NSSL Briefings

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

WSR-88D provided for NSSL to test advances in polarimetry

by Dusan Zrnic

One of the most exciting areas of research and development using the Weather Surveillance Radar 1988 Doppler (WSR-88D) is in dual-polarization techniques. The National Severe Storms Laboratory (NSSL) has pioneered many of the advancements in radar polarimetry to improve precipitation measurements and hail identification.

Through funding from Environmental Research Laboratory (ERL) headquarters and the National Weather Service (NWS), NSSL has begun a major research and development project to test a dual-polarization scheme on the WSR-88D. We want to see if such a scheme is feasible both from an engineering and a meteorological application standpoint. In support of this effort and to test other improvements, NSSL was provided the original WSR-88D prototype radar by the NWS.

Several engineering and scientific aspects will be addressed as part of the dual-polarization effort. First is development of a new polarization scheme (patented by NSSL) that is compatible with the current WSR-88D scanning strategy. Transmission and reception of vertically and horizontally polarized waves will be made simultaneously, and polarimetric variables will be retrieved to determine the characteristics of the precipitation. The objective is to improve measurements of rainfall amounts with applications towards flash flood forecasts and warnings.

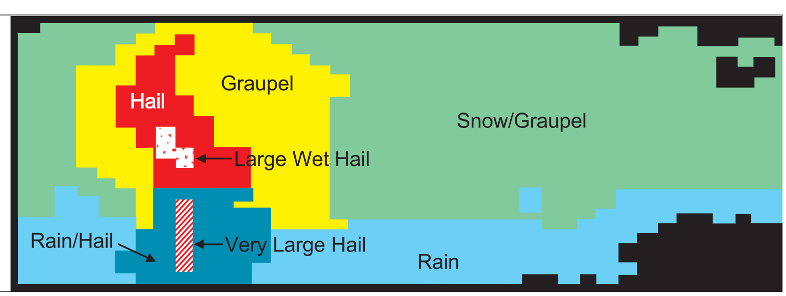
Second, the scheme will be tested in real-time on the NSSL WSR-88D to determine its practicality and compatibility with all current WSR-88D requirements. Further, polarimetric data will be evaluated to decide what techniques are the best candidates for operational applications. Both winter precipitation and rain/hail events are of interest, so the demonstration would straddle the winter-spring season with an intense field effort in verification.

In collaboration with the National Center for Atmospheric Research (NCAR) and the University of Oklahoma (OU), we are working to develop dual-polarization based algorithms and techniques. An example is shown in the figure below.

Scientists are still exploring the potential uses of polarimetric data. One futuristic goal is a surface map of precipitation types and amounts derived from polarimetric data that would be available to nowcasters. Another realistic goal of this research is to include polarimetrically-derived microphysical data for initialization and assimilation into numerical models to see what effect the data would have on model predictions. Ultimately this data should be an important addition to mesoscale models leading to significant improvements in quantitative precipitation forecasts. ◆

For more information contact Dusan Zrnic@nssl.uoknor.edu

Vertical cross section of hydrometeor types in a hail storm that occurred on June 13, 1984 in Denver, CO. Polarimetric data from NCAR's CP-2 radar were used in an automated procedure to generate this field. (Analysis courtesy of Dr. J. Straka, OU).



Volume 1 No. 4

Winter/Spring 1997

In Brief.....

NSSL News Briefs

NSSL meteorologist given Presidential Early Career Award

David Stensrud, a research meteorologist at NSSL, recently received the Presidential Early Career Award at a White House ceremony. The award gives him $10,000 a year for the next five years to conduct independent research of his choosing.

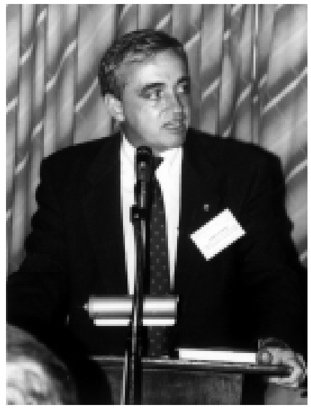
Stensrud has been at NSSL since 1986, and received the award for his work to bridge the gap between numerical modeling of severe weather by researchers and operational users of these weather models by forecasters. He plans to use the award money to continue his work in this area.

The Presidential Early Career Award is the highest honor bestowed by the U.S. Government upon outstanding scientists and engineers at the beginning of their careers. Stensrud is one of 60 federal scientists and engineers around the country to receive the annual award.

NSSL develops resource for forecasters and researchers

The Mesoscale Applications Group (MAG) at NSSL has developed a bibliographic database to help forecasters and researchers locate references on hazardous weather quickly and easily. Searching the database is easy. Anyone with access to the World Wide Web can use the database by simply pointing their web browser to (http://www.nssl.ou.edu/projects/nbd.) Currently the database contains over 1000 references on hazardous winter weather, with references on tornadoes, lightning, and uses of satellite data to be added soon. *MAG engages in basic and applied research that supports forecast operations at the Storm Prediction Center. For more information contact John Cortinas at cortinas@nssl.ou.edu.*

NSSL News Briefs continued on next page. . .



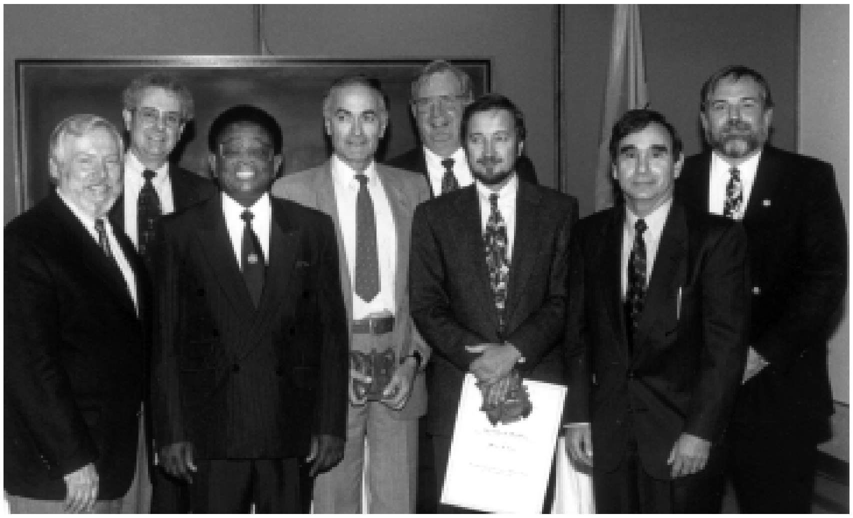
Introducing: James "Jeff" Kimpel, Director NSSL

I consider it a real honor to have been selected as only the third director of the National Severe Storms Laboratory in its 33 year history. Personally, I owe a lot to Ed Kessler and the NSSL scientists who helped me get started as an assistant professor at the University of Oklahoma (OU), and to Bob Maddox who helped build the Oklahoma Weather Center into national prominence. I hope I can continue the momentum they created through their wisdom and leadership.

