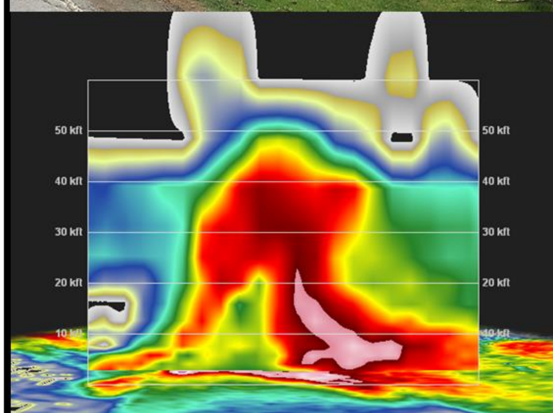
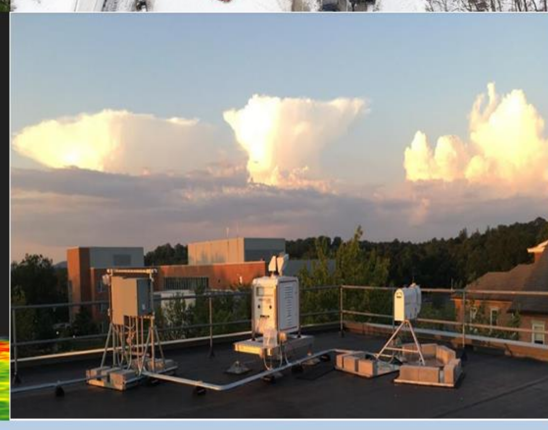
Northeast Regional Operational Workshop XIX November 7-8, 2018

Albany, New York





<u>Sponsored by:</u>

National Weather Service

SUNY-University at Albany's Department of Atmospheric and Environmental Science

Agenda
Northeast Regional Operational Workshop XIX
Albany, New York
NanoFab South Conference Center, Room 103, 255 Fuller Road
Wednesday, November 7, 2018

8:05 am
Welcoming Remarks & Conference Logistics
Raymond G. O'Keefe, Meteorologist In Charge
Joseph P. Villani, NROW XIX Steering Committee Chair
National Weather Service, Albany, New York

<u>Session A – Severe Weather I</u> (8:15 am to 9:55 am)

8:15 am
The 15 May 2018 Northeast U.S. Significant Severe Weather Outbreak
Joseph E. Cebulko
NOAA/NWS Weather Forecast Office, Albany, New York

8:35 am
Differences Between High–Shear / Low–CAPE Environments in the Northeast US Favoring Straight-Line Damaging Winds vs Tornadoes
Michael E. Main
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

8:55 am
The Use of Collapsing Specific Differential Phase Columns to Predict Significant Severe Thunderstorm Wind Damage across the Northeastern United States
Brian J. Frugis
NOAA/NWS Weather Forecast Office, Albany, New York

9:15 am
Evaluating the Effects of Terrain-Channeled, Low-Level Flow on Convective Organization
William Flamholtz
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

9:35 am
A Mesonet-Based Approach to Convective Cold Pools and Severe Thunderstorm Forecasting
Daniel Reese
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

9:55 am
Morning Break
SUNY Albany AMS selling Refreshments in NanoFab South Conference Center Rotunda

<u>Session B – Winter Weather I</u> (10:15 am to 11:35 am)

10:15 am
The 2 March 2018 Winter Storm in eastern New York
Michael Evans
NOAA/NWS Weather Forecast Office, Albany, New York

10:35 am
Forecasting the Inland Extent of Lake Effect Snow Bands Downwind of Lake Ontario
Joseph P. Villani
NOAA/NWS Weather Forecast Office, Albany, New York

10:55 am
The Influence of Boundary Layer Mixing on a Northeast Coastal Cyclone
Matthew Vaughan
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

11:15 am
Applying Forecast Track Diagnostics in High-Impact Northeast Winter Storms: Climatology and Case Analysis
Tomer Burg
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

11:35 am – 12:55 pm
Lunch

<u>Session C – Hydrology/Flooding/Tropical</u> (12:55 pm to 2:35 pm)

12:55 pm
The Mid–January 2018 Floods and Ice Jam Event
Neal M. Strauss
NOAA/NWS Northeast River Forecast Center, Boston/Norton, Massachusetts

1:15 pm
Cumulative Extreme Weather Events and Subsequent High-Impact Flooding in Southern Japan in Early July 2018
David R. Vallee
NOAA/NWS Northeast River Forecast Center, Boston/Norton, Massachusetts

1:35 pm
The 4 January 2018 Bomb Cyclone Record Breaking Coastal Flood Event
Frank Nocera
NOAA/NWS, Weather Forecast Office, Boston/Norton, Massachusetts

1:55 pm
Utilizing Dual-Polarization Instantaneous Precipitation Rate to Predict Flash Flooding
Aaron Reynolds and David Zaff
NOAA/NWS Weather Forecast Office, Buffalo, New York

2:15 pm
An Investigation of North Atlantic TC Ensemble Forecasts with Large Cross-track Errors
Nicholas Leonardo
School of Marine and Atmospheric Sciences
Stony Brook University, Stony Brook, New York

2:35 pm
Break: SUNY Albany AMS selling Refreshments in Nano South Conference Center Rotunda

Session D – Numerical Weather Predication and Applications

(2:55 pm to 4:35 pm)

2:55 pm
FV3GFS Official Evaluation Results for the Northeast U.S.
Alicia M. Bentley
I. M. Systems Group and NOAA/NWS/NCEP/EMC, College Park, Maryland

3:15 pm
A Sensitivity Analysis of WRF-Simulated Cold Air Damming Using Variable Parameterization Schema
Morgan M. Simms
NOAA/NWS, Weather Forecast Office, Newport/Morehead City, North Carolina

3:35 pm
CSTAR Update: Better Use of Ensembles in the Forecast Process: Scenario-Based Tools for Predictability Studies and Hazardous Weather Communication
Brian A. Colle
School of Marine and Atmospheric Sciences
Stony Brook University, Stony Brook, New York

3:55 pm
An Examination of Physical Approaches to Wind Gust Forecasting in New York City
Joshua Feldman
School of Marine and Atmospheric Sciences
Stony Brook University, Stony Brook, New York

4:15 pm
Validation of the WRF PBL over Long Island Sound during the LISTOS Experiment
Keenan Fryer
School of Marine and Atmospheric Sciences
Stony Brook University, Stony Brook, New York

NROW XIX Key Note Presentation

4:35 pm
Innovation in the Age of Autoforecasts
Greg Carbin
Chief of Forecast Operations
NOAA/NWS/NCEP, Weather Prediction Center, College Park, Maryland

5:35 pm
Wrap up
Joseph P. Villani

5:40 pm
Adjourn

****

6:30–9:00 pm
CSTAR Dinner at Brown's Brewing Company (Trojan Room) for participants in UAlbany–NWS CSTAR VI
417 River Street, Troy, New York
518-273-2337

Agenda
Northeast Regional Operational Workshop XIX
Albany, New York
Nano South Conference Center, Room 103, 255 Fuller Road
Thursday, November 8, 2018

8:10 am
Opening Remarks
Raymond G. O'Keefe, Meteorologist In Charge
Joseph P. Villani, NROW XIX Steering Committee Chair
National Weather Service, Albany, New York

Session E – High Impact Weather Events/Messaging (8:15 am to 9:55 am)

8:15 am
The High–Impact, Multi-Hazard Storm of 29 December 1948 – 1 January 1949 In New York and New England
Stephen DiRienzo
NOAA/NWS Weather Forecast Office, Albany, New York

8:35 am
Retrospective Analysis of the 31 May 1998 Northeastern U.S. Severe Weather Outbreak
Kevin S. Lipton
NOAA/NWS Weather Forecast Office, Albany, New York

8:55 am
The Christmas Day 2017 Snow and Damaging Wind Storm
Joseph W. DelliCarpini
NOAA/NWS, Weather Forecast Office, Boston/Norton, Massachusetts

9:15 am
Development of a Wind Extremes Forecast System for Transmission System Outage Prediction
Jeffrey M. Freedman
Atmospheric Sciences Research Center
University at Albany, State University of New York, Albany, New York

9:35 am
Communicating Hurricane Risk with Virtual Reality: Strategies for Improving Warnings
Jase Bernhardt
Department of Geology, Environment and Sustainability
Hofstra University, Hempstead, New York

9:55 am
Break: SUNY Albany AMS selling Refreshments in NanoFeb South Conference Center Rotunda

Session F – Winter Weather II (10:15 am to 11:55 am)

10:15 am
Operational Implementation of NWS Snow Squall Warnings for Winter 2018–19
Peter C. Banacos
NOAA/NWS Weather Forecast Office, Burlington, Vermont

10:35 am
Snow Squall Warnings: Operational Best Practices from 15 Years of Decision Support Services
Gregory A. DeVoir
NOAA/NWS Weather Forecast Office, State College, Pennsylvania

10:55 am
Convection-Permitting Ensemble Forecasts of the 10–12 December 2013 Lake-Effect Snow Event: Sensitivity to Microphysical Parameterizations
W. Massey Bartolini
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

11:15 am
Convection-Permitting Ensemble Forecasts of the 10–12 December 2013 Lake-Effect Snow Event: Sensitivity to Surface and Boundary Layer Parameterizations
Justin R. Minder
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

11:35 am
The 11–12 December 2008 Ice Storm across the Northeastern United States
John S. Quinlan
NOAA/NWS Weather Forecast Office, Albany, New York

11:55 am – 1:15 pm
Lunch

Session G – Climatology/Observations (1:15 pm to 2:35 pm)

1:15 pm
Preliminary Evaluation of Data from the GOES-16 Geostationary Lightning Mapper
Alan M. Cope
NOAA/NWS Weather Forecast Office, Mount Holly, New Jersey

1:35 pm

A Review of New York State Mesonet Site Properties and WMO Siting Criteria

Jerry Brotzge
New York State Mesonet
University at Albany, State University of New York, Albany, New York

1:55 pm

Comparisons of New York State Mesonet and ASOS Temperature data

Junhong (June) Wang
New York State Mesonet
University at Albany, State University of New York, Albany, New York

2:15 pm

Understanding Differences Between New York State Mesonet and ASOS Wind Observations

Alex Gallagher
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

Poster Session - NanoFab South Rotunda (2:35 pm to 3:05 pm)

2:35 pm

Microphysical Influences on Ensemble Members in the 15–16 December 2013 OWLeS Case

Jessica Blair
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

An Integrated Modeling and Observing System for the Study of the Ecology of Lake George in the Jefferson Project

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

Machine Learning Methods to Predict Wind Energy Availability using New York State Mesonet Data (2018)

Aleks Siemenn
Atmospheric Sciences Research Center
University at Albany, State University of New York, Albany, New York

Large Scale Observational and Model Analysis of the Unusual 2015–2016 El Niño Event: Implications for California Precipitation

Chelsea Snide
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

LISTOS 2018: How Land–Water Interactions Affect Ozone Transport in the Long Island Sound Area
Brennan J. Stutsrim
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

Analyzing the Role of Low-Level Forcing in Significant Severe Weather Outbreaks in the Eastern U.S.
Joseph E. Cebulko
NOAA/NWS Weather Forecast Office, Albany, New York

<u>Session H – Severe Weather II</u> (3:05 pm to 4:45 pm)

3:05 pm
Widespread Damaging Wind Severe Thunderstorm Event of 4 May 2018 across the NWS Albany, NY County Warning Area
Christina Speciale
NOAA/NWS Weather Forecast Office, Albany, New York

3:25 pm
Improving Tornado Detection and Lead Time:
The July/August Tornadoes of 2018 in Southern New England
Joseph W. DelliCarpini
NOAA/NWS Weather Forecast Office, Boston/Norton, Massachusetts

3:45 pm
Correlating Trends in Flash Extent Density to Tornadogenesis for Supercells in the Northeastern United States
Michael L. Jurewicz, Sr.
NOAA/NWS Weather Forecast Office, Binghamton, New York

4:05 pm
Albany Forecast Area Significant Hail Climatology and Case Studies
Thomas A. Wasula
NOAA/NWS Weather Forecast Office, Albany, New York

4:25 pm
Examining Terrain Effects on the 31 May 1998 Mechanicville, New York Supercell
Luke LeBel
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

4:45 pm – Wrap Up/Adjourn
Joseph P. Villani

NROW XX is scheduled November 6–7, 2019

The 15 May 2018 Northeast U.S. Significant Severe Weather Outbreak

Joseph E. Cebulko and Daniel B. Thompson
NOAA/NWS/WFO Albany, New York

A significant severe weather outbreak occurred across portions of the Northeast, Mid-Atlantic and New England on 15 May 2018. There were approximately 475 preliminary storm reports across the region with 37 of these being significant. Significant reports are defined as hail ≥ 5 cm (2 in), wind gusts ≥ 65 kts (75 mph), and tornadoes ranked ≥ EF2. Widespread straight-line wind damage, microbursts, macrobursts, and tornadoes occurred across portions of eastern Pennsylvania (PA), southern New York (NY), and western Connecticut (CT) as a result of an accelerating bowing line of convection. Multiple tornadoes spun up along this bowing segment with the strongest being ranked as EF2. Hail up to 7 cm (2.75 in) in diameter and 3 tornadoes were reported in association with a discrete, long-lived supercell that tracked from southeast NY into central CT. Remarkably, these were the first tornadoes to occur within a tornado watch box in the NWS Albany forecast area since 2003. According to the Connecticut Department of Emergency Services and Public Protection, this event caused the greatest storm-related damage in the state since 1989. It was estimated that damage equal to that of a Category 1 hurricane covered an area of 885 km^2 (550 mi^2) across 14 towns in CT. Unfortunately there were five fatalities and multiple injuries that occurred as a result of falling trees, limbs and other debris.

