

Agenda
Northeast Regional Operational Workshop
Albany, New York
Tuesday, November 4, 2003

8:15 am

Welcoming Remarks

Eugene P. Auciello, Meteorologist in Charge, NWS, Albany, New York
Warren R. Snyder, Science & Operations Officer, NWS, Albany, New York

8:25 am

Remarks by Session Chair

Session A. Severe Convection / Warm Season
Session Chair - Kenneth D. Lapenta

8:30 am

**The Father's Day 2002 Severe Weather Outbreak Across New York and
Western New England**

Thomas A. Wasula
NOAA/NWS, Weather Forecast Office, Albany, New York

9:00 am

A Study of Cool Season Tornadoes in the Southeast United States

Alicia C. Wasula
Department of Earth and Atmospheric Sciences, University at Albany
State University of New York, Albany, New York

9:30 am

**Using WSR-88D Reflectivity for the Predication of Cloud-to-Ground
Lightning: A Central North Carolina Study**

Douglas Schneider
NOAA/NWS, Weather Forecast Office, Raleigh, North Carolina

10:00 am

Break

10:30 am

**The Eastern New York and Western New England F2 Tornado of 21 July
2003**

Kenneth D. LaPenta
NOAA/NWS, Weather Forecast Office, Albany, New York

11:00 am

The Rapid Evolution of Convection Approaching New York City

Michael Charles
Institute for Terrestrial and Planetary Atmospheres, Stony Brook
University, State University of New York, Stony Brook, New York

Session B. Winter Weather / Cool Season
Session Chair - Jeff Waldstreicher

11:30 am

Remarks by Session Chair

11:40 am

AWIPS Procedures that Combine Science and Visualization to Evaluate the Mesoscale and Microphysical Potential for Significant Winter Weather

Josh Korotky

NOAA/NWS, Weather Forecast Office, Pittsburgh, Pennsylvania

12:15 pm

Fog - Some New Techniques to Better Predict this Aviation Menace

Hugh W. Johnson IV

NOAA/NWS, Weather Forecast Office, Albany, New York

12:45 pm

Lunch

2:15 pm

Snowin to Beat the Band: Using Satellite Imagery and Local Analysis and Prediction System (LAPS) Output to Diagnose the Rapid Development of a Mesoscale Snowband

David R. Vallee

NOAA/NWS Weather Forecast Office, Taunton, Massachusetts

2:45 pm

An Analysis of a Poorly Forecast Frontogenetically - Forced Early Spring Snowstorm

Michael S. Evans

NOAA/NWS, Weather Forecast Office, Binghamton, New York

3:15 pm

Break

3:45 pm

Lessons Learned and Best Practices - Converting from MDL matrices to GFE Formatters

David A. Zaff

NOAA/NWS Weather Forecast Office, Albany, New York

4:30 pm

The Unusually Intense Coastal Front Passage of 17-18 April 2002 in Eastern New England

Lance F. Bosart

Department of Earth and Atmospheric Sciences, University at Albany, State University of New York, Albany, New York

Agenda
Northeast Regional Operational Workshop
Albany, New York
Wednesday, November 5, 2003

Session C. Modeling
Session Chair - Jeffrey Tongue

8:00 am

Remarks by Session Chair

8:05 am

**The Collaborative Effort Between Stony Brook University and the
National Weather Service**

Part 1 - Previous Results, Current Status, and Future Plans

Brian A. Colle

Institute for Terrestrial and Planetary Atmospheres, Stony Brook
University, State University of New York, Stony Brook, New York

Part 2 - Development of a Real-Time Ensemble Forecast System

Matthew Jones

Institute for Terrestrial and Planetary Atmospheres, Stony Brook
University, State University of New York, Stony Brook, New York

**Part 3- Integration of Mesoscale Models into Operational Weather
Forecasting**

Jeffrey S. Tongue

NOAA/National Weather Service, Upton, New York

9:15 am

**Reliability Trends of the Global Forecast System Model Output
Statistical Guidance in the Northeastern US: A Statistical Analysis
with Operational Forecasting Applications**

John Goff

NOAA/NWS Weather Forecast Office, Burlington, Vermont

9:45 am

**Implementation of Mesoscale Numerical Weather Prediction for
Weather-sensitive Business Operations**

Lloyd A. Treinish and Anthony P. Praino

IBM Thomas J. Watson Research Center, Yorktown Heights, New York

10:15 am

Break

Session D. CSTAR Projects

Session Chair - Warren R. Snyder

10:45 am

Large-Scale Regime Transition and Its Relationship to Significant Cool Season Precipitation Events in the Northeast

Heather Archambault

Department of Earth and Atmospheric Sciences

University at Albany, State University of New York, Albany, New York

11:15 am

The Distribution of Precipitation over the Northeast Accompanying Landfalling and Transitioning Tropical Cyclones

David P. DeLuca

Department of Earth and Atmospheric Sciences, University at Albany,

State University of New York, Albany, New York

11:45 am

Cold Season 500 hPa Cutoff Cyclone Precipitation Distribution and a Case Study

Anthony Fracasso

Department of Earth and Atmospheric Sciences, University at Albany,

State University of New York, Albany, New York

12:15 pm

Lunch

1:30 pm

Global Climatology of Closed 1000-500 hPa Thickness Highs and Lows

Thomas J. Galarneau, Jr.

