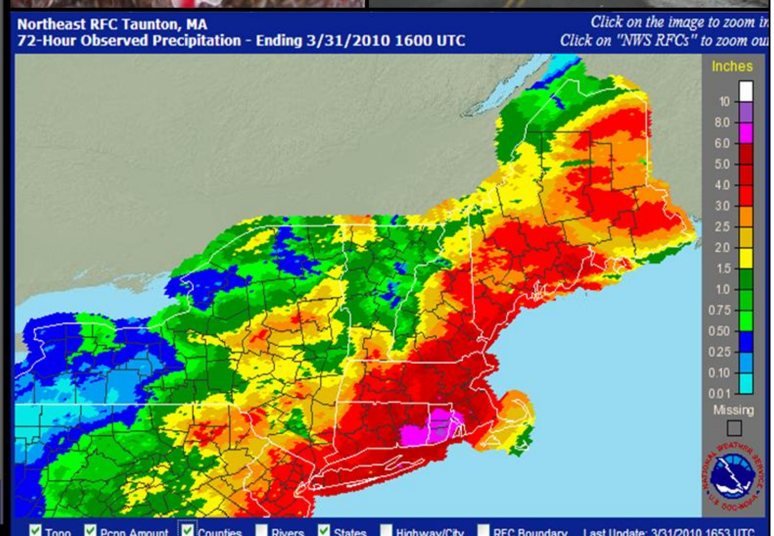
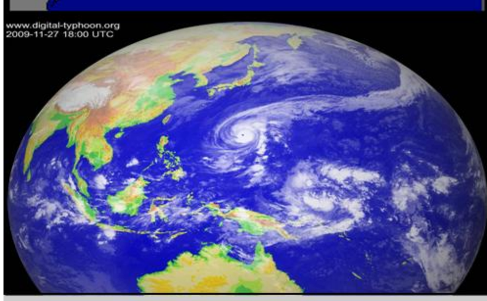
12th Northeast Regional Operational Workshop
November 3-5, 2010
Albany, New York





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Agenda
Northeast Regional Operational Workshop
Albany, New York
Wednesday, November 3, 2010

8:30 am
Welcoming Remarks
Raymond G. O'Keefe, Meteorologist In Charge
Warren R. Snyder, Science & Operations Officer
National Weather Service, Albany, New York

Conference Chairs
Hugh W. Johnson IV, General Forecaster, ALY
Thomas A. Wasula, General Forecaster, ALY

Session A – Warm Season Topics Convection

8:40 am
The May 26-27, 2010 Eastern New York and Western New England Significant Severe Weather Event
Thomas A. Wasula
NOAA/NWS, Weather Forecast Office, Albany, New York

9:05 am
A Tale of Two Severe Weather Surprises – The Isolated Outbreak of 16 July 2010 and the Widespread Severe Weather of 17 July 2010
Neil A. Stuart
NOAA/NWS Weather Forecast Office, Albany, New York

9:30 am
The Influence of the Elevated Mixed Layer on Record High Temperatures and Severe Weather Over the Northeast US in April and May 2010
Jason M. Cordeira
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

9:55 am
The Impacts of the Strong Subtropical Ridge of 2010
Kevin S. Lipton
NOAA/NWS Weather Forecast Office, Albany, New York

10:20 am
Break – Refreshments for sale by Capital Region AMS in the Rotunda

10:50 am
Improving New York City Thunderstorm Forecasts
Christina Speciale
Department of Environmental Sciences, Cook College, Rutgers University, New Brunswick, New Jersey

11:15 am
Synoptic and Mesoscale Conditions associated with Persisting and Dissipating Mesoscale Convective Systems that Cross Lake Michigan
Nicholas D. Metz
Department of Atmospheric and Environmental Sciences, University at Albany, State University of New York, Albany, New York

11:40 am
Investigation of Lightning Patterns over New Jersey and Surrounding Area
Alan M. Cope
NOAA/NWS Forecast Office, Mount Holly, New Jersey

12:05 pm Lunch

1:30 pm
Morphologic Investigation of Thunderstorm Initiates and GIS Attributes with Testing for Improved Operational Nowcasting of Thunderstorms and their Severity in New Jersey
Dr. Paul J. Croft, Meteorologist
Programs of Geology & Meteorology, College of Natural, Applied, & Health Sciences
Keene University, Union, New Jersey

1:55 pm
A “Survey” of Tornadoes and their Environments in the WFO Sterling, VA Forecast Area
Matthew R. Kramar
NOAA/NWS Weather Forecast Office, Sterling, Virginia

2:20 pm
Observed Inverted V Soundings and Downstream Severe Weather in New York and Pennsylvania
Michael Evans
NOAA/NWS Weather Forecast Office, Binghamton, New York

2:45 pm
Break – Refreshments for sale by Capital Region AMS in the Rotunda

Session B - Ensemble Forecasting, Modeling & Related Topics

3:15 pm
Forecast Challenges in the NWS Albany, NY Forecast Area Associated with the Winter Storms of the 2009-2010 Season
Neil A. Stuart
NOAA/NWS Weather Forecast Office, Albany, New York

3:40 pm
Ensemble Post-Processing and Its Potential Benefits for the Operational Forecaster
Michael Erickson
School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, New York

4:05 pm
An Automated Rossby Wave Packet Tracking Program: Preliminary Climatological and Model Verification Results
Matthew Souders
School of Marine and Atmospheric Sciences, Stony Brook University, State University of New York, Stony Brook, New York

4:30 pm
An Overview and Update of the HPC Medium Range Forecast Program
Michael Schichtel
NOAA/NWS Hydrometeorological Prediction Center, Camp Springs, Maryland

4:55pm
Using Short Range Ensemble Forecasts, Climate Anomalies, and High Resolution Model Guidance to Determine the Potential for Tornadoes across Parts of the Ohio Valley, New Jersey and New York City on 16 September 2010
Josh Korotky
NOAA/NWS, Weather Forecast Office, Pittsburgh, Pennsylvania

5:20 pm
Standard Anomalies to Identify High Impact Weather Events
Richard H. Grumm
NOAA/NWS Weather Forecast Office, State College, Pennsylvania

5:45 pm – Adjourn

Agenda
Northeast Regional Operational Workshop
Albany, New York
Thursday, November 4, 2010

Conference Chairs
Steve N. DiRienzo, Warning Coordination Meteorologist
Warren R. Snyder, Science & Operations Officer

Session C – Decision Support & Related Topics

8:30 am
Community Environmental Networks for Risk Identification and Management
Dr. Paul J. Croft, Meteorologist
Programs of Geology & Meteorology, College of Natural, Applied, & Health Sciences
Keene University, Union, New Jersey

8:55 am
Operational Utilization and Evaluation of a Coupled Weather and Outage Prediction Service for Electric Utility Operations
B. Hertell
Consolidated Edison, New York, New York

9:20 am
Application Of An Operational Meso-Scale Modeling System For Industrial Plant Energy Operations
Anthony P. Praino
IBM Thomas J. Watson Research Center, Yorktown Heights, New York

9:55 am – Break
Break – Refreshments for sale by Capital Region AMS in the Rotunda

Session D – Cool Season Topics & Hydrology

10:20 am
Microphysical Evolution Within Winter Snow Storms over Long Island, New York
David Stark
School of Marine and Atmospheric Sciences, Stony Brook University, State University of New York, Stony Brook, New York

10:55 am
Examining the Damaging New England Windstorm of 25-26 February 2010 as a Shapiro-Keyser Cyclone
Stacie Hanes
NOAA/NWS Weather Forecast Office, Mount Holly, New Jersey

11:20 am
WFO Binghamton Synoptic Flash Flood Classification Study
Christopher Gitro
NOAA/NWS Weather Forecast Office, Binghamton, New York

11:45 am
Lunch

Session E – CSTAR Part 1 – Projects and CSTAR Related Topics

1:15 pm
Predictability of High Impact Weather during the Cool Season over the Eastern U.S: CSTAR Scientific Objectives
Brian A. Colle
School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, New York

1:40 pm
Predictability of High Impact Weather during the Cool Season over the Eastern U.S: CSTAR Operational Aspects
Jeffrey Tongue
NOAA/NWS, Weather Forecast Office, New York, New York

2:05 pm
A 16-year Climatology of Ice Storms in WFO Albany's County Warning Area and a Comparison of Two Recent Events
Kevin S. Lipton
NOAA/NWS Weather Forecast Office, Albany, New York

2:30 pm
MCS Organization and Development Along Land/Lake-Induced Thermodynamic Boundaries near Lake Superior
Alan F. Srock
Department of Atmospheric and Environmental Sciences, University at Albany, State University of New York, Albany, New York

2:55 pm
The 2010 "PRE-Season" In Review: A Look at Tropical Cyclones Earl, Hermine, and Nicole
Michael L. Jurewicz, Sr.
NOAA/NWS, Weather Forecast Office, Binghamton, New York

3:20 pm
Southerly or 'Reverse' Mohawk Hudson Convergence Cases
Hugh Johnson and Kimberly McMahon
NOAA/NWS Weather Forecast Office Albany, New York

3:45 pm
Break – Refreshments for sale by Capital Region AMS in the Rotunda

Session F – Keynote Presentation
Introduction – Warren R. Snyder

4:10 pm
An Overview of the Northeast River Forecast Operations and Services and its migration to the Community Hydrologic Prediction System; "It's not your Grandfather's RFC anymore"!
David R. Vallee
NOAA/NWS Northeast River Forecast Center, Taunton, Massachusetts

5:45pm
Adjourn

Agenda
Northeast Regional Operational Workshop
Albany, New York
Friday, November 5, 2010

Conference Chairs
Joe P. Villani, General Forecaster, ALY
Warren R. Snyder, Science & Operations Officer

