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: Megan Schiede
PI and co-PIs: Justin Minder, Nick Bassill, Robert Fovell, Andrea Lang
NWS focal point: Lee Picard (ALY)

Research summary:

Megan Schiede has continued her evaluation of forecasts of freezing drizzle (FZDZ) aloft during Intensive Observing Period 9 (IOP9) of the Winter Precipitation Type Research Multi-scale Experiment (WINTRE-MIX) field campaign. Aircraft data from the NRC Convair-580 collected during IOP9, HRRR forecasts, and Weather Research and Forecasting (WRF) simulations with HRRR-like configurations were compared to diagnose model biases in variables conducive for supercooled large drop (SLD) formation.

Precipitation features were compared between observations and the HRRR as well as the control WRF simulation (CTRL). Data points were selected in the HRRR and CTRL to be the closest grid box to a specified latitude that aligns with the precipitation feature in HRRR and CTRL as the observed and model features do not align spatially within the domain. Vertical interpolations to aircraft altitude were performed to align with changes in aircraft altitude with longitude. Results from these interpolations are shown in Fig.1. A warm model bias is shown in HRRR and CTRL. Given notable TWC values, small values of LWC in the HRRR and negligible values of LWC in CTRL demonstrate that these models are incorrectly classifying hydrometeors as frozen, failing to simulate the observed icing conditions.

Average vertical profiles were constructed along the latitude examined. Mixing ratio categories were analyzed revealing the domination of the snow mixing ratio in both HRRR and CTRL (Fig. 2c). Signatures of rain mixing ratios, the category SLD falls into, are absent (Fig. 2b). We propose that seeding from aloft is responsible for the lack of SLD occurrence within the models as the presence of snow mixing ratios at all vertical levels inhibits the presence of liquid water. Observations dispute the presence of all frozen hydrometeors as suggested by periods of FZDZ.

Our hypothesis of the influence of seeding from aloft motivated the two sensitivity experiments that were conducted to determine
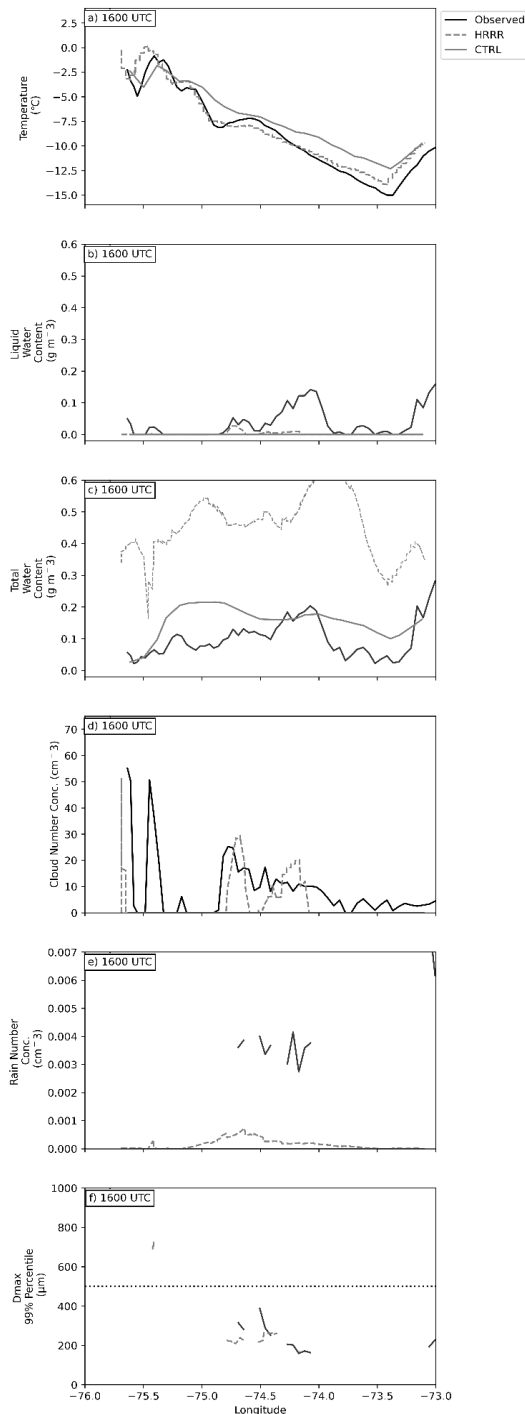

