The Collaborative Science, Technology, and Applied Research (CSTAR) Program

Improving Analyses, Numerical Models, and Situational Awareness of High-Impact Severe Convective and Mixed-Phase Precipitation Events in Complex Terrain

University: University at Albany

Name of University Researcher Preparing Report: Kristen L. Corbosiero

NWS/AFWA/Navy Office: National Weather Service, Albany, New York

Name of NWS/AFWA/Navy Researcher Preparing Report: Michael Evans

National Oceanic and Atmospheric Administration (NOAA) Award #: NA19NWS4680006

Date: 16 December 2022

1. SUMMARY OF STUDENT RESEARCH ACTIVITIES

a) Near-freezing winter precipitation type in complex terrain

Graduate student: Megan Schiede
PI and co-PIs: Justin Minder, Nick Bassill, Robert Fovell, Andrea Lang
NWS focal point: Michael Evans (ALY)

Research summary:

A new graduate student, Megan Schiede, began working on this project, starting in Fall 2022. Her research will likely focus on challenges associated with forecasting transitions between freezing drizzle and snow, leveraging data collected as part of the NSF-funded Winter Precipitation Type Research Multi-scale Experiment (WINTRE-MIX), led by PI-Minder. Megan has done background reading on observations and simulations of supercooled clouds and precipitation. She has also begun to access and analyze airborne observations of cloud and aerosol properties collected during WINTRE-MIX. She completed coursework in atmospheric physics, atmospheric dynamics, and aerosol physics that have helped prepare her to conduct her research.

PI Minder and Co-PI Bassill, in collaboration with NWS ALY and UAlbany have also been working on an operationally focused study of the 3–4 February 2022 mixed precipitation event that affected Albany, NY. This study is documenting operational forecast challenges, NWP performance, and the potential of novel nowcasting tools. NWS ALY partners presented two talks about this event at a local forecasting workshop.

b) Severe convection in complex terrain and across severe-weather environments

Graduate student: Rachel Eldridge
PIs and co-PIs: Brian Tang and Robert Fovell
NWS focal points: Thomas Wasula (ALY) and Joe Dellicarpini (BOX)

Research summary:

Rachel Eldridge evaluated HRRR model surface temperature and dewpoint biases across eight severe events that affected the Mohawk and Hudson valleys. Rachel specifically focused on evaluating biases at select New York State Mesonet (NYSM) locations: Herkimer, Johnstown, Sprakers, Oppenheim, and Voorheesville. The events were chosen to be during the HRRR v3 operational period: 24 May 2019, 20 July 2019, 8 August 2019, 17 August 2019, 21 August 2019, 15 May 2020, 29 May 2020, and 29 August 2020. The motivation for confining the case selection to this period was to avoid comparison of biases across different HRRR model versions.

HRRR forecasts of surface temperature and dewpoint in the pre-convective environments were compared to NYSM observations at the sites listed above for each event. Figure 1 summarizes these results at Voorheesville, which had some of the larger errors. The HRRR temperature forecasts, valid one hour prior to storm passage, were on average warmer than observed (Figure 1a). Meanwhile, the HRRR dewpoint forecasts were generally lower than observed, indicating a dry bias (Figure 1b).

We also investigated whether there is any seasonality of the biases. The May events differed from the late summer events, with two out of the three cases showing a cool and moist bias. In contrast, the later summer events tended to have a warm and dry bias. The difference in the biases for the May events versus the late summer events could be related to leaf-out timing in May and/or soil moisture content. A more in-depth analysis of this seasonality difference will be conducted in the coming months.