Session G - CSTAR Part 2 – Projects and CSTAR Related Topics

8:30 am
Synoptic and Mesoscale Processes associated with Predecessor Rain Events ahead of Tropical Cyclones
Benjamin J. Moore
Cooperative Institute for Research in the Environmental Sciences, University of Colorado, Boulder Colorado

8:55 am
The Impact of the Saint Lawrence Valley on the Precipitation Distribution Associated with Extratropical Transitions, 1979-2008
Giselle C. Dookhie
Department of Atmospheric & Oceanic Sciences, McGill University, Montreal, Quebec, Canada

9:20 am
Extreme Weather Events over the Northern Hemisphere during Winter 2009-2010
Lance F. Bosart
Department of Atmospheric and Environmental Sciences, University at Albany, State University of New York, Albany, New York

9:45 am
Break – Refreshments for sale by Capital Region AMS in the Rotunda

10:10 am
Forecasting the Inland Extent of Lake-Effect Snow Bands
Joseph P. Villani
NOAA/NWS, Weather Forecast Office, Albany New York

10:35 am
Use of the Albany Hail Study to Predict Large Hail During the 21 July 2010 Severe Weather Event
Brian J. Frugis
NOAA/NWS Weather Forecast Office, Albany, New York

11:00 am
High-Impact Weather and Reduced Predictability over the United States Associated with the Recurvature of Western North Pacific TC Malakas (2010)
Heather M. Archambault
Department of Atmospheric and Environmental Sciences, University at Albany, State University of New York, Albany, New York

11:25 am
Closing Remarks

11:35 pm
Adjourn

NROW XIII will be held for 3 full days, Tuesday November 1 through Thursday 3, 2011

The May 26-27, 2010 Eastern New York and Western New England Significant Severe Weather Event

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

On the evening of 26 May 2010, an anomalously warm and humid air mass was over much of the Northeast. Several record maximum temperatures were achieved across New York (NY) and New England that afternoon with widespread readings of 32-37°C. Surface dewpoints were between 15-21°C. A backdoor cold front approached late in the afternoon from eastern New England and southeastern Quebec. Convection rapidly developed ahead of the cold front and its associated mid-level short-wave trough. The strong to severe thunderstorms first developed in the vicinity of the Champlain River Valley around 0000 UTC 27 May 2010 and moved southward across extreme eastern NY and western New England to Long Island by 0600 UTC. There were a total of 70 severe weather reports of damaging winds in excess of 50 knots (58 mph) and severe large hail (greater than 2.5 cm) that occurred across eastern NY and New England.

Eastern NY and western New England were located near the right rear quadrant of a 300 hPa, 105 knot jet streak over eastern Maine and New Brunswick. This jet streak enhanced a plume of upper-level divergence over the region impacted by the severe weather. There was a plethora of instability in place ahead of the back door cold front. The 0000 UTC Local Area Prediction System (LAPS) analysis had surface-based convective available energy (SBCAPE) values of 1000-4000 J kg^{-1} over eastern NY and western New England. The 0000 UTC sounding at Albany yielded an SBCAPE value of 3948 J kg^{-1} and mid-level lapse rates approaching 8°C km^{-1}. The Downdraft CAPE value was extremely high at 1697 J kg^{-1}. The sounding exhibited a deep elevated mixed layer from the surface to around 600 hPa, indicative of the potential for strong winds to mix to the surface with the convection. The 0-6 km deep layer bulk shear was only around 25 knots. However, the better deep layer 0-6 km bulk shear was found over central and eastern New England. The KGYX (Portland, ME) sounding had a 0-6 km shear value of 62 knots. The shear increased westward associated with the deep cutoff cyclone over the Canadian Maritimes. The 0-6 km deep layer shear intersected the abundance of instability for a mesoscale convective system (MCS) to develop over western New England. The MCS produced several bowing convective elements, which resulted in widespread straight-line wind damage. There were also some embedded supercells within the organized linear severe convection.

This talk will take a multi-scale approach in analyzing the event from the synoptic-scale to the storm-scale, in order to understand the convective environment associated with the back door cold front that produced the severe weather outbreak on 26-27 May 2010. Observational data used in the analyses will include surface and upper air observations, satellite imagery, and Albany (KENX) WSR-88D 8-bit radar data. The storm-scale analysis will examine some impressive outflow boundaries with the cold pool to the MCS that focused some of the severe convection.

A Tale of Two Severe Weather Surprises – The Isolated Outbreak of 16 July 2010and the Widespread Severe Weather of 17 July 2010

Neil A. Stuart
NOAA/NWS Weather Forecast Office, Albany, New York

A surface cold front was forecasted to track through the northeastern U.S. on 16 July 2010 supporting the development and maintenance of thunderstorms, some possibly severe. A secondary cold front was also predicted to push through the northeastern U.S. the next day, 17 July 2010, but with only isolated showers and thunderstorms. The Storm Prediction Center (SPC) Day 1 Outlook at 1300 UTC 16 July indicated a slight risk of severe thunderstorms in the northeastern U.S. This included a 15 percent chance of damaging winds associated with the thunderstorms highlighted in the probabilistic outlooks for severe weather hazards. The 1300 UTC outlook on 17 July 2010 indicated too small a risk of severe thunderstorms for a categorical outlook, in addition to a 5 percent probability for damaging winds in the northeastern U.S.

The SPC, National Weather Service Forecast Offices (NWSFO) and broadcast sector were all communicating the heightened severe weather threat for 16 July 2010, yet did not acknowledge the chance for severe weather on 17 July 2010 until 2000 UTC after numerous severe weather events were reported in the NWSFO Binghamton, NY forecast area. The severe weather on 16 July 2010 was limited to a small cluster of wind damage reports in central Massachusetts. Conversely, on 17 July 2010, numerous hail and wind damage reports were received across interior and eastern New York and western New England. It will be shown that some important low-level and upper level features were depicted in Numerical Weather Prediction (NWP) models, such as the Global Forecast System (GFS) and North American Mesoscale Model (NAM), and observational data that supported the lack of severe weather on 16 July 2010, supported the more active severe weather day of 17 July 2010.

Key features in the NWP model guidance and observational data will be presented, including low-level jet segments, mid-level lapse rates, 700 hPa moisture and vertical velocity, and boundary layer thermal and moisture boundaries. These parameters among others provided important clues that would have minimized the severe weather threat on 16 July 2010 and enhanced the severe weather threat on 17 July 2010.

The Influence of the Elevated Mixed Layer on Record High Temperatures and Severe Weather Over the Northeast US in April and May 2010

Jason M. Cordeira, Thomas J. Galarneau, Jr., and Lance F. Bosart
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

Record surface and 850-hPa temperatures were either tied or set at several locations over the Northeast US in April and May 2010, contributing to the warmest March-April-May in the 116-yr record from the Great Lakes region to New England. For example, on 7 April widespread high temperatures >30°C were observed prior to "leaf-out" over the largely deciduously vegetated interior Northeast, whereas on 26 May widespread high temperatures >35°C and dew point temperatures ~20°C, produced favorable conditions for the maintenance of a southward-propagating high-impact mesoscale convective system (MCS) over western New England. A contributing factor to the record surface and 850-hPa temperatures and severe weather during both events was the presence of an elevated mixed layer (EML).

Backward air parcel trajectories and synoptic-scale analysis demonstrate that the 7 April and 26 May 2010 events were associated with mid-level high lapse rates (HLRs) that originated over the Mexican Plateau. These mid-level HLRs were maintained via subsidence on the poleward-side of an upper-level anticyclone over the south-central US and subsequently traveled poleward and eastward as an EML to over the Northeast. The presence of the EML and strong surface sensible heating in the absence of significant evapotranspiration over the Northeast on 7 April favored early-season high temperatures >30°C. Conversely, the presence of the EML and sufficient low-level moisture on 26 May produced surface-based CAPE values ~4000 J kg^{-1} over Albany, NY and maintained the high-impact MCS over western New England.

Given the high-impact nature of these events, the 7 April and 26 May events will be placed into historical context in terms of a HLR climatology, 850-hPa temperatures, and record high temperatures. Complementary *early-season* events, such as an EML over Michigan on 2 April 2010 with a record-breaking 21.0°C 850-hPa temperature, and previous record high temperatures and significant severe weather events over the Northeast (e.g., 22 May 1996), will be considered.

The Impacts of the Strong Subtropical Ridge of 2010

Kevin S. Lipton[1] , Richard H. Grumm[2] and Jason Krekeler[2]

[1]NOAA/NWS Weather Forecast Office, Albany, New York
[2]NOAA/NWS Weather Forecast Office, State College, Pennsylvania

Heat waves have been identified as a significant cause of weather-related fatalities in the United States. Chagnon et al. (1996) documented the 1995 Midwestern United States heat wave, which caused 525 deaths in Chicago, and 830 deaths nationwide. The heat wave of July 1999 caused an estimated 309 deaths in 21 states, with the majority of the deaths occurring in the Midwestern United States in late July. Heat waves are not unique to the United States. A deadly heat wave struck Europe in the summer of 2003 claiming an estimated 35,000 lives. The recent northern Europe heat wave from 8-15 July 2010 broke high temperature records set in 1753.

The summer of 2010 will be remembered as one of the hottest in recent memory over most of the eastern United States, eastern Asia, and Russia (Grumm 2010). Global temperature data suggest that the period of June-August 2010 was one of the warmest on record in the northern hemisphere. NOAA reported that "*The July worldwide land surface temperature was 1.03 °C (1.85 °F) above the 20th century average of 14.3 °C (57.8 °F) – the warmest on record.*" This record warmth followed a 3-month record warm period of April to June 2010.

A modestly strong subtropical ridge dominated the pattern over the eastern and southern United States from 1 June 2010 through 31 August 2010. Several periods of sustained heat affected the eastern and southern United States. These "heat waves" shared many of the common characteristics of previously documented heat waves (Lipton et al. 2005), including large and strong subtropical ridges with a closed 5940 m contour, above normal 850- and 700-hPa temperatures, and a surge of deep moisture north and west of the heat affected region.

