NEWSLETTER ON ATMOSPHERIC ELECTRICITY

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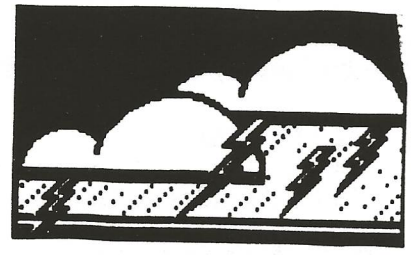

AMS COMMITTEE ON ATMOSPHERIC ELECTRICITY

AGU COMMITTEE ON ATMOSPHERIC AND SPACE ELECTRICITY

INTERNATIONAL COMMISSION ON ATMOS. ELECTRICITY

The Newsletter on Atmospheric Electricity is published twice annually, with releases in November and May. Announcements and contributed reports are requested one month in advance (i.e., October and April) and should be submitted to Earle Williams, Secretary ICAE, MIT 54-1818, Cambridge, MA 02139, FAX 617-253-6208. Please mark your calendars now for the next deadline: October 31, 1993 (Halloween).

ANNOUNCEMENTS

An International Workshop on Physics of Lightning will be held June 24-25, 1993 in Domain de Rochebois, France. Topics include: Physics of Lightning, Protection of ground installations, laboratory experiments modelling, and lightning location methods. The scientific committee is cochaired by Prof. T. Kawamura and Prof. M. Goldman.

A session on Atmospheric Electricity will be held at the International Association of Meteorology and Atmospheric Physics (IAMAP) meeting in Yokohama, Japan July 11-23, 1993. Dr's. M. Nakano and Z. Kawasaki are conveners.

A Conference on Atmospheric Electricity will be held within the AMS Severe Storms Conference from October 4-8, 1993 in St. Louis, Missouri. The chairperson is Dr John Hallett. About 40 papers are scheduled for presentation.

A colloquium entitled Lightning and Man is to be held November 11-13, 1993 at the Polytechnic Institute in Bucharest, Romania. Chairmen are Prof. Bouquegneau and Prof. Cristescu. Topics include: The lightning discharge and the striking event, lightning protection and damages caused by lightning.

A joint symposium on the use of the global electrical circuit for studies of global change and the meteorological applications of lightning detection networks will be held within the Annual Meeting of the AMS in Nashville, Tennessee, January 1994. Co-chairmen for this meeting are Dick Orville and Earle Williams. Abstracts on either of these topics should be submitted by June 15, 1993 (soon!).

The 1994 International Aerospace and Ground Conference on Lightning and Static Electricity will be held in Mannheim, Germany, May 24-27, 1994. Four copies of a 300-500 word abstract are due by July 31, 1993. All abstracts should be submitted to:

Mesago Messe & Kongress GmbH, Rotebuehlstrasse 83-85, D-7000 Stuttgart 1, GERMANY,
FAX 49-711-618079.

EUROEM '94, a symposium on electromagnetic environments co-sponsored by IEEE, the International Union of Radio Science and the Permanent NEM Committee will be held in Bordeaux, France, May 30-June 4, 1994. Richard Hasbrouck of Lawrence Livermore Laboratory will lead a session entitled: "Lightning Safety Through Threat Warning and Effects Mitigation". Abstracts must be received by January 10, 1994 and should be submitted to the Symposium coordinator:

Mr. D.J. Serafin
Technical Program Committee
Centre d'Etudes de Gramat
46500 Gramat, FRANCE
FAX 33-65-10-54-33

MEMORIAL ADDRESS FOR PROFESSOR HARUJI ISHIKAWA (1915-1992)

Professor Haruji Ishikawa, Advisory Board Member of the Society of Atmospheric Electricity of Japan, passed away on November 6, 1992.

Professor Ishikawa was born on April 13, 1915, in Shizuoka Prefecture. After graduating from the Department of Physics, University of Tokyo in 1941, he started his work at the Governmental Laboratory for Mechanical Engineering in Tokyo and was engaged in the investigation of machine tools for aircraft production.

In 1951 he was appointed as an associate professor of the Research Institute of Atmospherics, Nagoya University that was founded only two years before. Professor Atsushi Kimpara gave him a theme to study the progressive nature of lightning discharges by photographic method. He constructed an entirely new revolving camera, composed of rotating multi-mirrors and eleven still cameras surrounding them. It had enough high ti me-resolution and a view angle of 360 degrees. Operating this new camera system, he succeeded in getting many precious records of multiple ground flashes in field work during a few thunderstorm seasons in North-west Kanto plain. He simultaneously recorded electric and magnetic field changes associated with the flashes. Analyzing all the data, he successfully clarified the nature of lightning discharges as the origin of atmospherics. For this work, he was awarded the 1957 Tanakadate Prize and was conferred the degree of doctor of science at Kyoto University in 1961.

In 1962 he was promoted to professor, and served as director of the Institute for three years from 1968 to 1971 and two years from 1973 to 1975. In 1979 he retired from the Institute, according to the age regulation of the university.

Since 1970 he expanded his research field into atmospheric environment problems. He energetically conducted the observation of various atmospheric electrical parameters, such as electric field, electric conductivity, ion and aerosol densities, etc. He and his co-workers carried out observations by using ships, airplanes, balloons and rockets at various locations including an isolated island. He also organized international cooperation field studies, integrating Japanese scientists with U.S., German or Swedish scientists. Based on these studied, he comprehensively contributed to the study of lightning phenomena and the investigation of worldwide atmospheric pollution problems covering the higher atmosphere up to the mesosphere. At the same time he greatly contributed to the development of earth science, by training numerous able scientists working in these fields.

In May 1968 the Fourth International Conference was held in Tokyo in which he acted as the chairman of the executive committee. He performed prudent organizational work and led the Conference to great success. The execution of the Conference promoted the activity of Japanese scientists working on atmospheric electricity, and the Society of Atmospheric Electricity of Japan was established in March of the following year.

He was one of the leading members of the Society of Atmospheric Electricity of Japan. He was elected as President of the Society two times in 1977 and in 1981. He also worked as the chief editor of Research Letters on Atmospheric Electricity from 1985 to 1988. On the basis of his experience as chief editor, he donated considerable money to the Society. Accepting the money, the Society established the Ishika Fund that is now used for financial support for the development of the journal.

His activity and enthusiasm lasted till he was hospitalized in 1963. Throughout his life, Professor Ishikawa pursued his research work and led his junior scientists with all his heart. It is very much regrettable that he will no longer be in this world when the Tenth International Conference on Atmosperic Electricity is again held in Japan.

