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

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1. SUMMARY OF STUDENT RESEARCH ACTIVITIES

a) Near-freezing winter precipitation type in complex terrain

Graduate student: Matthew Seymour
PI and co-PIs: Justin Minder, Nick Bassill, Robert Fovell, Andrea Lang
NWS focal points: Michael Evans (ALY) and Frank Nocera (BOX)

Research summary:

During the reporting period, Matt Seymour continued progress towards his M.S. degree. In Spring 2021, he took a full load of research credits and continued his TA duties for the department. He continued to perform WRF simulations and analyze the output, comparing to radar, sounding, and New York State Mesonet (NYSM) datasets.

He continued analyzing the 6–7 February 2020 winter precipitation event while also studying the 23 March 2020 winter event. Both events focused on the Mohawk and Hudson Valley regions of eastern NY. The former involved a snow-to-ice transition, then a difficult rain vs. freezing rain (FZRA) precipitation type (p-type) forecast, followed by a change to snow before the event ended. The latter included rain vs. snow uncertainty with surface temperatures around to just above freezing, with the event ultimately producing snow over much of the area of interest.

He wrapped up studies of the planetary boundary layer (PBL) and microphysics (MP) ensemble suites for both cases, and ran WRF simulations forced with initial and boundary conditions from GEFS ensemble members. Output of this GEFS suite was analyzed, focusing on both individual members and a composite analysis. This set of experiments involved diagnosing the synoptic uncertainty within both cases and how it affects the differences in mesoscale features and surface precipitation type.

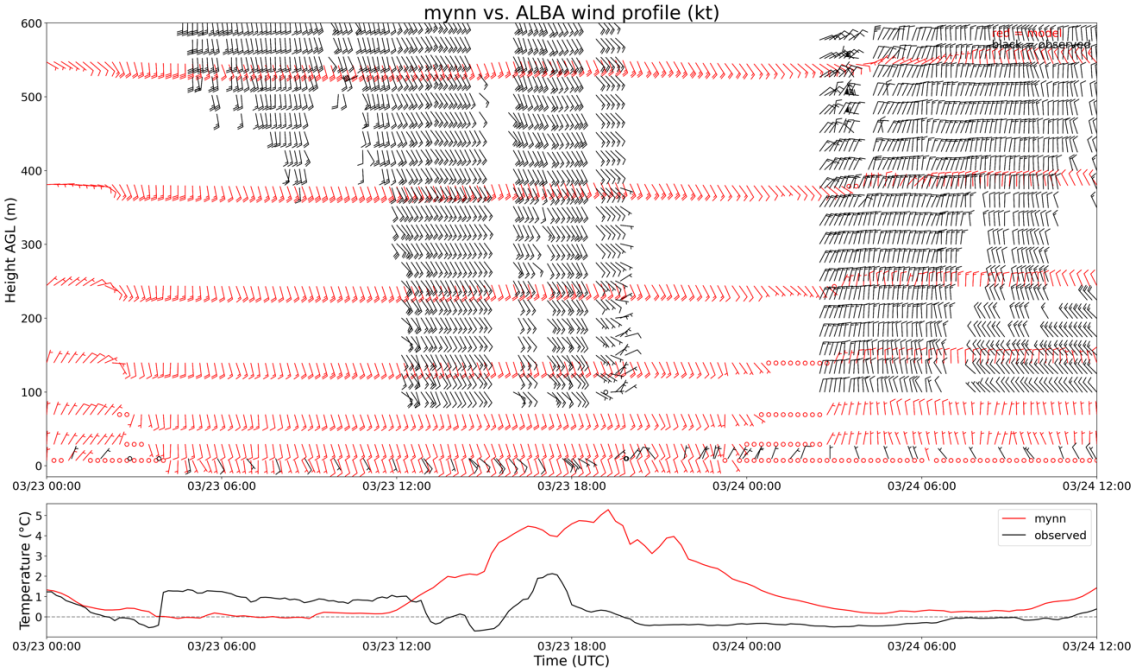

Figure 1: *Boundary layer winds and surface temperatures at Albany for March 2020 event. Top panel shows horizontal winds from the WRF control simulation (MYNN, red) vs. winds observed by a NYSM LiDAR (black). Bottom panel shows simulated and observed temperature time series. Note: Lidar wind observations are limited from around 2000 UTC 23 March to 0300 UTC 24 March by attenuation due to precipitation.*

For the March 2020 case, initial results indicate that excessive simulated incoming surface solar radiation, due to thinner-than-observed cloud cover (not shown), led to a warm bias early in the event, especially between 14 and 18 UTC 23 March. This warm bias was maintained, in part, due to biases in low-level winds. As shown in Figure 1, which compares the simulation with NYSM lidar wind profiles and surface temperature measurements at Albany, observed low-level winds shift from S-SE to N-NE around 1900 UTC 23 March, but simulated southerly winds persist for several more hours, leading to excessive warm air advection and persistence of the warm bias.

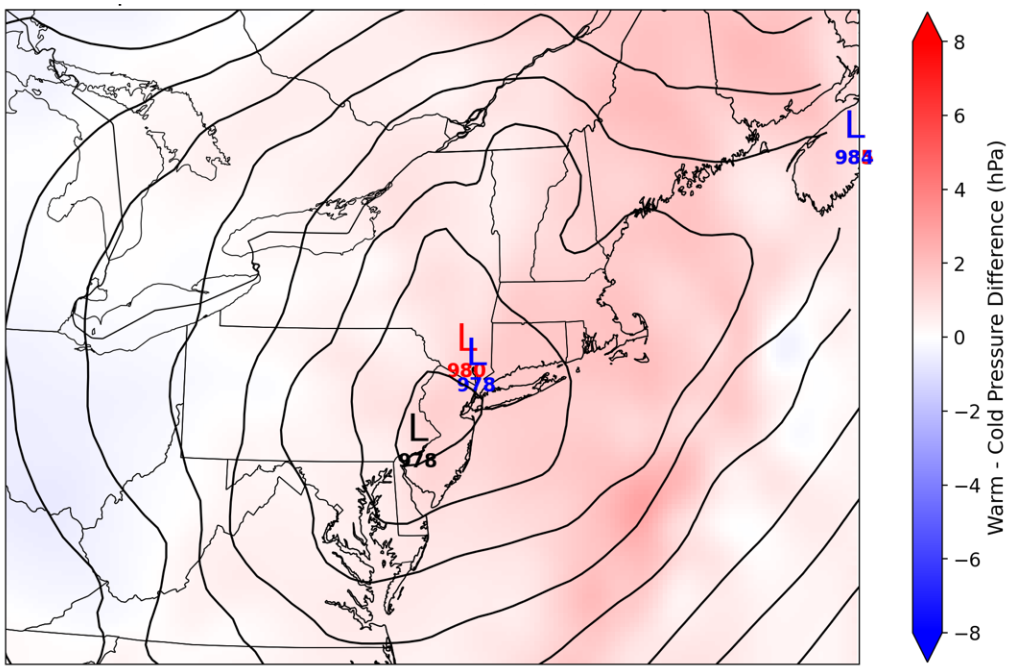

Figure 2: *Sea-level pressure (hPa) differences between the top three warmest and coldest GEFS ensemble members (color fill) at 15 UTC 7 Feb 2020. Albany, NY 2-m temperature was used to diagnose the warm and cold members. Red L indicates surface low center of the warm members, while the blue L is the same for cold members. Black contours and L indicate the surface low center and sea-level pressure contours of the ERA5 reanalysis.*

For the February 2020 case, the GEFS ensemble suite is allowing for diagnosis of synoptic-scale uncertainties and how they affect the mesoscale features found in the Albany area. Figure 2 provides one example of this: in the February case, the surface low pressure tracked further south and west than modeled, leading to a slightly colder and slower solution with more FZRA in the Upper Hudson Valley than was simulated. When grouping warm and cold ensemble members together, we find systematic differences in the structure and evolution of the synoptic flow, as evidenced by the warm minus cold SLP differences that show a slightly weaker and less expansive cyclone for the warm members.

