NEWSLETTER ON ATMOSPHERIC ELECTRICITY

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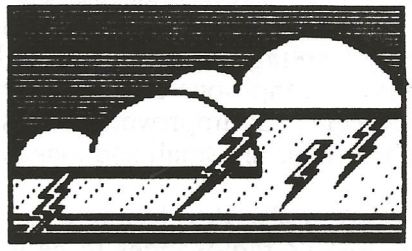

AMS COMMITTEE ON
ATMOSPHERIC ELECTRICITY

ANNOUNCEMENTS

Future Newsletter Contributions

For this and previous newsletters, requests for contributions have been mailed by AMS Headquarters 4-6 weeks prior to release of the Newsletter. In efforts to save the expense of this mailing (to approximately 300 recipients), we are requesting contributions for the next Newsletter now (and only now), to be received by September 30, 1992.
MARK YOUR CALENDARS NOW!

ICAE Travel Grants

The AGU is accepting travel grant applications for travel to the ICAE meeting in St. Petersburg (15-19 June, 1992) from students and recent grads as well as other professionals without major grant support. The AGU has applied for these travel funds from the National Science Foundation, in consultation with the chairmen of AGU/CASE, AMS/CAE and the President of the ICAE. Due to the short time prior to the meeting applications are being accepted in advance, in anticipation of a favorable review by NSF. Please send application to: Travel Desk, American Geophysical Union, 2000 Florida Ave., Washington, D.C. 20009.

Discussion On Charging Mechanisms

Considerable interest has been voiced for an informal session on charging mechanisms for cloud electrification at the 9th International Conference on Atmospheric Electricity (to continue the tradition initiated at the Albany Conference). Watch for notices for this session in St. Petersburg if you are interested.

RESEARCH ACTIVITIES BY ORGANIZATION

AIRBORNE RESEARCH ASSOCIATES (Weston, MA 02193)

Ralph Markson and colleagues at ARA have developed a hand held lightning detector (the M-10) containing both optical and flat plate field change detectors. The instrument picks up intracloud and cloud-to-ground lightning with close to 100% efficiency within several tens of miles. The optical section provides directional information on which clouds contain lightning while the field change section picks up flashes from all directions. The field change range varies from 40 miles to 1000 miles depending on the exposure of the antenna. The optical and field change sections can be operated independently or in a coincidence mode which eliminates false alarms. Recent improvements include changing the circuitry so that almost all strokes are detected within each flash. The M-10 is being used in many areas including government labs, university research groups, golf courses and industry.

The potential probe electric field system, developed for Kennedy Space Center, has recently been improved. While the traditional problem of wind sensitivity of a corona current instrument was overcome through the use of moderately high ohm resistance in series with the corona point, and the "dead band" was eliminated by keeping the needle in corona at all times with a high voltage AC power supply, the original instrument, which works well during thunderstorm conditions did not provide quantitative measurements of fair-weather electric fields. Recently an improvement has been made which greatly minimizes the noise during times when fields are small and makes the instrument capable of measuring fair-weather fields reliably.

ARA is also developing a fair-weather electric field sensing package that will easily interface to VIZ radiosondes to be used in global change studies. A pilot program will be conducted to compare ionospheric potential measurements with global tropical temperature, rainfall and cloud imagery in order to determine if global circuit variations may be useful in monitoring variations in these parameters.

ATMOSPHERIC RESEARCH SYSTEMS, INC. (Palm Bay, FL 32905)

Atmospheric Research Systems, Inc. (ARSI) and Zephyr Weather Information Service, Inc. recently completed communications and design enhancements to its LPATS National Network. Communication upgrades involved conversion of the remaining sites utilizing telephone lines to VSAT satellite communications. The Mid-South System, which supports the lower Mississippi Valley, South Central Plains, Texas and Northern Mexico was recently upgraded to employ the Global Positioning System (GPS) and its synchronized timing source. This is the first of the 11 systems to receive this upgrade.

ARSI and Zephyr recently introduced a special program for universities/colleges, who wish to access realtime lightning, which offers substantial discounts on data fees when such data is used in support of curriculum and research programs. The principle point of contact for this program is Kevin Porreco (Zephyr) at 508-898-3511.