I assumed the directorship on Monday, February 3, 1997. On the prior Thursday I walked through every nook and cranny of the Lab to meet the people of NSSL and to begin to piece together a sense of the organization. Frankly, I was amazed at the enthusiasm scientists and staff had for the projects they were working on, and at the variety of the topics being studied. I was pleased to learn that theory, observation, modeling and technology transfer are all well-represented and that there is a significant number of projects relating to winter weather phenomena. Also, I was surprised at the less than ideal work environment - overcrowded cubicles and noise. Over the next several weeks I will be meeting with the various divisions, visiting our operation in Boulder, and telephoning the scientists who are stationed off-site. I am conversing daily with Doug Forsyth, NSSL's Deputy Director, and weekly with Bob Maddox to get up to speed.

At the same time I will be learning the National Oceanic and Atmospheric Administration (NOAA)/Oceanic and Atmospheric Research (OAR)/Environmental Research Laboratory (ERL) system and meeting with as many of the people as possible. I have scheduled meetings with the leadership of the other NOAA organizations in Norman and the Cooperative Institute for Mesoscale Meteorology Studies (CIMMS). I intend to consult with individuals at the National Science Foundation (NSF), University Corporation for Atmospheric Research (UCAR)/National Center for Atmospheric Research (NCAR), NWS, Federal Emergency Management Agency (FEMA), several universities and private industry on their view of NSSL and where NSSL might be able to make significant contributions in the future. I expect to have formulated a "state of the NSSL" by the next issue of *NSSL Briefings*.

Prior to joining NSSL, Dr. Kimpel was a faculty member in the School of Meteorology at the University of Oklahoma (OU) for 23 years. He earned his M.S. and Ph.D. in Meteorology at the University of Wisconsin, Madison in 1970 and 1973, respectively. At OU, Dr. Kimpel served as Associate Dean of Engineering, Director of the School of Meteorology, Dean of the College of Geosciences, Director of the Weather Center, and Senior Vice President and Provost of the Norman Campus. He has chaired the NSF Advisory Committee for the Atmospheric Sciences (ACAS) and the Board of Trustees of UCAR. He currently chairs the National Centers for Environmental Prediction (NCEP) Advisory Panel and the American Meteorological Society's (AMS) Committee on Societal Impacts. He is a member of the National Research Council (NRC) Board on Natural Disasters (BOND). He co-chairs the United States Weather Research Program (USWRP) Prospectus Development Team on Socio-Economic Impacts. Dr. Kimpel's research interests include severe storm forecasting techniques and societal impacts. He is a Fellow of the AMS. ◆



Pictured left to right are: Dr. E.W. Friday, Dr. Bob Maddox, Professor G. O. P. Obasi, Dr. Dusan Zrnic, Dr. J. L. Rasmussen, Dr. Alexander Ryzhkov, Mr. Steven Chansky, Mr. Doug Forsyth

Zrnic and Ryzhkov receive Vaisala Award for radar polarimetry work

by Susan Cobb

NSSL scientists Dr. Dusan Zrnic and Dr. Alexander Ryzhkov were honored by the World Meteorological Organization (WMO) with the prestigious Vilho Vaisala Award in recognition for their work using polarimetric radar data to improve rainfall estimation. The award was presented by Dr. G. O. P. Obasi, Secretary of the WMO/Geneva during a ceremony at NSSL on November 5, 1996. Mr. Steven Chansky, President of Vaisala, Inc. was also present for the ceremony.

The purpose of the Vilho Vaisala Award is to promote interest in instrumentation and observation methods in support of WMO meteorological programs. Each year nominations for outstanding research papers published during the preceding 18 months are submitted by WMO members and permanent representatives.

Zrnic and Ryzhkov based their research on the fact that the difference in phase between the horizontally and vertically polarized waves is proportional to the rain amount. Furthermore, this specific differential phase has many advantageous properties compared to the reflectivity factor. Foremost among these is independence of calibration and immunity to attenuation. This paper provides the first quantitative evidence of superior rainfall estimation using the specific differential phase. This work has also detected unexpected and usually large attenuation in S-band radars caused by heavily-raining squall lines, due to the presence of spatially oriented hail and large drops containing ice cores. Use of specific differential phase overcame the effects of attenuation to yield correct rainfall amounts. These all have substantial operational implications for the new Doppler radar and radar networks. ◆

NSSL News Briefs

continued. . .

Appointments and elections

Rodger Brown has been appointed by the Council of the National Weather Association (NWA) to a three-year term as the newly-created Commissioner overseeing the operations of NWA committees. **Charlie Crisp** and **Rodger Brown** have been elected as Treasurer and Secretary, respectively, of the rejuvenated Central Oklahoma Chapter of the American Meteorological Society (AMS) and of the newly organized Central Oklahoma Chapter of the National Weather Association.

Visit our website!

NSSL's home page can be found at http://www.nssl.uoknor.edu. It has recently been enhanced, and contains information on the NSSL mission, laboratory administrative structure, special projects, new developments, employment opportunities, publications, useful links, and much more. *NSSL Briefings* is also available on line as an Adobe Acrobat document.

*The mission of the **National Severe Storms Laboratory** is to enhance the National Oceanic and Atmospheric Administrations's (NOAA) capabilities to provide accurate and timely forecasts and warnings of hazardous weather events (e.g., blizzards, ice storms, flash floods, tornadoes, lightning, etc.).*

NSSL accomplishes this mission, in partnership with the National Weather Service (NWS), through a balanced program of research to advance the understanding of weather processes; research to improve the forecasting and warning techniques; development of operational applications; and the transfer of understanding, techniques, and applications to the NWS and other private sector agencies.

***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.uoknor.edu.*

NSSL scientists probe winter cyclones

by Dave Jorgensen

NOAA scientists Dave Jorgensen (NSSL) and Mel Shapiro (Environmental Technologies Lab-ETL) lead a NOAA team aboard research aircraft and ships this winter to study storms that are near the eastern end of the Atlantic storm track. The deployment is part of a large multinational program called the Fronts and Atlantic Storm Track Experiment (FASTEX).

