Agenda
Northeast Regional Operational Workshop XV
Albany, New York
Wednesday, November 12, 2014

9:30 am
Welcoming Remarks
Raymond G. O'Keefe, Meteorologist In Charge
Warren R. Snyder, Science & Operations Officer
National Weather Service, Albany, New York

Session A – Cold Season Topics

9:40 am
The Effects of Downsloping on Storm Precipitation Distributions in the Capital District of New York State
Kyle Pallozzi
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

10:05 am
Modification of Long-Axis Lake-Effect Snow Bands Associated with Landfall and Orographic Uplift: Results from a profiling radar network deployed during OWLeS
Ted Letcher
Department of Atmospheric and Environmental Sciences
University at Albany, State University of New York, Albany, New York

10:30 am
Using the Froude Number to Improve Orographic Snow Forecasts in the Green Mountains of Vermont
Michael Muccilli
NOAA /NWS Weather Forecast Office, Burlington, Vermont

10:55 am
Verification of Storm Prediction Center Winter Weather Mesoscale Discussions
Christopher McCray
Lyndon State College, Lyndonville, Vermont

11:20 am
The Icy Nightmare Before Christmas
Robert Kuhn
Ontario Storm Prediction Centre, Environment Canada, Toronto, Ontario, Canada

11:45 pm - Lunch

Session B – Modeling

1:45 pm
An Alternative Gridded Verification Scheme: Zone-Based Snowfall Verification
Joseph P. Villani
NOAA/NWS/Weather Forecast Office, Albany, New York

2:10 pm
CSTAR Update: New Tools for More Efficient Use of Ensembles in Operations
Brian A. Colle
School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, New York

2:35 pm
Enabling Advanced Weather Modelling and Data Assimilation for Utility Distribution Operations
Anthony P. Praino
IBM Thomas J. Watson Research Center, Yorktown Heights, New York

3:00 pm
Observed and Simulated Multi-bands in Northeast U.S. Winter Storms
Sara A. Ganetis
School of Marine and Atmospheric Sciences, Stony Brook University,
Stony Brook, New York

3:25 pm
Evaluation of WRF PBL Schemes in the Marine Atmospheric Boundary Layer over Coastal Southern New England Waters
Matthew J. Sienkiewicz
School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, New York

3:50 pm - Break

4:15 pm
Using an Ensemble Kalman Filter to Explore Model Performance on Northeast U.S Fire Weather Days (via GoTo Meeting)
Michael Erickson
School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, New York

4:40 pm
A Multiple Linear Regression Approach for Storm Surge Predictions in the NY/NJ Bight
Keith J. Roberts
School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, New York

Session C – Blender Projects

5:05 pm
The New England Blender Project
Paul A. Sisson
NOAA/NWS, Weather Forecast Office, Burlington, Vermont

5:30pm
An Overview of the National Blend of Global Models Project
Jeff S. Waldstreicher
NOAA/NWS Eastern Region Headquarters, Bohemia, New York

5:55 pm – Closing Comments, Logistics
Warren R. Snyder
NOAA/NWS Weather Forecast Office, Albany , New York

6:00pm - Adjourn

Agenda
Northeast Regional Operational Workshop XV
Albany, New York
Thursday, November 13, 2014

Session D – Warm Season Topics/ Convection

8:30 am
An Examination of the 22 May 2014 Duanesburg, New York, Unexpected Tornadic Supercell
Brian Tang
Department of Atmospheric and Environmental Sciences
UAlbany, State University of New York, Albany, New York

8:55 am
A Radar-Scale Analysis of Three Tornadic Thunderstorms in the Albany County Warning Area during 2014
Brian J. Frugis
NOAA/NWS Weather Forecast Office, Albany, New York

9:20 am
An Assessment of Local Forecaster's Ability to Anticipate Convective Event Severity and Magnitude using the Hazardous Weather Outlook product at WFO Binghamton, New York
Michael Evans
NOAA/NWS Weather Forecast Office, Binghamton, New York

9:45 am
Radar Characteristics of the 13 August 2014 Portland, Maine Flash Flood Event
John Cannon
NOAA/NWS Weather Forecast Office Gray, Maine

10:10 am – Break

10:35 am
A Review of the Historic Long Island Flooding on 13 August 2014
David Stark
NOAA/NWS Weather Forecast Office, Upton, New York

11:00 am
Using SPC Slight Risk Convective Outlooks to Identify Cases with Low Predictive Skill over the Northeast
Matthew Vaughan
Department of Atmospheric and Environmental Sciences
UAlbany, State University of New York, Albany, New York

11:25 am
A Case Study of the Revere, MA Tornado of July 28, 2014
Matthew L. Doody
NOAA/NWS Weather Forecast Office, Taunton, Massachusetts

11:50 pm
What the Hail is Going On? A Comparison of 3 Recent Anomalously Large Hail Events that Impacted the Albany Forecast Area
Thomas A. Wasula
NOAA/NWS Weather Forecast Office, Albany, New York

12:15 pm - Lunch

Session E – General Session

2:15 pm
Proposed Changes in the Winter Weather Forecasts at the Weather Prediction Center (WPC), and New Experimental Forecasts
Dan Petersen
NOAA/NWS National Centers for Environmental Prediction
Weather Prediction Center, College Park, Maryland

2:40 pm
Forecasting Surface Wind Gusts in Positively Stable Environments
Brian LaSorsa
NOAA/NWS/National Weather Service, Weather Forecast Office, Sterling, Virginia

3:05 pm
The New York State Mesonet
J. Brotzge
Atmospheric Sciences Research Center, Albany, New York

3:30 pm
Using Ensemble Models to Develop a Long-Range Forecast and Decision Making Tool
Brandon Hertell
The Consolidated Edison Company of New York, Inc. , New York, New York

3:55 pm - Break

4:15 pm
Improving Decision Support Services for the Tri-State Area
Nelson Vaz
NOAA/NWS Weather Forecast Office, Upton, New York

4:40 pm
Using NOAA-Atlas 14 Return Periods to Aid in Flood Forecasting
Charles Ross
NOAA/NWS Weather Forecast office, State College, Pennsylvania

5:05 pm
Patterns of Historic River Flood Events in the Mid-Atlantic Region
Richard H. Grumm
NOAA/NWS Weather Forecast Office, State College, Pennsylvania

5:30 pm
An Overview of the Northeast River Forecast Center's Use of Daily Rainfall Observations from the Community Collaborative Rain, Hail & Snow Network (CoCoRaHS)
Ronald Horwood
NOAA/NWS Northeast River Forecast Center, Taunton, Massachusetts

5:55 pm - Wrap Up
Warren R. Snyder

6:10 pm
Adjourn

7:00 pm
CSTAR Dinner at Buca di Beppo Italian Restaurant
44 Wolf Road, Colonie, New York

NROW XVI is scheduled November 4-5, 2015
At the Nano South Conference Center, Room 103, 255 Fuller Road
On the Campus of the College of Nanoscale Science and Engineering
State University of New York, Albany , New York

The Effects of Downsloping on Storm Precipitation Distributions in the Capital District of New York State

Kyle Pallozzi[1] , Lance Bosart[1], Dr. Robert Gaza[2]
[1]Department of Earth and Environmental Sciences
UAlbany, State University of New York, Albany, New York
[2]New York State Department of Environmental Conservation, Albany, New York

Downsloping is a process which has been observed to have a high impact on precipitation distributions during many events in the Capital District of New York State. Forecasting the magnitude and westerly extent of precipitation decreases due to downsloping in the Hudson Valley is a major forecast challenge. This study seeks to address that issue by determining the best predictors for such events. Thus far individual 850 hPa and 925 hPa winds from soundings at Albany (KALB) and storm mean 850 hPa and 925 hPa wind vectors derived from NARR (North American Regional Reanalysis) data have been examined. Preliminary results from this study suggest that when winds have a strong easterly component at 850 hPa and 925 hPa, lower precipitation values in the Hudson Valley are most favored. A more surprising finding was the very small difference in precipitation totals between the two easternmost locations in the study area (despite the large elevation difference). Future work will be done to examine other variables such as surface wind and surface geostrophic wind at Albany to assess their relationship to downsloping cases in the Hudson Valley.