This presentation will investigate Convective Allowing Model (CAM) successes and failures for the event, multiscale environmental parameters, NWS Impact Based Warning utility, and a brief storm scale radar analysis. Some high resolution CAMs such as the HRRR produced short-term forecasts that successfully resolved the timing, intensity, and storm characteristics associated with the convection, emphasizing that the bulk of the active convection would be south of the Capital District in east-central NY, accurately focusing on southeast NY. Other high resolution models were less accurate, resulting in ensemble forecasts from the High Resolution Ensemble Forecast (HREF) that over-predicted convection farther to the north, across the Capital District and Lake George/Saratoga regions of NY. A tornado watch was issued for much of eastern New York which included the Capital District. While significant severe weather occurred over the southern portion of the watch area, ultimately the watch extended too far to the north. For example, only 13 of 26 of the counties within this watch experienced a thunderstorm while only 10 of 26 of the counties had any storm reports. This was a significant disservice to the Capital District, which is the fourth largest metropolitan area in the state (a population around 1.2 million). Examination of environmental data at times near and just prior to convective initiation will show that a careful meso-analysis could have resulted in exclusion of the Capital District and points northward from the watch.

Fast 500-hPa flow of 25–33 m s^{-1} (50–65 kt) existed across the area impacted by severe thunderstorms between an anomalously deep low over Quebec and a high in the western Atlantic. The near storm environment included MLCAPE values of 1000–2000 J/kg collocated with effective shear of 45–60 kt, and steep 700–500 hPa lapse rates observed at 7.7 C/km ahead of a robust cold front. This front was evident through a strong 850-hPa θ_e gradient observed in the 0000 UTC 16 May 2018 upper air observations network. Robust θ_e boundaries (Stuart 2004 and 2012) and steep mid-level lapse rates/elevated mixed layers (EML) (Banacos and Ekster

2010) have been shown to be associated with significant severe weather events like this one. The steep mid-level lapse rates over the Northeast with this event stemmed from an EML which originated from the Desert Southwest, and is tracked via analysis of various soundings approximate to locations along HYSPLIT backwards trajectories. Twenty eight of 37 (75%) of the NWS warnings associated with the significant storm reports included enhanced wording in the text product. This suggests that warning forecasters have the ability and skill to differentiate between “low-end” severe thunderstorms and those which pose an elevated threat to life and property.

Differences Between High–Shear / Low–CAPE Environments in the Northeast US Favoring Straight-Line Damaging Winds vs Tornadoes

Michael E. Main, Ross A. Lazear, Lance F. Bosart
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

High shear / low CAPE (HSLC) environments are common in the Northeast US and can occur at any time of year. Severe weather in HSLC environments is notoriously hard to predict, often catching both forecasters and the general public off-guard. The goal of this project is to help forecasters to identify HSLC environments favorable for severe weather in the Northeast US, and to discriminate between HSLC environments that are supportive of tornadoes versus those that favor straight-line damaging winds (SDW).

A 10-year HSLC severe weather environmental climatology was created for the Northeast US (New England, New York, New Jersey, Pennsylvania). This climatology includes 54 different parameters that can be used to identify and describe severe weather environments. HSLC criteria was defined as surface-based CAPE (SBCAPE) $\leq$ 500 J kg^{-1}, most unstable parcel CAPE (MUCAPE) and mixed-layer CAPE (MLCAPE) $\leq$ 1000 J kg^{-1}, and 0–6-km wind shear $\geq$ 18 m s^{-1} (Sherburn et al. 2016). Events included in the climatology consisted of numerous ($\geq$5) straight-line damaging wind reports, or at least 1 tornado report. Each event was classified by the season in which it occurred and the mode (discrete, cluster of cells, quasi-linear convective system (QLCS)) of the storm which produced the reports.

Results show that warm-season HSLC severe events typically occurred either at the beginning or at the tail end of an event in an environment where CAPE values were predominantly too large to meet the HSLC criteria. Storm mode was variable for warm-season events, but cool-season events were dominated by QLCSs. Results show lifted condensation levels (LCLs) as well as low-level shear and wind direction as some of the most skillful parameters at discriminating between tornadic and non-tornadic events. There are various other useful parameters, including but not limited to, surface relative humidity, effective shear magnitude, and convective inhibition. The usefulness of these, and other parameters, at discriminating between HSLC environments favorable for SDW versus tornadoes will be discussed.

The Use of Collapsing Specific Differential Phase Columns to Predict Significant Severe Thunderstorm Wind Damage across the Northeastern United States

Brian J. Frugis
NOAA/NWS/WFO Albany, New York

The Storm Prediction Center considers severe thunderstorms that produce measured or estimated wind gusts of at least 65 knots (74.8 mph), hail 5.08 cm (2 inches) in diameter or greater or an EF2 or greater tornado to be significant. Between 1 January 2012 and 31 December 2017, the Northeast (New England, New York, New Jersey Delaware, northeastern Maryland and central and eastern Pennsylvania) saw 261 severe thunderstorm wind reports that were either significant or produced injuries or fatalities. This total is almost double the number of tornadoes that were reported over the same time period (138). Many of these significant severe thunderstorm wind damage reports had a much larger societal impact as compared to the tornadic events as well. Considering the National Weather Service's (NWS) implementation of Impact-Based Warnings, knowledge of a severe thunderstorm's damage potential is critical information for forecasters to have when issuing severe thunderstorm warnings.

Pinpointing which particular severe thunderstorms will produce significant wind damage can be a difficult challenge for the warning decision forecaster. Out of the 1423 severe wind reports received by the NWS Albany between 1 January 2012 and 31 December 2017, only 46 (about 3%) were considered significant. However, these particular storms had a major impact on the lives of many people in the region and these storms received a large amount of media attention. Doppler radar radial velocity data may not always provide a clear picture on the scope of the storm, due to inherent problems regarding the radar beam's height and angle. As a result, forecasters need to rely on something other than just radial velocity to help give perspective of a storm's potential.

This study examined the use of the dual-polarization product Specific Differential Phase (K_{DP}) during radar interrogation to diagnose the potential of significant severe thunderstorm winds. When examined in vertical cross-sections, elevated strong cores of K_{DP} were shown to lower towards the surface just prior to the reports of significant severe thunderstorm wind damage in 30 of 46 cases across the NWS Albany forecast area. The use of K_{DP} columns can be a successful method to help forecasters predict when significant severe wind damage will occur, resulting in better lead times and more detailed information for impact-based severe thunderstorm warnings.

Evaluating the Effects of Terrain-Channeled, Low-Level Flow on Convective Organization

William Flamholtz, Brian Tang, and Lance Bosart
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

Forecasting severe weather in regions of complex terrain is often difficult due to convective environment inhomogeneities induced by terrain. In the northeastern United States, one common inhomogeneity arises where terrain channeling of low-level flow occurs in valleys, where localized backed flow, and a subsequent increase of low-level wind shear, may develop ahead of convection. This study uses idealized Weather Research and Forecasting (WRF) experiments to investigate how convective organization changes with representative low-level wind profiles.

A number of idealized WRF simulations were conducted with different initial wind profiles in the 0–1-km layer, while keeping the thermodynamic profile the same across simulations. This layer was chosen to reflect the depth over which terrain-channeling effects occur in northeastern U.S. valleys. The wind profiles are based on terrain and non-terrain simulations from realistic, parent numerical simulations of past severe weather events in the northeastern U.S. We focus on one low-predictive skill event that had high CAPE and low shear, and produced widespread wind damage. The parent simulation with terrain had 0–1-km storm-relative helicity perturbations of approximately 40 $m^2\ s^{-2}$ within valley locations, compared to the non-terrain simulation. The importance of these in-valley perturbations to convective organization were evaluated using the aforementioned idealized simulations. Circular warm bubbles were used to initiate convection.

An analysis of convective structure, cold-pool characteristics, and updraft strength will be presented. The convective evolutions of simulations with low 0–6-km shear do not exhibit significant differences between terrain-channeled and non-terrain channeled flow. When the 0–6-km shear is increased, simulations with terrain-channeled flow produce greater convective organization than simulations with non-terrain channeled flow. These results suggest that the risk of severe weather may not be sensitive to low-level flow perturbations caused by terrain channeling in high-CAPE, low-shear environments, and that other terrain factors and stochastic factors associated with the convection itself may be more important. In higher shear environments, terrain-channeled flow may play a more important role in determining where severe weather may occur.

A Mesonet Based Approach to Convective Cold Pools and Severe Thunderstorm Forecasting

Daniel Reese, Chris Thorncroft, Nick Bassill, and Jerald Brotzge.
Department of Atmospheric and Environmental Sciences,
University at Albany, State University of New York, Albany, New York.

The recently finished New York State Mesonet (NYSM), consisting of 126 standard surface weather stations across the state, has a wide range of potential uses in research and operational forecasting. One particular use is in the area of severe thunderstorm forecasting. While observations across the different sites are undoubtedly important in quickly signaling which areas have been most impacted by heavy rain and significant winds, they can also hint to trends in the coverage or intensity of severe weather. These observations, such as mesoscale convergence or temperature/pressure changes, are most significant in the forecast time window of several minutes to several hours.

.

In this short-term forecasting of severe weather, the dynamic and thermodynamic mesoscale environment in the vertical is also critical with regard to the evolution of convection. While radiosondes can capture the vertical structure with a high spatial resolution, they can not depict the rapid changes to the environment over time which are common in dynamic mesoscale environments (Knupp, 2008). The NYSM also has a network of seventeen vertical profile stations across the state, each containing a Lidar instrument and a Microwave Radiometer. Instruments such as these, while more limited in vertical resolution compared to a radiosonde, are better suited to depict these rapid mesoscale changes to the vertical profile over time.

This study examines profiler and standard data from across the NYSM during a severe weather event that occurred on 22 August 2017. On this day, two squall lines, each with a notable cold pool, moved across much of upstate New York, producing widespread damaging wind reports. In comparison, the profiler sites spread across the state are able to capture the pre-storm vertical environment, as well as changes to these profiles as the squall lines and cold pools moved across the state. Wind speed, cold pool strength and depth, and other thermodynamic and dynamic features are all considered. These features are analyzed with regards to both location and time, and to other observations such as radar and storm reports, in order to note patterns and features that may help with short term operational forecasting.

By analyzing and plotting standard and profiler NYSM data for this case, spatial and temporal trends are identifiable, giving forecasters a better idea of system behavior compared to using only traditional analysis techniques, such as radar, satellite, and ASOS observations. It is found that cold pool extent and magnitude can be best monitored by looking at short-term (~thirty minutes) changes in theta-e using standard data, as well as examining cold pool depth and slope via profiler data. Cold pool behavior and evolution can be examined by looking at individual station meteograms, specifically at how rapidly certain variables like pressure, temperature, and theta-e evolve over time at different stations. Building on this, it is found that there was a noticeable correlation between cold pool strength, defined by the maximum thirty minute drop in theta-e, and wind damage, defined by a running thirty minute sum of Storm Prediction Center local wind reports. During the event, there were notable increases in the maximum cold pool strength, and each of these increases was followed approximately thirty minutes later by a significant spike in local wind reports. While more research involving more cases is needed, it appears that an intensifying cold pool may serve as a signal that short term wind damage potential is increasing.