The primary goal of FASTEX is to investigate the large-scale dynamics of mature cyclones and develop methods to improve the forecasting of cyclogenesis. The principal interests of the NSSL/ETL group are the mesoscale precipitation and boundary-layer processes associated with rapid cyclogenesis. Results from the experiment will eventually be applied to large-scale and mesoscale numerical models used in forecasting.

The field phase of FASTEX was held from the beginning of January through February, 1997. Several NOAA facilities were involved, including the new Gulfstream IV high-altitude jet (G-IV), the P-3, and the research ship R/V Knorr. Additional facilities that were involved are the UK C-130, NCAR Electra, and NSF Lear aircraft, three additional oceanographic ships from France, Ukraine, and Iceland, and supplementary soundings from many countries. Operations and communications control were exercised from the main operations base at Shannon, Ireland with a number of other operations conducted at Meteo-

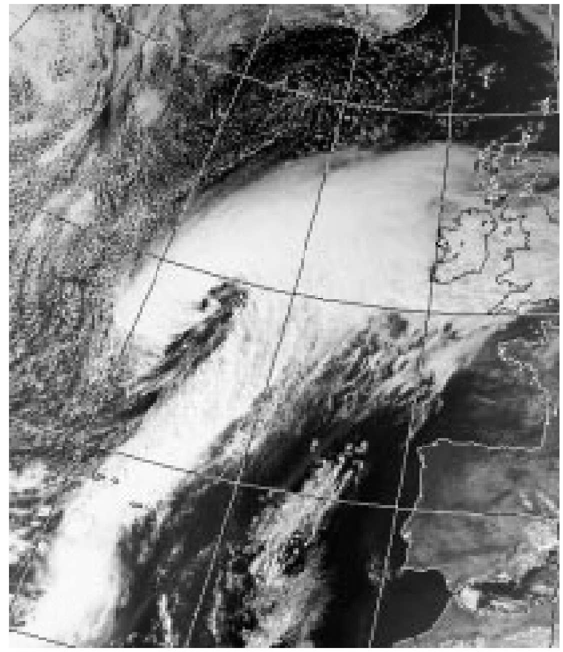


Figure 1: Infrared satellite depiction of the cloud pattern which is of interest to FASTEX

France in Toulouse, France, and the National Centers for Environmental Prediction (NCEP) in Washington, DC.

The photo in Figure 1 is an infrared satellite depiction of the cloud pattern which is of interest to FASTEX. The highest frequency of small-scale cyclogenesis events occurs just west of the British Isles. In this region, cyclones develop from waves on the frontal zone that have traversed the north Atlantic Storm-track zone over the previous one-to-two days. During the FASTEX field phase there were 19 Intensive Observations Periods (IOPs). A variety of weather systems were studied during these IOPs ranging from incipient disturbances to full-blown mature cyclones. Mother nature cooperated very nicely to provide many excellent IOPs. In fact, there were so many strong cyclones impacting Ireland during February that the Irish fishing industry was declared a disaster since the boats couldn't leave port due to high seas.

FASTEX was the first project to test “adaptive observing strategies” or targeting observations where numerical models indicate there would be a benefit to forecasts of cyclone development. A variety of new techniques were developed to guide the NOAA Gulfstream and Lear aircraft to suitable targets where they deployed the new GPS (Global Positioning System) dropsondes. These techniques included examining the spread of ensemble forecasts, error growth in adjoint models, and singular vectors. An example of forecast error sensitivity used to guide the G-IV aircraft is provided on the Naval Research Laboratory’s web

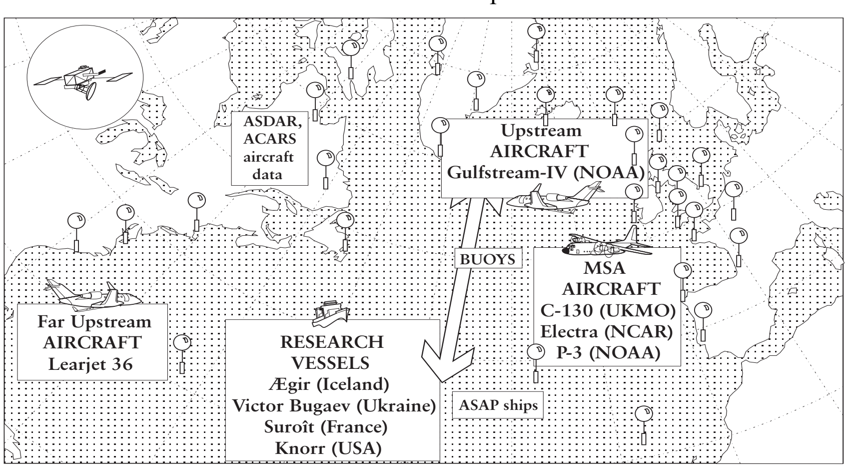


Figure 2: The FASTEX observing system

page at http://new.nrlmry.navy.mil/fastex.html. The dropsonde data was telemetered via satellite communications in near real-time to meteorological centers in several countries (including NOAA's National Centers for Environmental Prediction) so that they could be assimilated into synoptic analyses and model forecasts.

The scientific questions to be addressed in FASTEX are generic to oceanic storm tracks over both the Pacific and Atlantic oceans. The opportunity to follow FASTEX with an equivalent campaign in the eastern Pacific is also being discussed under the auspices of the US. Weather Research Program. ◆

For more information contact Dave Jorgensen at: davej@ncar.ucar.edu

Next Generation WDSS being planned

by Kurt Hondl

NSSL's Warning Decision Support System (WDSS) has been enhanced over the last 4-5 years, and new capabilities are continually being added as techniques are developed. The WDSS currently consists of a suite of algorithms run on the real-time WSR-88D Level II datastream and a graphical display system to view raw observational data and algorithm output.

The current WDSS was initially designed to handle only radar data and radar algorithm output. NSSL has worked to integrate other data sources into the system. However, there are some needed changes that can not be accommodated in the current software design of the WDSS. NSSL plans to address these needs in an upgraded "Next Generation WDSS" that will be developed over the next 1-2 years. The goal of the WDSS effort at NSSL is to test both display and algorithm concepts before they are implemented on either AWIPS or the WSR-88D.

One concept we want to test is how to integrate data from multiple WSR-88Ds into a single display system. This need is becoming increasingly evident as NSSL works with NWS Forecast Offices whose County Warning Area (CWA) of responsibility often includes an areal extent covered by multiple WSR-88Ds. There appears to be a large benefit to providing access to data from multiple radars in a single operational interface. This is not limited to mosaicing of radar images but also includes diagnosing storm characteristics from multiple radars that provide different viewing angles and coverage patterns.