Department of Earth and Atmospheric Sciences, University at Albany,

State University of New York, Albany, New York

2:00 pm

A Study of Landfalling Tropical Storms

Alan F. Srock

Department of Earth and Atmospheric Sciences, University at Albany,

State University of New York, Albany, New York

2:30 pm

Case Studies of Warm Season Cutoff Cyclone Precipitation Distribution

Jessica S. Najuch

Department of Earth and Atmospheric Sciences, University at Albany,

State University of New York, Albany, New York

3:00 pm

Assessing the Impact of Collaborative Research Projects on NWS Warning Performance

Jeff S. Waldstreicher

Scientific Services Division, NOAA/NWS Eastern Region Headquarters

Bohemia, New York

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Alumni House - University at Albany, National Weather Service Eastern
Region
Conference Facilities

NROW VI will be held November 2 and 3, 2004

The Father's Day 2002 Severe Weather Outbreak Across New York and Western New England

Thomas A. Wasula
NOAA/NWS, Weather Forecast Office, Albany, New York

On 16 June 2002, a significant severe weather outbreak occurred across the Northeast. This was the third major outbreak in three weeks across eastern New York and western New England during the 2002 severe weather season. Severe thunderstorms developed that produced large hail, strong winds and tornadoes. The tornadoes that developed in the Mohawk and Hudson River Valleys were F0's and F1's. A 500 hPa closed low that moved across the northern Great Lakes region on 15 June helped initiate the severe weather on Father's day (16 June). The mid-level cold pool associated with the 500 hPa low sparked a second day of severe weather for eastern New York and western New England. Several large hail (greater than 1.9 cm) producing thunderstorms on Monday 17 June 2003 developed, as the trough continued moving east across the Northeast.

Convective initiation occurred early in the afternoon on 16 June with thunderstorms developing over central New York. Steep lapse rates, moderately high Convective Available Potential Energy's (CAPE) and dewpoints coupled with a vigorous 500 hPa short wave trough helped trigger the convection. A 500 hPa southwesterly jet streak greater than 50 knots was moving across upstate New York and New England during this outbreak. Wind profiles from soundings across eastern New York and New England indicated the possibility of supercell thunderstorm development. The tornado that developed in the mid-Hudson River Valley was associated with a well-defined supercell that formed in Dutchess County, New York and moved into Litchfield County, Connecticut.

This presentation will focus on an investigation of the evolution of the large-scale synoptic pattern associated with the severe weather outbreak, and the mesoscale environment that generated the convection. The role of jet streaks at various levels (lower and upper) will also be examined. Data used in this analysis will include ETA model grids, surface observations, upper air data, satellite imagery, and WSR-88D radar data. The operational forecast challenges of 500 hPa closed lows across the Northeast will also be discussed

A Study of Cool Season Tornadoes in the Southeast United States

Alicia C. Wasula and Lance F. Bosart
Department of Earth and Atmospheric Science, University at Albany,
State University of New York, Albany, New York

Russell Schneider, Steven Weiss, and Robert Johns
NOAA/NWS, Storm Prediction Center, Norman Oklahoma

This talk will report on the preliminary results of a comprehensive study of cool season tornadoes in the southeast United States. Previous research has shown that there is a relatively high frequency of tornadoes in the overnight to early-morning hours during the cool season in the Southeast, particularly in areas close to the Gulf of Mexico.

In fact, most strong and violent tornadoes (F2 or greater) in Florida occur during the cool season, associated with extratropical cyclones. The cause of this nighttime maximum during the winter months is not well understood, and one focus of this research will be on gaining a better understanding of the causes of this phenomenon.

Previous research has also documented the importance of return flow of warm, moist tropical air across the Gulf region after the passage of cold fronts through the Gulf in the development of potential severe weather scenarios along the Gulf coast. The warm Loop Current in the Gulf also can increase fluxes of heat and moisture into this return flow air, which can lead to rapid air mass destabilization. It has also been shown, however, that forecasting the trajectories of return flow air is difficult, and that operational numerical prediction models are not able to accurately forecast the modification of the boundary layer (partially due to lack of data over the Gulf), which can be important in determining the severe weather potential over the Southeast.

Using WSR-88D Reflectivity for the Prediction of Cloud-to-Ground Lightning: A Central North Carolina Study

Brandon R. Vincent
NOAA/NWS, Weather Forecast Office, Newport, North Carolina

Lawrence D. Carey
Texas A&M University

Douglas Schneider, Kermit Keeter and Rod Gonski
NOAA/NWS, Weather Forecast Office, Raleigh, North Carolina

Charge separation most likely occurs during rebounding collisions between ice crystals and large ice hydrometeors such as graupel and hail that remain suspended in the mixed phase zone by the updraft of a growing thunderstorm. WSR-88D radar reflectivity can be used to indirectly identify this electrification process within a growing thunderstorm because graupel and hail return large reflectivity echoes. Occurrence of charge separation in a thunderstorm is a prerequisite to cloud-to-ground lightning strikes.

This study examined a sample of 50 central North Carolina thunderstorm cases using three different characteristics of WSR-88D data (e.g., reflectivity threshold [dBZ] at a given environmental temperature [C] for a specified number of volume scans [# Vol]) that were organized into 8 different sets of criteria for judging the CG lightning potential.

Results showed that the best lightning detection criterion was 1 Vol /40 dBZ/10 degrees C, with a 100% POD, a 37% FAR, and a 63% CSI. The average lead time was 14.7 minutes. Overall, the results obtained in this study compared very well with results obtained in past studies. In addition, an analysis of vertical reflectivity lapse rates between the 0C and 20C isotherm heights in both detection and false alarm cases showed that vertical reflectivity lapse rates for false alarms (2.04 dBZ/kft) were much larger than for detections (0.69 dBZ/kft). The results show that it is possible to use WSR-88D reflectivity to reasonably predict the onset of CG lightning in the central North Carolina region using criteria similar to that used in previous studies of thunderstorms in other regions. This technique has been used in real-time at WFO Raleigh with some success. Nowcasts have been issued to inform people that CG lightning strikes are imminent. Evaluating a storm potential to produce CG lightning can be done fairly quickly in an operational setting using AWIPS.