Fig 1. *Aircraft observations (black), HRRR interpolated (dashed grey), and CTRL interpolated (grey); (a) Temperature, (b) Liquid water content, (c) Total water content, (d) Cloud number concentration, (e) Rain number concentration. Data taken from Leg 0.*

if this mechanism is responsible for the lack of SLD. The UpperDry experiment was conducted to eliminate the upper-level cloud that is seen in observations. To remove this cloud, RH was reduced to 30% above an average altitude of 5092 m. The LayerDry experiment was conducted to mimic the two-level cloud structure shown in observations. In this experiment, RH was reduced to 30% between the average altitudes of 4076 m and 5836 m. The UpperDry is shown by the magenta lines and the LayerDry is shown by the lime green lines in Fig 2.
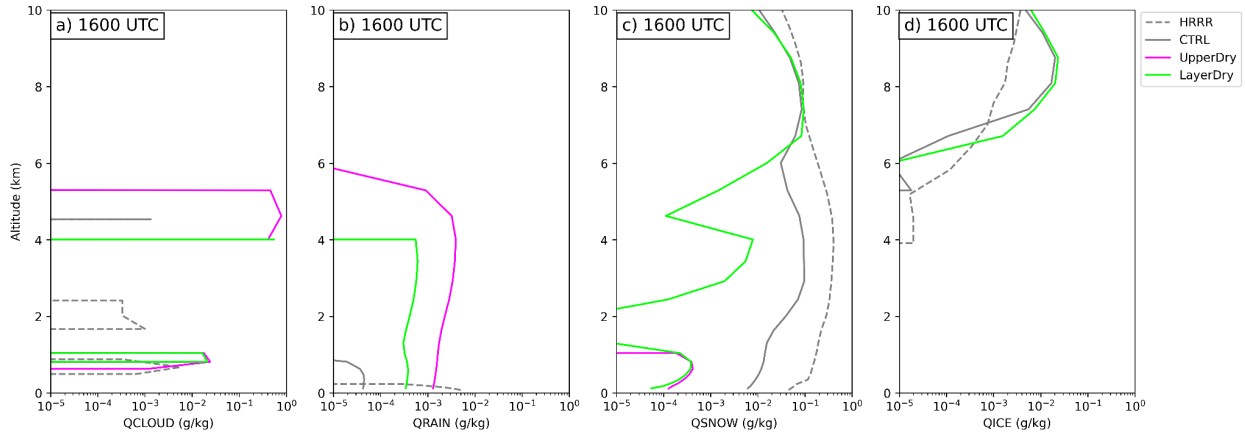

Fig 2. *Average MR Profile taken along the transect for (a) cloud mixing ratio, (b) rain mixing ratio, (c) snow mixing ratio, (d) ice mixing ratio. Model output time at 1600 UTC that corresponds to Leg0. UpperDry is shown in magenta and LayerDry is shown in lime*

In removing the upper-level cloud, snow mixing ratios aloft are now negligible, and rain mixing ratios are present, matching the observed icing conditions much better. This indicates that seeding from frozen hydrometeors aloft does contribute to the underproduction of rain mixing ratios seen in HRRR and CTRL. This result is reinforced with the results from LayerDry. At lower levels, the snow mixing ratio is reduced significantly compared to aloft. The sublimation of these frozen hydrometeors allows for rain to be produced at altitudes similar to those of the low-level cloud.

The identification of seeding as a source for bias in icing forecasts aloft provides guidance that can inform further work to improve the ability of operational models to forecast hazardous icing conditions.

