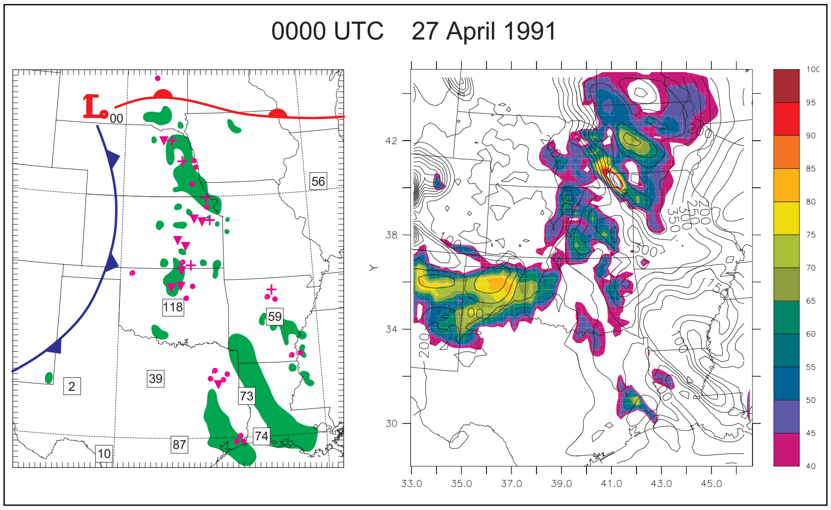
# NSSL Briefings

Volume 2 No. 1 Summer/Fall 1997

A newsletter about the employees and activities of the National Severe Storms Laboratory




***Left box**: Observed frontal location, modeled rainfall during the past hour (green), and observed severe reports (tornado as an inverted triangle; severe wind as a +; hail as a dot)* ***Right box**: Model parameters used to determine likelihood of tornadic thunderstorms overlaid on a single figure. Region where tornadic thunderstorms are most likely indicated by the color-filled sections in the right box that overlap where rainfall is simulated in the left box.*

# Forecasting tornadic thunderstorms

*by Dave Stensrud and Harold Brooks*

Operational forecasters are very good at identifying days when severe weather occurs across large regions of the country. It is more of a challenge, however, to determine whether these days will be dominated by tornadic thunderstorms or non-tornadic thunderstorms. This difficulty is related to our general lack of understanding of the processes that form tornadoes.

The National Severe Storms Laboratory (NSSL) is exploring this operational forecast problem using a mesoscale numerical weather prediction model. We have been examining hourly output from a number of model simulations to determine whether or not any signal exists that would help forecasters determine whether or not tornadic thunderstorms are likely.

Model results indicate that we *can* discriminate between days with tornadic and non-tornadic thunderstorms. The key parameter needed to answer this question is the storm-relative wind. When the winds in the atmosphere are much faster than the movement of the thunderstorm, the raindrops produced in the storm updraft get blown away from the storm, and the cooling effect of the rain has little effect on the storm evolution. In contrast, when the winds in the atmosphere are much slower than the movement of the thunderstorm, the raindrops all fall very close to the center of the storm, cooling the air near the ground and producing very strong outflow. In between these two extremes, the winds in the atmosphere are roughly equal to the movement of the thunderstorm, and just the right amount of rainfall reaches the ground near the center of the storm. In this case, the cooling effect of the rain can be used to help generate rotation in the thunderstorm at levels near the ground surface. This increases the likelihood of tornado formation. This conceptual model was developed by Brooks *et al.* (1994) by examining numerical simulations of thunderstorms but also appears in our mesoscale model simulations of outbreak days.

Three parameters are used to help determine whether or not tornadic thunderstorms are possible. One is a measure of the positive buoyant energy available to a storm (Convective Available Potential Energy - CAPE), another is a parameter that has been used to forecast the rotational characteristics of thunderstorms (Storm-Relative Environmental Helicity - SREH), and the third a measure of the wind shear over the lowest 6 km of the atmosphere (bulk Richardson number shear - BRNSHR), which is closely related to the storm-relative wind. When these parameters all fall into a specified range, tornadic supercell thunderstorms are more likely than non-tornadic supercell thunderstorms (see figure). This conceptual model is presently being used by forecasters at the Storm Prediction Center (SPC) to help provide improved severe weather guidance to the nation. ◆

## In Brief.....

# On the state of NSSL

*by Jeff Kimpel, Director*

> *It is important that we maintain our niche and continuously adjust as present initiatives conclude and new opportunities arise*

As promised in the last issue of NSSL Briefings, I wish to take this opportunity to report on the health of NSSL and to share with you my impressions of the strategic issues facing the Lab. I have been meeting weekly with the NSSL Management Team, consulted with many others, and believe this column reasonably reflects the consensus view.

NSSL is a healthy organization. It has grown rapidly in the last five years from a $7M, 90-employee laboratory to an $11M, 120-employee laboratory. This was accomplished while our true base funding and federal workforce declined. Thus, recent growth can be attributed to NSSL's ability to capitalize on opportunities to attract one-time and project-oriented funding for basic research, applications, and technology transfer work. This trend is likely to continue in the foreseeable future, and NSSL is in an excellent position in terms of niche.

Given the uncertainty in the external environment, it is important that we maintain our niche and continuously adjust as present initiatives conclude and new opportunities arise. In recent years NSSL has successfully expanded its research and development efforts to include severe winter weather and weather in complex terrain. To improve our responsiveness in this new environment we must:

- retain and recruit an excellent workforce,
- further develop our infrastructure, including state-of-the-art telecommunication, network and computer resources, and field observing facilities,
- diversify our funding sources, and
- form alliances with other organizations.