Strong subtropical ridges and extreme heat episodes were also present during the summer over central Europe and Asia. These ridges, too, persisted for most of the summer. This presentation will focus on the significant heat episodes which occurred across North America during the summer of 2010, with emphasis on the role and strength of the subtropical ridges associated with these heat episodes through the use of climatological anomalies.

Improving New York City Thunderstorm Forecasts

Christina Speciale[1], Dr. Steven Decker[1], and Brandon Hertell[2]

[1]Department of Environmental Sciences, Cook College, Rutgers University, New Brunswick, New Jersey
[2]Consolidated Edison Inc, New York, New York

Each year, the amount of damage caused by thunderstorms in the Northeast can range from inconvenient to catastrophic. Although the majority of impressive and life altering thunderstorms are found in the Midwest, the Northeast does see its fair share of damage caused by the thunderstorms that rumble through each spring and summer. There are specific ranges for each thunderstorm parameter (e.g. CAPE, CIN) that are traditionally used by meteorologists as forecast indicators for potentially severe storms, and these ranges are applied uniformly across the country. It is for this reason that the New York City utility company Consolidated Edison (ConEdison) thought it necessary to quantify these ranges based upon their observation that New York City severe thunderstorms frequently occur under different parameter regimes than what these traditional ranges would suggest.

As the first step of this project, a set of events were found between 2006 and 2009 where severe weather, as determined by storm reports collected by the Storm Prediction Center, occurred in or near any of the ConEdison service counties. From this collection of storm dates, values for seven thunderstorm parameters which included CAPE, CIN, Shear (0km-6km), Helicity (0km-1km), Lifted Index, Total Totals, and SWEAT were found from six Northeast stations. These values were then formulated into customized ranges and compared to the traditional ranges. The results showed that out of the seven thunderstorm parameters studied, only two parameters, CIN and Shear, matched the traditional ranges while the other five differed. The CAPE and SWEAT ranges had the most notable discrepancies. In fact, differences existed because the parameter values found were much smaller than the values of the traditional ranges. This provides evidence for the hypothesis that when a thunderstorm impacts a densely populated area, significant damage can result even when parameter values are lower than the traditional ranges. The second phase of this project will include expanding the storm events database and comparing them to non severe thunderstorm days.

Synoptic and Mesoscale Conditions associated with Persisting and Dissipating Mesoscale Convective Systems that Cross Lake Michigan

Nicholas D. Metz and Lance F. Bosart
Department of Atmospheric and Environmental Sciences, University at Albany, State University of New York, Albany, New York

Warm-season mesoscale convective systems (MCSs) that traverse the Great Lakes pose an important forecasting issue. Conventional wisdom suggests that mature MCSs might dissipate upon crossing lake waters that are typically cooler than the surrounding land. However, observational evidence reveals that MCSs can persist or even intensify upon crossing these relatively cool lake waters. As these MCSs interact with the lake-modified air, they undergo structural and evolutionary changes that vary from case-to-case, based on the environmental conditions present. This presentation will document environmental conditions associated with warm-season MCSs that cross Lake Michigan and examine MCS–lake interactions in an attempt to ascertain the spectrum of conditions under which MCSs persist and dissipate.

Climatological results from 2002 to 2007 indicate that 43% of warm-season MCSs persisted upon crossing Lake Michigan. Persistence is favored for MCSs that cross during the evening/overnight and the mid-summer. However, MCSs can persist at other times as well, such as during the early warm season (April–June), when lake water temperatures are only 3–10°C. Consequently, the lake water temperature is not a good predictor of MCS persistence. Rather, the very shallow near-surface lake inversion (buoy air temperature at 5 m minus lake water temperature) is typically much stronger when MCSs persist, particularly in the early warm season. Additionally, MCSs often persist in association with an intense low-level jet (LLJ) stream, and large amounts of CAPE and shear immediately downstream of Lake Michigan. Synoptic-scale composites generally agree with climatological results and show that MCSs usually persist in the equatorward-entrance region of a stronger upper-level jet stream than MCSs that dissipate.

Two case studies, one from 18 June 2010 of an MCS that persisted and one from 24 June 2003 of an MCS that dissipated, will also be presented to accentuate climatological and compositing results, and highlight the differing combinations of environmental and lake conditions that distinguish between MCSs that persist and dissipate. For instance, MCSs that persist usually are associated with convective cold pools that are much deeper than the very shallow, stable dome of cold air over Lake Michigan. Persisting MCSs typically feed on “surface” flow characteristic of adjoining landmasses that is advected by a strong LLJ above this lake cold dome.

Investigation of Lightning Patterns over New Jersey and Surrounding Area

Alan M. Cope
NOAA/NWS Forecast Office, Mount Holly, New Jersey

Adam Gonsiewski
Millersville University, Lancaster, Pennsylvania

Research on lightning patterns in New Jersey and surrounding areas, with a focus on the summertime months of June, July, and August, was conducted during the summer of 2010 at the National Weather Service Forecast Office in Mount Holly, New Jersey. The goal was to see whether or not lightning had different tendencies across the region based on month, hour of the day, 500 hPa flow direction and synoptic regime. Specific focus was placed on the daytime hours between 1200 UTC and 0000 UTC to coincide with a related study on summertime convective initiation over New Jersey being conducted by NWS Mount Holly and Kean University.

Quality controlled lightning flash data (cloud-to-ground only) were obtained from the Vaisala National Lightning Detection Network (NLDN) for the period 2004-2008. A subset of the lightning data was extracted for the area from 38.0N to 42.0N and from 73.5W to 77.0W, which includes the NWS Mount Holly forecast area and vicinity. A spreadsheet program was used to sort the lightning by month and hour of the day, and also by 500 hPa wind direction, synoptic weather pattern and timing of thunderstorm initiation, as determined from the related convection study with Kean. A locally-developed FORTRAN program was then used to count and map data from the various sorted files to a 0.20 degree latitude by 0.25 degree longitude grid, (approximately 22-km by 21-km grid spacing) over the study area. Output files from the program were uploaded to a mapping and visualization website (www.gpsvisualizer.com), in order to create lightning flash frequency maps for the area of interest.

Results from this study showed that the vast majority of lightning (81 percent) occurred during the three summer months, with the peak in July. Diurnally, lightning activity peaked between 2200 and 2300 UTC (6 pm and 7 pm EDT), with a minimum between 1400 and 1500 UTC (10 am and 11 am EDT). The geographic distribution showed an overall maximum over the Chesapeake Bay area and minimum activity over the Atlantic Ocean east of New Jersey. About half of all lightning (51 percent) occurred with southwest flow at 500 hPa; also about half (49 percent) occurred on days with cold front passages through the area. Other differences were noted in timing and spatial distribution according to synoptic regime and/or wind direction aloft; these will be presented in more detail at the workshop.

Morphologic Investigation of Thunderstorm Initiates and GIS Attributes with Testing for Improved Operational Nowcasting of Thunderstorms and their Severity in New Jersey

Dr. Paul J. Croft, Meteorologist
Programs of Geology & Meteorology, College of Natural, Applied, & Health Sciences
Keene University, Union, New Jersey

Al Cope
NOAA/NWS Weather Forecast office, Mount Holly, New Jersey

The morphology of summer season convective initiation, its ultimate coverage (based upon the storm total precipitation product – or STP) and its severity were used to test the previously developed conceptual model of convective activity in and around the Philadelphia-Mount Holly County Warning Area. The use of an operational website (http://hurri.kean.edu/~keancast/thunder/thunder.html) was made to assist forecasters in their assessment of the preferred locations for convective initiation according to 500mb flow, surface weather pattern, and combinations of the these conditions. Information on the website included composites of initial convective activity derived fields (e.g., precipitable water, omega, and shear through the Climate Diagnostics Center). Composites of STP according to upper air and surface flows were also made available online as well as data summaries and plots of severe convection.

Trials were run during the summer of 2010 to gauge the impact of the website on the forecasting process (e.g., through Area Forecast Discussions and other products or notes) and to evaluate the ability of the conceptual model to improve the probability of detection, false alarm rate, and critical success index. Study data and methods were also examined with regard to the application of a high resolution GIS-based grid (varying from 1 to 10 km) of the region to relate specific physiographic features in the area to the preferred locations of convective initiation and its severity. GIS grid calculations focused on land use and cover, slope, elevation, distance to the coast, and other characteristics using slope and other simple parameter calculations (e.g., gradient, vorticity, and convergence/divergence). This comprehensive system is intended to provide greater confidence, skill, and insight to convective activity in the study area and to provide greater specification in summer season thunderstorm forecasts.

A "Survey" of Tornadoes and their Environments in the WFO Sterling, VA Forecast Area

Matthew R. Kramar, Kyle Olmstead
NOAA/NWS Weather Forecast Office, Sterling, Virginia

Tornado events and environments in the WSR-88D radar era (1991 to present) were examined for the Weather Forecast Office (WFO) Sterling, VA (LWX) forecast area. Since tornadoes are considered generally an uncommon event in the WFO LWX forecast area, this effort aspired to two purposes: 1) to update previously generated tornado distribution maps by county for the LWX County Warning Area (CWA); and 2) to compile a synoptic composite of environments favorable for the development of tornadoes in the WFO LWX forecast area as a pattern recognition tool for forecasters.

Tornado events were obtained from National Climate Data Center's (NCDC) Storm Data publication. Radar data from 1991 to 2009 were used to classify storm and tornadogenesis mode subjectively for each tornado report during the period of study that was not associated with the remnants of a tropical system. Finally, synoptic composites were constructed using NCEP Reanalysis data. Similarities and differences in the composited synoptic setups for mesocyclonic and non-mesocyclonic (i.e. quasi-linear convective system) tornadoes will be discussed.

