Agenda
Northeast Regional Operational Workshop XIV
Albany, New York
Tuesday, December 10, 2013

10:00 am
Welcoming Remarks
Raymond G. O'Keefe, Meteorologist In Charge
Warren R. Snyder, Science & Operations Officer
National Weather Service, Albany, New York

Session A – Warm Season Topics

10:10am - (Presenting in person)
A Historical-analog-based Severe Weather Checklist for central New York and Northeast Pennsylvania
Michael Evans
NOAA/NWS Forecast Office, Binghamton, New York

10:30am – (Presenting in person)
The Utility of Considering Dual-Polarization Radar Signatures in the Tornado Warning Process
Michael L. Jurewicz
NOAA/NWS Weather Forecast Office, Binghamton, New York

10:55am – (Presenting in person)
A Preliminary Examination of Low Topped Supercells That Produce Tornadoes in the Binghamton, New York County Warning Area
Erik Heden
NOAA/NWS Weather Forecast Office, Binghamton, New York

11:20 – (Presenting in person)
The Use of GOES 7.4 µm Sounder Imagery for Severe Weather Detection:
2012 and 2013 Northeastern U.S. Examples
Christopher M. Gitro
NOAA/NWS Weather Forecast Office, Binghamton, New York

11:45am – (Virtual presentation)
Comparison of Radar-Derived Rainfall Estimates
For Heavy Precipitation Events
Mitchell Gaines
NOAA/NWS Weather Forecast Office, Mount Holly, New Jersey

12:10pm - Lunch

1:30pm – (Presenting in person)

A Comparison of Polarimetric Radar and Legacy-Based Radar Techniques from the 21 May 2013 Severe Weather Event across Eastern New York and Western New England

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

1:55pm - (Presenting in person)

Regional Variability and Frequency of Thundersnow Events over the Contiguous United States

Kyle J. Meier
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York

2:20pm - (Presenting in person)

A Storm-Scale Analysis of the 29 May 2013 Tornado Event across East-Central New York

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

2:45pm – (Presenting in person)

The Role of Boundary Layer Variability in Fire Weather and Aviation Forecasting Across Eastern New York and Western New England

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

3:10pm - Break

Session B – Sandy and Irene

3:35pm – (Virtual presentation)
Extracting Quantifiable Information From Social Media in the Wake of Hurricane Sandy
Oleg Aulov
Center for Hybrid Multicore Productivity Research
Dept. of Computer Science and Electrical Engineering
University of Maryland, Baltimore, Maryland

4:00pm - (Presenting in person)
Meteorological Factors that Resulted in Extreme Rainfall During Tropical Storm Irene
Joseph P. Villani
NOAA/NWS Weather Forecast Office, Albany, New York

4:25pm - (Presenting in person)
The Hydrology of Tropical Storm Irene
Britt E. Westergard
NOAA/NWS Weather Forecast Office, Albany, New York

4:50pm (Virtual presentation)
Forecast Performance of an Operational Mesoscale Modeling System for Tropical Storm Irene and Post Tropical Storm Sandy in the New York City Metropolitan Region
Anthony P. Praino
IBM Thomas J. Watson Research Center
Yorktown Heights, New York

5:15pm
Adjourn

Agenda
Northeast Regional Operational Workshop XIV
Albany, New York
Wednesday, December 11, 2013

Session C – Cold Season & General Session

9:30am – (Virtual presentation)
Operational Changes in the Winter Weather Forecasts at the Weather Prediction Center (WPC)
Dan Petersen
NOAA/NWS National Centers for Environmental Prediction, Weather Prediction Center

9:55am – (Virtual presentation)
Climatology and Predictability of Cool-Season High Wind Events in the New York City Metropolitan and Surrounding Area
Michael Layer
School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, New York

10:20am – (Virtual presentation)
A Microphysical and Polarimetric Review of the Evolution of the Northeast Blizzard of 8-9 February 2013
David Stark
NOAA/NWS Weather Forecast Office, Upton, New York

10:45am - (Presenting in Person)
Examination of the Thermodynamic and Microphysical Evolution of the Northeast Blizzard of 8–9 February 2013
Sara A. Ganetis
School of Marine and Atmospheric Sciences
Stony Brook University, Stony Brook, New York

11:10am - (Virtual presentation)
Advanced Linux Prototype System (ALPS) – Ensemble Tools for the Future ?
Jeffrey S. Tongue
NOAA/NWS Weather Forecast Office, Upton, New York

11:35pm - (Virtual Presentation)
A Composite Study of Snow Squall Environments: Forecasting and Hazard Mitigation
Peter C. Banacos
NOAA/NWS, Weather Forecast Office, Burlington, Vermont

12:00 noon
Lunch

1:30pm – (Presenting in person)
The Foundering of the HMS Ontario
Robert Hamilton
NOAA/NWS Forecast Office, Buffalo, New York

1:55pm – (Presenting in person)
The November 1913 Great Lakes Superstorm
Robert Hamilton
NOAA/NWS Weather Forecast Office, Buffalo, New York

2:20pm – (Presenting in person)
Improving the Quantitative Precipitation Estimate for Dual Polarization Hydrometeors Classified as Dry Snow
Aaron Reynolds
NOAA/NWS Weather Forecast Office, Buffalo, New York

2:45pm – (Presenting in person)
Validation of Planetary Boundary Layer Parameterizations over the Coastal Ocean of Southern New England Using the IMPOWR Field Campaign
Matthew J. Sienkiewicz
School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, New York

3:10pm (Presenting in person)
Enhancement of Integrated Decision Support Services in Southern New England
Rebecca Gould
NOAA, NWS Weather Forecast Office, Taunton, Massachusetts

3:35pm
Break

4:00pm (Presenting in person)
Impacts of Rossby Wave Packets on Forecast Uncertainties and Errors
Brian A. Colle
School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, NY

4:25pm (Presenting in person)
Towards the Usage of Post-processed Operational Ensemble Fire Weather Indices over the Northeast United States
Michael Erickson
School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, New York

Session D – UAlbany & CSTAR

4:50pm – (Presenting in person)
Characteristics of Northeast Winter Cyclones Associated With Significant Upper Level Easterly Wind Anomalies
Adrian N. Mitchell
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

5:15pm – (Presenting in person)
An Overview of the Ontario Winter Lake-effect Systems (OWLeS) campaign: winter 2013-14
Justin R Minder
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

5:40pm – (Presenting in person)
The Motion of Mesoscale Snowbands in Northeast U.S. Winter Storms
Jaymes S. Kenyon
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

6:05pm – (Presenting in Person)
An Analysis of the Intense Arctic Cyclone of August 2012
Adam H. Turchioe
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

6:30pm
Wrap Up - Warren R. Snyder
Adjourn

NROW XV will be held November 12-13, 2014 in the CSTEM Auditorium

A Historical-analog-based Severe Weather Checklist for central New York and northeast Pennsylvania

Michael Evans and Ron Murphy
NOAA/NWS Forecast Office, Binghamton, New York

This presentation shows an operational severe weather checklist developed at the National Weather Service Forecast Office in Binghamton, New York (WFO BGM). The checklist contains two sections; a traditional severe weather parameter data entry section, and a historical analog retrieval section. Parameters on the checklist are related to large-scale forcing, stability, wind shear and moisture. The analog retrieval portion of the checklist returns information on five historical events that are analogous to current conditions, based on data entered into the checklist. An example of the utility of the checklist is shown for a major severe weather event on 28 April, 2011, which featured numerous severe weather reports in the WFO BGM county warning area, including seven tornadoes. The top analog retrieved by the checklist for this case was associated with a major tornado outbreak, and another analog also featured multiple tornadoes. These results indicated the potential for a major severe weather event, including tornadoes. Results from a verification study on the similarity between observed events and corresponding analogs indicate that the system can help forecasters to anticipate convective mode, and discriminate between major and null events. The system also appears to provide useful guidance on the potential for tornadoes and convective flash flooding, and appears to exhibit some ability to determine whether events will be dominated by wind or hail.

The Utility of Considering Dual-Polarization Radar Signatures in the Tornado Warning Process

Michael L. Jurewicz, Sr. and Christopher Gitro
NOAA/NWS Weather Forecast Office, Binghamton, New York

Prior research (Crowe, et. al 2012) has shown that the combined radar signatures of differential reflectivity (Zdr) and specific differential phase (Kdp) helped identify regions of enhanced lower-tropospheric shear/tornadic potential, within varied thunderstorm environments across the southern United States in 2010-2011. The specific radar signatures included an arc-shaped region of enhanced Zdr, typically located along the front inflow side of the storm; as well as an enhanced area of Kdp, typically located deeper into the mesocyclone, and left of the aforementioned Zdr arc/maximum.