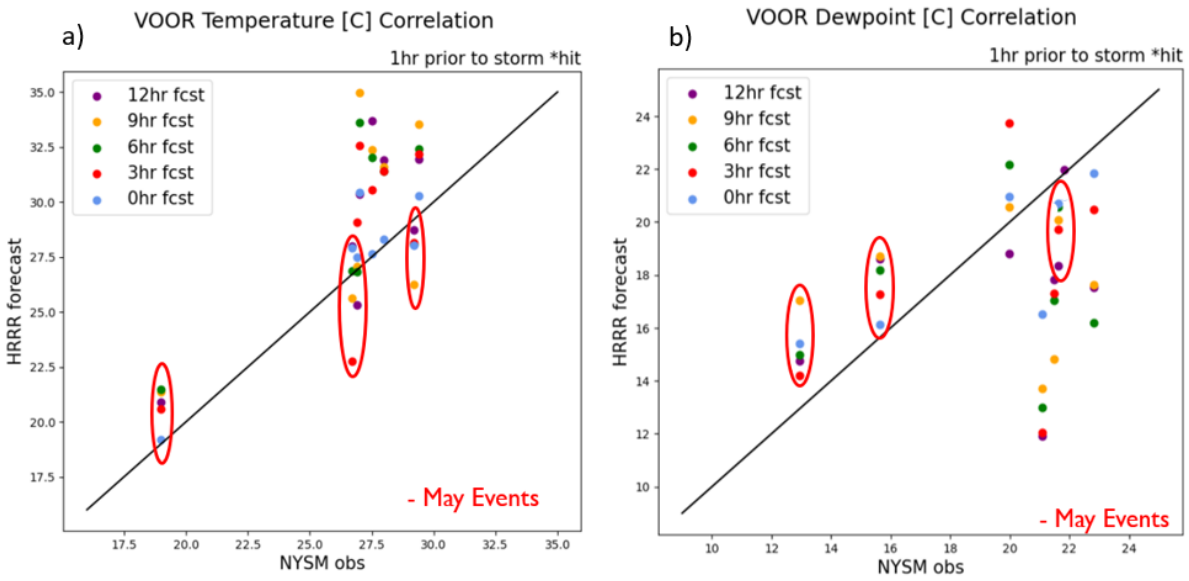

Figure 1. *HRRR forecasted (a) 2-m temperature and (b) 2-m dewpoint at various forecast lead times, versus NYSM observations. All eight events are included, valid ~1 hour prior to when storms hit Voorheesville to represent the immediate pre-convective environment.*

Rachel also investigated forecast soundings from the HRRR to analyze how biases influenced the forecasted CAPE. Figure 2 shows the HRRR f00 analysis sounding and f09 sounding for Voorheesville, valid at 2200 UTC 20 July 2019. Going from the analysis to increasing forecast hour (i.e., a d[prog]/dt), the HRRR forecasted mixed-layer depth increased, as evident by the warmer and drier boundary layer at f09 in Figure 2b. This difference resulted in much lower CAPE at f09 versus f00. This behavior also occurred with other summer cases that we examined, suggesting that the HRRR was over-mixing at low levels and at longer forecast lead times.

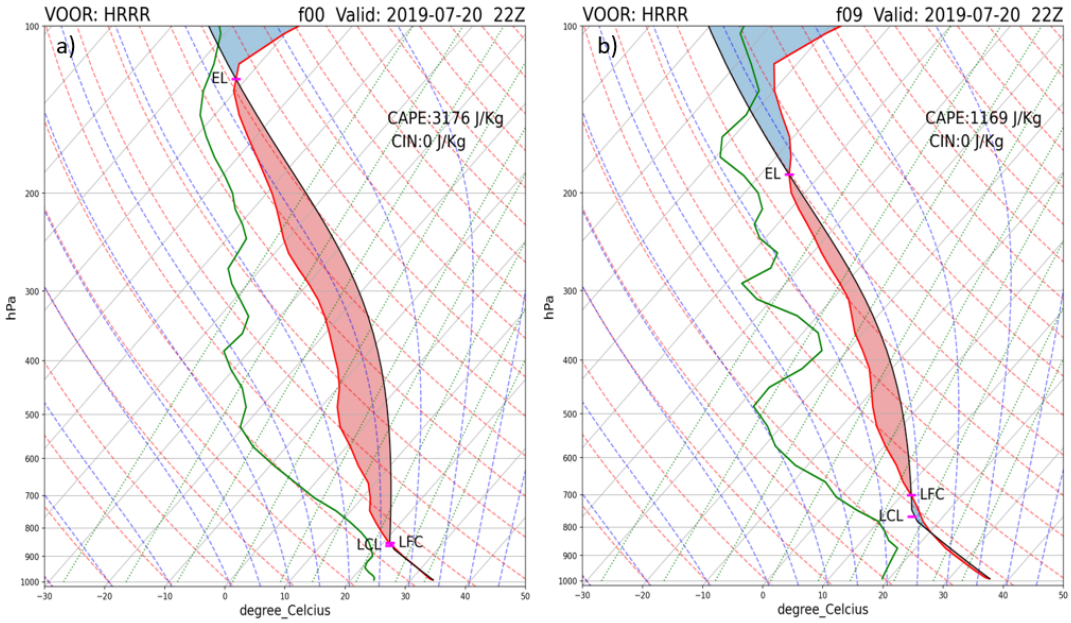

Figure 2. *HRRR (a) analysis and (b) 9-h forecast sounding at Voorheesville, both valid at 2200 UTC 20 July 2019. CAPE is given by the red area, and the value is indicated in the upper-right.*

Future work will focus on answering two main questions: 1) Why do these biases exist, and 2), how are these biases impacting the forecasts of convection? To address the first question, we will conduct an analysis of surface heat fluxes, soil moisture, land/soil type, 0–1-km shear, LCL height, and PBL height. To address the second question, we plan to examine the location and timing of forecasted convection (reflectivity) in comparison to the observed reflectivity.

In a separate project, Erik Creighton, an undergraduate student being mentored by Brian Tang and Ross Lazear, began analyzing the 15 May 2018 severe weather event. This high-impact event produced large hail, severe wind, and several tornadoes in the Northeast, particularly around and in the mid-Hudson Valley. One of the main foci of this project is to investigate why operational convection-allowing models largely missed forecasting the supercells ahead of a squall line. One possible reason is that the models did not accurately simulate an area of morning convection. NYSM observations showed that this morning convection formed a cold pool and baroclinic zone. Supercells formed along this baroclinic zone before growing upscale and merging with a squall line.