The 2 March 2018 winter storm in eastern New York

Michael Evans
NOAA/NWS/WFO Albany, New York

A major winter storm affected the northeast U.S. including eastern New York on March 2, 2018. The large-scale pattern associated with this storm was favorable for a pivoting band of heavy snow across the region, however forecast models indicated uncertainty associated with the precipitation type for much of the area. Specifically, the operational NAM model and much of the high resolution forecast guidance indicated a colder solution than the operational GFS, particularly over lower elevations in the Hudson Valley where precipitation type was most uncertain. Forecasts from the National Weather Service blended the colder and warmer solutions and indicated a mix of rain and snow in the Hudson Valley with all snow over higher elevations. Subsequent observations indicated that the precipitation fell as mainly snow, even at lower elevations in the mid and upper Hudson Valley, resulting in National Weather Service Forecasts snowfall forecasts being too low. A closer examination of the warmer GFS forecasts showed some unrealistic lower-tropospheric temperature profiles given the moderate-to-heavy precipitation expected. Errors in the GFS forecast sounding appear to be consistent with similar errors documented in several previous cases.

Forecasting the Inland Extent of Lake Effect Snow Bands Downwind of Lake Ontario

Joseph P. Villani[1] and Michael L. Jurewicz[2]
[1]NOAA/NWS/WFO Albany, New York
[2]NOAA/NWS/WFO Binghamton, New York

Determining the inland extent (IE) of lake effect snow (LES) is an ongoing operational forecasting challenge at the Albany and Binghamton National Weather Service (NWS) forecast offices, and several other NWS forecast offices in the Great Lakes region. Assuming favorable conditions for development of LES, determining how far inland snow bands will extend is critical to forecasters making decisions supporting the NWS watch/warning/advisory program and resulting impact-based decision support services.

This research sought to identify which atmospheric parameters commonly have the greatest influence on how far inland LES bands travel, and to develop forecasting techniques to assist meteorologists. Single band LES events for the 2006–2009 winter seasons were examined downwind of Lake Ontario. The IE of LES bands was measured over the duration of each event and broken into quartiles. The quartiles were used to create categories for IE (short, moderate, and long). Several parameters were analyzed, using statistical correlations at data points within, and just outside of, LES bands. Box-and-whiskers plots were constructed for individual parameters relative to each IE category.

The most strongly correlated parameters to IE included existence of a multi-lake/upstream moisture source connection (MLC), mixed-layer (ML) stability (represented by lake–air temperature differentials), 0–1-km bulk shear, and mean ML wind speed. LES bands featuring an MLC showed a greater tendency to progress farther inland, compared to those without. A predictive equation for forecasting IE of LES downwind of Lake Ontario was developed from a statistical model using a stepwise and backwards selection algorithm. A cross-validation method was used to determine skill.

The Influence of Boundary Layer Mixing on a Northeast Coastal Cyclone

Matthew Vaughan and Robert G. Fovell
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

Sub-grid scale turbulence in the Weather Research and Forecasting model (WRF) is typically handled by a planetary boundary layer (PBL) parameterization. These schemes attempt to represent turbulent mixing processes occurring below the resolvable scale of the model grid, and act upon temperature, moisture, and momentum within the boundary layer in order to produce a more realistic representation of the low-level atmospheric structure. PBL mixing can impact extratropical cyclone development by influencing the low-level baroclinicity and altering the moisture content of the boundary layer. Changes in PBL moisture may alter the upper-level environment through diabatic ridge building via condensational heating in the middle troposphere as parcels are lifted through convection and overrunning processes.

This study varies the PBL mixing strength within 4-km WRF simulations of the 27–28 January 2015 snowstorm. The Yonsei University PBL parameterization is used to assess the impact of strong vs. weak mixing. The bulk critical Richardson number for unstable regimes is varied between 0.0–0.25, as a way of directly altering the depth and magnitude of sub-grid scale turbulent mixing. Results suggest differences in boundary layer moisture availability lead to variations in the magnitude of latent heat release above the warm front, resulting in stronger upper-level downstream ridging in the simulation with less PBL mixing. This more amplified flow pattern impedes the eastward propagation of the surface cyclone and results in a westward shift of precipitation. Additionally, trajectory analysis indicates ascending parcels in the less mixing case condense more water vapor, ascend through a larger depth, and end at a higher potential temperature than ascending parcels in the more mixing case, suggesting stronger latent heat release when PBL mixing is reduced.

The bulk critical Richardson number variations provoke changes in PBL mixing that cannot be independently or easily verified from observations. However, the changes in PBL mixing lead to important differences in surface cyclone track and precipitation patterns relevant to operational forecasting. These results suggest PBL mixing should be considered in ensemble forecasting systems that attempt to quantify uncertainty for high-impact synoptic and sub-synoptic weather events.

Applying Forecast Track Diagnostics in High-Impact Northeast Winter Storms: Climatology and Case Analysis

Tomer Burg, Andrea L. Lang, Ryan D. Torn, and Kristen L. Corbosiero
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

A conventional forecasting notion is that as lead time decreases, numerical weather prediction models exhibit a westward trend in the forecast position of low-pressure systems along the East Coast of the U.S. This westward trend, which may turn seemingly weak ocean cyclones into high-impact weather events for the Northeast U.S., is attributed to various potential causes, such as variability in upstream shortwave troughs, or the representation of latent heat release in the NWP models downstream of the trough associated with the incipient cyclone. This study seeks to address whether this rule of thumb holds any significant merit, and to examine a long term climatology of Northeast U.S. cold season cyclones from a forecast skill and error perspective.

A climatology of ensemble forecasts of high-impact Northeast winter storms initialized from 0 to 5–day lead times was constructed using the Global Ensemble Forecast System (GEFS) Reforecast version 2. Cases included in this climatology were first identified within 750km of the 40ºN/70ºW benchmark in the Sprenger et al. (2017) track dataset, then tracked within the CFSR using an 850-hPa area-averaged vorticity maxima and height minima based tracking algorithm. To illustrate the cyclone tracking algorithm used for this study, as well as the forecast verification methodology, a representative low-forecast skill case from 4 March 2001 is used as a case study. The verification of the ensemble forecasts at 0 through 5-day lead times are computed against the CFSR observed track, with the resulting forecast track and intensity errors compared against climatological errors.

The results show that for most of the reforecast lead times, cyclones tended to exhibit a slightly left-of-track bias on average, while the 12–66-hour lead time range shows a prominent slow bias for most cases. Cases were then partitioned by various categories such as along and across track bias, storm motion vector direction, region of cyclogenesis, intensity bias, and along vs. across track variability utilizing ensemble cyclone forecast position ellipses following the methodology of Hamill et al. (2011). Synoptic-scale composites were then created for each of these categories to identify any statistically and physically significant upstream differences.

The Mid–January 2018 Floods and Ice Jam Event

Neal M. Strauss and David R. Vallee
NOAA/NWS/Northeast River Forecast Center, Norton, Massachusetts

A widespread minor to moderate flood event struck the Northeast in mid-January. The floods were the result of significant snowmelt during a record warm-up. Dozens of ice jams led to flooding of rivers and streams across the region. In total, seventeen forecast locations exceeded flood elevations with three exceeding moderate flood stage. An additional twenty locations experienced some degree of ice jam flooding.

Significant ice buildup occurred on rivers and streams as the Northeastern United States was in the midst of an extended Arctic cold outbreak from December 26, 2017 to January 8, 2018. Average daily temperatures during this two week period generally ranged from 12 to 18 degrees below normal. In addition, near normal to above normal precipitation occurred since December 2017, mostly in the form of snow.

A significant January thaw commenced as temperatures began to rebound above freezing prior to the approach of a cold front January 12-13, 2018. Gusty southwest winds helped drive temperatures into the 50s to lower 60s, and dew points into the 50s. Heavy rainfall ensued along with significant snowmelt. The resulting runoff produced substantial river rises, widespread flooding on area rivers, and numerous breakup ice jams. This presentation will review this event and its impacts on the region.

Cumulative Extreme Weather Events and Subsequent High-Impact Flooding in Southern Japan in Early July 2018

Lance F. Bosart[1] and David R. Vallee[2]
[1]Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York
[2]NOAA/NWS/Northeast River Forecast Center, Norton, Massachusetts

Devastating flooding in southwestern Japan on 7–8 July claimed more than 200 lives and was the deadliest flood-related disaster in Japan since 1982. This flooding was the cumulative effect of four heavy rainfall events across southwestern Japan between 28 June and 8 July 2018. The accumulated rainfall from the first three heavy rainfall events saturated soils across much of southwestern Japan. Rainfall rates during the fourth heavy rainfall event on 6–8 July reached 50–100 mm and triggered massive flooding as the saturated soils were unable to absorb the extensive runoff. The purpose of this presentation is to document the meteorological events responsible for the four heavy rainfall episodes, and to provide an overview of the resulting widespread impacts that collectively devastated southwestern Japan.

The first heavy rainfall event on 28 June was associated with a stalled upper-level trough west of Japan and an amplifying and back-building upper-level ridge east of Japan. The interaction of the upstream upper-level ridge and downstream upper-level trough enabled a stalled surface frontal boundary to drift northwestward toward southwestern Japan beneath confluent flow aloft in the equatorward entrance region of an upper level jet. Precipitable water (PW) values > 60 mm and integrated water vapor transport (IVT) values > 1000 kg m^{-1} s^{-1} fueled the heavy rainfall. The second heavy rainfall event occurred on 29–30 June under similar upper-level flow conditions, but with the benefit of additional deep tropical moisture from TC Prapiroon. A third heavy rainfall event on 2–3 July occurred when TC Prapiroon brushed past the southwestern tip of Japan. A persistent low-level southeasterly flow resulted in orographic enhancement of the heavy rainfall in all three events.

The antecedent for the fourth, and final, heavy rainfall event was the formation of a high-amplitude anomalously deep trough over central Russia on 4–5 July that facilitated extensive upper-level ridging downstream over China on 5–6 July and the subsequent formation of a very slow-moving weak trough across Korea and the southwestern Sea of Japan. Deep tropical moisture (PW values > 70 mm and IVT values > 1200 kg m^{-1} s^{-1} reached southwestern Japan on 6–7 July along a weak frontal boundary behind TC Prapiroon in the aftermath of the storm's extratropical transition (ET). These heavy rains were associated with warm-air advection along an elongated northeast–southwest inverted trough axis located near the equatorward entrance region of an unseasonably strong 60+ m^{-1} s^{-1} jet stream. This jet stream, located east of northern Japan and south of the Kamchatka Peninsula, was a direct result of the ET of TC Prapiroon and the associated enhanced baroclinicity in the middle and upper troposphere.

The 4 January 2018 Bomb Cyclone
Record Breaking Coastal Flood Event

Frank Nocera
NOAA/NWS/WFO Boston/Norton, Massachusetts

The 4 January 2018 Bomb Cyclone reached a minimum central pressure of 951 mb about 300 miles south of Boston - an astounding low pressure value for this latitude. Perhaps more impressive was that the cyclone achieved a 59 mb pressure drop in 24 hrs! Most of the general public will remember this storm for its near blizzard conditions in Rhode Island and eastern Massachusetts and hurricane force wind gusts across Cape Cod and Nantucket.

However the entire east coast of Massachusetts from Nantucket to Boston to Cape Ann experienced major to record breaking coastal flooding, accompanied by an all-time record water level at the Boston tide gauge of 15.16 ft MLLW, surpassing water levels from the 1978 blizzard (15.10 ft MLLW). Other notable impacts include, the Boston T Blue line flooded for the first time in the subway's history. In addition, the Chatham upper air site on Morris Island, Cape Cod flooded and was inaccessible for the first time since 1987!

This event review will focus on the coastal flood impacts and forecasts, evaluating predictions including model performance and messaging/communicating the threat of significant coastal flooding.

Utilizing Dual-Polarization Instantaneous Precipitation Rate to Predict Flash Flooding

Kirk R. Apffel[1], Aaron Reynolds[1] David Church[2], and Jacob Escobedo[3]
[1]NOAA/NWS/WFO Buffalo, New York
[2]NOAA/NWS/WFO Salt Lake City, Utah
[3]Texas A&M University, College Station, Texas

Dual polarization radar uses an algorithm called Digital (instantaneous) Precipitation Rate (DPR) which can be useful in predicting flash flooding. When re-processed to estimate the duration for which areas meet a minimum threshold of two, three, and four inches per hour respectively, initial research shows that potential flash flood events may be easier to detect when compared to traditional radar interrogation techniques. Heavy rain events from 2015-2017 between 10 and 120 km of the Buffalo (KBUF) and Cleveland (KCLE) radars respectively were examined to find coherent cases where DPR exceeded each rain rate threshold for 20 minutes or longer. A total of 28 event days were then examined, yielding 1710 cases, which were then compared to observed flash flood events. These cases were categorized further based on a location's vulnerability to flash floods through the use of a local static Flash Flood Potential Index (FFPI) and stratified by rainfall rate and how long the heavy rain lasted during a 60 minute time period. Results showed that for areas at least moderately susceptible to flash flooding that the risk increases significantly when instantaneous precipitation rainfall rates of at least 2 inches per hour last more than 35 minutes, or when rainfall rates of at least 3 inches per hour last more than 25 minutes. Rainfall rates over 4 inches an hour showed less skill since they did not provide much lead time and may be prone to hail contamination. This research is currently being used by two National Weather Service (NWS) offices and has aided forecasters with detection and lead time of flash floods. Future research may support the use of this product in all NWS offices.