INTERNATIONAL COMMITTE ON BALL LIGHTNING (Pasadena, CA 91106)

The International Committee on Ball Lightning is sponsoring the Third International Symposium on Ball Lightning at U.C.L.A. on 28-30 July 1992. Previous Symposia were held in Tokyo and Budapest. For information contact Stanley Singer, 381 South Meridith Ave., Pasadena, CA 91106.

KENNEDY SPACE CENTER (JFK Space Center, FL 32899)

Carl Lennon reports on the new Lightning Detection and Ranging (LDAR) system. Six remote sites and data transmission systems were intalled by 7/22/91. Operational problems were resolved and good data was available from all sites by 8/9/91. Since the LDAR real time data processing equipment was not complete, a waveform recording system was used to gather as much data as possible. The quality of the waveform data appears to be good, but is limited in quantity due to memory size and ability to download to storage medium.

The LDAR real time hardware has been completed and is undergoing laboratory testing. Problems are still present in reliably getting data from the LDAR equipment into and out of the system's real time parallel processors. These problems are related to software timing problems and interrupt priorities. Programming resources are now available to effectively work these problems.

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

Serge Chauzy reports that his group in Atmospheric Electricity is developing a new project on the study of cloud microphysics-cloud electrification interactions. Model calculations simulate the influence of ambient electric field and net electric charge on precipitating water drops. Electrical conditions causing drop disruption or corona emission can be established. In this way, the situation leading to intra-cloud lightning initiation is characterized. Furthermore, laboratory experiments on microdischarges between solid hydrometeors are developed. To do so, microdischarges produced between "home-made" and charged icicles are analyzed under various conditions. The temperature dependence of the electric current signatures obtained is especially studied.

On the other hand, field experiments on the slow transfer of electric charge between ground and thundercloud are underway. They consist in simultaneously measuring the electric field at various altitudes using self-contained sensors suspended from a tethered balloon. After the 1991 summer campaign at Kennedy Space Center, during which the balloon and the hanging sensors were ferociously blown away by a tempest, a new experiment will be held in France during the summer of 1992. New electric field sensors will be tested.

LAWRENCE LIVERMORE LABORATORY (Livermore, CA)

Richard Hasbrouck is organizing the 3rd Lightning Warning Workshop to be held August 14, 1992 at the University Park Hotel in Salt Lake City. Workshop attendees will include members of the Range Commanders Council/Meteorology Group, members of the meteorological community and other interested individuals. For further information contact Richard at 510-422-1256.

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

LPP is continuing its research program aimed at improving detection efficiency and location accuracy in lightning detection networks. Further improvements in site-error correction methods have resulted from algorithm extensions which allow the inclusion of ground-truth data. Application of this algorithm to U.S. National Lightning Detection Network data in Florida has produced a 3-fold improvement in location accuracy (now 1-3 km accuracy). These improvements have been quantified using data from the Air Force 45th Space Wing (ESMC) network, which has been demonstrated to have an average accuracy of 0.4 km.

We have also developed a model and procedure to determine actual network detection efficiency using measured lightning data.

During the upcoming storm season, we will be performing real-time detection and location of cloud discharges in our local research network in Tucson.

In the last year, we have also introduced an omnidirectional electrical storm identification device (ESID) for thunderstorm warning. This device is based on the coincidence of optical and electric field signals, and is capable of identifying cloud and cloud-to-ground (C-G) lightning and determining the range to C-G lightning within 25 miles of the sensor. The signal processing methods employed in this device allow us to operate it in electrically noisy environments and to place it near large structures such as towers and on top of buildings. This sensor has been in field testing for a full year, where it has been analyzed "stroke-by-stroke" using short-baseline networks.

In the interest of furthering the understanding of lightning phenomenology and global weather patterns, LLP will be providing three Advanced Lightning Direction Finders for use in the TOGA-COARE project. These sensors will be configured for long-range (>1000 km) lightning detection, and will be equipped with GPS Absolute clocks.

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

MANCHESTER INSTITUTE OF SCIENCE AND TECHNOLOGY (Manchester, U.K.)