NWS interactions:

Rachel presented her research findings at the 30th Conference on Severe Local Storms and the 23rd Northeast Regional Operational Workshop. NWS forecasters were able to hear about the research and ask questions about the work and its operational relevance. Likewise, Erik Creighton presented a poster at the 23rd Northeast Regional Operational Workshop, and was also able to discuss his preliminary findings with NWS forecasters.

On 7 July 2022, Rachel, Brian Tang, and Robert Fovell had a meeting with Tom Wasula and Mike Evans at the NWS Albany office to discuss Rachel's project. The visit allowed Rachel to be introduced to more of the NWS staff and get a sense of operations. The visit also provided a valuable opportunity to gain input from NWS forecasters about possible cases and future research directions that would be operationally helpful. We agreed that a focus on convection-allowing model biases (e.g., HRRR and other members of the HREF) would be useful for forecasters to be aware of when forecasting local severe weather. The discussion also focused on the challenges of forecasting and simulating convective initiation.

c) Data fusion applications to assess forecast uncertainty and improve analyses

Graduate student: Brian Filipiak
PI and co-PIs: Kristen Corbosiero, Nick Bassill, Andrea Lang, and Ross Lazear
NWS focal points: Christina Speciale (ALY) and Neil Stuart (ALY)

Research summary:

During this reporting period, Brian made important strides understanding how the random forest (RF) algorithm operated during the past two winter seasons. He used this information to develop new products for forecasting precipitation type and to aid in the precipitation type forecasting process. The first major step completed was verifying the NYSM and upper-air, NYSM and upper-air reduced, and NAMNEST products. All three sets of forecast guidance were verified from 1 November to 31 March 31 for the 2020–2021 and 2021–2022 winter seasons. The forecast guidance was compared to ASOS and mPING reports at or around the valid forecast time. The ASOS and mPING reports were matched to the nearest RF forecast location to compare the forecast both deterministically and probabilistically.

Starting with the deterministic verification, Figure 3 displays the confusion matrix for the entire two-winter period for each of the three forecasting datasets. The NYSM and upper-air dataset over forecasted sleet across all categories (Fig. 3a). There were 20,256 sleet predictions over the two-winter period compared to 970 rain, 328 freezing rain, and 8,864 snow predictions. The NYSM and upper-air reduced dataset provided a much-improved forecast compared to the original NYSM and upper-air dataset (Fig. 3b). The darker red colors along the top left to bottom right diagonal indicate more accurate forecasts. The NAMNEST confusion matrix (Fig. 3c) also showed success at predicting precipitation type. It captured mixed precipitation (freezing rain or sleet) better than either NYSM or upper-air products. Although, it had a slight over prediction of freezing rain, it at least identified sleet and freezing rain observations more than 75% as some form of mixed precipitation.

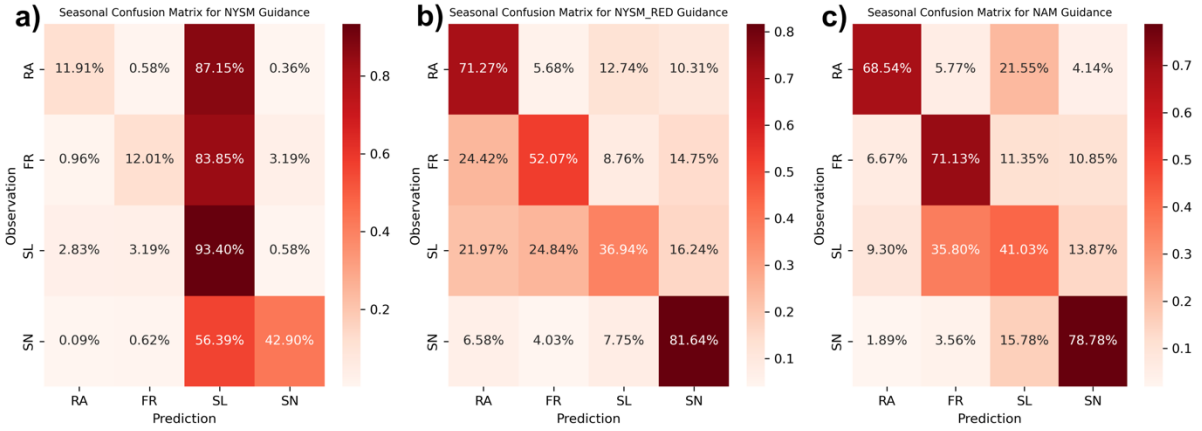

Figure 3. *Confusion matrices for NYSM and upper-air (a), NYSM and upper-air reduced (b), and NAMNEST (c). The numbers show the percentage of observations that occur in each of the boxes for the two-winter evaluation period. Darker red boxes indicate a higher percentage of observations in that box.*

Evaluating the RF in a probabilistic manner allows for understanding of what the probabilities displayed truly represent, which is important because it allows forecasters to understand what probability values are significant and how often they verify. Figure 4 shows this for the NAMNEST product. Fig. 4 not only indicates how many predictions were made and verified for each precipitation type, but for the probability bin distribution, what percent of cases in that bin verified correctly. For example, 70–75% is the highest probability bin for freezing rain, but that bin verifies 89% of the time. This result indicates that that probabilities in this bin verify more often than the probabilities would imply, so this can be used to tune the RF output. The probability bin distributions also allow for a quick check to make sure the RF is outputting a normal range of probabilities.