The Eastern New York and Western New England F2 Tornado of 21 July 2003

Kenneth D. LaPenta, Thomas A. Wasula and George J. Maglaras
NOAA/NWS Weather Forecast Office, Albany, New York

An unusual mesoscale convective vortex (MCV) moved across northern Pennsylvania into southeast New York on 21 July 2003. The MCV originated from an area of convection over eastern Iowa around 0300 UTC. The system strengthened and reached southern Indiana and western Ohio by about 1200 UTC. A large hook-shape system evolved over eastern Ohio by 1800 UTC. The system traveled east along the New York Pennsylvania border turning north into central New York by 0130 UTC 22 July 2003. A line of strong convection extending south from the vortex center crossed eastern New York producing widespread severe weather. A long-lived supercell developed along the line and produced a series of tornadoes across 4 counties, extending from the eastern Catskills through the mid Hudson Valley in New York and into southern Vermont, with a maximum F2 intensity.

The convection developed in a highly favorable dynamic environment aloft. A 100 knot (kt) jet maximum lifted north of New York during the afternoon placing eastern New York and western New England in the right-rear quadrant of the 250 hPa upper-level jet, which was marked as an area of strong, concentrated divergence. A strengthening 850 hPa low-level jet intensified to 50 kt, as it crossed the Hudson Valley. Winds increased and veered from the surface through the mid troposphere at 500 hPa. This created a wind shear profile favorable for severe weather, including bow echoes and supercell thunderstorms. Convective instability values were very large. For example, Convective Available Potential Energy (CAPE) values exceeded 2000 J kg⁻¹ in the mid Hudson River Valley and western New England.

An initial burst of convection moved through eastern New York and western New England during the early afternoon producing locally severe weather over the northern Catskills and the Capital Region of eastern New York. Widespread severe convection associated with the MCV arrived during the evening. A detailed radar analysis of the evolution of the long-lived tornadic supercell and the convective complex in which it was embedded will be presented. Reflectivity data will be used to examine the structure of the convective system, with velocity data used to analyze supercell strength and the intensity of the tornadic signature. In addition, this tornado will be compared to the significant tornadoes of 29 May 1995 and 31 May 1998, which occurred across eastern New York and western New England.

The Rapid Evolution of Convection Approaching New York City

Michael Charles and Brian A. Colle
Institute for Terrestrial and Planetary Atmospheres, Stony Brook
University, Stony Brook, New York

Jeffrey S. Tongue
NOAA/National Weather Service, Upton, New York

The rapid evolution of convective systems approaching the coastal metropolitan region of New York City (NYC) is a significant forecast problem. During the spring and early summer, many severe squall lines weaken rapidly or become distorted approaching this densely populated urban coastal environment. As a result, forecasts and even warnings may not verify. This talk quantifies this problem using a lightning climatology over the region, a case study, and a brief discussion of the failure of mesoscale models to forecast such events.

A limited climatology of cloud to ground lightning data was compiled for the months of June and August over the Northeastern U.S. During June, there is a clear minimum in lightning activity along the coast when compared to interior locations. The cool marine boundary layer clearly impacts the evolution of convection during this early warm season month. In contrast, lightning activity is similar to that of inland locations during August. This is likely the result of warmer sea surface temperatures and the resultant warmer boundary layer.

A case study from 18 May 2000 demonstrated the evolution of a squall line approaching New York City (NYC). On 18 May 2000, at 2200 UTC, a severe squall line was approaching the NYC region from the northwest at 2200 UTC. The squall line had a distinct bow echo, leading convective line reflectivity values of as high as 65 dBZ, and a 50-60 kt surface outflow. During the next hour, as the convective line approached NYC, its forward progression slowed and the squall line transformed into a band of heavy (35-45 dBZ) stratiform precipitation. The resultant transformation resulted in local flooding across NYC without producing severe wind gusts. The convective line weakened where the convective available potential energy (CAPE) was analyzed to rapidly decrease from 1500 J/kg-1 to less than 250 J/kg-1. This lowering of CAPE was a result of the cooler marine boundary layer over the NYC region.

Mesoscale models, such as the Eta and MM5, often do not capture details of this rapid evolution. The example from the 18 May 2000 case will be shown along with the climatological data that demonstrates the influence.

AWIPS Procedures that Combine Science and Visualization to Evaluate the Mesoscale and Microphysical Potential for Significant Winter Weather

Josh Korotky

NOAA/NWS, Weather Forecast Office, Pittsburgh PA

Studies of mesoscale snowband formation demonstrated that substantial snowfall accumulations are associated with significant midlevel deformation and frontogenesis in the vicinity of weak conditional and symmetric stability. Other studies showed that a combination of thermal stratification and microphysical processes largely determine precipitation type and intensity. Based on these studies, 3 methods were developed to assess and forecast the mesoscale and microphysical details of significant winter weather events. One technique uses a four panel time-height cross section to evaluate the potential for snowband formation. A second method uses the "Top Down" approach to forecast the effects of thermal stratification and microphysics on precipitation type and intensity. The "Cross Hair" approach uses a time-height cross section to assess where significant upward vertical motion, maximum dendritic growth temperatures, and saturated conditions coincide.