Anthony Illingworth is continuing the radar lightning comparisons using the S-band 25m disks of the Chilbolton Antenna and the EA technology low frequency magnetic direction finding lightning location system run by Mike Lees. The radar data provide a check of the accuracy of the locations and the polarization properties of the radar returns confirm that the lightning is associated with regions of soft hail. Ian Brooks continues his laboratory studies of charge transfer during supercooled water droplet collisions with an ice target in a vertical electric field. The inductive charging process may yet play a role in thunderstorm electrification and Ian will present his results in St. Petersburg. Clive Saunders has finished a review of Thunderstorm Electrification for the Pat Squires memorial issue of JAS and will present a review of Charging Processes at St. Petersburg. Laboratory experiments are being conducted to try to resolve the opposing charge transfer results of Jayaratne and Caranti when they replace ice crystals with sand or quartz in collision with an ice target. The question to answer is "Does the nature of the interacting particle (the ice crystal or sand/quartz particle) play a role in controlling the sign of the charge transfer and are these results relevant to the realistic case of a riming graupel pellet in thundertorms?" These and other controversial issues on charging processes should make for a stimulating discussion in St. Petersburg.

MIT LINCOLN LABORATORY (Lexington, MA 02173)

A collaborative field measurement program will take place in Orlando, Florida during the period June-August, Lincoln Laboratory (Mark Weber), the University of North Dakota (Ron Rinehart) and MIT (Earle Williams) will operate a short baseline triple-Doppler radar network for documentation of the structure and dynamics of storms over Orlando's airport. ONERA (Pierre Laroche) will deploy their 3-dimensional interferometric lightning mapping system to collect data relating VHF activity from lightning to the radar measurements. NSSL (Vlad Mazur) plans to deploy a high-speed, stereographic video camera system and various electromagnetic waveform recorders. NMIMT (Paul Krehbiel) plans to operate his single-station, high-time resolution UHF interferometer at the Orlando airport during July and August. Supporting instrumentation include a 15-station MESONET providing surface thermodynamic and corona point data and multiple daily rawinsonde soundings (University of Lowell). Data from the Melbourne NEXRAD will be archived by Lincoln Laboratory.

MIT WEATHER RADAR LABORATORY (Cambridge, MA 02139)

Interest continues in the use of the global electrical current as a sensitive diagnostic for global tropical temperature change. Archived Schumann resonance observations from Charles Polk (URI, Kingston, RI) have been analyzed for monthly mean magnetic field (8 Hz) in the period 1969-1974 and compared with tropical temperature anomalies from Hansen and Lebedeff (1987). As expected, a warmer tropics is associated with a more intense Schumann resonance, particularly on the 40-month El Niño time scale, when the surface temperatures in the three major zones of tropical convection rise and fall synchronously. A 1°C temperature fluctuation is associated with an approximate quadrupling of the power in the 8 Hz resonance, a power which should be linear in global lightning activity. This sensitivity is consistent with local measurements in the tropics of the variation of lightning activity with changes in surface wet bulb temperature. In collaboration with Dave Sentman of the University of Alaska, we propose to continue investigations of the Schumann resonance with particular emphasis in the near term on the TOGA COARE region of the Western Pacific Ocean.

Stan Heckman has recently completed his doctoral thesis entitled "Why Does A Lightning Flash Have Multiple Strokes?" A stability analysis of arcs (driven by current sources) with characteristic negative differential resistance identifies two regimes (1) a stable regime (associated with continuing currents) and (2) an unstable regime which is self-extinguishing (associated with discrete strokes). The stability threshold depends on both

supply current and lightning channel length; 3D interferometer and TOA data will be valuable in testing these predictions.

Igor Gonta continues to experiment with a modified Franklin chimes, which now operates continuously in both fair weather and thunderstorm conditions with the aid of the 100 m tall Green Building at MIT. Results of this study will be reported in St. Petersburg.

The MIT C-band radar is being assembled in Orlando following an extensive upgrade this winter through the dedicated efforts of Steve Rutledge and colleagues at CSU, in preparation for the TOGA COARE experiment. In Orlando, we continue our collaboration this summer with Mark Weber, Lincoln Laboratory and Pierre LaRoche and Anne Bondiou of ONERA to study the continuous evolution of lightning 'trees' and the triple-Doppler-derived convective structure of Florida storms. Also participating in Orlando will be Rick Gumley of International Protection Consultants in Australia and Vlad Mazur from NSSL, who will investigate air discharges. Other investigators are welcome during the months of June-August; please contact Earle Williams in St. Petersburg if interested.