In addition to verifying the three sets of forecast guidance, a web archive was developed to host previous year forecasts and the verification plots associated with them. This archive is available through the main web page and is open access. It will be updated with this winter's forecast in quasi-real time.

Two new products will be available on the operational webpage. The first is a HRRR-based dataset for the RF to process and make precipitation type forecasts. This dataset was developed because during the previous two winter seasons, it became apparent that a denser spatial distribution of vertical model profiles would allow for more accurate and representative profiles.

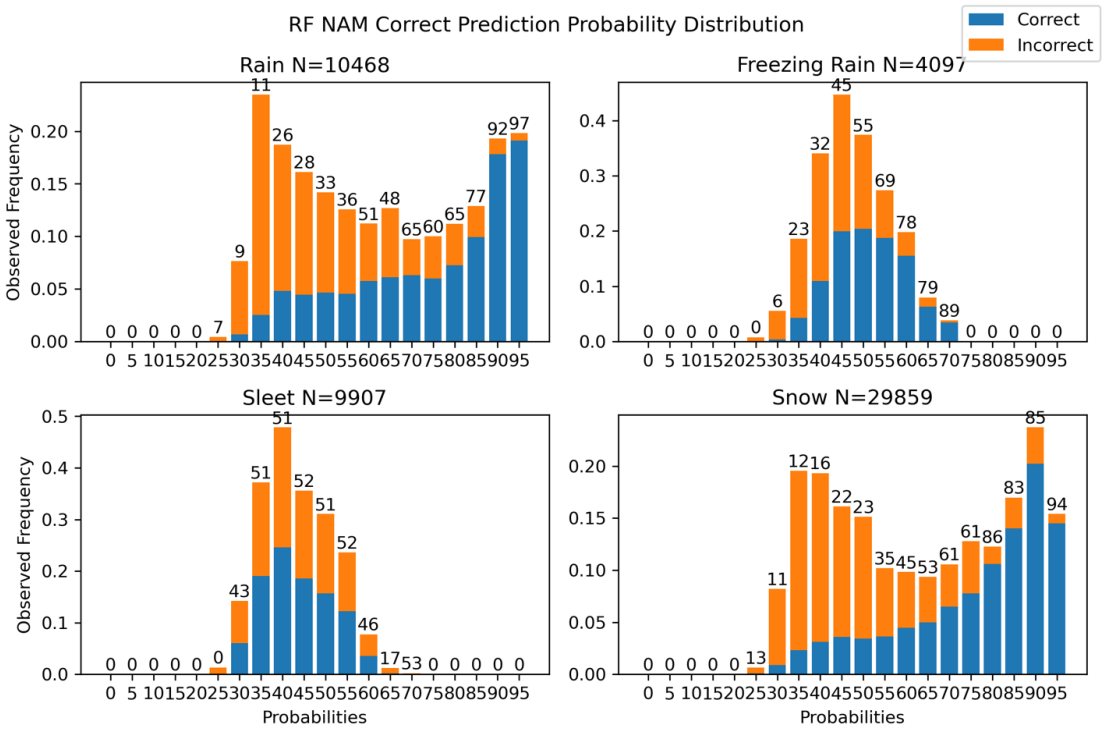

Figure 4. *Observed frequencies for the probability distribution of correct and incorrect predictions of NAMNEST product. N is number of predictions for each type of precipitation in the two-winter period. The number on the top of the frequency bars represents the percentage of correct predictions in each bin.*

Figure 5 shows the distribution of NAMNEST and HRRR vertical profiles; it is clear the proposed HRRR sounding grid (40-km spacing, blue circles) provides more representative profiles especially when considering the complex terrain of New York. The HRRR dataset will be implemented through both a forecasting and a nowcasting product. The HRRR forecasting product is initialized every 3 h and generates 12 h of lead time (same as the NAMNEST product except it is initialized every 6 h) once it becomes available. For the nowcasting product, the HRRR combines NYSM surface observations with the HRRR vertical profiles to allow for combining accurate surface observations with relative accurate model profiles. This product is the first operational product combining model data with surface observations.