This presentation will use a case study of appreciable heavy snowfalls on 6-7 January 2002 to demonstrate visually enhanced AWIPS Procedures, based on the cited methods. The procedures include four panel time and time-height cross sections that highlight 1) the potential for mesoscale snowbands, 2) the "Top Down" approach for determining the likelihood of precipitation type and intensity, and 3) the "Cross Hair" approach for assessing where significant upward vertical motion coincides with maximum dendritic growth temperatures and saturated conditions. Additional four panel Procedures incorporate scientifically relevant diagnostics and visualizations to show the forecast evolution of the event.

Fog - Some New Techniques to Better Predict this Aviation Menace

Hugh W. Johnson IV
NOAA/NWS Weather Forecast Office, Albany, New York

Fog is significant and costly weather phenomenon to the aviation community. Forecasters often pay more attention to forecasting heavy snow, tornados, thunderstorms, or even strong winds. However, fog and low ceilings are perhaps the hardest elements to accurately forecast.

During the late summer to mid autumn, on clear calm nights, radiation fog formation reaches a maximum in most of the northeast United States. Radiation Fog formation most commonly forms near dawn when temperatures are their lowest. This coincides with a maximum in aviation activity, as many corporate and commercial flights take off within an hour of sunrise.

The basic fundamentals of fog formation are wellunderstood. They include a clear sky, little or no wind and high relative humidity. The forecasting of fog is still at best, an inexact science. Compounding the challenge, the Aviation forecaster has to decide the validity of the ASOS data. Fortunately, improved satellite techniques can help the forecaster detect stratus and fog during the predawn hours, but these have limitations as well.

Formation of radiation fog and stratus at the following airports: Albany International Airport in Albany, NY (KALB), Henry Floyd Airport in Glens Falls, NY (KGFL) and the Dutchess County Airport in Poughkeepsie, NY (KPOU) is investigated. The National Weather Forecast Office (WFO) at Albany, NY (ALY) issues Terminal Aerodrome Forecasts (TAF)s for these sites routinely, four times a day, and amendments as needed. This study seeks to improve WFO ALY's Probability of Detection (POD) for fog and/or low stratus ceilings resulting in Instrument Flight Restrictions (IFR) below minimum landing criteria ($\frac{1}{2}$ mile) at these sites. Data from September and October of 2003 is utilized that includes soundings from Albany, NY, model forecast soundings, four inch ground temperatures and surface observations.

An improved forecasting methodology for radiation fog and low stratus formation will be presented.

Snowin to Beat the Band: Using Satellite Imagery and Local Analysis and Prediction System (LAPS) Output to Diagnose the Rapid Development of a Mesoscale Snowband

David R. Vallee and Eleanor Vallier-Talbot
NOAA/NWS Weather Forecast Office, Taunton, Massachusetts

A fast moving winter storm system impacted the National Weather Service Weather Forecast Office (WFO) Taunton, MA County Warning Area (CWA) with a short duration of heavy snow on February 7, 2003. The system produced a narrow swath of 10 to 16 inch snowfall from northeast Connecticut to Boston, impacting both the mid morning and early evening rush hour commutes. While numerical model guidance suggested that the potential existed for heavy snow, most of the forcing mechanisms were forecasted to be along or just off the coast of southeast New England.

This paper will discuss how satellite imagery and Local Analysis and Prediction System (LAPS) output were used to diagnose the rapidly changing evolution and eventual northwest displacement of the heavy snow band. The paper will address the sharpening of the mid level impulse as seen on water vapor imagery, the evolution of mid level frontogenesis and deformation, and snow growth mechanisms.

An Analysis of a Poorly Forecast Frontogenetically - Forced Early Spring Snowstorm

Michael S. Evans

NOAA/NWS, Weather Forecast Office, Binghamton, New York

An early spring snowstorm that effected central New York and northeast Pennsylvania on March 30, 2003 is analyzed. Significant snowfall across this area is usually associated with deep surface low-pressure centers located near the mid-Atlantic coast. In this case however, the environment was characterized by a very weak surface cyclone, located well to the east of the mid-Atlantic coastline. It is shown that the primary forcing for upward motion and snowfall with this event was supplied by strong mid-level frontogenesis over New York and Pennsylvania. The mid-level frontogenesis appeared to be enhanced by a strong ageostrophic circulation associated with a coupled upper-level jet streak pattern.

Winter Storm Warnings were issued on this day for expected snowfalls of 6 to 12 inches (16 to 32 cm) over northeast Pennsylvania and the western Catskill mountains of upstate New York. Advisories were issued farther west, for expected snowfalls of 3 to 6 inches (8 to 16 cm) across central New York. These forecasts were based largely on model 12-hour quantitative precipitation forecasts (QPF) that indicated totals of around 0.75 inches (20 mm) across the warning area, and 0.25 to 0.50 inches (7 to 14 mm) across the advisory area. In this case, there was strong agreement with the QPF between the Eta, GFS and short-range ensemble forecasts (SREFs). There was also good run-to-run agreement with the QPF over several model cycles. Observed snowfall amounts across the area indicated that the snowfall forecast across the advisory area was good, with 4 to 8 inches (10 to 20 cm) of snow falling in band from north central Pennsylvania through central New York. However, the snowfall forecasts over the warning area were overdone, with accumulations across most of that area ranging from an inch or less (2.5 cm or less) at lower elevations to around 4 inches (10 cm) at higher elevations. A comparison between observed mid-level temperatures at the onset of the event, and the Eta model's mid-level temperature analysis, indicates that part of the difficulty in forecasting the location and intensity of the heaviest snow may have been related to problems with the model's initialization of the thermal gradient associated with the frontogenesis. In addition, an examination of Eta forecast temperature profiles valid during the height of the event indicates that the profiles within the advisory area were favorable for dendritic snow growth, while the profiles within the ill-fated warning area were less favorable.