NOAA's strategic goal of advancing short-term warnings and forecasts coupled with the NWS Modernization serves us well. New national priorities in natural hazards prediction, reduction and mitigation offer excellent opportunities for the future. Historically, NSSL's mission has been to conduct basic and applied research focused on severe weather. Within that mission, major goals now include: improved understanding of severe weather producing systems, improving and evaluating mesoscale models, building and supporting observational facilities for field studies (Doppler radars, mobile laboratories), developing applications and systems, and transferring that technology to the NWS and other operational environments. Future initiatives under the NOAA and natural hazards umbrella may include:

- hydrometeorology as a follow-on to dual-polarization radar,
- cross-mesoscale model evaluation and ensemble forecasting,
- making the Joint Mobile Research Facility a national resource,
- exploring socio-economic and health aspects of severe weather including heat and cold waves,
- transferring technology into the private sector via systems and tool kits, and
- mitigating weather hazards.

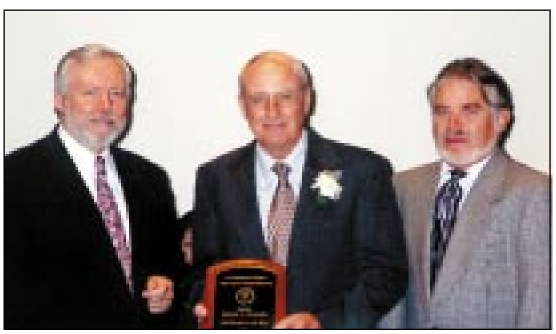
The strength of NSSL lies in its people. Their willingness to seek new opportunities, collaborate with others in joint ventures, and emphasize customer service while enduring less-than- adequate workspace is extraordinary. This "can do" attitude is responsible for the reinvention of NSSL over the last decade and the success it enjoys presently. NSSL is healthy. Its future is bright. ◆

# OAR Employees of the Year

Every year the Oceanic and Atmospheric Research (OAR) Committee presents its Employee of the Year Awards to recognize OAR employees for "significant contributions to OAR programs and exceptional and sustained effort towards accomplishment of the OAR mission." The programs and laboratories under the OAR umbrella include: the National Undersea Research Program, the National Sea Grant College Program, and the Environmental Research Laboratories (ERL). This year, two of the recipients are from NSSL. They were honored in a ceremony in Washington D.C., and are pictured on the next page with Elbert W. "Joe" Friday, assistant administrator for OAR (pictured left) and Alan Thomas, deputy assistant administrator (pictured right).

*(continued on next page)*

**Doug Forsyth**, Deputy Director, has been honored with the Employee of the Year Award for his service as Assistant and Deputy Director (1990-present), temporary Acting Director (late 1996-early 1997), and ex-officio Director of NSSL for four and one-half years due to medical emergencies affecting the permanent Director and his family. Doug's nominating letter stated, "Mr. Forsyth's dedication to the employees of NSSL and to the ERL/OAR mission during this extended period of time, often at great personal sacrifice, is nothing short of heroic." Doug's skilled leadership contributed greatly in helping NSSL advance in many ways over the past seven years. A few of these accomplishments included: the start-up of the $1.6M re-host project for the WSR-88D Radar Product Generator and Radar Data Acquisition System, the move of the SPC into the NSSL facility and the establishment of a close working relationship with the SPC, the planning and execution of the very successful VORTEX field program, and increased interaction with NSSL's primary customer, the NWS. Also, during this period, NSSL became the first research laboratory to ever be awarded the Department of Commerce Gold Medal. Doug prepared and championed the nomination of NSSL for its pioneering research effort that culminated in the national deployment of the WSR-88D system.



**Dennis Nealson**, senior Electronics Technician at NSSL, was chosen "Employee of the Year" for being instrumental in improving NSSL's mobile observing capabilities. Dennis is the primary technician for the Mobile Laboratories. He led the technical effort to convert 15-passenger vans into mobile laboratories as well as integrating the National Centers for Atmospheric Research (NCAR) Cross-Chain Atmospheric Sounding System (CLASS) into the mobile laboratories (M-CLASS). The mobility of the M-Class has increased our understanding of the atmosphere. Previously, soundings were available only at fixed sites or during large and costly field programs. The M-Class has made atmospheric soundings possible from anywhere in the United States. During the VORTEX project, Dennis led the technical efforts to field the Doppler-on-Wheels and instrument 13 vehicles with Mobile Mesonets (cars instrumented with the capability to gather winds, pressure, temperature and humidity information) that lead to new and important data on the formation of tornadoes. Dennis's letter of nomination said, "Mr. Nealson's 'can do' attitude and his ability to work with others has resulted in many improvements and cost savings for the Laboratory. His ability to take abstract ideas and to build well-designed and fully functional components is an important and valued trait for accomplishing our research in a timely and cost effective manner." ◆

# NSSL News Briefs

## OAR Outstanding Scientific Paper award recognizes NSSL scientists

Harold Brooks and Chuck Doswell were awarded the "Outstanding Scientific Paper" Award for "The Role of Midtropospheric Winds in the Evolution and Maintenance of Low-Level Mesocyclones," Monthly Weather Review (1994) 17 December 1996.