Observed Inverted V Soundings and Downstream Severe Weather in New York and Pennsylvania

Michael Evans[1] , Barry Lambert[2], Jarrod Constantino[3]
[1]NOAA/NWS Weather Forecast Office, Binghamton, New York
[2]NOAA/NWS Weather Forecast Office, State College, Pennsylvania
[3] State University of New York, Oneota, New York

Two case studies of severe weather events in New York and Pennsylvania are shown. Both events occurred with upstream, observed, lower-tropospheric "inverted V" thermodynamic profiles, characterized by steep low-level lapse rates and increasing relative humidity with height in the lower troposphere, capped by a mid-tropospheric moist layer. Each event was characterized by small values of surface-based and mixed layer convective available potential energy (CAPE), yet both produced many damaging wind reports. Radar imagery in both cases revealed a line of low-topped, rapidly moving convection, associated with strong winds at the lowest elevation level. In one case, the NWS/Storm Prediction Center issued a severe thunderstorm watch for the affected area, while in another case, no watch was issued.

The remainder of this presentation highlights results from a climatological study of severe weather events in the northern mid-Atlantic region associated with upstream, observed inverted V soundings. Some results from this study include the finding that approximately 35 percent of 79 major severe weather events (defined as events with at least 20 severe reports in New York and Pennsylvania) from 2005 – 2010 were associated with a 12 UTC inverted V sounding at Pittsburgh (KPIT) or Buffalo (KBUF). Meanwhile, 27 percent of 140 minor severe weather events (defined as events with 1 to 4 severe weather reports in New York and Pennsylvania) from 2005 – 2010 were associated with a 12 UTC inverted V sounding at KPIT or KBUF.
Application of a strict, objective criteria for what defines an inverted V sounding reduced the number of major, inverted V severe weather events in the study from 79 to nine, and reduced the number of minor, inverted V severe weather events from 140 to 14. These events were then examined in further detail. The median forecast CAPE values for the nine major events was only 584 J kg^{-1}, and four of the nine major events occurred with forecast CAPE values less than 500 J kg^{-1}. Meanwhile, the median forecast CAPE value for the 14 minor events was only 214 J kg^{-1}. By contrast, observed downdraft CAPE (DCAPE) values were relatively large (median value of 755 J kg^{-1} for major events, vs. a median value of 641 J kg^{-1} for minor events). Some environmental parameters that appeared to discriminate most effectively between major vs. minor events included the low-level lapse rates downstream from the observed sounding near the location of the first severe report (larger for major events), the observed sounding mean wind speed (larger for major events), and the observed storm speed (larger for major events).
Composites and corresponding standardized anomalies of several large-scale atmospheric parameters indicated that major events were associated with pronounced trough/ridge couplets at 500 hPa over the eastern U.S., while minor events were associated with anomalously strong eastern U.S. ridging, but no corresponding upstream trough over the Great Lakes. Both major and minor events were associated with anomalously strong 700 hPa zonal flow over the Great Lakes. Low-level relative humidity was anomalously low for both types of events, but lowest for major events, while low-level temperatures were anomalously high for both types of events, but highest for major events.

Forecast Challenges in the NWS Albany, NY Forecast Area Associated with the Winter Storms of the 2009-2010 Season

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High impact winter storms during the 2009-2010 season provided considerable forecast challenges, due to large uncertainties depicted in Numerical Weather Prediction (NWP) and ensemble guidance with regard to the track and strength of the storms, and resultant sensible weather. Storms such as the December 2009 East Coast snowstorm, Post-New Year's Day 2010 snowstorm, and multiple historical east coast snowstorms in February and March 2010 highlighted the significant spatial and temporal differences associated with precipitation type, areal extent of the precipitation and the track and strength of each storm.

Each storm provided different forecast challenges in terms of predicting snowfall amounts, placement of maxima, and areal extent of precipitation shields. Examples of both spatial and temporal uncertainty in storm track and precipitation from multiple guidance sources associated with the winter storms will be presented. These uncertainties will be illustrated using ensemble data from the NCEP GEFS and SREF, and the higher resolution deterministic models. In addition to standard ensemble output, forecast anomalies often associated with significant winter storms will be presented.

The limitation of using a single deterministic solution is the lack of uncertainty information that can be derived from ensembles. This talk will illustrate how to leverage uncertainty information in the forecast process. Suggestions will be offered on how to interpret guidance to better understand uncertainty, and to better convey uncertainty information to the user community. The cases presented are excellent examples that demonstrate why forecasters should embrace and understand meteorological uncertainty information.

Ensemble Post-Processing and Its Potential Benefits for the Operational Forecaster

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Forecasters have access to a growing number of operational ensemble systems. However, there are a number of challenges with fully utilizing these ensembles, from how to integrate this probabilistic information into the forecast process to ensemble underdispersion. Raw ensemble output frequently exhibits deterministic and probabilistic biases, which can depend on the weather regime. This talk will detail how bias correction and Bayesian Model Averaging (BMA) improves ensemble forecast probabilities for surface temperature and precipitation over the Northeast United States. Additionally, case studies will be presented to demonstrate how BMA could be used in an operational setting.

The ensembles utilized in this study include the 13 members run at Stony Brook University (SBU) down to 12-km grid spacing around the Northeast U.S. and the 21-member Short Range Ensemble Forecast (SREF, 32 – 45 km grid spacing) run at the National Centers for Environmental Prediction (NCEP). These models include different initial conditions and physical parameterizations (convective parameterization, boundary layer, and microphysics) to increase member diversity. This study applies a spatially dependent cumulative distribution function (CDF) bias correction before BMA. The CDF bias correction adjusts the CDF of the model to the observation for each member before removing any lingering bias as a function of elevation. Thereafter, BMA calibrates the ensemble probabilities by estimating the uncertainty and weight of each member. This multi-model ensemble was verified using ASOS temperature observations and stage IV precipitation data for the 2007 to 2009 warm seasons (4/1-9/31).

This talk will detail how bias correction and BMA creates a well-calibrated and unbiased ensemble on the average when considering surface temperature and precipitation for all thresholds with a sufficient sample size. Additionally, BMA helps adjust the ensemble to create improved forecast probabilities. Since these probabilistic forecasts are now more reliable, weather forecasters can use them with greater confidence. Case studies will show how BMA can be applied in real time forecasting.

An Automated Rossby Wave Packet Tracking Program: Preliminary Climatological and Model Verification Results

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Rossby wave packets have been linked with high impact weather events, hemispheric regime transitions and large-scale flow predictability issues. Given the potential link between wave packets and forecast errors in NWP models, wave packets have been investigated for a variety of major events. However, no comprehensive and objective climatology of wave packets has been completed. In this study a feature based tracking algorithm was developed to produce the first such long term climatology, and some preliminary results will be shown to illustrate the potential benefits to operational forecasting.

The 300-hPa meridional wind from six-hourly NCEP/NCAR reanalysis from 1948 to 2009 was used to objectively identify wave packets. Wave packet amplitude (WPA) was found using a Hilbert transform technique along a time-averaged basic stream flow (Zimin, 2006). The WPA data was then spectrally filtered to wave numbers 1-8 to reduce the noise introduced by synoptic scale features. Peaks in the filtered WPA were tracked using the Hodges (1999) method previously applied to tracking tropical cloud clusters, cyclones and other phenomena (entitled TRACK). Because no automated algorithm can perfectly track features as large and diffuse as wave packets, a further algorithm (written in MATLAB) combined tracks related by their close proximity and direction of movement. The track data (position, intensity, velocity and time) for every identified wave packet in the reanalysis record are used to produce summary climatological statistics. WPA and track data from the NCEP/NCAR reanalysis and archived GFS operational forecasts are compared for days when there are large errors in the intensity of U.S. east coast cyclones in the medium (3-5 day) range. Differences in the average position of wave packets between cyclones that are under-deepened and over-deepened may illustrate the potential connection between certain model biases and wave packet activity.

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An Overview and Update of the HPC Medium Range Forecast Program

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This talk reviews the Hydrometeorological Prediction Center (HPC) Medium Range program, including recent efforts to improve gridded guidance. HPC meteorologists manually produce a 3-7 day forecast product suite. Two forecasters work in tandem to complete this task and coordinate with users after assessment of numerical, ensemble, and statistical guidance. Climatological data and verification diagnostics are also used. A main component of the HPC forecast suite includes production of a 4-7 day deterministic gridded forecast data sent twice daily at 5 km horizontal resolution for the continental United States in support of the National Digital Forecast Database (NDFD). Current forecast elements are daily minimum and maximum temperatures, 12 hour probability of precipitation (PoP), dewpoint temperature, wind speed and direction, sky cover, and weather type.

HPC forecasters have workstation access to gridded data from the ECMWF, UKMET, Canadian (CMC), NOGAPS, and operational and experimental runs of the GFS global models. Regional models include the NAM and DGEX. GEFS guidance and access to ECMWF, CMC, NOGAPS, and NAEFS ensemble guidance has become increasingly available to and embraced by HPC forecasters. Forecasters also use statistical guidance from Model Output Statistics (MOS). HPC adjustments are initiated on N-AWIPS workstations via graphical user interfaces that allow creation of numerically “blended” guidance calculated from user defined weighting of GFS and GEFS MOS values, the NDFD, prior HPC forecasts, and HPC derived ECMWF, CMC, and DGEX adjusted MOS values based upon their mass field differences with the GFS. Adjustments are supplemented by local and terrain defined manual and automated corrections. Forecast continuity is maintained within the constraints of weather pattern stability and forecast guidance variability and spread.