Another identified need is to integrate data from other sensor platforms (GOES 8/9, lightning data, profiler, etc.) so that each data set is a complement to the system and allows the forecaster to use the data in the method for which it was developed. This can be complicated since each sensor has its unique coordinate system and requires coordinate transformation equations to be used when integrating the data into a common system.

There are also user interface requirements that will be addressed with the new display system. Surveys at current Proof-of-Concept test sites indicate that forecasters would like variable size windows, vertical cross sections, and the ability for each forecaster to configure the user interface and save the setup in a file. Other needs include streamlining current display features in the WDSS to provide loops, multi-panel displays, trends and tables and to automatically update these products as new data are obtained. NSSL will also be developing the capability to overlay new data fields, to merge various data fields, and possibly to view 3-D displays, as we work to determine better ways of staging and displaying information to forecasters in a warning situation.

Another goal of the next generation WDSS system is to provide the means to easily integrate new algorithms into the WDSS for testing. In addition, the development of the Open System Radar Products Generator (ORPG), described in the previous issue of *NSSL Briefings*, will allow greater access to the Level II datastream and WSR-88D algorithm output. Data from other operational datastreams will also be available through the Advanced Weather Interactive Processing System (AWIPS). NSSL will be working with the ORPG and AWIPS development teams to create Application Programmer Interface (API) modules that provide easy access to the operational datastreams. This will allow application developers to spend their efforts on the meteorological aspects of their applications rather than the complex issues dealing with data access.

This new software will provide an environment that will allow personnel from various research labs, universities, and the NWS to develop algorithms and applications on a WDSS-like platform. As new applications are developed and tested, they may be run in real-time on a local machine in the forecast office for further testing and validation. After validation, the applications may be implemented in operational systems. ◆

NSSL plans to address a range of needs in an upgraded "Next Generation WDSS" that will be developed over the next 1-2 years.

For more information contact Mike Eilts at: mike.eilts@noaa.gov

Employee spotlight

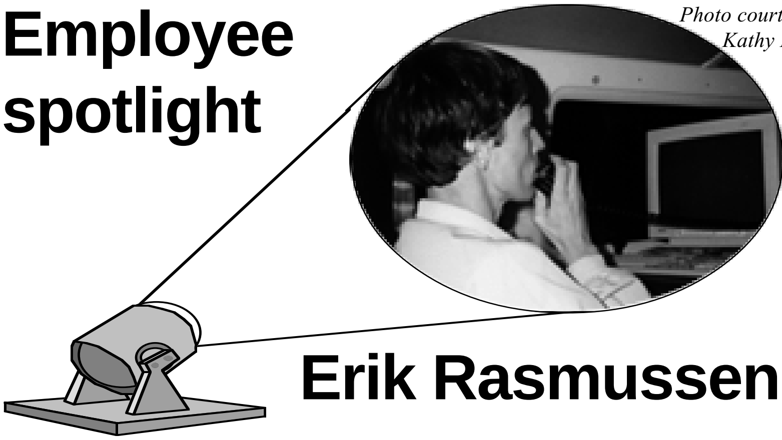


Photo courtesy of Kathy Kanak, OU

Erik Rasmussen

by Susan Cobb

Was it the grapefruit-sized hail he experienced as a child at his home in Kansas? Or the lightning bolt striking a nearby ham radio tower when he was a little boy? Mrs. Day in the second grade was an influence too. She not only taught him how to read and spell, but also let him maintain a weather chart in the classroom. By junior high Erik Rasmussen was plotting daily weather maps using observations from long-wave radio. In high school he was forecasting for his teachers. And when he got a car and a driver's license, he trained himself to be a storm chaser. Erik, a self-proclaimed "weather geek" says his fascination with meteorology "just happened."

Erik is a Research Scientist at the Cooperative Institute for Mesoscale Meteorology Studies (CIMMS) and has recently moved to Boulder, CO to join the NSSL-NCAR/ Mesoscale and Microscale Meteorology collaboration. He is probably most well known for being in charge of the VORTEX project, and Erik says VORTEX was his biggest success. "Looking back," Erik says, "It's easy to be a critic. But we ran a wonderful experiment with lots of good people working hard, lots of volunteers, and great data. It was done well and I'm proud of it." Erik already has a plan for the next VORTEX-type project, "except it's more of a micro-VORTEX," he says. "I would only have a few mobile mesonets, rather than a car dealership. I would have them (mobile mesonets) placed closer to the tornado, and I would have two Doppler-on-wheels." Erik says the VORTEX project collected enough data to refine their questions and to know where to look and what specifically to look for - "we don't need a shotgun approach."

Bio Box

Current position: *Research Scientist at CIMMS*

Current project: *Analyzing VORTEX data*

Education:

B.S. Meteorology, University of Oklahoma

M.S. Texas Tech

Additional graduate work at Illinois

Ph.D. Colorado State University

Most of Erik's time is spent analyzing the vast amounts of data from VORTEX. " I like to look at real data to learn new things," says Erik. He estimates that it will take 5 years to get through the "good stuff," and another 5 years to study it all. Erik is a very careful scientist. "We collected big and difficult data sets during VORTEX that contain wonderful secrets." The challenge for him is discovering those secrets and interpreting them without mistakes. Sometimes he gets the wrong answer. How does he know it's wrong? "Because I get a different answer the next day."

"A good observationist has to go out and look at the sky," he says, and maybe that explains why he admits to kicking off his shoes and running down a beach in a suit to take movies of a waterspout off-shore in Biloxi, Mississippi. Or why he was fascinated with tropical thunderstorms he experienced during four separate trips to Australia. Or the monsoon season in Asia - how it can pour rain for hours and it still be hot outside. Or maybe it was the lightning bolt that knocked him on his back a few years ago. "It explains a lot," says Erik.

Erik's family takes an interest in the weather too. His wife, Lisa Rasmussen, has a M.S. in Meteorology and is now a practicing pharmacist. Kyle (5) and Lindsay (3) beg their dad to go chase when he picks them up from school and day care. They go on safe "gentlemen's chases" Erik says. The kids yell "come on dust!" while waiting for something to develop. Erik's spare time is spent doing "family stuff." Since he and Lisa work staggered shifts, he and the kids cook dinner and spend their evenings doing arts and crafts (painting, drawing, making boats). On the weekend they go up to the mountains and cross-country ski, camp, or bike.