Bob Davies-Jones and Harold Brooks were also recognized with the 1996 ERL Outstanding Scientific Paper Award for "Mesocyclogenesis from a Theoretical Perspective," Geophysical Monograph (1993).

## Scientists make first dual-Doppler tornado intercept

A team of NSSL, Cooperative Institute for Mesoscale Meteorology Studies (CIMMS), and University of Oklahoma (OU) scientists called "Subvortex" intercepted an F1 tornado on May 26, 1997 southwest of Tulsa, OK. Scientists were able to position two Doppler radars mounted on flatbed trucks within a few kilometers of the storm and scan the slow-moving tornado for ten minutes.

Subvortex is a follow-up to VORTEX, the Verification of the Origins and Rotation in Tornadoes Experiment conducted in 1994 and 1995. During VORTEX, scientists intercepted 10 tornadoes and studied them with a suite of instruments. Using data gathered during the experiment, scientists have refined their hypotheses, and through Subvortex are focusing in on the little-understood rear flank downdraft region of the storm. Scientists say the region may play a key role in the transportation of rotation to the ground.

*__NSSL Briefings__ is a publication from the National Severe Storms Laboratory (NSSL) intended to provide federal managers, staff, and other colleagues in the meteorological community with timely information on activities and employees. If you would like to be added to the NSSL Briefings mailing list, or have a change in your address, please forward requests to Kelly Lynn, NSSL, 1313 Halley Circle, Norman OK, 73069; or email: klynn@nsslgate.nssl.noaa.gov.*

# Oklahoma Weather Center groups pool field observing resources

*by Dave Rust and Susan Cobb*

***The Oklahoma Weather Center is a group of "several University, State, and Federal entities in the Norman area engaged in atmospheric science research and its application to civilian needs."***

Some of the best velocity and reflectivity data ever collected on a tornado were obtained by a mobile Doppler radar at a distance of 2 miles. Another tornado was documented by nearly a thousand surface observations collected by mobile mesonets, while a thousand different observations were obtained in other parts of the storm. Data sets such as these, collected by field observing systems, provide invaluable knowledge to scientists seeking to unlock the secrets of the weather.

Oklahoma Weather Center (OWC) groups including NSSL, the Cooperative Institute for Mesoscale Meteorological Studies (CIMMS), and the Oklahoma University School of Meteorology (OU/SOM) have expressed a strong desire to share field observing systems for the combined benefit of all. As a result, these three groups have agreed to sponsor a Joint Mobile Research Facility (JMRF) to foster cost-effective use, maintenance, and upgrade of our existing observing systems. A variety of data collection systems are part of the JMRF including: mobile Doppler radars, mobile

and deployable balloon sounding systems, mobile laboratories, a field coordination vehicle, deployable instrument pods ("turtles"), and mobile mesonets.

Scientists wanting to use the facilities will work with JMRF system managers who determine technical feasibility and costs. Proposals are submitted to a Utilization Panel composed of two scientists from each sponsoring group. The Panel reviews the proposed usage for scientific merit and

*(**Left**) One of the mobile labs used to gather surface thermodynamic, wind, electric field, and lightning data on a developing storm.*

*(**Above**) Scientists prepare to launch a balloon train instrumented to obtain vertical soundings of thermodynamics, wind, and electric field. The yellow tube was designed specifically for high wind launches in our mobile ballooning projects.*

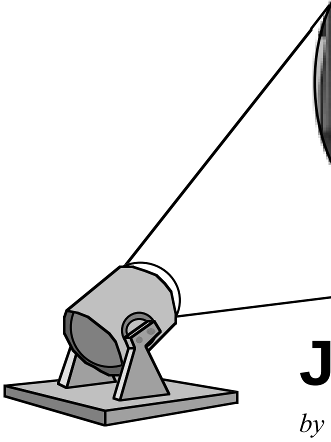
*(**Page 5 Top**) Example of a 'balloon truck' used to transport inflated balloon and extra helium and supplies for subsequent launches during mobile ballooning project.*

examines the evaluation of the system manager regarding technical feasibility and budget. The Panel then recommends to the Board of Governors whether the proposed request for facilities should be granted. This procedure is still evolving. The Board of Governors has coordinated aspects of JMRF with the National Center for Atmospheric Research (NCAR) to make sure the JMRF is a complement to, not a competitor of, the facilities sponsored by the National Science Foundation (NSF) at NCAR.

About a dozen projects have received approval for use of these important observational facilities, and more are in line for consideration. Part of the philosophy of the JMRF is to keep the interactions between groups as informal as possible. Thus far, proposals have been considered as they are received, allowing JMRF to be very responsive. More detailed and updated information on the JMRF can be found on the internet. The schedule for mobile labs, ballooning, and the Doppler-on-wheels may be found under NSSL's home page or directly at http://www.nssl.noaa.gov/jmrf/schedule.html. ◆


*(**Middle Left**) Deployable upper air sounding system. The trailer contains heat and air conditioning and its own generator. Sounding balloons are inflated and released from a high-wind launch device placed outside the trailer. A surface mesonet can be deployed with the trailer.*
*(**Middle Right**)Armada of mobile labs, field coordination van, and automobile-mounted mobile mesonets used during VORTEX.*
*(**Bottom**) Tethered-balloon system for making repeated boundary layer profiles. Here, scientists were preparing to make vertical soundings of the electric field at Kennedy Space Center in a successful project designed to increase the availability of launch window time for the Space Shuttle.*

# Employee spotlight



# John Cortinas

*by Susan Cobb*

The harsh and dynamic weather of Nebraska was an early laboratory for John Cortinas. He anticipated the different weather each change of season would bring. His curiosity of the weather grew as he watched thunderstorms form and dissipate. John even experienced a destructive tornado that tore through his home town of Omaha. It hit five miles from his house in a heavily populated area. He was excited as the storm moved in, but the destruction he saw later showed him the result of nature's wrath. In 8th grade, John was exposed to the science of meteorology for the first time. A teacher, who was also a pilot, taught a class about weather and he was hooked. The teacher encouraged him to pursue his interest in the mysteries of the atmosphere.