Over the next two months, Matt will be completing his M.S. degree. He will present a seminar on his research to the department on 15 July 2021. He will complete his thesis by 1 August 2021 for August degree conferral. During August, we will begin to write a paper on our studies to be submitted for publication. Results of the February case GEFS ensemble suite will be presented at the NWA Annual Meeting from 21–25 August 2021.

NWS Interactions:

Matt has been in email contact with his focal points throughout the reporting period about his results are future directions for the work

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

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

Research summary:

Graduate student Brennan Stutsrim, co-PI Brian Tang, and co-PI Robert Fovell continued work on this portion of the CSTAR project, focusing on identifying environmental characteristics that are conducive to back-building convection. The goal of this analysis is to provide forecasters with information, both on the synoptic scale and mesoscale, to increase situational awareness when there is a higher likelihood of back-building convection, and the attendant threat of heavy rainfall, within the Hudson Valley of eastern New York.

Brennan identified 70 cases of convection in upstate New York during June, July, and August of 2015–2020. The cases were further classified into cases with and without back-building convection in the Hudson Valley through analysis of composite radar animations. A case was considered to have back-building behavior if new convective cells were initiated adjacent to mature cells, creating a continuous radar-echo signature that was quasi-stationary or propagating slowly to the south. Of the 70 total cases, 15 of them were classified as back-building cases.

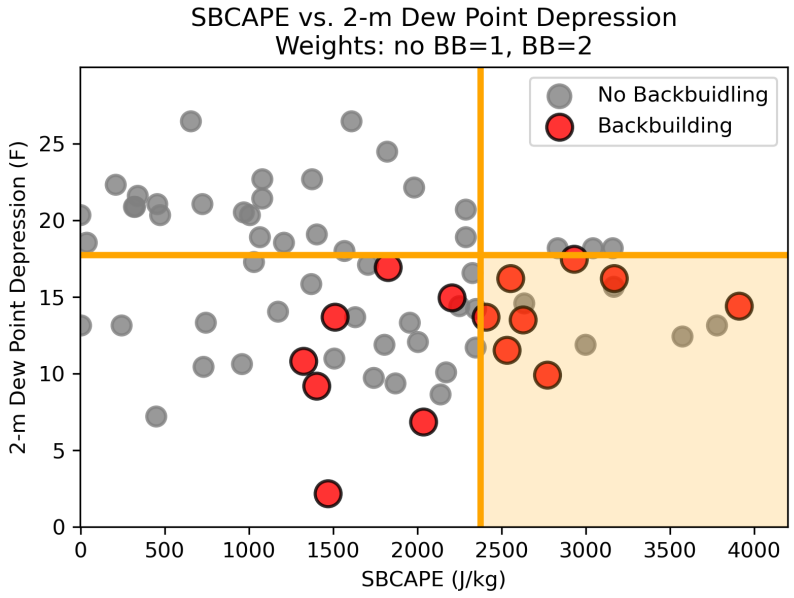

Figure 3: *Parameter space of back-building (red) and non-back-building (gray) cases. Parameters are the Hudson Valley area-averaged, surface-based CAPE and 2-m dewpoint depression from HRRR 18 UTC analyses. Orange lines indicate the "best splits" from the decision tree, with the orange area indicating the combination of parameters that yields the best identification of back-building versus non-back-building cases.*

High Resolution Rapid Refresh (HRRR) 1800 UTC analyses of each case were used to calculate area-averaged values of select thermodynamic and dynamic quantities within the Hudson Valley. Brennan then used the Python Scikit-Learn machine learning library to create decision trees to analyze pre-convective, environmental differences between cases with and without back-building convection. It was found that low-level thermodynamic variables (e.g., 2-m dewpoint depression) and instability measures (e.g., surface-based CAPE) had the most skill in

differentiating cases (Figure 3). Further investigation of back-building cases revealed that weaker westerly winds in the middle troposphere (400–700 hPa) were also an important environmental characteristic, which allowed for a longer residence time of convection in the Hudson Valley and continuous initiation of new convection along the trailing cold pool.

Synoptic composites of back-building cases, using HRRR analyses, were also analyzed. Back-building cases tended to have an extratropical cyclone over Quebec, Canada with a cold front extending to the southwest over the Great Lakes region, leaving upstate New York in the warm sector (Figure 4). There also tended to be southerly winds in upstate New York, which contributed to low-level moisture flux up the Hudson Valley. The enhanced low-level moisture resulted in a local maximum in surface-based CAPE within the Hudson Valley.

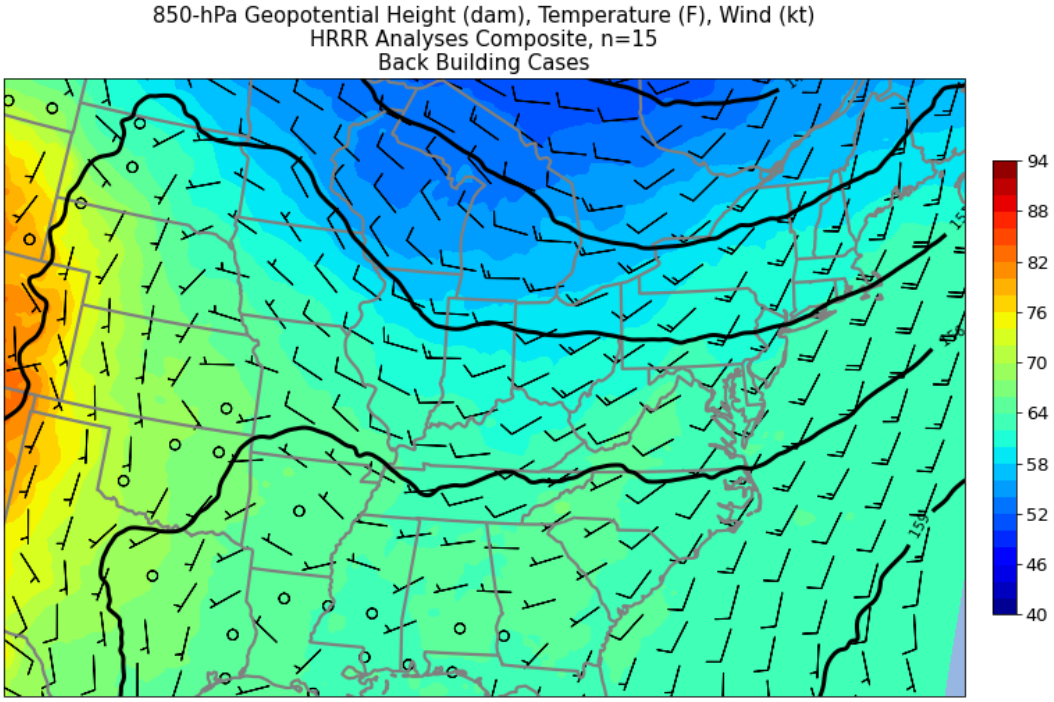

Figure 4: *Back-building case composite of 850-hPa temperature (shaded), geopotential height (contours), and wind (barbs) from 1800 UTC HRRR analyses.*

In addition to the pre-convective environment, the convective evolution is also an important factor to consider, especially on short (Warn-on-Forecast) timescales. Brennan analyzed the composite radar imagery of non-back-building cases to assess if there were convective evolutions that precluded back-building from occurring (i.e., "failure modes"), even if the environment in the Hudson Valley was conducive for back-building convection. These failure modes for back-building include: 1) convection initiating too far upstream and never reaching the Hudson Valley, 2) convection being too organized and intense before reaching the Hudson Valley (i.e., being a more progressive squall line), and 3) the general motion of convective cells being anything other than eastward.