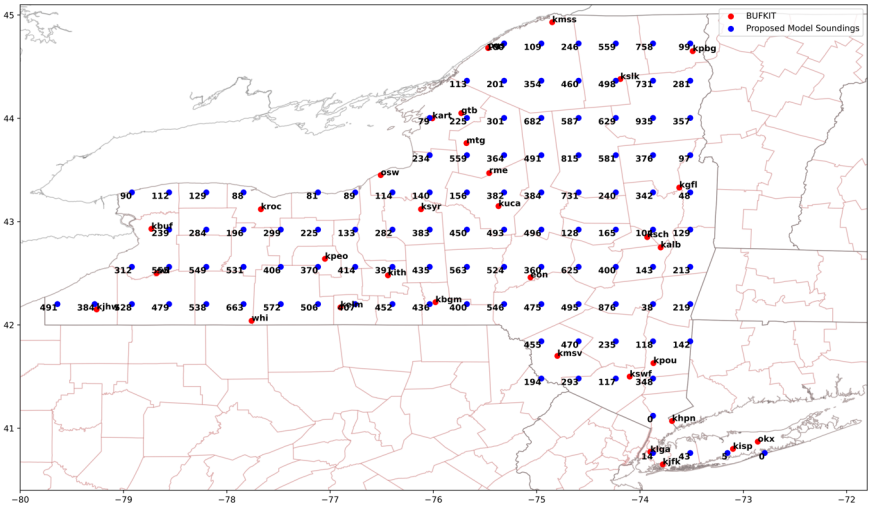

Figure 5. *Map of New York displaying locations of NAMNEST (red circle) and HRRR profile sites (blue circles). Numbers next to blue circles are elevations in meters.*

The other new operational product developed was based on conversations with NWS Albany. The product is a comparison tool between NYSM observation and model output for both temperature and dewpoint. This tool is both beneficial and important because it allows forecasters to understand how representative the model data is compared to observations, which can be helpful for forecasters to know which model to trust more. The product is made for the HRRR and NAMNEST.

Brian completed his work by writing and presenting his Master's thesis. In addition, he wrote a journal article focusing on the methodology used in his work that is working its way through the peer-review process. He also plans to write a second journal article covering the verification of the RF model and how the new products performed.

NWS Interactions:

During this period, Brian met with NWS Focal Points regularly to maintain an open line of communication regarding updates and changes to the RF algorithm. He met with his Focal Points during the summer to discuss how the RF algorithm performed over the previous two-winters. He worked with them to find clear and understandable ways to convey this information to other forecasters. In addition, he and his NWS Focal Points developed two slideshows showing forecasters what a sample RF forecast looked like for the 3–4 February 2022 event to collect feedback from them. The feedback was used to make updates and improvements to the RF forecasts. This work coincided with Brian presenting to the NWS Albany staff at their Fall Staff Meeting giving him another opportunity to work with forecasters.

Brian also worked with Ross Lazear and his NWS Focal Points to develop a VLab quick reference for his work. Since the website contains most of the findings, the quick reference was developed as a reference for forecasters who need a refresher or want a reminder about how the RF algorithm works and how to read the forecast guidance. With this, a product description document, something the WPC does for experimental products, is being developed for forecasters who want more detailed information about the algorithm. That will be located on the operational webpage.

2. CSTAR VII PROJECT THESES, PRESENTATIONS, AND PUBLICATIONS

(For a complete list of UAlbany–NWS Albany CSTAR project publications, please see *http://www.atmos.albany.edu/facstaff/kristen/CSTAR/CSTAR_CumulativePublications.pdf*.)

a) Theses completed

Filipiak, B., 2022: Probabilistic forecasting of winter mixed precipitation types in New York State utilizing a random forest. Master of Science Thesis, Dept. of Atmospheric and Environmental Sciences, University at Albany/SUNY, 101 pp.

b) Presentations

Creighton, E., R. Lazear, and B. Tang, 2022: Analysis of the 15 May 2018 severe weather event in Eastern New York. *23rd Northeast Regional Operational Workshop*, 3 November, Albany, NY.

Eldridge, R., B. Tang, and R. Fovell, 2022: Evaluating HRRR model forecasts of impactful severe weather events in Upstate New York between 2017 and 2020. *30th Conference on Severe Local Storms,* 28 October, Albuquerque, NM.

Eldridge, R., B. Tang, and R. Fovell, 2022: Evaluating HRRR model forecasts of impactful severe weather events in Upstate New York. *23rd Northeast Regional Operational Workshop*, 2 November, Albany, NY.

Filipiak, B., K. Corbosiero A. L. Lang, R. A. Lazear, and N. P. Bassill, 2022: Data fusion: A machine learning tool for forecasting winter mixed precipitation events. *Second Annual New York State Mesonet Symposium*, 13 September, Albany, NY.

Filipiak, B., K. Corbosiero A. L. Lang, R. A. Lazear, and N. P. Bassill, 2022: Data fusion: A machine learning tool for forecasting winter mixed precipitation events. *23rd Annual Northeast Regional Operational Workshop*, 3 November, Albany, NY.

Filipiak, B., K. Corbosiero A. L. Lang, R. A. Lazear, and N. P. Bassill, 2022: Data fusion: A machine learning tool for forecasting winter mixed precipitation events. *Albany Weather Forecasting Office Fall Meeting*, 8 November, Albany, NY.