> **Bio Box**
>
> ***Current position:*** *Research scientist*
>
> ***Current project:*** *Winter weather hazards*
>
> ***Education:***
>
> *B.S. Meteorology, Metropolitan State College of Denver*
>
> *Ph.D. Georgia Institute of Technology, studies related to cloud physics and dynamics*

From nature's laboratory to a laboratory studying nature's fury, John came to NSSL in 1992. He says, "The most interesting thing about working at NSSL is that there are so many things to do — and we are fortunate to have a say in what we study." His first project at NSSL involved using mesoscale models to study the mesoscale environment of severe thunderstorms. He then worked on ways to help forecasters understand more about mesoscale modeling. John is now a part of the Mesoscale Applications Group (MAG), which supplies scientific research in support of SPC's operational services. John says, "We want to link research to operations — transfer results faster than in the past." Lately, his involvement with SPC has caused his research to shift to include winter weather hazards. "There's a lot we don't know about winter weather compared to severe weather."

John is a people person. He likes opportunities to interact with the public and share information, hopefully piquing someone else's interest in science as his was back in 8th grade. John does a lot of work with minority scientific organizations including the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS). SACNAS members are primarily science professors, and the mission of the society is to encourage Chicano, Latino, and Native American students to pursue graduate education in order to obtain the advanced degrees necessary for research careers and science teaching professions. John continues to contribute to this effort by giving seminars at SACNAS annual meetings and most recently by organizing an atmospheric science symposium.

John's passion is to help talented and qualified students make informed career decisions regardless of whether or not they choose to pursue a research career. His talks focus on what it means to be a scientist, what different career opportunities are available, and advising and educating students on a number of summer internships. He gave a talk this past summer to students involved in the University Corporation for Atmospheric Research's (UCAR) Significant Opportunities in Atmospheric Research and Science (SOARS) program, and during the summer of 1995 helped coordinate a Research Experiences for Undergraduates (REU) program at the Oklahoma Weather Center. The program introduced 14 students to the rigor of meteorological research in addition to providing them with information and experiences to help make informed career decisions. The program used a mentorship approach to teach the students how to conduct research.

John continues to mentor students, with two currently under his supervision. He has an undergraduate student working on forecasting precipitation types and a graduate student studying freezing rain. "They are our future - I want them to be as prepared as possible in a competitive field and to work to their fullest capacity." ◆

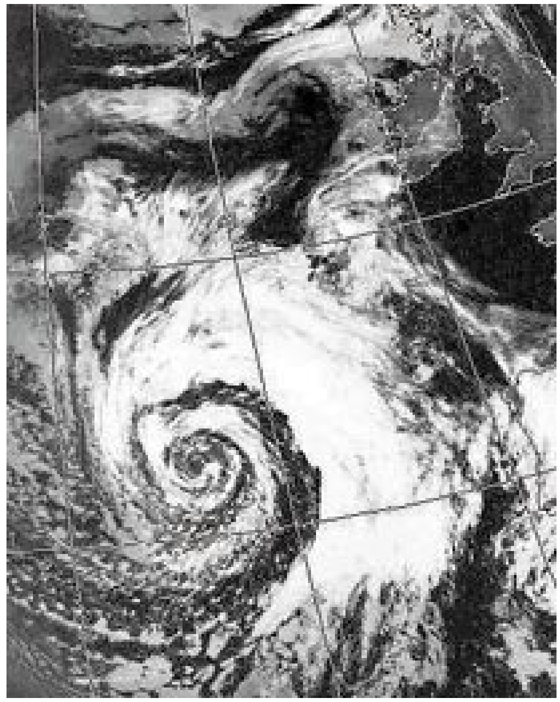
# FASTEX yields abundant cases for analyses

*by Dave Jorgensen*

Mother nature provided many more opportunities for aircraft flights than were expected during the field phase of the Fronts and Atlantic Storm Tracks Experiment (FASTEX). And preliminary examination of the aircraft data has revealed the high quality of the cases. The field phase of FASTEX was held during January and February 1997. NSSL scientists played a lead role in the design and execution of FASTEX as principal investigators, aircraft chief scientists, and P-3 crew members. The primary objectives of FASTEX were two-fold: (1) document the mesoscale structure and evolution of cyclones that rapidly develop in the eastern Atlantic, and (2) test the concept of "adaptive observational strategies" in upstream precursor regions to improve numerical forecasts of cyclogenesis. Although the basic physics of cyclogenesis by baroclinic processes has been known for 40 years, detailed "mesoscale" observations of oceanic cyclones have only recently been possible through use of the NOAA P-3 aircraft and its airborne Doppler radar. Earlier studies of cyclones have shown the varied structural evolution that occurs as cyclones mature, and this evolution greatly modulates the surface energy fluxes. FASTEX will provide the first data sets to document the evolution of these types of cyclones that often rapidly intensify without much warning.