Lessons Learned and Initial Best Practices Converting from MDL matrices to GFE Formatters

David A. Zaff

NOAA/NWS Weather Forecast Office, Albany, New York

The National Weather Service (NWS) is in the process of transitioning from hand-typed weather forecast text output to a seamless mosaic of digital information. Although the NWS has entered the digital age, there is still a requirement that text products be produced. For the past two years, NWS Eastern Region (ER) offices have used the Graphical Forecast Editor (GFE) to produce a set of digital grids. The grids were then converted and displayed as a matrix. The matrix was then modified as necessary to output a set of readable weather forecast text products. Finally, the resultant text product was hand edited to remove any lasting grammatical or meteorological problems in the text. This multi-tiered approach to creating a set of weather forecasts: grids, matrix, and text editing, resulted in an initial set of grids often being vastly different than the final set of text products. In addition, this approach was not an efficient use of forecaster time.

Beginning January 1, 2004, all NWS ER offices will produce zone and service area forecasts directly from GFE digital grids, no longer using NWS Meteorological Development Lab (MDL) matrices as a way to modify the text before generating text forecast products. In June 2003, the Weather Forecast Office (WFO) Albany, NY was given permission to test GFE formatters, thereby bypassing the matrix before it became a requirement. In addition, we were allowed to transition to new NWS Directive 10-503, which provides new public text product specifications.

Abandoning the matrix is expected to streamline the forecast preparation process, and ensure there is a better correlation between text and grids. However, the change requires careful grid preparation; one can no longer use the grids as a first draft to the text. As the grids become the primary NWS forecast product, the forecaster needs to ensure there is a high level of meteorological detail within them. These grids need to be meteorologically consistent with each other, across forecast area boundaries, and in time. Without this consistency, the text product will continue to suffer, and require editing, once again taking up valuable forecasting time. This presentation will discuss the lessons learned in converting to the GFE formatters, and the initial best practices at the WFO ALY office.

The Unusually Intense Coastal Front Passage of 17-18 April 2002 in Eastern New England

Lance F. Bosart and Alicia Wasula
Department of Earth and Atmospheric Sciences, The University at
Albany, State University of New York

Walter Drag
NOAA/NWS Weather Forecast Office, Massachusetts

Record high temperatures in the 32-34°C range were noted in parts of southern and central New England on 17 April 2002. Late that afternoon a marine surge of cold air chilled by the 5°C surface waters in the Gulf of Maine pushed onshore across eastern New England. The resulting strong coastal front passage featured vector wind shifts in excess of 40 kt and temperature decreases of 15-20°C with most of the temperature decrease occurring in less than one hour.

The evolution of this marine surge event will be described from a synoptic and mesoscale perspective. The forecastability of the event will also be discussed on the basis of the performance of the operational model and statistical-dynamical guidance.

The Collaborative Effort Between Stony Brook University and the National Weather Service, Part 1 - Previous Results, Current Status, and Future Plans

Brian A. Colle and Matthew Jones

Institute for Terrestrial and Planetary Atmospheres, Stony Brook
University, State University of New York, Stony Brook, New York

Jeffrey S. Tongue

NOAA/National Weather Service, Upton, New York

Stony Brook University (SBU), in collaboration with NOAA/National Weather Service (NWS), Upton, NY has been running the Penn State University-NCAR Mesoscale Model (MM5) in real-time since 1999. This effort is supported partially by the Cooperative program for Operational Meteorology, Education and Training (COMET). The initial motivation was to help forecasters learn how to incorporate high-resolution model data into the forecast process. The project was recently expanded to include an 18-member MM5 ensemble at 12-km grid spacing and involves other NWS offices (Mt. Holly, NJ and Taunton, MA), as well as the NWS Northeast River Forecast Center and the NWS Eastern Region Headquarters.

A verification dataset was collected during the project to evaluate the model's performance as well as that of the National Center for Environmental Prediction's Eta model. The verification system was recently expanded to include real-time data from the Port Jefferson, NY to Bridgeport, CT ferry. In addition, numerous applications have been developed at SBU using the MM5, such as real-time integration of the WaveWatch III (WW3) model, a storm surge model for the New York City Metropolitan area, and electrical load forecasts for the Long Island Power Authority.

This presentation will briefly summarize the SBU/NWS collaborative effort and its motivation. Examples of verification and some of the application of the MM5 will be presented as well as future plans.

The Collaborative Effort Between Stony Brook University and the National Weather Service, Part 2 - Development of a Real-time Ensemble Forecast System.

Matthew Jones and Brian A. Colle
Institute for Terrestrial and Planetary Atmospheres, Stony Brook
University, State University of New York,
Stony Brook, New York

Jeffrey S. Tongue
NOAA/NWS Forecast Office, Upton, New York

Since the spring of 2003, Stony Brook University (SBU) has been running an 18-member MM5 ensemble down to 12-km grid spacing over the Northeast United States for the 0000 UTC cycle using the Penn State University-NCAR Mesoscale Model (MM5). This work, which is partially supported by COMET, is in collaboration with NOAA/National Weather Service (NWS), Weather Forecast Office (WFOs) at Upton, NY, Mt. Holly, NJ, and Taunton, MA, as well as the NWS Northeast River Forecast Center and the NWS Eastern Region.