Erik knows he needs more balance in his life. But he says, "I want to know what makes tornadoes - it's an obsession - a great quest." He and collaborator Jerry Straka feel they have a pretty clear picture of what forms tornadoes. But Erik is careful to say that they need time to look at ALL of the data and confirm their hypothesis. And when this question is answered? "What makes storms!" is next. One of the first lessons learned from VORTEX, he says, is that it is much harder to forecast if convection will form and where, than what kind of weather it will contain. "My job is my passion - if I had free time it's what I 'd be doing." ◆

NSSL Cell Algorithm Output for Volume 98

CELLID	AZ	RAN	CIRC	BURST	SVRH	SIZE	HAIL	VIL	MAXZ	HT MXZ	BASE	TOP	DIR/SP	SREH	LTG	% +LTG	COUNTY
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20	73	79			0%	<1.00	10%	15	49	9	9	26	199/12	-13	0	0%	
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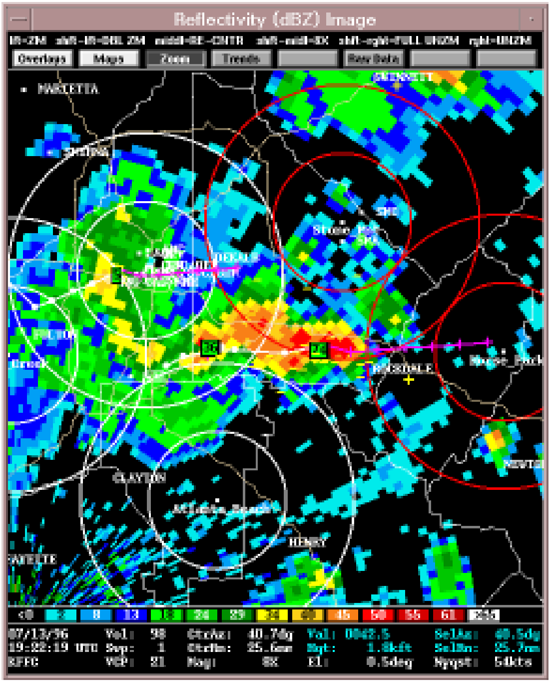


NSSL's WDSS display used for Olympic weather support during the 1996 Olympic Games in Atlanta. ***Top****: Cell Algorithm Output table which provides quick reference about various attributes of existing storms. The storms are listed in the table in order of strongest to weakest at the current time.* ***Bottom****: Radar reflectivity display of storms in the Atlanta area on July 13, 1996. Red and white rings are 5 and 10 miles around the Olympic "venue clusters." Green boxes with black numbers enclosed indicate storms that have been "identified" and are being tracked. The storm's past positions are shown with white dots (connected by a solid white line) and the forecasted positions are given by magenta cross-hairs (connected by a solid magenta line). In this example, storm "36" is moving toward the northeast through the southern portion of the Olympic Ring. Storm "74" is forecast to impact the Georgia International Horse Park in 20-30 minutes, and storm "5" is forecast to move through the heart of the Olympic Ring. Yellow "-" and "+" indicate the location of lightning strikes.*

NSSL's WDSS performs at the Olympics

by J.T. Johnson and Susan Cobb

Thunderstorms are scattered across the Atlanta metroplex on the night of August 4, 1996. The Atlanta Committee for the Olympic Games (ACOG), watching the *Weather Channel*, sees Atlanta's radar indicating thunderstorms around the downtown area near the Olympic Stadium, where the closing ceremonies for the 1996 Summer Olympic Games are scheduled to begin in one hour. The ACOG is facing its worse nightmare... thousands of people flocking to the stadium to experience the grand finale of two weeks of Olympic competition - now under the threat of postponement due to weather. Repeated calls are made by ACOG to the NWS Olympic Weather Support Office (OWSO). Using NSSL's Warning Decision Support System (WDSS), forecasters at the OWSO stand by their forecast of no thunderstorms impacting the closing ceremonies.

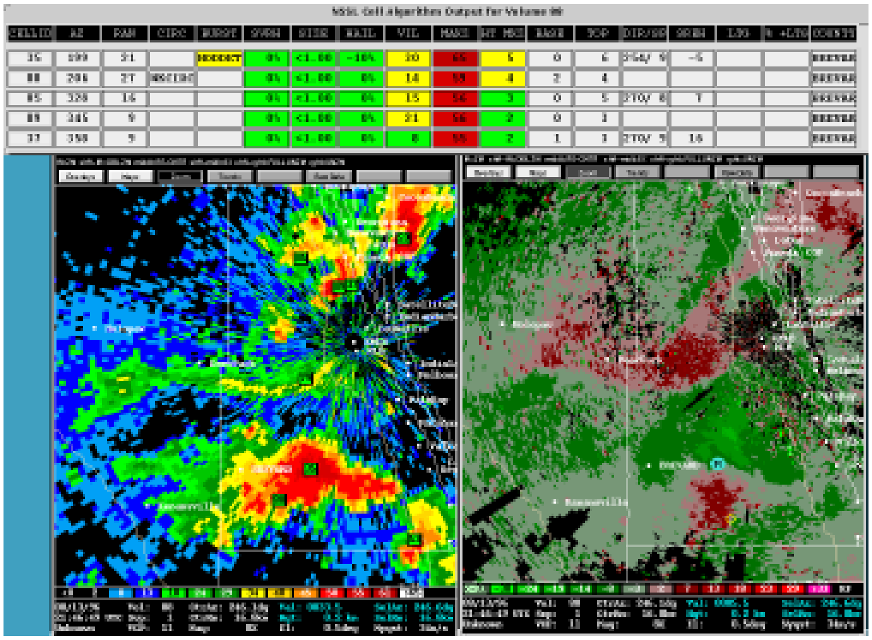
During the 1996 Summer Olympics, the WDSS was used exclusively as the radar and lightning display in the OWSO and the Olympic Marine Weather Support Office in Savannah, GA. In addition to predicting and warning for Georgia's stormy weather, the OWSO forecasters were challenged with additional strict warning criteria. These criteria, developed by the NWS and ACOG, were developed to keep the athletes, officials, and spectators safe during the Games. For example, the Olympic Aquatic Center required warnings for winds greater than 20 mph so divers would not be on the board during high winds.

The WDSS was considered a useful tool by the forecasters of the Olympic weather support operations. They felt that some of the most valuable characteristics of the WDSS were its ability to provide general and detailed information on storm motion, to examine storm initiation, growth and decay, and to predict lightning.