Brennan is in the final stages of this research project. He plans to finish writing his M.S. thesis and present his research in July. Activities thereafter will be to transfer operationally relevant portions of this research to the NOAA VLab.

We were able to successfully recruit our next CSTAR student, Rachel Eldridge, who received her bachelor's degree from Texas A & M University. Rachel will be continuing the theme of investigating convection in complex terrain.

Luke LeBel (a former undergraduate student who is now a graduate student at Pennsylvania State University), co-PI Brian Tang, and Ross Lazear submitted a publication to *Weather and Forecasting*. The publication details previous CSTAR research examining terrain effects on the Mechanicville, NY tornado event that occurred on 31 May 1998. Using a high-resolution (1-km horizontal resolution) WRF simulation, it was found that terrain-channeled flow up the Hudson Valley contributed to the formation of a dryline-like boundary at the intersection of the Mohawk and Hudson valleys. The environment east of the boundary was characterized by large low-level shear and instability. As a simulated supercell crossed the boundary, the greater buoyancy and streamwise vorticity of the low-level inflow resulted in a substantial increase in updraft strength and low- and mid-level mesocyclone vorticity, favoring tornadogenesis. Similar terrain-induced boundaries may play an important role in modulating severe convection in the area more generally. Forecasters should be aware of these boundaries to help anticipate where the risk of severe weather may be locally higher. Reviews of the manuscript were generally positive. A revised manuscript was resubmitted in late May. We expect this manuscript to be published later this year.

NWS Interactions:

Brennan met with NWS focal points, Tom Wasula and Joe Dellicarpini, in January of 2021. Synoptic composites from days with back-building convection were discussed, largely focusing on the spatial patterns of moisture content in the lower troposphere. It was suggested that Brennan investigate mid-tropospheric lapse rates and moisture variables in his continued research.

Brennan presented his research progress in April 2021 to NWS SOOs and forecasters from WFOs ALY, BOX and BTV at the Spring Station Meeting. Brennan's presentation showed his initial results on pre-convective, environmental parameters that may be important for back-building convection in the Hudson Valley. The presentation was followed by a short discussion on the role of vertical wind shear and typical wind profiles during back-building cases.

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 the reporting period, Brian Filipiak continued his work in building a case list to examine the CoCoRaHS reports he collected in the last period. He spent time processing these reports to check their accuracy and manipulated them to be more valuable to use in the matching phase of his work. Each of the over 2,200 daily precipitation reports were checked to ensure they met the criteria of each category (sleet, freezing rain, mixed precipitation, wintry mix). During this process, an event date and time were added to the daily reports as the date and time given represented the ending time of the reporting period and not the precipitation event time. These added components were based on observations in the notes section of the report as well as nearby New York State Mesonet (NYSM) and radar/satellite data. In order to improve the ability to match the reports with data, the nearest NYSM station was calculated based on latitude and longitude. Based on this information and the report, the event date and time was classified on a scale of 1–4

with 1 being the best, most accurate report. This rating allows for the relative variability in reports to be accounted for because what is included in the report depends on the individual reporting it.

After processing the data, the reports were matched with the 5-min and hourly observations from their nearest NYSM site. An issue arose with missing Mesonet data. To account for this, certain variables were replaced by other similar variables in order to keep the reports included in the random forest algorithm. One example was for missing 2-m temperatures; they were replaced by using the 9-m temperature at the same reporting period. Replacement was also done for missing sonic anemometer wind speeds; they were replaced by using the propeller wind speed at the same time.

Once the reports and data were processed, the random forest was run in three different configurations: hourly Mesonet data, hourly-averaged mesonet data, and all Mesonet data (5-min and hourly). To test the random forest, the data was split randomly into 75% training and 25% testing data. The random forest was then run with differing amounts of estimators (decision trees) to assess if it had a significant impact. More extensive work needs to be done here, but currently, the plan is to use 200 or more trees. In combination with the estimators, the random forest was run over multiple intervals to account for the randomness in the accuracy scores. After running the random forest with predictions being made for sleet, mixed precipitation, freezing rain, and wintry mix, it became clear that the random forest was not able to predict mixed precipitation and wintry mix cases very well; the overall accuracy scores, for the four categories, of these runs returned values near 40–42%, while the individual accuracy scores for mixed precipitation and wintry mix were close to 0%. Figure 5 is a sample confusion matrix that shows what the algorithm is predicting compared to the actual results. Labels 1 and 3 are for mixed precipitation and wintry mix; this was a very common result across all the runs. Both mixed precipitation and wintry mix are very general terms. Because these terms are often used incorrectly by CoCoRaHS reporters, they confuse the random forest. To alleviate this concern, we removed the mixed precipitation and wintry mix cases from the datasets and reran the algorithm, which resulted in increased overall accuracy scores, for sleet and freezing rain, between 51–52%.

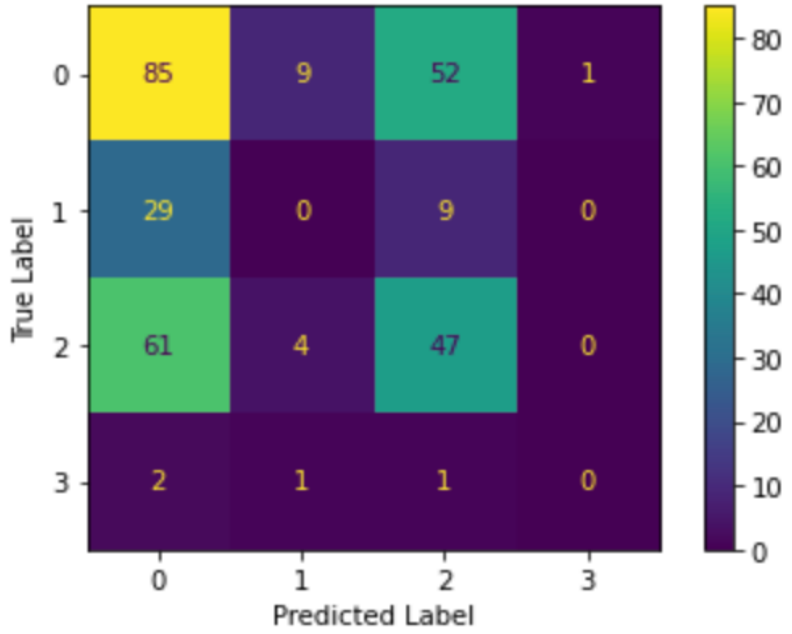

Figure 5: *A confusion matrix generated by the random forest with 50 estimators (decision trees). The numeric values of 0, 1, 2, and 3 on the axes represent the type of precipitation, where 0 = sleet, 1 = mixed precipitation, 2 = freezing rain, and 3= wintry mix) being predicted or occurred. The diagonal of this matrix represents the correct predictions.*

Over the next six months, the focus will be on advancing the prediction abilities of the random forest. One key step in this process is to incorporate vertical profile data. This is a very important step because most mixed precipitation events are determined from the vertical profile. In addition to that, there must be non-mixed precipitation reports added in. By adding in rainy, snowy, and clear days into the algorithm's dataset, the random forest will learn what is and is not mixed precipitation. This will allow for more accurate predictions across all weather types and will be increasingly important in the end stages of the project when turning the algorithm into an operational product.

NWS Interactions:

In March, Brian and his NWS focal points, Christina Speciale and Neil Stuart, discussed possible key datasets and variables to include in the random forest algorithm. This meeting helped to plan what data needed to be collected and processed. In May, Brian and his NWS focal points met again to discuss some of the initial results of the random forest algorithm based on comments from the March discussion. These constructive conversations led to more concrete ideas of what the random forest should include, and it helped to determine what may be most useful when the algorithm becomes an operational tool.

