Appendix of Abstracts

Abstracts are in alphabetical order by first author's last name.
Affiliation of first author is listed.
Missing abstracts: Pete Browning, Ted Funk, Morris Weisman

Atkins, Nolan – Lyndon State College

Can We Discriminate Between Damaging and Non-damaging Mesovortices within Bow Echoes?

Recent observational studies have suggested that there may be structural differences in the evolution of damaging and non-damaging mesovortices formed within bow echoes. In this presentation, these differences will be discussed. The detection and warning implications will also be presented.

Auten, James, Pat Bak, and Ernest Goetsch – National Weather Service Central Illinois

Discussion of the April 2nd 2006 Tornado Producing Quasi-Linear Convective System (QLCS) over Central Illinois and Comparison with Previous Work on WSR-88D Radar Signatures of F0 and F1 Tornadoes

On April 2nd 2006, a major quasi-linear convective system (QLCS) over the Central Illinois WSFO warning area produced 26 tornadoes. All tornadoes, but one, were rates as weak tornadoes (F0 or F1 on the Fujita scale). WSR-88D signatures associated with these tornadoes were examined and compared to radar signatures seen in the F0 and F1 Central Illinois tornadoes during the record setting 2003 tornado season (Auten and Goetsch, 2005).

In addition, an analysis of a rare storm chaser video combined with radar data was done for a series of tornadoes produced by the QLCS near Springfield, IL. Tornado development was observed from a rotating wall cloud seen on the forward edge of the approaching QLCS. This location is contrary to most conceptual models on QLCS structure and most training observations taught to spotter groups.

Coleman, Tim – University of Alabama-Huntsville

Propagation Modes for QLCS's: Gravity Waves, Density Currents, and Bores

The generally-accepted theory for years has been that most quasi-linear convective systems (QLCS's) move due to the motion of the density current of cold air created by the convective downdrafts and associated melting and evaporation. This is indeed the case with many QLCS's.

However, as will be shown, other atmospheric processes may be linked to the movement of some QLCS's. The process through which a convective system and a gravity wave move together, with the heating associated with the convection maintaining the gravity wave and the gravity wave organizing the convection, is known as wave-

CISK, and has been discussed by many authors (eg., Raymond 1975). In these cases, QLCS's move according to the phase speed of the wave.

Also, some convective lines are associated with undular bores. Such bores are simply hydraulic jumps associated with a stable layer near the surface. The lifting created by the hydraulic jump may initiate convection, and the associated convection moves at the bore speed, as given by Rottman and Simpson (1989), and Knupp (2006).

Cases of QLCS's propagating along density currents, bores, and through wave-CISK, will be presented using radar, 915-MHz profiler, ceilometer, and microwave profiling radiometer (MPR) data.

DiStefano, John – National Weather Service Wilmington, Ohio

Tornadogenesis Observed on a Developing Bow Echo Complex over Southwest Ohio on 2 July 1997

During the late afternoon and early evening hours on July 2, 1997, the environment across the Ohio valley was categorized by strong-to-extreme instability and moderate shear. Strong convection developed in associated with a weak frontal boundary over northern Indiana, and moved southeast into southwest Ohio. Storm mergers helped initiate a line of convection which soon developed into a bow echo complex. This study will focus on a short-lived F2 tornado that developed on this bow echo.

Dowling, Tim – University of Louisville

Severe Weather on Jupiter and Saturn

It is instructive to view Earth's severe weather in the context of all the atmospheres in the Solar System. Of the twelve active systems, Earth's stands out in a number of unexpected ways. For example, it receives the most energy from the Sun (even more than Venus) and yet it exhibits the weakest zonal winds, it has arguably the most unpredictable weather, and certainly has the most complicated boundary conditions. So, how does severe weather on Jupiter and Saturn compare? We will review the latest observations and modeling in giant-planet storm systems, including a Category '15' cyclone recently discovered at Saturn's south pole, a second large Red Spot on Jupiter, and superbolt lightning, with an eye towards some jovial comparative planetology.