An Investigation of North Atlantic TC Ensemble Forecasts with Large Cross-track Errors

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

While medium-range (day 3-5) track forecasts for North Atlantic tropical cyclones (TCs) have improved during the last three decades, numerical models occasionally have very large errors when forecasting certain TCs, such as Hurricane Sandy (2012) and Hurricane Joaquin (2015). Large cross-track errors can be especially problematic in that they can determine if or where the TC makes landfall. Understanding the commonalities of these events can help forecasters recognize situations when the model track guidance is prone to be significantly biased.

This study verifies the 2008-2016 North Atlantic TC track forecasts of global ensembles, focusing on the GEFS (21 members) ensemble. The NHC's best-track data is used as the verifying analysis. The largest ensemble mean cross-track errors from each day 3-5 forecast are analyzed. The forecasts are defined as "ET" ("n-ET") based on the cyclone phase space diagram (Hart 2003) and whether the observed TC (never) crosses north of 30°N, thereby isolating cases not strongly interacting with mid-latitude baroclinic systems. For each set of cases, the top 20% most negative and most positive cross-track errors are considered "Left" and "Right" cases, respectively. The CFSR gridded fields are used to identify common flow patterns in these cases and to verify the model forecasts. The contributions of environmental steering and TC size to motion errors are quantified using the diagnostic described by Galarneau and Davis (2013). The relationship between model fields and cross-track errors are further assessed using ensemble sensitivity analysis.

The GEFS has a slight overall right-of-track bias for "n-ET" cases after 72 h. There is a statistically significant correlation between the cross-track biases and initial TC intensities, with major hurricanes tending to have right-of-track errors. Meanwhile, by 24 h in the forecast, environmental steering errors tend to have larger contributions to the track biases than errors in TC size in both Left and Right cases. Vortex-relative composites reveal that these environmental steering errors are attached to a subtropical ridge northeast of the TC in more than half of the Left and Right cases. For the right-of-track cases, the geopotential heights north of the TC become more underpredicted with time in the forecast.

FV3GFS Official Evaluation Results for the Northeast U.S.

Alicia M. Bentley, Logan C. Dawson, Tracey A. Dorian, and Geoffrey S. Manikin
I. M. Systems Group and NOAA/NWS/NCEP/EMC, College Park, Maryland

The current operational Global Forecast System (GFS) will be replaced by the FV3GFS in early 2019. The upcoming transition to the FV3GFS, with its finite-volume cubed-sphere (FV3) dynamical core and updated microphysics package, is the first major step toward the future implementation of the Next Generation Global Prediction System (NGGPS) and the transition of the NCEP model suite to the FV3 dynamical core as part of the Unified Forecast System (UFS). This presentation focuses on the results of the FV3GFS official evaluation led by the NCEP/Environmental Modeling Center (EMC) Model Evaluation Group (MEG), a subset of NCEP/EMC's Verification, Post Processing, and Product Generation Branch. The FV3GFS official evaluation, a four-month long opportunity for the field to assess FV3GFS performance in real time and during three years' worth of retrospective forecasts, produced a variety of results that are of interest to operational forecasters in the Northeast U.S. Statistical results from the 3-yr retrospective period, including 2-m temperature, 10-m wind, and precipitation skill scores over the Northeast U.S., will be presented. Case studies of particularly impactful Northeast U.S. weather events, including the "Pi Day" Blizzard of 13–15 March 2017 and the "Bomb Cyclone" of 3–5 January 2018, will be examined. Examples of new output parameters, including instantaneous precipitation type and composite radar reflectivity, will also be shown.

A Sensitivity Analysis of WRF-Simulated Cold Air Damming Using Variable Parameterization Schema

Morgan M. Simms[1], Jason M. Cordeira[2], and Eric P.Kelsey[2]
[1]NOAA/NWS/WFO, Newport/Morehead City, North Carolina
[2]Department of Atmospheric Science and Chemistry, Plymouth State University, Plymouth, New Hampshire

Cold air damming (CAD) is a common phenomenon in Northern New England U.S.A. in which cold air persists to the south and east of the northern Appalachian Mountains during region-wide warm air advection. CAD often allows for wintry precipitation to persist for extended periods and can negatively impact transportation and local commerce in Northern New England, especially during the winter months. Numerical models are known to struggle with the evolution of CAD, particularly the erosion process and the portrayal of the vertical temperature profile and precipitation type. Numerical models often mix-out the cold air too soon, which can lead to the unanticipated continuation of hazardous wintry weather.

This National Science Foundation (NSF)-funded study utilizes the Weather Research and Forecasting Model (WRF-ARW) to investigate the sensitivity of variable microphysical and planetary boundary layer (PBL) schema to the WRF forecast of the evolution and vertical extent of CAD in Northern New England. For example, a simulation of CAD on 11 January 2014 using the Mellor-Yamada-Janjic (MYJ) PBL and WRF single-moment 3-class ice microphysics schema reveals a longer duration CAD than the Yonsei University (YSU) schema, which mixes out CAD too quickly. The simulation also provides excellent insight into the depth and maximum height of the cold pool. This research tests different combinations of schema and compares their differences from surface weather station observations over Northern New England. Further improvements to the WRF simulations are possible with the assimilation of the aforementioned observations and those from the Mount Washington Observatory (MWO) Auto Road Vertical Profile (ARVP).

CSTAR Update: Better Use of Ensembles in the Forecast Process: Scenario-Based Tools for Predictability Studies and Hazardous Weather Communication

Brian A. Colle[1], Edmund Chang[1], Taylor Mandelbaum[1], Rui Zhang[1], and Christine O'Connell[2]
[1]School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, New York
[2]Alan Alda Center for Communicating Science/School of Journalism, Stony Brook University

This project addresses the need for more tool/graphics to display ensemble data as well as better communication of uncertainty information. Forecasters need more opportunities to interact with ensemble data other than the conventional mean, spread, and probabilistic products. The science motivation is how to effectively combine and validate information from multiple models/ensembles together to better understand the predictability of high impact weather. The practical motivation is how this information can be effectively communicated to stakeholders to render them more useful. The primary goals of this CSTAR are: (1) To extend our newly developed fuzzy clustering approach to high impact weather events including precipitation, freezing level, and 10-m wind for days 1-7 using the short-range and global ensembles; (2) Expand our new spread-anomaly ensemble tool; (3) Use these tools to verify these phenomena in the ensembles and understand the large-scale flows attached to the less predictable events; and (4) Integrate the Alan Alda Center for Communicating Science (www.aldacenter.org) into our CSTAR to help forecasters better communicate probabilistic information through a series of three workshops, some of which involving stakeholders.

This talk will provide an update on the Stony Brook CSTAR activities, which includes: an update on the online spread anomaly tool using GEFS, fuzzy clustering of GEFS,CMC, and ECMWF, some validation of ensemble sensitivity upstream area, and planning for the first Communication Uncertainty Workshop. The spread tool constructed utilizing the GEFS Reforecast between 21 November 1985 and 10 March 2017. A method is developed which identifies the centroids of spread and MAE for the upper quartile of cyclone-relative data. The ECMWF does significantly better in both short and long range when looking at the distance between centroids, as well as the percentage of points on the cyclone-relative grid that overlap. Spread and mean absolute error (MAE) expand at different rates and are consistently different magnitudes, with maximum values of the GEFS MAE 270% greater than the spread for days 1-3 and 188% greater for days 5-7, which suggests underdispersion. The fuzzy clustering tool has been expanded to include 12-h or 24-h precipitation and surface freezing, and an example will be shown. For the ensemble sensitivity analysis (ESA) tool, we validate the accuracy of the upstream regions identified by the leave-one-out cross validation method (LOOCV). Both 3-day and 6-day results demonstrated the forecast skill of ESA in the medium range is significant for most of the cyclone cases, although the relations worsen close to the initialization time. The Communication Uncertainty Workshop is an interactive 2-day workshop that will focus on helping NWS forecasters learn how to distill their message and effectively engage their colleagues, potential collaborators, decision makers, media, and the general public about the uncertainties associated with the various issues with winter storms.

An Examination of Physical Approaches to Wind Gust Forecasting in the New York City Metropolitan Area

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

Non-convective wind gusts pose extensive weather hazards to the Northeast United States, particularly because they occur year-round and even during clear skies. Wind gusts have historically posed a significant forecasting challenge given that vertical momentum transport in the planetary boundary layer is not explicitly represented by numerical weather prediction (NWP). Consequentially, wind gusts prediction typically involves empirical procedures that do not necessarily consider the physical mechanisms that generate them. The practical motivation of this study is to explore the effectiveness of physically-based NWP post-processing algorithms in forecasting non-convective wind gust compared to empirical NWP wind gust algorithms. This talk will focus on two such physically based methods: (1) The Wind Gust Estimate (WGE), which is a turbulence--based method; and (2) the Air Force Weather Agency (AFWA) method, which is a static stability--based method. Most previous studies only ingested data from mesoscale atmospheric models into these algorithms, limiting the temporal extent to which high gust events can be detected. One mesoscale model, the deterministic 12km North American Mesoscale Model (NAM); one global model, the deterministic Global Forecast System (GFS); and one global ensemble, the GFS ensemble (GEFS); were included in the evaluation of the methods. The NAM is the only model included in the study with a turbulence parameter, so the WGE was only evaluated for data supplied by the NAM but the AFWA was evaluated using data from all three models. The WGE was evaluated for wind gust events that impacted the New York City metropolitan area between January 2016 and March 2018, while the AFWA was evaluated for wind gust events between October 2016 and March 2018. Cases were evaluated aggregately and separately by classification of either cyclone or post cold frontal (dry).

The WGE demonstrated to be the most accurate method, but maintained an overforecasting bias within 36 hours of wind gust events. Conversely, the AFWA routinely underforecasts wind gusts. The empirical NAM and GFS forecasts were the worst performing for all classifications except at several forecast lead times before cyclone wind gusts. All algorithms forecast post-frontal gusts substantially better than gusts produced during cyclones. Within short lead times before impact from cyclones, neither the AFWA nor the WGE offered substantial utility over the empirical NWP algorithms. The utility of the GEFS over the GFS was shown to be in its improved detection of wind gust threat compared to the GFS using probabilistic validation metrics. A real-time web page is being constructed to highlight the daily forecasts from each of the approaches, and some examples will be shown (https://you.stonybrook.edu/windgusts/).

Validation of the WRF PBL over Long Island Sound during the LISTOS Experiment

Keenan Fryer, Brian A. Colle, and John Mak

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

Air quality is an important forecast problem over the New York City Metropolitan Region. It requires accurate forecasts of the winds and temperatures in the planetary boundary layer (PBL), but there has been little model validation, especially over the coastal water areas, such as Long Island Sound. During the summer of 2018, as part of the Long Island Sound Tropospheric Ozone Study (LISTOS), a Long-EZ research aircraft was deployed to collect several hours of kinematic and thermodynamic data on a number of high ozone days. The purpose was to investigate the general PBL characteristics of the complex coastal interface including both a look at the structure of the PBL spatially as well as its structure in the vertical. For the presentation we focus on the particularly high ozone days of July 9 and 10.

For these two case-study days a series of overlapping transects were done across the LIS from LI to CT at varying heights up to 1200m. For each case, two transect sets were done, one to the western end of the LIS and the other towards the eastern end close to the Port Jefferson area of LI. These transects were then stitched together onto cross-sections that give a unique peak into the PBL over the coastal regions of LI and CT and importantly over the LIS. In addition to the cross-sections, time series plots of TKE were constructed, which shed light on the varying amounts of mixing that are occurring during these events. A series of high-resolution model runs were done using the Weather Research and Forecast model (WRF). Three runs were done for each case employing either the MYNN2, the YSU, or the ACM2 PBL parameterizations. These runs consisted of three one-way nested domains using 12, 4, and 1.3 km grid spacing, each with 38 vertical levels.

For these two days a maximum of over 130 ppb ozone was measured over Long Island Sound (LIS). These high concentrations extended down to the surface in the western LIS but did not in the eastern part of the LIS. These differences reflect the varying influence of the sea surface between LI and Connecticut on the PBL evolution. Furthermore, a lower level jet (LLJ) with its core at 150 m was observed lying along the Connecticut coast and lying adjacent to the highest ozone concentrations. We hypothesize that this LLJ may have served to transport ozone and precursor gases eastward over the LIS from the NYC metro area. Finally, using TKE as a metric, it was found that mixing was varied greatly from the western LIS to the eastern LIS. The WRF simulations struggle to ramp up the LLJ as well as with matching the observed TKE, these struggles have large implications for the WRF’s ability to accurately depict the PBL on these high ozone days.