Modification of Long-Axis Lake-Effect Snow Bands Associated with Landfall and Orographic Uplift: Results from a profiling radar network deployed during OWLeS

Ted Letcher[1], Justin Minder[1], Peter Veals[2], Jim Steenburg[2], Leah Campbell[2]
[1]Department of Earth and Environmental Sciences
UAlbany, State University of New York, Albany, New York
[2]University of Utah, Salt Lake City, Utah

During the winter season, convective lake-effect snowstorms deposit large amounts of snow downwind of the Great Lakes. The Tug Hill Plateau is a 600 meter high topographic feature on the eastern end of Lake Ontario, and is ideally located to receive heavy lake-effect snow. A local climatological maximum (>200” per year) of snowfall occurs approximately 40-50km downwind of the lakeshore on the western slope of the Tug Hill. The exact dynamical and microphysical mechanisms behind this maximum are not well understood, due, in large part, to a lack of good observations.

The Ontario Winter Lake-Effect Systems (OWLeS) field campaign ran during the winter of 2013/2014. During OWLeS, an east-to-west transect of four vertically pointing Micro Rain Radars (MRR) was deployed to study the transition of lake-effect storms as they move inland over the lakeshore and up the Tug Hill. The MRRs are profiling 24 GHz FM-CW-Doppler radars. All four MRR's were deployed in October 2013 and taken down in early 2014. During several events, the MIPs X-band Profiling Radar (XPR) was co-located with the MRR at Sandy Creek central school, providing additional data.

The 2013/2014 winter was extremely generous in terms of lake-effect snow, providing ample data for analysis. The MRR observations provide unprecedented insight into how the vertical and temporal structures of lake-effect storms evolve as they move inland and interact with the Tug Hill.

A comparison between the MRRs across the transect shows that the echo tops remain roughly constant as the lake-effect convection moves up over the tug. In addition, convective updraft intensity decreases. This suggests that convective invigoration forced by the terrain is not responsible for the snowfall enhancement on the tug. MRR data show stronger reflectivity echoes and stronger updrafts nearer the shore, suggesting a transition from convective to stratiform precipitation as the band moves inland. Furthermore, the data reveal that low-level (<1.5km AGL) microphysical processes including snow growth and sub-cloud sublimation significantly contribute to the inland maximum in lake-effect snowfall. The importance of these low-level processes reveals a possible limitation in quantitative precipitation estimates (QPE) from the local NEXRAD radar.

These new results will aid weather forecasters by providing a better physical understanding regarding the inland transition of lake-effect storms, and by serving as a basis for improving NEXRAD-based QPE for lake-effect systems.

Using the Froude Number to Improve Orographic Snow Forecasts in the Green Mountains of Vermont

Michael Muccilli
NOAA /NWS Weather Forecast Office, Burlington, Vermont

Orographic snow is a very challenging aspect of forecasting in the northeastern United States. This presentation provides a method for improving these forecasts using the Froude number. Past research has shown that variations in the non-dimensional Froude number during upslope snow events can be correlated to the nature of the orographic snow bands and distribution of snowfall accumulations. Twenty-five observed northwest flow orographic snowfall cases from 2007 to 2012 in the Green Mountains of Vermont are examined. Composite synoptic analyses for all cases show 500-hPa northwest flow and cyclonic north to northwest flow at 850-hPa. Froude numbers were calculated for each case which show that the Froude number has a critical level of 1.0, at which events lower than this critical level become blocked and precipitation backs up into the lower elevations of the western slopes of the Green Mountains. With Froude numbers less than 0.5, snow affects the Champlain Valley and the Burlington metropolitan area. At Froude numbers above 1.0, air flows more freely over the Green Mountain spine, and the majority of the precipitation falls along the mountains and downwind. Using the forecast Froude number, in addition to other fields from numerical weather prediction models, can assist forecasters in determining the potential for and resultant distribution of orographic snow.

Through the use of archived North American Model (NAM) and Rapid Update Cycle (RUC) forecast model soundings, archived individual and composite snowfall accumulation reports and maps, and calculated Froude numbers, characteristics of the orographic snow bands will be discussed as well as how to anticipate their behavior and the snowfall amounts and distributions they produce. This research has led to a Froude number forecast tool which has already been used successfully in the National Weather Service Burlington, VT Weather Forecast Office.

Verification of Storm Prediction Center Winter Weather Mesoscale Discussions

Christopher McCray[3],
Christopher Melick[1,2], Israel Jirak[1], Patrick Marsh[1], Andrew Dean[1], Ariel Cohen[1], Jared Guyer[1]
[1] NOAA/NWS National Centers for Environmental Prediction, Storm Prediction Center, Norman Oklahoma
[2] Cooperative Institute for Mesoscale Meteorological Studies, University of Oklahoma
[3]Lyndon State College, Lyndonville, Vermont

The Storm Prediction Center (SPC) has issued winter weather mesoscale discussions (MDs) since 1997 to alert meteorologists at National Weather Service (NWS) Weather Forecast Offices (WFOs) and other partners of the near-term potential for heavy snowfall or freezing rain rates, winter mixed precipitation events, and for the initiation of mesoscale blizzard conditions. To date, SPC has had no means of objectively verifying these discussions. An evaluation of mesoscale discussions from January 2007 to April 2014 is performed to determine the spatial and temporal characteristics of the various types of MDs issued. To aid in enhancing SPC winter weather operations, a verification method is developed using gridded surface station precipitation type observations, local storm reports (LSRs), and quantitative precipitation estimation (QPE) data. From the surface observations and LSRs, a gridded dominant precipitation type product is generated and used alongside gauge-corrected National Mosaic & Multi-Sensor QPE (NMQ) and a snow-to-liquid ratio climatology to calculate estimated hourly snowfall accumulations. Similar methods utilizing these datasets are developed for verifying blizzard, freezing rain, and mixed precipitation MDs. A case study is performed for a heavy snow event over the upper Midwest, from which it is determined that a 40 km neighborhood verification method, similar to that used in the verification of SPC convective forecasts, best represents MD forecast accuracy. All datasets used are available in real-time, and products developed such as dominant precipitation type can be incorporated into operational systems for use in analysis and forecasting. The verification system developed is also flexible, allowing for the implementation of new methods and datasets as they become available.

The Icy Nightmare Before Christmas

Steve Knott and Robert Kuhn
Ontario Storm Prediction Centre, Environment Canada, Toronto, Ontario, Canada

This presentation summarizes a major ice storm that nailed Southern Ontario including the Greater Toronto Area during the period December 20 to 22, 2013. A brief overview of the pre-storm set up and messaging will be given, followed by an examination of some of the numerical guidance and ongoing analyses that were used before and during this classical two part ice storm. This presentation will also show parts of new NinJo workstation software that Environment Canada is using as part of the forecast production process. Significant impacts across much of Southern Ontario will be illustrated, including direct effects on operations on the Ontario Storm Prediction Centre and many of the Toronto area staff at Environment Canada. This ice storm will be clearly remembered by many for years to come.

An Alternative Gridded Verification Scheme: Zone-Based Snowfall Verification

Joseph P. Villani, Vasil T. Koleci, Ian R. Lee
NOAA/NWS/Weather Forecast Office, Albany, New York

National Weather Service (NWS) Weather Forecast Offices (WFO's) verify snowfall for Winter Storm Warnings by computing the mean snowfall within each NWS forecast zone. To determine the mean snowfall within each zone, snowfall reports are added together and divided by the number of reports. This method is antiquated, as it does not factor in distance between points and is heavily weighted towards areas of greater population, where typically more snowfall observations exist. This method can be unrepresentative of outlying and higher terrain areas where snowfall can vary significantly.