Megan has concluded this work by writing and presenting her master's thesis, which will be completed in August 2024. Results from this investigation will serve to motivate her future work for her PhD as she hopes to diagnose the reasoning for overseeding within the HRRR and CTRL.

NWS Interactions:

Megan presented the biases shown in HRRR data at the Northeastern Storm Conference this past March. The Northeastern Storm Conference has attendance from NWS employees from multiple forecast offices within the northeastern region.

Additionally, Megan met with Lee Picard, the NWS focal point on this project twice since the last report was issued. The two met in January to discuss initial results from HRRR forecasts. Megan and Lee also met in July to discuss the model biases uncovered through WRF simulations.

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 finished her master's thesis during this period. The final part of her thesis focused on investigating differences in surface temperature, moisture, and fluxes between the HRRR and New York State Mesonet (NYSM).

We analyzed 12 days that were classified into one of three categories: clear, isolated convection, and widespread convection. These classifications were based on the Clear Sky Index (CSI), calculated using the average observed incoming shortwave radiation, or global horizontal irradiance (GHI), divided by the estimated clear-sky value at that location for the time of year. Only daytime values between 15 UTC through 23 UTC were included in the average. Radar imagery was used to confirm whether days had isolated or widespread convection. Near-surface variables were analyzed for 10 NYSM stations in the Mohawk and Hudson valleys, with two of those stations (VOOR and REDH) having co-located flux sites. While all sites have pyranometers that measure shortwave radiation, the flux sites have higher quality instruments.

Previously, the positive shortwave down discrepancies seen in the HRRR on clear days were thought to be an issue with the HRRR. However, after comparison of pyranometer measurements, along with the estimated clear-sky values, we determined the discrepancies were due to instrument rather than model error. In Fig. 3, the clear-sky GHI (Ineichen_cs), WRF clear-sky (WRF_cs), and HRRR values are all in close agreement for all 10 NYSM stations. The NYSM_Flux measurements are also in close agreement at VOOR and REDH. However, there is a negative error with the standard pyranometer measurements, with some days and stations showing an error greater than 20%. In contrast, differences between the higher quality pyranometer measurements at NYSM flux sites and HRRR SW_down were mostly less than 5% on clear days. After discussion with the NYSM staff, calibrations of the pyranometers are regularly needed. Thus, caution should be used when using the shortwave radiation measurements at standard NYSM sites.
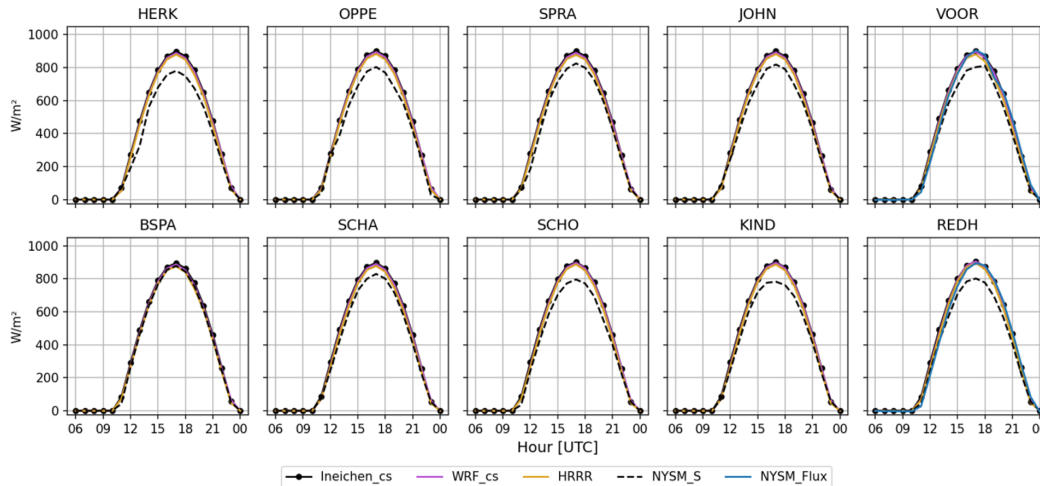