NASA AMES RESEARCH CENTER (Moffett Field, CA)

William Borucki reports that a paper discussing lightning on Neptune has been submitted to the special issue of ICARUS. Gurnett et al. (1990, JGR 95, 20967) have reported the detection of whistler-like events by the plasma wave analyzer on board the Voyager 2 spacecraft when it encountered Neptune. The characteristic signature of these events is strong evidence for the presence of lightning activity in the atmosphere. To confirm the identification of whistlers with lightning events and to locate the positions of the activity, a search for optical flashes was conducted. During the encounter hundreds of images of the nightside were obtained with both the wide-angle and narrow-angle imagers. Some of these images were obtained at ranges as short as those used at Jupiter that showed intense lightning storms. Ninety eight of the best images have been processed to remove noise and artifacts and were then searched for optical flashes. These images covered 94% of the surface of Neptune including such features as the Great Dark Spot, the Second Dark Spot, and the Scooter. No lightning storms were found. Either Neptunian lightning storms are less bright than those on Jupiter or they occur no more than 1/4 as frequently as on Jupiter.

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

Colin Price and David Rind report on modelling global lightning activity in the GISS General Circulation Model (GCM). At this stage we have been fairly successful at modelling total lightning distributions and frequencies (intra-cloud + cloud-to-ground flashes) around the globe. A paper describing the parameterization used in the simulations will soon appear in JGR-Atmospheres.

Presently we are working on a method of calculating the fraction of cloud-to-ground flashes in thunderstorms. Two theories exist as to why the ratio IC/CG varies with latitude. One is due to a variation in freezing level height with latitude, while the other is related to variations in the volume of the mixed phase region with latitude. We are investigating these two hypotheses to identify what factors determine the fraction of cloud-to-ground flashes in thunderstorms.

NASA GODDARD SPACE FLIGHT CENTER, SEVERE STORMS BRANCH
(Greenbelt, MD 20771)

Joanne Simpson reports that the Tropical Rainfall Measuring Mission (TRMM) Science Team met with the Japanese TRMM Mission Team in Tokyo, March 16-19, 1992. The addition of LIS (Lightning Imaging Sensor) to the TRMM payload was greeted with great enthusiasm as was a presentation by Hugh Christian, Head of the LIS Science Team. LIS will

help identify strong convective updrafts. The 35 degree inclination of the TRMM orbit will provide lightning information over the global tropics at all times of the diurnal cycle which will help in understanding cloud electrification and its differences between land and ocean.

NASA/MARSHALL SPACE FLIGHT CENTER (Huntsville, AL)

P. Geis (Rice University, Ph.D.student) and R. Blakeslee obtained electric field and air conductivity measurements above thunderstorms using the high altitude ER-2 aircraft during the STORM-FEST field program (Feb./Mar.). Analysis of this and ER-2 CAPE data obtained last summer is underway.

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, and H. Christian have completed 3 of 4 operational analyses, the aircraft calibration report, and are currently reviewing summertime launch commit criteria (LCC) rules. Plans for installing upgraded field mills at KSC this summer are proceeding on schedule.

Plans are underway to participate in the TOGA-COARE field program next fall and winter with aircraft electrical measurements (ER-2 and DC-8) and ground-based lightning detection stations. Establishing the ground station is a cooperative effort involving MSFC (H. Christian, R. Blakeslee, and S. Goodman), U. of Ariz. (P. Krider and C. Weidman), Texas A&M University (R. Orville and E. Zipser), and New Mexico Tech (M. Brook). 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 lightning data sets 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: HCRHSTIAN@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. S. Goodman and H. Christian have contributed the chapter "Lightning Observation from Space" to the Global Change Atlas due to be published in July in honor of the International Space Year. The atlas is devoted to discussing satellite observation of geophysical variables that are or will be used to monitor and study global change.

A very productive meeting of the Lightning Observation System science committee was held on Dec.7-8 in California. The purpose of the meeting was to develop science plans for LIS and pre-mission research activities. A summary of the meeting will appear in an upcoming issue of "The Earth Observer" published by NASA EOS. Attending were R. Blakeslee, M. Brook, H. Christian, S. Goodman, P. Krider, D. Latham, J. Latham, E. Williams, and E. Zipser.

Observation of vertical discharges above thunderstorms continue to be found and documented in night-time space shuttle video. An image of one of the vertical discharges will be published in May in MWR as Photo-of-the-Month. Also a paper by W. Boeck (Niagara U.), O. Vaughan, R. Blakeslee, B. Vonnegut (SUNYA), and M. Brook (NMIMT) describing "Lightning induced brightening in the airglow layer" was published in the Jan. 24 issue of GRL.