In April 2010 HPC implemented improvements to the method used to derive the medium range dewpoint temperature and sky cover grids, which have shown significant skill improvement. HPC has also prototyped enhancements to the medium range probability of precipitation (PoP) and weather grids. In particular, a 6 hour “Precipitation Likelihood Index Grid” has been developed, which is based on the HPC 12 h PoP and ensemble timing. This grid can be considered and used as a "floating PoP". The weather grid temporal resolution has been increased to every 6 hours and additional qualifiers (slight chance, chance) have been added. In addition, the precipitation type (weather) algorithm has been improved.

HPC is planning to implement several changes to the procedure used to downscale the medium range maximum/minimum temperature guidance. In addition to GFS/GEFS MOS related guidance and HPC/NDFD continuity, HPC forecasters will have the option to incorporate downscaled 2 meter model temperatures from an international model and ensemble suite. These parameter values do not gravitate toward climatology in a manner similar to MOS, but forecasters can reduce anomalies over time consistent with forecast spread/uncertainty. Verification studies from 2009-present show significant improvement inherent to these new procedures.

Using Short Range Ensemble Forecasts, Climate Anomalies, and High Resolution Model Guidance to Determine the Potential for Tornadoes across Parts of the Ohio Valley, New Jersey and New York City on 16 September 2010

Josh Korotky
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Forecast products from the Short Range Ensemble Forecast (SREF) and the Global Ensemble Forecast System (GEFS) are used with forecast output from the 3 km High Resolution Rapid Refresh (HRRR) and the 4 km NCEP NMM WRF models to identify severe weather potential across parts of the Ohio Valley, West Virginia, New Jersey, and New York City on 16 September 2010. This study demonstrates that SREF probability forecasts and deterministic high resolution model solutions shouldn't be considered as mutually exclusive approaches to forecasting. Rather, the strengths of each approach can lead to a better forecast of severe weather impacts. This case also illustrates the value of using forecast departures from climatology to highlight areas that are favorable for severe weather.

This study demonstrates a forecast strategy that uses 1) SREF probability forecasts to assess the likelihood, storm type potential, and predictability of the event; 2) SREF/GEFS forecast departures from climatology to evaluate the climatological context of the event; and 3) high resolution model output to determine the details of moisture, instability, lifting/forcing mechanisms, and convective mode (e.g., cellular, linear, etc.). This study also highlights a "model funnel" approach that employs ensemble data to evaluate event potentials in the extended and mid ranges of a forecast (days 2-7), and progressively higher resolution model output to assess the important details of the short term forecast (day 1).

Severe storms developed ahead of a cold front on 16 September, part of a surface system associated with a well defined mid level trough that tracked eastward across the eastern Great Lakes during the afternoon and evening hours. Preliminary reports indicate 19 tornadoes, 56 high wind reports, and 24 Hail reports across parts of Ohio, West Virginia, New Jersey, and New York City. High impact events included tornadoes that caused significant damage across parts of Ohio, West Virginia, and New York City.

Standard Anomalies to Identify High Impact Weather Events

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The role of standardized anomalies in identifying the potential for high impact weather events is presented. Four historic rainfall events including the 30-31 March 2010 New England Floods, the 5 May 2010 Nashville Floods, the July 2010 Pakistani Floods and the 30 September 2010 Mid-Atlantic heavy rainfall event are presented using re-analysis data. In addition to these rainfall events, the East Coast Heat wave of July 2010 and the Great Russian heat wave of July-August 2010 are presented from a standardized anomaly perspective.

Each event was associated with significant standardized anomalies in key parameters forecasters often use to identify such events. Quantifying the standardized anomalies facilitates quick assessment of the potential impact of these events. Two to 3 standard deviations in the precipitable water field combined with 3 to 4 standard deviations in the wind fields often aid in quickly identifying the potential for significant heavy rainfall events. Heat events are often characterized by 1 to 2 standard deviation above normal mid-tropospheric heights and 2 to 3 standard deviation above normal low to mid-level tropospheric temperatures.

A new method of displaying ensemble data is presented. This display method uses the probability distribution function (PDF) of ensemble forecasts of key standardized anomaly fields. The PDF information can facilitate the quick identification of the potential for high impact events. For heavy rainfall events, these PDF data can be used to tie the potential high impact pattern back to the high probability forecasts of heavy rainfall.

Community Environmental Networks for Risk Identification and Management

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Through a collaborative among faculty and students in Computer Science, Meteorology, and GIS/Geography, the Community Environmental Networks for Risk Identification and Management project was designed to create and specify the research protocol for an environmental information network for real-time decision making through the analysis and visualization of data from wired and wireless sensors, suitable for deployment in urban and residential communities, for use in risk identification and management. Through the use of an interactive GIS website such a network allows for real-time (or a planning mode) examination of variables and scenarios of interest (e.g., carbon dioxide levels or urban flooding) that are related to human (e.g., rail lines, highways, and population) and environmental (e.g., forests) systems.

These naturally include atmospheric conditions with regard to local conditions, transport, and the occurrence or approach of a critical threshold value or set of parameters that signify a particular phenomenon. Environmental information gathered using micro-scale sensor network architectural approach, in addition to using hand-held observational measurements and real-time user inputs through mobile devices were correlated with regional data available through weather and environmental agencies during the summer of 2010. Given the lack of spatiotemporal consistency, and the disparate sensitivities and calibration of sensors, there was a need for the production of analytic fields in addition to point observations so as to facilitate data mining techniques. These fields may be derived from archival data (e.g., Climate Diagnostics Center tool for diagnostic parameter fields) and numerical weather prediction models in order to identify initial and boundary conditions as well as forecast values.

The intent was to demonstrate the utility of an integrated database to address such limitations and to identify relationships, design alerts and produce visual broadcasts online through data mining, geospatial analysis, and geovisualization for public communication, educational and decision support; and for initiatives in support of training and outreach. A web-based prototype system is in preparation to publish the integrated GIS-based environmental information and to provide users with a means for data discovery for specific and individualized applications.

Operational Utilization and Evaluation of a Coupled Weather and Outage Prediction Service for Electric Utility Operations

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The distribution system of an electric utility, particularly with an overhead infrastructure, can be highly sensitive to local weather conditions. Power outages caused by severe weather events can have major impacts on such operations. Hence, the ability to predict specific events or combination of weather conditions that can disrupt that distribution network with sufficient spatial and temporal precision, and lead time has the potential to enable proactive allocation and deployment of resources (people and equipment) to minimize time for restoration.

Previously, we determined the viability of this idea and validated it by building upon the efforts at the IBM Thomas J. Watson Research Center to implement and apply an operational mesoscale prediction system to business problems, dubbed “Deep Thunder”. We have continued this effort in the New York City metropolitan area in several key ways, working with the emergency management group at a major utility company in the northeastern United States. In particular, we have deployed a coupled modeling system for outage prediction, in which the weather component is derived from a configuration of the WRF-ARW (version 3.1.1) community numerical weather prediction (NWP) model. It operates in a nested configuration, with the highest resolution at two km resolution focused on the utility’s service territory and that of its subsidiaries. The configuration also includes parameterization and selection of physics options appropriate for the range of geography within the service territory from highly urbanized to rural. It produces 84-hour forecasts, which are updated every twelve hours.

Based upon analysis of historical damage events and anecdotal evidence, it is clear that storm-driven disruptions of the overhead distribution network (e.g., poles and wires) are caused by physical interaction of the atmosphere directly with that infrastructure or indirectly via nearby trees. However, reliable modelling with sufficient throughput for operational utilization of such interaction is neither tractable from a computational perspective nor verifiable from observations. Given that and the relative uncertainty in the processes and data, we approached the outage prediction from a stochastic perspective.

Historical observations from a local, relatively dense mesonet operated by AWS Convergence Technologies were analyzed along with data from the utility concerning the characteristics of outage-related infrastructure damage from weather events, as well as the information about the distribution network and local environmental conditions. Data from this mesonet are also utilized to validate and improve the forecasts as well as model tuning. A Quasi-Poisson model was developed to forecast the number of jobs to be dispatched to repair outages for each substation area within the utility’s service territory. Since these areas are coarser than the computational grid for the aforementioned WRF configuration, this approach is effectively a statistical upscaling of the weather model to enable estimates for each of the three full days covered by each WRF execution. This approach also incorporates uncertainties in both the weather and outage data. Therefore, the model provides probabilities of outage restoration jobs per substation, which is associated with visualizations that explicitly depict the uncertainty.

Based upon the analysis of the historical data, one of the key linkages between outages and severe storms is the magnitude of wind gusts. However, the NWP model does not produce a direct representation of gusts. Therefore, a post-processing model was developed using a Bayesian hierarchical approach, which links the physical model outputs with real observations to create a calibrated, statistical representation of gusts. This model post-processes the sustained wind forecast on the topologically regular output generated by WRF based on the gust observations from the mesonet over time.

We will discuss the on-going work, the overall approach to the problem, some specifics of the solution, and lessons that were learned through the development and deployment. In particular, we will present how the content is being used and how we are evaluating its quality with respect to specific weather events that affect utility operations. This includes the validation methodology used for the weather and damage forecasts and deployment of customized visualizations. We will also discuss the overall effectiveness of our particular approach for these and related applications, issues such as calibration of data and quantifying uncertainty as well as recommendations for future work.

Application Of An Operational Meso-Scale Modeling System For Industrial Plant Energy Operations

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In our continuing work on the implementation and applications of a mesoscale modeling system dubbed "Deep Thunder", we examine its application for industrial plant energy management operations. The Deep Thunder system has provided 24-hour forecasts for several metropolitan regions in the United States for a number of years. It has recently been extended to enable up to 84-hour forecasts at a similar scale. Model forecasts, are typically updated twice daily with triply, nested grids down to the meso-gamma-scale. Explicit, bulk cloud microphysics are included in the model predictions to enable forecasts of potentially severe weather. All of the processing, modeling and visualization are completed in approximately one hour per 24-hours of forecast time on relatively modest hardware to enable sufficiently timely dissemination of forecast products for potential weather-sensitive applications.