A more modern snowfall verification method using Geographic Information Systems (GIS) has been developed at NWS Albany (ALY) using Geographic Information Systems (GIS) and an objective analysis technique. The verification is still performed by calculating the zone-average snowfall, but utilizes GIS software for a more innovative and scientific approach. Contoured snowfall maps are created using an inverse distance weighted (IDW) interpolation scheme to obtain a graphical representation of observed snowfall across a given area. Zonal statistics can then be calculated using the IDW snowfall maps, resulting in a more representative mean snowfall for each forecast zone. The end result is a more precise verification. A method for generating forecast bias maps for snowfall using GIS is also presented, which compares forecast snowfall from the NWS Graphical Forecast Editor (GFE) with observed snowfall. Examples from the 2013-2014 winter season are shown.

CSTAR Update: New Tools for More Efficient Use of Ensembles in Operations

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

Stony Brook has been developing diagnostics and tools to help increase the use of ensembles in operations, especially in the medium range. Partners for this CSTAR project include several NWS offices in Eastern and central Region, as well as several operational centers at National Centers for Environmental Prediction (the Hydrometeorological Prediction Center, Environmental Prediction Center, Ocean Prediction Center, and Aviation Weather Center), and the Developmental Testbed Center. At previous NROW meetings, we highlighted an ensemble sensitivity tool, as well as a tool for Rossby Wave packet (RWP) identification and tracking. To provide forecasters a better understanding of ensemble sensitivity signals as well as a connection with daily flow regimes, we have selected 20 random potential storm cases in the day 6 NCEP+CMC+EC ensemble forecasts (90 members) to characterize the features of ensemble sensitivity signals under different flow regimes. The 20 cases also include several false alarms (false cyclone or underpredicted anticyclone) with no RWPs and no upstream blocking. When a coherent RWP exists, ensemble sensitivity signals tend to be much more robust and well organized. The largest values are either collocated with RWP or over the leading regions of Rossby wave packet. When there is a stationary blocking system upstream, areas of ensemble sensitivity seldom extend upstream of the block, but they can be quite robust adjacent to blocking systems.

One major challenge for forecasters is to quickly extract useful information from a large multi-model ensemble. An efficient evaluation of ensemble models' performance in high impact weather events over the East Coast region is very important. We are developing a new ensemble clustering tool to help forecasters condense ensemble information, and evaluate ensemble models' performance by separating the multi-model ensemble into different scenarios and comparing them with the analysis. To start the iterative cluster procedure, a predefined number of clusters or initial guess is randomly placed in the EOF PC1-PC2 phase space (using, for example, MSLP). Each ensemble member denoted by the pair of PCs is then assigned to the nearest group center. New centers are computed by minimizing an objective function that represents the distance from each point to each new cluster center. Each point is examined again relative to the updated cluster centers. If no points can be reassigned because they are closer to another center, the iterations stop. Each member is assigned a weight value that identifies their relative strength of membership to their cluster. This talk will describe the fuzzy clustering procedure and apply it to a few cases, such as the 26-27 December Boxing Day blizzard using 91 multi-model ensemble members.

Enabling Advanced Weather Modelling and Data Assimilation for Utility Distribution Operations

A.P. Praino[1], L. A. Treinish[1], J. P. Cipriani[1] , Richard Foltman[2]
[1]IBM T.J. Watson Research Center, Yorktown Heights, New York

[2]DTE Energy

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

To address these problems for a utility in southeastern Michigan, we are developing an approach to couple weather forecasts to optimal crew deployment to enable positioning of appropriate restoration resources prior to an event. The first component of this coupled system builds upon the on-going work in applying mesoscale numerical weather prediction (NWP) at the IBM Thomas J. Watson Research Center dubbed "Deep Thunder". It is derived from a configuration of the WRF-ARW (version 3.4.1) community model, and operates in a nested configuration focused on the utility's service territory, with the highest resolution at one km, utilizing 42 vertical levels. The configuration also includes parameterization and selection of physics options appropriate for the range of geography within the domain from highly urbanized to rural. This includes Thompson double-moment microphysics, Yonsei University non-local-K scheme with explicit entrainment layer and parabolic K profile in the unstable mixed layer for the planetary boundary layer, NOAH land-surface modelling with soil temperature and moisture in four layers, fractional snow cover and frozen soil physics, Grell three-dimensional cumulus parameterization in the outer domain (nine km resolution), and a three-category urban canopy model with surface effects for roofs, walls, and streets. It produces 72-hour forecasts, which are updated twice daily. In addition, it incorporates a diversity of input data sets ranging from NCEP RAP for background conditions, NCEP NAM for lateral boundaries, three-dimensional variational data assimilation from several thousand surface and near-surface observation stations operated by Earth Networks, NOAA and other agencies, and surface conditions derived from remotely sensed observations provided by NASA and USGS. The surface data are particularly important for stable and accurate boundary layer, land surface and urban canopy modelling.

Impacts on the utility operations from severe weather vary from convective, summer thunderstorms to winter wind and snow/ice events. Therefore, to converge on an optimal model configuration for consistent, year-around operations that are computationally tractable, retrospective analyses were conducted on ten events that occurred in 2012 and 2013, which were representative of the weather events that led to disruption of the overhead network. Numerical experiments as hindcasts were performed to evaluate the model, whose results were compared to both conventional observations as well as reported utility outages. The validation methodology was developed focused on the utility's needs. It was built with the Model Evaluation Tools (MET version 4.0) community verification package. Temperature, wind, dew point and precipitation data from the aforementioned set of in situ surface observations were compared to the forecast data as well as the data from the NOAA/NCEP North American Model.

Although such NWP-based weather forecasts are only a prerequisite to the optimization of weather-sensitive business operations, we will focus herein on the analysis of the weather component. A companion presentation will cover the impact (damage/outages) and restoration prediction effort. Hence, we will discuss the on-going work, the overall approach to the problem, some specifics of the solution, and lessons that were learned through the development and deployment. This will include a discussion of the retrospective analysis and the results of operational forecasting that began in July 2013. In addition to the evaluation, we will present how the forecasts are being used, including the deployment of customized visualizations. We will also discuss the overall effectiveness of our particular approach for these and related applications, issues such as calibration of data and quantifying uncertainty as well as recommendations for future work.

Observed and Simulated Multi-bands in Northeast U.S. Winter Storms

SARA A. GANETIS[1], BRIAN A. COLLE[1], SANDRA E. YUTER[2], AND NICOLE CORBIN[2]

[1] *School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, New York*
[2] *Department of Marine, Earth and Atmospheric Sciences, North Carolina State University, Raleigh, North Carolina*

Mesoscale precipitation structures within Northeast U.S. winter storms result in heterogeneous spatial and temporal snowfall throughout the region during any one particular storm. There have been many studies of single-banded snowbands in the comma head, but fewer studies of multi-banded events. Multi-bands have been observed to be more transient and shorter-lived structures than single bands but are capable of producing similar snowfall rates and wind speeds. The goal of this study is to use observational and model datasets to better understand multiband evolution in the context of a large sample of snow events across southern New England. The precipitation structures were subjectively classified into single bands, multi-bands, both single and multi-bands, and non-banded using WSR-88D Doppler radar data that was stitched together from Fort Dix, NJ (KDIX), Upton, NY (KOKX), to Boston, MA (KBOX) for 33 storms from 1997-2014. The classification followed Novak et al. (2004; 2010) except that multi-bands are defined as ≥ 3 bands with a lifetime ≥ 2 h with similar structure and spatial orientation and movement. Out of the 33 total storms, 5 (15%) were classified as single bands only, 5 (15%) as multi-bands only, 9 (27%) as both single and multi-bands, and 14 (42%) as non-banded. Results will also be shown highlighting the observed stability, moisture, and wind differences using soundings at OKX, Albany, NY (KALB) and Chatham, MA (CHH) as well as spatial composites using the NCEP North American Regional Reanalysis (NARR) to compare with those of previous studies.