Elkins, Calvin – University of Alabama-Huntsville

Analysis of the 9 March 2006 Huntsville Bow Echo

On 9 March 2006, a severe cold season squall line formed over Louisiana and intensified near the Mississippi (MS)/Alabama (AL) border, where it assumed a bow echo configuration and produced a long swath of damaging winds from eastern MS to northern AL. This paper looks at the inception of the original squall line, a synoptic overview of the situation and investigates the late mature stages of this bow echo over northern Alabama, using Doppler radar data from the UAH (C-band dual polarization) Advanced Radar for Meteorological and Operational Research (ARMOR), combined with the Hytop WSR-88D radar (KHTX), located 65 km ENE of the ARMOR. As the bow echo approached the Huntsville region, a break in the squall line occurred in the vicinity of the apex that formed over eastern MS, dividing it into distinct northern and southern segments. As the squall line moved on, the different segments developed distinct kinematic features and, therefore, behaved in different ways.

The evolution of this break is examined with single-Doppler data. Data collection begins at 22:40Z from ARMOR as the storm is approaching (west-southwest of) the Huntsville region. Dual Doppler analyses using ARMOR and KHTX are performed on the squall line after the break from 23:20Z to 00:15Z. These analyses reveal the different kinematic features between the northern and southern segments. Single Doppler analyses applying the synthetic dual Doppler technique to the KHTX data are then applied to examine the late mature phase of the squall line between 23:54Z and 00:32Z, and compare the kinematic features to those analyzed over eastern MS two hours earlier. ARMOR is a dual-polarization radar, therefore analysis is also done on precipitation characteristics. These characteristics shed insight on the dynamic processes occurring in both the convective and stratiform regions of the system. Throughout the analysis process, special attention is given to the kinematics, characteristics and structure of the break.

Hultquist, Thomas, Jennifer L. Lee, and Matthew Zika – National Weather Service Marquette

The 21 July 2002 Upper Michigan Bow Echo Event. Part I: Observational Analysis

During the afternoon of 21 July 2002 a high precipitation supercell formed over western Upper Michigan in a high CAPE/moderate shear environment. This supercell evolved into a bow echo as it moved into central Upper Michigan, grew upscale, and subsequently developed book end vortices and a rear inflow jet. Smaller scale mesovortices were also observed in the radar data, and these features were co-located with the most significant observed damage. The issuance of effective warnings for this event was compounded by the fact that the Marquette WSR-88D experienced technical problems and was inoperable for approximately 25 minutes during the time when the storm underwent the supercell to bow echo transition.

A case study of the event will be presented. The review will focus on atmospheric signals regarding expected convective mode and evolution, and will also include a detailed analysis of radar data at key points during the event. A comparison of observed damage locations and corresponding radar features will be shown, focusing on the relationship between mesovortices and localized areas of enhanced damage.

Hultquist, Thomas, Jennifer L. Lee, and Matthew Zika – National Weather Service Marquette

The 21 July 2002 Upper Michigan Bow Echo Event. Part II: High Resolution Numerical Modeling

Output from a high resolution (5 km horizontal grid spacing) numerical model (WRF-ARW) will be presented to show whether such information could have been used effectively by forecasters prior to the Upper Michigan bow echo event of 21 July 2002. The model configuration is nearly identical to a high resolution nested model currently being used operationally at the NWS in Marquette. Such models, run at resolutions which marginally allow for the convective parameterization schemes to be turned off, are now being run in many forecast offices in an effort to provide forecasters with information on potential convective initiation, mode, and evolution.

A very high resolution (1 km horizontal grid spacing) numerical model simulation was also conducted to further investigate the bow echo event. Although it is not currently possible for such output to be made available to forecasters in real-time, analysis of the simulation does offer further insight into the ability to anticipate the possible storm scale structure and evolution of convective systems from a numerical modeling perspective. In addition, such an analysis provides a cursory glimpse into the future potential of visions such as “Warn on Forecast”.

Jewett, Brian F., Robert Rauber, Greg McFarquhar, Joe Grim, Bryan Guarante, Andrea Smith, Mike Timlin and Dave Jorgensen – University of Illinois-Champaign
Observation and Modeling of Mesoscale Convective Systems: What We Have Learned from BAMEX

In 2003, PIs and students from the University of Illinois took part in the Bow Echo and MCV Experiment (BAMEX). Our primary observation platform was the NOAA P-3 aircraft, which was tasked to probe behind developing and mature mesoscale convective systems (MCSs) and collect in-situ microphysical and Doppler radar data, often in close cooperation with the Naval Research Laboratory (NRL) P3 flying ahead of each MCS. This talk will summarize our findings to date, including published and ongoing research of: microphysical observations from P3 spiral descents, their analysis, relationship to radar-documented structure and implications for MCS downdrafts; selected studies of rear-inflow jet (RIJ) and bow echo evolution; careful intercomparison of 10 June airborne Doppler and microphysical measurements and high-resolution WRF model results; idealized studies relating MCS evolution to cooling processes; and the relationship between documented severe surface winds and MCS structure and evolution.