Fig. 3. *Hourly timeseries of theoretical clear sky (black line), WRF clear sky (pink line), HRRR (yellow line), standard pyranometer (dashed line), and high-quality pyranometer (blue line at VOOR and REDH only) surface shortwave radiation at 10 NYSM stations for 31 August 2023, one of the clear days in our sample of cases. Note that the standard pyranometer measurements are lower than the rest.*

In addition to the shortwave radiation analysis, surface variables were also investigated (Fig. 4). Overall, a warm and dry bias was observed across all three categories, with the greatest biases seen on days with isolated and widespread convection. This bias seems persistent in the HRRR during the heart of the warm season and likely affects convective initiation and evolution, which is something forecasters should be aware of. We next assessed whether this warm, dry bias is consistent with the surface fluxes. Our findings indicate they are – a consistent positive sensible heat flux bias and a negative ground heat flux bias were observed, indicating a coupling of the warm, dry bias with the HRRR land-surface model. One caveat is that the location and timing of precipitation differs between models and observations, which presents challenges in performing the comparison. A second caveat is that only four days were included in each category, so a larger sample of days is needed to more robustly determine HRRR model biases in these variables.
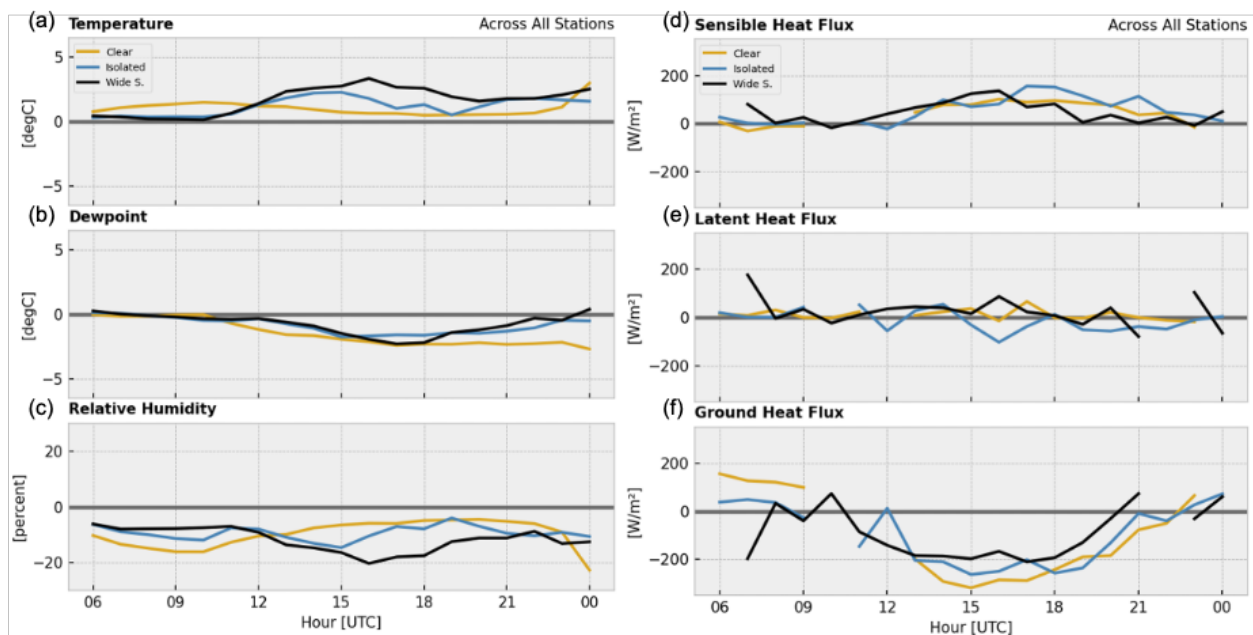

Fig. 4. *Hourly mean biases, averaged across all 10 NYSM stations, of (a) 2-m temperature, (b) 2-m dewpoint, (c) 2-m relative humidity, (d) surface sensible heat flux, (e) surface latent heat flux, and (f) ground heat flux averaged across clear (yellow lines), isolated convection (blue lines), and widespread convection (black lines) days.*

NWS interactions:
We will collaborate and iterate with NWS personnel on developing a one-page summary of main findings from this work as a quick reference for forecasters.

