

DATE: March 23, 1990

SUBJECT: NEWSLETTER

FROM: AMS Committee on Atmospheric Electricity

TO: Mainstream atmospheric electricians and all other interested meteorologists and geophysicists

This compilation briefly summarizes the current research interests and wherever possible, the future experimental plans, of workers in the field of atmospheric electricity. The purpose of the Newsletter is to promote communication among atmospheric electricians beyond the annual focus of interaction at the San Francisco AGU meeting, and to foster contacts with other meteorologists and geophysicists who are increasingly drawn to the wonders of lightning. The knowledge of experimental plans in place by other workers can often lead to fruitful collaborations.

The livelihood of any newsletter depends on the contribution of its recipients, and the AMS Committee solicits both your contributions and your feedback. We cannot hope to have gathered input from all interested parties in this first attempt; the time required is prohibitive. A distribution list is attached so that overlooked names can be included in future installments.

RESEARCH ACTIVITIES

AIR FORCE GEOPHYSICS LABORATORY (AFGL) (Hanscom AFB, MA)

John Willett moved to AFGL from the Naval Research Laboratory in December and joins Arnold Barnes, Ken Glover, Bob McClatchey and Jim Metcalf in a new initiative in atmospheric electricity aimed at identifying conditions for triggered lightning in and around electrified clouds. John will collaborate with Bill Winn of NMIMT on an electric field sounding rocket which will be deployed at Kennedy Space Center to study electrical conditions conducive to upward streamer propagation in rocket-triggered lightning. Arnold Barnes is experimenting with neural nets to predict the occurrence of lightning over Kennedy Space Center. This prediction will incorporate the KSC surface field mill data as well as the wind and temperature data from meteorological towers. He is also exploring the possibility of creating an ionized column in the atmosphere for purposes of triggering lightning. Arnold joins investigators from NASA (Langley and MSFC) in the development of a set of airborne field mills for measurement of the vector electric fields aloft at KSC. Jim Metcalf is making use of polarimetric Doppler radar at the Laboratory's field site in Sudbury, MA.

The measurement of the complete polarimetric backscatter matrix permits the determination of the shapes and orientation of hydrometeors that in turn provide information on thermodynamic phase, particle type and response to changing electric fields in clouds.

Bob McClatchey and John Willett will attend the upcoming meeting at NCAR concerned with the CAPE experiment.

AIR FORCE OFFICE OF SCIENTIFIC RESEARCH (Bolling AFB, D.C.)

Jim Stobie reports that the objective of AFOSR's new initiative is the development of a fundamental understanding for the remote sensing of the electrical charge properties in clouds, especially those in which natural lightning is not observed but which have sufficient charge to trigger lightning to a nearby aircraft or rocket. To achieve this objective over the next five years, AFOSR will fund laboratory and field experiments along with theoretical and modelling studies. The first field experiments they expect to support will be at the Kennedy Space Center (KSC) in conjunction with the Convection and Precipitation/Electrification (CAPE) experiment in the summer of 1991. (See also Additional Notes at the end of the Newsletter.)

AIRBORNE RESEARCH ASSOCIATES (Weston, MA)

Ralph Markson has been experimenting with corona point sensors of a new design which record electric potentials at 20 meter height. Comparisons with contour plots of electric field at KSC suggest that the corona point results are less affected by space charge near the earth's surface. The objective of the measurements is the use of contoured real-time data as a predictor for cloud-to-ground lightning at KSC. Ralph is collaborating with Chris Fairall of NOAA/WPL in the development and testing of space charge models for the interpretation of the measurements.

Ralph hopes to participate in the CAPE program at KSC in 1991 with a special electric field dropsonde.

UNIVERSITY OF ARIZONA (Tucson, AZ)

Phil Krider plans to concentrate on data analysis in Tucson this summer. In 1991, as part of the CAPE program, he intends to pursue the measurement and interpretation of displacement currents with the KSC

field mill network, and electric field and optical spectroscopic measurements on rocket-triggered lightning.

Chuck Weidman intends to make infrared spectroscopic and near-infrared radiometer measurements of rocket-triggered lightning channels at KSC to determine the temperature of the lightning during the continuous current phase. He is also interested in making close electric field and optical measurements during the attachment process in return strokes near the ground in efforts to resolve current puzzles arising in transmission line interpretations. He plans to work with John Willett of AFGL during the summer of 1991 in these endeavors.