By 9 PM, as forecast, the storms over the Atlanta area completely dissipated. A storm to the south of Atlanta had produced a cool outflow that suppressed additional storm development. The WDSS's capability to integrate various data sources helped tremendously in making this forecast and contributed to the OWSO's confidence that the it would verify. The Closing Ceremonies took place on schedule with no weather problems, bringing the 1996 Summer Olympics to a spectacular close. ◆

During the 1996 Summer Olympic Games, the WDSS was used exclusively as the radar and lightning display in the OWSO.

For more information contact Mike Eilts at: mike.eilts@noaa.gov



Microburst detection (blue circle with "M" on velocity display) by NSSL's Damaging Downburst Prediction and Detection Algorithm (DDPDA) from the Melbourne WSR-88D. This was one of several detections produced during the August 1996 Proof-of-Concept Test.

NASA evaluates WDSS for potential launch support

by Bill Conway

NSSL's WDSS was evaluated by NASA last summer on its ability to predict, detect, and track thunderstorm hazards

Thunderstorms are reported on the east coast of Florida at the Kennedy Space Center (KSC) on over one-half of the days during the summer. This presents a challenge for forecasters as strict weather criteria are used at KSC for daily operations as well as for various stages of space shuttle launches and landings. Launch commit criteria include an absence of thundershowers and lightning within 10 NM of the launch site. The NASA Applied Meteorology Unit (AMU) is currently looking at ways to accurately detect and track hazardous features including thunderstorms, sea breeze fronts, outflow boundaries, and lightning. NSSL's Warning Decision Support System (WDSS) is one system that was evaluated by NASA last summer to identify these hazards.

NASA's Applied Meteorology Unit

New meteorological technologies including data sources, algorithms, and display systems are evaluated for NASA by the Applied Meteorology Unit (AMU). The AMU consists of a group of scientists located at Cape Canaveral Air Station (CCAS) and operational forecasters at the Melbourne Florida National Weather Service Office (MLB NWSO). The AMU provides recommendations to NASA on which platforms should be implemented for mission support. As a result, new systems evaluated by the AMU are examined off-line in addition to facing the rigors of real-time testing.

The evaluation of NSSL's WDSS

With funding supplied by NASA, the AMU is leading the evaluation of NSSL's WDSS, in collaboration with the 45th Weather Squadron (which provides space vehicle launch forecasts, secondary shuttle landing support, and NASA ground operations support). This evaluation included a Proof-of-Concept Test during August, 1996 at the MLB NWSO. This test was part of a continuing effort by NSSL to test severe weather detection and prediction algorithms, and display concepts during actual NWS operations. The primary goals of this test were to

- evaluate the skill and operational utility of NSSL's Doppler radar-based algorithms in the Florida summertime environment for real-time NWS operations
- determine their potential to provide support of NASA missions
- gain feedback from the MLB/NWSO meteorologists on the utility and the effectiveness of NSSL's WDSS
- foster collaboration between NSSL scientists, MLB/NWSO meteorologists, the AMU, and the 45th Weather Squadron in the enhancement of the WDSS
- examine the feasibility of transferring this technology to NASA meteorological support operations.

Florida's weather

Florida's wet season (May - October) is characterized by moderate-to-high instability with weak atmospheric dynamics and an occasional tropical storm. Thunderstorms are reported over one half of the days during the summer. The seabreeze and thunderstorm outflow boundaries cause the majority of the convective initiation. The problematic (non-hurricane) areas in this regime are damaging downbursts, isolated severe hail events, brief tornadic spinups along colliding boundaries, and lightning.

The NSSL algorithms tested in Melbourne include the Hail Detection Algorithm (HDA), Storm Cell Identification and Tracking (SCIT) algorithm, Damaging Downburst Prediction and Detection Algorithm (DDPDA), Mesocyclone Detection Algorithm (MDA) and the Tornado Detection Algorithm (TDA). During the August test period, the HDA, SCIT, and DDPDA outputs were examined extensively in real-time during convective weather situations. Preliminary results show that HDA typically overestimated hail size and probability, although forecasters found the large hail false alarms to be quite useful in assessing overall storm strength if this bias was taken into account. The DDPDA produced numerous valid downburst predictions and detections, but also produced a number of false alarms. Because of the weak dynamical nature of the tornadic situations, the MDA and TDA were not significantly challenged.

NSSL will continue examination of the WDSS successes and failures in Florida in order to address this type of convective regime. In the longer term NSSL is hopeful this feasibility test will foster additional collaborations addressing the unique needs of NASA mission support as well as Melbourne NWS forecasters. ◆

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Update on NSSL-SPC interactions

The move of the Storm Prediction Center (SPC) into the NSSL building has brought new opportunities for close interactions between researchers and operational forecasters interested in hazardous weather. The Mesoscale Applications Group (MAG) leads the NSSL effort with SPC. "We're excited about having SPC here, because their forecasts will provide interesting research problems on a daily basis," said Harold Brooks, head of MAG.

As it moves to Norman, SPC's mission is being expanded from forecasting severe thunderstorms and tornadoes to include hazardous winter weather and flash flooding. These added areas have provided the bulk of research focus for MAG.

MAG researchers are producing climatologies for the new forecast hazards in order to provide baselines for SPC forecasters. In addition, they have worked with SPC staff to develop a winter weather "composite chart," where a variety of atmospheric parameters can be plotted on one map, helping focus forecasters' attention on important regions and hazards.

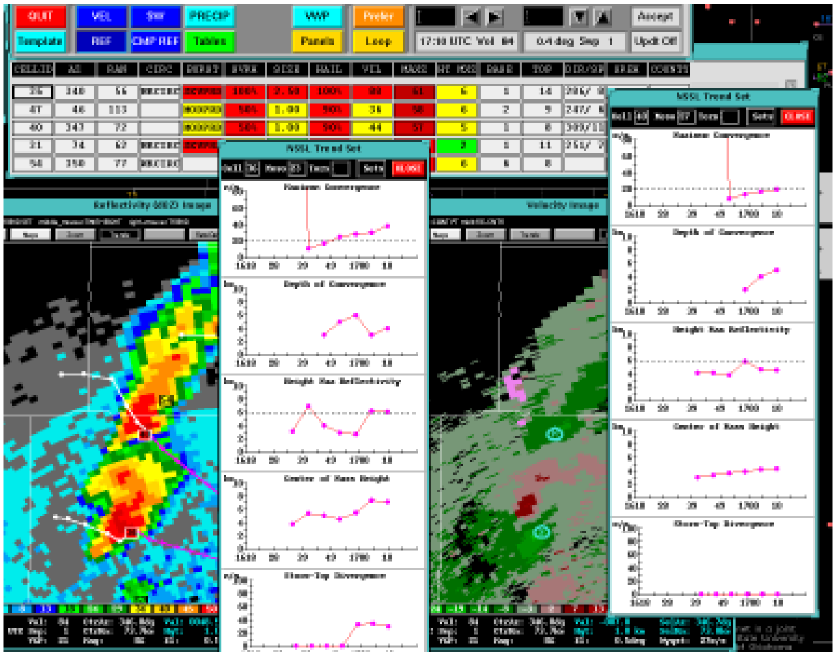
During the winter of 1995-6, MAG and SPC staff collaborated to participate in a winter weather forecasting experiment. The experiment tested techniques and formats for the winter hazards forecasting that SPC will have to carry out operationally starting late in 1997. Bob Johns, Science and Operations Officer (SOO) of SPC, said, "The experiment helped a lot to shake out problems in the system and taught us a lot about where we are." A follow-up experiment in 1996-7 will further test those techniques and the implementation of an anticipated suite of products.