February 15, 1993

Nobu Kitagawa

RESEARCH ACTIVITIES BY ORGANIZATION

AIRBORNE RESEARCH ASSOCIATES (Weston, MA)

Airborne Research Associates has completed Phase I of a project to investigate the use of ionospheric potential data to monitor the variation of global tropical temperature. A prototype electric field sensing system and software were developed which could be interfaced to a VIZ radiosonde. During the summer and fall of 1992, Ralph Markson and Derek Lane-Smith conducted 31 ionospheric potential measurements - eight were made at 3-hour intervals over a full diurnal cycle. Statistical analysis showed that ionospheric potential was positively correlated with tropical temperature with high statistical confidence. When the measurements were plotted as a function of universal time, the Carnegie curve type of variation was clearly seen lending confidence to the quality and global characteristics of the measurements. Future plans (pending funding) call for expanding the investigation over the next 2 years including use of two additional remote launching sites.

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

Atmospheric Research Systems, Inc. announces that Siemens of Austria have purchased a Lightning Position and Tracking System (LPATS). This LPATS is interconnected with the Siemens Germany southern system, and makes a total of three systems that Siemens owns in Europe. This new system will also be operating as a commercial data service, providing both realtime data to utilities and archive data to researchers and insurance companies. More than 70% of Europe is now covered by LPATS systems. The Austrian system was installed and commissioned in January and is already starting to plot lightning in the area.

The Israel Electric Corporation (IEC) has ordered a five-receiver LPATS to cover Israel and the adjacent areas. The IEC placed this contract after nearly two years evaluating available systems. The IEC LPATS includes waveform digitizers at all sensor sites along with a Lightning Waveform Archive System (LWAS) at the central site. This capability provides up to 200 microseconds of digitized waveform for each stroke and sends the digital information over separate communications lines to the display/archive workstation. At the display station the waveforms are correlated to solve lightning strokes from the LPATS. Therefore, each stored waveform has associated with it the location where it occurred and the calculated amplitude from the system. It is then possible to view all the waveforms from each site for a given spheric. This is now the 5th LPATS in the world to have waveform capture and archive capabilities, which has proven to be a very valuable research tool.

The National Weather Service (NWS) announced on March 31, 1993 that the AFOG National Lightning Graphic has been changed to a 5-minute product, as opposed to the 15-minute product. The announcement notes that "implementation of this improved lightning graphic marks the end of the experimental status of the National Lightning Network. A contract was awarded to ARSI in August 31, 1992 to provide an operational lightning network. The National Severe Storms Forecast Center (NSSFC) produces the National Lightning Graphic from the lightning data which is received in realtime from ARGI."

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

COLORADO STATE UNIVERSITY (Ft. Collins, CO)

Walt Petersen and Steve Rutledge from CSU, in collaboration with Dennis Boccippio and Earle Williams from MIT are currently analyzing electric field data collected in the equatorial warm pool during the intensive observation phase of TOGA-COARE. An inverted electric field mill was installed aboard the University of Southern California research vessel Vickers to measure ambient electric fields in fair and foul weather conditions. The electric field data will be examined along with Doppler radar data (the Vickers also served as a platform for the MIT C-band Doppler radar, stabilized for shipboard operation) in an effort to document the dynamical, microphysical and electrical characteristics of oceanic convection that occurs over the warm pool. Cloud to ground and in-cloud lightning over the COARE domain were mapped by an LLP DF network (Dick Orville, PI).

Preliminary analysis of the data suggests that a strong relationship exists between the intensity of radar reflectivity observed in the mixed phase region of the convective clouds and the degree to which they are electrified. When reflectivities of 24-30 dBZ extended to elevations of 7-8 km within convective clouds, electric fields on the order of 2-10 KV/m and occasional lightning were observed (average flash rates of 1-4/min). When warm rain processes dominated the precipitation structure of the cloud (i.e., peak radar reflectivities were situated at or below the melting level and reflectivities aloft were weak), no lightning and only weak perturbations of the electric field were observed (i.e., on the order of 100-500 V/m). Often, storms possessing radar echo tops of 13-15 km were only weakly electrified, and were marked by weak reflectivities in the mixed phase region of the cloud (<20-25 dBZ typically). Deep radar echoes associated with convective clouds were not a sufficient condition for significant electrification to occur. A key question that we will try to answer with our study is: What processes in the warm pool environment allow electrification of these storms to occur? More specifically,what characteristics of the tropical environment allow deep mixed phase growth and electrification of some clouds, while other clouds of similar depth and organization do not electrify?

Steve Rutledge is serving as the lead PI from the US university community for the planned MCTEX (Maritime Continent Thunderstorm Experiment) which is being planned for the months of November and December 1995 near Darwin. MCTEX will include an electricity component focussing on the electrification of deep convection over tropical islands off the coast from Darwin. A science planning document is now under development.

CONSULTING BUREAU REITER (Garmisch-Partenkirchen, Germany)

Reinhold Reiter's mountain station (Wank Peak, 1780 m.a.s.l., 1,200 m above the valley of Garmisch-Partenkirchen, Bavarian Alps) has been extended to its final state. Automatically recorded are now:

A. Atmospheric electricity:
   Field, air-earth current, point discharge current, air conductivity, Aitken particle number density;
B. Cosmic rays:
   i. with unshielded GM-counters
   ii. with strongly shielded GM-counters (10 cm lead +5 cm iron)
   iii. with a 30 liters xenon-filled ionization chamber
C. Meteorological parameters:
   temperature, rel. humidity, sky brightness, wind velocity, existence of precipitation

Data processing and transmission:

All data are processed automatically by respecting zero lines and calibration constants and are stored on a hard disc of the "mountain computer". The "valley computer" is connected with the peak station via modem and telephone. The final values are stored on a 450 MB hard disc and printed out in form of diagrams.

Main topics:

i. Investigation of the relationship between fine particle aerosol concentration and atmospheric electric parameters, mainly air conductivity - under different well defined meteorological conditions: from extremely pure air above the exchange layer, on its upper surface, and inside vertical exchange.

ii. Influence of changes in cosmic ray intensity (of gabbroic as well as solar origin) in different energy ranges on atmospheric electric elements.

iii. Special studies on time variations of the different energy components of galactic cosmic rays in relation to solar events.

iv. Investigation on periodical variations of the air-earth current by application of Fourier analyses and their connection with solar events and magnetospheric processes.