COLORADO STATE UNIVERSITY (Ft. Collins, CO)

Steve Rutledge has returned from a collaborative field program with Earle Williams in Darwin, Australia concerned with the electrification and dynamics of deep tropical convection. Steve is proceeding with the analysis of dual-Doppler data and lightning data from a 4-station LLP network, and with modelling studies to quantify the relationship between potential buoyant energy on the one hand and mid-level ice accumulation and lightning activity on the other. He is also modelling charge separation in trailing stratiform regions for comparison with electrical observations in COPS in 1989 in Oklahoma.

Steve and V. Bringi of CSU have also acquired the CHILL radar whose installation is already underway.

DESERT RESEARCH INSTITUTE (DRI) (Reno, NV)

John Hallett participated with MIT and CSU in studies of electrification in tropical convection in Darwin, Australia in December, 1989 with particular emphasis on the electrical/microphysical conditions in early stages of development. Following up on his interest in the electrification of hurricanes, he participated earlier in a reconnaissance flight of Hurricane Hugo aboard the NOAA P-3 aircraft. He plans to collaborate with Clive Saunders of UMIST on studies of electrification in stratiform precipitation in SWAMP (Southwest Area Meteorological Experiment) south of Phoenix into Mexico.

FLORIDA STATE UNIVERSITY (Tallahassee, FL)

Peter Ray is examining radar and electrical data from Socorro, New Mexico to relate the co-evolving electric field and distribution of

water substance. The objective of this work is the identification of charging mechanisms. In 1991 Peter plans to participate in CAPE in Florida with a somewhat more applied objective: distinguish storms which are electrified (and pose a hazard) from those which are not.

UNIVERSITY OF FLORIDA (Gainesville, FL)

Ewen Thomson is currently assembling a network of six radio receivers and electric field sensors at Kennedy Space Center. The objective of this research is to locate sources of VHF radiation caused by breakdown processes in intracloud lightning and to identify electric field pulses caused by subsequent currents along fully formed channels.

Martin Uman, a collaborator in the previously described project, is also involved with the analysis of optical emission associated with M-components and K-changes of lightning in Japanese winter storms (with Dr. Scinichi Sumi of Chuba University of Japan). Martin is also examining previously collected measurements of electric fields associated with triggered lightning, and is coauthor on three papers on return stroke modelling.

MIT LINCOLN LABORATORY (Lexington, MA)

MIT Lincoln Lab will conduct Doppler weather radar measurements this summer at Orlando, Florida in support of the Federal Aviation Administration's development of Terminal Doppler Radar and enhanced weather detection capability for its new airport surveillance radars (ASR-9). Points of contact for Lincoln Laboratory are James Evans and Mark Weber.

ONERA will deploy an interferometric lightning RF source locator to provide two-dimensional images of lightning activity for comparison with radar-derived reflectivity and wind fields. These data will allow for an assessment of the utility of combining lightning information with radar for predicting turbulence and windshear, and the movement and growth of weather cells. Principal investigators for ONERA are Jean-Louis Boulay, Pierre Laroche, Anne Bondiou, and Phillippe Richard.

Marilyn Wolfson will coordinate Lincoln's scientific effort in the CAPE experiment slated for 1991 as a member of the CAPE Steering Committee.

MIT WEATHER RADAR LABORATORY (Cambridge, MA)

Recent studies in DUNDEE (Down Under Doppler and Electrical Experiment) conducted with Steve Rutledge (CSU) suggest that the tropical 'hot towers' which are heat pumps in the equatorial Hadley cell are distinct from the charge pumps in the global electrical circuit. The main charge pumps lie outside the monsoon trough and dominate tropical lightning activity.

Stan Heckman and Earle Williams will continue this summer with close-range CW radar measurements (2.4 cm wavelength) of the triggered lightning channels and simulated corona sources at the KSC rocket-triggered lightning site. The objectives of these measurements are to test predictions for lightning radar crosssections and to examine the cooling behavior of the lightning plasma in the interstroke interval.

Earle Williams, Speed Geotis and graduate students will operate MIT's C-band Doppler radar (now on its way back from Darwin, Australia) in Orlando, Florida this summer in collaboration with Lincoln Laboratory and ONERA. Objectives will be comparisons of initiation regions for cloud-to-ground lightning with the structure and location of graupel shafts, the estimate of cloud-to-ground lightning currents over the lifetime of individual thunderstorms, and the continued examination of electrical precursors to microbursts with interferometric lightning data.