Speciale, C., 2022: The heavy mixed precipitation and localized ice storm on 3–4 February 2022 in eastern New York Part II: Warnings, communication of hazards, and verification. *23rd Northeast Regional Operational Workshop*, 2 November, Albany, New York.

Wasula, T., 2022: The heavy mixed precipitation and localized ice storm on 3–4 February 2022 in eastern New York Part I: Synoptic and mesoscale overview. *23rd Northeast Regional Operational Workshop*, 2 November, Albany, New York.

c) Refereed publications

None

3. RESEARCH TO OPERATIONS

Updates to the *Albany CSTAR Virtual Lab (VLab) community page* are ongoing, with traffic to the page monitored using Google Analytics. The agenda, preprint, and presentations from the November 2022 Northeast Regional Operational Workshop (NROW) was added to the VLab page. In the past six months, web traffic to the VLab page was highest in the fall and early winter months, coincident with some of the more widely-used research results from past CSTAR projects. There were 253 visits to the page from 162 unique users, similar to that of the previous six-month period.

Ross Lazear began working with Brian Filipiak along with his NWS Focal Points Christina Speciale (ALY) and Neil Stuart (ALY) to develop an operationally-relevant quick reference for his major research results, to be hosted on the VLab community page. Because much of Brian's work has been to develop forecasting tools for operational staff during and prior to mixed-precipitation weather events in New York State, the quick reference first describes the methodology (random forest) used for probabilistic precipitation type forecast products, and then describes how a forecaster can interpret the products using a sample figure taken directly from the *website*. Brian also created a more technical product description document, linked from the website and soon to be linked from the VLab, similar to documents created by WPC for new and/or experimental forecast tools.

Finally, as has been done with previous CSTAR research, these references are linked to operations using keywords via the AWIPS Interactive Reference (AIR) tool, although views of quick references through AIR are not monitored.

4. NWS PERSPECTIVE ON CSTAR VI PROGRESS *(Michael Evans, SOO WFO ALY)*

The collaborative relationship between the NWS Albany forecast office and UAlbany's Department of Atmospheric and Environmental Sciences has remained strong, despite recent challenges associated with COVID-19. The collaboration associated with CSTAR VII continues to be one of the cornerstones of this relationship. From the NWS perspective, work on this and other projects with UAlbany remains critical for maintaining a strong culture of science-based forecasts, warnings, and decision support at the Albany forecast office. The recent move to collocate the NWS with the department in the new ETEC building will strengthen our relationship moving forward.

For Major Project #1, Mike Evans was recently contacted by a UAlbany undergraduate student who would like to work with our office on evaluating two winter storms with near-freezing conditions including the impacts of our local terrain on snowfall. These events both occurred in December 2022. This new collaboration is an example of the ongoing relationship between our office and the department that continues to promote a strong scientific culture at our office, which feeds back to our operations and products.

There remain many forecast challenges with winter weather events associated with marginal, near freezing temperatures and the impacts of terrain on these types of events. Recent events that highlight these challenges include a major mixed-precipitation and ice storm on 3–4 February 2022 and a terrain-enhanced snow event on 17 January 2022. Another example was a heavy, wet snowstorm that occurred on 9 March 2022 when enhanced vertical motion within a frontogenesis band resulted in cooling and a narrow band of wet snow across the Capital District of New York. Subtle impacts on the temperature profile caused by upslope/downslope flows, cold air funneling by terrain, variable elevations resulting in variable depths of cold-air layers, and mesoscale variations in vertical motion make these events challenging. The new student working on this project will emphasize all of these factors in their work and hopefully lead to increased situational awareness on possible outcomes with these types of cases.

For Major Project #2, results from the initial phase of this study were presented to National Weather Service forecasters at a Science Sharing Webinar on 2 June 2022. After the webinar, a conceptual diagram was developed for our VLAB webpage (*https://vlab.noaa.gov/web/albany-cstar/backbuilding-convection-in-the-hudson-valley)* highlighting what to look for prior to storms re-organizing upon reaching the Hudson Valley from the west, which happens frequently. A good example occurred this past spring when storms appeared to be weakening as they approached the Hudson Valley, then re-organized and strengthened as they reached the valley floor. The work on this project has helped forecasters anticipate the possibility that this would happen, and assisted in issuing warnings more quickly than would otherwise have occurred. The office continues to share information on these types of events with the rest of our staff in local Quality Assurance Reports, which are developed after every significant weather event in our forecast area.

Project Focal Points Tom Wasula and Mike Evans attended a 7 July meeting with Dr. Brian Tang and Dr. Robert Fovell reviewing new graduate student Rachel Eldridge's work. Rachel is examining the role terrain channeling can have on the local environment in the Mohawk and Hudson River valleys by evaluating forecasts from the HRRR model using observations from the New York State Mesonet. Among her most important findings has been identification of a warm, dry bias in the model, indicating "over-mixing" in the boundary layer prior to the onset of convection. Going forward, the office would like to see Rachel identify cases when overmixing is most likely to occur and to compare those cases to events when this is less likely to occur.