Other earlier work (Kumjian and Ryhkov 2007, 2008a, and 2009; Romine 2008; Crowe 2010) demonstrated that the physical reasoning for the development/locations of Zdr arcs and Kdp maxima involved preferential drop size sorting. Conceptually, both relatively high values of Zdr and low values of Kdp on the forward (typically eastern) side of the mesocyclone imply a smaller concentration of large rain drops. Such large drops would tend to fall more rapidly, thus decreasing their residence time in the storm. Conversely, both relatively high values of Kdp and low values of Zdr imply a higher concentration of smaller rain drops. Such smaller drops would have a greater residence time in the storm, thus having a better opportunity to be advected by the strongly sheared flow into the rear (typically western) portions of the mesocyclone.

Based on the initially promising results (Crowe, et. al 2012), a number of events in the Northeastern United States featuring favorable synoptic environments for tornadic supercells, in which tornado warnings were issued and/or tornadoes occurred, were interrogated. For these cases, qualitative storm-scale assessments were made on the relative positions of Zdr arcs/maxima versus Kdp maxima, and also specific separation distances in nautical miles (nmi) between the two. For tornadic storms, an evolution featuring a separation between Zdr arcs/maxima and Kdp maxima, with the Kdp maxima typically juxtaposed to the rear/left of the Zdr arcs/maxima was quite common. For non-tornadic storms, Zdr and Kdp maxima were either collocated for the life cycle of the mesocyclone, or the Kdp maxima were displaced slightly to the right/eastern sides of Zdr maxima. These preliminary results favorably match those demonstrated across Alabama and the Tennessee Valley region (Crowe, et. al, 2012).

A Preliminary Examination of Low Topped Supercells That Produce Tornadoes in the Binghamton, New York County Warning Area

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

Low- topped supercells have produced several tornadoes in recent years in the Binghamton, NY county warning area (CWA). The impetus for this study was to improve detection of low-topped supercells and their resultant tornadoes in the Binghamton, NY CWA, since the CWA averages about 1 low-topped supercell event per year where at least 1 tornado occurs. In this study three recent cases were examined, 29 July 2011, 23 June, 2010, and 29 July 2009, where a total of 3 EF1 and 2 EF0 tornadoes occurred in association with low-topped supercells. A summary of these three cases shows the storms that produced tornado damage had maximum 50 dBZ heights averaging just over 20,000 feet, confirming they were low-topped in nature. Similar values of low level shear included 0 to 1 (km) bulk shear values of 20 (kts) or greater, 0 to 1 km storm-relative helicity (SRH) of 100 $m^2 s^{-2}$ or greater and 0 to 3 SRH values of 200 $m^2 s^{-2}$ or greater. In addition lifting condensation level heights were 1000 (m) or lower and Convective Available Potential Energy (CAPE) values of 750 J kg^{-1} or greater.

This data was compared to two recent cases, a low-topped supercell that produced an EF1 tornado on July 27th, 2013 in Steuben County, NY and a null case from the following day where no tornadoes were reported despite a similar synoptic environment. The results of the comparison showed that favorable parameters for low topped supercells to support tornadoes in the Binghamton, NY CWA include 0-1 km shear values of 20 kts or greater, 0-1 SRH of 100 $m^2 s^{-2}$ or greater, 0-3 SRH of 150 $m^2 s^{-2}$ or greater, and LCL heights 1000 m or lower.

The Use of GOES 7.4 µm Sounder Imagery for Severe Weather Detection: 2012 and 2013 Northeastern U.S. Examples

Christopher M. Gitro
NOAA/NWS Weather Forecast Office, Binghamton, New York

With a substantial amount of forecaster training focused on radar and model data interpretation, the use of satellite data for hazardous weather operations can often be overlooked. For example, it has been shown that data from the GOES Sounder 7.4 µm channel can be useful for the detection of elevated mixed layers, which have a well-documented history of producing significant severe weather across the U.S. (Carlson et al. (1983); Ferrell and Carlson 1989; Banacos and Ekster 2010). During the recent convective season, several episodes of severe weather associated with elevated mixed layers occurred across the Northeastern U.S., and a few of these cases will be shown to emphasize the utility of using 7.4 µm imagery for severe weather operations.

In addition to the 2013 convective season, a significant severe weather episode developed across the BGM forecast area on 26 July 2012. On this day, 7 tornadoes were confirmed across the Southern Tier of central New York and northeastern Pennsylvania, with an EF-1 rated tornado occurring within the city limits of Elmira, New York. It will be shown that this event was associated with an elevated mixed layer which was readily identifiable on GOES 7.4 µm Sounder imagery. Furthermore, additional review of this event indicated that the developing convection initiated along the leading edge of the elevated mixed layer plume, in a well-pronounced gradient of highly unstable air to the south and more stable air to the north. It is believed that moist unstable air trapped below the elevated mixed layer was laterally transported north to an area where no capping existed aloft through a process known as "underrunning." This process occurs when the boundary layer ageostropic wind component normal to the capping inversion increases due to the presence of a jetstreak induced direct thermal circulation aloft. While the topic of elevated mixed layers has recently gained renewed popularity; the concept of underrunning has largely been absent from recent scientific literature and as a result, the 26 July 2012 case will be presented to reinforce recognition and understanding of this process.

Comparison of Radar-Derived Rainfall Estimates For Heavy Precipitation Events

Mitchell Gaines
NOAA/NWS Weather Forecast Office, Mount Holly, New Jersey

Excessive rain events can have a high impact on society including potential loss of life and extensive property damage. During summer 2013 several excessive rainfall events occurred over the Mount Holly, NJ, National Weather Service County Warning Area (CWA), which includes the Metropolitan Philadelphia region. These heavy rainfall events on June 7th, June 10th, June 18th, July 23rd and July 28th led to numerous occurrences of flash flooding and some broken rainfall records. An all time daily rainfall record of 8.02 inches was set at Philadelphia International Airport on July 28th, falling mostly in a four hour period that evening. Significant flooding was observed in the Philadelphia region with vehicles taken away by high water and residents using boats as a method of transportation. These excessive rainfall amounts can be estimated through the use of Doppler radar.

Two radar-based methods are available to estimate rainfall totals for a region of a concern during any rainfall event: (1) the Precipitation Processing System (PPS) which in essence relies on base reflectivity data and (2) Quantitative Precipitation Estimation (QPE); which includes several new algorithms involving Dual-Pol data. These methods can aid meteorologists in forecasting heavy rainfall leading to a higher quality of information going to the general public. An evaluation of the PPS and QPE radar estimation was done using the WSR-88D radars at Ft. Dix, NJ (DIX) and Dover Air Force Base, DE (DOX) for several heavy rainfall events across the Philadelphia region. This evaluation compares ground truth precipitation data and radar estimates from both methodologies, making use of statistical and graphical tools available via the "National Mosaic and Multi-Sensor QPE" web site at http://nmq.ou.edu/legacy2012.html. Overall, it was found for this group of events that the PPS underestimated heavier amounts (over two inches) making the QPE preferred for heavy rainfall events. However, for lighter rainfall amounts no preferred method could be established.

A Comparison of Polarimetric Radar and Legacy-Based Radar Techniques from the 21 May 2013 Severe Weather Event across Eastern New York and Western New England

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

On 21 May 2013, severe thunderstorms developed and moved across the WFO Albany CWA producing 41 reports of hail and wind damage. This event occurred just over a year since dual polarization capabilities were installed at the Albany (KENX) WSR-88D in April 2012. Polarimetric radar (PR) data has been utilized in a research setting since the early 1980s, but only recently in an operational setting over the past couple of years. Previous studies have been performed using legacy (pre-PR) radar techniques that have had mixed performance in an operational setting when warning for severe thunderstorms. Although guidance has been developed for new PR-based techniques, much of this guidance remains in training form with limited operational use as a result of varying installation dates of PR capabilities and variable convective weather.

This presentation will utilize PR data in conjunction with legacy-based radar techniques in order to validate current warning methods, while applying new PR techniques to the warning process. Three thunderstorms that produced hail are analyzed: two that produced severe hail and wind damage, and one that produced subsevere hail. A fourth thunderstorm that produced wind damage is also presented. A new method of issuing Severe Thunderstorm Warnings solely for hail is also proposed. Although each severe weather event is unique, this presentation shows how the combination of legacy-based and PR-based radar techniques such as comparing the heights of reflectivity echo tops to ZDR and KDP columns can greatly enhance warning meteorologists' confidence when it comes to issuing warnings for severe thunderstorms.