UNIVERSITY OF MISSISSIPPI (Oxford, MS)

Tom Marshall is continuing with the analysis and interpretation of balloon soundings of electric field in a variety of meteorological conditions. He will collaborate with Dave Rust of the National Severe Storms Laboratory (NSSL) this summer in the measurement of particle charge and electric field in Colorado, Florida, or Oklahoma this summer. Tom also is exploring simple models to explain the occurrence of the End of the Storm Oscillation in the surface electric field of thunderstorms.

NASA - MARSHALL SPACE FLIGHT CENTER (MSFC) (Huntsville, AL)

Hugh Christian, Doug Mach, and Jeff Bailey are busy with the airborne field mill project involving five mills on a Learjet with the main objective to study vector electric field structure of marginally electrified clouds in the vicinity of KSC, beginning in July of this summer. This is a joint effort with Bruce Fisher of Langley, Launa Maier at KSC and Arnold Barnes of the Air Force Geophysical Laboratory. MSFC will archive all data along with KSC surface field mill data and McGill radar data from Patrick AFB.

Rich Blakeslee and Hugh Christian plan to continue with ER-2 measurements of electrical conductivity and electric field for determination of Maxwell current over the tops of clouds, an experiment they initiated in COHMEX in collaboration with Bernard Vonnegut of SUNYA. They expect to be back in the air in the fall of 1990, with more extensive measurements planned for KSC in the summer of 1991.

Hugh Christian is coordinating the upgrade of the electric field mill network at KSC. Proposals for new mills are currently under evaluation. Target date for completion is March of 1991.

Steve Goodman is examining large lightning data sets, with particular attention to DMSP satellite data. The objective here is to explore applications of global lightning data to be provided by LIS (Lightning Imaging Sensor) aboard the polar orbital satellite EOS-A to be launched in the late 1990's. Steve will collaborate with Dave Rust of NSSL in ground-truthing the DMSP data on active storms in the midwestern U.S.. Steve also plans to continue with radar polarization measurements over the electrical life-cycle of individual thunderstorms in the summer of 1991 as part of the CAPE program.

Bill Boeck will join MSFC on a sabbatical visit from Niagara University.

NASA - KENNEDY SPACE CENTER (KSC) (JFK Space Center, FL)

Bill Jafferis will continue to operate the triggered lightning site at KSC this summer. He has access to a Navy tethered balloon, and will work with Serge Chauzy of the University of Toulouse, France and possibly Tom Marshall and Chris Phelps on a measurement of electric field from the surface to about 5000 feet. The objective is the assessment of the overall electric field configuration conducive to the triggering of lightning.

Carl Lennon has begun the construction of a new LDAR (Lightning Detection and Ranging) system at KSC which is expected to be operational by the summer of 1991.

Launa Maier will collaborate with MSFC and NASA-Langley on the airborne field mill project at KSC this summer.

Dick Fisher of Sandia Laboratory will occupy the triggered lightning site this summer to evaluate the performance of a mobile lightning system and also the direct effects of lightning on different metals.

Carl Popp and Ed Franzelall of NMIMT will examine changes in atmospheric chemistry near the triggered lightning channel at KSC during the coming summer.

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH (NCAR) (Boulder, CO)

Jim Dye will continue with the study of thunderstorm data collected in New Mexico, including the analysis of large (10-100 fold) anomalies in NO_x concentration near the tops of thunderstorm anvils. This summer he plans to make sailplane measurements of precipitation particle size, shape and electric charge in Colorado.

Andy Weinheimer is organizing his results on in situ measurements of precipitation particle charge in electrified clouds for publication but is currently in transition from atmospheric electricity to atmospheric chemistry.

NATIONAL SEVERE STORMS LABORATORY (NSSL) (Norman, OK)

Dave Rust will be in the field this spring in Oklahoma with the mobile laboratory and this summer (in Florida, Colorado, or Oklahoma) to investigate storm structure, particle charge and electric field in collaboration with Tom Marshall. He also plans to participate in SWAMP this summer with an optical detector on board the NOAA P-3 aircraft and with Lightning Location and Protection (LLP) coverage.

In 1991 Dave will participate in COPS (Cooperative Oklahoma Profiler Studies) in Oklahoma. He is currently involved with efforts to organize an electrical study for the experiment at KSC for the summer of 1991.