Innovation in the Age of Autoforecasts

Greg Carbin
NOAA/NWS/NCEP Weather Prediction Center, College Park, Maryland

Forty years ago this past February, a defining moment in weather history occurred for many across New England and elsewhere when a Nor'easter of epic proportions whipped feet of snow into nearly house-sized drifts and a record storm surge battered the Atlantic coastline from Long Island to Maine. On the spot, a weather savant or database query might provide a count of Nor'easters since then, ranking them by pressure, snowfall, or highest wind gust. Other post-storm metrics, such as the Northeast Snowfall Impact Scale (Kocin and Uccellini 2004), or the Regional Snowfall Index (Squires et al. 2014), could be evaluated to place snowstorms before and after February 3-4, 1978 into historical context. This talk will discuss new techniques NCEP is exploring to help place *forecast* events, from rainstorms to tornado outbreaks, into historical context. In the age of social media and IDSS (Idiots Distributing Single Simulations), best practices in developing and disseminating this type of authoritative and science-based weather information will be discussed.

Data mining, advanced observation platforms, probability forecasts from ensembles, and high performance computing, have all been exploited to improve prognostication beyond what anyone thought possible four decades ago. At the same time, these advances have come at a price of terabytes of data, well beyond the capabilities of human forecasters to track, filter, and interpret. Determining those weather regimes when forecasts can be left on "autopilot" versus those when humans must intervene to focus on "targets of opportunity" will also be explored. The powerful combination of expert systems and informatics will greatly enhance the development of decision making tools needed to better anticipate and respond to weather impacts. Innovation (through R2O and O2R) in these topic areas will propel operational meteorology into the 2020s. This talk will conclude with a look at relatively new Python modules helping to address some of the challenges of large dataset exploration and visualization.

The High Impact, Multi-Hazard Storm of 29 December 1948 – 1 January 1949 In New York and New England

Steve DiRienzo
NOAA/NWS/WFO Albany, New York

Between 29 December 1948 and 1 January 1949, eastern New York and western New England were hit by a large slow-moving, multi-hazard storm system. Initially, the storm brought mild temperatures, heavy rain and flooding. As the storm slowly moved northeastward, colder temperatures brought damaging freezing rain accumulations followed by snow. Flooding washed out roads, bridges and railway lines. Landslides closed additional roads. Ice accumulated on trees and wires and brought down power and telephone lines. Power and phone service was still out on January 5th in many locations. Damage in the Albany Forecast Area was estimated at over $10 million (over $105 million in 2018 dollars). At many of the river forecast points in the eastern half of the Albany Forecast Area, the New Year Flood of 1949 is the flood of record or nearly so. This event merits a closer examination, as it may be one the lesser-known and studied historical storms to have produced such massive societal disruption in our area. It is also noteworthy because, according to a USGS report and despite the time of year, melting snow and frozen ground played little part in causing the flooding. This presentation will try to shed some light on how we got 5-12 inches of liquid equivalent precipitation in late December followed by damaging accumulations of ice glaze and snow. Newspaper articles will be used to document and provide a list of impacts should meteorologists have to message hazards and impacts for a similar event in the future.

Retrospective Analysis of the 31 May 1998 Northeastern U.S. Severe Weather Outbreak

Kevin S. Lipton
NOAA/NWS/WFO Albany, New York

On 31 May 1998, a widespread, multi-day severe weather outbreak occurred across the upper Midwest, Great Lakes and northeast states, with 32 tornadoes, 264 reports of wind damage, and 84 reports of 3/4 inch diameter or larger hail. The severe weather outbreak resulted in 5 fatalities and 127 injuries.

As part of this severe weather outbreak, a tornado rated F3 on the Fujita scale tracked through Mechanicville, New York, and traveled over 30 miles before reaching southwest Vermont as an F2 tornado. The passage of the tornado through Mechanicville resulted in 68 injuries, and over $71 million in damage.

A synoptic and mesoscale analysis of this significant severe weather outbreak will be presented utilizing North American Regional Reanalysis (NARR) and NCEP/NCAR Reanalysis data, as well as regional rawinsonde, radar and satellite data. Synoptic-scale characteristics and climatological anomalies will also be compared with other significant northeast U.S. severe weather outbreaks which had tornadoes rated F3 or greater.

The Christmas Day 2017 Snow and Damaging Wind Storm

Joseph W. DelliCarpini
NOAA/NWS/WFO Norton, Massachusetts

A rapidly intensifying low pressure system off Cape Cod produced a high impact but short duration snow and wind storm in much of southern New England on the morning of 25 December 2017. It followed on the heels of a light snow and icing event that occurred two days before. Most of the region along and west of Interstate 95 experienced near blizzard conditions and strong winds as rain changed quickly to accumulating snow. Wind gusts of up to 75 mph were reported along the South Coast of Massachusetts, including Cape Cod and the Islands during the morning which resulted in downed trees and power lines. More than 20,000 customers in southeast Massachusetts were left without power. This event was well-forecast by numerical weather guidance which led to effective communication of the potential threats a few days in advance of the storm.

This presentation will review the synoptic and mesoscale environments associated with this event. High-resolution model and ensemble data leading up to this event will be shown which helped to increase the forecasters' confidence in the storm's outcomes. Methods to provide effective IDSS in scenarios where two separate weather events are expected will also be discussed, with the goal of alerting the public and providing road crews and transportation officials sufficient lead time to prepare for plowing and road treatments.

Development of a Wind Extremes Forecast System for Transmission System Outage Prediction

Jeffery M. Freedman[1], John W. Zack[2], Mike Berlinger[3], Aleks Siemenn[4], and Christopher Cheng[5]
[1]Atmospheric Science Research Center, University of Albany, State University of New York, [2]MESO, Inc., [3]Consolidated Edison Company of New York, [4]Department of Atmospheric and Environmental Sciences, University of Albany, State University of New York, [5]New York State Energy Research and Development Authority

This presentation will summarize the development of the Wind Extremes Forecast System (WEFS), which will produce forecasts of threshold wind speeds and wind gusts that may produce power outages at county to sub-county scales (transmission down to distribution lines). The project is sponsored by the New York State Energy Research and Development Authority and is focused on the service areas of the Consolidated Edison Company of New York and its subsidiary, Orange and Rockland (Con Ed),

During the last 20 years, thousands of wind or wind-related events in New York have produced power outages affecting millions of customers causing billions of dollars in economic losses throughout the state. Under a changing climate, New York is experiencing an increase in the frequency of extreme weather events, many of which are accompanied by high winds. The rising number of extreme wind events is leading to an increase in the frequency of power outages, resulting in economic losses to utilities, businesses (including the especially vulnerable digital economy), and residential customers. Current forecast systems used by utilities to predict potential wind-related power outages have not satisfactorily addressed operational needs and therefore the development of a more dependable approach to produce forecasts of imminent extreme wind events is paramount.

The initial version of WEFS is based upon state-of-the-art National Weather Service and customized in-house Numerical Weather Prediction output. WEFS assimilates real-time local area surface-based and remote sensing data and incorporates Machine Learning techniques. WEFS will produce high spatial (1 km) and temporal (15 minutes) resolution deterministic and probabilistic forecasts of short-term average and peak wind speeds out to 120 hours. Future versions of WEFS may produce outage probability forecasts at the same resolution. This information will enable utilities and other stakeholders (e.g. emergency management services) to plan for and deploy necessary resources to minimize power outage impacts, resulting in improvements to reliability and resiliency of the power distribution system.

WEFS is leveraging the assets of the New York State Mesonet, including 126 surface stations, and more strategically, enhanced (profiler) sites that continuously sample the vertical profiles of temperature, humidity, and winds from the surface through the top of the atmospheric boundary layer (ABL, typically 1 – 3 km). Although the initial focus of WEFS is on the Con Ed service area in southeastern New York (including New York City, Rockland, Orange and Westchester Counties), the system will be usable for any transmission service territory.

Communicating Hurricane Risk with Virtual Reality: Strategies for Improving Warnings

Jase Bernhardt and Angela Rienzo
Department of Geology, Environment and Sustainability
Hofstra University, Hempstead, New York

Landfalling hurricanes in the United States can inflict extreme damage and loss of life. This can be caused by a host of socioeconomic factors, including insufficient understanding of risk by individuals forecast to be impacted by the storm. Thus, we test the use of an emerging technology, virtual reality (VR), to enhance the communication of real-time risk from a hurricane forecast to make landfall. In this series of two pilot studies, individuals are presented with a hypothetical scenario where a major hurricane is forecasted to impact their community within 48 to 72 hours. The survey includes two different types of warning products related to the hypothetical hurricane: static text messages and maps emulating those traditionally used by the National Hurricane Center (NHC) to communicate risk, and a VR video simulating a hurricane landfall in a residential neighborhood. We first survey two groups of equal size (each n=62) at Hofstra University on Long Island, one viewing both the VR simulation and traditional NHC products, and the other only the latter. Each group was then asked a series of Likert-scale and open-ended questions to assess the effectiveness of both products. The survey was then repeated in Long Beach, New York, a coastal community severely impacted by Sandy in 2012. We determine that participants viewing both the VR and traditional products are significantly more likely to take action in preparation for the hypothetical landfall than those being exposed to just the traditional products, although there are differences based on certain geographic and social factors. These results demonstrate that VR can be a useful component of hurricane warning products, and further work can be done to improve the effectiveness of these products and assess how broader segments of the population can access this information.

Operational Implementation of NWS Snow Squall Warnings for Winter 2018–19

Peter C. Banacos
NOAA/NWS/WFO Burlington, Vermont

Snow squalls are brief bursts of heavy snow accompanied by gusty surface winds and characterized by a rapid onset and near-zero visibility. While snow squalls typically produce only modest snow accumulations (< 2 in, < 5 cm), the sudden reduction in visibility and icy road conditions results in increased motor vehicle accidents and pileups, especially on highways and interstates where high rates of speed occur. Tragically, injury and loss of life have been documented in dozens of snow squall events since the late 1990's, in addition to millions of dollars in economic loss.

It is the top priority of the National Weather Service (NWS) forecast offices to protect lives and property via issuance of short-fused warnings for potentially life-threatening weather and water conditions. However, well-organized snow squalls present unique issues from the standpoint of the traditional multi-tiered NWS watch/warning/advisory product suite. First, snowfall accumulations typically fall short of criteria used to guide issuance of winter weather advisories or winter storm watches and warnings. Second, the short duration (< 1hr) and localized nature of a snow squall does not fit the intent of those longer-fused, and primarily zone/county based winter weather products. Third, a snow squall is a hazard to transportation, but not to those in stationary environments (i.e., typically not a threat to infrastructure or power lines, as can occur with very heavy snow or ice accumulation).

Heretofore, NWS forecast offices have issued Special Weather Statement (SPS) to highlight snow squalls. Unfortunately, a "catch all" product such as the SPS does not command the same level of urgency or breadth of dissemination as a warning product, resulting in a lengthy notification process to NWS core partners and a communication process that is not fully consistent between NWS forecast offices. To remedy this, an operational demonstration of a new product, the snow squall warning (SQW), was conducted during the winter 2017-18 at six NWS forecast offices. For 2018-19, the SQW capability will be placed in an operational status, and expanded for use across the NWS.

This presentation will highlight the motivation for the SQW and lessons learned from the operational demonstration. The presentation will also highlight important meteorological and non-meteorological factors that modulate societal impact associated with snow squalls. Lastly, the role of the SQW within a broader suite of operational actions associated with snow squalls will be discussed.

Snow Squall Warnings: Operational Best Practices from 15 Years of Decision Support Services

Gregory A. DeVoir
NOAA/NWS/WFO State College, Pennsylvania

After the 2017-2018 operational demonstration of a new Snow Squall Warning (SQW) product, November 1 marked the official rollout of the SQW throughout the National Weather Service. The updated WFO Winter Weather Products Specification (NWSI 10-513) details meteorological criteria with respect to SQW issuances. SQW criteria was agreed upon by local, regional and national stakeholders following many years of operational decision support and research-to-operations efforts. Lessons learned during the absence of a formal warning product being available to forecasters informed the criteria established in NWSI 10-513.

To maximize the effectiveness and value of this new warning product for the public and stakeholders, it's critical for WFO forecasters to keenly understand the impact-based nature of the SQW, and to clearly articulate potentially severe impacts and resultant calls to action in operational products and social media posts. An overview of operational best practices and lessons learned from 15 years of DSS in central Pennsylvania is provided to help forecasters establish a comfort level from which to both issue SQWs and provide Decision Support Services to NWS partners in emergency management and road weather management.