A more comprehensive study of PR techniques discussed in this presentation will be applied to the 2012 and 2013 convective seasons in the future.

Regional Variability and Frequency of Thundersnow Events over the Contiguous United States

Kyle J. Meier[1], *Lance F. Bosart*[1], *Daniel Keyser*[1], *and Michael L. Jurewicz*[2]

[1]Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York

[2]NOAA/NWS Weather Forecast Office, Binghamton, New York

Thundersnow is often accompanied by mesoscale snowbanding and may be associated with locally heavy snowfall events (6–12 in.) and intense snowfall rates (2–3 in. h^{-1}). Given the sensible weather impacts accompanying thundersnow, the contributing dynamical and thermodynamic processes need to be better understood so that forecasters can recognize the various pathways in which thundersnow can occur. Two thundersnow events from the 2012–2013 winter season were recently analyzed. Similarities among the events included near-saturated conditions, weak moist symmetric stability, and strong updrafts, which occurred in the lower-to-middle troposphere over the range of temperatures corresponding to the mixed-phase region of a thundercloud. However, the two events occurred in dissimilar synoptic-scale settings. Motivated by the recognition that thundersnow can occur in a variety of synoptic-scale settings, current work will seek to establish the regional frequency and variability of thundersnow events across the U.S.

All instances of thundersnow in the contiguous U.S. spanning the years 1994–2012 are identified from archived METAR surface observations and NLDN data. From these observations, a comprehensive U.S. thundersnow climatology is created and compared with previous climatologies. Gridded datasets from the 0.5° resolution NCEP Climate Forecast System Reanalysis are used to generate constant-pressure and vertical-profile composites of the environment preceding and during the occurrence of thundersnow. The composites will help determine the dynamical and thermodynamic processes that contribute to regional thundersnow frequency and variability. Representative case studies also will be presented to illustrate the various pathways in which thundersnow can occur.

A Storm-Scale Analysis of the 29 May 2013 Tornado Event across East-Central New York

Thomas A. Wasula, Brian J. Frugis, and Ian R. Lee
NOAA/NWS Weather Forecast Office, Albany, New York

On 29 May 2013, a major severe weather event occurred across much of upstate New York (NY), and portions of western New England. The NWS/Storm Prediction Center posted a slight risk a few days in advance for much of central and eastern NY, and western New England (southern Vermont (VT), western Massachusetts (MA), and northwest Connecticut (CT)). A severe thunderstorm watch was issued during the mid-afternoon for much of central and eastern NY, southern VT, western MA, and northeastern Pennsylvania. NY and New England had a few dozen severe reports of damaging winds in excess of 50 knots (58 mph) and large hail (greater than 1.9 cm). However, 3 tornadoes were confirmed in the Albany forecast area ranging from EF1 (winds of 86 to 110 mph) to EF2 (winds of 111 to 135 mph). These three tornadoes affected portions of Montgomery, Schenectady, Schoharie and Saratoga Counties late that afternoon. One of these was a long-path tornado that touched down at 6:47 p.m. EDT in the town of Florida, situated on the border of Montgomery and Schenectady Counties. This tornado continued on towards the east-southeast for 13 miles across most of Schenectady County before ending in the city of Schenectady, at 7:04 p.m. EDT. The tornado had a narrow path at the beginning of its track in the town of Florida. The damage was more impressive and widespread in Schenectady County, where the tornado was around a mile wide at times, with EF1 to EF2 damage observed at Mariaville Lake in Schenectady County with a well-built barn destroyed, numerous hardwood and softwood trees sheared and uprooted, and high tension power line towers crushed and destroyed. Two shorter path length tornadoes touched down in Schoharie and Saratoga Counties.

Observational data, as well as short range deterministic Rapid Refresh data suggested a significant severe weather outbreak would occur. Much of the impacted area had just entered a warm sector with a warm front just north of the Mohawk Valley and Greater Capital Region. Upstate NY and New England were situated near the right entrance region of a 250 hPa 85 kt jet streak with an approaching strong upper level short-wave for the afternoon. A moderate instability and high shear pre-convective environment was in place before the severe weather. Surface based convective available potential energy values ranged from 500 to 1500 J kg^{-1} with increasing effective bulk shear values of 35 to 50 kts. 0-1 km Storm-Relative Helicity values were in the 150-200 m^2/s^{-2}. The effective bulk shear values in the 0-6 km layer suggested the possibility of supercells with rotating updrafts capable of producing large hail and tornadoes. This talk will focus on a detailed radar analysis of the event, utilizing the new dual polarization data (differential reflectivity, correlation coefficient, and specific differential phase). The impressive tornadic debris signature will be shown with the correlation coefficient data showing debris detected up to 6200 ft AGL. Traditional base and derived WSR-88D radar products will also be shown in conjunction with the Dual-Pol data. The storm-scale analysis will focus on helpful forecast techniques, including applying results from a local rotational velocity (Vr)-shear study, to determine what caused the tornadoes and how the tornado warning process can be improved.

The Role of Boundary Layer Variability in Fire Weather and Aviation Forecasting Across Eastern New York and Western New England

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

Fluctuations within the boundary layer, the layer of the atmosphere directly susceptible to frictional effects resulting from contact with the earth's surface, can have a direct influence on operational fire weather and aviation forecasting by altering mixing, wind production, and moisture distribution. This variability plays a crucial role in the occurrence of impact-based events such as the issuance of Red Flag Warnings (RFW) and forecasting of Instrument Flight Rules (IFR) conditions.

Current concepts of boundary layer meteorology, such as boundary layer depth, mixing height and stability, are often applied operationally using solely the temperature and moisture profile based off of atmospheric soundings and model data. These concepts, however, can lead to missed verification, as the actual boundary layer may not be as deep or shallow as forecast. A more accurate representation of the boundary layer can be defined using the static stability profile. Previous research confines the boundary layer beneath the free atmosphere, or where the potential temperature profile increases with height as a result of negligible frictional forces. This representation of the boundary layer can provide insight into improving fire weather and aviation forecasting.

Preliminary results are presented showing the significance of boundary layer variability in fire weather forecasting during the 2006-2012 period, and aviation forecasting in 2012. Emphasis is placed on the role of the static stability profile, turbulence characteristics, and depth of the boundary layer. Initial results show a potential correlation between IFR occurrences and shallower, stably-stratified laminar boundary layers, and RFW occurrences with deeper, unstable turbulent boundary layers. An additional application is used to test wind verification during Hurricane Sandy.

Continuation of the research and findings discussed in this presentation will be conducted in the future.

Extracting Quantifiable Information From Social Media in the Wake of Hurricane Sandy

Oleg Aulov, Adam Price, Milton Halem
Center for Hybrid Multicore Productivity Research
Dept. of Computer Science and Electrical Engineering
University of Maryland, Baltimore, Maryland

In the face of extreme events, emergency responders have long relied on data collected by other government agencies for disaster modeling and risk assessment, and on conventional media outlets for communication of risk and evacuation orders to the public. In recent years, emergency responders have utilized social media outlets such as Facebook and Twitter to communicate urgent information to populations affected by disasters. But social media outlets also provide the opportunity for a flow of information from the affected population back to emergency responders, such a flow, however, is very challenging due to enormous volume of very noisy data. In our work, we present methods and frameworks that would allow emergency responders to "listen" to the affected population through monitoring social media outlets for posts related to the disaster at hand. This approach would provide them with an invaluable, timely understanding of how the disaster has unfolded in different geographical areas and segments of the population, and would allow for more accurate assessments of the relief and assistance needs of different neighborhoods. It would also be useful in validating the forecasts of risk assessment and geophysical models.

In our work, we view social media data as a Human Sensor Network (HSN). The users are viewed as "sensors" deployed in the field, ands their posts are viewed as "observations". As a use-case scenario, we focus on Hurricane Sandy. We have collected over 8 million tweets and about 370,000 Instagram images referencing the hurricane. We developed a Google Maps-based web application that allows us to visualize and analyze the geolocated HSN data in the same framework with the storm forecasts from a variety of geophysical computational models. In this use-case scenario, we use NOAA's SLOSH (Sea, Lake and Overland Surges from Hurricanes) model and P-Surge model to provide a forecast for Hurricane Sandy. Due to inherent uncertainties in the weather forecasts, those models only present the worst-case scenario for any given hurricane. We demonstrate how the model forecasts, if combined with social media data in a single framework, can be used for near-real time forecast validation, damage assessment and disaster management. Geolocated and timestamped Instagram photos allow us to assess the surge levels at different locations, which not only validate the model forecasts, but also give a timely glimpse into the actual levels of surge. Photos of flooded streets, cars and basements provide us a rough estimate of the surge level at that given location and time, while photos of rainy but not flooded scenes allow us to determine an upper bound beyond which the surge did not spread.