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

None

b) Presentations

Filipiak, B., 2021: Data fusion: A machine learning tool for mixed precipitation. *New York State Mesonet Forum*, 7 May. (Virtual)

Seymour, M., 2021: Sensitivity of forecast precipitation type to WRF physics parameterizations during the 23 March 2020 winter storm in upstate New York. *46th Northeastern Storm Conference*, 24 April. (Virtual)

Stutsrim, B., B. Tang, and R. Fovell, 2021: A mechanism for upscale growth of convection in complex terrain. *National Weather Service Interior Northeast Science Webinar*, 20 April. (Virtual)

Stutsrim, B., B. Tang, and R. Fovell, 2021: A mechanism for upscale growth of convection in the complex terrain of the Northeast U.S. *46th Northeastern Storm Conference*, 23 April. (Virtual)

c) Refereed publications

None

3. RESEARCH TO OPERATIONS

Agendas and preprints for NROW dating back to 2000 continue to be added to the VLab. In summer 2021, Ross Lazear will be meeting with CSTAR students Matthew Seymour and Brennan Stutsrim along with their NWS focal points to begin developing operationally relevant quick references of their major

research results. As has been done with previous CSTAR research, these references will be linked to operations via the AWIPS Interactive Reference (AIR) tool.

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.

Regarding Major Project #1, Matt Seymour is in the process of finishing his work and writing his thesis during the winter and spring of 2021. Matt gave a talk updating his progress at our virtual CSTAR meeting on 10 December 2020. Matt contacted our office in January to request upper-air data from our site. At this time, Matt also provided Mike Evans with an update on his work, including a case study from 23 March 2020. Matt gave a virtual presentation updating his progress with the project titled, "Uncertainty in near-freezing winter precipitation type in complex terrain", at the Northeast Storm Conference in April 2021. The presentation highlighted the performance of several different configurations of a high-resolution WRF model for complex, mixed precipitation events that have recently affected the Albany County warning area. Mike Evans attended this conference virtually and was able to communicate with Matt on his findings. Finally, Mike and Matt have arranged for Mike to attend Matt's thesis defense in July.

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. We have discussed some of these challenges with Matt. Matt's project focused on identifying and quantifying model biases associated with various configurations of the WRF. His results highlight many of the challenges faced by operational forecasters during these events. For the case study from 23 March 2020, Matt highlighted the importance of accurate forecasts of precipitation rate and simulation of terrain-induced factors such as downslope wind flows. His findings imply that forecasters need to be especially concerned about model warm biases in scenarios where models may be under-forecasting precipitation rates associated with mesoscale precipitation bands. In addition, forecasters need to carefully evaluate the accuracy of model depictions of terrain-induced flow patterns, which can adversely affect forecasts of boundary layer temperatures and precipitation type. These findings will help our forecasters to more effectively evaluate model guidance to make better forecasts.

For Major Project #2, Brennan Stutsrim gave an update on his research with a talk at the Fall CSTAR meeting on 10 December 2020. Tom and Joe viewed his presentation remotely. The title of his talk was, "A mechanism for upscale growth of convection in complex terrain". He reviewed the 21 August 2019 case study and examined the role of back building. The main results of Brennan's work on the case are: 1) Discrete convection drifted into the Hudson River Valley, where it intensified and formed a cold pool; 2) southerly flow up the Hudson Valley increased low-level moisture flux upstream of the cold pool; 3) new cells initiated when higher theta-e air was lifted over the gust front; 4) new cells trained parallel to the gust front reinforcing the cold pool with evaporative cooled air; and, 5) a squall line produced localized maximum of precipitation with 1.8" (44 mm) in Saratoga County.

Brennan's current and future work is to address a few remaining questions: 1) What combinations of environmental characteristics are conducive to the convective behavior described

above?; and, 2) Are there threshold values or spatial patterns useful for operational meteorologists? Brennan is compiling area averages of surface variables in the Hudson River Valley using HRRR analyses from August 2016–2020 to identify back building cases. He is making maps of severe weather indices using the HRRR analysis. We have several cases to share from August 2020.

Tom, Joe, and Brennan had a virtual "quarterly" meeting on 29 January 2021 on the progress of his research. He is trying to develop operational tools involving a Hudson Valley phase diagram where four quadrants exist (high shear/low CAPE, high CAPE/low shear, etc.). The goal on the finite number of cases (60) is to come up with some conceptual models, decision trees, and rules of thumb. Brennan has worked on a decision tree with dew points at a certain threshold, CAPE >1500 J/kg, 0–6-km shear 15 m/s or greater, etc. We suggested looking at 500-hPa temperatures, theta-e, and theta-e lapse rates.

Brennan gave an updated presentation at the 20 April 2021 NWS Albany Station Meeting. The title of his presentation was, "A mechanism for upscale growth of convection in complex terrain". He has further developed his decision tree methodology with a Scikit-Learn Decision Tree with Weighting. The main ingredients to predict back-building convection are: 1) low-level moisture content, 2) deep instability, 3) dry air in the mid-troposphere (promotes evaporative cooling), and 4) weak westerly winds in the mid-troposphere (allows cells to remain in the Hudson River Valley). The parameters to focus on for back-building convection vs. discrete convection are: 2-m dew point depression, SBCAPE, mid-tropospheric dew points, and mid-tropospheric winds.

Tom gave presentations at NWS Albany's Spring Workshop and the Northeast Storm conference titled, "The 24 August 2020 Whitehall, NY flash flood". In the Whitehall, NY flash flood case, a Cooperative Observer had 5.85" of rainfall from training/back-building cells in 2–4 hours. This flood was a 500-y heavy rain event based on the NRCC Extreme Precipitation Analysis. The presentation was also shared with NWS Burlington for their spring training.

A major initiative for our office related to forecasts of severe convection continues to be the production of forecasts with enhanced temporal and spatial detail in short time ranges, from 0 to 6 h. The idea is to fill in the gap of forecast information available to our partners and the public during the time period between when watches are issued and when warnings are issued. Improvements in our ability to enhance these forecasts will result from an increased emphasis on mesoanalysis as well as improvements in short-range, high-resolution modeling. One NWS-supported effort to improve high-resolution modeling of severe convection is the "Warn-on-Forecast" initiative, which is being developed at the National Severe Storms Lab. Mike sees the work being done in this project as complementary to the broader NWS-supported Warn-on-Forecast initiative. Like the Warn-on-Forecast work, this project focuses on accurate, high-resolution modeling of short-term convective threats; however, this project also concentrates on the modeling of events local to our area and, in particular, on the impact of our unique topography on the evolution of these events. Results from the modeling studies in this project will help us to develop some conceptual models on how our topography impacts the evolution of convection in our area, which will help us to produce more accurate short-term forecasts. In addition, access to output from model forecasts from the UAlbany system in real-time would also help us to produce more accurate forecasts and warnings.

Finally, for Major Project #3, Christina met with our CSTAR graduate student Brian Filipiak on 25 May 2021 and discussed his project. So far, Brian has compiled a list of wintry mix events (sleet and freezing rain) from January 2017 to May 2020. His plan this summer is to create his random forest algorithm and to train it on these cases. Once it is trained, he will test it on the freezing rain, rain/snow mix, and sleet cases from the 2020–2021 winter to see how accurate it is

at predicting each precipitation type. If the model struggles, he will go through the various parameters used in each decision tree to figure out what may be going wrong.

As far as NWS input for this study, we suggested that Brian use comments from CoCoRaHS to search for key phrases such as ice, freezing rain, sleet, etc. to build his listing of wintry mix cases. Since he is not limiting himself to only large-scale events that warrant a Winter Weather Advisory or Winter Storm Warning from the NWS, we thought CoCoRaHS comments from observers could highlight some of the more minor cases. It is known that even minor wintry mix events (especially freezing rain) can lead to impacts and, therefore, should be included in this study. The CoCoRaHS reports worked well (although became rather time intensive) and helped expand Brian's case listings. Additionally, we discussed which winter parameters he should teach the random forest to investigate for each precipitation type. We suggested parameters that are accessible from the NYS Mesonet stations or the ALY/BUF/OKX soundings. These included dew point temperatures, wet-bulb temperature within the boundary layer, warm nose in the 700–500-hPa layer (i.e., not limiting to 850-hPa temperatures), cold air wedge beneath 850 hPa, 2-m temperatures, RH in the 700–500-hPa layer and boundary layer, and wind speed/direction in the boundary layer. Brian asked which models NWS forecasters analyze the most when predicting precipitation type and we shared that we rely on the 3-km NAM (emphasized this is commonly used as input to run our AWIPS smart tools), HRRR, the HREF, ECMWF, RAP, and CMC.