Many mature, and strong, cyclones passed within range of the aircraft from their base of operations at Shannon, Ireland. February was particularly active, with 8 of the 12 P-3 flights. February was so stormy that the Irish Fishing Industry had to virtually shut down since fishing boats couldn't leave port due to rough seas. Aircraft involved in FASTEX included one of the NOAA P-3's, the NCAR Electra (with the ELDORA radar), the UK C-130, the new NOAA G-IV, a Lear-36 (leased by NSF and operated from St. Johns, Newfoundland), and several USAF C-130s.

NSSL/Mesoscale Research-Boulder (MRB) will be acting as the data quality control and dissemination point for worldwide access to FASTEX NOAA aircraft data sets. There is now a web page catalog of field observations under the MRB home page (FASTEX link) that provides a convenient summary of the data sets (http://mrd3.mmm.ucar.edu/nssl.html). During the next year several case studies will be undertaken to document the structure and evolution of several cyclones. In cooperation with NOAA/Environmental Technologies Laboratory (ETL) and Naval Research Laboratory scientists, numerical simulations of cyclone structure and dynamics will be undertaken to judge the effect of the upstream "targeted" observations on the ability of the models to simulate "correctly" their structure and intensity. The aircraft data will be used to "ground truth" the simulation results.



*Meteosat visible imagery of a well-defined extra-tropical cyclone.*

**February was so stormy that the Irish Fishing Industry had to virtually shut down since fishing boats couldn't leave port due to rough seas.**

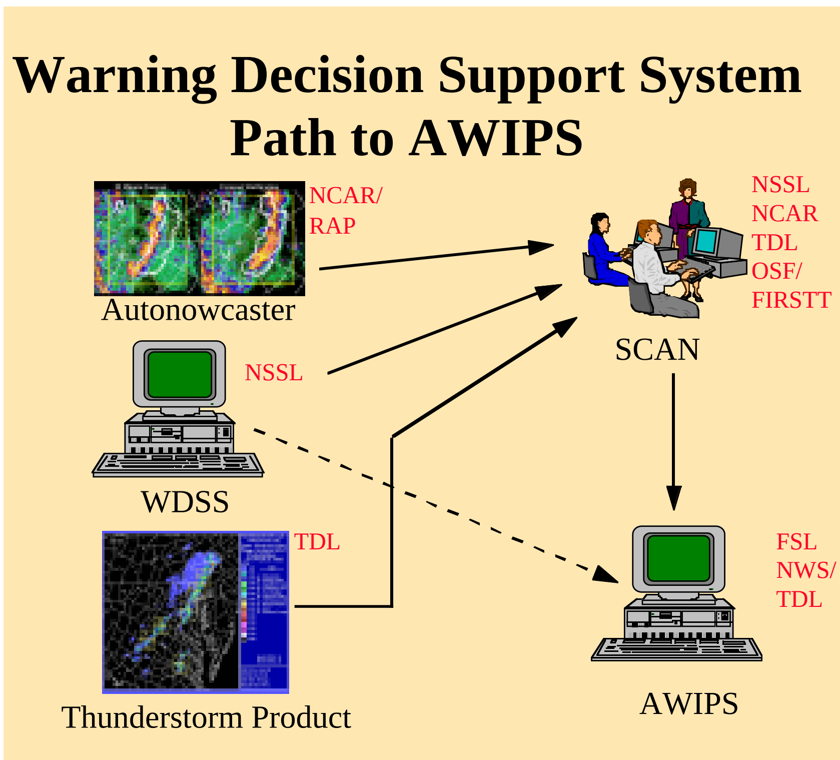
FASTEX was also the first operational test of the new NOAA Gulfstream-IV aircraft and its Global Positioning System (GPS) dropsonde system. Over 600 dropsondes were deployed in regions defined by objective guidance (e.g., ensemble-based sensitivity analysis, singular-vectors, and adjoint methods) to improve numerical forecasts and examine interesting upper level features associated with cyclogenesis precursors. In cooperation with NCAR/JOSS, these dropsonde data will be quality controlled before being released to modelers interested in simulation studies. ◆

*For further information contact: davej@ncar.ucar.edu or visit the FASTEX data catalog on the world wide web at: http://mrd3.mmm.ucar.edu/FASTEX/FASTEX.html.*

# AWIPS will include NSSL's WDSS

*by J.T. Johnson*

NWS's new Advanced Weather Information Processing System (AWIPS) has, for a long while, served as a beacon of true technological advancement in the NWS. AWIPS promises to serve as the final piece in the NWS' modernization, following the implementation of the WSR-88D (to be completed this year), launching of new GOES (the most recent was successfully launched April 25), and deployment of the Automated Surface Observing Systems (ASOS). AWIPS will integrate data from these modernized systems into a single computer system.




***NSSL is working with NCAR/RAP and TDL to develop a prototype application for AWIPS called the "System for Convective Analysis and Nowcasting" or "SCAN".***

Also included in AWIPS will be the latest severe weather warning technology. NSSL's **Warning Decision Support System** (WDSS), after positive feedback from tests across the country, is one of the systems expected to be incorporated into AWIPS. The WDSS is a series of severe weather detection and prediction algorithms, data integration techniques and innovative display concepts for meteorologists to use during severe weather warning operations. Other products expected to be included in AWIPS will be the **Autonowcaster** developed by the Regional Applications Program at the National Centers for Atmospheric Research (NCAR/RAP) and the **Severe Weather Probability Algorithm** and **Thunderstorm Product** from the Techniques Development Laboratory (TDL).