Geolocated tweets can be used not only to monitor the emotional response of different geographic areas affected by the disaster, but also to provide insight into issues that different communities experience during extreme events including power outages, elevated crime (looting, etc.) and refusal to evacuate.

Meteorological Factors that Resulted in Extreme Rainfall During Tropical Storm Irene

Joseph P. Villani, Stephen N. DiRienzo, Hugh W. Johnson, Vasil T. Koleci, Kevin S. Lipton, George J. Maglaras, Timothy E. Scrom, Thomas A. Wasula, and Britt E. Westergard.
NOAA/NWS Weather Forecast Office, Albany, New York

On 28 August 2011, Tropical Storm Irene produced extremely heavy rainfall across eastern New York and western New England, which resulted in record flooding along several rivers. The heavy rainfall and record flooding were especially prevalent across the eastern Catskill River basins, including the Schoharie Creek, which fed downstream into the Mohawk River. A maximum area of 30 cm to 45 cm (approximately 12 to 18 inches) of rain fell across the elevated terrain of Greene County, which was followed by extreme runoff into the Schoharie Creek basin. This area received much more rain than the rest of the Albany Forecast Area. This presentation will primarily discuss the meteorological factors that contributed to the extreme rainfall in the eastern Catskills and in general the heavy rainfall across the Albany Forecast Area.

There were several key factors that enhanced rainfall amounts in the eastern Catskills, primarily in Greene County. One factor in particular likely contributed significantly to the extreme rainfall maximum. Low-level north-northeast winds with speeds of around 25 m/sec (anomalies of +5 to +6 standard deviations above normal) were oriented perpendicular to the northeast portion of the Catskills in central Greene County. It is hypothesized that upslope enhancement was particularly significant in this area due to the strong low level winds oriented perpendicular to the escarpment. Also, the steepness of the escarpment has a dramatic elevation rise of over 900 meters (approximately 3000 feet) in a short distance. The areas which received over 30 cm of rain were directly downstream of where this upslope enhancement likely occurred.

It is also hypothesized that steeply-sloped frontogenesis played a significant role in contributing to the extreme rainfall. The magnitude and depth of the frontogenesis noted during Irene is not typical of most tropical cyclones, implying extra-tropical transition was occurring as Irene approached southern New England. A cross-section of the frontogenesis fields will be shown, which implies the presence of strong upward vertical motion. Vigorous ascent of air parcels in a moist tropical environment was an important contributor to the copious rainfall amounts. Antecedent conditions played a significant role in the magnitude of flooding. Rainfall for August 2011 was above normal prior to Irene, with ground water tables already running high. This was in contrast to when Tropical Storm Floyd impacted the area with heavy rainfall on 16-17 September 1999. Dry conditions were in place prior to Floyd, with some areas approaching drought status. Flooding was not nearly as severe for Floyd compared to Irene. Also, rainfall during Floyd lasted 18 to 19 hours, while Irene's duration was only 12 to 13 hours. Thus, the rainfall rates were around 40% higher during Irene, which also contributed to severe flash flooding.

The Hydrology of Tropical Storm Irene

Britt E. Westergard, Joseph P. Villani, Hugh W. Johnson, Vasil T. Koleci, Kevin S. Lipton, George J. Maglaras, Kimberly G. McMahon, Timothy E. Scrom, and Thomas A. Wasula.
NOAA/NWS Weather Forecast Office, Albany, New York

Tropical Storm Irene produced extremely heavy rainfall across eastern New York (NY) and western New England from 27-28 August 2011. A maximum area of storm total precipitation of 12 to 18 inches (30 to 46 cm) fell across the elevated terrain of the Catskills in Greene County. A secondary maximum of 6 to 8 inches (15 to 20 cm) fell across south-central Vermont and northwestern Massachusetts, with widespread rainfall amounts in excess of 4 inches (10 cm). A New York State 24-hour rainfall record was set at a National Weather Service (NWS) rain gage in Tannersville, NY. Record flooding occurred at thirteen forecast points in the NWS-Albany Hydrologic Service Area, including ten points throughout the Hudson-Mohawk River basin as well as points in the Connecticut River and Lake Champlain drainages. Thirty five of NWS Albany's river forecast points experienced flooding as a result of the excessive runoff.

The path of Tropical Storm Irene also caused storm surge up the Hudson River at Poughkeepsie and Albany. This presentation will review both the hydrologic effects and impacts of this event and the operational challenges of forecasting widespread rapid rises to record flooding.

Forecast Performance of an Operational Mesoscale Modeling System for Tropical Storm Irene and Post Tropical Storm Sandy in the New York City Metropolitan Region

Anthony P. Praino, James P. Cipriani, Lloyd A. Treinish,
IBM Thomas J. Watson Research Center
Yorktown Heights, New York

On 27-28 August 2011, Tropical Storm Irene severely impacted the northeastern portion of the United States, including New Jersey, Connecticut, Vermont, and the New York City metropolitan area, five days after being initially classified as a Category 1 Hurricane. The storm produced three to almost ten inches of rainfall in the New York City metropolitan region with rainfall totals from six to twelve inches in the Hudson Valley through New England. Wind gusts ranged from fifty miles per hour to higher than seventy miles per hour near the coast with forty to fifty miles per hour inland. Extensive flooding and infrastructure damage resulted from the intense precipitation and strong winds.

A little over a year later on 28-31 October 2012, Post-Tropical Cyclone Sandy severely impacted the same region of the United States, including New Jersey, Connecticut and the New York City metropolitan area, four days after being initially classified as a Category 1 Hurricane. Sandy had weakened to a tropical storm and then became a post-tropical cyclone just prior to landfall. Although the storm produced widespread heavy rainfall, the most significant impacts were as a result of storm surge along the coast as well as high winds inland. Wind gusts ranged from 70 to higher than 90 miles per hour both along the coast and inland. The storm's large size with tropical storm force winds extending nearly 500 miles from the center prior to landfall resulted in extensive coastal flooding and infrastructure damage from the storm surge and an extended period of strong winds.

Both storms resulted in widespread power outages. For Irene there were over one million people affected, and in the case of Sandy, over eight million people were affected. In both cases some power outages lasted for more than two weeks.

In our continuing work focused on providing weather sensitive business solutions, IBM's "Deep Thunder" service provides operational forecasts twice daily for areas of southeastern New York State and northern New Jersey. With an operational history that spans more than a decade, producing one- to three- day model-based forecasts at one to two kilometer resolution, the overall model configuration has evolved and improved over time to reflect improvements in NWP model capability as well as computational efficiency. Over the past several years, the system has focused on producing 84-hour predictions updated every 12 hours. The NWP component is derived from a configuration of the WRF-ARW community model (version 3.1.1 in August 2011 for Irene and version 3.31 in October of 2012 for Sandy). It operates in a nested configuration, with the highest resolution at two km, utilizing 42 vertical levels. The configuration also includes parameterization and selection of physics options appropriate for the range of geography within the domain from highly urbanized to rural. This includes WSM-6 microphysics (explicit ice, snow and graupel), Yonsei University non-local-K scheme with explicit entrainment layer and parabolic K profile in the unstable mixed layer for the planetary boundary layer, NOAH land-surface modelling with soil temperature and moisture in four layers, fractional snow cover and frozen soil physics, Grell-Devenyi ensemble cumulus parameterization, and the 3-category urban canopy model with surface effects for roofs, walls, and streets.

Given the model length and frequency, the system produced several operational forecasts that covered the period prior to landfall and the impact in New York and New Jersey for both storms. The system exhibited proficient skill in forecasting regional as well as local scale impacts of Irene and Sandy with significant lead time. In particular, beginning with the run initialized at 12 UTC on 26 August 2011, the model consistently forecasted Irene to weaken and make landfall as a tropical storm. For the case of Sandy, beginning with the run initialized at 12 UTC on 27 October 2012, the model captured local scale impacts of Sandy as it made landfall as a post-tropical storm.