For the random forecast to produce a forecast, it not only requires input (NYS Mesonet, ASOS/AWOS observations, and real-time soundings), but also needs the user to select a model so the random forecast can use predicted values for future time steps as input to produce a forecast. Since current NWS smart tools give forecasters the opportunity to select more than one model and use a "blend" of models, we suggested that the random forest algorithm offer the same function. NWS forecasters also suggested that the output of the random forest algorithms should produce a probability for each precipitation type (i.e., freezing rain, sleet, rain/snow mix), so that forecasters can learn the most favored precipitation type, but also what the probabilities are for other types to create somewhat of an ensemble and ranking system. We also stressed that the output from the random forest should only require a few minutes to run for it to be useful to NWS forecasters. Additional NWS suggestions included producing an output that compared current conditions (based on the NYS Mesonet observations and real-time soundings) to high-resolution and deterministic model guidance to learn which model is performing the best to enhance forecaster confidence when selecting which model(s) to use as input for the random forecast.

Accurate predictions of high-impact weather in the short range requires that forecasters be well-versed in mesoscale analysis. A robust mesoanalysis requires that forecasters have access to a wide-ranging suite of observational data, and that forecasters understand which types of data are most important to evaluate to accurately assess high-impact weather potential. This project has the potential to help our operations by making a wide range of observational data available to our forecasters. In addition, results from this study should help our forecasters learn which types of data are most important to evaluate, and how uncertainties in certain observational data sets could potentially translate into uncertainties in resulting weather outcomes and impacts. Ultimately, direct output from an application produced by UAlbany could help forecasters to not only assess which observational variables are most important, but to compare the values of those observed variables to values in models to help determine the likelihood of various model forecast outcomes. The result of this will be improved communication with weather-sensitive partners on the range of possible impacts that they may experience.

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 2020 through May 2021.

1. Improvement of tornado detection and lead time

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

A meeting was held with participants in the project on 15 May. Plans were made for NWS Brookhaven and Albany to add their cases to the data base. A NOAA Hollings Scholar is working at NWS Albany this summer on developing tornado identification techniques and part of her project will be to work on cases and add data to the database associated with this project. The student will focus on parameters already entered by researchers at NWS Boston for their cases, as well as an examination of factors identified by the National Weather Service's tornado warning improvement project (TWIP). The impact of merging cells will also be examined and some legacy techniques will be tested. The Hollings Scholar attended the meeting in May and was brought up to speed on the scope of the project. The scholar will be working with NWS Albany until mid-August.

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 sub-team tasked with examining the performance of the HREF and NCAR high-resolution ensembles has gathered data, performed an initial verification, and has shared results with the group. Managing the amount of data was a particular challenge with the NCAR ensemble where mean/probability matched and mean/maximum QPF statistics were generated locally after receiving the data from SPC. Therefore, at this point, we have all of the data necessary (observed cases, forecast cases, and NWS headlines) to proceed to the conclusion of the project.

The team had a meeting at the beginning of June to share the initial high-resolution ensemble verification information. Verification of HREF forecasts showed the best POD/FAR statistics for identifying heavy rain using the maximum QPF forecast and 1" threshold. Verification of NCAR ensemble forecasts showed that the best MAE/bias characteristics for that high-resolution ensemble was from the mean QPF forecasts. The plan now is to begin to move to developing a write-up and presentation of the material while the sub-group in charge of verifying the forecast events adds some additional verification information to their analysis. Given the database of observed events that has been gathered, a sub-group will also examine the climatology of heavy rainfall events during the period of study as well. Finally, another sub-group will perform a case study of a single event outside of the database (likely from the 2021 warm season) to test applying the research results. The plan is to present updated results at the 2021 NROW with the goal of sharing with forecasters in the northeastern United States during the spring training season in 2022.

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

Team lead: Mike Jurewicz (CTP)

Scott Loeffler defended his PhD recently, in which the dual pol/tornado work was his main

presentation topic. Our main goals with this work right now are to: 1) develop operational tools for real-time usage, and 2) finish another manuscript for WAF. As for task #2, only small progress has been made. For task #1, we continue to work with the Tornado Warning Improvement Project (TWIP) folks in CR, as well as NSSL, and some other academic researchers to develop a real-time tool for GR2 Analyst. We have made progress, but there are still a few technological hurdles to overcome before it is ready for general consumption. I also still think the average forecaster would need more training and exposure to this work before they could use associated techniques effectively.

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

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

We have reached out to other collaborators at WFO PHI and a few other places to perhaps expand the scope of work, but it has not yielded many results. Jared Klein has moved down to Slidell and he is unsure if he'll have time to continue with this work.

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

Team leads: Joe Villani and Mike Evans (ALY)

We have created forecast error maps (for NDFD, HRRR, and NAM nest) and observed composite snowfall maps stratified by each environmental parameter using GAZPACHO and ArcGIS for the 37 combined events from the 2017–18, 2018–19, and 2019–20 winter seasons. We compiled final results into a draft paper that has been submitted to the National Weather Service's Eastern Region Scientific Services Division for review. A poster is also be developed for a presentation at the NWA Annual Meeting in August 2021.

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

Team lead: Tom Wasula (ALY)

Some work has been done on this project since December with the 2" database updated through 31 March 2021. No new 2" hail reports occurred in the NWS ALY WFO in the 2021 cool season. The NWS ALY WFO climatology continues to have a total of 65 significant hail reports (2" or greater in diameter hail stones) from 1950 to March 2021. Columbia County has the most reports with 13 and Albany was second with 7 reports. Two counties in the forecast area have never had a report (Hamilton and Schoharie Counties). Thirty-nine out of the 65 reports (60%) were 2" in diameter or hen egg/lime size. The greatest number of significant hail events happened in June with 25 and 71% occurred in May and June (46 reports). All the events happened in May to September. There has been a dramatic increase in reports since 2000 with 78.5% (52) of the reports occurring the past few decades, as this may be attributed to increased number of spotters, social media and advanced technology.

Tom continued to work on the significant hail database, which is now being stratified beyond the NWS ALY WFO to work on different parameters (CAPE, shear, lapse rates, etc.) that contributed to the events based on the dates. This analysis involves observational soundings and some proximity soundings, as well as reanalysis data. Tom is currently working on reports in the NWS BTV, BGM, and BUF areas. He has also asked Mike Main if he would assist me in the analysis and the study. He is very interested and will try to contribute when he has time while he goes through all his introductory training (Mike

started as the NWS at Albany in November 2020). Mike suggested looking at freezing levels on the soundings for hail growth to significant thresholds.

Tom submitted an abstract titled, "A multiscale analysis of the 29 August 2020 tornadic event across eastern New York" for the 18–21 October 2021 AMS Severe Local Storms Conference in Santa Fe, NM. He was hoping to show a poster, but the conference was postponed again due to the COVID-19 pandemic. Application of the local V-R shear and normalized rotation (NROT) studies Brian and Tom worked on were applied. Three tornadoes occurred this day along with some wind damage. Also, a few large hail events were analyzed but they were less than 2" in diameter. The NWS ALY forecast area, and NYS tornado climatologies were also updated through March 2021. This case also utilized the MRMS 0–2-km AGL low-level azimuthal shear tracks.