NSSL is working with NCAR/RAP and TDL to develop a prototype application for AWIPS called "SCAN," or the System for Convective Analysis and Nowcasting. SCAN represents the formal path for these three organizations to have their individual applications incorporated into the AWIPS platform. The goal of SCAN is to provide short term "MOS-like" (Model Output Statistics generated by large scale numerical models) guidance in convective weather scenarios.

The first phase of the SCAN project is the initial integration of the Autonowcaster, Severe Weather Probability Algorithm and Thunderstorm Product into the NSSL WDSS display. Following the integration, the SCAN system will be tested in real-time for a period of 2 months in the Sterling, VA National Weather Service Office. Additional operational field testing will occur during the next few years at other NWS sites.

Plans for integrating the WDSS into AWIPS include a dual path with both limited integration of WDSS functionality into the baseline AWIPS using operationally-available WSR-88D products and longer term development of WDSS functionality using WSR-88D wideband data and other operational datastreams for future inclusion into AWIPS. The initial integration is pointed at Build 6.0 (scheduled for the end of 1998) and the longer term development pointed at beyond 2000. ◆

*For more information, contact J.T. Johnson at: johnson@nssl.noaa.gov*

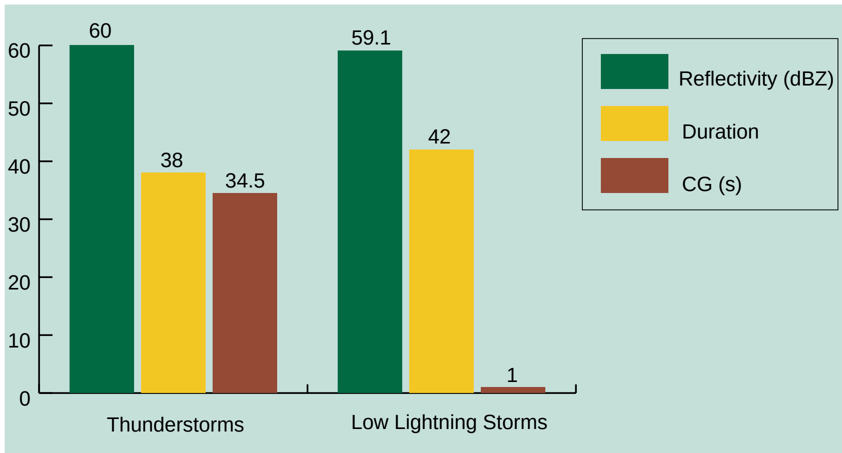
# Chaff released from fighter planes may suppress lightning in thunderstorms

*by Bob Maddox, Ken Howard, and Susan Cobb*

Studies in the 1970's showed that a zinc-coated substance called chaff, when injected into thunderstorms, markedly decreased cloud-to-ground lightning strikes. The chaff seemed to reduce the electric field below the value necessary to initiate lightning. A recent example of this occurred a few years ago on August 20 and 21, 1993 near Phoenix, AZ where strong thunderstorms exhibited strange cloud-to-ground lightning behavior. Further investigation revealed clouds of chaff, emitted by fighter planes from nearby Luke Air Force Base and detected by the Phoenix WSR-88D, were a possible explanation.

On August 20 and 21, 1993, deep convective storms occurred across much of Arizona, except for the southwestern quarter of the state. Several storms were quite severe, producing downbursts and extensive wind damage in the greater Phoenix area during the late afternoon and evening. The most severe convective storms occurred from 0000 to 0230 UTC on August 21. The interesting thing about these storms was that, except for the first reported severe thunderstorm, there was almost no cloud-to-ground (CG) lightning observed during their life cycles. Other intense storms on this day, particularly early storms to the south of Phoenix and those occurring over mountainous terrain to the north and east of Phoenix, were prolific producers of CG lightning. Radar data for an 8-h period (2000 UTC 20 August-0400 UTC 21 August) indicated that 88 convective cells having maximum reflectivities greater than 55 dBZ and persisting longer than 25 minutes occurred within a 200-km range of Phoenix. Of these cells, 30 were identified as "low-lightning" storms, that is, cells having three or fewer detected CG strikes during their entire radar-detected life cycle. The region within which the low-lightning storms were occurring spread to the north and east during the entire analysis period.

We examined the reflectivity structure of the storms using operational Doppler radar data from Phoenix and of the supportive environment using upper-air sounding data taken at Luke AFB just northwest of Phoenix. Our study revealed no apparent physical reasons for the distinct difference in observed cloud-to-ground lightning character between the storms in and to the west of the immediate Phoenix area versus those to the north, east, and south. However, the radar data do reveal that several extensive clouds of chaff were initiated over flight restricted military ranges to the southwest of Phoenix. The prevailing flow advected the chaff clouds to the north and east. Convective storms that occurred in the area likely affected by the dispersing chaff clouds were characterized by little or no CG lightning.