There are currently 12 different physics-based members (three boundary layer and four convective parameterizations schemes - 12 combinations) using National Center for Environmental Prediction (NCEP) Eta grids for initial and boundary conditions. The additional six (6) members are MM5 runs with fixed boundary layer and convective parameterizations, but with different model initializations from the 2100 UTC NCEP's short Range Ensemble Forecast System's Eta breds and the 0000 UTC Global Data Assimilation System.

This talk highlights the design of the MM5 ensemble and post-processing techniques used to interpret the forecasts. A web page has been constructed (<http://fractus.msfc.sunysb.edu/mm5rte>), which includes ensemble means, spreads, and spaghetti plots. Precipitation averages from some of the physics members will also be shown to highlight the fundamental differences in which convective parameterizations generate precipitation on average over the Eastern U.S.

The Collaborative Effort Between Stony Brook University and the National Weather Service, Part 3 - Integration of Mesoscale Models into Operational Weather Forecasting

Jeffrey S. Tongue
NOAA/NWS Weather Forecast Office, Upton, New York
Upton, NY

Brian A. Colle and Matthew Jones
Institute for Terrestrial and Planetary Atmospheres, Stony Brook
University, State University of New York, Stony Brook, New York

Stony Brook University (SBU), in collaboration with NOAA/National Weather Service (NWS), Upton, NY has been running the Penn State University-NCAR Mesoscale Model (MM5) in real-time since 1999. This effort is supported partially by the Cooperative program for Operational Meteorology, Education and Training (COMET). The initial motivation for the effort was to help forecasters learn how to incorporate high resolution model data into the forecast process. The project was recently expanded to include an 18-member MM5 ensemble at 12-km grid spacing and involves other NWS offices (Mt. Holly, NJ and Taunton, MA) as well as the NWS Northeast River Forecast Center and the NWS Eastern Region Headquarters.

This presentation uses a case example of how through use of an ensemble of Penn State University-NCAR Mesoscale Model (MM5) runs, operational forecaster thinking can be affected. While MM5 ensemble data is not yet fully available within the NWS's Advance Weather Interactive Processing System (AWIPS) and the Graphical Forecast Editor, static and looping web graphics are available and proven valuable tools to the forecaster. As demonstrated through this case, the ability of forecasters to increase situational awareness and focus on the significant weather is enhanced through integration of ensembles into the forecast process. Finally, a description of the local training effort will be presented.

Reliability Trends of the Global Forecast System Model Output Statistical Guidance in the Northeastern US: A Statistical Analysis with Operational Forecasting Applications

John M. Goff

NOAA/NWS Weather Forecast Office, Burlington, Vermont

Global Forecast System (GFS) Model Output Statistical (MOS) Guidance Probability of Precipitation (PoP) bias is examined for the northeastern U.S., New England and Burlington, VT. Clear and distinct trends are identified in the data sets, with a mean positive bias noted across lower PoP categories ($\leq 40\%$), and a mean negative bias across higher PoP ($\geq 60\%$) categories. This is especially evident in the New England and Burlington, VT data sets. Possible causes of the observed lower PoP category bias are discussed, namely the coarseness in model resolution and the inherent design of the regional regression equations that drive the GFS MOS PoP scheme. Applications of the observed bias to operational forecasting techniques are then presented. It is argued that by lowering values by five to ten percent across the lower PoP categories during the first three forecast periods, improvement over GFS PoP guidance may be realized over the long run. Due to good observed GFS MOS reliability (low bias) across the higher PoP categories, discreet adjustment of these values in either direction is not recommended. Due to the limited scope of this study from a physical and temporal perspective, further research is needed to ascertain whether the noted trends are inherent in the GFS MOS POP scheme.

Implementation of Mesoscale Numerical Weather Prediction for Weather-sensitive Business Operations

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For many applications, expected local weather conditions during the next day or two are critical factors in planning operations and making effective decisions. Typically, what optimization that is applied to these processes to enable proactive efforts utilize either historical weather data as a predictor of trends or the results of synoptic-scale weather models. Alternatively, mesoscale numerical weather models operating at higher resolution in space and time with more detailed physics may offer greater precision and accuracy within a limited geographic region for problems with short-term weather sensitivity. Such forecasts can be used for competitive advantage or to improve operational efficiency and safety.

To evaluate this hypothesis, a prototype system, dubbed "Deep Thunder", has been implemented for the New York City area. This effort began with building a capability sufficient for operational use. In particular, the goal is to provide weather forecasts at a level of precision and fast enough to address specific business problems. Hence, the focus has been on high-performance computing, visualization, and automation while designing, evaluating and optimizing an integrated system that includes receiving and processing data, modelling, and post-processing analysis and dissemination. Part of the rationale for this focus is practicality. Given the time-critical nature of weather-sensitive business decisions, if the weather prediction can not be completed fast enough, then it has no value. Such predictive simulations need to be completed at least an order of magnitude faster than real-time. But rapid computation is insufficient if the results can not be easily and quickly utilized. Thus, a variety of fixed and highly interactive flexible visualizations focused on the applications have also been implemented.

We will discuss our particular architectural approach and implementation as well as the justification and implications for various design choices. We have collaborated with local agencies in using Deep Thunder to assist in operational decision making with various weather-sensitive problems in surface transportation, emergency response and electricity distribution. Some results will be presented concerning the effectiveness of such modelling capabilities for these applications.

Large-Scale Regime Transition and Its Relationship to Significant Cool Season Precipitation Events in the Northeast

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Past research has pointed to a relationship between synoptic-scale cyclogenesis and the reconfiguration of the planetary-scale flow. Motivated by this work, and by the subjective observation of large-scale regime transitions concurrent with major precipitation events such as the Superstorm of 1993, this research tests the hypothesis that a correlation exists between regime transition and major precipitation events impacting the Northeast.