A paper by K. Driscoll (Auburn University, Ph.D. student), R. Blakeslee, and M. Baginski (Auburn U.), "A modeling study of the time-averaged electric currents in the vicinity of isolated thunderstorms" has been accepted by JGR. This research demonstrates that by using time-averaged electrical properties of a thunderstorm, including the effects of lightning, the electrical behavior of the atmosphere in the vicinity of the storm can be examined with a simple Holzer and Saxon type formulation.

A paper by W. Koshak (NASA MSFC), and P. Krider (U. of Ariz.), "A Linear Method for Analyzing Lightning Field Changes" will be submitted to JAS. This study introduces a quantitative means for determining information content in ground-based ΔE data, and presents a general technique for finding the charges deposited by lightning.

Currently, lightning radiative transfer models are being developed at MSFC (W. Koshak, R. Blakeslee) in cooperation with U. of Huntsville (D. Phanord), and Chicago State Univ. (R. Solakiewicz). Standard techniques of neutron diffusion theory have been applied to model cloud-top lightning optical pulses. The general information content of such signals is being examined for a variety of known lightning model sources.

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH (Boulder, Colorado)

Dan Breed reports that work is continuing on calibrating and comparing E-field measurements from the different aircraft that participated in CaPE. Emphasis has been placed on NCAR sailplane data thus far, and preliminary results from four clouds sampled early in their electrical development will be presented at the conference in St. Petersburg. The following summarizes these results:

"In all cases, enhancement in $\vec{E}$ corresponds with a weakening in updraft and LWC at the sailplane's level. Except for one case (July 22), it appears as though the cell was decaying. [Cloud top was not growing and upper level reflectivity was weakening.] This is contrary to conditions of E growth in New Mexico storms, but may be related to microphysical develolpment occurring above ~7 km. Tops are not much higher than that in these Florida cases, while a significant portion of the cloud exists above 7 km in New Mexico. Further analysis of cloud particle data and radar data should resolve uncertainties regarding cell development around the sailplane penetrations.

In collaboration with Jim Dye and others at NCAR, further analysis of sailplane data and NCAR King Air data will be directed at characterizing several other cases sampled early in their electrical development. Particle charge data are also being analyzed in collaboration with Tom Marshall (who is doing most of the work).

Jim Dye has been working on analysis of NCAR King Air measurements gathered during the CAPE program this past summer. The abstract of a paper for the St. Petersburg conference is as follows:

The Co-Evolution of Precipitation and Electric Fields in Florida Cumuli during CaPE, J.E. Dye, D.W. Breed, G.M. Barnes, J.J. Jones, and R.C. Solomon.

Abstract

Aircraft observations of vertical electric field, liquid water content, temperature and vertical speed of the air are presented along with closely coordinated radar reflectivity measurements made in three clouds in Florida during CaPE. These serve as examples of measurements made to investigate the relationship between precipitation development and initial electrification during the CaPE project. This preliminary analysis of CaPE data further supports the importance of graupel and ice in the electrification of clouds. These observations are discussed in the context of our current understanding of cloud electrification via the non-inductive ice-graupel collision mechanism of charge separation.

Jim also has made frequent trips to Bangor, Maine the past few months where he was making stratospheric particle measuremens from the NASA ER-2 aircraft in association with the NASA polar ozone studies.

NATIONAL SEVERE STORMS LABORATORY (NSSL) (Boulder, CO)

A final report on the past year's work for NASA-Kennedy Space Center was completed in March 1992. Portions dealing with lightning were prepared by Irv Watson, Raúl López, and Ron Holle in three areas. The first concerns the short-term forecasting of CG flashes with surface wind divergence, and comparison with reflectivity and Doppler radar data. The second

is the comparison between the performance characteristics of the 3-DF medium-gain and 5-DF low-gain LLP networks at KSC. The third includes an eight-year climatology of lightning in central Florida subdivided by low-level wind regime.

A paper by Raúl López, Mike Maier of CSR at the Kennedy Space Center, and Ron Holle, "Comparison of the signal strength of positive and negative cloud-to-ground lightning flashes in northeastern Colorado" was published in the 20 December 1991 issue of JGR. This article shows how the signal-strength distributions of positive and negative flashes in the 3-DF network in northeastern Colorado are significantly affected by different detection biases. Subsequent study is showing how detection efficiency can be both influenced and corrected by taking into account these biases in DF networks.