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)

The role of large-scale, low-level forcing on severe weather event magnitude was evaluated as part of a COMET partner's project with the New York State Mesonet. The strength of low-level forcing was evaluated by looking at diagnostics of equivalent potential temperature gradients using data from the New York State Mesonet. An undergraduate student from UAlbany developed a product available online for forecasters to utilize to evaluate the strength of the low-level forcing, in order to evaluate thunderstorm potential during the next few hours.

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

Monday 14 December 2020

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

FXUS61 KALY 142204
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
504 PM EST Mon Dec 14 2020

.SHORT TERM /WEDNESDAY THROUGH WEDNESDAY NIGHT/...

The overall synoptic set-up of this system fits with the quasi-stationary banding shown in the Kenyon CSTAR research which supports the idea that some periods of heavy snowfall with rates near 1 inch per hour at times are possible Wednesday night, especially for our southern zones.

SHORT TERM...Speciale

Monday 14 December 2020

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

FXUS61 KALY 152219
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
519 PM EST Tue Dec 15 2020

.SHORT TERM /6 AM WEDNESDAY MORNING THROUGH THURSDAY/...
While initial snowfall looks light, a band of moderate to heavy snow should arrive Wednesday night resulting in 1 to 2 inch per hour snowfall rates with confidence for such snowfall rates occurring mainly along and south of I-90. **The probabilistic HREF guidance outlines the potential for high snowfall rates nicely and the storm`s general synoptic evolution lines up with the conceptual model for a quasi stationary band outlined in the Kenyon CSTAR research.** As the 700mb closes off by 06 UTC, there are indications that the quasi stationary band evolves into a pivoting band which would produce locally higher snowfall amounts where the band pivots. The main window for high snowfall rates ranges between 03 and 12 UTC (10pm to 7am) Wednesday night. In addition, BUFKIT soundings show strong lift intercepting the dendritic snow growth zone during this window which indicates the potential for high snowfall ratios (13-15:1) and very efficient snow accumulations.

SHORT TERM...Speciale

Tuesday 15 December 2020

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

FXUS61 KALY 160905
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
405 AM EST Wed Dec 16 2020

.SHORT TERM /6 PM THIS EVENING THROUGH 6 PM THURSDAY/...
Model guidance has converged on a solution over the past couple of runs that widespread moderate to heavy snowfall is expected across the region late Wednesday afternoon through Thursday morning. The latest guidance still has some minor differences regarding the northern extent of snowfall, but is in stronger agreement on a band or multiple bands of heavy snow to lift northward from the mid-Hudson Valley and Litchfield Hills toward the Capital District. The strongest mid-level frontogenesis looks to set up along or just to the south of the Capital District during Wednesday night. Within this corridor, snowfall rates are expected to reach 2 inches per hour at times with visibilities dropping below one-quarter of a mile. **The storm`s general synoptic evolution lines up with the conceptual model for a pivoting band outlined in the Kenyon CSTAR research.**

SHORT TERM...Rathbun

Wednesday 16 December 2020

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

FXUS61 KALY 162121
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
421 PM EST Wed Dec 16 2020

.NEAR TERM /UNTIL 6 AM THURSDAY MORNING/...
There is a good consensus in all sources of guidance/ensembles/CAMs for exceptional frontogenesis, moisture advection and convergence within the developing mesoscale band as it tracks into the eastern Catskills to mid Hudson Valley to areas near or just south of the Capital Region through this evening. **The battle between the strong low level ridging building south out of Canada and the exceptional convergence/frontogenesis (850-500 hPa) and moisture advection will support a pivoting mesoscale band (per CSTAR research) that could produce snowfall rates exceeding 3 inches per hour at times.**

NEAR TERM...NAS

Thursday 17 December 2020

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

FXUS61 KALY 170611
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
111 AM EST Thu Dec 17 2020

.NEAR TERM /UNTIL 6 AM THIS MORNING/...
As of 110 AM EST...Impressive Nor`easter is pounding the forecast area with moderate to heavy snow with multiple bands. Strong isentropic lift is occurring ahead of the 1000 hPa cyclone near KACY and southern NJ. The strong upward vertical/omega is intersecting the -12C to -18C Dendritic Growth Zone with strong and steeply sloped low to mid level FGEN in the H850-H700 and H700-H500 layers. The initial band that moves through the northern Catskills, Greater Capital Region, and Berkshires is moving into the Mohawk Valley, Saratoga Region, Washington Co. and southern VT. **Another band is south of I-90. These bands fit into the Laterally Translating Band conceptual model from Kenyon CSTAR cool season research with the dual jet structure evident. We are expecting a transition to pivoting bands /CSTAR conceptual model/ later this morning, as the equatorward jet streak becomes dominate with the strong FGEN in the northwest quadrant of the deepening Nor`easter.** Good pcpn efficiency will continue and we are likely going to see area of 18-24" of snow in the forecast area, as the mesoscale bands are yielding snow rates of 1-3" an hour. We upgraded southern Herkimer to a warning with snowfall amounts of 6-10". The 18-24" area will likely occur over the northern Catskills, Helderbergs, portions of the Capital Region into the northern Taconics, and possibly the northern Berkshires and southern Greens.

NEAR TERM...MSE/NAS/Wasula

Thursday 17 December 2020

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

FXUS61 KALY 170926
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
426 AM EST Thu Dec 17 2020

.NEAR TERM /UNTIL 6 AM THIS MORNING/...
As of 425 AM EST...A blockbuster snowstorm continues to pound the forecast area with widespread moderate to heavy snowfall and multiple mesoscale snow bands. Astronomical Fall is going out with a snowy finish! The first adjustment to the forecast was to increase totals from the Capital Region northward towards the Lake George Saratoga Region and to upgrade northern Warren County to a Warning. A pair of snow bands are merging from the Capital Region north and west into the central Mohawk Valley and Lake George Area. **These bands initially started out as Laterally Translating Bands based on the Kenyon CSTAR cool season research, but now we should start to see a transition to a Pivoting Band based on the CSTAR conceptual model.**

NEAR TERM...Wasula

Thursday 17 December 2020

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

FXUS61 KALY 260944
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
444 AM EST Sat Dec 26 2020

.NEAR TERM /UNTIL 6 PM THIS EVENING/...
As of 440 AM EST...A mid and upper level trough will continue to be over the region today with a cyclonic flow of chilly, seasonable air. Lake effect snow will continue to develop off Lake Ontario during the late morning into afternoon, as the low-level trajectories begin to back to the southwest/west to west. A multi-lake connection will develop based on the 3-km NAM and HRRR off Lake Ontario. Looking at model soundings off the 3-km HRRR and the NAM, the inversion heights are in the 8-10 kft AGL range with favorable delta-T temps, as the avg lake temp is warm at 45F. The instability class is moderate to extreme in BUFKIT looking a single band to form in the late morning off Ontario. **The band looks to get going in the late morning and the early afternoon with the latest KVIE CSTAR Inland lake trajectory 150-200 miles using the NAM guidance.** The question will be if it will drift fair enough south into the western Adirondacks for a major impact. Right now during the day locations along and northwest of Old Forge and Route 28 have the best chance for 4-8" of snow before 6 pm (We issued a warning since 6-12" is possible into the night time period). The placement of the band may be closer to Stillwater Reservoir and Beaver River. Northwest Hamilton County may receive a few inches of snow prior to dark and that is why we went with only an advisory for the northwest corner of the county.