Knopfmeier, Kent, Robert J. Trapp, and Dustan M. Wheatley – Purdue University
Real-data and Idealized Simulations of the 4 July 2004 Bow Echo Event

During the morning hours of 4 July 2004, an intense, long-lived bow echo produced a swath of straight-line wind damage and an F1 tornado along its path from southeastern Kansas through northern Alabama. Level II radar observations from the Springfield, MO (KSGF) Doppler Radar revealed that the system contained a strong rear-inflow jet and a low-level mesovortex. These observations also captured the interaction between the bow echo and an externally produced outflow boundary. The dynamics of this interaction are of particular interest, and are examined using the Weather Research and Forecasting (WRF) model in both a real-data and idealized framework.

The real-data WRF simulation successfully represents the formation of the bow echo as well as the external outflow boundary. An interaction is also simulated, as is a modest low-level mesovortex. The extent with which these two processes are related is analyzed in two different ways. The first is through traditional diagnoses of the real-data WRF output. The second is through an idealized WRF simulation, which is based on a pre-convective sounding extracted from the real-data simulation.

Knupp, Kevin, and Calvin Elkins – University of Alabama-Huntsville

Cold-Season Bow Echoes and QLCS's: Research Activities at UAH

This presentation will include an overview of current and future research activities on cold-season bow echoes and QLCS's. The Huntsville Hazardous Weather Testbed has emerged as a world class observational facility that is being utilized to conduct research on all types of severe local storms. Measurement capabilities include multiple Doppler with 2-4 Doppler radars, dual polarization measurements at C- and X-band, comprehensive profiling instruments, and total lightning from a lightning mapping array. These remote sensing instruments are complimented by surface instrumentation, including 2 Parcival disdrometers and standard meteorological measurements. This talk will also present an overview of the types of observational analyses that are being conducted to better understand the dynamical and precipitation processes associated with cold-season QLCS's.

Lese, Angela – National Weather Service Louisville

A Case of a Supposed Stable Environment and a Severe/Tornadic QLCS

It is often assumed that convection occurring during the typical overnight hours would tend to be "elevated," meaning unable to mix severe winds down to the surface because of the stable or decoupled boundary layer. This is a general misconception held by many operational meteorologists within the National Weather Service. It is imperative to analyze near-storm environmental soundings, especially in the lowest layers, to determine confidently whether or not convection would be completely elevated. Examination of routine upper-air soundings, model analysis and forecast soundings, other real-time environmental soundings (i.e., Aircraft Communications Addressing and Reporting System, or ACARS), and all surface observations sites is essential, and should yield a concrete data set from which to forecast severe convective potential.

What happens when constant analysis of real-time ACARS soundings indicates an elevated environment, yet a severe and tornadic QLCS occurred? That scenario took place during the early morning hours on 2 May 2006 across central Kentucky. Studying the ACARS soundings from Louisville International Airport (SDF) ahead of the QLCS generally indicated that a stable environment was in place across central Kentucky. However, closer analysis of the soundings and surface data indicate that a potential for severe winds mixing down to the surface existed, despite a stable boundary layer. Radar data and near-storm environmental data will be examined, and suggestions for appropriate overnight environmental analyses will be made.

Logsdon, Jeffrey – National Weather Service Northern Indiana

The 24 October 2001 Tornado Outbreak

The second largest tornado outbreak on record occurred on 24 October 2001 over the Northern Indiana National Weather Service County Warning Area (CWA) which covers northern Indiana, southwest lower Michigan and northwest Ohio. Ten distinct tornadoes touched down, including two rated F3 on the Fujita scale. This tied with the

Palm Sunday Outbreak of April 1965 and only the Super Outbreak of April 1974 rates higher in the number of tornadoes for this area.