In order to evaluate the quality of the forecasts produced by Deep Thunder at a storm-scale and its potential skill, we compare the model results with observational data as well as the operational availability of specific forecast products. Such performance is examined by considering forecast timing, locality, and intensity of storm impacts as well as through the utilization of traditional and spatial verification methodologies.

Operational Changes in the Winter Weather Forecasts at the Weather Prediction Center (WPC)

Dan Petersen
NOAA/NWS National Centers for Environmental Prediction, Weather Prediction Center

The WPC product suite is constantly evolving in response to new customer needs and the increasing need for decision support. Recent changes to the WPC winter weather product suite are discussed in this presentation. First, 72-hour snowfall probability forecasts are now operational and cover the entire 3 day forecast period. These probabilities are in addition to the 48 hour and 24 hour probabilities that have been expanded to include 6 hour increments to provide greater definition of the timing of snow/ice events.

Also new this season, the winter snow/ice probability products are now available in a Google Maps display on the primary winter weather page. The capability to display gif images remains the same as in prior years. Also, probabilities of exceeding snow and ice thresholds are available as shapefiles and KML files on our webpage. Percentiles (in KML and shapefile form) will be made available later in the season, roughly on Nov. 1.

Verification of the deterministic snowfall accumulation forecasts for the 2012-13 season shows a slight improvement over the prior 2011-2012 season. These accumulation forecasts have a higher threat score than a model/ensemble mean consensus forecast for days 1-3. Forecaster edits to the probabilistic snow forecasts for days 1-3 provided little improvement over the draft forecasts. Consequently, forecasters will spend less time editing the probabilistic snow forecasts this year.

Finally, during 2013, the Hydrometeorological Testbed (HMT)-WPC designed a prototype probabilistic outlook product for days 4-5 winter forecasts. Winter weather forecasters will experimentally issue a ”probability of winter weather” outlook for each 24 hour period for days 4-7 during the 2013-14 season. During this in-house prototype period, WPC will evaluate progress and optimize the product for an experimental product for the 2014-15 season.

Climatology and Predictability of Cool-Season High Wind Events in the New York City Metropolitan and Surrounding Area

Michael Layer and Brian A. Colle
School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, New York

Several damaging wind events not associated with severe convection or tropical cyclones occur annually over the Northeast U.S. These non-convective windstorms occur primarily in the cool season, and can cause significant problems with transportation, infrastructure, and public safety. Since these wind events can be associated with a variety of different weather phenomena, public awareness is not as high as it is with hurricanes and severe convective storms. Additionally, there has been relatively limited research on the predictability of high wind events over the Northeast U.S. These events have proven difficult for operational forecasters to predict for the NYC region as revealed by relatively poor probability of detection (POD) and false alarm ratio (FAR) in recent years. Improving the predictability of non-convective high wind events through the use of both conceptual models and ensemble numerical weather prediction (NWP) models will help increase public awareness, improve public safety, and encourage authorities to plan more accordingly in advance of such events.

This talk will look at the climatology of cool-season wind events occurring between 15 September and 15 May over 13 seasons from 2000-2001 through 2012-2013. METARs reported at 25 ASOS sites over a box encompassing southern Connecticut, southeast New York, and northern New Jersey are used as the observational data source, while the North American Regional Reanalysis (NARR) is used as the analysis data source. The previous version of the Short Range Ensemble Forecast system (SREF), operational from October 2009 through August 2012, is used for model verification over the three cool seasons from 2009-2010 through 2011-2012. Both observed and false alarm events meeting High Wind Warning criteria (at least one ASOS site reporting a sustained wind of at least 35 kts and/or a wind gust of at least 50 kts) are analyzed in this study. The events are also broken down into three distinct types commonly observed in the region: pre-cold frontal, post-cold frontal, and nor'easter/coastal storm cases.

A climatology of the observed and false alarm events is created in order to gain a better understanding of the large-scale atmospheric regimes common to such events, including the evolution of the 500 hPa and MSLP patterns leading up to the events. Smaller-scale atmospheric parameters such as 900 hPa height gradient, 3-hour MSLP tendency, and low-level winds and stability are also analyzed. Relationships between the observed maximum wind speed and gust and some of the aforementioned parameters will be shown. Possible atmospheric mechanisms contributing to the production and downward momentum transfer of high winds to the surface will be hypothesized following the meteorological analysis. Finally, point verification of the SREF will be shown to evaluate the ensemble performance during high wind cases.

A Microphysical and Polarimetric Review of the Evolution of the Northeast Blizzard of 8-9 February 2013

Joey Picca and David Stark
NOAA/NWS Weather Forecast Office, Upton, New York

On 8-9 February 2013, a historic winter weather event impacted a large portion of the northeastern United States. Heavy snowfall, including blizzard conditions, occurred from the New York City metropolitan area into New England, with snow accumulations in excess of two feet in many locations. The combination of heavy precipitation, strong winds, and even some coastal flooding paralyzed the region's transportation systems.

Measurements from the dual-polarized WSR-88D KOKX (Upton, NY) provide unique insight into the microphysical processes of this storm, which was characterized by very heavy precipitation with a large amount of hydrometeor diversity. These data reveal several unique features, including a very apparent re-freezing signature indicative of sleet, strong ice crystal growth aloft, mixed phase regions likely responsible for "anomalous hail-like" frozen hydrometeors, as well as other features. When combined with an abundance of high quality in-situ reports, the location of the radar yields a truly unique dataset.

This presentation reviews this historical storm event that serves as valuable and unique educational look into the rapid microphysical evolution of a winter storm.

Examination of the Thermodynamic and Microphysical Evolution of the Northeast Blizzard of 8–9 February 2013

SARA A. GANETIS[1], *BRIAN A. COLLE*[1], *MATTHEW J. SIENKIEWICZ*[1],
DAVID M. SCHULTZ[2], *PAMELA L. HEINSELMAN*[3], *DAVID NOVAK*[4], *AND JOSEPH PICCA*[5]

[1] School of Marine and Atmospheric Sciences
Stony Brook University, Stony Brook, New York
[2] Centre for Atmospheric Science, School of Earth, Atmospheric and Environmental Sciences,
University of Manchester, Manchester, United Kingdom
[3] NOAA/National Severe Storms Laboratory, Norman, Oklahoma
[4] NOAA/NWS/NCEP/Hydrometeorological Prediction Center, College Park, Maryland
[5]NOAA/NWS Weather Forecast Office, Upton, New York

A mesoscale snowband during the Northeast U.S. extratropical cyclone of 8–9 February 2013 resulted in a narrow swath of accumulations greater than 76.2 cm (> 30 in) across Long Island and southern New England with observed snowfall rates in excess of 3 in h^{-1}. There were many socio-economic impacts, including the shutting down of major highways due to abandoned, buried vehicles and heavy snow and high winds causing 700,000 customers to lose power throughout the region. The evolution and structure of this snowband warrants investigation because of the observed range of radar reflectivity from > 55 dBZ at the peak of the band's apparent intensity to around 30 dBZ within 1 h.

The Weather and Research Forecasting (WRF) model was used to simulate the event down to 1.33-km horizontal grid spacing to provide a high-resolution dataset to better understand the processes responsible for the genesis and intensity of the mesoscale snowband. Model output was verified with observational data including soundings, microphysical surface observations at Stony Brook, NY (SBNY), and the KOKX dual-polarization radar at Upton, NY. The complex thermodynamic structure will be discussed that was responsible for the diverse hydrometeor types observed with the dual-polarization data and in-situ ground observations at SBNY as discussed by Picca et al. The importance of diabatic processes will be highlighted for the persistence of above-freezing temperatures collocated with the band at low levels during the time of maximum observed reflectivity. The rapid decrease in the apparent intensity of the band is hypothesized to be due to the cessation of mixed-phase processes and a colder environment resulting in colder-type crystals.

Advanced Linux Prototype System (ALPS) – Ensemble Tools for the Future ?

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

Brian A. Colle and Edmund Chang
School of Marine and Atmospheric Sciences, Stony Brook University
Stony Brook, New York

The National Weather Service's (NWS) Advanced Weather Interactive Processing System (AWIPS) was the cornerstone of the NWS's modernization and restructuring during the 1990's. While there have been many improvements to data visualization and analysis abilities within AWIPS over the years, the access to ensemble data along with the ability to visualized, analyze and communicate these data remains lacking. In a recent survey of over 100 NWS operational forecasters, that number one reason that ensemble data is only "sometimes" used in the NWS forecast process was attributed to the lack of graphics and tools to display ensemble data. Fortunately, NOAA's Earth System Research Laboratory Global Systems Division (GSD) research efforts have brought to operations an AWIPS modification that addresses the needs of the operational forecaster.