Convection-Permitting Ensemble Forecasts of the 10–12 December 2013 Lake-Effect Snow Event: Sensitivity to Microphysical Parameterizations

W. Massey Bartolini and Justin R. Minder
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

Lake-effect snow (LeS) presents a substantial forecast challenge for convection-permitting models, due in part to uncertainties in the parameterization of microphysical processes. Here we focus on understanding these uncertainties for a LeS event that occurred from 10–12 December 2013 during the Ontario Winter Lake-effect Systems (OWLeS) field campaign. Throughout this event, long-lake-axis-parallel snowbands persisted downwind of the eastern shore of Lake Ontario, leading to snowfall accumulations as high as 101.5 cm (liquid precipitation equivalent of 62.5 mm) on the Tug Hill Plateau.

We run nested simulations of this event at 12-, 4-, and 1.33-km horizontal grid spacing using the Weather Research and Forecasting (WRF) model configured similarly to the operational High-Resolution Rapid Refresh model. Sensitivity experiments are conducted by simulating the event with different microphysical schemes. Large differences between these microphysics experiments are found in the LeS band intensity and morphology, with smaller differences in the band timing and position. Maximum storm-total liquid precipitation equivalent amounts among microphysics ensemble members range from 30 to 60 mm.

Results from the WRF simulations are compared to detailed observations from OWLeS, including NEXRAD radar data and surface snowfall and crystal habit observations. Additional measurements from the University of Wyoming King Air aircraft, including vertically pointing cloud radars and in-situ flight-level thermodynamic and microphysical observations, are used to compare observed and modeled cloud structures. Microphysical properties, such as supercooled cloud liquid water content, hydrometeor size distributions, and precipitation fallspeeds, are considered to assess which microphysics schemes are most accurately simulating microphysical processes during this LeS event.

Convection-Permitting Ensemble Forecasts of the 10–12 December 2013 Lake-Effect Snow Event: Sensitivity to Surface and Boundary Layer Parameterizations

Justin R. Minder and W. Massey Bartolini
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

Lake-effect snow (LeS) presents a substantial forecast challenge for convection-permitting models, due in part to uncertainties in the parameterization of near surface turbulent fluxes. Here we focus on understanding these uncertainties for a LeS event that occurred from 10–12 December 2013 during the Ontario Winter Lake-effect Systems (OWLeS) field campaign. Throughout this event, long-lake-axis-parallel snowbands persisted downwind of the eastern shore of Lake Ontario, leading to snowfall accumulations at least as high as 101.5 cm (liquid precipitation equivalent of 62.5 mm) on the Tug Hill Plateau.

We run nested simulations of this event at 12-, 4-, and 1.33-km horizontal grid spacing using the Weather Research and Forecasting (WRF) model configured similarly to the operational High-Resolution Rapid Refresh model. Sensitivity experiments are conducted by simulating the event with different surface layer (SL) and planetary boundary layer (PBL) parameterization schemes. Large differences between these experiments are found in the LeS band intensity and morphology, with smaller differences in the band timing and position. Maximum storm-total liquid precipitation equivalent amounts vary by a factor of two among SL/PBL ensemble members.

The large variations in simulated snowfall appear to be primarily due to variations in the strength of lake-atmosphere turbulent surface fluxes of heat and moisture as parameterized by the different SL schemes. For instance, lake-averaged sensible heat fluxes vary by up to 200 Wm^{-2} between schemes, with larger fluxes corresponding to large precipitation accumulations. In order to better constrain the realism of these simulations, we compare their output with radar-observed storm structure and both manually observed and radar-estimated snowfall. Overall, the simulations with the highest fluxes appear to produce excessively intense snowfall and often have unrealistic storm morphologies.

Further evaluation of parameterization sensitivity and realism is conducted for a LeS event downwind of Lake Superior from 10-13 February 2016. Similar results are found in terms of the sensitivity of snowfall and surface fluxes to SL parameterization choices. For this event, direct observations of over-lake turbulent surface fluxes are available from eddy covariance measurements collected atop a lighthouse. These measurements indicate that the schemes with the largest precipitation rates produce unrealistically large lake-atmosphere fluxes. The implication of these results for the design and interpretation of high-resolution multi-physics model ensembles will be briefly discussed.

The 11–12 December 2008 Ice Storm across the Northeastern United States

John S. Quinlan and Neil A. Stuart
NOAA/NWS/WFO Albany, New York

A major ice storm impacted eastern New York and New England on December 11th and 12th of 2008. The set up for the ice storm featured a cold front moving across the region on Wednesday, December 10th, which ushered a cold arctic air mass into the area. A low pressure system developed over the southeastern states Wednesday and Wednesday night. The storm then moved northeast Thursday and Thursday night with precipitation spreading northward well in advance of the low up the eastern seaboard. The low continued to track northeast passing over the middle Atlantic region late Thursday night and over southeastern New York and southern New England Friday morning. The low then moved into the Canadian Maritimes Friday night with colder air funneling into our region.

The storm brought warmer air aloft to the region with the cold air mass remaining in place at the surface which allowed for a mixed precipitation event. The precipitation came down heavy at times, especially late Thursday night. Precipitation rates of quarter to a third of an inch an hour were reported for several hours in the form freezing rain across a good portion of the forecast area. The precipitation did not taper off until Friday morning by which time ice accumulations ranged from around half an inch up to an inch from the Greater Capital District east into the Berkshires and southern Vermont. Areas immediately to the north and west of the Greater Capital District had more in the way of frozen precipitation as the thermal profiles were colder. Snowfall reports ranged from 2 to 4 inches just north and west of the Capital District where sleet mixed in, up to 6 to 12 inches which were reported across portions of the southern Adirondacks and upper Hudson Valley.

Farther south where the thermal profiles were warmer the mixed precipitation quickly changed to rain from the central and southeastern Catskills eastward across the middle Hudson Valley into portions of the Berkshires and Litchfield County. In these areas 2 to 4 inches of rain fell along with some mixed precipitation which caused widespread urban and small stream flooding with some river flooding as well. River flooding occurred on the Hoosic River, Esopus Creek, Housatonic River, Batten Kill, Still River, and Wappingers Creek. The Housatonic River reached moderate flood levels at Falls Village, Gaylordsville and Stevenson Dam.

There was widespread tree, power line, and power pole damage across eastern New York into New England. An estimated 1.7 million utility customers lost power across the northeastern United States at the height of the storm. Over 100,000 customers were still without power a week after the storm had ended. The American Red Cross opened numerous shelters in and around the greater Capital District.

This presentation will focus on the conditions which were in place ahead of and during the ice storm, as well as ice accumulations, and disaster declarations.

Preliminary Evaluation of Data from the GOES-16 Geostationary Lightning Mapper

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

The GOES-R (now GOES-16) weather satellite was launched in November of 2016 with two earth-pointing instruments aboard, the Advanced Baseline Imager (ABI) and the Geostationary Lightning Mapper (GLM). New higher-resolution images from the ABI became available the following spring at NWS forecast offices, and were quickly assimilated into operations. However, data from the GLM proved to be more problematic, with data becoming available to forecast offices on an experimental basis over a year later, in summer 2018.

The basic GLM data (events, groups and flashes) are further processed and then distributed to selected NWS offices as three gridded parameters: flash extent density (FED), average flash area (AFA) and Total Optical Energy (TOE). These grids have a 1-minute time resolution, updated each minute, and a spatial resolution matching the 2-km ABI image grid, although they largely retain the original 8-km GLM optical sensor resolution. While most offices are receiving the FED grids, only a handful, including the Mount Holly NJ office, were selected to help evaluate the operational utility of the AFA and TOE grids.

GLM grids became available at WFO Mount Holly in late June of this year. AWIPS procedures were created to facilitate display of the three grids alongside each other and in comparison with ground-based lightning data, ABI imagery and radar reflectivity. Routine examination of the GLM data has shown it to be a useful tool for situational awareness. However, a number of issues have also become apparent, including parallax displacement, coarse resolution compared to other data sets, discontinuities in time, lack of tools to extract quantitative information and unfamiliar quantities and units. These issues will be examined further and illustrated at the workshop. Some examples of the potential use of GLM data in operations will also be provided.

A Review of New York State Mesonet Site Properties and WMO Siting Criteria

Jerry Brotzge, June Wang, Stephanie Soroka-Butt, and Nick Bassill
New York State Mesonet
University at Albany, State University of New York, Albany, New York

The New York State (NYS) Mesonet Early Warning Weather Detection System is a new advanced meteorological meso-network of 126 "standard" surface weather stations with at least one site located in every county and borough across the state. Funded by FEMA, the network is designed, implemented, and operated by scientists at the University at Albany with support from the New York State Department of Homeland Security and Emergency Services. Real-time data along with graphical products are available to the public via website at http://nysmesonet.org.

Each of the Mesonet's 126 standard stations measures surface temperature, relative humidity, wind speed and direction, precipitation, solar radiation, atmospheric pressure, snow depth, and soil moisture and temperature at three depths. However, the accuracy and representativeness of these measurements is highly dependent upon local siting properties, including the topography, land use, nearby obstacles such as trees and buildings, and land cover.

Unfortunately, New York's topography, forests, and land use limited site options in some areas of the state to less-than-ideal standards. To quantify the regional representativeness of each station, each site was compared against WMO siting standards and rated. In addition, long-term station averages were compared against neighboring averages to identify any unique features that may be tied to local obstructions or land features. These results highlight two major conclusions: (1) Weather observations are extremely sensitive to local siting anomalies, and (2) Even stations that satisfy WMO criteria may incur some localized 'problems'. This presentation reviews the WMO classifications of the NYS Mesonet sites, and examines some specific problematic sites.

Comparisons of New York State Mesonet and ASOS Temperature data

Junhong (June) Wang and Jerry Brotzge
New York State Mesonet
University at Albany, State University of New York, Albany, New York

The New York State Mesonet (NYSM) consists of 126 stations across the state with an average spacing of 19 miles (see map below). All stations collect measurements of standard meteorological variables with additional soil moisture at three levels, solar radiation, snow depth and still camera images. In addition, in a first for a state mesonet, NYSM has three sub-networks ("Profiler", "Flux", and "Snow") comprised of 17, 17, and 20 sites to provide atmospheric vertical profiles, the surface energy budget, and snow water equivalent, respectively. There are 27 Automated Surface Observing System (ASOS) stations in NYS. Comparing two networks, 27 ASOS stations are very sparse with holes in mountain regions and are mostly located in airports, which raises the issue of ASOS representativeness. ASOS has been in operation since 1947 and has been widely used for various applications. In contrast, NYSM just became operational since April 1, 2018, but it is very promising given its better spatial coverage, more variables and more advanced instruments. Therefore, it is important to compare the data from two networks for cross- validation, investigate impacts of potential biases in each dataset on prior and future studies and inform the user community.

Six pairs of NYSM and ASOS stations are located within 10km and are selected for temperature comparisons (see map below). Preliminary results show that at four typical pairs of NYSM-ASOS stations, ASOS temperature is systematically warmer than NYSM with a small bias of ~0.5°C during both day and night, but shows much larger cold bias for some days with a larger magnitude in summer (see plot below). The latter mainly occurred during clear and calm nights. As a result, ASOS would significantly overestimate diurnal temperature range (DTR). It seems that land cover difference (NYSM grass land vs. ASOS concrete airport) is the primary reason for night temperature discrepancies. Other factors, such as differences in locations and environmental conditions, causes the temperature differences at the other two stations. We will also study the impacts of biases in ASOS data, including prior research using ASOS data, such as long-term trends of surface temperature and DTR. The comparisons for other variables and the impacts of the results will be also investigated in the future.

Understanding Differences Between New York State Mesonet and ASOS Wind Observations

Alex Gallagher
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

The New York State Mesonet (NYSM) is dense high-quality observation network consisting of 126 stations that spans the entirety of New York State. The network aims to provide observations in previously data sparse regions and as a result, in addition to a multitude of limitations associated with New York geography, station locations are not always ideal for unbiased observations, particularly those of wind speed. Conversely the majority of ASOS stations are sited at airports with long obstructed fetches along the predominant wind direction. Wind observations the two networks are compared, using only ASOS stations within or directly bordering New York. To create a more direct comparison and isolate the influence of siting on wind observations the raw three second data from the NYSM is used to create a dataset that mimics the specifications of the ASOS one-minute data. Comparisons using both the original and modified raw data are repeated over seasons and hours of the day to understand seasonal and diurnal variability.

It is revealed that the NYSM winds are on average 15-26% slower than ASOS depending on the season. This gap in sustained winds is independent of averaging interval used, and although the raw difference of the average winds has a strong diurnal cycle the relative ratio of the two remains nearly constant throughout the day. Comparisons of gust factor (GF), a quantity that can be used as a proxy for site exposure, support the theory that site obstruction drives the difference between NYSM and ASOS winds. Altering averaging interval to create a direct comparison reduces the NYSM average GF from 1.72 to 1.52, failing to close the remaining gap with the ASOS average GF of 1.3. These results remain qualitatively similar when only class one and two NYSM stations are used, with only a slight increase in the NYSM average winds. This shows that even the best sited NYSM stations are on average more obstructed than ASOS. Although both networks provide valid and true measurements of wind speed at times it may be beneficial to parameterize what the NYSM wind be with exposure more typical of ASOS stations. Because gusts are less influenced by obstructions a method using the ratio of the network average GFs is proposed to modify NYSM winds for greater observation exposure.