The Northeast U.S. blizzard of 26-27 December 2010, also known as the "Boxing Day Storm," was an exemplary case of multi-banding. The Weather Research and Forecasting (WRF) mesoscale model forced using 0.5° NCEP Global Forecast System (GFS) for initial and boundary conditions was used to assess the predictability of multi-bands during this event down to 1.33-km horizontal grid spacing. Observations include the 88D radars as well as a vertically-pointing Microwave Rain Radar (MRR) on top of the roof at Stony Brook University. The typical 3-4 km grid spacing used in some operational models is thought to not to be enough horizontal resolution to resolve multi-bands, and the ability of 1.33-km grid spacing is discussed. There is also relatively large sensitivity for the simulated multi-bands to varying the microphysical and boundary layer parameterization schemes within the model.

Evaluation of WRF PBL Schemes in the Marine Atmospheric Boundary Layer over Coastal Southern New England Waters

MATTHEW J. SIENKIEWICZ AND BRIAN A. COLLE
School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, NY

Coastal marine layer forecasts are important for the forecasting of severe storms and wind energy resources in the highly populated coastal marine environment of the Northeast U.S. (NEUS). Mesoscale models are known to have large biases in wind speeds, temperatures and moisture in the marine atmospheric boundary layer (MABL) over the NEUS coastal waters. The goal of this project is to evaluate the performance of six planetary boundary layer (PBL) schemes in the Weather Research and Forecasting (WRF-ARW) model version 3.4.1 in the coastal marine environment of the NEUS. This study region, stretching from the south shore of Long Island out to Cape Cod is an ideal location for an offshore wind energy grid based on such factors as regional energy demand, water depth, and available wind resource.

Verification of the six WRF PBL schemes (two non-local, first-order schemes and four local, TKE-order schemes) was primarily done using a dataset of observations at multiple levels from the Cape Wind tower in Nantucket Sound from 2003 to 2011, as well as surrounding NDBC and ASOS stations. A series of 30-hour WRF runs were conducted for 90 randomly selected days between 2003 and 2011, with initial and boundary conditions supplied by the North American Regional Reanalysis (NARR). All schemes generally displayed negative wind speed biases at the tower location, with larger biases in the cool season than the warm season. Cool season winds were predominantly out of the west-northwest and the schemes were typically too unstable in the lower MABL, resulting in weaker-than-observed wind shear and negative wind speed biases increasing in magnitude with height, suggesting too much mixing of weaker momentum from below. During the predominantly south-westerly winds in the warm season the opposite was true, with all schemes displaying a too-stable lower MABL and the largest negative wind speed biases nearest to the surface. This suggests too little momentum mixing from above. The origin of the stability errors is currently being explored, starting with any errors in the sea-surface temperatures.

Additional model verification was performed from several Long-EZ aircraft flights during the IMPOWR (Improving the Mapping and Prediction of Offshore Wind Resources) field campaign during the spring and summer of 2013. Three Long-EZ flights were conducted during the period of 20-23 June 2013 in strong south-westerly flow with a developing low-level jet, supplying high-frequency observations of temperature, relative humidity and three-dimensional winds throughout the depth of the marine boundary layer. WRF simulations showed that all schemes overestimated the height of the jet while underestimating the magnitude. Model runs were forced with a variety of analyses, and for relatively long simulations (72 hours) the results were far more sensitive to the boundary conditions than to the PBL schemes.

Using an Ensemble Kalman Filter to Explore Model Performance on Northeast U.S Fire Weather Days

Michael Erickson and Brian A. Colle
School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, NY

Wildfires in the Northeastern United States (NEUS) pose a significant hazard due to the regions high population density. Operationally, creating useful ensemble-based products would be valuable to fire weather meteorologists; however, most atmospheric ensembles exhibit significant near-surface biases that adversely affect the quality of the model generated fire weather forecast. There are two ways to address this model bias; 1) bias correct model output after the fact or 2) attempt to address the model bias at its source. This talk will focus more on the latter subject and our early attempts to use data assimilation to improve fire weather forecasts.

The data assimilation platform comes from the Pennsylvania State University Ensemble Kalman Filter (PSU-EnKF) Version 4.0 with forward iterations performed using the Weather Research and Forecasting (WRF) Advanced Research WRF (ARW) core Version 3.5. The WRF-EnKF system is run for the first several days in April of 2012 with a focus over the NEUS. April 2012 is chosen due to the large number of fire weather days over the New York City Tri-State region. Observations are assimilated into the WRF-EnKF system every 6 hours and include data from buoys, ships, mesonet stations, profilers, rawinsonde soundings, satellite winds, Standard Aviation Observation (SAO), Automated Surface Observation System (ASOS) and Aircraft Communications Addressing and Reporting System (ACARS) data. A 45-member ensemble is created by perturbing the Global Forecasting System (GFS) initial and lateral boundary conditions.

This talk will first verify that the EnKF is performing as expected by comparing the analysis field to multiple observations types and the Rapid Update Cycle (RUC) analysis. The filter performance on fire weather days will then be compared to non-fire days to assess how quickly model biases develop in the WRF model and quantify how well the EnKF corrects these biases. On average, the EnKF creates an analysis that is slightly better than the RUC (mean absolute error reduced by ~0.25^{o}C), even on fire weather days where the average model bias is about 1^{o}C colder. Finally, future work involving how the EnKF will be modified to potentially correct these biases through parameter estimation will be discussed

A Multiple Linear Regression Approach for Storm Surge Predictions in the NY/NJ Bight

Keith J. Roberts and Brian A. Colle
School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, NY

Storm surge is the meteorological forced portion of the sea level that is dynamically generated by winds and pressure perturbations associated with the passage of tropical and extra-tropical cyclones. Often numerical hydrodynamical models (NHM) are forced with meteorological inputs (i.e. NAM or WRF) to generate spatial forecasts of storm surge. Since storm surge is directly forced by wind and pressure from the atmosphere, the accuracy of storm surge forecasts hinges on the accuracy of meteorological inputs. As such, it has been shown that probabilistic forecast guidance involving ensembles results in more skillful predictions of storm surge compared to deterministic forecasts. However, NHM's are computationally expensive to run, especially in ensemble coupled atmosphere-ocean simulations. This study proposes a statistical method to predict storm surge using inputs from atmospheric models.

A perfect prog approach using multi-linear regression (MLR) was used to train the statistical model for storm surge using two different atmospheric reanalysis datasets (NARR and CFSR) and observed storm surge data at three stations along the NY/NJ Bight (Atlantic City, New Jersey, The Battery, New York, and Montauk Point, New York). The odd years between 1979-2012 are used to train the 3-hourly storm surge predictions during the cool season months (Oct 1-March 31), while the even years were used as verification. The predictors of the MLR represent prolonged surface wind fetch and sea-level pressure perturbations. This approach also works well for more extreme events, such as hurricane Sandy (2012). The MLR predicted a 2.56 m peak surge at The Battery using the NARR, while the observed peak was 2.68 m. Overall, the MLR is shown to be approximately unbiased. MLR predictions are also shown to have competitive mean absolute error compared to an operational hydrodynamical model (SIT-NYHOPS) between 2010-2014 at The Battery, New York.

Since it is inexpensive to run the MLR approach, it is used to generate ensemble storm surge predictions (http://nybightstormsurges.weebly.com) at The Battery. The NCEP Short-Range Ensemble Forecast System (SREF) is used to force the statistical model to generate 9 members at 0900UTC and 0300UTC daily. Basic metrics are calculated, such as mean and spread, which a forecaster can relate to the ensemble predictions of wind and pressure on this same web page. Other applications include applying MLR to global climate model data for long-term (~100 y) 3-h projections of storm surge at selected stations in the NY/NJ Bight.

The New England Blender Project

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Over the past ten years, National Weather Service (NWS) Weather Forecast Offices (WFOs) in New England have attempted to improve the consistency, collaboration, and science of producing gridded forecasts through a series of meetings to share methodologies, forecast tools, and philosophies. From October 2013 through March 2014, these offices conducted an experiment to determine if a blend of NWS human-influenced forecasts with raw, statistical, and post-processed model output could improve the accuracy and consistency of forecasts for days 4 through 8 and help to enhance the efficiency of operations. It was also intended to serve as an intermediate step to the National Blender project, which is envisioned to be implemented at NWS WFOs nationwide in the next two years. The experiment was modeled after the NWS Central Region's blender project. The New England blend was equal parts of the previous NWS official forecast, consensus of the latest model guidance, bias-corrected model guidance, and the NWS Weather Prediction Center's forecast. Surveys of NWS forecasters were conducted before, at the midpoint, and at the end of the experiment to determine the impacts on operations and usefulness of the model blend method. Survey and verification results indicate that the blend was helpful to the forecasters in producing an accurate and consistent forecast while working efficiently. This presentation will show the results of the experiment and recommendations for use throughout the NWS Eastern Region, as a bridge to the National Blender project.