The Advanced Linux Prototype System (ALPS) is a modification to the Display Two Dimension (D2D) and Graphical Forecast Editor (GFE) within AWIPS that operational NWS forecasters are accustom to. This AWIPS add-on allows easy display and analytical tools for forecasters to integrate ensemble date sets from the National Centers for Environmental Prediction (NCEP). The NWS New York City Weather Forecast Office has limitedly used the D2D ALPS add-on since 2009 to interrogate NCEP short range and global ensemble systems as part of a SUNY Stony Brook Collaborative Science, Technology, and Applied Research project.

Recently, NWS has tasked GSD to migrate ALPS capabilities to AWIPS 2. This presentation will demonstrate ALPS capabilities in AWIPS 1 and discuss the integration of ALPS functionality into AWIPS 2.

A Composite Study of Snow Squall Environments: Forecasting and Hazard Mitigation

Peter C. Banacos[1], Andrew N. Loconto[1], and Gregory A. DeVoir[2]

[1]NOAA/NWS, Weather Forecast Office, Burlington, VT
[2]NOAA/NWS, Weather Forecast Office, State College, PA

A ten-year climatology of snow squalls producing surface visibility ≤ 0.5 statute miles associated with cold fronts and upper-level troughs was constructed for three sites over northern New York and Vermont to determine favorable synoptic and mesoscale conditions for their occurrence. A total of 36 snow squalls were identified, including 21 at Burlington, Vermont (BTV). The snow squalls had a median duration of heavy (moderate) snow lasting 17 (26) minutes, and a median snow accumulation of only 1.0” (2.5 cm) for events those affecting BTV. Despite modest accumulations, the rapid onset of blinding snowfall, gusty winds, and falling temperatures can result in potentially deadly road surface conditions making snow squalls an important forecast and communication challenge.

A composite study based on these 36 events and a control dataset for winter 2005-06 was performed using North American Regional Reanalysis data. All identified snow squall events occurred on the cyclonic shear side of a mid to upper tropospheric jet streak and within deep-layer cyclonically curved flow. Surface-based instability (median CAPE < 50 J kg^{-1}), high relative humidity in the 0-2 km AGL layer, and strong surface isallobaric (rise/fall) couplets were often found with the snow squalls. The isallobaric wind was found to add constructively to the background gradient flow, and combined with steep near-surface lapse rates acted to produce the squall conditions. The presence of CAPE was the best discriminator between the snow squall cases and the control sample. As a result of their convective nature, snow squalls were observed most often during the daylight hours with 69% of the events occurring between 13-23 UTC. The composite study results and case examples were used to formulate a four-panel visualization display and a multivariate, non-dimensional snow squall parameter, to aid in highlighting favored environments. Operational strategies aimed at societal mitigation of snow squalls as a transportation hazard are also discussed.

The Foundering of the HMS Ontario

Robert Hamilton
NOAA/NWS Forecast Office, Buffalo, New York

The HMS Ontario, an impressive 22 gun Snow Brig, sunk in a gale on Lake Ontario on Halloween night in 1780. The 80 foot British warship, certainly the largest of her day, was one of the largest sailing ships to ever navigate the waters of Lake Ontario. This sinking stands to date as the cause of the largest loss of life on the lake. While 120 people were officially claimed to have been lost in the disaster, there are accounts of as many as 175 people on board...including a garrison of British soldiers, civilians and American prisoners of war. The discrepancies are part of an overall lack of information that came from an 18th century cover up that attempted to hide the loss from General Washington and the Colonial troops in the closing years of the Revolutionary War. Knowledge of this tragedy would have been very useful to the colonials as this was a huge blow to British defenses and morale.

The HMS Ontario, the oldest confirmed shipwreck and only fully intact British warship ever to be found in the Great Lakes, was discovered in 2008 some 500 feet below the surface of Lake Ontario. Known as the “Holy Grail of Great Lakes Shipwrecks”, local divers found the ship after nearly 35 years of relentless searching. The ship has since been described as “an archeological miracle” because of its extraordinary condition in the cold, low oxygen, environment found at the bottom of its marine environment.

Stories and speculation are plentiful about the weather surrounding the sinking of the HMS Ontario. Accounts of the tragedy put the blame on various weather scenarios, ranging from the ‘Great Hurricane of 1780’ to a mid Fall Great Lakes blizzard. Since the ship was lost leaving barely a trace of evidence, the disputed weather has only added to the overall mystery and legend of the event.

Careful archival research and weather re-analyses of rare and difficult to obtain weather data from the period has finally shed some light on the conditions during the time of the sinking. The findings from this information will be discussed and further examined during this presentation.

The November 1913 Great Lakes Superstorm

Robert Hamilton
NOAA/NWS Weather Forecast Office, Buffalo, New York

The great November storm of 1913 stands as the deadliest and most destructive natural disaster in recorded Great Lakes history. The powerful and unpredictable storm produced a blizzard, hurricane force winds and thirty five foot waves while sinking or grounding nearly forty ships and claiming over two hundred and fifty lives. The four day cyclone wreaked havoc on all of the Great Lakes, which in the early 20th century, stood as one of the most important commercial traffic areas in the country. Financial losses, in modern day currency, exceeded over $116 billion.

The responsibility of forecasting and warning for this devastating storm fell onto the shoulders of the fledgling Weather Bureau, which had been organized by President Grant in 1870 for just such an occurrence, but meteorology was still in its infancy at this time. The Norwegian cyclone model was still a few years away from being introduced, so the concept of fronts and conveyor belts was not known, let alone understood. Government forecasters had to rely on crude advection schemes, including time consuming analogs, to accompany the cumbersome process of analyzing twice daily surface maps. All of the forecasts were issued from the Weather Bureau headquarters in Washington D.C. and relayed to small local weather offices via telegraph and early telephone. The forecasts and warnings were then relayed to the primary recipients, the shipping industry, by a combination of colored flags that were hung close to the harbors for highest visibility.

The storms development and impacts will be analyzed during this presentation while exposing the crucial limitations and subsequent forecast problems experienced by the early Weather Bureau.

Improving the Quantitative Precipitation Estimate for Dual Polarization Hydrometeors Classified as Dry Snow

Kirk R. Apffel, Aaron Reynolds and David Zaff
NOAA/NWS Weather Forecast Office, Buffalo, New York

Between 2011 and 2013, National Weather Service (NWS) operated Weather Surveillance Radar 1988 Doppler systems (WSR-88D) were upgraded with a dual polarization capability. The polarimetric upgrade is considered by many to be the most significant enhancement made to the nation's network since Doppler radar was first installed, with better information about precipitation type, intensity, and size. Much work has gone into improving quantitative precipitation estimates (QPE) for rainfall, but dual polarization radar uses a modified (pre-dual polarization) radar rain relation for hydrometeors classified as dry snow that applies a factor of 2.8 to take into account for lower reflectivity returns associated with dry snow.

NWS Forecast Office Buffalo, NY was upgraded with dual polarization during April 2012 and together with surrounding offices noticed an overestimation in QPE for several cold season events. A local study used 13 events with 383 separate gauge-to-radar comparisons to test the 2.8 coefficient and found that it was too high and led to a high bias in QPE. Until a more comprehensive dry snow relationship is developed, the study suggests a variable coefficient for dry snow should be used. When taking into account radar sampling and classification challenges for mixed precipitation, preliminary results suggest that the dry snow coefficient should roughly range between 1.3 and 1.7.

Validation of Planetary Boundary Layer Parameterizations over the Coastal Ocean of Southern New England Using the IMPOWR Field Campaign

Matthew J. Sienkiewicz and Brian A. Colle

School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, New York

Winds, temperatures and moisture in the planetary boundary layer (PBL) are often difficult for operational models to predict given the relatively sparse observations and that most model PBL parameterizations were developed over inland locations. Coastal marine layer forecasts are important for the forecasting of severe storms and wind energy resources in the highly populated coastal marine environment of the Northeast U.S. (NEUS). Mesoscale models are known to have large biases in wind speeds and temperatures at these lower levels over coastal waters. The goal of this project is to evaluate the performance of six PBL schemes in the Weather Research and Forecasting (WRF-ARW) model version 3.4.1 in the coastal marine environment of the NEUS. This study region, stretching from the south shore of Long Island out to Georges Bank, is home to not only major shipping lanes and the commercial fishing industry, but is also an ideal location for an offshore wind energy grid based on such factors as regional energy demand, water depth, and available wind resource.