NEAR TERM...Wasula

Monday 28 December 2020

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

FXUS61 KALY 282351
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
651 PM EST Mon Dec 28 2020

.NEAR TERM /UNTIL 6 AM TUESDAY MORNING/...
As of 640 pm, a stratus layer is persisting longer than anticipated across the vast majority of the forecast area. This is keeping temps rather elevated. Have updated the forecast to linger clouds and warmer temperatures longer, but still expect somewhat of a dissipating trend in the cloud cover after midnight. Lake effect band is pushing into the Old Forge area at this hour, with possibly a couple of hours of good snowfall rates before the band shifts south and breaks apart somewhat. **Still expect lake effect activity to reinvigorate very late tonight (after 09Z or so) as a winds align to create a multi-lake fetch pointed at the western Mohawk Valley, eventually favoring large inland extend per CSTAR research. Going forecast captures the lake effect activity well.**

NEAR TERM...Frugis/Thompson

Friday 1 January 2021

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

FXUS61 KALY 010911
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
411 AM EST Fri Jan 1 2021

.SHORT TERM /6 PM THIS EVENING THROUGH SATURDAY NIGHT/...
Main change from previous forecasts is an increase snowfall totals around and especially north of I-90, as strong isentropic lift on the 290K surface should result in a good front end thump of snowfall across parts of the Mohawk Valley, southern Adirondacks and even into the Saratoga region for a few hours this evening shortly after onset. The 00Z HREF signaling good potential (70-90 percent prob) for greater than 1 inch/hour snowfall rates between 9 PM to Midnight**. The**

pattern resembles a Laterally Translating Mesoscale Band setup from CSTAR research, given a primary cyclone to our west with a potent 700 mb short wave and strong warm advection downstream of the cyclone. This gave us confidence to raise snowfall amounts in these areas. It appears these snowfall rates will occur just north of Albany, but will need to monitor trends leading to this evening.

SHORT TERM...JPV

Thursday 14 January 2021

CSTAR research on precipitation associated with cold-season cutoffs was cited in the short-term section of the NWS ALY AFD.

FXUS61 KALY 142144
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
444 PM EST Thu Jan 14 2021

.SHORT TERM /6 AM FRIDAY MORNING THROUGH SATURDAY NIGHT/...
Fri night into Saturday...CSTAR research has shown cold season cutoffs and their associated pcpn can be challenging to forecast. This one looks to be challenging in terms of the formation of the secondary low and the ptypes which should be elevation dependent and tied to wet bulb cooling.

SHORT TERM...Wasula

Friday 15 January 2021

CSTAR research on precipitation associated with cold-season cutoffs was cited in the short-term section of the NWS ALY AFD.

FXUS61 KALY 150857
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
357 AM EST Fri Jan 15 2021

.SHORT TERM /6 PM THIS EVENING THROUGH SATURDAY NIGHT/...

Friday night...Per the previous excellent AFD, a review of local CSTAR research over the past several years, upper lows are quite problematic with placement of thermal profiles and QPF. Even as we type this AFD, 06Z NAM/HRRR are suggesting the best moisture transport may be just to the east of the western New England and keep the colder air locked in longer for portions of the Berks and southern Greens. Meanwhile, dry slot approaches faster which in turn lowers QPF and impacts for eastern NY counties. An ensemble approach per GEFS/HREF, the best low level jet will quickly transverse the region overnight. Per local climatology, this places portions of the Taconics, Berks and southern Greens with wind gust magnitudes approaching advisory level criteria. This hazard potential will be addressed in the HWO this morning. Otherwise, per top-down ensemble approach, seems the cold air will linger per wet-bulb processes into portions of the Berks, southern Greens at or above 1500 feet, Dacks and higher elevations the Catskills. It is the western areas where the QPF remains in question as latest trends were a bit lower. Regardless, a band of precipitation will spread across the region tonight with a mix of rain/snow (perhaps a period of sleet at the onset) as a secondary wave develops and tracks northward along the occluded frontal zone. Temperatures overnight not likely to drop too much with upper 20s across the higher elevations with low-mid 30s for lower elevations.

SHORT TERM...BGM

Friday 15 January 2021

CSTAR research on precipitation associated with cold-season cutoffs was cited in the near-term section of the NWS ALY AFD.

FXUS61 KALY 152200
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
500 PM EST Fri Jan 15 2021

.NEAR TERM /UNTIL 6 AM SATURDAY MORNING/...
As the boundary moves towards the area the secondary cyclone rapidly forms along the triple point and near the cyclonic exit region of a 150+ jet streak at 250 hPa. Wet bulb cooling should allow for some snow in the western Mohawk Valley and a snowy start over the southern Adirondacks, northern reaches of the Lake George Region, and southern VT. Snowfall rates could reach an inch and hour and the HREF 1-hr snow probs showed decent probabilities in the high chc/likely range into southern VT between 06Z-12Z. We have warnings in effect for the southern Adirondacks and southern VT above 1500 feet. A few advisories were also issued for the hills of northwest Saratoga and southeast Warren County for 2-6" of snow. **Past CSTAR research has shown cool season cutoff lows are always tricky with the pcpn distributions the predominate ptype.** It looks like east of the Hudson River Valley over western New England will have the higher QPF and perhaps along the eastern spine of the southeast Catskills.

NEAR TERM...Wasula

Monday 18 January 2021

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

FXUS61 KALY 190011
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
711 PM EST Mon Jan 18 2021

.SHORT TERM /6 AM TUESDAY MORNING THROUGH WEDNESDAY NIGHT/...
Synoptic snow will quickly transition to lake effect snow late Tuesday afternoon into Tuesday evening, as colder air aloft filters in. Westerly flow of colder air aloft (-12C to -14C) over the relatively warm Lake Ontario (~+6C) will result in a fairly robust lake response, with lake induced instability rapidly going from conditional to moderate. Initially, the flow trajectory will be westerly into Tuesday evening, with lake effect snow mainly affecting the northwest Adirondacks (around Route 28 northward) through the evening. Then as winds become more W-NW overnight, the snow bands will become transient and shift southward through the western Adirondacks into the SW Adirondacks. Snowfall rates will likely approach an inch per hour, however with expected residence times of generally less than 6 hours over any given location, accumulations should be in the 3-6 inch range in the most persistent bands. **Local inland extent LES program based on previous CSTAR research indicates even without a continuous multi-lake connection (which could exist briefly), lake effect snow bands should be able to maintain inland through at least central Hamilton County.** So we have issued a Winter Weather Advisory for northern Herkimer and Hamilton counties, with the greatest accumulations west of Route 30. Outside of the persistent lake effect, snow showers will produce generally less than an inch of accumulation.

NEAR TERM...IAA/JPV

Sunday 31 January 2021

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

FXUS61 KALY 312218
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
518 PM EST Sun Jan 31 2021

.SHORT TERM /6 AM MONDAY MORNING THROUGH TUESDAY NIGHT/...
Backing up, a powerful secondary coastal low forms deepening to 990-995 hPa near the southern NJ coast between 18Z/MON to 00Z/TUE. Strong isentropic lift occurs ahead of the coastal cyclone and its warm front. An anomalous H850 LLJ increases to 50 to 70 knots advecting into the region Atlantic moisture. The pcpn should quickly be moving northward from the southeast Catskills, mid Hudson valley, NW CT and Berkshires in the late morning into the early pm. The H850 u-wind anomalies of the LLJ are -3 to -5 STDEVS above normal. These are very impressive easterlies and they should enhance the snow amounts along the eastern slopes of the Berkshires, Litchfield and the eastern Catskills. The strong upward vertical motion will intersect the dendritic growth zone for enhanced snowfall rates in the afternoon. The latest 12Z HREFs indicate high probs greater than an inch an hours over portions of the mid Hudson Valley, eastern Catskills, and NW CT into the Berkshires. The 850-700 FGEN is very impressive for a potential mesoscale snow band impacting these areas, and this is why we have the highest snow amounts on Monday here. **The CSTAR cool season research indicates a Laterally Quasi Stationary Band may form and then evolve into a Pivoting Band.** The band may get disrupted moving north during the late afternoon and early evening due to the downsloping. Overall, we think snowfall rates of 1-3" or 1-2" per hour are possible over the southern zones south of the Capital Region. The snow may barely get into the southern Adirondacks, Lake George Region, and portions of the Mohawk Valley by nightfall. The Capital Region region may have 1-2" or so by nightfall. Highs will be in the upper teens to mid/upper 20s. The north to northeast sfc winds will be 10-20 mph with some gusts 30-35 mph prior to nightfall over the eastern Catskills, mid Hudson Valley, Berkshires and Litchfield Hills.