An Overview of the National Blend of Global Models Project

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It has been demonstrated that consensus forecasts produce a more accurate forecast than any single individual model or forecaster when verified over an extended period of time. Recently, regional efforts across the National Weather Service have explored utilizing a consensus of raw model output and MOS forecasts, along with bias corrections of these guidance forecasts, for population of the National Digital Forecast Database (NDFD) with very encouraging results.

Resources from the Sandy recovery legislation (e.g., the Disaster Relief Appropriations Act of 2013) has provided support for the NWS to harness these regional blending efforts to implement a national-scale, centrally-produced, model blending approach. To have something implementable by the end of 2015 (the scope of this project during the Sandy Supplemental funding period) the initial focus is on developing calibrated forecast guidance from the global models, with an emphasis on the medium range (days 3 – 8) for the weather elements contained in the National Digital Forecast Database (NDFD).

The National Blend of Global Models Project, when successfully completed, will produce a nationally consistent and skillful suite of calibrated forecast guidance from a blend of both NWS and non-NWS models for use in forecasting at national centers, the local field offices, and the private sector. This development will leverage evolving state-of-the-science data assimilation analyses (for calibration and verification), ensemble guidance which enables the estimation of uncertainty in the forecast, and emerging statistical post processing techniques to calibrate and blend model output and make the forecast guidance more useful. The performance of the national model blend will be assessed by objective and subjective approaches. Objective verification will compare the blend to individual model components and the NDFD, both by using an analysis of observations at gridpoints, and at observation locations for the nearest gridpoint. Subjective evaluations will be conducted via forecaster surveys and other feedback.

Future development plans include expansion to the Days 1-3 with the inclusion of regional model systems (e.g., NAM and SREF), and the development of a suite of probabilistic guidance products for assessment of forecast uncertainties and decision support applications.

An Examination of the 22 May 2014 Duanesburg, New York, Unexpected Tornadic Supercell

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Around 1900 UTC on 22 May 2014, a long-lived supercell dropped up to 4.00" hail in Amsterdam, New York and spawned an EF3 tornado in the towns of Delanson and Duanesburg, New York. The storm was remarkable in that the morning antecedent convective available potential energy (CAPE) and vertical shear values did not suggest the possibility of supercells. We examine radar data, lightning data, in-situ observations, and model analyses in the hours leading up to and during the event to identify factors that led to the initiation and maintenance of the supercell, including the large hail and tornado.

The supercell formed between 1500 and 1600 UTC at a triple point, and then moved south along a north-south oriented stationary front that was maintained by strong differential shortwave heating. High equivalent potential temperatures in the Mohawk Valley at the intersection of stronger heating to the east and moisture pooling along the stationary front increased the CAPE to 2500 J/kg locally. This, combined with the low wet bulb freezing levels around 2500 m and mesocylonic circulation, led to the formation of large hail as the storm passed through the valley around 1900 UTC. Falling surface pressures to the west of the boundary led to increased backing of surface winds over the Hudson and extreme eastern Mohawk Valleys, providing an enhanced region of >10 m/s 0–1 km and >20 m/s 0–6 km vertical wind shear that created a localized environment favorable for the reinvigoration of the mesocyclone and formation of the tornado between 1900–2000 UTC. Interaction of the mesoscale flows, such as the rear flank downdraft, with the terrain may have also played a crucial role in the storm evolution.

This unexpected case highlights the challenge of severe convective forecasting in the northeastern United States, particularly due to the complex interaction of synoptic, mesoscale, and terrain features that may not be initialized or well-resolved by the current generation of convective-permitting models.

A Radar-Scale Analysis of Three Tornadic Thunderstorms in the Albany County Warning Area during 2014

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A recently completed Collaborative Science, Technology and Applied Research (CSTAR) study upgraded the V-R Shear Technique for tornado warning guidance to account for 8 bit, high resolution radar data. This technique, developed during a local Cooperative Program for Operational Meteorology, Education and Training (COMET) study in 2000, found that maximum gate-to-gate shear below 3 km was useful in identifying tornadic storms and that a linear relationship exists between the strength of the low level tornadic couplet and the mid-level mesocyclonic rotation (La Penta et al. 2000). The update to this original study found that while stronger tornadoes continue to show a signal using the V-R Shear Technique, weaker tornadoes didn't always show a signal using this method.

Three tornadoes occurred across the Albany County Warning Area between May and July in 2014. The strongest one tracked 7 miles across central Schenectady and northwestern Albany Counties in late May. The tornado damage was rated EF3 on the Enhanced Fujita Scale in the Duanesburg-Delanson area. The other two tornadoes were weaker and much shorter-lived, with an EF0 occurring in early July in the Adirondacks in North Creek, New York and a weak EF1 occurring in late July in Dalton, Massachusetts. While the Duanesburg-Delanson tornado showed a strong signal using the V-R Shear technique, the other tornadoes were difficult to detect using this method.

Although the extent of the damage caused by the weaker tornadoes is similar to straight line wind damage from microbursts, better techniques are needed to detect these weak tornadoes. Other storm interrogation methods, such as looking at Normalized Rotation (NROT) in Gibson Ridge's GR2Analyst software and dual-polarimetric techniques, such as Differential Reflectivity (ZDR) arcs, will be examined to see if they help detect these weaker tornadoes. Although these weaker tornadoes are short-lived, recent radar advances, such as the Supplemental Adaptive Intra-Volume Low-Level Scan (SAILS) and Automated Volume Scan Evaluation and Termination (AVSET) could help detect these storms that previously may have gone undetected. A radar interrogation and analysis of each storm will be shown with respect to local and national tornado warning guidance philosophy.

An Assessment of Local Forecaster's Ability to Anticipate Convective Event Severity and Magnitude using the Hazardous Weather Outlook product at WFO Binghamton, New York

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The Hazardous Weather Outlook (HWO) is an important tool for National Weather Service forecasters to communicate the potential magnitude and severity of upcoming significant weather events. The outlook is issued at least twice per day, and contains information on the potential for hazardous weather during the next seven days. As such, a review of the contents of the product can be used to evaluate forecaster's ability to anticipate hazardous weather. This presentation shows results from a study that examines the HWO issued at the National Weather Service Forecast Office in Binghamton, NY (WFO BGM), and compares the contents of the product to subsequent occurrences of convective severe weather within the first 24 hours of the forecast.

HWO products from WFO BGM were examined from 2011-2014. Contents of the product were compared to the occurrence of severe convective weather in the first 24 hours of the forecast, to evaluate the forecaster's ability to anticipate severe weather. This research is part of a larger project to identify severe convective scenarios with low-predictive skill in the northeast U.S., which is being supported by the Collaborative Science, Technology and Applied Research (CSTAR) program, including the National Weather Service and the State University of New York at Albany.

In order to objectively evaluate the content of the HWO forecasts, an assumption was made that forecasters were communicating a substantial probability for significant severe convection when certain key words and phrases, such as "severe", "large hail" and "damaging winds" were included in the product. A subsequent event was defined as significant any time five or more severe reports occurred in the WFO BGM county warning area in the 24 hours after the HWO was issued. Verification was confined to HWO products issued during the early morning hours. Preliminary results from this study indicate that forecasters at WFO BGM were able to anticipate significant convective events 63 percent of the time at time ranges less than 24 hours. However, the false alarm rate for those events was 54 percent.