INSTITUTE OF GEOPHYSICS (Warsaw, Poland)

The recent research activity of the group AERG in Warsaw concerns selected topics of thunderstorm electricity and some fair-weather electricity observations made in polar cap station (Spitsbergen) and middle latitude station (Swider) in Poland.

The air-earth current/with convective component, electric field and space charge density at the ground surface are measured during thunderstorm activity with the background of meteorological observations. The aim of the measurements is to obtain an electrical indicator of microburst events accompanying the observed thundercloud (P. Baranski). Some preliminary results were presented at the European Geophysical Union Conference in Kopenhagen in 1991 and at a poster session at the St. Petersburg Atmospheric Electricity International Conference 1992. An extension of these observations to include wind flow measurements is planned over the flat terrain of airport by P. Baranski, S. Michnowski, and S. Israelsson.

A study of initiation of lightning discharges in the cloud by Nguyen Manh Duc and S. Michnowski was recently undertaken on the basis of observations of discharges made inside tropical thunderclouds in Tamdao, Vietnam.

Electric field variations following lightning discharges have been analyzed theoretically for their dependence on the nonuniform distribution of electric conductivity and different position of charge centers by Do Dinh Vieng.

Systematic recordings of the electric field, current density and conductivity as well as radioactive and aerosol pollution have been continued at Swider with a the background of meteorological observations. On the basis of Swider, Poland and Marsta, Sweden, data the utility of conductivity monitoring as an indicator of radioactive and aerosol pollution is examined by S. Michnowski, S. Israelsson, and S. Warzecha.

A design of a new type of light ion mobility analyzer is being tested by J. Berlinski.

Some effects (e.g. those produced by magnetic substorms) of magnetospheric and ionospheric current system on the electric field and current at the earth's surface in the aurora oval region are studied on the basis of data from the Polish atmospheric electricity station in Hornsund, Spitsbergen by S. Michnowski, N. Nikiforova, A. Losakiewicz, M. Kozlowski, and W. Krainski. Preliminary results are published in the Proceedings of the International Workshop on Global Atmospheric Electricity Measurements, Madralin, Poland, 1989.

A theoretical study of turbulent noise in electric current density measured in the boundary layer by long antenna have been carried out by A. Losakiewicz and presented at the St. Petersburg Atmospheric Electricity Conference. The first results of the simultaneous recordings in Spitsbergen and Poland have been published (A. Losakiewicz and J. Drzewiecki) in the Proceedings of the Madralin Workshop.

LOTHAR RUHNKE (Reston, VA)

Lothar H.Ruhnke, former President of the ICAE, retired recently from his position at the Naval Research Lab. in Washington D.C. Although he is now relieved from the burden of admnistrative duties, his scientific efforts still continue on a private basis. As Guest Editor for JGR he manages the

Special Issue to publish presentations from the 9th Int. Conf. on Atmospheric Electricity in St. Petersburg of last year. He also maintains leadership of Project 5.4, the Global Atmospheric Electricity Program within STEP (Solar Terrestrial Energy Program) of SCOSTEP. He also has joined Heinz Kasemir and his non-profit organization 'Colorado Scientific' for possible consulting work on lightning and fair weather electricity.

MIT LINCOLN LABORATORY (Lexington, MA)

Mark Weber reports that Lincoln Laboratory will continue to operate the Terminal Doppler Weather Radar (TDWR) testbed at Orlando, Fl. ONERA's 3-dimensional lightning Interferometer will be used in conjunction with the TDWR to provide lightning ground strike warnings to the airports to forecast thundercell growth or dissipation and to predict the occurrence of microburst wind shear. A collaborative study with NSSL will examine lightning activity in the dissipating stage of large, multicellular thunderstorms and its relation to cloud kinematics and reflectivity structure.

Prototype testing of an Integrated Terminal Weather System (ITWS) at Dallas-Ft. Worth will provide real-time displays of weather radar reflectivity, cell movement forecasts and associated National Network lightning data to a variety of operational facilities at that airport.

Studies of thunderstorm activity and associated wind shear will be conducted at Albuquerque, NM to support development of an Airport surveillance Radar wind shear process. Earle Williams will operate his C-band weather radar there during the summer months.

MIT WEATHER RADAR LABORATORY (Cambridge, MA)

Dennis Boccippio is continuing his radar and electrical analysis of the structure of the End of Storm Oscillation (EOSO) following large thunderstorms in Orlando, Florida. Substantial use has been made of the Doppler radar upgrade provided through the efforts of Steve Rutledge of CSU for the TOGA COARE experiment in the Western Pacific Ocean. 3D locations for EOSO 'spider' lightning from the French (Dimensions/ONERA) interferometer (provided by Pierre LaRoche) are being used as a proxy for space charge layer identification in the EOSO. The evidence for sustained in situ charge separation in the presence of weak downdrafts above the 0°C isotherm points to an ice-based charge separation process operating without the presence of supercooled water.

The MIT C-band, from the Pacific in March, is now operating in Albuquerque, New Mexico on an aviation weather project with Mark Weber (Lincoln Laboratory). Nilton Renno and Earle Williams will continue the development in Albuquerque (this summer) of an instrumented remotely controlled model airplane for boundary layer and cloud physics observations.

Work continues on global circuit studies with an eye toward monitoring global temperature change. Earle Williams is collaborating with Dave Sentman of the University of Alaska on the operation of multi-station Schumann resonance measurements of global lightning activity. Sentman is currently operating a station in Alaska and will reactivate his stations in California and Australia. Williams is upgrading the field station in Kingston, Rhode Island formerly used by Charles Polk of the University of Rhode Island for Schumann studies in the 1960's and 70's. Williams also has planned collaboration on this topic with Yuri Bashkuev of the Radiogeophysical Laboratory in Ulan-Ude, Siberia. Both Sentman and Williams seek comparisons with other SR investigators. On September 24, 1993, SR spectra were recorded in Cambridge during the 24 hour interval when R. Markson made eight consecutive soundings of the ionospheric potential from his backyard in Weston. These simultaneous measurements of the AC and DC global circuit are being analyzed. Other comparisons are welcomed.

