have been obtained. These records will provide accurate timing (+/.16 μsec) of the occurrence of a flash and accurate estimates of the azimuth to individual flashes (0.5 degree). Coupled with cloud-base information and/or time-to-thunder, we will use these images to determine the detection efficiency and location accuracy of the NLDN in our local region. A preliminary evaluation of these results will be presented in San Francisco. In the next few weeks, we intend to field a "Marx System" (originally designed by Prof. Marx Brook) that will provide continuous E-field records of about 1 sec total duration per flash with 0.5 μsec time resolution. We hope to acquire records from numerous flashes at various ranges and in differing meteorological regimes. We intend to use these observations to help investigate how the data from the NLDN can be processed so as to yield large sample statistics on the characteristics of subsequent strokes. Also, we hope to further investigate the characteristics of wintertime lightning flashes in collaboration with Prof. Marx Brook.

In the course of the research involved for their Master's theses Michael Brook and Scott Jacobs began investigations of the very unusual storms that are sometimes indicated on the LDN, which produce almost nothing except positive CG flashes and few if any of the very common negative CG flashes. Anton Seimon and Vincent Idone have continued this study and discovered further examples of these anomalous storms, some of which last for as much as several hours. These storms are of great interest because, as Anton has shown, these rare storms sometimes generate unusually destructive tornadoes. Seimon, Idone, and Vonnegut are also particularly interested in such storms because their occurrence may possibly shed some light on the mysteries of the cloud electrification process. A fascinating example of a storm that gave positive CG lightning has recently been provided by Don Latham of the U.S. Forest Service who described a cloud formed from a forest fire that produced 16 CG flashes, each of which was of positive polarity. Charles Moore of New Mexico Tech and Vonnegut believe that the flux of air into the cloud forming from the fire carried negative space charge and caused the cloud to grow with inverted polarity, just as in the case of the early New Mexico experiments with the artificially generated negative space charge. They are presently at work on the preparation of a paper based on this concept. Vonnegut continues his campaign for the execution of the remote sensing experiments that will reveal what happens to the charge deposited on the cloud by the CTR Wilson current and the amount of charge carried by falling precipitation. It is unfortunate that these crucial experiments were not carried out in the CAPE project.

TEXAS A & M UNIVERSITY (College Station, TX)

Texas A & M University scientists in the Cooperative Institute for Applied Meteorological Studies continue to study a broad range of mesoscale processes. Ed Zipser, Mike Biggerstaff, John Nielsen, and Dick Orville completed a successful Spring field program in cooperation with the NWS Houston Office. Doppler data were obtained with the A&M 10-cm radar and the new WSR-88D at Houston on over twenty significant storms in central and eastern Texas. Simultaneously, lightning data were recorded from the National Lightning Detection Network and special high-frequency soundings were taken with a CLASS system on loan from the NSSL. Our research group has been strengthened over the summer with the addition of Lou Wicker, a recent PhD from the University of Illinois and now a new assistant

professor in the Department of Meteorology. Lou Wicker broadens the background of our research group with extensive experience in the modelling of severe storms.

Our studies this winter will be expanded to the TOGA COARE western Pacific program. A lightning study funded by the National Science Foundation (Dick Orville and Ed Zipser, PI's) will establish a three-DF LLP network at Rabaul, Kavieng, and Kapingamarangi Atoll. The TOGA COARE lightning research team consists of eight scientists. In addition to Zipser and Orville, Marx Brook (New Mexico Tech), Charles Weidman and Phil Krider (University of Arizona), and Hugh Christian, Steve Goodman, and Rich Blakeslee (NASA Marshall) are participating. Individuals wishing more information on this oceanic lightning program should write Dick Orville, Department of Meteorology, Texas A&M University, College Station, Texas 77843-3150.

UMIST (Manchester, UK)

In UMIST, Clive Saunders and Ian Brooks are finishing off the laboratory studies of the inductive charge transfer mechanism involving droplet/rimer interactions in a vertical electric field. The measured charge transfers are so small that severe signal/noise problems are difficult to overcome. A definitive statement as to whether the mechanism is viable will probably err on the side of caution. It is intended to write this up for the St. Petersburg Conference issue of JGR. Clive has been bringing his St. Petersburg review up to date, trying to reconcile the various laboratory studies of graupel charging with the various proposed theories of charge transfer. Also, the CAPE P3 charge measurements are presently being analyzed. Future laboratory work will involve a return to the vexed issue of graupel charging.

UNIVERSITY OF WASHINGTON (Seattle, WA)

ELBBO Update: The Extended Life Balloon Borne Observatory program is on schedule for a series of five superpressure balloon flights beginning in early November 1992 from Dunedin, New Zealand. These payloads will measure a variety of electrodynamical parameters at 26 km altitude for durations on the order of one month. The five payloads successfully underwent integration at NSBF in Palestine, TX in September 1992. Anyone wishing to coordinate observations from either hemisphere is invited to communicate with the ELBBO project for up-to-minute balloon location. Please contact: R. Holzworth at **(206) 684-7410** or e-mail: bobholz@geophys.washington.edu.

THUNDERSTORM II update: This experiment involves the simultaneous launch of balloons and rockets over a thunderstorm at NASA/Wallops Flight Facility, Wallops Island, VA. The launch window was opened for over one month this summer, but due to unusual weather conditions, we never had the opportunity to launch the series. The window has now closed for 1992 and we are planning to try again in summer 1993. For detailed information about measurements and schedules contact R. Holzworth at **(206) 685-7410** or C. Croskey at **(814) 865-2357**.

Blackbeard update: The Blackbeard payload on the Alexis mission is now scheduled for launch not before December 1992. The experiment includes both optical and electrical lightning transient measurements from a satellite in low earth orbit. The Pegasus launch vehicle is undergoing testing and we expect a real launch date to be set in the near future. The Blackbeard experiment is built by Los Alamos National Labs under Dr. Tom Armstrong. All activity at LANL and University of Washington is sponsored by DOE. For coordinating observations or more information contact R. Holzworth, **(206) 685-7410**.