Microphysical Influences on Ensemble Members in the 15–16 December 2013 OWLeS Case

Jessica Blair[1], Kara Sulia, Lauriana Gaudet, Jen-Ping Chen, Tzu-Chin Tsai
[1] Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

The eastern Great Lakes regions has served as a hotspot for some of the most intense lake-effect snow systems on record. With lakes such as Erie and Ontario being the host to long-lake-axis parallel showbands, large amounts of snow can affect these regions in just a short amount of time. The December 15-16th, 2013 lake-effect snow system left upwards of 20 inches of snowfall over Western New York in just a 24-hour period, leaving much of this region incapacitated. This event was the last of three lake-effect and synoptic snow systems to have struck this region during that week. This study focused of the snow band just east of Lake Ontario which produced the highest snowfall accumulations of 23 inches over the Tug Hill Plateau. At times, this lake-effect band had snowfall rates of around three to four inches per hour. In this study we took an in depth look at the microphysical factors that can affect both the location of these bands as well as the snowfall accumulations associated with the December 15-16th, 2013 Ontario Winter Lake-effect Systems (OWLeS) field campaign. Microphysical factors examined include fall speed, condensation nuclei type, crystal shape, ice nuclei concentrations and number of moments for this study. In an attempt to visualize and compare these impacts, a 19-member physical ensemble was developed. Ensemble members were created by running the Weather Research and Forecasting Model using National Taiwan University's microphysical scheme as well as various other microphysical schemes. This ensemble provides an opportunity to investigate observed microphysical processes associated with this lake-effect system and allows us to directly compare various sensitivities to different microphysical factors and schemes. Through this physical ensemble it was found that microphysics significantly influenced snowfall accumulations, while the location of these bands could be attributed to the overall dynamics of such lake-effect systems. It should also be noted that in this study precipitation production was found to be highly sensitive to fall speed and number of moments.

An Integrated Modeling and Observing System for the Study of the Ecology of Lake George in the Jefferson Project

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

We describe the design and implementation of an Internet of Things (IoT) cyber infrastructure for environmental sensing in support of the Jefferson Project at Lake George. The Jefferson Project is collaboration between Rensselaer Polytechnic Institute, IBM, and the FUND for Lake George focused on developing a detailed understanding of the overall ecology of Lake George, including the interactions of the physical, chemical, and biological environment in the watershed. Of key concern for the ecology is the q management of road salt, storm water runoff, and invasive species.

Lake George is located in the Adirondack State Park region of upstate New York, approximately 350 km north of New York City. It is a glacial, oligotrophic water body and is unique among fresh water lakes because of its ecology, geographic orientation, historical importance, and tourism-driven economy. To address the project's objectives and to supporting an on-going research and monitoring program, an integrated modeling and observing system is being developed. It has three major components. The first is a coupled, high-performance, computing modeling system to physically model the atmospheric, hydrological, and hydrodynamic aspects of the lake and surrounding region. The second is a real-time multi-sensor observing network composed of in-situ sensors for atmospheric, stream and lake measurement, to inform the coupled models as well as provide realtime observation of the lake environment.

The third component of the system is a cohesive, and adaptive, Internet of Things (IoT) cyber infrastructure responsible for the control, coordination, communication, aggregation, and delivery of the various data streams in real-time. The integration of a peer-to-peer observational network and modeling system enabled by the cyber infrastructure provides system-level control of power management, data collection rates and autonomous adaptation of sensing strategies in real time. The integrated system will provide predictive and real-time analytics for research, operations, and management functionality as part of a lake monitoring and assessment program whose principal purpose is the detection and timely response to adverse environmental and ecological effects. We will present an overview of the CI as well as its operation and integration.

Machine Learning Methods to Predict Wind Energy Availability using New York State Mesonet Data (2018)

Aleks Siemenn[1], Jason Covert[1], Richard Perez[2], Jeffrey Freedman[2]
[1]Department of Atmospheric and Environmental Sciences, University of Albany, State University of New York
[2]Atmospheric Science Research Center, University of Albany, State University of New York

Wind energy is a form of renewable energy which may be harvested by using wind turbines as a method to capture the kinetic energy of the wind flows. Even though wind as a resource is available almost everywhere, the primary limiting factor to building wind farms is the amount of available wind to pay off the costs of the turbines and to generate positive net gains in energy production versus consumption. This study examines the feasibility of using 10 m wind speed data collected by the New York State Mesonet (NYSM) in combination with a Neural Network to predict wind speeds at turbine hub height and to estimate the overall energy production several hours into the future. The purpose of implementing a machine learning algorithm is to understand the fundamentals of developing a predictive numerical tool to forecast wind speeds and, in turn, wind energy to assess the future resources of wind farms.

July 2017 at the Ontario NYSM site was selected as a case study to design and validate the algorithm performance because there are wind turbines installed near the Ontario NYSM site. At each time step within the case study training dataset, a distribution of wind speeds exists when the month of data is vertically concatenated over a single day, and this distribution is what will be used to develop the backend of the algorithm. The average value, $\bar{\boldsymbol{x}}$, and the standard deviation, $\boldsymbol{\sigma}$, of this distribution were calculated to generate a range of upper and lower limits corresponding to $\bar{\boldsymbol{x}} \pm \boldsymbol{\sigma}$, respectively. To generate a new dataset of wind speeds that is independent from the input data, a method of stochastically subsampling values from the new range of data was employed. This algorithm “learns” as more data is funneled into its training set because the most probable wind speed for each time step becomes more easily identifiable since the Gaussian error about a mean value decreases proportional to the standard deviation multiplied by the inverse square root of the training dataset sample size.

The amount of energy that may be potentially generated in the future is a function of wind speeds, air density, and wind turbine parameters including efficiency; where the wind speed inputs have been estimated by the stochastic sampling algorithm. NYSM wind speeds are measured at 10 m so extrapolation conversions were applied to these predictions to estimate 100 m wind speeds; turbine hub heights are traditionally closer to 80 m, however, the current validation dataset being used is 100 m measured LiDAR wind speeds. For this study, empirical engineering and efficiency data of a DOE/GE 1.5 MW turbine were retrieved from NREL and was used to base the energy conversion calculations on.

For model validation, 100 m LiDAR data was correlated with the machine learning output wind speeds, a constant persistence model, and a ten-point integrated persistence model over 5,000 simulation runs. Predicted wind speeds resulted in the highest correlation with the validation dataset (RMSE = 1.75, MAE = 1.52) and, in turn, the highest correlation with expected energy outputs; the ten-point integrated persistence model and constant persistence model had correlations of RMSE = 1.80, MAE = 1.62 and RMSE = 1.83, MAE = 1.65, respectively.

Large Scale Observational and Model Analysis of the Unusual 2015–2016 El Niño Event: Implications for California Precipitation

Chelsea Snide[1], David M. Straus[2], Erik Swenson[2]
[1]Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York
[2]George Mason University, Fairfax, Virginia

Forecast models generally predicted above average winter precipitation for California during the 2015-16 El Niño event, similar to what occurred during the 1997-98 and 1982-83 events. The large scale pattern that actually occurred during the winter of 2015-16 showed differences from the earlier El Niño events, including a weaker enhancement of the Aleutian Low, and an Eastern Pacific jet shifted further to the south. The result was low observed precipitation over California. Comparison of the observations to the ensemble seasonal forecasts made with the Climate Forecast System Version 2 (CFSv2) model for the winters of 2015-16 and 2016-17 showed that the model failed to fully capture the observed structure of the tropical vertically integrated diabatic heating as well as the jet stream and the height field at 200 hPa during the 2015-16 winter. The circulation predicted by the model caused a shift in precipitation comparable to a typical El Niño in the model.

This study investigates the degree to which the model's failure to predict the dynamic circulation was due to the misrepresentation of model heating by performing intervention experiments. The estimated diabatic heating boreal winter mean and seasonal cycle were estimated from ERA-Interim reanalyses and from the CFSv2 forecasts as a residual in the thermodynamic equation. Subsequently the ensemble mean error in the seasonal cycle of heating was subtracted from the model's internally generated heating during a new ensemble of integrations. The procedure is iterated until the ensemble mean diabatic heating is realistic. Similar experiments are carried out with the Community Earth System Model (CESM). It was shown that the added heating runs created a canonical ENSO response resulting in more storms tracking through California, different than what is shown in observations. This experiment failed to show the unusually low precipitation anomaly, from which we conclude that this anomaly and was not a forced response to the tropical heating, but was in some way due to internal variability.

LISTOS 2018: How Land–Water Interactions Affect Ozone Transport in the Long Island Sound Area

Brennan J. Stutsrim
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

Air quality is a persistent issue for many states in the northeast United States during the summer months, causing respiratory health issues for many residents. One of the most significant pollutants contributing to poor air quality is tropospheric ozone (O3). Ozone is considered an oxidizer which can be created rapidly in the atmosphere given sufficient levels of precursors; including NOx, volatile organic compounds (VOCs), and sunlight. This process can be exacerbated by land-water interactions, making Long Island, NY and coastal Connecticut ideal locations for poor air quality due to their close proximity to the Atlantic Ocean and New York City, NY. The Long Island Sound Tropospheric Ozone Study (LISTOS) was launched by Northeast States for Coordinated Air Use Management (NESCAUM) with the goal of better understanding the temporal and spatial evolution of tropospheric ozone in the New York City area as well as down-wind from this region. Meteorological balloons were deployed from the Flax Pond Marine Laboratory in Old Field, NY, located on the northern shore of Long Island. Eighteen EN-SI electrochemical cell (ECC) ozonesondes couple with Vaisala RS 41 radiosondes were deployed between June and August of 2018, in order to capture vertical profiles of ozone, temperature, pressure and relative humidity throughout the troposphere. These ozone profiles, along with meteorological data from the New York State Mesonet and other sources, will be used to investigate the complex system of the sea breeze, sound breeze and the background flow to describe the transport of ozone in the Long Island Sound area. The resulting analysis will contribute to better understanding the mechanisms by which high surface pressure coupled with westerly winds throughout the profile transport ozone and its precursors from New York City and the I-95 corridor eastward towards the Long Island Sound, causing unsafe levels of ozone at the surface for single or multiday events on Long Island and coastal Connecticut.

Analyzing the role of low-level forcing in significant severe weather outbreaks in the eastern U.S.

Neil A. Stuart and Joseph E. Cebulko
NOAA/NWS/WFO, Albany, New York

Distinguishing the mode of convection prior to development is a challenge that has always existed for forecasters. The Storm Prediction Center routinely issues convective outlooks in 6 categories: no severe, marginal, slight, enhanced, moderate and high risks. These risks are based on expected density of severe weather reports and the magnitude of the potential severe weather, significant or not. Local National Weather Service offices then tailor these convective outlooks for their local forecast areas. Determining whether a severe weather event has the potential to be significant or not, has been especially challenging in the mid-Atlantic and northeastern U.S.

Previous studies were prompted by multiple past scenarios since 2003 where significant severe weather was predicted but little to no severe weather (and in some cases no convection) occurred. Those studies identified atmospheric features that distinguish the occurrence of significant (hail > 2 inches in diameter, straight-line winds of $\geq$ 32 ms^{-1} (65 kt) and/or tornadoes of EF2 magnitude or greater) severe weather outbreaks (including derechos) versus marginal or no severe. It was determined that progressive 850 hPa and 500 hPa vorticity centers and 850 hPa equivalent potential temperature change ($\Delta\theta_e$) $\geq$25K in 12 hours identified the strong synoptic scale low-level forcing that supported significant severe weather events. Other important features include significant instability associated with steep midlevel lapse rates (4-layer lifted indices exceeding -4 C) and an 850 hPa wind maximum $\geq$40Kt.

In this study, 28 significant severe weather events from 1953 to present were analyzed and composites of 850 hPa $\Delta\theta_e$ were created. It should be noted that the composites represent the maximum $\Delta\theta_e$ within 6 hours of severe weather reports, since the 850 hPa density discontinuity is often displaced from local and mesoscale surface features in complex terrain. It should also be noted that depictions of $\Delta\theta_e$ and θ_e gradients differ depending on the resolution of the dataset being used. The North American Regional Reanalysis (NARR) dataset, with 0.3° (32Km) resolution was used in this study.

The composites determined that $\Delta\theta_e \geq$ 20K over a distance of 400 Km (250 miles) represented the synoptic scale density discontinuity associated with significant severe weather events. Separate composites were created for the northeastern U.S., mid-Atlantic U.S. and for derechos. Time lagged composites of $\Delta\theta_e$ and recent examples of significant severe weather events will also be shown.