The problem of seasonal variations in the global circuit has been revisited from the standpoint of global seasonal temperature variations. Ed Adlerman has recently completed the digitization of the entire Carnegie/Maud data set (~16,000 data points) and an additional 4-5 year data set on air-earth current at Mauna Loa Observatory has been kindly provided by W. Cobb. Analyses of these data, together with the data set on ionospheric potential by Ralph Markson, are consistent in showing a seasonal maximum in the DC global circuit in Northern Hemisphere summer, when the earth's

temperature is greatest and when the WMO thunderday counts are also maximum. This analysis as with the earlier diurnal analysis with Stan Heckman (JGR March 1993) indicates that global lightning exhibits a substantially larger amplitude variation than the DC global circuit.

NASA GODDARD INSTITUTE FOR SPACE STUDIES (Columbia University, New York)

Colin Price and David Rind recently published a paper in Geophysical Research Letters titled "What determines the cloud-to-ground lightning fraction in thunderstorms?" (GRL, 20, 463-466, March 19, 1993). This paper provides an alternative hypothesis as to why the ratio of intracloud to cloud-to-ground lightning (IC/CG) decreases with increasing latitude. An additional paper by Colin Price titled "Global surface temperatures and the atmospheric electrical circuit" will shortly appear in GRL. This paper deals with the diurnal, seasonal and interannual relationships between a global lightning index/global electrical circuit, and global surface temperatures. The results imply that for a 1°C global warming the mean ionospheric potential may increase by approximately 10%.

Additional work at NASA/GISS involves using the GISS general circulaton model (GC) to study the sensitivity of global lightning frequencies to changes in surface temperatures. These results will soon appear in the scientific literature. We are also investigating how lightning and hydrology interact to influence the frequency and intensity of lightning-caused fires.

On April 9 1993, Colin Price successfully defended his Ph.D. thesis titled "Global Lightning Activity and Climate Change". He will be starting a post-doc position at Lawrence Livermore National Laboratories on June 1, 1993. Any correspondence after June 1 should be addressed to him in the Atmospheric and Geophysical Sciences Division, Lawrence Livermore National Laboratories, P.O. Box 808, Livermore, CA 94550.

NASA MARSHALL SPACE FLIGHT CENTER (Huntsville, AL)

The joint NASA/Air Force Airborne Field Mill (ABFM) program conducted at the NASA Kennedy Space Center (KSC) is nearing completion. D. Mach, J. Bailey, W. Koshak, and H. Christian have completed the operational analyses, the aircraft calibration report, and the review of launch commit criteria (LCC) rules. The installation of upgraded field mills at KSC which began last summer has been completed.

This past January and February aircraft electrical measurements using NASA's ER-2 and DC-8 were successfully conducted by R. Blakeslee, J. Bailey, and H. Christian during the international TOGA COARE field program. Also during TOGA COARE ground-based lightning observations were obtained. The ground-based observation are a cooperative effort involving TAMU (R. Orville and E. Zipser), MSFC (H. Christian, R. Blakeslee, and S. Goodman), Univ. of Ariz. (P. Krider and C. Weidman), New Mexico Tech (M. Brook) and LLP. LLP has kindly loaned three specially modified advanced lightning detection systems (ADLF) for this experiment. The ground network will be operated until at least December 1993. Plans are being made to deploy other ALDF systems at Tropical Rainfall Measurement Mission (TRMM) ground truth radar locations. These airborne and ground-based observations will be used to study relationships between lightning and storm electrification and a number of interrelated phenomena including severe storm morphology, precipitation structure, and the global electric circuit. The ground-based observations will contribute to a global lightning climatology.

MSFC is continuing to assemble information on global lightning from digitized DMSP/OLS data sets. We are very interested in any lightning data sets that could contribute to a global lightning climatology (e.g. regional lightning detection networks, etc.). Persons with such data sets are encouraged to contact S. Goodman (phone: 205-544-1683, fax: -5760, e-mail: SGOODMAN@nasamail.nasa.gov) or H. Christian (phone: 205-544-1649, fax: -5760, e-mail: HCRHSTIAN@nasamail.nasa.gov). The address for both is ES43, NASA/MSFC, Huntsville, AL 35812.

A functional demonstration of a Lightning Simulator (LSIM) for the Lightning Imaging Sensor (LIS) calibration is now scheduled to be conducted by W. Koshak and J. Bergstrom in June 1993. LSIM

will generate a realistic lightning scene using acout-optical modulation and scanning of a diode laser output.

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH (Boulder, CO)

Dan Breed and Al Criswell continue to evaluate the electric field mill systems on the NCAR sailplane and the NCAR King Air. A temperature dependence in some of the mills' electronics necessitates frequent adjustment of offsets during a flight, accomplished during periods when electric fields were weak. Establishing these offsets and determining calibration coefficients from artificial aircraft charging and maneuvers is nearly complete. Evaluation of an intercomparison flight between the sailplane and the King Air led to an adjustment in the enhancement factors used for the King Air system. Electric fields of order 50-100 V/m (at the low end) appear to be reliably measured. Efforts are just beginning with Jeff Bailey and others at NASA/MSFC to compare electric field measurements during an intercomparison flight between the King Air and the well-calibrated NASA Learjet. Opportunities also exist for intercomparing electric fields between several CaPE aircraft and the South Dakota T-28.

Dan Breed and Jim Dye are examining about twenty cases from CaPe of electric field development concurrent with reflectivity development. A paper is being prepared along the same line of analysis as was done for New Mexico storms. Furthermore, two cases have been identified where ZDR and LDR parameters from CP-2 were collected in clouds being sampled by the sailplane (during early electrification). Preliminary analysis documenting the development of the CP-2 parameters with the in situ electrical and microphysical data is planned for presentation at the AMS Atmospheric Electricity Conference in St. Louis in October.

NEW MEXICO TECH (Socorro, New Mexico)

C.B. Moore has been testing an idea on the formation of cloud-to-stratosphere (CS) lightning with a laboratory analog: discharges in electron-impregnated polymethacrylate (PMMA) blocks. Observations show that lightning internal to thunderclouds precedes the upward CS by tens of milliseconds. If positive charge is removed by the interval lightning it is possible that "orphaned" negative screening layer charge will subject the clear air region above the cloud to a field intensification sufficient to propagate the CS. Laboratory expermients with electron-impregated PMMA blocks (which are recognized to carry positive surface screening layers) show secondary discharges into the surrounding air when negative charge is withdrawn from within the block.