This talk will focus on the IMPOWR (Improving the Mapping and Prediction of Offshore Wind Resources) field study, which is a marine observational campaign of the PBL consisting of high-frequency Long-EZ aircraft measurements and instrumented offshore towers. During the spring and summer of 2013 several high-frequency instruments were installed on the Air-Sea Interaction Tower (ASIT) south of Martha's Vineyard and the Cape Wind tower located in Nantucket Sound. The instrumentation consisted of sonic anemometers, temperature and relative humidity sensors, and an optical wave gauge. A Long-EZ aircraft capable of taking high-frequency temperature, relative humidity, and three-dimensional wind measurements performed 11 flights in the study region from April to September 2013. The aircraft observations combined with the tower observations allowed us to construct full vertical profiles of wind speed, temperature, and humidity from the surface to the top of the marine boundary layer.

Verification of the six WRF PBL schemes (two non-local, first-order schemes and four local, TKE-order schemes) was primarily done using a dataset of observations at multiple levels from the Cape Wind tower in Nantucket Sound from 2003 to 2011, as well as surrounding NDBC and ASOS stations. A series of 30-hour WRF runs were conducted for 90 randomly selected days between 2003 and 2011, with initial and boundary conditions supplied by the North American Regional Reanalysis (NARR). All schemes generally displayed positive wind speed biases over the water at the surface, and decreasing biases above the surface. Additional model verification will be presented from the Long-EZ flights during the field campaign. Preliminary results from flights on 12 November 2012 and 16 May 2013 showed that the models consistently underestimated wind speeds and relative humidity in the marine boundary layer, while overestimating temperatures. Future analysis will include looks at how the PBL schemes handle specific sea-breeze and coastal jet cases, as well as further verification using aircraft-observed TKE values over ocean and coastal environments.

Enhancement of Integrated Decision Support Services in Southern New England

Rebecca L. Gould and Joseph W. DelliCarpini
NOAA, NWS Weather Forecast Office, Taunton, Massachusetts

The theme of NOAA's Weather-Ready Nation (WRN) program is about building community resilience in the face of increasing vulnerability to extreme weather and water events.

In 2012, the NWS Taunton Weather Forecast Office (WFO) began efforts to enhance integrated decision support services (IDSS) for its County Warning Area which encompasses Rhode Island, most of Massachusetts, parts of southern New Hampshire and northern Connecticut and includes the three state capitals. These efforts have been centered upon three initiatives: the ability to provide on-site support for large-scale events, the development of probabilistic forecast graphics, and digital aviation services. Each of these initiatives ties into the WRN program on a local level and provides IDSS for a wide range of stakeholders such as the Federal Aviation Administration (FAA), U.S. Coast Guard, and Federal Emergency Management Administration (FEMA).

In order to more efficiently meet new demands for enhanced services and products, changes were made to internal operations at WFO Taunton. This included the implementation of Enhanced Short Term Forecasting which promotes the use of hourly forecast grid resolution and integrates scientifically-based tools into the forecast process. A dedicated IDSS shift was established to proactively coordinate with federal, state, and local agencies and utilize new technologies such as chat software, social media platforms, and video briefings to more effectively deliver information.

Impacts of Rossby Wave Packets on Forecast Uncertainties and Errors

Brian A. Colle, Edmund K.M. Chang, Minghua Zheng, and Matthew Souders
School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, NY

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

Rossby wave packets (RWPs) have frequently been linked to high impact weather events, including being precursors to explosive cyclogenesis and severe flooding. Previous studies have also shown that short range forecast errors and uncertainties frequently develop and propagate like linear RWPs. However, to date it is not clear how RWPs impact the development of forecast uncertainties and errors, although there have been suggestions that in some cases, large forecast uncertainties developed simultaneously with the initiation of RWPs.

Ensemble sensitivity analysis has been applied to examine how forecast track and intensity uncertainties in medium range forecasts of the development of strong cyclones depend on uncertainties in the initial conditions. Results suggest that in some cases, coherent sensitivity signals can be traced back in time to at least 6-7 days prior to the explosive cyclogenesis events. Medium range GFS forecast errors of 300 hPa geopotential height over a region covering eastern North America and western North Atlantic during 5 cold seasons have been examined. Time-lagged composites of RWP amplitudes (computed based on a Hilbert Transform technique) based on forecasts with large errors show a significant signal of enhanced wave packet amplitude developing over the western North Pacific 5-6 days in advance, with the composite wave packet propagating across the Pacific and North America towards the large error domain.

This Collaborative Science, Technology, and Applied Research (CSTAR) work has motivated a new CSTAR project at Stony Brook helping to increase the use of ensembles in operations by: (1) demonstrating the impact of RWPs on ensemble medium range predictions, (2) calibrating ensemble gridded data, and (3) developing and training forecasters on new ensemble display tools to better understand ensemble predictions and the evolution of ensemble uncertainty. These issues will help address the results of a survey of over 100 National Weather Service operational forecasters that indicated that the top three reasons why ensembles are not used in operations are: (1) the lack of tool/graphics to display ensemble data, (2) ensemble data access, and (3) ensemble training. This presentation will also discuss the plans for the new CSTAR project. We will review the results of the completed SUNY Stony Brook CSTAR project and how they apply to the new effort. Details on the Stony Brook CSTAR Project are located at: http://dendrite.somas.stonybrook.edu/CSTAR/cstar.html.

Towards the Usage of Post-processed Operational Ensemble Fire Weather Indices over the Northeast United States

Michael Erickson[1], Brian A. Colle[1], and Joseph J. Charney[2]
[1] School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, New York
[2] USDA Forest Service, East Lansing, Michigan

Ensemble modeling systems have become commonplace in many operational forecasting communities. Ensemble modeling allows for the probability of future forecast outcomes to be quantified by approximating the uncertainty in the initial atmospheric state or model physics. However, ensembles are just beginning to be used in generating operational short-range fire weather forecasts and should be verified using appropriate metrics to quantify fire threat strength. For this reason, the impact of post-processing an atmospheric ensemble is examined for the purpose of generating accurate model-derived fire-weather forecasts over the Northeastern United States (NEUS). The 21-member Short Range Ensemble Forecast (SREF, 32 to 45-km grid spacing) run at the National Centers for Environmental Prediction (NCEP) is used in this study from 2008 to 2012. The SREF includes different initial conditions and physical parameterizations (convective parameterization, boundary layer, and microphysics). The 13-km grid spacing Rapid Update Cycle (RUC) analysis fields are used to verify the ensemble predictions. The NEUS is defined as any land region from 38^{o}N to 44^{o}N and 80^{o}W to 65^{o}W. Additionally, the RUC analyses are compared to Automated Surface Observing Systems (ASOS) observations in the New York City area to check for accuracy.

Fire threat risk is quantified by analyzing two fire weather indices. First is the well-established Haines Index which considers the low-level lapse rate and dew point depression. A second new metric called High Fire Threat Weather Index (HFTWI) is developed in order to quantify the impact of near surface weather on high fire threat risk. In the absence of snow-cover (determined from the Interactive Multisensor Snow and Ice Mapping System Snow and Ice Analysis) or rainfall during the past 48 hours (from the Stage IV precipitation database), the HFTI exceeds zero only if the relative humidity is within the bottom 2.5 percentile of the 2008-2012 RUC climatology. Thereafter, HFTI is calculated by considering both 2-m relative humidity and 10-m wind speed. The total HFTI, which ranges between zero and five, is summation of the relative humidity and wind speed components. Results will show that the SREF consistently under predicts both HFTI and the Haines Index, especially for more extreme events. This is largely the result of a persistent cool and wet bias in the ensemble, particularly in the lower levels of the planetary boundary layer. Applying a simple additive bias correction to each model state variable significantly improves these biases and the overall error in the ensemble. This suggests that post-processing should be applied to model output before attempting to make operational fire threat forecasts.

Characteristics of Northeast Winter Cyclones Associated With Significant Upper Level Easterly Wind Anomalies

Adrian N. Mitchell, Lance F. Bosart, Kristen L. Corbosiero
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

Northeast winter cyclones can disrupt the lives of millions of people and, as a result, have been thoroughly studied. Much progress has been made in characterizing certain types of cyclones by analyzing the dynamics associated with their genesis and subsequent lifecycle. An investigation of historical data reveals that a smaller subset of northeast winter cyclones tends to be associated with an uncharacteristically strong 300-hPa easterly wind anomaly poleward of the surface cyclone. This sub-category of cyclones may be associated with a well-defined upper level cutoff circulation as well as a significant low-level temperature anomaly dipole over the northeast U.S. This presentation will feature a climatological and case study analysis of these cyclone events with a focus on significant synoptic and mesoscale features.