In order to quantify an objective definition of a weather regime, teleconnection indices such as the North Atlantic Oscillation (NAO), the Pacific/North American (PNA) pattern, the East Pacific Oscillation (EPO), and the West Pacific Oscillation (WPO) were used to characterize preferred modes of atmospheric circulation. Using daily-averaged 500 hPa geopotential height data from the National Centers for Environmental Prediction (NCEP)/National Center for Atmospheric Research (NCAR) reanalysis dataset, daily values from January 1948 to December 2001 were produced for each index, according to the procedure defined by the Climate Diagnostics Center (CDC). Upon examining the variability of each time series, a major weather regime change was defined to be a teleconnection phase change (i.e. a change from negative to positive phase or positive to negative phase) of greater than two standard deviations over a seven-day period.

As an intermediate step in determining correlation between Northeast precipitation events and regime transitions, a normalized height anomaly index was developed to identify anomalously low 1000 hPa geopotential heights in the Northeast and vicinity. Daily values of this index are being used in conjunction with daily values of change for each teleconnection index in order to determine whether a correlation exists between surface height anomalies in the Northeast and regime transitions. Future work will determine whether more major precipitation events can be expected during regime changes as compared to climatology. Composite analyses will be constructed so that characteristic signatures of significant large-scale regime changes may be identified. These composites and results from case studies will be used to determine whether a causal relationship exists between a regime change and a major precipitation event.

The Distribution of Precipitation over the Northeast Accompanying Landfalling and Transitioning Tropical Cyclones

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Landfalling and transitioning tropical cyclones pose a significant forecast challenge in forecasting distributions of heavy precipitation in the northeastern United States. The forecast challenge is heightened because the heavy rainfall distribution associated with these tropical cyclones can be modulated significantly when the poleward-moving storms interact with mobile midlatitude upper-level troughs and coastal fronts over regions of complex terrain. The purpose of this presentation is to document the large spatial and temporal variability of heavy precipitation that accompanies landfalling and transitioning tropical cyclones and to determine the physical basis for the observed rainfall distribution.

A 38-storm dataset of landfalling and transitioning tropical cyclones that produced at least 10 cm (4 ") of precipitation during 1950-1998 has been constructed. The NCEP 24 h daily (1200-1200 UTC) Unified Precipitation Dataset (UPD) and the twice-daily (0000 and 1200 UTC) NCEP/NCAR reanalysis dataset were used to produce maps of storm rainfall and synoptic-scale circulation features for each of the 38 storms. The 38-storm dataset also served as the basis for the preparation of maps showing the rainfall distribution relative to the track and the topography for each tropical cyclone. The National Hurricane Center (NHC) best track dataset at 6 h intervals (0000, 0600, 1200 and 1800 UTC) was used to define the 38 individual storm tracks, while the surface elevations in the 40 km RUC model were used to produce topographic features.

A subset of eight storms with possible influence from coastal frontogenesis was chosen for a more detailed synoptic analysis in an attempt to elucidate physical processes associated with heavy rainfall events. The four times daily (0000, 0600, 1200 and 1800 UTC) NCEP/NCAR reanalysis dataset and archived surface charts served as the foundation for this analysis.

This presentation will focus on the analysis of storm-total precipitation relative to storm track in an effort to identify the impact of complex terrain and coastal fronts on the observed precipitation distribution. It will also examine how storm-trough interactions and diadiabatically induced outflow in the downstream ridge/jet feed back on and impact the observed precipitation distribution.

Cold Season 500 hPa Cutoff Cyclone Precipitation Distribution and a Case Study

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Cutoff cyclones pose a challenge to forecasters, especially in the northeastern United States. A climatology of cold season (October - May) cutoff cyclones has been produced for the period 1948-1998 using the gridded reanalysis datasets available from the National Centers for Environmental Prediction/National Center for Atmospheric Research (NCEP/NCAR). Similarly, the NCEP Unified Precipitation Dataset (UPD), a once-daily (1200-1200 UTC) gridded precipitation dataset available on a 0.25 deg grid, has been used to construct precipitation maps for all cases where a cutoff cyclone was present in the northeast US and vicinity. The purpose of this presentation is to use these datasets to diagnose and understand the distribution of precipitation associated with the passage of cutoff cyclones in the Northeast by means of composite and case studies, and to identify whether there are characteristic precipitation signals associated with particular cutoff cyclone tracks.

Ongoing research is focused on stratifying precipitation as a function of cutoff cyclone track and intensity in an effort to determine whether a track-dependent precipitation signal exists for cutoff cyclones as they cross a region of complex terrain. Individual case studies representative of specific cutoff cyclone tracks will also be examined as part of this research effort. As an example, a recent cutoff cyclone that posed a significant forecast challenge occurred in late May 2003. The cutoff cyclone tracked across the Great Lakes and over New York State. Although heavy rains were forecast for most of the area, some locations received well under 25 mm, while other areas received closer to 100 mm over a period of a few days. The structure and evolution of this cutoff cyclone and its associated precipitation shield will be examined.

Global Climatology of Closed 1000-500 hPa Thickness Highs and Lows

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Closed 1000-500 hPa thickness highs and lows are an important aspect of the mid-latitude and subtropical weather and climate. They provide an indication of the genesis and lysis region(s) for warm and cold air masses and, if studied on the decadal time scale, they can provide a first-order approximation of climate change. Variations in these thickness features in El Nino versus La Nina years are also of interest. Given the importance of these thickness features to the weather and climate, the results of a global climatology of closed 1000-500 hPa thickness highs and lows for 1951-2001 will be presented.