Vlad Mazur will collaborate this spring with Dr. Kawasaki of Osaka University in Japan and with Marx Brook of NMIMT on studies of the extension of lightning channels in clear air this spring at NSSL. A high speed video camera and wideband electric field measurements will be used to study the relationship between different processes in the junction stage of intracloud lightning. Vlad may also participate with MIT and Lincoln Laboratory in experiments in Orlando this summer. He plans to attend the CAPE meeting at NCAR in April.

Don MacGorman is working on the analysis of Cimmaron Doppler data, P-3 aircraft data, and LLP data for positive cloud-to-ground lightning in COPS 1989.

Conrad Ziegler continues with modelling studies of New Mexico thunderstorms and comparisons between the model results and aircraft measurements of electric field and particle charge by Jim Dye of NCAR and other investigators from NMIMT. He is also collaborating with Don MacGorman on the modelling of the Binger tornado storm, whose electrical and radar characteristics Don had examined earlier.

NSSL is planning a larger field program (COPS 1991) in the following spring with emphasis on dry line frontal situations and an examination of conditions for the presence and absence of electrification. Profiler data will be used for the initiation of mesoscale models. The NOAA P-3 is expected to participate in this experiment, with field mill(s) attached.

NATIONAL WEATHER SERVICE (NOAA-NWS) (Silver Springs, MD)

The Working Group on Lightning Detection Systems (WGLDS) was organized in 1976 with the intent of providing lightning information on a national scale for use by the National Weather Service. Don MacGorman of NSSL is the ERL representative on this committee and Henry Newhouse is the NWS representative. The NWS is currently acquiring cloud-to-ground lightning information on a national scale from three main contributors: the SUNYA Lightning Network in Albany (Dick Orville) the NSSL Network in Norman, Oklahoma and the Bureau of Land Management (BLM) Network. This data has been provided on a trial demonstration basis originally planned to terminate in December of 1991, but the NWS has found the information extremely valuable, on both the aviation and forecasting side, and wishes to continue with the use of this information. The lightning data have been valuable in identifying the formation of mesoscale lines of precipitation, in spotting local 'hot spots' in convective activity within otherwise uniform-looking radar echoes, and in identifying regions of marginal convection. Fred Mosher at the Kansas City office has been a key figure in testing applications of the lightning information.

NAVAL RESEARCH LABORATORY (Washington, D.C.)

Lothar Ruhnke plans to divert some of the plasma physics expertise at NRL toward lightning problems. He attended a recent multi-agency meeting concerned with a field program at KSC in 1991.

NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY (Socorro, NM)

Charlie Moore will continue his investigations of the electrical charging of helicopters in flight, and the effect of artificial space charge release on subsequent electrical development of overhead clouds.

During the coming summer, Bill Winn will work on the design of a particle charge instrument and on the analysis of thunderstorm data collected earlier in Socorro. He is also collaborating with John Willett of

AFGL on a rocket instrument to measure electric field aloft, a device they expect to deploy at KSC during the summer of 1991. Bill will probably join Bill Rison and Dan Jones in the study of cloud electrification and the conditions for triggered lightning at KSC in the CAPE program in 1991.

Marx Brook will collaborate this spring in Oklahoma with Vlad Mazur of NSSL on the electrical and optical measurements of air discharges beneath thunderclouds. During the summer of 1990, Marx will return to Socorro to make wideband measurements of electric field in conjunction with interferometer (with Charley Rhodes) and polarization radar measurements. Paul Krehbiel and Marx Brook will continue with the measurement and interpretation of changes in cross-polarized returns (x-band) from precipitation between lightning discharges. These measurements will continue in Socorro this summer and will resume at KSC in the summer of 1991.

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

Dick Orville continues to oversee round-the-clock operation of the National Lightning Network in Albany. He will probably opt to concentrate on data analysis this summer, and return to KSC in 1991. He is examining trends in lightning peak currents with geographical latitude.

Vince Idone, has been using UV photography to study the upward leaders of rocket-triggered lightning. One objective of his studies is to understand the relationship between dart leader speed and the duration of the interstroke interval. In some of these studies he is working closely with investigators from ONERA (Paris) and CENG (Grenoble). Vince will also take a break from field experiments in 1990 in order to analyze data collected in previous summers in Oklahoma and at the rocket-triggered lightning site at KSC.

UNIVERSITY OF OKLAHOMA (Norman, OK)

Bill Beasley is out of Washington, D.C. and is now an Associate Professor of Meteorology and Deputy Director of CAPS (Center for the Analysis and Prediction of Storms) at the University of Oklahoma, where he has taken on the teaching of atmospheric thermodynamics. He plans to return to active research in atmospheric electricity/lightning in collaboration with his new neighbors Vlad Mazur, Don MacGorman, and Dave Rust and Bill Taylor.