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:

Brian Filipiak graduated with his Master's degree in December 2022. His first manuscript on his work was published earlier this year. He recently updated his forecast website (*https://www.atmos.albany.edu/student/filipiak/op/index.html*) for the 2023–2024 winter season and plans on writing up the verification portion of his work in late 2024.

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

Eldridge, R., 2024: Examining the performance of the High-Resolution Rapid Refresh model during clear, isolated, and widespread convective days in the New York State Capital Region. Master of Science Thesis, Dept. of Atmospheric and Environmental Sciences, University at Albany/SUNY, 55 pp.

b) Presentations

Schiede, M., and J. R. Minder, 2024: Using airborne measurements to evaluate HRRR forecasts of freezing drizzle aloft: Results from the WINTRE-MIX Field Campaign. *49th Northeastern Storm Conference*, 9 March, Burlington, VT.

Wasula, T. A., and N. A. Stuart, 2024: Daniel Keyser's 30 years of contributions to operational research: Impacts in the operational forecasting community and beyond. *104th American Meteorological Society Annual Meeting - Daniel Keyser Symposium,* 29 January, Baltimore, MD.

Wasula, T. A., L. M. Picard and N. A. Stuart, 2024: 22–23 March 2024 early spring snow and ice storm. *ETEC Showcase Presentation,* 2 May, Albany, NY.

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. Ross Lazear is working with graduate students Rachel Eldridge and Megan Schiede and their NWS focal points in developing operationally relevant quick references for their major research results, to be hosted on the VLab community page. As has been done with previous CSTAR research, all 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 *(Thomas Wasula and Neil Stuart; Lead Meteorologists, WFO ALY)*

The collaborative relationship between the NWS Albany forecast office and UAlbany's Department of Atmospheric and Environmental Sciences remains strong as CSTAR VII ends this year. 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 move in September 2021 to collocate the NWS with the department in the ETEC building has cemented this relationship moving forward. Tim Humphrey was selected as the new Science Operations Officer at WFO Albany in February 2024 and joined the staff in mid-June. He will be leading this strong relationship with UAlbany in the future.

Mixed precipitation events were frequent in the Northeast this past cool season with a moderate to strong ENSO. The NWS ALY Office staff applied results from Brian Filipiak's data fusion project in mixed precipitation events during the cool season 2023–2024. Lee Picard, Tom Wasula, and Neil Stuart gave a review discussion and presentation on a high-impact snow and ice storm applying some CSTAR results and novel products. The 22–23 March early spring snow and ice storm was reviewed as an ETEC showcase presentation on 2 May. University at Albany Atmospheric Science Department, NYS Mesonet, State Weather Risk Communication Center, and College of Emergency Preparedness, Homeland and Cyber Security members attended and participated in the discussion.

Rachel Eldridge continued her work, with a focus on the performance of HRRR forecasts of the environment, and subsequent convection, during severe weather events. She focused on the role terrain channeling can have on the local environment in the Mohawk and Hudson River Valleys (low-level shear, storm-relative helicity, and moisture variables) and on local HRRR biases in the boundary layer based on comparison to a half dozen NYS Mesonet points in the Mohawk Valley. Rachel added another five NYS Mesonet sites in the Hudson River Valley, as she expanded her case list to review the dry biases and short-wave flux differences in the HRRR guidance which does impact the CAPE distributions. The goal of her work is to improve NWS forecasts, make improvements to the HRRR and future models, and increase local awareness. It is hoped that Rachel's Master presentation results can be used in future NWS severe weather operations.