Now that SPC staff and operations are moved to Norman, the next step in the collaboration will take place. MAG personnel will be trained as operational forecasters and will spend part of the time on shift work, putting out operational products alongside SPC forecasters. One of the side benefits of this is that it will allow SPC staff to have part of their time set aside to work with MAG personnel on research problems. "We look forward to having MAG helping on shifts. It will help our forecasters apply results from research to their forecasts and help them study important forecast problems," said Gary Grice, Deputy Director of SPC. ◆

For more information contact Harold Brooks at: brooks@nssl.noaa.gov

"We're excited about having the SPC here because their forecasts will provide interesting research problems on a daily basis"

- Harold Brooks



Trends of downburst precursors for two cells. Cell # 36 (southern cell) produced a severe downburst, while cell #40 (middle cell) had no verifiable damage.

NSSL algorithm predicts onset of damaging winds

by Travis Smith

Damaging straight-line wind events cause many millions of dollars of property damage each year. These events are typically short-lived and present a challenge for forecasters who must warn the public of these phenomena. There are presently no algorithms in the WSR-88D system which give users guidance for straight-line damaging wind events. Small airports which are not served by a Terminal Doppler Weather Radar (TDWR) also receive little warning of these wind shear events. NSSL is developing a Damaging Downburst Prediction and Detection Algorithm (DDPDA) with support of the WSR-88D Operational Support Facility to help fill this gap. This algorithm, when fielded, will provide useful information to forecasters making warning decisions. It also has potential utility at Department of Defense sites and for the aviation industry.

The current version of the DDPDA predicts the onset of damaging surface winds about 80% of the time with a five to ten minute advance warning

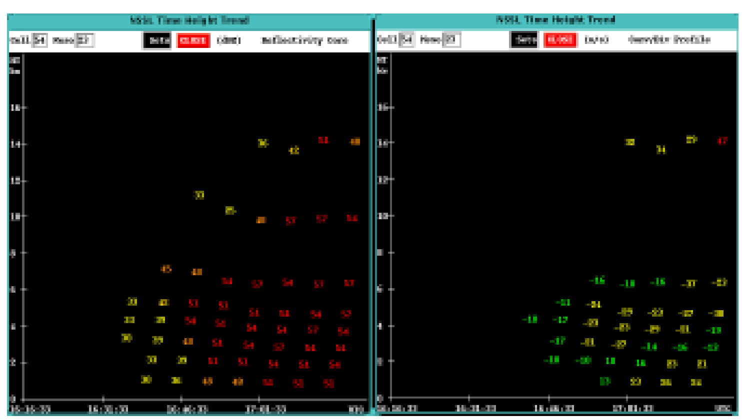
The DDPDA scans through Doppler radar data in an attempt to locate downburst precursors -- events which may precede the onset of strong winds at the surface. Downburst precursors which give a strong predictive signal include an elevated high-reflectivity core which rapidly descends in time and strong mid-altitude convergence into the storm cell. These events can be detected in a storm cell using reflectivity and radial velocity data from a WSR-88D.

The current version of the DDPDA predicts the onset of damaging surface winds about 80% of the time, usually with a five-to-ten minute advance warning when compared with radar signatures of downbursts. In addition to the algorithm's predictive component, it is also capable of detecting downburst signatures within about 40-70 km of the radar. After the algorithm has detected a downburst, it is usually too late to issue a warning to the public, but the information may still be useful for aviators.

Both downburst predictions and detections are displayed using NSSL's Radar Algorithm Display System (RADS). The display shows expected outflow intensities from various storm cells. Valuable information is shown to forecasters, including trends and time-height trends of important precursors.

We are adding environmental sounding data into future versions of the algorithm in an effort to increase prediction lead-time and reduce false alarms. We also hope to broaden the scope of damaging wind prediction capabilities to include bow echoes and other larger scale damaging wind-producing phenomena as well. We expect it will take about a year of development before the algorithm will be sufficiently mature to evaluate for implementation into the WSR-88D baseline. ◆

For more information contact Mike Eilts at: mike.eilts@noaa.gov



Time-height trends of maximum reflectivity and convergence for a downburst producing cell

Going after ground truth - Part I

by Jeanne M. Schneider

Any scientist interested in predicting the state of the atmosphere needs to have a handle on the forces and fluxes that drive atmospheric evolution. And while our focus is on the sky, one of these controlling factors is the amount of water available at the ground surface and in the soil near the surface. It's true -- you need to look below your feet and find out how wet it is, and how warm it is, whether you want to predict severe weather or climate change.

Until recently, the only atmospheric scientists who paid attention to soil conditions were those involved in micrometeorology, studying water, heat, and carbon exchanges across vegetation canopies. This has changed. Now mesoscale meteorologists, hydrometeorologists, and everyone predicting the water budget over climatic time scales are including the effects of soil water and temperature in their models of the atmosphere. Unfortunately, such data has been scarce, or existing in isolation, without collocated data on the other significant land-atmosphere driving forces such as atmospheric radiation. So scientists became quite excited in October 1993 when they learned of the development of an extensive atmospheric observing facility in Oklahoma and Kansas, which needed *only* the addition of profiles of soil water and temperature sensors to make it nearly ideal for their purposes. What has evolved since then is a story of cross-discipline, cross-program, cross-agency collaboration resulting in two scientists digging holes and installing soil water sensors across Oklahoma and Kansas.