When the threshold for an event was increased to 10 or more reports, the probability of detection increased to 76 percent. An examination of RAP model proximity soundings associated with the events indicated that the best forecasts were made in environments characterized by large convective available potential energy and large 0-3 km shear. However, when one of those factors was missing, the tendency toward both missed events and false alarms increased substantially. It is believed that the results of this study, along with the larger CSTAR-supported research for the entire northeast U.S., will ultimately be useful for improving forecaster's ability to anticipate the magnitude and severity of imminent convective events.

RADAR CHARACTERISTICS OF THE 13 AUGUST 2014 PORTLAND, MAINE FLASH FLOOD EVENT

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Urban flash flooding occurred in southern Maine, only hours after historic, all-time rainfall records fell in New York State (Islip) from the same synoptic system on 13 August, 2014. In Portland, Maine, 6.44 inches (164 mm) rain fell, which is the fifth heaviest rainfall ever during a 24 hour period and represents the only non-tropical system in that category. 4.21 inches (107 mm) fell in a two hour period, making this statistically a 200 to 500 year rainfall event for Portland.

Paralleled comparisons can be made between these seemingly separate, but historical events in Portland and Islip. Both flash floods occurred along the coastal plain, a distance away from complex terrain and during the nighttime and early morning hours. In each case, an anomalously dynamic upper level trough interacted with a deep, moisture supply and a coastal front, triggering mesoscale convection to produce excessive rainfall. Many of these atmospheric and diurnal characteristics are associated with a Maddox synoptic rainfall event type (Maddox et al. 1979).

Radar characteristics were closely examined and depicted a progressive line segment approaching the Portland area from New Hampshire during the evening of 13 August. This convection evolved into a bowing structure and produced an outflow boundary that eventually stalled along the southwest coast of Maine. The superposition of this boundary with the coastal front and moisture from an intense low level jet, implied significant convergence and focused low level ascent in the Portland region. Cells continually regenerated, with renewed genesis on the southern end of this line. The convection repeatedly trained over the same region as the storm motion was parallel to the coastline.

This presentation will provide an atmospheric review and radar characteristics that led to the flash flood event in Portland, while discussing comparisons with the Islip flash flooding. Dual Pol products and beam blockage issues from the Gray, Maine radar (KGYX) will be examined which led to irregularities in the storm total precipitation estimations. Lastly, a special case of enhanced flooding in the community of Ocean Park, Maine will be shown, which was indirectly affected by the interaction with ongoing coastal flooding.

A Review of the Historic Long Island Flooding on 13 August 2014

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On 13 August 2014, a historic heavy rainfall event impacted highly urbanized central Long Island. Nearly a foot of rain fell in approximately four hours across many locations in western Suffolk County. At the Islip MacArthur Airport, the official New York State 24 hour precipitation record was set with 13.57” of rainfall. This heavy rain occurred during the morning rush hour, flooding major highways and stranding thousands of motorists in flood waters.

An anomalously deep upper level trough was moving over the northeast during the morning of 13 August 2014, transporting high precipitable water over Long Island. At the surface, a parent low pressure system was moving across southeast Canada, with secondary low development just south of New York City. A warm front associated with the secondary low focused heavy precipitation over Long Island. With the mean storm motion parallel to the orientation of the front, heavy rain “trained” over the same location for several hours. A weak meso-low also tracked along the warm front, enhancing low-level convergence.

This presentation will review the synoptic and mesoscale environment, and examine the key ingredients that led to the historic flooding.

Using SPC Slight Risk Convective Outlooks to Identify Cases with Low Predictive Skill over the Northeast

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This study provides an objective evaluation of severe convection predictability using Storm Prediction Center (SPC) convective outlooks as well as a method to identify severe weather events with low-predictive skill. The database consists of 0600 UTC SPC outlooks for the 24-hour period beginning at 1200 UTC to 1200 UTC the next day. Slight risk areas are projected on a 40 x 40 km grid across both the continental U.S. and northeastern U.S. domains to evaluate the predictability of severe weather over the Northeast region relative to the predictability over the continental U.S. as a whole. Using hail, wind, and tornado reports valid for the forecast period, probability of detection, false alarm ratio, and critical success index verification metrics are calculated for a 33-year period from 1980-2013. Preliminary results indicate the Northeast has higher predictability scores than the nation. Cases with low predictability are separated into two types consisting of cases with low Probability of Detection (Type 1) and cases with high False Alarm Ratios (Type 2). Events in these categories were subdivided into 8 sections according to their 500 hPa flow directions, e.g., northerly, northwesterly, etc. Event-centered composites using the point of maximum report density (Type 1) and the centroid of the Slight Risk contour in the Northeast domain (Type 2) are created to highlight synoptic conditions related to poor predictability.

A Case Study of the Revere, MA Tornado of July 28, 2014

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On July 28, 2014 at about 9:30 AM, an EF-2 tornado touched down for only about 4 minutes in Revere, Massachusetts, a highly urbanized area just north of Boston. It was the first tornado to occur in Suffolk County since record keeping began in 1950 and was the most destructive tornado of the season. This particular tornado was unwarned by the local National Weather Service Weather Forecast Office (WFO). The combination of the unusual early morning occurrence of this tornado, and the spate of other rapidly evolving short-lived tornadoes to occur within the county warning area of the WFO in the past few years was the impetus for this case study, so that warning detection and lead time for such events can be improved.

This presentation will feature a review of the synoptic and mesoscale environment before, during, and after tornadogenesis and will be compared to an ongoing local study on Northeast tornado environments. Using an examination of radar images leading up to and after touchdown, in conjunction with the environmental discussion, it will be discussed whether there could have been advanced warning for this tornado in spite of the fact that it only exhibited the typically strong gate-to-gate shear signature on radar at the time it touched down. The presentation will also interpret radar data from similar events to determine if these rapidly developing, short-lived tornadoes in New England can be better assessed, rather than relying on the traditional gate-to-gate shear mechanism solely for determining tornado development. Finally, using this case as a starting point, further research of these short-lived tornadoes will be proposed.

What the Hail is Going On? A Comparison of 3 Recent Anomalously Large Hail Events that Impacted the Albany Forecast Area

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Three "historically" significant hail events have occurred in the National Weather Service (NWS) at Albany forecast area since June 1, 2011. The NWS at Albany forecast area includes east-central New York (NY), and western New England (southern Vermont (VT), the Berkshires of western Massachusetts (MA), and Litchfield County in northwestern Connecticut). One event occurred on 1 June 2011 where supercells generated five baseball-size (≥7.0 cm) or larger hail reports that impacted the Saratoga Springs, NY area, southern VT, and the Berkshires. The hailstones reached 8 cm in diameter at Shaftsbury, VT, and about 10 cm in diameter were measured in Windsor, MA located the Berkshires. The hailstones that fell in the Berkshires set the all-time state record. Another impressive hail event impacted the area on 29 May 2012 with four significant hail reports exceeding 5.0 cm in diameter. One large hail report in the Lake George area was nearly 9.0 cm in diameter from a hail monster supercell that nearly tied the state record. The record would be tied on 22 May 2014 where an isolated supercell not only produced a long track EF3 tornado in the Mohawk River Valley, but also a NY record tying 10 cm hailstone in Amsterdam, Montgomery County. This hailstone tied the record set in Niagara Falls, NY on 27 September 1998.

This comparative study will assess the role of cut-off lows, upper-level jet streaks, and pre-frontal surface troughs played in the formation of the supercells that produced the large hail. Mesoscale and pre-convective storm analyses will analyze instability and shear profiles for each event. The crucial role of elevated mixed layers, low and mid-level lapse rates and critical wet bulb zero heights will be discussed for the record-breaking and historically large hailstones.

This talk will take a multi-scale approach in analyzing and comparing the hail storm events from the synoptic-scale to the storm-scale, in order to understand the convective environment that produced the anomalously large hailstones across eastern NY and western New England from these 3 events. Observational data used in the analyses will include surface and upper air observations, satellite imagery, and Albany (KENX) WSR-88D 8-bit radar data. The storm-scale analysis will utilize a variety of radar tools. Some tools included in the analysis will be the Four-Dimensional Stormcell Investigator and GR2Analyst software. The storm-scale analysis will focus on helpful large hail forecast techniques, including applying results from a local 1-inch hail study and recent research with Dual-Pol data (i.e. utilization of ZDR Columns to assess updraft strength and hail growth and determination).