Tom presented a comprehensive poster heavily focusing on CSTAR results and projects that Dr. Daniel Keyser mentored, facilitated, and collaborated with University at Albany students for more than two decades at the Daniel Keyser Symposium at the 104th AMS conference on 28 January – 1 February 2024 in Baltimore, MD.

Finally, NWS funding has been very limited, which has made it difficult to send NWS personnel to conferences this fiscal year. Tom was not allowed to go to the 49th Northeast Storms Conference in mid-March 2024 in Burlington, VT due to lack of funds to show recent work on a collaborative warm season project. Mike Main and Tom were denied submitting abstracts in May for the 31st AMS Conference on Severe Local Storms this upcoming 21–25 October 2024 in Virginia Beach, VA. The lack of funds is hurting professional development and collaborations of the recent research findings and results for CSTAR results. The conferences are also very helpful for NWS focal points to see the latest research from students and other related projects.

5. COLLABORATIVE PROJECTS *(Compiled by Neil Stuart, Tom Wasula, and focal points)*
The eight collaborative projects associated with CSTAR VII are listed below, along with updates on progress from December 2023 through June 2024.

1. Improvement of tornado detection and lead time
Team leads: Joe Dellicarpini (BOX) and Christina Speciale (ALY)

Updates this six-month period include a BOX database with 2023 tornadoes, the addition of new events confirmed previous environmental and radar thresholds. The work was presented at NWS BOX Severe Weather Workshop (May), NBC Boston Severe Weather Workshop (June), and WPRI Providence Severe Weather Workshop (June).

2. Warm season QPF challenges: identifying when model precipitation, areal coverage, location, and maximum amounts will be skillful
Team lead: Justin Arnot (GYX)

Work on this project has been completed.

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 (ALY) and Mike Evans (retired)

Joe Villani continues to update a database of winter storms to evaluate snowfall forecast trends for several cases from 2020 to 2024. The project utilizes GAZPACHO to compare observed vs. forecast snowfall patterns in the Albany County warning area, and specifically evaluates whether there are any poleward or equatorward biases in the forecasts, and whether these biases can be related to characteristic flow patterns.

ARCGIS software has been utilized to quantify some of these potential biases. Preliminary results indicate that a "forecast too-far south" bias was identified for several of our most recent high-impact snow events. A recent presentation was given at the NROW meeting in November 2023 highlighting methodology and some preliminary results.

6. Examination of significant hail events: expand the project across the Northeast U.S.
Team lead: Tom Wasula (ALY)

Some limited additional work has been completed on the significant hail climatology from 1 January 1950 to 31 March 2024 in the NCEI *Storm Data* database. The key results reviewed so far: 1) Significant hail events are on the increase with 181 out of 275 (66%) having occurred this century across NY and New England; 2): 96% (263 out of 275) of events occurred in the months of May to August; 3)138 events have occurred across NY (1 report equals an event). 53 of the 139 events were identified in the warning area of responsibility for the National Weather Service Weather Forecast Office at Albany (eastern NY).

A total of 275 significant hail events have been identified from 1950 to 31 March 2024 across NY and New England. Two new events occurred in 2023. A total of 139 cases have been identified in NY, 53 in the WFO ALY portion of NYS and 86 outside of eastern NY.

The vast majority of the significant hailstones occur between the months of May and August. Forty-three significant hail events have been identified in the state of Massachusetts, 37 significant hail events in Maine (one new report 13 August 2023 in Wellington, ME), 22 in Vermont, 15 in Connecticut, 17 in New Hampshire, and 2 in Rhode Island.

Mike Main and Tom Wasula attempted to submit abstracts for the 31st AMS Conference on Severe Local Storms 21–25 October 2024 that will be in Virginia Beach, VA in May. They were denied by NWS management for submitting an abstract or two. Travel to these conferences is limited by NOAA/NWS funding. Tom and Mike will try to submit for future conferences contingent they are granted permission.

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: Brian J. Frugis (ALY)

   This project has been completed.