Some of the recent extensions to Deep Thunder have included support for weather-sensitive operations at several major IBM facilities in the northeastern United States. These facilities range from large office complexes to research facilities and semi-conductor manufacturing plants. To enable environmental analytics relevant to such sites, we are investigating the use of high-resolution numerical weather prediction models in optimizing energy management strategies for smart building applications. The NWP model provides highly granular (temporally and spatially) predictive information (e.g., temperature) that is directly relevant for HVAC operations and electrical load shedding algorithms. As part of the work, we are attempting to quantify the potential for improving energy and cost savings for industrial building and site operations. We will discuss our overall approach to these issues, the specific site issues, and some of the results to date.

Microphysical Evolution Within Winter Snow Storms over Long Island, New York

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Predicting the magnitude and location of heavy snow bands is a challenging forecast problem over the Eastern U.S. There has been recent progress in our knowledge of the dynamical evolution of these snow bands, but only limited research on the microphysics within East Coast winter storms. The goal of this research is to determine the microphysical evolution and the factors that influence this evolution during several winter storms over Long Island, NY during the 2009-2010 winter season. In addition, the microphysical observations will be compared to model output from a few different Weather Research and Forecast (WRF) microphysical schemes. A vertically-pointing Ku-band radar was used to observe the vertical profile of reflectivity and Doppler velocity of the winter storms as they passed overhead. A PARSIVEL disdrometer was used to obtain particle sizes, fall speeds, and number concentration. A stereo microscope and camera were used to observe the snow crystal habit and degree of riming. Snow crystal identification followed Magono and Lee (1966). Snow depth and snow density were also measured.

The observed surface ice crystals and snow densities varied significantly during three heavy snowfall events partially due to different vertical temperature profiles. One snow event on 19-20 December 2009 produced widespread snowfall (48.3 cm) over Long Island and included a heavy snow band. Before the snow band, needles and columns were observed with light riming. During snow band maturity, stronger vertical motions resulted in primarily dendritic crystals with moderate to heavy riming. A transition to sector and plate-like crystals occurred as the band moved east of the observation location and the event concluded. The snow-liquid ratios varied from 9:1 before the band to 13:1 at maturity and 8:1 soon after the band. In comparison, other events produced heavy snowfall, but did not include a heavy snow band. The 10-11 February 2010 event produced heavy snowfall (34.3 cm) with mostly needle-like crystals observed. This was due to temperatures near -5°C in the lower levels of the atmosphere where vertical motions were maximized. Snow-liquid ratios varied from 4:1 to as high as 10:1. A colder thermal profile on 26-27 February 2010 (27.9 cm) and vertical motions in the 15°C to -20°C growth region led to mainly dendritic crystal types. Snow-liquid ratios varied from 8:1 to as high as 17:1. There are large microphysical differences in the WRF for the 19-20 December snowband event, with the Purdue Lin scheme producing mostly graupel while the WSM6 scheme has mainly snow.

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Examining the Damaging New England Windstorm of 25-26 February 2010 as a Shapiro-Keyser Cyclone

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The cyclone that affected northern New England on 25-26 February 2010 brought significant snow, flooding rain and damaging winds to the region. Wind damage was reported in New England from near Boston MA to Quoddy ME, and as far inland as Concord NH. In New Hampshire alone, almost 270,000 customers lost power as thousands of trees were downed, making it the second worst storm in terms of outages in the state.
Mid-latitude cyclones frequently produce strong winds in New England during the cool season.

Even so, storm damage of this magnitude is uncommon, even in New England. The timing of the damaging winds (late evening of 25 February and early morning of 26 February) and the wind direction (east to northeast) suggest that the cyclone that produced the damaging winds was not that of the traditional Norwegian cyclone model.

The structure of the cyclone more closely resembled that of the Shapiro-Keyser cyclone model, as the damaging winds were associated with the passage of a bent-back front. Shapiro-Keyser cyclones are rare across the east coast of North America; these cyclones are more common across Western Europe and the west coast of North America.

Forecasts from deterministic models earlier in the week indicated the potential for a significant storm across northern New England on or around 25 February 2010, though there were some differences in timing. All of the deterministic models did show that the surface low would develop in an area of large confluent flow, which is common for Shapiro-Keyser cyclones. As the event neared, short term ensemble forecasts indicated the potential for a high impact wind event between 0000 UTC and 1200 UTC 26 February 2010. The 1200 UTC 25 February 2010 NAM solution showed 925 mb and 850 mb U wind component anomalies between 4 and 5 standard deviation above normal for the date.

Surface observations, radar imagery and other real time tools were used to track the bent-back front across coastal sections of northern New England between 2100 UTC 25 February 2010 and 0900 UTC 26 February 2010.

WFO Binghamton Synoptic Flash Flood Classification Study

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In an effort to assist forecasters with identification of favorable flash flood producing environments, a synoptic classification study of flash flood events occurring in central New York and northeast Pennsylvania was completed following the Maddox classification scheme. In total, 42 events spanning a time period from the mid 1990s through present day were investigated and subjectively classified as either Frontal (7 events), Synoptic (20 events), or Meso High (2 events) type flash flood events. The classification was based on the 00/12 UTC 500 hPa patterns, the analyzed HPC surface map valid at the time the initial flash flood report, and local radar animations. For synoptic environments in which the upper level or surface pattern did not reflect the traditional synoptic patterns as described by Maddox, the events were labeled as Unclassified (10 events). In addition, if a flash flood event resulted from a remnant tropical circulation moving across the area, the event was classified as Tropical (3 events).

Using the local WFO Binghamton BUFKIT archive, NAM proximity soundings were analyzed using the forecast point closest to the initial report of flooding. Several variables were investigated to help establish values characteristic of each flash flood type. Preliminary results indicated that Synoptic flash flood type-producing environments displayed the strongest, most easily recognizable signals prior to the onset of flash flooding. Meanwhile the weaker more barotropic environments which were often characteristic of summer Meso High and Frontal flash flood events, displayed less recognizable variable signals.

Upon completing the classification of each event, daily mean anomaly composites were created for each type, using the NCEP/NCAR Reanalysis data from the Earth Science Research Laboratory (ESRL)/Physical Sciences Division (PSD) website. Preliminary results indicate that Synoptic type flash flood events, which often produced the most widespread flash flooding across the WFO Binghamton Hydrologic Service Area, were typically associated with large, mean variable anomaly departures from climatology. Meanwhile, for cases where the synoptic forcing was weaker and flash flooding more localized, mean variable anomaly departures were less extreme. These results support previous research which concluded that anomaly data could be used operationally by forecasters to help recognize favorable conditions for widespread flash flood producing environments 24-48 hours in advance.

Predictability of High Impact Weather during the Cool Season over the Eastern U.S: CSTAR Scientific Objectives

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NOAA Collaborators:
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The National Centers for Environmental Prediction
Hydrometeorological Prediction Center
Ocean Prediction Center
Environmental System Research Laboratory

Stony Brook University in collaboration with several NWS offices and NCEP operational centers has a new CSTAR project (http://dendrite.somas.stonybrook.edu/CSTAR/cstar.html) focusing on the predictability of high impact weather. Although forecasters have ensemble guidance available, it is often not used effectively since: (1) ensembles have not been comprehensively verified, (2) ensemble underdispersion and biases limit ensemble skill, (3) forecasters lack tools to understand the origin of ensemble spread and errors in realtime, and (4) forecasters have few ways to communicate uncertainty in their forecast products. This project will evaluate and improve operational ensembles for high impact weather and develop probabilistic tools for the forecaster. The project will also explore the predictability of extratropical cyclones (and associated Rossby wave packets) over the eastern U.S. and adjacent offshore waters for the 1-7 day predictions and select mesoscale phenomena associated with cyclones (1-2 day predictions), with particular emphasis on snow bands.

This presentation motivates this new CSTAR project by summarizing the various science issues and analysis tools. Some of the new real-time approaches to objectively track Rossby wave packets in operations will be noted. The ensemble issues will be highlighted by showing some verification of the Stony Brook ensemble and NCEP-SREF system. The need for ensemble post-processing and calibration will be motivated by showing the improvement gained by using a historical training dataset with similar weather days. The 19-20 December 2009 blizzard for Long Island will highlight some of the medium range predictability issues as well as the model parameterization uncertainties. The difficulties in predicting the microphysical evolution for winter storms has led to the development of a new bulk microphysical parameterization at Stony Brook for the Weather and Research Forecasting model, which is being tested using in situ vertically-pointing radar, parsivel (size distribution and fall speed), ice habit, and snow density observations at Stony Brook.

Predictability of High Impact Weather during the Cool Season over the Eastern U.S: CSTAR Operational Aspects

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Extratropical cyclones have major societal impacts on the northeastern U.S., particularly during the cooler months. These impacts can include flooding, heavy snow, high winds and coastal flooding. While meteorologists have studied these storms in great detail and vast improvements in forecast skill have occurred in recent years, prediction of mesoscale phenomenon within extratropical storms remains a major challenge. Stony Brook University and several National Weather Service (NWS) Weather Forecast Offices (WFO) have been awarded a Collaborative Science, Technology, and Applied Research (CSTAR) project that began in May 2010 to help address this operational forecast challenge.

The focus for WFO's participating in the CSTAR Project includes the development of ensemble data visualization software and techniques, as well as ensemble data applications to aviation, storm surge and coastal flooding forecasting. The ultimate goal is the improvement in operational forecaster understanding of uncertainty and how to communicate those uncertainties. The four WFO's that are participating in the project (New York NY, Philadelphia PA, Pittsburg PA and State College, PA) will share their results through conference participation, training presentations and publications. This presentation will highlight the WFO activities planned for this CSTAR project and highlight the early training activities and efforts to improve visualization of ensemble forecast systems.