NOAA/ERL/NATIONAL SEVERE STORMS LABORTORY (Norman, Oklahoma)

Effective April 1, the National Severe Storms Laboratory (NSSL) underwent a significant restructuring. As a result, the former Storm Electricity and Cloud Physics Reserch (SECPR) group has been fully absorbed into NSSL. NSSL now has two divisions and a group studying Doppler radar and remote sensing; scientists from the former SECPR are in all three divisions. The research on storm electrification, and the development of applications of electrical information in operational meteorology should be enhanced by the new structure as research scientists will work closely with those in applications. This development is crucial as the new Storm Prediction Institute (SPI) is established in Norman over the next two years; SPI will absorb and expand on functions of the current National Severe Storms Forecast Center (NSSFC) in Kansas City. Based on the responsibilities of SPI, there will be many opportunities to bring more electrical information into operational meteorology. NSSL is continuing to expand associations with the National Weather Service through activities of the Experimental Forecast Facility at Norman and other locations. While losing identity of SECPR is a big change, electrical aspects of meteorology are now fully integrated with other laboratory programs.

Personnel change: Irv Watson will arrive in Norman late in the summer of 1993.

Dave Rust (NSSL), Maribeth Stolzenburg (OU), and Tom Shepherd (OU/CIMMS) are collaborating with Tom Marshall (Univ. of Mississippi), and Monte Bateman and Bill Winn of NMIMT by providing electric-field meters and a CLASS to make measurements of particle charge inside storms over Langmuir Laboratory. In addition to providing equipment, we plan to be at Langmuir Laboratory for at least two weeks.

Vlad Mazur will collaborate with the MIT/LL group (Doppler data) and ONERA (3-dimensional interferometer) during the Orlando field observations to test lightning algorithms for hazard warnings relevant to air-traffic operations. Electrical measurements will include E-field and delta E. Ground truth of lightning activity will be provided by video observations using parabolic mirrors and regular-speed cameras at two sites.

Don MacGorman has developed a new lightning tracking algorithm to be tested this spring at the National Weather Service (NWS) office in Norman, Oklahoma. The method uses existing NSSL software that identifies and tracks radar cells, and tabulates ground flashes striking within a set distance of each cell centroid. The ground flash data accumulated for each volume scan are then added to the radar and storm tracking display to provide time histories of total, positive, and negative flash rates and of the ratio of positive to total ground flashes.

Don MacGorman also has been analyzing data from a single all-sky video system operated during the August 1992 field program in Orlando to examine the performance of the LPATS lightning ground strike mapping system for the NWS. As noted in the Fall 1992 newsletter, the NWS began using LPATS data last Fall. The evaluation has been complicated by what appear to be erratic errors of up to 10 seconds in the time of flashes provided by the LPATS network in Florida. Preliminary results are becoming available and will be reported shortly.

A study of underreporting of lightning casualties in Colorado was submitted to the AMS Bulletin. The study was made by Raul Lopez and Ron Holle of NSSL, together with Todd Heitkamp of the Denver National Weather Service, Michael Cherington of Denver's St. Anthony Hospital, Michael Boyson of the Colorado Hospital Association, and Ken Langford of the Colorado Lightning Data Center. The standard source for weather-related casualties, NOAA's monthly publication *Storm Data*, missed 28% of fatalities and 42 % of hospitalized injuries. The primary reason is that nearly all lightning cases come to *Storm Data* from newspaper clipping services, and many newspapers learn only of the more extreme events.

PENNSYLVANIA STATE UNIVERSITY (State College, PA)

Les Hale reports: It has come to my attention that various models of ELF noise are probably very inaccurate, including the ELF part of the recent Long Wave Noise Prediction Model. Although Volume 1, the "Physical Basis of the Model" is not specific about the ELF model, I have determined that the originators used a "flat spectrum," which is certainly not correct.

I came on this as I have recently retired, and finally got some time to do some research. The first thing I did was to examine some rocket data and a computer model of currents to the ionosphere and "global circuit," both of which showed "wavelets" of order 1 millisecond duration, containing the bulk of the "external" electrical energy due to lightning, but which is not recognized in the current literature. I had developed a qualitative theory of their origin, as necessary to satisfy the post-stroke "quasi-static" electric field, considering both the earth and the ionosphere, and submitted an abstract to the Kyoto URSI meeting, predicting their properties, including a $r^{-1/2}$ dependence on distance in a "flat earth" model with perfectly conducting earth and ionosphere.

Then I thought that there must be data on such a dominant phenomenon, and made a trip to the library. Even though these "slow tails" are not widely referenced in current literature, I found a wealth of data dating to the 1950's, when they were widely studied. The most comprehensive data set was described by Hepburn (1957). It agreed well with my "lossless" model at night, but showed substantial dispersion and attenuation under mid-latitude daytime conditions (and would presumably show much more under high-latitude or "disturbed" conditions). The Hepburn data set was analyzed by J.R. Wait (1970), who showed that the dispersion could be explained by a different "height" of the ionosphere

between day and night, although he did not provide a credible explanation for their source. It is apparently this lack of a credible theory that has led to their demise from current literature, as the commonly accepted premise that "slow tails" are due to "radiation" from "continuing currents" (100's of amperes, very slow variation) requires a much higher "radiated" spectral density than that radiated by the return stroke of VLF and above (10,000's of amperes rapidly varying), which is of course ridiculous. However, lack of credible theory does not invalidate established and easily reproducible data, or justify "sweeping it under the rug," as has been done in nearly all the "establishment" literature in this field.

Apparently the main problem is that, even though the modal analysis of Wait and others is basically correct for the earth-ionosphere waveguide, there is still a wide-spread belief that the free-space or half-space dipole moments, named electrostatic, induction of intermediate, and radiation are valid concepts for the source or antenna in calculating the launching of the wave. At frequencies whose wavelength is longer than the earth-ionosphere distance this is not correct, and the source (antenna) cannot be analyzed without including the "load," usually the entire earth-ionosphere cavity. However, for pulses which complete before one round-the-world propagation delay time, the analysis may be simple, reducing to simple capacitive coupling for lightning at lower ELF frequencies (Hale, 1993). However, antipodal reconvergence and multiple round-the-world propagation must be considered at ELF frequencies and conditions when attenuation and dispersion are sufficiently low.

A well-done ELF noise model would need to include a correct analysis of the excitation of the TEM wavelets under various conditions, using a correct formulation, including the presence of a realistic ionosphere. The propagation should include the dispersion (spectral shift) due to the presence of the real ionosphere. For analysis of effects on communications systems a time-domain model is preferable, as the ensemble sum of millisecond pulses from a few hundred strokes/second will be quite "bursty." It should also be remembered that the electric field pulses add algebraically, and not vectorially, in TEM waves containing H_x and H_y, but only E_z. The question of statistical independence (lightning triggering other lightning) needs to be investigated.