The details of this collaboration go like this. The observing facility is the Southern Great Plains Cloud and Radiation Testbed Site (SGP CART Site), operated by the Department of Energy's Atmospheric Radiation Measurement (ARM) Program. The SGP Site will include at least 21 surface observing stations scattered over about 90,000 square kilometers (see Figure 1), which measure visible and infrared radiation, standard meteorological variables (temperature, humidity, wind, pressure), and turbulent fluxes of heat and moisture. The ARM Program is supporting the cost of adapting its sites to support the new soil water and temperature sensors. Ken Fisher and I are designing, calibrating, installing, and managing the new field sites. Ken is an engineer from the Biosystems and Agricultural Engineering Department at Oklahoma State University and was responsible for the weighing lysimeters and leaf- wetness sensors in the Oklahoma Mesonet. He is now a postdoctoral research associate at the Cooperative Institute for Mesoscale Meteorological Studies (CIMMS) at the University of Oklahoma. We're formally collaborating with both the Oklahoma Mesonet and the USDA/ARS soil scientists at El Reno who monitor the Little Washita Watershed in south-central Oklahoma. We're all instrumenting our networks with identical sensors and are sharing information on calibration, installation, and data quality issues as we work.

When all is in the ground, we will have something unique: continuous data on the profiles of soil water and temperature, from three collocated networks that also observe the atmosphere, resolving three different physical scales (Figure 2). Such data should produce new "under"standing of the water and energy fluxes driving the atmosphere. ◆

(Part II will describe the soil water and temperature sensing systems and calibration and installation procedures and show examples of data.)

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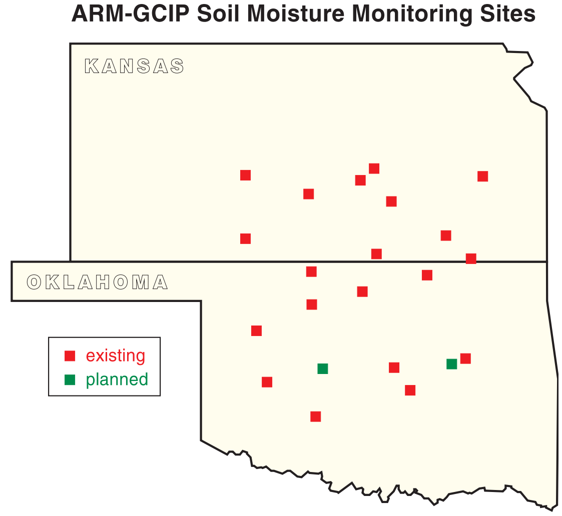

Figure 1: The SGP Site will include at least 21 surface observing stations scattered over about 90,000 square kilometers

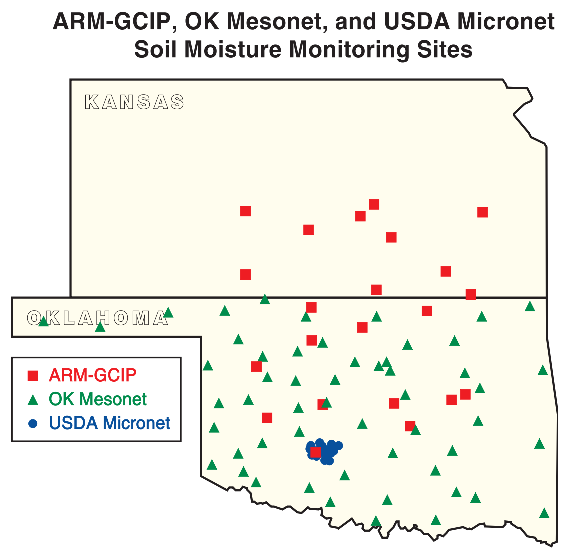

Figure 2: The three collocated networks

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SRAD aims to improve short-term predictions and warnings of hazardous weather

Mike Eilts
SRAD Chief

The SRAD mission is: "to perform research to gain understanding of severe thunderstorms and hazardous weather, to complete applied research to understand their signatures in observational data, and to develop and transfer applications, techniques, and new scientific understanding to the NWS and our other customers to enhance their capability to provide short-term predictions and warnings of hazardous weather."

NSSL is organizationally broken into two large scientific divisions and an administrative division. The two scientific divisions are called the Stormscale Research and Applications Division (SRAD) and the Mesoscale Research and Applications Division (MRAD). In this issue, I have been given the opportunity by the executive editor of *NSSL Briefings* to showcase SRAD.

SRAD has two teams who mainly focus on longer-term mission-critical research. The Thunderstorm Studies Team recently performed the two-year field phase of the Verification of the Origins of Tornadoes Experiment (VORTEX), and it is now heavily involved with analysis of the data collected. The Doppler Radar and Remote Sensing Research Team is working hard towards implementing dual-polarization on the Research and Development WSR-88D that was recently given to NSSL by the NWS and performing research to extract the most from dual-polarization data. Its goal is to complete an operational demonstration of the dual-polarization capability in the Norman NWS/WFO in 2000/2001 time frame.

In the past 2 years, we have ramped up another activity, funded by the NWS, to rehost the WSR-88D Radar Products Generator (RPG) to an open systems computing environment. The "Re-Host Team" plans to deliver a functional prototype, equivalent to RPG Build 10, to the WSR-88D Operational Support Facility by the summer of 1998 for implementation in the field.

Two other teams are focused on completing applied research and developing algorithms to help forecasters and other users make better warning and short-term prediction decisions. The Severe Weather Warning Algorithm and Technology Transfer Team (SWAT) has developed five algorithms: Storm Cell Identification and Tracking (SCIT), Hail Detection (HDA), Tornado Detection (TDA), Mesocyclone Detection (MDA), and a newer Damaging Downburst Prediction and Detection (DDPDA) which are being developed to meet both NWS and FAA needs. One important milestone was achieved this past year when we successfully transitioned the SCIT and HDA to the WSR-88D system in Build 9. The TDA is expected to be part of Build 10. A new team that has been recently formed within SRAD is a Data Integration Team. Their mission is to complete applied research and develop applications using all operationally-available data streams that help forecasters warn of, and short-term predict, severe and hazardous weather. Their first prototype algorithm uses GOES 8/9 data to calculate cloud-top temperature trends for each storm cell identified on radar.

Finally, another team called Real-time Assessment, Prototyping and Idea Development (RAPID) manages our WDSS sites, interacts with NWS SOO's and our other customers to generate ideas and to determine customer needs that can be met using SRADs expertise and knowledge base. We are all excited about the advances we have made in the past couple of years in both understanding of severe weather phenomena and in the applications and tools for the forecaster we have developed. In the coming years we will work hard to transition the prototype applications and display concepts we have developed, as well as the knowledge we have gained in VORTEX, to the NWS. We will continue to develop and test new integrated data applications and analyze new exciting data all in our quest to enhance the nation's capability to warn and predict of hazardous weather. ◆