*Mean values of maximum observed reflectivity, duration, and total CG lightning strikes during storm cell life cycles for 50 intense thunderstorms and 30 low-lightning storms observed during period 2000 UTC 20 August-0400 UTC 21 August 1993.*

**Convective storms that occurred in the area likely affected by the dispersing chaff clouds were characterized by little or no CG lightning.**

There are no data available regarding either the in-cloud lightning character of storms on this day or the technical specifications of the chaff being used in military aircraft anti-electronic warfare systems. However, it is hypothesized that this case of severe, but low-lightning, convective storms resulted from inadvertent lightning suppression over south-central Arizona due to an extended period of numerous chaff releases over military ranges. We have compiled a substantial database of radar, satellite, and sounding data that will allow us to investigate this likelihood more thoroughly and rigorously. ◆

*For more information, contact Ken Howard at: khoward@nssl.noaa.gov*

# The glidersonde: a concept in recoverable radiosondes

*by Michael Douglas, Ken Howard, and Susan Cobb*

**Our project intends to provide a partial solution to the recurring cost of the expendable radiosonde by developing three different measurement systems.**

Radiosonde observations are widely considered to be the single most important component of the current atmospheric observing system. They have been the mainstay of the global observing network for more than 45 years. However, the global distribution of these observations remains very uneven, with the highest density in the middle latitudes of the northern hemisphere. The large tropical land areas in South America and in Africa remain sparsely sampled. Although labor costs are a substantial fraction of the total cost of making such observations in developed countries, the so-called "expendable" radiosonde package dominates the sounding budget of most developing countries, and this cost generally determines both the number of stations that can be operated and the frequency of soundings. The cost of maintaining this world-wide network has been, in recent years, subject to scrutiny, and it is not clear if the network can be maintained at its present level, let alone expanded into the remaining continental data voids. Even developed countries are reevaluating the frequency of their soundings in efforts to reduce budgets, and some networks (e.g., former Soviet Union) are under serious financial stress. Our project intends to provide a partial solution to the recurring cost of the expendable radiosonde by developing three different measurement systems.

A modified radiosonde system will be developed first. This radiosonde would be carried aloft by a balloon, taking regular temperature and humidity measurements in the same manner as current radiosondes. However, rather than falling uncontrollably, this radiosonde would be released at a predetermined pressure and glide back to the launch site or recovery zone using a Global Positioning System (GPS) navigation system. We call this concept a "glidersonde." The glidersonde will be aircraft-safe and will transmit the data in real-time as does a regular radiosonde. The data will be received and processed at a radiosonde ground station.

*Preparing to launch the glidersonde*

Possible problems are anticipated with interference between the radiosonde transmission and the glidersonde avionics. This has lead us to work on a second "downloading glidersonde." The downloading glidersonde would record all data on a memory chip; this data would be downloaded only after the glidersonde was recovered. With the appropriate, relatively simple software, the GPS-position information can be converted into winds and the thermodynamic data can be displayed and converted into a standard coded message on a very modest PC. Thus, any location that can inflate a balloon and has access to a PC can make radiosonde soundings.

A third recoverable system we will develop involves the use of a radio-controlled, motorized aircraft. This system would be especially useful for lower-tropospheric profiling with the capability for both real-time transmission of data and downloading of data after recovery. This radiosonde system would permit atmospheric soundings that are even less expensive than the proposed glidersonde. This system would also allow more frequent soundings (every 20-30 minutes) to altitudes up to 3 km, whereas a glidersonde turnaround time might be several hours. As with the glidersonde, the aircraft could be either transmitting data via radio or downloaded after landing. The aircraft could be equipped with autopilot and GPS for use in cloudy conditions, or for strictly visual operation it could be without these, for a much smaller per-unit investment.

The above tasks will be carried out by a combination of three closely-coordinated teams. The feasibility study, development of the glidersonde control software, and construction of both the prototypes and a refined glidersonde will be carried out in large part by two faculty members from the University of Oklahoma Department of Aerospace Engineering. The development of the meteorological sensor package, including the capability to write the data to memory on the glidersonde, will be supervised by Sherman Fredrickson of NSSL, a specialist in meteorological instrumentation. Field testing will be carried out primarily in Arizona, under the supervision of N. Renno of the Department of Atmospheric Sciences of the University of Arizona. Overall supervision of all aspects of the project, especially in reference to the meteorological applicability of the glidersonde and the operational constraints on its usage, will be provided jointly by M. Douglas and K. Howard of NSSL. ◆

*For more information, contact Ken Howard at: khoward@nssl.noaa.gov*

# Forecast evaluation

*by Harold Brooks*

Mesoscale Applications Group (MAG) scientists, in collaboration with other scientists from NSSL, the National Weather Service, Environment Canada, and the private sector, are actively involved in the evaluation of a wide variety of forecasts, from tomorrow's weather to seasonal forecasts of hurricane activity.

In a period of tight budgets, it is important to identify the accuracy and economic value of weather forecasts, so we can paint a true picture of the impacts of forecasting on society. By examining the relationship between forecasts, events, and users, it is frequently easy to see simple changes to the forecasts that could be made to improve their quality.

Consideration of the economic value of forecasts may give a different impression than just looking at the accuracy. Projects to look at both the accuracy and economic value of weather forecasts from the media in Oklahoma City have shown this point. Although the difference in accuracy for forecasts out to 48 hours isn't that large, a model of electric utility loads for Oklahoma Gas and Electric Company has shown that there would be approximately half a million dollars per year difference between the most valuable and least valuable forecasts (see figure).