Proposed Changes in the Winter Weather Forecasts at the Weather Prediction Center (WPC), and New Experimental Forecasts

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The WPC product suite is constantly evolving in response to new customer needs and the increasing need for decision support. Changes to the 2014-15 WPC winter weather product suite are discussed in this presentation, including an experimental days 1-3 Winter Weather Watch Collaborator and days 4-7 probabilistic winter weather forecasts.

The WPC produces probabilistic winter weather forecasts for snow and ice accumulation across the 48 contiguous states (http://www.wpc.ncep.noaa.gov/pwpf/about_pwpf_productsbody.html). The forecast models and ensembles used to derive the probability distribution included 20 Short Range Ensemble Forecast (SREF) system members (out of 33 forecasts used in the 2013-14 season). Other data sets are needed to enhance the reliability of the probabilistic forecasts. WPC has added 25 ECMWF ensemble members to the suite forecasts to compute snowfall probabilities and percentiles for 2014-15.

Probability forecasts for 2013-14 provided the potential for snow/freezing rain accumulations covering the entire 3 day forecast period for 24, 48, and 72 hour time intervals (http://www.wpc.ncep.noaa.gov/wwd/winter_wx.shtml). Since multiple forecast offices use 12 hour snowfall/freezing rain accumulation criteria for watch/warning decision making, forecasts probabilities for snow/ice accumulating in each 12 hour window are proposed to aid in the watch/warning decision making process.

WPC will conduct preliminary testing of a Winter Weather Watch Collaboration Tool to aid in making watch, warning, and advisory decisions at forecast offices. The graphics will highlight areas where there was greater than 50 percent chance of exceeding heavy snow and/or freezing rain watch issuance criteria. Examples will be shown of the Collaboration Tool graphics prior to a March 2014 heavy snow event in the Great Lakes and northeast.

Also in 2013-14, WPC conducted preliminary testing of an experimental Day 4-7 product, which forecast the probability of snow and/or icing exceeding 0.10 inches of liquid equivalent precipitation, with one forecast for each 24 hour period. The manually-produced WPC Quantitative Precipitation Forecast (QPF) for the Day 4-7 period was used, as well as temperature profiles from the Global Ensemble Forecast System (GEFS) members. During the 2014-15 season, WPC plans to incorporate multiple model/ensemble systems to diversify the probability distribution and will begin issuing the Day 4-7 probability forecasts to NWS Weather Forecast Offices (WFOs) for evaluation beginning December 1, 2014.

Forecasting Surface Wind Gusts in Positively Stable Environments

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Wind maxima between 0.5 km and 3 km above the earth's surface frequently bring warm air over a colder earth's surface in the mid-Atlantic region, producing a positively stable environment. This stable environment inhibits mixing; however, it has been observed anecdotally that a portion of the low level wind does mix to the surface in the form of surface wind gusts.

During the 18 year period from 1996 to 2014, 56 positively stable cases were found matching the following criteria: 1) winds at 850 hPa, as observed from RAOBs at KIAD (Sterling, VA), were in excess of 45 knots (kt) and 2) the Automated Surface Observation System (ASOS) unit at the same KIAD location had a wind gust report within 2 hours of upper air launch. After analysis of each of the 56 cases, correlations were developed between surface wind gusts and the following three parameters: depth of the stable layer, lapse rate between the surface and the nose of the inversion, and the wind speed at the nose of the inversion. A strong correlation was found between the lapse rate and surface wind gusts. With the goal of developing a technique that shows skill in predicting surface wind gusts in an environment with positive stability, a model equation, derived from quadratic regression is presented to provide a more accurate wind gust forecast.

The New York State Mesonet

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Recent studies (e.g., Lazo et al 2011) show that New York is the most vulnerable of the 50 states to the negative economic effects of weather variability. Karl et al 2009 also suggest that during recent decades there has been a clear trend towards more extreme precipitation in the northeastern United States including New York, suggesting that this vulnerability may increase in the future. A number of notable recent extreme weather events have extensively affected New York – both Upstate and the greater New York City metropolitan area – leading to loss of life, significant damage to property and infrastructure, business and industry disruption and economic loss, and power interruptions to millions of New Yorkers. For example Hurricane Sandy in 2012 and Hurricane Irene caused $32 Billion, and $1 Billion in damages, respectively. Extreme winter storm events have also resulted in adverse impacts to many regions statewide and severe storms have resulted in notable flooding.

Currently, the National Weather Service (NWS) in New York relies on 27 automated surface observing system (ASOS) stations deployed across the state. As most of these stations are located at airports, they are not representative of the state's complex topography and weather. Furthermore, the ASOS network does not provide the high-resolution data needed to support monitoring and predictive modeling of events responsible for weather-related risks (such as rainfall/floods, heavy snow/ice, and high winds) statewide. Notable and significant gaps exist throughout the state including in such regions like the Adirondacks and Catskills. These topographies are amongst the wettest regions of New York State but currently have very limited hydrological observations. Numerous studies have shown that accuracy of weather forecasts is limited by the lack of meteorological observations within and above the planetary boundary layer (PBL). PBL temperature, humidity, and winds are presently sampled twice daily at just three NWS upper air stations in NY (Upton, Albany and Buffalo). Given these limitations weather forecasts – including the nature and intensity of hazardous and extreme weather events – are compromised.

To help mitigate the vulnerability of New York to severe weather events the New York State Mesonet (NYSM) being led by UAlbany in partnership with the New York State Division of Homeland Security & Emergency Services (DHSES) and the Federal Emergency Management Agency (FEMA) is being developed. NYSM will consist of a network of 125 meteorological stations permanently and strategically deployed across New York State to provide hazardous weather early warning and decision support to weather forecasters, state emergency managers, and the public. With its 17 enhanced sites that will include atmospheric profilers, advanced data processing system and high quality data standards the system will be one of the most advanced and capable for hazardous weather real-time monitoring and prediction. The NYSM is estimated to be completed by fall 2016. An overview of the system, progress, and lessons learned so far will be presented.

Using Ensemble Models to Develop a Long-Range Forecast and Decision Making Tool

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Preceding a large storm an electric utility will consult the weather forecasts in order to estimate the level of impact on their system. If the impact is estimated to be greater than what the utility can handle with its own resources it will reach out to fellow utilities for assistance. This process is called mutual assistance and most utilities throughout the United States have agreements in place to facilitate this process. The process starts with assistance requests to neighboring utilities. Depending on the demand for resource assistance, which is based on the size and severity of the storm impact, the request radius may expand. For example, utility resources were flown in on military cargo planes from California to assist during the New York Sandy recovery. However, long distance assistance is rarely employed due to long travel time, complicated logistics, and cost.

No utility wants to be short on resources, so one way to solve this is to acquire the additional resources as early as possible to ensure they are ready to start restoring immediately after the storm. This is where the pressure is applied to the weather enterprise. Currently utilities make mutual assistance decisions in the 3-5 day ahead forecast window. To ensure we have long distance resources in place to immediately respond after large storms, we must start making requests in the 6-10 day frame. Unfortunately, forecast accuracy drops rapidly after 5 days and such unreliable information may result in wrong decisions that far out in advance. At longer lead times the use of probabilistic information might provide a better decision tool for utilities. Con Edison has partnered Stony Brook University to use ensemble model forecasts coupled with a database of historical weather to create such a tool. The ensemble output will be focused specifically on Con Edison's weather triggers like strong coastal storms, high winds, and snow. By coupling a historical database to the real-time model forecasts we hope to improve the probabilistic outputs by calibrating the ensemble for these long-range forecasts.