Ron Holle, Raúl López, Bob Ortiz, and Irv Watson of MRD have started a new study of lightning-related human casualties and property damage in central Florida during the eight years of LLP data that were used for the KSC studies. Participants in the study also include Dan Smith of the National Weather Service's Southern Region in Fort Worth, Charlie Paxton at the Tampa NWS station, and Dennis Decker at the Melbourne NWS office. NOAA's Storm Data has been reviewed for 70 deaths and injuries and 35 property damage reports within this region. Plans are to composite CG flashes relative to these events in time and space to better understand the scenario under which lightning incidences are occurring.

Raúl López and Ron Holle have also completed an archive of all Storm Data reports related to lightning in the state of Colorado since 1950. Together with Todd Heightkamp of the Denver NWS, they will publish a report summarizing these cases in a variety of subdivisions. They also started to work with a group of medical researchers, including Michael Cherington in Denver, who are beginning several efforts aimed at better understanding of the medical effects and treatment of lightning victims, as well as the underreporting of lightning-strike victims.

NIAGARA UNIVERSITY (Niagara, NY 14109)

William Boeck has returned to Niagara University after a year at NASA/MSFC. He will continue to work on algorithms for the lightning imaging sensor and analyze lightning video from space shuttle. Ten examples of vertical lightning in the stratosphere and one optical transient in the lower ionosphere have been found. The simultaneous observation of a flash from space shuttle and two other space sensors, has been possibly recorded.

ONERA (Meudon, France)

Anne Bondiou and Pierre LaRoche at ONERA will set up an improved version of the high resolution VHF 3D interferometer, during the ORLANDO 92 experiment with MIT. The objective of the experiment is to compare, versus time, the location of the electromagnetic activity due to atmospheric discharges, with the 3D microphysical and dynamical description of the generating cells, provided by the multiple radar network (TDWR, UND and MIT 5 cm radar).

This work must improve our knowledge of the intra cloud lightning process; it is supported by the modelling of the bidirectional discharge which is in progress with the collaboration of Padova University.

Results will be applied to the nowcast of convective cells producing microbursts. The electrical part of the ORLANDO 92 experiment wil take place from mid-June to the end of August; it will include the participation of other scientists.

OSAKA UNIVERSITY (Osaka, Japan)

Zen Kawasaki reports that Lightning Research Group of Osaka University (LRGOU) has acquired a SAFIR interferometer system and has been operating it since June 12, 1991 as as a cooperative project among DIMENSIONS, Kansai Electric Power Corporation (KEPCO) and LRGOU. Both summer and winter thunderstorms have been observed. The objectives of

this project are the evaluation of system performance and understanding winter lightning, which often show anomalous features. Comparisons of SAFIR data and conventional meteorological radar observations show excellent performance of SAFIR. A paper on this issue will be presented at the International Conference on Atmospheric Electricity in Russia.

LRGOU is one of the members of the Rocket Triggered Lightning Experiment in Japan, which is conducted by Prof. Horii of Toyota College of Technology. The experiment is normally carried out during the winter thunderstorm season and LRGOU is assigned to measure the electric field change, magnetic field change, and VHF/UHF radiation associated with triggered lightning.

LRGOU has joined the CN Tower Lightning Project, a cooperative project among Toronto University, McMaster University, Ontario Hydro and LRGOU since 1989. LRGOU is assigned to measure the velocity of the lightning return stroke. They manufactured a meter for lightning return stroke velocity, which detects the luminosity associated with return strokes using a photo diode array. In 1991 they obtained many data and analysis is ongoing.

LRGOU has been carrying out a cooperative project on natural lightning observations with NSSL. LRGOU participated in lightning observations in June 1991 at NSSL.

LRGOU is also a member of the Indonesian Rocket Triggered Lightning Experiment. Prof. Kawasaki has been involved with this project since 1991 and has obtained more than ten triggered lightnings in this tropical region.

REITER, DR. REINHOLDT (Garmisch, Germany)

Reiter's book: Phenomena in Atmospheric and Environmental Electricity is ready for distribution from Elsevier, Amsterdam at the latest by 15 May 1992. His mountain station at 1780 m (a.s.l.) is now in full operation and fitted with electronic data processing and telecommunications. The measured parameters now are: Electric field/air-earth current/point discharge current/air conductivity/cosmic ray intensity/air temperature and humidity/wind velocity/sky coverage/precipitation.