Gridded 1000-500 hPa thickness analyses were obtained from the NCEP/NCAR re-analysis, on a 2.5 x 2.5 degree latitude-longitude grid for 0000 and 1200 UTC. Closed thickness highs (lows) were counted if a grid-point was 30 m higher (lower) than all surrounding grid-points and the 1000-500 hPa thickness at the center grid-point was greater than or equal to 576 (less than or equal to 540) dam.

Preliminary results show that closed thickness highs occur preferentially in continental regions in all seasons. Closed thickness lows can occur anywhere in all seasons, but tend to occur further equatorward over continental regions, especially in the cold season. Specifically, we will: (1) present the results of the global climatology of closed 1000-500 hPa thickness highs and lows, (2) compare and contrast the Northern and Southern Hemisphere climatology, (3) compare and contrast the climatology of El Nino versus La Nina years, (4) show the decadal spatial variations of the thickness climatology, and (5) present two representative case studies.

A Study of Landfalling Tropical Storms

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One of the most difficult forecast challenges is associated with landfalling and transitioning tropical cyclones because the potential for a major natural disaster associated with high winds, significant storm surges, and coastal and inland flooding is a major concern. The forecast challenge is increased because the distribution of precipitation in a tropical cyclone is highly variable from one storm to another with respect to intensity, maximum amount, areal distribution, and duration.

The goal of this study is to examine the causes for variability between these systems. Tropical Cyclones Chris (1988) and Marco (1990) have been chosen with observed precipitation distributions and tracks which are representative of some characteristic rainfall signatures observed along the East Coast. The Unified Precipitation Dataset (UPD), the National Center for Environmental Prediction/National Center for Atmospheric Research (NCEP/NCAR) reanalysis, and observed data and conditions have been utilized. Sub-synoptic scale influences to precipitation will also be examined, including effects of coastal fronts and orographic effects.

Case Studies of Warm Season Cutoff Cyclone Precipitation Distribution

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Forecasting heavy precipitation associated with warm-season cutoff cyclones presents a particularly challenging forecast problem in the northeastern US. These challenges arise in part from physiographic features that modulate the distribution of precipitation and severe weather, and the rapid changes in the character of precipitation due to the evolution and motion of the cutoff cyclones.

Four case studies of cutoff cyclones, which produced significant damage from severe weather and flooding across the Northeast, are being analyzed using the 40 km ETA initialized dataset from the National Centers for Environmental Prediction/National Center for Atmospheric Research (NCEP/NCAR). Precipitation plots were also made for each day of each case using the NCEP Unified Precipitation Dataset (UPD).

In this presentation emphasis will be placed on the case of 30 June to 1 July 1998, featuring a cutoff low that tracked through the Great Lakes, producing significant severe weather in many parts of the Northeast. Severe weather included flash floods in Vermont, New York, and Rhode Island, and three tornadoes on Long Island, New York. This cutoff featured a strong upper-level jet on its equatorward side and a strong low-level jet on its eastern side. The heaviest rain fell along the New York and Pennsylvania border and in isolated pockets in the vicinity of significant orographic features (e.g., Adirondacks). Synoptic and mesoscale analyses will be used to relate the severe weather and heavy precipitation to orographic features, lower- and upper-level jet interactions, and to the structure, shape, and track of the evolving cutoff.

The presentation will also include a monthly climatology of the tracks of closed lows over the northeast. The climatology is derived from plotting 500 hPa low height centers at 6h intervals (0000, 0600, 1200, and 1800 UTC) from 1980-1998 for the months June to September. From analyzing these tracks, a set of common paths and origins was created for each month. These paths and origins will be further analyzed in conjunction with a monthly climatology of precipitation derived from the UPD.

Assessing the Impact of Collaborative Research Projects on NWS Warning Performance

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In 1990, the Cooperative Program for Operational Meteorological Education and Training (COMET) initiated an Outreach Program. The goal of the COMET Outreach Program is to improve local forecast and warning services by providing financial support for applied mesoscale and synoptic-scale research. To achieve this goal, COMET funds collaborative projects between universities and National Weather Service (NWS) offices.

These projects generally lead to the development and adoption of new forecast techniques, an increased understanding of local meteorology, and/or preparation of joint papers and training workshops. Since the inception of the COMET Outreach program, over 250 collaborative projects have been funded nationwide, involving approximately 90 NWS offices and over 70 different universities. However, to date there have not been any widespread studies to objectively assess the impact of these collaborative projects on NWS warning performance.

This paper will present the results of an assessment of the impacts of COMET Cooperative and Partners collaborative research projects on NWS performance metrics for tornado, severe thunderstorm, flash flood and winter storm warnings. The study evaluated relevant collaborative projects within the Eastern Region of the NWS completed between 1995 and 2001. In addition, the verification trends at WFO Raleigh, NC (RAH), Albany, NY (ALY), and State College, PA (CTP) will be examined to evaluate the influence of long-term collaborative activities on performance. WFO RAH has been continuously involved in collaborative projects with North Carolina State University since January 1991. WFO Albany (with the University at Albany - SUNY) and WFO State College (with Pennsylvania State University) have been working on collaborative research projects since early 1995.

There are many factors that influence warning program verification scores on the long-term (e.g., technology infusion; implementation of applied research results, etc.) and the short-term (weather "regime" impacts on event types and frequencies; office staffing issues; etc.). This paper will describe how the assessment methodology attempted to isolate, to the extent possible, the impacts of the collaborative projects from these other factors.