SHORT TERM...Wasula

Monday 1 February 2021

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

FXUS61 KALY 020309
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
1009 PM EST Mon Feb 1 2021

.NEAR TERM /UNTIL 6 AM TUESDAY MORNING/...
Strong upslope continues across the eastern Catskills and Helderbergs with the band as snow totals up to 17.0" have come in from Tannersville. The latest hourly snow depth change from the NYS

Mesonet was 2.7"! Many locations have received 10-16" in the mid Hudson Valley, southern Taconics, southern Berkshires and Litchfield County Connecticut. **An additional 2-4" is possible in the mid Hudson Valley/Litchfield County CT before the snow diminishes with the Pivoting band per the CSTAR research.** The eastern Catskills could get additional around 8-12" and some snow totals may reach 24-30". Spotty higher amounts. The Capital Region may get another 3-6" with amounts of 2-6" coming in so far, as totals in the 6-12" are possible still. Southern VT in the Berkshires will be in the 8-18" range with the lower amounts in the valley areas of VT.

NEAR TERM...BGM/Wasula

Wednesday 31 March 2021

CSTAR research on Hudson–Mohawk convergence was cited in the near-term section of the NWS ALY AFD.

FXUS61 KALY 312003
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
403 PM EDT Wed Mar 31 2021

.NEAR TERM /THROUGH THURSDAY/...
Thursday, the surface low will continue lifting across the Gulf of Maine into Maritime Canada. This will result in the steadier rain/snow tapering off from the late morning into the afternoon in the area covered by the headlines. Precip may continue longer over some areas to the south and east of where the headlines are in effect due to a combination of lingering midlevel deformation and low-level convergence. **The 3km NAM is particularly aggressive in a prolonged Mohawk-Hudson Convergence signal (see CSTAR research).** Will maintain high chance to likely PoPs into the afternoon for the Capital District and surroundings. Temperatures will be marginal for accumulating snow, especially due to the time of day and sun angle, and accumulation during the day will likely be dependent on elevation. Have sided with the colder side of the guidance given cold advection and likelihood of precip to keep temps down. Some upslope flow could prolong snowfall over the Taconics and southern Greens Thursday evening as well. Overall, no changes planned to headlines at this time, although many will likely see at least some accumulating snow tomorrow. Accumulation will preferentially occur on colder surfaces such as grass, especially where it is lighter overall.

NEAR TERM...Thompson

Thursday 1 April 2021

CSTAR research on Hudson–Mohawk convergence was cited in the near-term section of the NWS ALY AFD.

FXUS61 KALY 010816
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
416 AM EDT Thu Apr 1 2021

.NEAR TERM /UNTIL 6 PM THIS EVENING/...
There is a consensus in mesoscale guidance sources for some Mohawk Hudson type convergence this afternoon and early evening and based on CSTAR research, the low level wind flow, upper pattern and surface feature placement, along with the lingering low and midlevel moisture, there is a chance. Exactly where it sets up is in question, southern Saratoga through the Capital Region or just east into the Rensselaer Plateau. Including a period of likely showers transitioning to snow showers late this afternoon and evening over both southern Saratoga through the Capital Region and the eastern areas into the Rensselaer Plateau and central Taconics. There may be some slushy dustings in the Capital Region depending on the timing of the colder air with 1 to 3 inches in some isolated spots of the Rensselaer Plateau and central Taconics above 1000 feet.

NEAR TERM...NAS

Thursday 1 April 2021

CSTAR research on Hudson–Mohawk convergence was cited in the near-term section of the NWS ALY AFD.

FXUS61 KALY 011820
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
220 PM EDT Thu Apr 1 2021

.NEAR TERM /THROUGH TONIGHT/...
Early afternoon water vapor imagery shows a broad trough shifting eastward and encompassing much of the eastern US. Elongated moisture plume has shifted east of the area along with the synoptic-scale lift. In its wake, cold advection aloft is steepening lapse rates and resulting in some rain and snow showers developing, especially downwind of Lake Ontario in the northwest flow. **An area of Mohawk-Hudson Convergence (see CSTAR research) is generating a more focused area of precipitation from NW Saratoga County through portions of the Capital**

District. We have raised snowfall totals a bit over NW Saratoga County due to the good convergence signal and the fact that the higher elevation is resulting in more snow P-types. Otherwise, the high sun angle has resulted in minimal impacts to transportation thus far that we are aware of, and a rain/snow mix being reported in many locations. Going forward this evening, the precip will continue to be focused on the Capital District and eventually some upslope into the Taconics and windward slopes of western New England. Temps will begin to fall below freezing which could result in snow sticking better mainly at higher elevations, but it will be decreasing in coverage as the temperatures fall.

NEAR TERM...Thompson

Sunday 11 April 2021

CSTAR research on cutoff cyclones was cited in the near-term section of the NWS ALY AFD.

FXUS61 KALY 112001
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
401 PM EDT Sun Apr 11 2021

.NEAR TERM /UNTIL 6 AM MONDAY MORNING/...
As of 400 PM EDT...Cut-off lows are always tricky to forecast, as what has been researched over the past couple of decades with SUNYA in the CSTAR program. Ridging off the Maine coast and a weak back door front have kept most of the showers south and west of the I-90 corridor this afternoon. The cut-off low is over the lower Great Lakes Region and Midwest. The southeast low-level flow is increasing ahead of a warm front that will act like an occluded front, as a cold front catches up to it.

NEAR TERM...Wasula

Friday 30 April 2021

CSTAR research on high winds associated with midlatitude cyclones was cited in the near-term section of the NWS ALY AFD.

FXUS61 KALY 300801
AFDALY

AREA FORECAST DISCUSSION

National Weather Service Albany NY
401 AM EDT Fri Apr 30 2021

.NEAR TERM /THROUGH TONIGHT/...
Today, surface low continues to deepen over the Gulf of Maine to below 980 mb before it eventually occludes over the Canadian Maritimes Friday night. Meanwhile, a ridge of high pressure will be located over the western Great Lakes, setting up a strong low- level height gradient over the local area. Also, an anomalously deep, compact midlevel low will be tracking ESE through the ALY CWA by the afternoon/evening. Precipitation will be ongoing over our northern zones within the trowal between the two upper lows, modulated by orographic forcing with strong low-level flow. This means showery conditions will be favored much of the day over the upslope regions of the southern ADKs, southern Greens, and to a lesser extent, the Berkshires and Catskills. Punch of cold air aloft with the approaching upper low is impressive, with 850 mb temps forecast to fall to around -5C by around 00Z Sat. The cold advection along with diurnal heating will steepen low level lapse rates, mixing down higher momentum air from above. Though mixing depths are highly questionable with the degree of cloud cover and precip, especially over higher terrain, 925 mb wind magnitudes are impressive with the NAM12 on the higher end of the envelope showing 40-45 kt down the Mohawk Valley. 850 mb winds of 50-60 kt are modeled as well. This may be just above the peak height of the boundary layer based on model forecast soundings. Simulated cloud cover from CAMs depicts a few breaks in the clouds during the afternoon/evening, which could be a signal that some high gusts will be realized. Based on the above factors, it looks like this is going to be a borderline advisory/warning (50 kt gust) event. Due to the potential for 3-6 hours of 50+ mph gusts and some of the trees having leafed out at lower elevations, we have decided for a targeted high wind warning for the Mohawk/Schoharie Valley through the Capital District. **Local research based on past CSTAR research indicates this is the favored area for high winds with a surface low off to the northwest.** The strongest winds look to be in the 2-8 pm timeframe. Wind advisories remain in place north and south of the warning area. Have adjusted the headline to end at 00Z to the north and 06Z to the south.

NEAR TERM...Thompson