Although the pattern was more reminiscent of early spring and a rare occurrence for late October, nearly ideal atmospheric conditions were in place for the development of severe weather. The synoptic pattern on 1200 UTC 24 October 2001 showed a surface low over northern Minnesota with a 500mb closed low over North Dakota. An intense cold front extended south from the low across Wisconsin, western Illinois and central Missouri down to a second low over the northeast corner of Oklahoma. The special 1800 UTC sounding taken at Lincoln Illinois (ILN) indicated a 65kt low-level jet at 700mb over east-central Illinois. The 0000 UTC sounding from Detroit revealed a moderately unstable and weakly capped atmosphere with CAPE = 1000J/kg and LI = -6. By 0000 UTC 25 October 2001, the 500mb low had deepened and become negatively tilted as it moved into eastern Minnesota. This resulted in height falls in excess of 100m over the CWA and the nose of a 100+kt jet pushing into the region. This further de-stabilized the atmosphere over the area during the afternoon hours as the surface cold front surged into the area.

By 1900 UTC 24 October 2001, a squall line had formed along the cold front from northeast Illinois down through southwest Missouri. Analysis of surface observations showed a mesoscale low had formed along the cold front near Champaign Illinois at 1800 UTC, which intensified as it moved into western Indiana. This caused an increase and backing of the surface winds near the squall line which significantly increased the low level shear and storm relative helicity and provided a favorable environment for tornado development within the squall line. As the northern end of the squall line moved into northwest Indiana, a Line Echo Wave Pattern (LEWP) formed consisting of two strong bow echoes with strong cyclonic shear just north of the apex. The resulting tornadogenesis occurred just northwest of the apex of the bow echoes in the southeast portion of the comma head. One additional tornado occurred later over northwest Ohio as the squall line merged with a minisupercell which had formed out ahead of the squall line. This paper will present a detailed analysis of radar data and near-storm environment data to explain the structure of the storms that produced the tornadoes and suggest operational "best practices" learned from this event in identifying potential tornadic storms that are embedded within a squall line.

Przybylinski, Ron and James E. Sieveking – National Weather Service St. Louis

A Preliminary Assessment of the Environment and Reflectivity Characteristics of the 19 July 2006 Derecho over Illinois and Missouri

One of the most damaging wind storm events ever recorded over the Mid-Mississippi River Valley Region occurred during the late afternoon and evening of 19 July 2006. Severe wind gusts resulted in numerous trees and large limb damage, along with structural damage to many homes and businesses across the Greater St. Louis metropolitan area. The city of St. Louis and surrounding suburbs suffered historic power outages. Over half of a million homes and businesses were left without power, and many people of the region suffered for up to seven days through unbearable heat and humidity with no means to cool their homes. Detailed ground surveys revealed widespread wind damage with embedded intense cores of tree and structural damage, suggesting the presence of strong microbursts exceeding 40 ms^{-1}. Two weak and short-lived tornadoes also occurred over southwest Illinois.

At 1800 UTC on 19 April 2006, a weak surface boundary extended east-southeast from an area of low pressure over northeast Nebraska through south-central Iowa. An axis of mid 70 degree surface dewpoints extended from northwest through southeast Iowa, along and north of the surface boundary, and then south across the eastern half of Missouri and far western Illinois. The near storm environment at this time was characterized as being strongly unstable with MLCAPEs exceeding 4000 Jkg^{-1} with magnitudes of surface-based CIN ranging from -75 to -100 Jkg^{-1} over central and southern Illinois and eastern Missouri. Magnitudes of 0-3 and 0-6 km bulk shear values from the Winchester, Illinois profiler at 1800 UTC were 9 and 15 ms^{-1} respectively, suggesting the presence of weak to moderate shear.

A cluster of strong thunderstorms formed over parts of south-central Minnesota and moved southeast into northeast Iowa during the late morning of 19 July 2006. The thunderstorms took on the shape of a small bowing segment over northeast Iowa and moved southeast across the Quad City, Illinois area and then southward through central Illinois after 2100 UTC. As the MCS moved across central Illinois through east-central Missouri the primary convective mode was multi-cell evolution with new reflectivity cores developing downshear from the mature cores.