Widespread Damaging Wind Severe Thunderstorm Event of 4 May 2018 across the NWS Albany, NY County Warning Area

Christina Speciale
NOAA/NWS/WFO Albany, New York

A cold front and unseasonably strong mid-tropospheric trough produced a powerful squall line resulting in widespread damaging winds across eastern NY and parts of western New England on 4 May 2018. A neutrally tilted 500hPa trough at 12 UTC 4 May 2018 quickly became negatively tilted as it traveled from the Great Lakes into southern Canada, resulting in rapid cyclogenesis and a 990 hPa surface low over the Saint Lawrence River Valley by 02 UTC 05 May 2018.

Since this event occurred in the transitional spring season, it featured characteristics typical of both the cold and warm seasons. Most notable was the very impressive kinematics throughout the troposphere. Nearly unidirectional, deep southwesterly flow ranged from 35-45 kts at 925hPa to 50-60 kts at 700hPa. In addition, a strengthening southerly flow east of the system enhanced the warm sector over NY and western New England with afternoon temperatures at KALB, KGFL and KPOU peaking near 27-29^{o}C and dew points around 17-18ºC. Despite the humid air mass, instability remained low due to morning cloud coverage in the vicinity of the warm front, keeping MLCAPE values under 1000 J/kg.

While high winds aloft do not always mix to the surface in high shear, low CAPE convective environments, the 4 May 2018 event featured widespread wind damage, likely a result of high low-level lapse rates ranging from 7.0-7.5ºC/km ahead of the squall line. It is hypothesized that these steep lapse rates occurred in part because most trees had not yet foliated. Vegetation adds moisture to the boundary layer through evapotranspiration, limiting its depth potential. The lack of foliage may have enabled the boundary layer to deepen to nearly 600 hPa as illustrated on the 00 UTC 5 May 2018 KALY sounding. The resulting squall line mixed damaging winds to the surface leading to nearly 60,000 power outages in eastern NY and 2,500 in southern VT. Governor Cuomo visited parts of Washington County, NY and deployed the National Guard.

This presentation will also provide a radar analysis focusing on the hardest hit areas of Washington, Saratoga and Warren Counties in NY. Although the KENX radar was oriented nearly parallel to the squall line and thus did not sample velocity well, reflectivity data clearly shows evidence of rear inflow notches in the wake of strong bowing segments. These features signify rapidly descending downdrafts and enhanced areas of damaging winds. In addition, bounded weak echo regions are evident along the leading edge of convection, suggesting particularly intense updrafts. As a result, numerous trees fell or snapped in this region, some in concentrated areas, with impacts to cars, homes and structures. Peak wind gusts include 54 kt and 52 kt gusts at the Glens Falls and Johnstown NYS Mesonet stations, respectively.

Improving Tornado Detection and Lead Time:
The July/August Tornadoes of 2018 in Southern New England

Joseph W. DelliCarpini[1] *and Jonathan O'Brien*[2]
[1]*NOAA/NWS Boston/Norton, Massachusetts*
[2]*Department of Atmospheric and Environmental Sciences*
University at Albany, State University of New York, Albany, New York

Providing warnings with lead time for tornadoes in southern New England has been a long-standing challenge. The tornadoes tend to form quickly, possess subtle signatures on radar, and only last for a few minutes. The environment often favors flash flooding which can draw forecasters' attention away from other severe weather threats. These tornadoes are the most common but can have a high impact, such as the August, 2014 Revere, MA tornado.

A Hollings Research Project completed one year ago confirmed the findings of an initial study completed more than ten years ago. Favorable environments for the more frequent tornadoes included relatively low instability, high shear, a tropical air mass with precipitable water values in excess of 50 mm, and the presence of a nearby low-level boundary. Radar signatures were identified to help create a Warning Guide that can assist forecasters in the Warning Decision Making process. Staff training was reinforced through group workshops and self-paced exercises.

These efforts led to improved Tornado Warning detection and lead time this past summer. Five tornadoes were confirmed in northeast Connecticut and central Massachusetts, all of which occurred during a two-week period from mid-July through early August. Three of the tornadoes were rated EF-1 on the Enhanced Fujita Scale (Upton, MA; Douglas, MA, and Dudley/Webster, MA) and two were rated EF-0 (Ashford, CT and Woodstock/Thompson, CT). Tornado Warnings were issued prior to four of the five tornadoes and a Severe Thunderstorm Warning with a "Tornado Possible" tag was issued for one.

This presentation will review the findings from the Hollings Research Project including the synoptic and mesoscale environments that are favorable for tornadoes in southern New England and the Warning Guide that can be used in real-time. It will also include a brief review of the five tornadoes that occurred to show how the research was successfully integrated into operations at NWS Boston/Norton, MA.

Correlating Trends in Flash Extent Density to Tornadogenesis for Supercells in the Northeastern United States

Michael L. Jurewicz Sr[1]., Douglas Butts[1], Jared Klein[1], and Brian Carcione[2]
[1]NOAA/NWS/WFO Binghamton, New York
[2]NOAA/NWS/WFO Huntsville, Alabama

GOES-16 Geostationary Lightning Mapper (GLM) is a new tool that has only been made available operationally to NWS forecasters since the summer of 2018. The purpose of this research is to document the use of GOES-16 GLM flash extent density (FED) product to monitor convective trends for tornadic supercells in the Northeastern United States. An examination of two recent convective events that each produced multiple tornadoes in northeast Pennsylvania will be presented, including two supercells that became tornadic (two EF-2) on the evening of 13 June 2018 and five tornadic supercells (two EF-0, two EF-1 and one EF-2) that occurred during the late afternoon and early evening on 2 October 2018. These two cases had similar synoptic-scale setups featuring severe convection ahead of an amplified upper-tropospheric short-wave trough and strong surface cold front.

In just about all of the seven tornadoes that were examined in this study, intensification of the storm was evidenced by a sharp increase in FED as detected by the GOES-16 GLM and rapid enhancement of the tightness, depth, and magnitude of the lower-tropospheric rotational couplet of the mesocyclone. These lightning jumps preceded tornadogenesis, sometimes occurring minutes before the rapid tightening of the rotational couplet was detected in the lower levels on WSR-88D radar.

Limited past studies for tornadic supercells over portions of the Central and Southern United States have shown a tendency for total lightning flashes to significantly increase near the periphery of the main updraft, on the order of 10-20 minutes prior to tornadogenesis. These same studies also indicated a tendency for the flash rate to decrease sharply later in the storms' life cycle, at times near the point of tornadogenesis itself, and other times during the tornado dissipation phase as the storms collapse. Cursory evidence would suggest the seven tornadic storms of interest over northeastern Pennsylvania represent a reasonably close match to previously studied supercells, in terms of total lightning behavior. Given the availability of rapid update, 1-minute GOES-16 satellite data and also the geographic setting over the Northeastern United States, both the 13 June and 2 October cases in 2018 represent a unique opportunity for further study.

Albany Forecast Area Significant Hail Climatology and Case Studies

Thomas A. Wasula and Brian J. Frugis
NOAA/NWS/WFO Albany, New York

Significant hail events are fairly rare across eastern New York (NY) and western New England. The National Center of Environmental Prediction Storm Prediction Center considers a severe thunderstorm to be significant if it produces measured or estimated wind gusts of at least 65 knots (74.8 mph), hail two inches (5.0 cm) in diameter or greater or an EF2 tornado or greater. The National Weather Service at Albany Weather Forecast Office (ALY WFO) county warning area (CWA) consists of 15 counties in eastern NY, two counties in southern Vermont (VT), and one each in western Massachusetts (MA), and northwest Connecticut. A climatology of significant hail reports from 1 January 1950 to 30 June 2018 from the National Climate of Environmental Information *Storm Data* revealed a total of 65 events (1 report = an event). The most significant hail events occurred in Columbia County with thirteen, and no events have been recorded in the mountainous and sparsely populated counties of Schoharie and Hamilton Counties in the northern Catskills and southern Adirondacks. 22 out of the 65 (33.8%) significant hail events have occurred in the Dual Polarization era of Albany (KENX) radar technology from 1 May 2012 to 30 June 2018. June 2011 was a particularly active severe weather month; a total of 13 significant hail events occurred in the ALY WFO CWA on the 1st, 8th and 9th. The 1 June 2011 event was unique that five baseball-size or larger (≥7.0 cm) hail reports occurred. Mammoth hail stones of 8-10 cm in diameter fell at Shaftsbury, VT, and Windsor, MA located in the Berkshires. The 15 May 2018 severe and tornado event across portions of New York and New England had 6 significant hail reports in the ALY WFO CWA with 5 reports in Columbia County, NY and one in Litchfield County, CT.

The purpose of this study will be to review the significant hail climatology and discuss common synoptic and mesoscale features with several of the events through composites and case studies. The pre-convective environmental analysis will examine the 0-6 km deep shear, convective availability potential instability, mid-level lapse rates, and the role of elevated mixed layers. Convective modes will briefly be discussed, as the vast majority of the cases in the climatology were supercells that became hail monsters with tall updrafts and associated massive elevated reflectivity cores.

Finally, this presentation will examine briefly the historical significant hail events that occurred early in June 2011 and 15 May 2018 in the ALY WFO. A multi-scale approach will be done analyzing these major severe events from the synoptic-scale to the storm-scale, in order to understand the convective environment that produced the anomalously large hail stones. Observational data used in the analyses will include surface and upper air observations, satellite imagery, and KENX WSR-88D 8-bit radar data. The storm-scale analysis will utilize a variety of radar tools (Four-Dimensional Stormcell Investigator and GR2Analyst) and techniques.

Examining Terrain Effects on the 31 May 1998 Mechanicville, New York Supercell

Luke LeBel, Brian Tang and Ross Lazear
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

On 31 May 1998, a strong (F3) tornado struck Mechanicville, New York. This tornado was a part of an extreme severe weather outbreak that impacted the northeastern United States. Previous research on the Mechanicville supercell and tornado suggested that terrain may have influenced the development and evolution of the severe convection. Specifically, LaPenta et al. (2005) hypothesized that terrain-channeled flow in the Hudson Valley contributed to increased low-level wind shear and instability in the valley. A lack of observations and capability to perform high-resolution model simulations, however, prevented this hypothesis from being fully tested.

The present study more robustly evaluates the impact of terrain on the evolution of severe convection on this day, using the Weather Research and Forecasting (WRF) model. The model was run with an inner-nest resolution of 1 km and was initialized with North American Regional Reanalysis data. A warm bubble was inserted into the model, triggering the development of a supercell that closely follows the track of the Mechanicville supercell. The simulated supercell had a substantial increase in low-level vorticity and updraft helicity as it moved into the Hudson Valley area. Preliminary results of the simulations support previous hypotheses regarding terrain-channeling effects. Specifically, there was an enhanced corridor of moisture that was advected northward up the Hudson Valley. Moreover, the magnitude of wind shear was locally enhanced in the valley. These two results suggest that the region in which the tornado occurred was especially favorable for tornadogenesis.

The simulations also reveal the structure and evolution of mesoscale inhomogeneities influenced by terrain, such as the development of a mesoscale moisture gradient within the Hudson Valley that may have impacted the evolution of the supercell. Preliminary results from the simulations suggest that this boundary developed as a surface warm front interacted with channeled flow in the Hudson Valley. This boundary has similar characteristics to one that developed during a more recent severe weather case. Therefore, the analysis of the interaction of the boundary with the simulated supercell may generalize to a larger number of local severe weather cases that had similar terrain-influenced mesoscale inhomogeneities.

Acknowledgements

State University of New York Polytechnic Institute
College of Nanoscale Science and Engineering
Albany, New York
Conference Facilities

National Weather Service, Weather Forecast Office, Albany, New York
Go-To-Meeting Setup

Cover Photo Credit
Jerry Brotzge, Joe Cebulko, Greg Carbin, Greg DeVoir, Mike Evans, and Washington County Department of Public Safety

Northeast Regional Operational Workshop XVIII Agenda Review
The NROW XIX Steering Committee
and
Kristen Corbosiero
University at Albany, State University of New York, Albany, New York

Northeast Regional Operational Workshop Steering Committee Chair
Northeast Regional Operational Workshop Preprints
Joe Villani

Northeast Regional Operational Workshop Preprint Cover Design
Christina Speciale and Joe Cebulko

Northeast Regional Operational Workshop Steering Committee
Joe Cebulko, Steve DiRienzo, Mike Evans, Brian Frugis, Vasil Koleci, Christina Speciale, Neil Stuart, Dan Thompson, Jen Vogt, and Tom Wasula

NROW XVIII Conference Support
Ray O'Keefe and Jeannine Nelli

Web Support
Vasil Koleci