Preliminary results indicate that the Arctic Oscillation (AO) exhibits a negative tendency during the lifespan of many of these deep easterly flow cyclone cases, indicative of a blocked upper level flow pattern in the mid to high latitudes. Significant upper level easterly wind anomalies (<-20 m s^{-1}), and in some cases easterly jet streaks (>30 m s^{-1}), appear during the mature phase of the cyclones and are often associated with northerly low-level warm-air advection wrapping cyclonically around the poleward and western sides of the surface cyclone. This sub-category of cyclones may exhibit highly localized precipitation maxima over the northeastern U.S. as a result of northerly low-level flow favoring lake and orographic enhancement.

An Overview of the Ontario Winter Lake-effect Systems (OWLeS) campaign: Winter 2013-14

Justin R Minder, David A. R. Kristovich, B. Geerts, W. J. Steenburgh, R. D. Clark, S. M. Steiger, J. M. Wurman, R. Ballentine, G. S. Young, K. R. Knupp, N. F. Laird, T. D. Sikora, K. A. Kosiba, N. D. Metz, J. W. Frame
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

Wintertime lake-effect systems (LeS) routinely produce high-impact weather in the Great Lakes region and also shape the region's precipitation climatology. Forecasting LeS can be challenging due to the various morphologies possible, the sensitivities to large-scale conditions, and the importance of convective-scale and microphysical processes. The collaborative NSF-funded OWLeS project will examine the formation mechanisms, cloud microphysics, boundary layer processes and dynamics of LeS using new observational tools capable of detailing characteristics not documented in previous field experiments.

The OWLeS project focuses on Lake Ontario because of its geometry and size, frequency of LeS, nearby orography, and location usually downwind of the other Great Lakes. Both short-fetch LeS (those oriented at large angles to the long axis of the lake) and long-fetch LeS (those more aligned with the lake's long axis) will be targeted in OWLeS, to be conducted in December 2013 and January 2014.

The overarching objectives of the OWLeS project are to: a) describe the upwind surface and atmospheric factors determining the three-dimensional structure of short-fetch LeS convective bands that develop over a relatively-warm, open water surface; b) understand the development of, and interactions between, internal planetary boundary layers (PBL) and residual layers resulting from advection over multiple mesoscale water bodies and intervening land surfaces; c) examine how organized, initially convective LeS structures in short-fetch conditions persist far downstream over land, long after leaving the buoyancy source (i.e., the ice-free water); d) examine how surface fluxes, lake-scale circulations, cloud microphysics and radiative processes affect the formation and structure of long-fetch LeS; e) understand dynamical and microphysical processes controlling the fine-scale kinematic structures and lightning characteristics of intense long-fetch LeS; f) provide in situ validation of operational (S-band) and research (X-band) dual-polarization hydrometeor type classification and lake-effect snowfall QPE; and g) understand the influence of downwind topography on LeS generated over Lake Ontario.

Facilities include the University of Wyoming King Air with cloud radar and cloud lidar (WCL) systems, three Doppler on Wheels (DOW) radar systems, and an array of PI-supported mobile and stationary flux, surface, and sounding systems. It is anticipated that research based on observations taken during OWLeS will improve understanding of these intense storm systems in ways that will improve numerical modeling, nowcasting, and forecasting of LeS events.

The Motion of Mesoscale Snowbands in Northeast U.S. Winter Storms

Jaymes S. Kenyon[1], Daniel Keyser[1], Lance F. Bosart[1], and Michael S. Evans[2]
[1]Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York
[2]NOAA/NWS Weather Forecast Office, Binghamton, New York

The distribution of snowfall accumulation attending winter storms is a product of both precipitation intensity and duration. Many heavy snowfall events are associated with distinct mesoscale snowbands, which strongly modulate snowfall accumulation. Mesoscale snowbands are known to be favored within environments characterized by frontogenetical forcing in the presence of weak moist symmetric or gravitational stabilities. Although the development of mesoscale snowbands often can be successfully anticipated at 24−36 h forecast ranges, anticipating band duration at a fixed location remains a forecasting challenge. However, given that snowband duration is closely related to attributes of snowband motion, improved understanding of band motion presents an opportunity to improve snowfall accumulation forecasts.

This study investigates synoptic and mesoscale features associated with specific snowband motion characteristics. A classification scheme for snowband motion will be described, wherein bands are categorized into four modes: laterally translating, laterally quasi-stationary, hybrid, and pivoting. Laterally translating bands exhibit predominantly cross-axis motion, thereby favoring uniform snowfall accumulation along their paths. In contrast, laterally quasi-stationary bands exhibit near-zero cross-axis motion, favoring heavy snowfall accumulation along a narrow corridor. Hybrid bands are dominated by along-axis motion, but with a concurrent cross-axis component of motion, favoring snowfall accumulations on an intermediate spatial scale. Finally, pivoting bands exhibit pronounced rotation such that heavy snowfall accumulation is particularly favored near the center of rotation. Using archived WSR-88D data, this classification scheme has been applied to 70 heavy snow cases in the Northeast U.S. between 2005 and 2010. Gridded data from the 0.5° resolution NCEP Climate Forecast System Reanalysis are used to identify synoptic and mesoscale features associated with these cases.

Results indicate that low- to mid-tropospheric temperature advection, confluence/diffluence, curvature, and horizontal shear in the near-band environment are useful in distinguishing between environments favoring laterally translating, laterally quasi-stationary, hybrid, or pivoting snowband modes. In turn, these environmental factors are related to the along- and cross-isentrope components of the Q-vector. Composite fields that typify the synoptic and mesoscale environments attending each snowband mode will be presented, along with selected case studies.

An Analysis of the Intense Arctic Cyclone of August 2012

Lance F. Bosart and Adam H. Turchioe
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

On 03 August 2012, a cyclone formed over Central Siberia and progressed northeastwards. By 0000 UTC 05 August, the cyclone reached the Arctic Ocean with a mean sea-level pressure (MSLP) of 984 hPa. Once over the Arctic Ocean, the cyclone rapidly intensified and reached a minimum pressure of 962 hPa on 06 August near 83°N and 170°W. The cyclone slowly weakened, and on 0000 UTC 10 August once again had a minimum MSLP of 984 hPa. The motivation for this presentation is driven by the likelihood that this cyclone is one of the most intense storm systems to ever impact the Arctic Ocean in the modern data era. The rarity of this storm is further supported by the fact that it occurred during the summer, prior to the climatologically favored more intense cyclone-season of the fall. The purpose of this presentation will be to present the results of a climatological analysis of Arctic Ocean cyclones between July and October for 1979 to 2012. We will conduct a diagnostic analysis of the intense cyclone of early August 2012 to help place it within the context of this Arctic cyclone climatology.

Prior to development, there existed an anomalously strong baroclinic zone at 850 hPa over north-central Russia. The corresponding 850 hPa temperature anomalies were between -2°C and -4°C poleward of 70°N and upwards of +8-9 °C over eastern Russia near 60°N. This enhanced baroclinicity aided in developing an anomalously strong 300 hPa polar jet along the coast of northeastern Russia (20-25 m s^{-1}) that helped to intensify the cyclone. Noteworthy, the most rapid intensification occurred as the cyclone traversed the ice-free waters of the Arctic Ocean. How much of an influence latent and sensible heat fluxes had in destabilizing the lower atmosphere will be discussed during this presentation. The intense cyclone of early August 2012 featured very warm air at 850 hPa (> 15 C) collocated with high values of precipitable water (> 35 mm) within the warm-sector of the storm poleward of 70°N. These anomalously high temperature and moisture anomalies were indicative of the strength of the warm-air advection, as well as the overall strength of this cyclone. An attempt will be made to distinguish between the influence that the thermodynamical forcings had on intensifying the cyclone as compared to the aforementioned synoptic-scale dynamical forcing.

Acknowledgements

Weather Forecast Office Albany, New York
Conference Room
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Cover Photo Credits
Lance Bosart, Herkimer County Office of Emergency Management, Thomas Wasula, Greg Carbin, Raymond O'Keefe, Jaymes Kenyon, New York State Thruway Authority

Warren R. Snyder
Northeast Regional Operational Workshop Coordinator
Northeast Regional Operational Workshop Preprints
Northeast Regional Operational Workshop Preprint Cover Design

Vasil Koleci
Web Support