An overview of the near-storm environment and radar analysis of the 19 July 2006 derecho event will be presented. We will attempt to explain why the convective system moved nearly southward across central Illinois, and then turned south-southwestward across east and south-central Missouri. We will show that the leading edge of the storm's outflow accelerated as much as 15 to 20 km downshear from the higher reflectivity cores and produced surface wind gusts of 20 to 25 ms^{-1}. This presentation will also reveal that the system not only exhibited nearly classic multi-cell evolution, but through damage assessment information, show that the stronger winds were associated with higher reflectivity cores several kilometers behind the initial gust front. Another interesting aspect to this event was the presence of weak and shallow rotation near the eastern end of the storm complex. We will show that this region of cyclonic shear was linked to the brief tornado touchdowns over southern Macoupin and central Madison counties in southwest Illinois.

Roche, Andy - National Weather Service Charleston, West Virginia

Exploring a New Approach to Improving Severe Weather Warning Lead Times Using GFE

Several dynamic and thermodynamic parameters describing the state of the atmosphere conducive to the formation of severe thunderstorms are available from observations and numerical prediction sources. Other composite parameters have been developed and refined at the Severe Prediction Center (SPC) to aid in forecasting areas favorable for significant severe thunderstorm development. These parameters assist in the diagnosis of the environment in which severe thunderstorms develop and occur. However, putting a better method of predicting the precise timing and location of deep convection in the hands of the forecaster is needed to facilitate a next generation warning service which improves severe warning lead times by double or more from current levels.

This presentation will explore a technique developed at WFO (Weather Service Office) Charleston, West Virginia for the forecasting of areas of severe thunderstorm development using GFE (Graphical Forecast Editor).

The formation of severe thunderstorms depends on the interaction of lift, shear, instability and available moisture. The combination of these conditions has an important effect on the convective updraft strength. The convective available potential energy (CAPE), convective inhibition (CIN), and mid level lapse rates are directly related to updraft strength, and have been widely used as diagnostic quantities for assessing severe thunderstorm potential. Boundary layer (BL) convergence has also been found to be highly effective in highlighting mesoscale boundaries often acting as convective initiation triggers. Other parameters like deep shear, storm relative helicity (SRH), and precipitable water (PW) are known to enhance or suppress convective initiation.

The availability of higher resolution model output has made the forecasting of these parameters in realtime possible. The new approach using GFE focuses on those parameters that provide detailed information about the most favorable location for development each hour in the short term forecast period. The technique enables the forecaster to analyze these factors collectively and detect areas more favorable for severe convection in a more accurate time and spatial resolution. From this, it is expected that severe thunderstorm development can be forecast.

A Python-coded Smarttool in GFE has been developed to calculate and relate the selected parameters. Common areas where CAPE, BL convergence, and lapse rate coincide are highlighted as severe threat areas. These threat areas can be enhanced by exceeding thresholds of deep shear or SRH, or suppressed by certain thresholds of CIN and PW fields. This Smarttool allows the forecaster to select which layer of BL convergence and mid level lapse rate they consider to be more representative to a particular weather situation. In addition, the user can select which model they believe to be best suited to a particular weather situation. Using the tool, an hourly forecast severe hazard grid can be created narrowing down the locations where the atmosphere is forecast to be best suited to support the development of severe convection. It is anticipated that by combining this with the observed development and movement of storms on radar, situational awareness will be improved resulting in longer warning lead times in some situations.

Sieveking, James E., and Ron Przybylinkski – National Weather Service St. Louis

Analysis of the 21 July 2006 Greater St. Louis and Southwest Illinois Bow Echo Event

Thunderstorms rapidly developed across central Missouri during the morning of 21 July 2006, and evolved into a classic bow echo as it approached and crossed the St. Louis metropolitan area. This occurred less than 48 hours after a line of severe thunderstorms caused significant and historic damage to the St. Louis metropolitan area on 19 July. Trained spotters estimated wind speeds in excess of 30 ms^{-1} across eastern St. Charles and northern St. Louis Counties which caused additional widespread tree and power line damage to an area that was still reeling from the aforementioned event. This further exacerbated the power outage, causing the total number of households and businesses without electricity to rise over 750,000. This was the largest and most widespread power outage ever to occur in the St. Louis metropolitan area.