Finally, for Major Project #3, Brian Filipiak presented his work at the Northeast Regional Operational Workshop on 2 November 022. In addition, Brian gave an overview of his project at

our pre-winter staff meeting on 8 November 2022. Brian's Master's thesis is complete and the project is nearing completion. Neil Stuart and Christina Speciale will continue to be Focal Points at our office encouraging the implementation of Brian's work into operations.

This project ultimately evolved into the development of a machine learning application to help our office predict high-impact winter weather events. Machine learning techniques are becoming increasingly utilized in operational meteorology, and the development and use of this tool has been an excellent learning experience for our staff. We expect that this tool will be expanded to include forecasts of warm season convective weather, heavy rainfall, and perhaps other types of high-impact weather. Our office continues to focus on short-range prediction of high-impact weather events, which means that this application will continue to be highly-relevant to the most important aspects of our operations.

5. COLLABORATIVE AND ASSOCIATE PROJECTS *(Michael Evans and focal points)*

The eight collaborative projects associated with CSTAR VII are listed below, along with updates on progress from December 2021 through May 2022.

1. Improvement of tornado detection and lead time

Team leads: Joe Dellicarpini (BOX) and Christina Speciale (ALY)

Over the past six months the BOX database has been updated with events from 2018–2021 and graphs of various environmental and radar parameters were created. Results were presented NROW and at one of the BOX Public Webinars. We Coordinated with Dave Radell (OKX) to start incorporating their events into the project. Our plan is to continue this project in the coming year.

2. Warm season QPF challenges: identifying when model precipitation, areal coverage, location and maximum amounts will be skillful

Team lead: Justin Arnot (GYX)

Over the past six months, the team has been working on wrapping up the project. A presentation was created summarizing the results of the project for an April Eastern Region Science sharing webinar (given by Rodney Chai and Justin Arnott). Similar results were given at the spring station meeting at WFO Gray (*https://www.youtube.com/watch?v=dDFKBkDiD3g*).

The team did not meet the April goal of also developing an Eastern Region Technical Attachment but a sub-team was put together to work towards this task.

3. Recent dual-polarization radar techniques to support severe weather operations

Team lead: Mike Jurewicz (CTP)

No new activities reported.

4. Using GLM lightning data in operations for severe weather forecasting and enhanced DSS

Team leads: Jared Klein (LIX) and Mike Jurewicz (CTP)

No new activities reported.

5. Using GAZPACHO to verify high-resolution model snowfall forecasts from 2017–2019

Team leads: Joe Villani and Mike Evans (ALY)

A new upgrade to the GAZPACHO program has been developed which allows users to evaluate the 5th, 10th, through 95th percentile snowfalls from the National Blend of Models (NBM) with gridded observations. In addition, the program can be used to determine the best percentile forecast from the NBM for each grid point in the domain. WFO Albany uses this new version of GAZPACHO to evaluate our forecasts and model performance after every snowstorm.

Joe Villani and Mike Evans have recruited a student during the Fall 2022 semester to work on a spin-off project to use GAZPACHO's capabilities to verify forecast and model performance of snowstorms based on storm track. Our hypothesis is Miller A and Miller B storms may have differing characteristic biases that can be identified. Work on this project will continue through the Spring 2022 semester.

6. Examination of significant hail events: expand the project across the Northeast U.S.

Team lead: Tom Wasula (ALY)

The severe hail database has been updated through August 2022. The database has been updated through February 2022 for New York and New England. The database is now being stratified by various environmental parameters, such as CAPE, shear, equilibrium level, etc..

Tom Wasula virtually attended the 24–28 October 2022 AMS conference on Severe Local Storms and presented "The multi-hazard severe weather event of 21 August 2019 across eastern New York and western New England". An extended abstract on this study has been completed and should be loaded to the conference website before the end of December. Tom has begun preparations for a presentation on his hail study at the Northeast Storms Conference, which would be presented in March 2023.

7. The role of the strength of large-scale low-level forcing on severe weather event magnitudes

Team leads: Neil Stuart (ALY) and Joe Cebulko (National Water Center)

This project has been completed.

8. Use of collapsing specific differential phase columns to predict significant severe thunderstorm wind damage across the Northeast United States

Team lead: Joe Cebulko (National Water Center)

Joe Cebulko has taken a position with the NWS Water Center and, as a result, this project will not be completed.

6. CSTAR PROJECT RESEARCH IN NWS AFDs

Tuesday 15 November 2022

CSTAR research on mesoscale snowbands was cited in the short-term section of the NWS ALY AFD.