Such a model might be of considerable value to studies of "global change," particularly global (and regional) thermometry. It has been suggested by Williams (1992) that total lightning activity may be a sensitive measure of average temperature. This is currently being studied by "DC" (ionospheric potential), ULF, "Schumann resonance" (7-35 Hz), and VLF and higher measurements. "DC" has truly global coverage, but is sensitive to solar cycle (GCR) variability, and more importantly, to volcanic activity. "ULF" may contain too much noise from "hydromagnetic waves" in the magnetosphere and, possibly, other geophysical events. The Schumann resonance studies look promising, because of very low attenuation and the potential to grossly determine the amount of ionospheric "disturbance" from the data. The VLF and higher measurements are promising, although propagation is complex (many modes lead to interference). Combined radio and optical techniques for "flash counting" on satellites appear promising (multiple-frequency "iris effects" provide crude location at HF).

Although all of these methods might be useful, it would appear that the TEM wavelets described above would offer some unique and interesting possibilities. They are larger in total energy and directly related to the amount x distance (moment) of the separated charge in lightning. Although the lightning current waveforms are quite variable, the launching of the millisecond TEM wavelets "standardizes" the source pulse width to one dependent mainly on the "height" of the ionosphere, which is reasonably predictable for undisturbed day and night conditions. A number of stations might be required, but this is true for most of the alternatives. Actually, it would appear that the possibility of a good, sensitive, global thermometer would warrant the investigation of a number of promising approaches, and the best solution might employ several measurements. Of course, it goes without saying that study of the cloud physics problems related to lightning and atmospheric electricity needs to be continued.

PHILLIPS LABORATORY (Hanscom Field, MA)

An informal 3 day seminar in April on lightning streamer/leader propagation and an analysis of Gallimberti's paper on this subject was led by Stan Heckman and attended by John Willett, Vince Idone, Henry Jurenka and Earle Williams in April.

STATE UNIVERSITY OF NEW YORK AT ALBANY

Vince Idone reports the lightning research group at the University of Albany is presently engaged in an extremely active period of field work. During the next few months, video observations of lightning will be made from three local sites for the purpose of locating flashes accurately (within 500 m) and documenting their characteristics for comparison with corresponding measurements derived from the National Lightning Detection Network. In addition, electric field waveforms digitized at a rate of 2 MHz will be recorded to further document the flash characteristics and allow a better evaluation of various performance characteristics of the NLDN in the central New York region. Much of this work will be done in collaboration with Marx Brook of New Mexico Tech.

We will also participate in the triggered lightning studies to be carried out at Camp Blanding near Gainesville, Florida. This work is part of a collaborative effort with researchers from the University of Florida and Power Technologies Inc., of Schenectady, New York. A new master's student, Jeff Freedman, will be spending several weeks at Camp Blanding. His thesis work will involve working with the time-resolved optical data obtained from this and several previous summers of triggered lightning observations.

On a personal note, we are happy to announce that Ron Henderson has resumed his position full-time as a research associate. Everyone is pleased to have him available again as both a fellow researcher and resident "computer jock nonpareil."

Bernard Vonnegut reports:

Our interest continues in the rather infrequent storms seen on the NLDN that give predominantly positive rther than negative CGs. Not only are these storms of scientific interest for the insights they give concerning the nature of the electrification process, but they are also of practical importance in forecasting because many of the most severe tornadoes are produced by such storms.

In connection with these abnormal storms, attention has been focussed on the thunderclouds produced by forest fires, whose CG lightning Don Latham has shown to be exclusively of positive polarity. There is general agreement that it is important that we secure electrical measurements above the cloud to determine the polarity of the electric field.

We are encouraged to learn that more detailed measurements made by Charles Moore in New Mexico confirm preliminary tests made in Albany two years ago by Jonsson and Vonnegut showing tha tunder the influence of the earth's electric field burning flames release negative space charge into the air. These observations suggest that a cloud that grows from a forest fire may ingest air that contains negative space charge in much the same way as did the clouds growing from the charges in Moore's experiments in which he released negative space charge from a wire maintained at a high negative voltage.

Vonnegut is submitting obituaries to EOS, The Bulletin of the AMS, and Atmospheric Research telling of the death of our colleague, Gaston Grenet, in Nice, France, December 28, 1991. Hs is also hoping that it will be possible to publish an English translation of Grenet's important, brief paper that contributed to our understanding of thundercloud electrification processes.

TEXAS A&M UNIVERSITY (College Station, TX)

Atmospheric electrical and related studies have covered a broad spectrum over the past six months from field studies in the Western Pacific to a Spring Doppler/Lightning Program now underway at Texas A&M University. The NSF-NASA sponsored electrical studies in TOGA COARE were successfully completed. Scientists involved include Dick Orville and Ed Zipser, principal investigators, Chuck Weidman and Phil Krider (Arizona), Marx Brook (New Mexico Tech), and Hugh Christian, Steve Goodman, and Rich Blakeslee (NASA Marshall).

Chuck Weidman and Dick Orville traveled to Kapingamarangi Atoll in November and installed a modified high-gain LLP direction finder. This effort was repeated in December at Rabaul and Kavieng, Papua New Guinea where Chuck and Dick were joined by Graydon Aulich (New Mexico Tech). A "Marx Brook waveform digital recording instrument" was installed at Kavieng. To the surprise of all, there were no major problems and all instrumentation performed as designed. The highly successful and

reliable operation of the LLP direction finders in the hostile scientific environment of the equatorial Pacific has prompted us to continue the operation of the three DF network through December 1993. This will give us lightning cloud-to-ground measurements over the ocean in one of the most remote locations in the world for 12 continuous months. As this note is composed for the AE Newsletter, the DF's continue to perform without problems at Kapingamarangi, Rabaul, and Kavieng.

Our Spring Doppler and Lightning Program is underway. Mike Biggerstaff leads the program with observational capabilities that include, two MCLASS upper-air stations on loan from NSSL, the A&M Doppler radar, the NSW Houston WSR-88D, and the recently added DOD 88D at Granger, Texas, less than 70 miles from Texas A&M. The GDS national lightning network provides cloud-to-ground information in real-time to the radar operations. To date, three mesoscale convection systems have been sampled. A squall line system that occurred on 7 April 1993 produced a pronounced bipolar cloud-to-ground lightning pattern. The convection line, which exhibited rapid discrete propagation, was associated with positive strikes. A low-level echo-free region separated the convective line from the stratiform precipitation, resulting in the pronounced bipolar pattern. Operation designed to document the structure and evolution of convective storms and their associated lightning characteristics in the central Texas region will continue throughout April and May 1993.