As the bow echo accelerated across the Mississippi River the first two mesovortices, exhibiting strong rotational characteristics, developed at the northern end of the bowing segment well north of the bow apex where damaging downburst winds were observed. As the bow echo continued to travel southeast across parts of southwest Illinois there other weak to moderate mesovortices formed near or just north of the apex of the bow. Detailed storm assessments conducted by the National Weather Service revealed that clusters of damaging downburst winds occurred along and north of the apex of the bow echo with five microbursts documented within the larger burst swath. Wind speeds as high as 40 ms^{-1} were estimated to have occurred within these microbursts regions, and the tornadoes were classified as F0 and F1 intensity. An overview of the near storm environment which the bow echo evolved from will be presented. A detailed radar analysis along with damage surveys will show the relationships between storm mergers and damaging winds over St. Louis and subsequent tornado development with the mesovortices in southwest Illinois. In addition to documenting the mesovortex characteristics, analysis of the mesoscale rear inflow jet evolution and its contribution to the mesovortex development will be shown.

Smallcomb, Chris – National Weather Service Louisville

Examining Quasi-Linear Convective Systems and Bow Echoes Using Potential Vorticity Thinking

Potential vorticity (PV) is a concept that is routinely applied to synoptic scale features but can also be employed on the mesoscale. This presentation is simply a review of established research on the makeup of OV within quasi-linear convective systems (QLCSs) and its relation to structures within and surrounding them. It is hoped this talk will promote discussion on the topic at the workshop and facilitate ideas for future research.

Spoden, Pat – National Weather Service Paducah

The Tornado and Damaging Wind Event on the Morning of 23 September 2006

During the late morning hours of 23 September 2006, an F1 tornado and a separate narrow swath of damaging winds occurred in western Kentucky and extreme southern Illinois. The F1 tornado produced $40,000 damage along a path 2 miles long and 50 yards wide in extreme western Kentucky. Ten miles south of the tornado a narrow swath of sporadic damaging winds, which were estimated at peak speeds of 75 mph, produced nearly $100,000 in damage due to damaged roofs and trees in and around the Paducah, Kentucky area. The swath extended from 2 miles south of Barkley Regional Airport to 5 miles east of Paducah revealing an overall approximate path length of 15 miles while the width was only about 200 yards wide.

Review of the Doppler radar data from KPAH (Paducah Kentucky) showed that a bowing line segment formed within a larger squall line as the convective line entered western Kentucky and southern Illinois. At least 3 mesovortices developed and intensified along the leading edge of a developing bowing line segment. One mesovortex produced the tornado, another produced the swath of damaging winds, while no reports were received from the third. This presentation will survey the pre-storm environment and evolution of the convective line and mesovortices from KPAH Doppler radar data. Particular attention will be devoted to the path and evolution of the mesovortices which may aid in further understanding of vortex growth within smaller bowing segments embedded within larger convective lines.

Trapp, Robert J. – Purdue University
A Review of Low-Level Mesovortices in Quasi-Linear Convective Storms

I will review and elaborate on some of the basic findings of Weisman and Trapp (2003) and Trapp and Weisman (2003) on the genesis of low-altitude meso-γ scale vortices within quasi-linear convective systems (QLCSs). Our idealized experiments with a numerical cloud model have shown that significant low-level mesovortices develop in simulated QLCSs only when the environmental vertical wind shear is within a relatively narrow range of values, and, when the Coriolis forcing is nonzero. The mesovortexgenesis is initiated at low levels by the tilting, in downdrafts, of horizontal crosswise baroclinic vorticity. Over a ~30-min period, the resultant vortex couplet gives way to a dominant cyclonic vortex as the relative, and more notably, planetary vorticity is stretched vertically. The details of this mechanism depend on the stage of the QLCS. This has led to some confusion about our conceptual model that I hope to clarify.

I will also discuss some of the effects of the mesovortices on the QLCS. In particular, the mesovortices can fracture the QLCS, giving the false impression that supercell storms are "embedded" within the QLCS.

Troutman, Tim – National Weather Service Huntsville
Situational Awareness and Innovative Warning Dissemination Techniques

This presentation will provide examples of effective situational awareness involving the comparison of significant, long duration bow echo events with other types of severe weather. Significance will be placed upon the correct usage of warning information to effectively warn the public and partners of damaging wind events. This presentation will also show the new techniques and dissemination methods that WFO Huntsville uses to enhance and improve the warning process and accuracy with emergency management, media and public.