A 16-year Climatology of Ice Storms in WFO Albany's County Warning Area and a Comparison of Two Recent Events

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Ice storms are a relatively common occurrence in the northeast United States, and have a significant societal impact. This presentation will examine the ice storm climatology from 1993 through 2008 across eastern New York and adjacent western New England, including a frequency and areal distribution analysis. Two specific case studies within this ice storm climatology where ice accretion impacted the Albany County Warning Area (CWA) will be examined in depth, the Martin Luther King Day 2007 storm, and the 11-12 December 2008 ice storm. Sounding data, forecast thermal profiles, surface analyses, low level wind fields, radar and satellite data, and ice accretion measurements will be presented. In addition, the societal impacts of these storms will be discussed.

Between 1993 and 2008, twenty seven ice storms occurred within the Albany CWA, which covers eastern New York and adjacent western New England. This results in an average of 1.7 ice storm events per year. Within this area, the highest concentration of ice storm events occurred across the Lake George-Saratoga region.

A composite 300 hPa wind vector analyses for this dataset showed a distinct upper level jet stream maxima across southeast Canada. This placed the Albany CWA within the right entrance region of the thermally direct circulation, a location for favorable enhanced northerly ageostrophic wind, and shallow low level cold air advection. In addition, the composite analyses indicated a plume of anomalously high precipitable water (PWAT) extending from the mid-Mississippi Valley into the upper Ohio Valley and northern Appalachians.

The two specific case studies to be shown, while having differences in surface low tracks and origins, exhibited an upper level jet stream maxima and PWAT anomalies consistent with the composites for the entire ice storm climatology. The Martin Luther King Day 2007 Storm tracked from the Ohio Valley toward the northeast, while the 11-12 December 2008 Storm was a "Miller A" coastal storm with Gulf of Mexico origin.

MCS Organization and Development Along Land/Lake-Induced Thermodynamic Boundaries near Lake Superior

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Horizontal potential-temperature gradients near the periphery of large lakes can play an important role in the formation and evolution of severe weather-producing mesoscale convective systems (MCSs). These mesoscale, thermodynamic boundaries often form during the warm season near the shores of the Great Lakes due to differential heating of the land and lake surfaces. An intense land/lake boundary can combine with synoptic features favorable for convection (e.g., a low-level jet and upper-level divergence) to enhance local forcing for ascent, which can in turn induce convection and MCS organization near the lake. This study will focus on a radar climatology and observational and WRF-simulated case studies which elucidate pathways for MCS organization and development near the Great Lakes during the warm season.

The climatology will highlight some of the most important conditions for MCS initiation near the Great Lakes, including the magnitude and location of the surface boundary and the presence of a low-level moisture source. Then, a case study and high-resolution model simulations of an intense MCS which developed along the southern shore of Lake Superior will illustrate the importance of and interactions among the land/lake surface boundary, the magnitude and direction of the low-level jet and wind shear, and the prevailing synoptic environment. These results will show that accurately resolving near-surface boundaries and features is especially important for proper diagnosis and prognosis of near-lake MCS development.

The 2010 "PRE-Season" In Review: A Look at Tropical Cyclones Earl, Hermine, and Nicole

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Despite an above average number of named storms in the Atlantic Basin during the 2010 tropical season, Predecessor Rainfall Events (PRE) were infrequent across the central and eastern United States. The relative lack of PRE development can be attributed mainly to the large distance of many of these tropical cyclones from the United States mainland. In addition, the large-scale flow patterns in which the storms were embedded, often were not favorable for PRE development.

This presentation will take a closer look at three separate tropical systems, which did approach the U.S. coastline, or officially made landfall. Each of these tropical cyclones was very distinct, with regards to PRE formation.

The first of these was Hurricane Earl. Earl made its closest approach to the U.S. on 3-4 September, tracking just east of the Outer Banks in North Carolina and also Cape Cod, before ultimately reaching the Canadian Maritime provinces. No PRE development occurred over the eastern United States during this period.

Tropical Storm Hermine made landfall near the border of Mexico and southern Texas on 7 September, before gradually dissipating over central Texas from 8-9 September. While torrential rainfall (locally 10 in.+) was directly associated with Hermine over southern and central Texas on 7-8 September, a PRE also occurred over northern Arkansas, where a separate band of 4-7 in. rainfall occurred.

Tropical Storm Nicole formed over the northwestern Caribbean Sea on 28 September, and then tracked across central Cuba, before weakening near the southern Bahamas on 29 September. As deep-layered tropical moisture was transported northward from the vicinity of Nicole, very heavy rainfall (locally 10 in. +) impacted the eastern United States during 28-30 September, from North Carolina northward into New York State. However, this heavy rainfall episode did not strictly meet PRE criteria. Nonetheless, this was a high-impact flooding event for portions of the Mid-Atlantic and Northeastern states.

For tropical cyclones Earl and Hermine, synoptic-scale ingredients that enhanced or mitigated PRE formation will be reviewed. Comparisons will also be made to composite charts and conceptual models, constructed from the latest PRE research. As for the heavy rainfall loosely attached to the remnants of Nicole, similarities and differences to established PRE criteria will be noted.

"Southerly or 'Reverse' Mohawk Hudson Convergence Cases"

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The Hudson Mohawk Convergence was identified as a localized meteorological effect that can prolong winter snowstorms (Augustyniak 2008), and occasionally spawn convection (Johnson 2009) in the absence of the synoptic forcing associated with a cold front or other low level forcing. In the warm season this convection usually forms close to the apex of the Hudson and Mohawk Valleys. This phenomenon has been called Southern Mohawk Convergence since it appears that low level convergence may be produced by a difference in low level wind, which is west or southwest to the west of the Hudson Valley, versus a south or even southeast wind in the Hudson Valley.

The difference in wind direction might be sufficient to initiate convection in the Hudson Valley, perhaps up to six hours ahead of when synoptically forced convection would take place. This difference in wind direction may lead to low level convergence as well as moisture pooling in the Hudson Valley. Previous studies (LaPenta and al. 1999) indicated that low level wind shear increased in the Hudson Valley with this difference of surface wind flow between the Hudson Valley and terrain to its west.

The combination of increased dewpoints and low level shear has also been observed to enhance convective cells after they develop in the Hudson Valley, even in the absence of upslope flow. This enhancement has lead to non-severe pulse or air mass thunderstorms, occasionally transforming into supercells or bow echoes.

A forecast algorithm has been developed to indentify when Southern Mohawk Convergence (and/or enhancement) might take place. Case studies and the forecast algorithm will be discussed.

An Overview of the Northeast River Forecast Operations and Services and its migration to the Community Hydrologic Prediction System; "It's not your Grandfather's RFC anymore"!

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The Northeast River Forecast Center (NERFC) began operations in 1955, just one month prior to the devastating floods of Connie and Diane. Over the past 55 years, the NERFC has experienced numerous changes to its modeling approaches and forecast system structure, but none quite as remarkable as its current migration to the Community Hydrologic Prediction System (CHPS). The NERFC during its history has infused new science, refined river modeling applications, changed rainfall-runoff modeling approaches and experienced the dramatic change from using only observed precipitation in its modeling to utilizing Quantitative Precipitation Forecasts. Most recently, the center has incorporated NWP Ensemble output into its streamflow forecast scheme, all in an effort to improve decision support services.

Connections to Collaborative Science, Technology and Applied Research (CSTAR) activities have been many; none more pronounced and significant than NERFC's participation in the study of Heavy Rainfall Associated with Land-falling Tropical Cyclones in the Northeast U.S. Of all the variables encountered as part of the forecast process, rainfall forecasting remains the most challenging and remains our greatest source of error in the forecast process.

River Forecast Centers by their nature are unique as they are part development center and part forecast center. In the past few years, NERFC has found itself participating in a number of unique activities, many of which have had limited visibility, but truly illustrate the unique capabilities of River Forecast Centers. Activities include dam break and ice jam modeling, tidal and storm Surge modeling, dam removal and river restoration activities and even harmful algal bloom forecasting.

This presentation will review NERFC day to day operational responsibilities and will review some of the more unique projects being worked on. The presentation will also address the center's CSTAR participation and areas for collaboration with our academic partners as CHPS becomes operational. The presentation will also provide a live demonstration of CHPS, illustrating its tremendous capabilities.

Synoptic and Mesoscale Processes associated with Predecessor Rain Events ahead of Tropical Cyclones

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Predecessor rain events (PREs) are distinct mesoscale regions of heavy rainfall that develop approximately 1000 km poleward and in advance of landfalling tropical cyclones (TCs), and approximately 24–36 h before the passage of the main rain shield associated with the TC. PREs develop as a continuous poleward-moving stream of deep tropical moisture emanating from the TC encounters a region of atmospheric lifting to produce heavy, prolonged rainfall. PREs present a forecast challenge because they have the potential to cause significant inland flooding, given that they are typically characterized by large rainfall totals (>100 mm in 24 h). Additionally, an increased risk of flooding is posed if the TC rain shield subsequently passes over the region previously affected by the PRE. The objectives of this presentation are to: (1) document, through PRE-relative composite analysis, key synoptic-scale features in the environments of PREs in order to establish distinctive scenarios for PRE development, and (2) examine, through a case study of a PRE associated with TC Ernesto (2006), processes associated with PRE development and maintenance.

In order to investigate their preferred synoptic-scale environments, PREs occurring during 1988–2008 are stratified into three distinct categories: "jet in ridge," "southwesterly jet," and "downstream confluence," based upon the configuration of the upper-tropospheric flow within which the TC is embedded. PRE-relative composites are presented to elucidate key dynamical processes in each category. While the composites indicate the importance of a poleward-moving stream of deep moisture from the TC, a low-level baroclinic zone, and an upper-level jet streak, the location, orientation, and magnitude of these key synoptic-scale features differ markedly among the three PRE categories. Our results are therefore suggestive of three distinct flow configurations favoring PRE development.