FXUS61 KALY 152059
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
359 PM EST Tue Nov 15 2022

.NEAR TERM /UNTIL 6 AM WEDNESDAY MORNING/...
As the system tracks northeastwards towards our region tonight, this aforementioned area of low pressure tracks northeastwards over Lake Erie and tracks towards Lake Ontario by 12z Wednesday. At the same time, a secondary surface low will develop off the Mid Atlantic Coast and track northeastwards towards the eastern tip of Long Island by 12z. These dual-lows will bring widespread precip to the area, with most places seeing their first wintry precip of the season. Precipitation is being forced by warm advection, isentropic lift, and a band of frontogenesis. **CSTAR research suggests that these forcing mechanisms will result in a laterally translating snow band that should lift northwards across our area overnight tonight.**

NEAR TERM...Main/

Wednesday 16 November 2022

CSTAR research on inland extent of lake-effect snowbands was cited in the near-term section of the NWS ALY AFD.

FXUS61 KALY 162030
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
330 PM EST Wed Nov 16 2022

.NEAR TERM /THROUGH THURSDAY/...
Tonight, a midlevel trough axis oriented from MI to the Lower Ohio Valley will translate eastward. Meanwhile, 850 mb temps will continue to cool to around -8C in low-level westerly flow. Fairly unidirectional westerly flow will evolve across Lake Ontario, resulting in a good moisture fetch across the lake. The lake temps are very warm, around 10C, so there will be sufficient instability for a good lake response. Forecast soundings for RME suggest inversion heights deepening to near 4 km by 12Z Thursday, and a multi-lake connection should be established. **All of this favors large inland extend late tonight into Thursday morning (per CSTAR research), with snow showers becoming possible across the southern Adirondacks, Mohawk Valley, and perhaps some lighter showers into the Hudson Valley north of Albany.** Upslope snow showers will likely occur in the southern Greens as well. This will also favor moderate to heavy snow in portions of the western Adirondacks. One mitigating factor to heavier snowfall in the lake effect belt is the low-level temps are not super cold, so snow ratios should not be extreme. Typical uncertainty as

to where the most persistent band will set up, but consensus favors areas north of the Thruway near Routes 8/365. Snowfall rates in excess of an inch per hour are expected here late tonight into Thursday morning. Elsewhere, partly to mostly cloudy skies with a stray rain or snow shower possible. Went a bit above NBM guidance for lows given clouds and winds.

NEAR TERM...Thompson

Thursday 17 November 2022

CSTAR research on inland extent of lake-effect snowbands was cited in the near-term section of the NWS ALY AFD.

FXUS61 KALY 170919
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
419 AM EST Thu Nov 17 2022

.NEAR TERM /UNTIL 6 PM THIS EVENING/...
3-km NAM BUFKIT soundings at KRME and KUCA indicate the inversion heights rising to about 12-15 kft AGL with a moderate to extreme class of lake-induced instability. The lake temp is about 10-11C with H850 temps -8C to -9C and H700 temps around 20C. Abundant low-level moisture is in place and it looks like the band becomes more better aligned later this morning. We tried to follow the 3-km NAM and RGEM for the evolution and movement. It should be a multiple lake fetch based on the guidance and trajectory. The 3-km NAM shows the band extending down the Mohawk Valley in the Capital Region in the afternoon. **Good inland extent is possible supportive by local CSTAR research for the band.** The best accumulating snowfall today into tonight will be in the west-central Mohawk Valley and southwest Adirondacks. Additional snowfall amounts of 2 to 6 inches will be possible with isolated 8 inch amounts over the next 24 hours. This will be a continued long duration event. We went close to WPC`s snow to liquid ratios in the 10-14:1 range. A little lower than usual for lake effect, but for this time of year this seems to fit better. We emphasized the majority of the snowfall will likely fall just north of I-90 towards Route 8 still. It is possible I-90 is impacted intermittently this morning into the\ afternoon, as the band oscillated with weak impulses impacting it. The 00Z HREFS yield low chance probabilities of 1"/hr snowfall rates near the western Mohawk Valley/southwest Adirondacks this morning into the pm. Winter Wx Advisory continues today through tonight for Herkimer County.

NEAR TERM...Wasula

Saturday 20 November 2022

CSTAR research on inland extent of lake-effect snowbands was cited in the short-term section of the NWS ALY AFD.

FXUS61 KALY 190856
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
356 AM EST Sat Nov 19 2022

.SHORT TERM /6 PM THIS EVENING THROUGH MONDAY NIGHT/...
Potentially active weather day Sunday, as potent upper level trough pivots through the region during the morning. Strong low/mid level winds in the wake of this trough passage will align from the west-northwest, allowing for a lake effect snowband to develop and extend far east/southeast from the Lake Ontario shoreline into portions of the SW Adirondacks and western Mohawk Valley. **The strong, nearly unidirectional winds (H850-700 winds 45-55 KT) and low level instability due to the passage of low/mid level cold pool (H850 temps of -12 to -15C, H700 temps of -22 to -26C) favor unusually far inland extent of the snowband, with local CSTAR inland extent program suggesting band could extend as far as 190-200 miles from the lake shore, reaching into southern VT and western MA Sunday afternoon/early evening.**

SHORT TERM...KL