Weiss, Steve – Storm Prediction Center
Severe Windstorms and Isolated Tornadoes During the 30 November-1 December 2006 Severe Weather Episode: Some Operational Forecasting Issues Associated with a Cool Season Low Topped Convective Line

A strong baroclinic weather system moved from the southern Rockies across the Great Lakes during the period from 29 November through 1 December 2006. Although very strong forcing for large scale ascent and unseasonably high values of low level moisture were associated with the system, thermodynamic profiles were only marginally favorable for deep convection in advance of the advancing cold front. On 30 November narrow lines of relatively shallow convection with little or no cloud-to-ground lightning developed along the cold front moving across the Tennessee and Ohio Valleys, with clusters of wind damage and an isolated tornado reported during the night. The deep surface low and associated front moved northeastward toward the Great Lakes and Appalachians during the morning of 1 December with shallow convective lines continuing to produce sporadic reports of damaging wind gusts. By the afternoon, however, the convection intensified as it moved into somewhat larger but still marginal instability (CAPE generally less than 1000 J/kg), with multiple line segments moving across Pennsylvania, New York and parts of New England producing widespread wind damage and several tornadoes.

The evolution of the environment associated with this severe weather episode is examined using observational data and SPC Mesoscale Analysis fields. Output from the convection-allowing experimental 4.5 km WRF-NMM model is also examined to assess the ability of high resolution models to develop rapidly moving narrow convective line segments embedded within larger regions of precipitation. Finally, operational issues related to the discrimination between damaging winds associated with strong synoptic scale pressure gradients and more concentrated zones of wind damage associated with forced convective lines are discussed.

Wheatley, Dustan – Purdue University

Numerical Simulation of Quasi-Linear Convective Systems in Heterogeneous Mesoscale Environments

This study examines the relationship between quasi-linear convective systems (QLCSs) such as squall lines and bow echoes and the heterogeneous environments within which they evolve. Idealized numerical simulations produce apparently severe QLCSs in the absence of environmental heterogeneity. Yet, observational studies suggest that significant surface boundaries and/or isolated thunderstorms cells in advance of QLCSs are precursors to severe weather. Satisfactory resolution of this scientific issue cannot be accomplished through analysis of incomplete observational data or idealized numerical simulations, which use horizontally homogeneous initial conditions. The primary objective of this study, therefore, is to perform real-data numerical simulations of observed QLCSs in order to: i) identify the various environmental features that modify the structure and evolution of simulated QLCSs, and quantify their characteristics; and ii) determine the role of such interactions in enhancing QLCS severity, and how it differs in homogeneous versus inhomogeneous scenarios.

The Advanced WRF (WRF-ARW) Version 2 has been used to perform real-data numerical simulations of the 24 October 2001 and 6 July 2003 bow echo events. In each simulation, on the subsystem-scale, a diversity of low-level mesovortices form along the main convective line's leading edge, consistent with single-Doppler radial velocity data for that event. For the simulated bow echo of the 6 July 2003, time series of the time-integrated contributions to vertical vorticity from tilting and stretching show that mesovortex strength can significantly increase through vertical vortex stretching, owing to a focused region of enhanced convergence at a QLCS-boundary point of intersection. In contrast, low-level mesovortices that form within the simulated squall-line bow echo of 24 October 2001 achieve strengths greater than three times mesocyclone-scale vorticity in the absence of significant surface boundaries and other mesoscale features.

The suggestion is then made that significant environmental heterogeneity is a sufficient condition for the development of severe weather.

Wolf, Ray – National Weather Service Davenport

Examination of Tornadic vs. Non-tornadic Mesovortices

Characteristics of mesovortices are examined to determine if tornadic mesovortices are different than their non-tornadic counterparts. Ramifications for warning operations will also be discussed.

Wolf, Ray, Ron Przybylinski, Robert J. Trapp, and Nolan Atkins – National Weather Service Davenport

The Importance of Using Mesovortex Tracks When Conducting Storm Surveys and Preparing StormData

The importance of using radar-based mesovortex tracks when conducting storm surveys and preparing StormData will be documented. Implications for warning decision making and spotter communication will also be addressed.