UNIVERSITY OF BOTSWANA (Gaborone, Botswana)

Rohan Jayaratne is continuing his laboratory work on the charge separation during ice-ice and sand-ice interactions. Several recent hypotheses involve physical mechanisms of charge transfer based on temperature gradients in the ice and between two interacting ice surface. Rohan has been conducting a series of experiments looking into these various possibilities and the results are to be published in a paper to appear soon. Current laboratory work includes an investigation of the Williams surface state hypothesis and the Baker-Dash liquid-like layer hypothesis.

Rohan Jayaratne and V. Ramachandran have now acquired over two continuous years of data from a CGR3 lightning flash counter gifted by Dave Mackerras of the University of Queensland. The results show that the ratio of intracloud flashes to ground flashes in Gaborone is very close to 1, confirming recent assertions that it is not necessarily related to latitude alone. An attempt is also under way to relate the lightning incidence to wet bulb temperature data. Using a transient recorder, K.R.S. Devan is hoping to study lightning waveforms using digital techniques to investigate such characteristics as the type of flash, multiplicity, peak current, interstroke interval, etc.

UNIVERSITY OF FLORIDA (Gainesville, FL)

Martin Uman, Rajeev Thottappillil, Ewen Thomson, and Pedro Medelius, in collaboration with Marcos Rubinstein and Farhad Rachidi (Swiss Federal Institute of Technology, and Carlo Alberto Nucci (University of Bologna, Italy) have completed the characteristics of triggered-lightning leader electric fields at 500 m (from a 1986 KSC experiment) and 30 m (from a 1991 KSC experiment) and modeled the observations. The results are being prepared for publication in JGR.

Rajeev Thottappillil, Vlad Rakov, Martin Uman, and Jon Goldberg, in collaboration with Dick Fisher and George Schnetzer (Sandia National Laboratories) continue analysis of the Sandia 1990 and 1991 triggered-lightning data to determine the detailed characteristics of the current pulses associated with M components.

Vlad Rakov and Martin Uman are examining the electric field signatures of double-grounded lightning strokes identified in multiple-station TV records.

Joseph Versaggi, Martin Uman, Vlad Rakov, and Jamie Stone, in collaboration with Klaus Rinnert (Max-Planck-Institut für Aeronomie, Katlenburg-Lindau, Germany) continue testing a copy of the lightning detector (LRD) to be carried by the Galileo probe into Jupiter's atmosphere in December, 1995.

Farhad Rachidi and Rajeev Thottappillil have derived for the Diendorfer-Uman return stroke model an expression relating the far electric field and the channel-base current of the lightning return stroke. A

technique for solving the equation for the current in terms of the field has been developed. A paper containing these results has been accepted for publication in JGR.

The UF lightning research group will participate in the 1993 triggered lightning experiments (funded by EPRI) at Camp Blanding, Florida. Electric and magnetic field measurements at a few tens of meters and at about 40 km are being planned.

UNIVERSITY OF MANCHESTER INSTITUTE OF SCIENCE AND TECHNOLOGY (UMIST)

In UMIST, Ian Brooks and Clive Saunders have set up apparatus in the cloud chamber to measure crystal/graupel charge transfers. The new apparatus is modeled on that used by Takahashi in his 1978 work and the experiments are designed to help resolve the debate concerning the differences between the results obtained by Takahashi and UMIST (Jayaratne, Hallett, Keith and Saunders). The intention is to present an analysis of the results at the St. Louis meeting this October.

UNIVERSITY OF MISSISSIPPI (Oxford, MS)

Dave Rust and Tom Marshall will be working at Langmuir Laboratory this summer with Bill Winn and Monte Bateman. We will make balloon soundings in storms to measure the electric field and the charge and size of individual precipitation particles.

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

Dr. Ya. M. Shvarts sends the following:

The atmospheric physics and The Earth physics departments of St. Petersburg State University held a large meeting in November 26, 1992 dedicated to the centenary from the birthday of Professor Pavel N. Tverskoy (1892-1962) and the sixtieth anniversary of the atmospheric physics department. Professor Pavel N. Tverskoy is the famous Russian scientist in atmospheric physics and in atmospheric electricity. He was a founder of the atmospheric physics department, the author of the first course of geophysics in the USSR, the author of two courses of meteorology and the book "Atmospheric electricity". He was an editor of the Russian verses of the books "Atmospheric Electricity" by K. Köhler and H. Benndorf. He organized spheric records in the USSR and small atmospheric electric nets in the twenties and the thirties. He was a teacher of Dr. Nikolay N. Paramonov who was the author of the paper "Unitary variation of atmospheric electric field gradient". Dr. Dolezalek told me it was one of the papers that simulated global electric circuit researches in the West in the middle of our century.

The schedule of the meeting was as follows: Prof. I.N. Minin, the Chief of the atmospheric physics department - the opening address, Dr. N.P. Tverskaya "The life of Pavel N. Tverskoy", Prof. L.T. Matveev "The role of P.N. Tverskoy in the development of cloud physics researches", Dr. B.S. Rusinov "Ideas of P.N. Tverskoy at the present day", Dr. Ya.M. Shvarts "The continuous observations of atmospheric electric state", Dr. V.A. Yankovskyi "An educational work in the Department". Prof. E.S. Selezneva, Prof. L.G. Kachurin, Dr. A.S. Korovchenko, Prof. G.V.Molochnov have given memorial lectures.

Some scientists informed me concerning their current plans.

Prof. V.D. Stepanenko, Dr. Yu.A. Dovgalyuk and their colleagues are improving the thunderstorm model that was presented to the participants of 9th Int. Conf. Atm. El. They intend to carry on with their work in the cloud chamber of MGO to understand the influence of ionization on the microstructure of fog.

Dr. Yu. P. Mikhailovsky intends to carry on with to creating an archive of atmospheric electric data that were recorded during scientific flights near and within convective clouds.

Following some problems in regular mail communication with colleagues in Russia Dr. N. Klimin offers to use for communication his E mail (Internet) address: nicolas@tor.spb.su.