TEXAS A&M UNIVERSITY (College Station, Texas)

The Texas A&M University atmospheric electricity and mesoscale research group continues to expand. Dr. Lou Wicker will join the faculty as an assistant professor this August. He has a background in storm chasing from Oklahoma and numerical modeling from Illinois where he obtained his PhD recently. He joins Ed Zipser, Dick Orville, Mike Biggerstaff, and John Nielsen who now have ongoing research programs. Approximately 10-15 graduate students are working in mesoscale or lightning related research problems. The cooperative Institute for Applied Meteorological Studies (CIAMS) at Texas A&M will be conducting a Spring 1992 Doppler program to investigate mesoscale storm systems and their associated electrical activity over central Texas. This project will be conducted during April-May and will involve the Texas A&M S-band Doppler radar which became operational on 12 February. In addition, we will use the National Weather Service WSR-88D Doppler radar in League City (near Houston), the Texas ground-strike lightning network, and special radiosonde sites at Texas A&M and League City. Several faculty, graduate and undergraduate students will participate in the field program.

UNIVERSITY OF FLORIDA (Gainesville, FL)

Doug Jordan, Vlad Rakov, and Martin Uman, in collaboration with Vince Idone and Henry Jurenka (SUNYA), and with Bill Beasley (Univ. Oklahoma) have examined dart-leader speed in Florida natural and triggered lightning and in New Mexico triggered lightning as a function of the following: return-stroke peak current, return-stroke initial field peak, and previous no-current interval. Results from this study are presented in the paper accepted for publication in the JGR.

Vlad Rakov, Rajeev Thottappillil, and Martin Uman have analyzed and extended the work of Willett et al. [1989] on the relation between lightning return-stroke peak current and peak electric field (paper accepted for publication in the JGR). Rakov et al. also have found, from electric field records of close ground flashes in Florida, that pronounced microsecond-scale pulses during step-like K-changes (1) are inconsistent in waveshape with the characteristic K pulse proposed by Arnold and Pierce [1964], and (2) differ from pulses during hook-shaped M-changes as regards the frequency of occurrence, the position of pulses within the slower field change, and the pulse amplitude (paper to be published in the JGR).

Rajeev Thottappillil, Vlad Rakov, and Martin Uman, in collaboration with Bill Beasley (Univ. of Oklahoma), Maneck Master (AT&T Bell Labs), and Dmitry Shelukhin (High Voltage Res. Inst., Tomsk, Russia) have found, from the analysis of electric field and TV records of negative cloud-to-ground flashes in Florida, that (1) one-third of the multiple-stroke flashes have at least one subsequent return stroke whose distance-normalized initial field peak is greater than that of the first stroke of the flash, and (2) that the geometric mean separation between channel terminations in multi-grounded flashes (accounting for about a half of the total) is 1.7 km (paper accepted for publication in the JGR).

Marcos Rubinstein, Martin Uman, Ewen Thomson, and Pedro Medelius (currently with Boeing) have examined the characteristics of 1986 KSC vertical electric fields from triggered lightning at 500 m and of the voltages induced by lightning electromagnetic fields on overhead wires. The results are being prepared for publication in the IEEE EMC Transactions.

Marcos Rubinstein, Martin Uman, and Doug Jordan, in collaboration with Farhad Rachidi (Ecole Polytechnique de Lausanne, Switzerland), and Carlo Alberto Nucci (Univ. Bologna, Italy) continue to analyze 1991 KSC electric fields measured 30 m from triggered lightning and correlated with the channel-base current.

Yuri Villanueva, Vlad Rakov, and Martin Uman, in collaboration with Marx Brook (New Mexico Tech) have started the analysis of microsecond-scale electric field pulses in different stages of cloud flashes, from records acquired with Marx's digitizing system (12 bit; 2 MHz sampling rate) at KSC, in Gainesville, Florida, and in Socorro, New Mexico. The purpose of this study is to verify previous findings and resolve discrepancies regarding pulse activity during cloud discharges reported by Kitagawa and Brook [1960] and by Bils et al. [1988].