ONERA (Meudon, France)

Jean-Louis Boulay, Pierre LaRoche, Anne Bondiou and Phillippe Richard will install and operate an interferometer for location of lightning sources at Orlando, Florida in collaboration with Lincoln Laboratory and MIT in a joint study of thunderstorm microbursts. Pierre LaRoche and investigators from CENG (Grenoble, France) will also work at KSC toward the deployment of high altitude (7 km) sounding rockets for electric field. All of these studies are expected to continue in Florida during the summer 1991.

RICE UNIVERSITY (Houston, TX)

Arthur Few has recently completed modelling studies of the global electrical circuit. He is currently constructing a Maxwell current meter to be deployed for surface measurements in Antarctica in December of 1990. This study is a joint project with Greg Byrne, Edgar Bering and James Binbrook of the University of Houston.

SOUTH DAKOTA SCHOOL OF MINING AND TECHNOLOGY (Rapid City, SD)

John Helsdon is analyzing lightning and radar data from the NDTP (North Dakota Thunderstorm Project) and making local measurements with a field change meter for comparisons with the SUNYA network results. On the modelling side, John is extending the 3D cloud electrification model to examine further case studies.

UNIVERSITY OF WASHINGTON (Seattle, WA)

Bob Holzworth will make measurements in the stratosphere of the vector electric field, conductivity and current density over Antarctica using superpressure balloons beginning in December of 1990. Collaborators on this project are Arthur Few of Rice University, R.L. Dowden from New Zealand, and W. Gonzalez and O. Pinto from INPE in Brazil. Bob is also involved with looking for 'trimpi' perturbations associated with the injection of VLF waves in the ionosphere and the stimulation of wave-particle interactions. He continues with rocket and balloon probing of electrodynamics directly over active thunderstorms.

ADDITIONAL NOTES

A meeting was held in Washington, D.C. on Feb. 1, 1990 for discussion of multi-agency support for an experimental program at KSC in the summer of 1991. Vlad Mazur, Ron Taylor, John Theon, Jim Stobie, Jack Ernst, Jim Nicholson, Peter Ray, and Lothar Ruhnke were in attendance. Topics discussed were (1) radar support (2) airborne measurements (3) ground measurements (including the KSC field mill network) and (4) rocket-triggered lightning. It was estimated that a minimum of \$1 million would get the proposed program off the ground, and that this amount could be provided with multi-agency participation. One point of particular concern was the need for active participation on the part of KSC.

Another meeting concerned with CAPE was held as part of the AMS Meeting in Anaheim, CA on Feb. 7, 1990 with Roger Wakimoto, Bill Boyd, Rit Carbone, Paul Herzegh, Jack Ernst, Art Hansen, John Madura, Jim Stobie, Ron Taylor, John Theon, Otto Thiele and Jim Wilson in attendance. While the CAPE steering committee was encouraged in pursuing its plans, notes of caution were raised by the potential size of the program and the need for logistical support.

Roger Wakimoto of UCLA has called a meeting at NCAR on April 3-4, 1990 of all scientists interested in participating in The CAPE experiment at KSC in 1991. Roger's objectives at the meeting will be (1) the identification of PI's and their scientific objectives (2) the finalization of network design (3) establishment of plans for the development of a field document and (4) the discussion of other logistical issues. Interested atmospheric electricians should try to attend or contact Roger (213-825-1751).

Lt. Col. James Stobie of the Air Force Office of Scientific Research has received 30 proposals for atmospheric electricity and a total request of \$2.5 million for a total budgeted amount of \$400,000 in the first year of his program. The deadline for proposal submission was March 1, 1990. Col. Stobie estimates that awards will be made in May of this year.

The Organizing Committee for the 16th Conference on Severe Local Storms (to be held in Kananaskis Provincial Park, Alberta, Canada in October 1990) has received 23 abstracts concerned with atmospheric electricity. Tom Marshall of the University of Mississippi and Vince Idone of SUNYA are co-chairing the Atmospheric Electricity Committee. Phil Krider and Peter Ray are credited with encouraging the integration of atmospheric electricity in this conference and the earlier Tallahassee radar conference.

The Organizing Committee (chaired by Dave Randall of CSU) for the Cloud Physics Conference to be held in San Francisco in July has received six abstracts concerned with charge separation in electrified clouds.

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