In 1992 Dr. V.S. Snegurov and his collaborators have carried on with their study of amplitude versus frequency and phase versus frequency plots of near-range lightning radio emission. The direction finder data were used and a digital processing of signals was made. Dependences of lightning radio emission spectral charateristics versus distance were established in a frequency range of 0.5-8 kHz. On the basis of these results the spectral method of lightning ranging up to 70-100 km is developed. The lightning ranging errors of the spectral type thunderstorm range unit will be explored in 1993.

Dr. T.V. Lobodin is going to carry on with his work to develop a small self-contained lightning counter for the meteorological network of Russia.

Dr. V.P. Gordyuk intends to finish a computerization of WDC/AE and to improve an international data exchange. We appeal to the operators of ground atmospheric electric stations to send data to WDC/AE in St. Petersburg. Dr. Ya.M. Shvarts is going to help Dr. Gordyuk in his work. Technical and financial support are needed by the WDC/AE.

Dr. B.F. Evteev intends to carry on his work to detect and to look into electroactive zones in clouds. He is going to carry on research of cloud electrification and investigation of an airborne electric field measurement technique. He and his colleagues are interested in the Proceedings of 1992 International Aerospace and Ground Conference on Lightning and Static Electricity, October 6-8, 1992, Atlantic City, NJ. They can send copies of the Proceedings, 9th International Conference on Atmospheric Electricity 1992, June 15-19, 1992, St. Petersburg, Russia, vol. I-III, A.I. Voeikov Main Geophysical Observatory, in exchange. They are interested in the FAA Research Grants Program (see FAA Technology Talk, vol. 2, no. 2, July 1992, pp. 4-5).

There are still some available copies of the above Proceedings, 9th International Conference on Atmospheric Electricity for sale; the person to contact: Dr. B.F. Evteev, Main Geophysical Observatory, Karbysheva 7, St. Petersburg 194018, Russia.

The present financial difficulties of MGO may prevent putting many of the above plans into reality.

DEPARTMENT OF DYNAMICAL METEOROLOGY (MGO, St. Petersburg, Russia)

Presently Dr. Iuri Ianushanets works for the Department of Dynamical Meteorology (the Main Geophysical Observatory as well) led by Prof. V.P.Meleshko - a world known expert in the Climate Change investigations by means of complicated numerical Atmospheric-Oceanic Models. He became interested in my previous experience (my doctorate was aimed at the problems of optimal assimilation of the remote sensing data reflecting the ozone distribution on the basis of an original dynamical model of the stratosphere).

But as far as the problem of the proper description of clouds in the Global Climate Models is one of the most important and on the regional scale (which is now planned to be included as a part into the Global Model of MGO) is even extremely important there is an interesting and promising opportunity of introducing thunderstorm factors into at least regional Climate Model (and am absolutely sure this is not the only case).

So if you feel that the Scientific Community is fascinated by the Problem of "The Great Unification" of Meteorololgical/Climatologica and Atmospheric Electricity Models (which is in fact the up-to-date version of an old Lord Kelvin's idea "to predict Weather by means of an Electrometer") will you be so kind as to make me know about it.

Radar Meteorology Department (MGO)

Comprehensive investigations of thunderstorms are carried out using a multiwavelength radar system: weather radars (0.8; 3.2; 10 cm) with combined radiometers (0.8; 1.35; 3.2 cm) for cloud and precipitation detection, and radars (11; 35; 200 cm) capable of detection of ionized lightning flash (LF) channel, and a LF electromagnetic recording system. Digital radar data processing allows to obtain cloud reflectivity patterns, turbulent state, supercooled liquid water content, and LF amplitude distribution in every 1 km of a cloud extension. Experiments in the last two years were aimed at the relative position determination of LF and various intensity cloud precipitation areas, zones of increased turbulence, and supercooled liquid water content. Some of these results were introduced by S. Galperin, V. Stasenko and G. Shohukin at the 9th International Conference on Atmospheric Electricity in St. Petersburg last June.

A regional storm warning system is being pursued by MGO for the large airtraffic cross-roads of St. Petersburg and Moscow with meteorological technologies improved. A planned LF detection network will be an important part of this system. NLDN experience in the USA, France and other countries demonstrates good forecast potential from current information. Interpretation of lightning detection data from different types of thunderstorm sensors is being used in different synoptic conditions of practical interest to various agencies interested in meteorological information. The proximity of NLDN in Sweden and Finland could promote the integration of the north-west part of Russia into the European LDW.

The field experimental base of MGO (Turgosh) is experienced with different thunderstorm sensors and interpretation of their data. Due to a certain meteorological characteristics of our research facility, State tests of several types of DF system were provided here. These are all necessary conditions for the exploration of different type thunderstorm sensors.

Thunderstorm investigations are carried out in both daytime and nighttime conditions. Simultaneous experiments with instrumented aircraft and satellites aimed at convective cloud detection were conducted. During the course of subsatellite experiments, the character and intensity of rain areas and wind shear zones were studied. In these experiments several radars capable of LF channel detection in the 250 km range were used to study cloud clusters forming on atmospheric fronts. As a result the features of LF behaviour in multicellular clouds were detected. Appearance of LF with echo dimension exceeding 40-50 km is a very remarkable feature in frontal clouds when one lightning discharge initiates a flash in a neighbouring cell (some kind of a chain reaction). There is a State time standard with 10^{-3} s accuracy. For this reason the MGO research facility can be used in a lightning detection experiment within the DMSP/OLS program. Joint experiments could be prepared by a coordinated scientific program and make use of satellite orbit forecasts. During the course of this experiment satellite lightning data may be compared with thunderstorm structure and dynamics, precipitation, and the area dispersion along and cross the cloud clusters. By using several subsatellite test sites in different climatic regions it is possible to validate satellite information and to obtain reliable data on global lightning activity.

Another possible cooperative study on thunderstorm detection could focus on cloud fields of tropical cyclones (TC). MGO has documented the evolution of TC's using the coastal MRL-5 radar (with two channels at 3 and 10 cm) in Vietnam. The second channel of the radar was used by V. Stasenko for LF detection in MCCs in both the peripheral and central parts of a typhoon cloud field. LF echoes were documented at distances up to 400 km. It is desirable to elaborate joint scientific program of thunderstorm investigation in hurricanes and typhoons taking into account that thunderstorms are a good indicator of TC's intensity change. Short term forecasts of TC's evolution based on numerical simulation often fails near the mountain coast. Only coastal radar is capable of reliable detection of variations in TC's intensity and trajectory.

For further details, please contact Valery Stasenko and Georgy Shchukin at Fax (812) 2478661.