We are in phase one of the project and the initial goal is to make a probabilistic cyclone track product using the National Centers for Environmental Prediction/Environmental Modeling Center (NCEP/EMC) cyclone track files. The first product displays cyclone track and ensemble probability spatial information for all available model forecast hours. The second uses a box-method approach to separate the forecast evolution of individual storms by analyzing the times all cyclone tracks pass through the box. The operational products use the Global Ensemble Forecasting System (GEFS), Short Range Ensemble Forecast (SREF), Canadian Meteorological Center (CMC) and Navy's Operational Global Atmospheric Prediction System (NOGAPS) ensembles and update 4 times daily with each new ensemble run. The operational page is available at:

http://wavy.somas.stonybrook.edu/cyclonetracks/. We have also run the Hodges cyclone tracker on several historical snow storm cases to help evaluate the products for some major events. We will show how the probabilities evolved for some of these major events, describe what is available today in the decision making process, and how we hope to improve that with this project. We will also illustrate how stakeholders are looking at this information and integrating it into their operations.

Improving Decision Support Services for the Tri-State Area

Nelson Vaz, Ashlie Sears and Gary Conte
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The National Weather Service (NWS) and the Upton, NY office have been providing Decision Support Services (DSS) to customers for years. The questions are basic: Why provide DSS? Who needs DSS? How can DSS be improved?

Time and effort is needed to develop and maintain our customer bases. Our long standing customers have been emergency managers. Five to ten years was taken to develop new working relationships with the FAA and the aviation community. It is through these relationships that the knowledge of specific operational criteria and their impacts are gained, including the importance of delivering clear and concise weather briefings.

Our NWS office routinely performs on- and off-site DSS to a variety of customers within the emergency management community; mainly at the county and city levels, the aviation community, and the maritime community. These services cover potential high impact weather events and many large scale special events for public safety.

During this time, more staff has been gradually exposed to provide DSS while receiving both formal and informal internal and external training. Through these experiences, best practices, reference material, playbooks and briefing templates have been developed to assist our forecaster understanding and communication of hazard impacts. In addition, significant progress continues to be made with utilizing web, social media, and video technology in furthering the communication and interpretation of our services.

Providing enhanced weather support to our core customers, such as NYC Office of Emergency Management, is a challenging and evolving process. Based on the close working relationships we have developed with our core customer base, we will continue to make improvements to more efficiently meet our NWS mission.

Using NOAA-Atlas 14 Return Periods to Aid in Flood Forecasting

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The NOAA-Atlas 14 data provides estimates of the climatological return of rainfall in timescales ranging from minutes to days. These data can be used to compare rainfall rates from observations of rain in real-time from gauges and radar rainfall estimates. The Multi-Radar Multi-Sensor System/Flooded Locations and Simulated Hydrographs Project (MRMS/FLASH) developed by the National Severe Storms Laboratory provides near real-time access to rainfall estimates relative to NOAA Atlas 14 data. The return period data includes 1, 3,6,12, and 24 hour return period products along with the maximum return period.

The FLASH/MRMS data were used to examine the value of the return periods to assess the threat of heavy rainfall and flood events across the United States in 2013 and 2014. For the selected events the rainfall estimates were examined and collected from the MRMS website. This provided the larger spatial context of the rainfall and areas affected by heavy rainfall and a gauge of the return period of the event over a broad geographic region.

Near areas of heavy rainfall, hourly rainfall data was collected from the nearest ASOS site. These hourly data were put into tables to compare to NOAA-Atlas 14 data for the location in question. During the Long Island deluge of 13 August 2014, the maximum 1 and 6 hour rainfall rate at KISP were 5.34 and 12.92 inches respectively. Both values exceeded the estimated 500 year return period rates of 3.72 and 8.86 inches respectively. Point data at Portland, ME and Baltimore, MD during the same weather system exceeded the 100 year return periods for 1 and 6 hour rainfall. The MRMS data revealed a wide swath of central Long Island had 3-h and 6-h return periods in excess of 200 years. The return periods appeared to provide value in gaging the severity of the flooding. Examining flooding in the southwestern United States, the Midwest, and Mid-Atlantic region appears to indicate that return periods exceeding 100 years tend to be noteworthy. For example, the heavy rain and flooding of 8 September 2014 in Phoenix had a 6-hour return period just 0.26 inches below the estimated 1000 year value and 0.68 inches over the 100 year return period. However, the 3-h return period did not exceed the 100 year value. The nature of the flooding in Phoenix made the national news. Two days later, a flood event which produced 2 and 6 hour return periods of over 100 years produced flooding which was not as news worthy.

This presentation will present cases studies showing the potential value of NOAA-Atlas 14 data in gaging the severity of flooding. Preliminary results indicate that lower thresholds are required to produce severe flooding in urban environments relative to more rural environments. These data also appear to show that with return periods below 100 years, flooding is often in the nuisance range. As rainfall return periods exceed 100 and 200 years the severity of the flooding and significance of the flooding increases dramatically. This implies these data may provide useful information in forecasting flood severity in near real-time.

Patterns of Historic River Flood Events in the Mid-Atlantic Region

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The Middle Atlantic River Forecast Center historic flood data base was used to re-construct the patterns associated with river flooding in the Mid-Atlantic Region. The database spans over 200 years with more detailed information available in the latter 19th and early 20th Century. The data base was sorted by the number of points which reached or exceeded flood stage over the span of the database and by month.

The Earth Systems Research Laboratory Twentieth Century Reanalysis (V2) data was used to reconstruct the pattern for the larger flood events between 1871 and 1947. Events which occurred between 1948 and 1978 were reconstructed using the NCEP/NCAR Reanalysis (R2) data. All events from 1979 to the present were reconstructed using the Climate Forecast System Reanalysis.

The reconstruction of the events revealed several distinct patterns. The dominant events in the Mid-Atlantic Region were the Maddox-Synoptic and Maddox-Frontal event types. The former, when associated with tropical moisture or a tropical wave produced many of the top flood events in the region. Several subtle event types included slow moving deep cut-off lows.

Examining the pattern 5-10 days prior to an event often revealed the importance of antecedent conditions. Many flood events were preceded by heavy rainfall several days earlier and these events were often similar in character. The flood event of 26 May 1946 was associated with a deep plume of high precipitable water into the Mid-Atlantic region. A similarly strong precipitable water plume and heavy rainfall event affected the region on 21 May 1946. In fact, May 1946 proved to be a record wet month in several locations in the Mid-Atlantic which culminated in the significant flood event of 26 May 1946.

Many of the events associated with south-to-north oriented moisture plumes also had a large 500 hPa ridge located over the western Atlantic. The more subtle events such as 8-9 and 12 May 1924 events lacked high precipitable water anomalies. These events had slow moving deep 500 hPa cyclones and often had strong easterly winds in the region of heavy rainfall. The March 1936 and January 1996 flood events represent the tragic mix of an ideal pattern for flooding combined with a deep snow pack.

This paper will show the key patterns and features associated with some of the more significant flood events in the Mid-Atlantic region. The combination of the reanalysis data sets and the historic flood data provide an opportunity to learn about the patterns associated with heavy rainfall and historic flooding. It is a means to provide both forecasters and students access to decades of high impact flood events in time scales of days.

An Overview of the Northeast River Forecast Center's Use of Daily Rainfall Observations from the Community Collaborative Rain, Hail & Snow Network (CoCoRaHS)

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The Northeast River Forecast Center (NERFC) produces 6 hour and 24 hour basin average precipitation estimates. These estimates are assimilated into the Hydrologic models to produce river forecasts. Data is collected from a variety of platforms including automated data collection systems that report hourly and are accumulated over 6 and 24 hours and National Weather Service Cooperative Observer observations that provide a 24 hour total and are then time distributed based on available hourly observations.

During the past 2 years, NERFC undertook an effort to incorporate 24 hour rainfall data available through the Community Collaborative Rain, Hail & Snow Network (CoCoRaHS). The CoCoRaHS network is a unique, non-profit, community-based network of volunteers of all ages and backgrounds working together to measure and map precipitation (rain, hail and snow). The Hydrometeorological Analysis and Support (HAS) unit conducted an extensive review of stations in its service area to determine a subset of the most reliable stations and to select stations that would augment the existing gage network to fill critical gaps in rainfall data coverage.

This presentation will review the NERFC incorporation of CoCoRaHS observations and will demonstrate the benefits of these rainfall observations in the production of rainfall estimates to support river forecast operations.

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