Rajeev Thottappillil (presently finishing his Ph.D. on modeling of the return-stroke and othe lightning processes), Vlad Rakov, and Martin Uman, in collaboration with Dick Fisher and George Schnetzer (Sandia National Labs.) plan to publish a summary of various properties of triggered lightning as derived from the channel-base current records (both return-stroke pulse currents and lower-level continuing currents) acquired by Sandia in Florida (1990) and in Alabama (1991). A comparison will be made with natural-lightning data [Berger et al., 1975] and with other triggered-lightning data available.

Martin Uman, Vlad Rakov, and probably some of the UF students will be further testing the Lightning and Radio Emission Detector, a copy of that being carried by the Galileo spacecraft which is scheduled to arrive at Jupiter in late 1995, this summer in Florida. To facilitate these tests a new multiple-channel 12-bit digitizing system capable of recording whole-flash fields with 200 to 500 ns time resolution is being developed.

The UF lightning research group will be presenting 4 papers (2 of them joint with other groups from U.S., Japan, and Switzerland) at the 9th Int. Conf. on Atmospheric Electricity in St. Petersburg, Russia this June, and 2 papers at the 21st Int. Conf. on Lightning Protection in Berlin, Germany this September.

UNIVERSITY OF MISSISSIPPI (Oxford, MS)

Tom Marshall is working with Dave Rust, Brad Smull, Dave Jorgensen, Monte Bateman, Maribeth Stolzenburg, and Tom Shepherd of the National Severe Storms Lab and Terry Schuur and Steve Rutledge of Colorado State University on understanding electricity in mesoscale convective systems (MCS's). We made 35 electric field soundings through MCS's

during the spring of 1991 as part of the COPS-91 field program. One interesting result is that the soundings through the trailing stratiform region or transition zone of MCS's seem to have only two electrical patterns. Also, many of the soundings reveal an especially large amount of charge at 0°C.

Tom Marshall is also working with Jim Dye and Dan Breed at NCAR, looking at the charge and 2-D shape of individual precipitation particles inside CaPE thunderstorms. The data were taken with the Explorer sailplane using a modified Knollenberg probe described by Weinheimer et al. in the November, 1991, issue of JGR.

UNIVERSITY OF PERIDENIYA (Sri Lanka)

Paul Hoole reports that a Research Assistant (RA) has been appointed to set up a computer-based data acquisition system to monitor broad-band, visible, uv, sound, and electrically induced voltages in the tropics during (i) thunderstorms, (ii) geomagnetic activity. A paper on lightning interaction with aircraft and tall towers was to appear in IEEE Trans.; another paper on the modelling of a plasma column was recently submitted. High Voltage Laboratory and Computer-based studies of electrode- plasma interaction has made some progress. A research assistant position was funded (US $100/month!) by a local organization. Much more useful work could be done if 2 or 3 more RAs could be appointed.

UNIVERSITY OF TORONTO (Toronto, CANADA)

J.W. Janischeweskj reports on simultaneous measurements of lightning characteristics at the CN Tower in Toronto. With joint efforts of researchers at the University of Toronto, Ontario Hydro, McMaster University, and Osaka University in Japan during the 1991 lightning season, simultaneous measurements have been made of significant parameters for lightning strikes to the 553 meter high CN Tower in Toronto. Six 10-bit 10-nanosecond computer-controlled digitizers, with long segmented memory, captured simultaneously the current derivative at the CN Tower and the corresponding electric and magnetic fields at a distance of a few kilometers from the tower. Lightning flashes to the tower were also videotaped from two locations for the purpose of constructing a three-dimensional image of lightning path. Furthermore, the return stroke velocity, a parameter needed for the analysis of lightning radiation models, was captured by a computer-controlled system of photodiodes.

UNIVERSITY OF WASHINGTON (Seattle, WA)

Bob Holzworth reports on the following activities:

ELBBO delay: The Extended Life Balloon Borne Observatory program, involving several superpressure balloons in the stratosphere making electrodynamical measurements, has been delayed. The first flights will be this November 1992 and up to three month lifetimes are expected. The delay was due to a flight power supply problem.

A joint Workshop on Electrodynamics and Composition of the Mesosphere, sponsored by NSF and STEP, was held in Nizhny Novgorod (formerly Gorky), Russia in March 1992. The Workshop provided an interesting review of recent work the Russians have done in the field of middle atomspheric and ionospheric electrodynamics. For a written review of the meeting contact R. Goldberg (NASA/GSFC code 696, Greenbelt, MD 20771) or Bob Holzworth.