MAG researchers have also addressed the problem of standards of references for forecasts. Sometimes, very accurate forecasts are easy, such as forecasting no snow in August for Norman. Standards of reference for measuring the skill of a forecast try to take the difficulty of the forecast into account. Traditionally, a simple standard of reference, such as the long-term average, has been used for a standard of reference. MAG scientists have been working on a way to use more information about how frequently different values occur in the standard of reference. Matt Briggs of Cornell University said, "You really want to judge measures of skill not just on a point of a distribution (like the mean), but the entire distribution."

The evaluation of weather forecasts is an important part of any forecasting system. Without it, it is impossible to identify areas where additional resources could improve the system and to monitor changes in performance. MAG scientists continue to work towards a comprehensive approach to the important questions concerning the effects of weather forecasting on society. ◆

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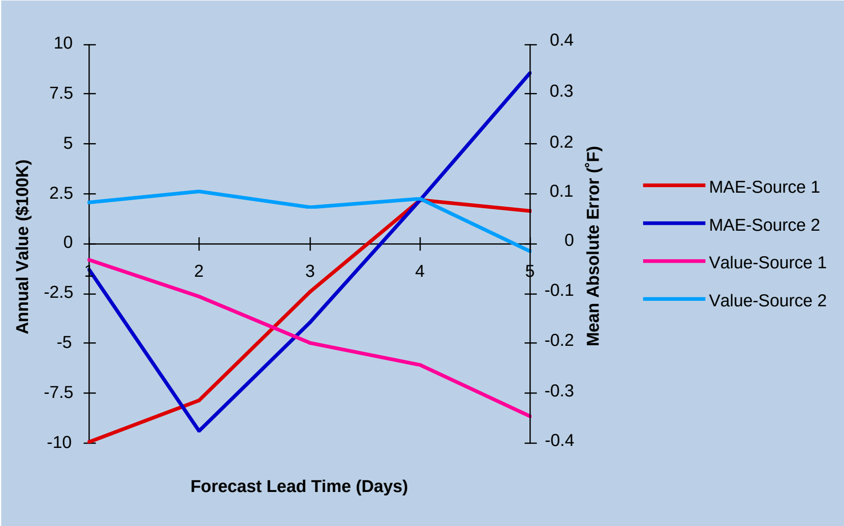


*Measures of the accuracy (mean absolute error (MAE) in degrees F) and value (in hundreds of thousands of dollars per year) of temperature forecasts from two different sources in the Oklahoma City media. Horizontal axis is lead time of the forecast in days. All values are relative to National Weather Service forecasts. Positive values indicate forecast source is better than NWS forecast for that lead time.*

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# MRAD research aims at improving short-term forecasts

*by Dave Rust, MRAD Chief*

The four research groups within the Mesoscale Research and Applications Division (MRAD) focus mostly on severe and dangerous weather on a scale larger than that of a single storm cell, i.e., we focus on the mesoscale. Our research aims at improving short-term forecasts, and our research projects range from basic studies of mesoscale phenomena to studies producing improvement in forecasting a specific dangerous weather phenomenon. Our applied research projects have activities specifically designed to rapidly transfer newly developed scientific understanding and forecast skills into operational components of the NWS. MRAD scientists include observationalists and users of all the major U.S. forecast and research models. MRAD scientists use a combination of mesoscale observations and modeling to conduct their research and test new forecast techniques. We collaborate with our customers in the NWS forecast offices through Science Operations Officers, the NWS Storm Prediction Center, and the National Center for Environmental Prediction.

All groups in MRAD have extensive work designed to improve operations, but we are pleased to have NSSL's specifically focused group to work directly on a daily basis with the Storm Prediction Center (SPC). This group, the Mesoscale Application Group (MAG), is led by Harold Brooks. Over the past two years, we have developed the style of working closely with SPC staff. I refer you to highlights of this productive interaction in the Winter/Spring 1997 NSSL Briefings.

Dave Stensrud leads the Models and Assimilation Team (MAT). The team does basic and applied research on the use of numerical models in the understanding and prediction of hazardous weather. The MAT works to: a) investigate new approaches for the use of high-resolution numerical weather prediction models (NWP) and optimal approaches to get information from those models for operational forecasting; b) improve incorporation of observations into NWP models; and c) simulate hazardous weather events and their environments to advance the understanding of such events.

Dave Jorgensen heads MRAD Boulder, whose scientists and staff are best known for expertise in analysis of mesoscale convective phenomena using the airborne Doppler radars on the NOAA P-3 aircraft. The group has played a key role in several major programs studying mesoscale convective systems, both continental and oceanic. Furthermore, this group is NSSL's direct and active link with NCAR's Mesoscale and Microscale Meteorology Division, which allows collaborative research using numerical simulations of phenomena studied by the observational data sets. The group is now completing analysis of Tropical Oceans/Global Atmosphere-Coupled Ocean/Atmosphere Response Experiment (TOGA/COARE) and beginning analysis of data collected during the Fronts and Atlantic Storm Tracks Experiment (FASTEX).

Ken Howard heads the Western U.S. Storms Forecasting group. Group members use routine operational and experimental observing systems and output from numerical prediction models to further understanding of summer and winter storms that affect western and southwestern North America through analyses of the synoptic, mesoscale, and storm-scale environments of these events.

Also within MRAD are other NSSL activities such as the In Situ Observing Systems group, a major contributor to the Joint Mobile Research Facility (see the companion story in this issue). We also have an active role in Coastal Observations and Simulations with Topography (COAST) through the presence of Brad Smull at the Joint Institute for Study of the Atmosphere and Ocean in Seattle. ◆