Synoptic and mesoscale processes associated with PREs are elucidated through a case study of a high-impact "downstream confluence" category PRE (event rainfall totals >100 mm), which occurred during 30–31 August 2006 in advance of TC Ernesto. This PRE developed in central and eastern North Carolina and Virginia as a poleward stream of deep tropical moisture (precipitable water values ~50 mm) interacted with a stalled cold front and a region of cold-air damming beneath the equatorward entrance region of a 200-hPa jet streak. Through the duration of the PRE, lifting within a mesoscale region of enhanced baroclinicity on the southeastern flank of an evaporationally generated cold pool provided a focus for the continuous development of stratiform and convective rainfall. Subsequently, significant flooding occurred as TC Ernesto (and its associated rain shield), aided by weak southwesterly steering flow, moved poleward over

The Impact of the Saint Lawrence Valley on the Precipitation Distribution Associated with Extratropical Transitions, 1979-2008

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Recent work (i.e. Carrera et al. 2009; Razy 2010) has documented the role that the St. Lawrence River Valley (SLRV) can play in modulating the surface wind regimes. While the influence of the SLRV has long been thought to be important in relation to the modulation of precipitation type, particularly with reference to freezing rain events, several recent tropical systems (Katrina, Rita 2005, Ike 2009) impacting the SLRV in general and Montreal in particular, have highlighted that fact that this relatively shallow topographic feature can also have a significant impact on the modulation of precipitation amount as well. In fact, the relatively low static stability air characteristic of the warm season in general and particularly with tropical cyclones, helps facilitate large responses in the vertical circulation for relatively shallow forcing mechanisms. Consequently, our purpose is to isolate dynamical processes associated with heavy precipitation events over Montreal, and to quantify the contributions or lack thereof from tropical storms and wind channelling along the Saint Lawrence Valley.

Initially, a heavy precipitation dataset using Environment Canada Climate data online daily accumulated precipitation and National Weather Service National Hurricane Center archive of Hurricane season from June1st-November 30th of 1979-2008 was created to help identify relevant extreme precipitation events associated directly or indirectly with tropical cyclones. Preliminary results show hurricanes ranked top one or two of eleven out of twelve years and 80% of heavy precipitation events in September are associated with tropical cyclones. These events were then partitioned on the basis of the 500 hPa flow regime in order to try and create "synoptic types" which display distinct dynamic and thermodynamic signatures. Five "synoptic types" were created including: zonal flow, amplified flow, 500mb trough west of Montreal, 500mb trough over Montreal and an Alberta-Clipper type pattern.

An overview of the dynamic and thermodynamic structures associated with the various synoptic-types will be presented. An initial examination of these types suggest that the less amplified flows are often associated with more statically unstable conditions as well as larger moisture transports from tropical or subtropical locations, while the amplified flows are less dependent on the thermodynamic structure of the air mass involved. However, the more meridional flow types were often characterized by near-surface frontogenesis that is focused along the SLRV, suggesting that the Valley may play a significant role in focusing or enhancing the precipitation along the valley for these types of events.

Extreme Weather Events over the Northern Hemisphere during Winter 2009-2010

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The large-scale circulation over the Northern Hemisphere (NH) during winter 2009-2010 was dominated by a strongly negative (3-5 standardized anomalies) Arctic Oscillation (AO). Blocking that began over the North Pacific in early December in conjunction with "ridge-building" ahead of recurving and transitioning tropical cyclones over the western North Pacific culminated in the formation of a strong high-latitude ridge over Alaska. High-latitude blocking subsequently expanded to the North Atlantic where it continued intermittently into February. The winter of 2009-2010 was noteworthy for extreme weather over North America (storminess over the southern U.S., epic snowstorms in parts of the eastern U.S, damaging cold in Florida), western Europe (persistent snow cover and cold weather), and eastern Asia (extreme cold) that occurred in conjunction with the strongly negative AO teleconnection pattern, the associated high-latitude blocking events, and a moderate El Nino event.

The purpose of this presentation will be to examine how intraseasonal variaibility arising from the strongly negative AO pattern and associated persistent high-latitude blocking contributed to episodic extreme weather events that helped to determine the location, sign, and magnitude of the seasonal temperature and precipitation anomaly patterns during winter 2009-2010. The winter of 2009-2010 over the NH is a textbook example of how tropical and midlatitude flow interactions govern intraseasonal variability.

Forecasting the Inland Extent of Lake-Effect Snow Bands

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Much research has been devoted to better understanding processes that govern lake-effect snow (LES) band development in the last 20-30 years. However, one aspect that has received comparatively little attention is the inland extent of such features. The focus of this project is two-fold: First, to identify atmospheric parameters which have the greatest bearing on how far inland LES bands travel. Secondly, to develop techniques to assist operational meteorologists in the forecast process.

A number of different LES events were studied from 2006-2009 in the Eastern Great Lakes region (mostly Lake Ontario and some Lake Erie bands). From these cases, different parameters were analyzed using statistical correlations at strategically placed data points within, and just outside of LES bands, to determine which parameters consistently had the most influence on inland extent.

The three parameters that correlated most strongly to the inland extent of LES bands were the existence of a multi-lake/upstream moisture connection (as judged by satellite and radar imagery), mixed-layer stability (represented by Lake-850 hPa and Lake-700 hPa temperature differentials), and mixed-layer speed and directional shear. In general, an environment favorable for greater inland extent of LES bands was characterized by a strong, well aligned flow in the mixed-layer, and only conditional terrestrial instability (moderately to extremely unstable environments seemed to produce more diffuse banded structures, which did not penetrate inland very far). LES bands that featured a multi-lake connection (MLC) had a much greater tendency to progress farther inland, as compared to those without an upstream moisture source. Also, favorable environments featured strong 0-1 km speed shear, with little shear in the 1-3 km layer.

Synoptic patterns for LES environments were classified into four different event types: MLC present with conditional instability, MLC with moderate/extreme instability, no MLC with conditional instability, and no MLC with moderate/extreme instability. The category which resulted in the greatest inland extent was MLC with conditional instability, yielding an average distance of close to 120 miles inland from the Lake Ontario shore. The other categories resulted in lesser inland extent, with varying distances generally averaging only around 50 miles.

Based on the results, an AWIPS forecasting application has been developed, which provides forecasters a reasonable first approximation of inland extent, given favorable conditions for LES. This technique specifically includes several of the most strongly correlated parameters. Plots of sea-level pressure, 850 hPa, and 700 hPa patterns that favor multi-lake connected LES bands for different flow regimes have been developed and will be utilized in the forecast process.

Use of the Albany Hail Study to Predict Large Hail During the 21 July 2010 Severe Weather Event

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The National Weather Service has changed the criteria for severe hail from 0.75 in. (1.9 cm) to 1.00 in. (2.5 cm) as of 5 January 2010. Many techniques have been developed for forecasting severe hail, such as the Vertically Integrated Liquid (VIL) of the Day method, VIL density and using reflectivity echo (dBZ) heights relative to the -20°C level. However, these are all based on the legacy 0.75 in. severe hail criteria. Previous studies have also been based on combined large hail and severe wind reports. In an attempt to better forecast hail with the new criteria in place, the Albany (ALY) hail study has been an ongoing research project that examined over 330 hail reports from the NWS Albany County Warning Area (CWA) from 2005-2010. This study has determined the reflectivity echo height at various dBZ thresholds (50, 55, 60 and 65 dBZ), as well as gridded VIL, Storm Echo Top (ET), VIL Density and several other parameters at a storm-scale level. The study also calculated mean and median values for severe hail from this dataset, which would be potentially useful to a warning forecaster in an operational setting.

In order to evaluate the use of these data, the results of the ALY hail study were applied to a case from 21 July 2010. This date was chosen because it featured both severe and non-severe hail, resulting from thunderstorms in the form of supercells and multi-cellular clusters. The freezing level and height of the -20° Celsius isotherm, based off the 18 UTC KALB upper air sounding were at typical levels for warm season convection in the Northeast. According to local storm reports entered into *StormData*, these storms produced 9 reports of severe hail, 34 incidents of wind damage and a tornado in the ALY CWA. This event was analyzed to see how well the average and median values from the hail study correlated to the storms responsible for producing both severe and non-severe hail.

An analysis of a supercell that moved across Litchfield County, Connecticut depicted dBZ thesholds consistently several thousand feet higher than both the mean and median of severe storms in the database for each of the various measured threshold levels. The storm also featured VIL values above the average for storms in the database with a similar thermodynamic environment. Incidentally, this storm produced hail up to 1.75 inches (4.4 cm) in diameter. Conversely, another supercell that impacted Berkshire County, Massachusetts was shown to have dBZ thesholds generally below the average values of severe storms collected in the hail study for the majority of its lifecycle. This storm produced hail only up to 0.50 inches (1.3 cm) in diameter. WSR88-D radar data was utilized from the KENX in East Berne, New York and KOKX in Upton, New York.

A storm-scale analysis of each of these storms will be presented as an examples of how the application of the hail study values, in conjunction with other methods of storm interrogation of both base and derived radar products, can be used in an operational setting for increased confidence in the occurrence of severe hail.

High-Impact Weather and Reduced Predictability over the United States Associated with the Recurvature of Western North Pacific TC Malakas (2010)

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As a tropical cyclone (TC) recurves into the midlatitudes, its divergent anticyclonic outflow can perturb the midlatitude jet stream such that a Rossby wave train is excited. Downstream development accompanying the wave train may then lead to high-impact weather associated with the onset of large-scale flow anomalies, as well as to reduced predictability. This presentation will illustrate how the recurvature of western North Pacific TC Malakas and the resulting downstream development served as an antecedent to record-setting heat in the western U.S. and heavy rain along the U.S. east coast between 26 September and 1 October 2010. Dynamical and physical mechanisms for the observed increase in deterministic model forecast error and ensemble model spread over the U.S. during this period will also be explored.

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