6. CSTAR PROJECT RESEARCH IN NWS AFDs

Tuesday 5 December 2023

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

FXUS61 KALY 052037
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
337 PM EST Tue Dec 5 2023

.NEAR TERM /THROUGH WEDNESDAY/...
The upper-level trough will still be over the region much of Wednesday, with the trough axis moving through during the day. **Still limited forcing expected, although some of the higher res guidance indicating some weak Mohawk-Hudson Convergence (CSTAR research) as low pressure tracks south/east of the benchmark resulting in scattered snow showers into parts of the Capital District into the Taconics and Berkshires.** While any snow accumulation would be minor (Trace to 0.5"), will increase measurable PoPs to 30 percent in these areas. High temperatures look to be slightly below normal with 20s in the higher terrain and 30s in the valleys.

NEAR TERM...JPV

Wednesday 6 December 2023

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

FXUS61 KALY 060919
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
419 AM EST Wed Dec 6 2023

.NEAR TERM /THROUGH TONIGHT/...
These snow showers and flurries will persist through this morning and despite very light snow accumulations, morning commuters should still exercise caution this morning as untreated roads and sidewalks could be slippery. Snow showers should gradually diminish in coverage this morning as the trough passes to our east and should exit into New England by 18 UTC. However, a coastal low developing offshore combined with high pressure positioned over Ontario and a weak sfc pressure trough overhead could support snow showers redeveloping over the Capital District this afternoon thanks to some Mohawk Hudson Convergence (MHC) effects. CAMs and other high-res guidance all point to snow showers redeveloping locally as northerly winds down the Hudson interact with west-northwest in the Mohawk Valley. **The CSTAR conceptual model for true MHC shows that the coastal low should be closer to the 40N/70W benchmark and guidance shows the coastal low today displaced to the south.** Thus, any snow shower enhancement from MHC this afternoon over the Capital District should be light with only a coating to a few tenths of snow expected. Otherwise, skies remain cloudy today with little diurnal swing in temperatures once again thanks to northerly sfc winds keeping temperatures cool and snow showers providing some wet-bulb cooling processes. High temperatures only rise into the low to mid 30s for most (cooler mid to upper 20s in the higher terrain).

NEAR TERM...Speciale

Wednesday 6 December 2023

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

FXUS61 KALY 062055
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
355 PM EST Wed Dec 6 2023

.NEAR TERM /UNTIL 6 AM THURSDAY MORNING/...

As of 3:55 PM EST...Upper trough and associated low/mid-level moisture that resulted in widespread snow showers across the region today is currently moving eastwards across the region. Our northern and western zones have seen some low/mid-level drying over the past couple hours, and snow showers have come to an end here. However, we are still seeing an area of snow showers across the Saratoga Region, Capital District, and portions of the Taconics. The snow here is associated with Mohawk Hudson Convergence (MHC), which shows up nicely in NYS Mesonet surface convergence/divergence plots. **This setup closely fits that of the conceptual model developed as part of collaborative CSTAR research with SUNY Albany, with low-level moisture trapped beneath an inversion, low-level cold advection, and a surface low tracking southeast of the 40/70 benchmark.**

NEAR TERM...Main

Sunday 31 December 2023

CSTAR research on Mohawk–Hudson convergence long-term section of the NWS ALY AFD.

FXUS61 KALY 312102
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
402 PM EST Sun Dec 31 2023

.LONG TERM /THURSDAY THROUGH SATURDAY/...
A northern stream upper-level trough is expected to remain neutral to positively tilted as it pushes across the region Thursday into Thursday evening. This feature should eventually phase with a stronger southern stream system but trends continue to favor a track well off the coast and south/east of the 40/70 benchmark. Still, some moisture with the northern stream disturbance will bring some snow showers or a rain/snow mix to the area. **The track and strengthening of the coastal low combined with possible northerly winds down the Hudson and west-northwest winds down the Mohawk fits the conceptual model of possible Mohawk-Hudson Convergence (MHC) per CSTAR research which could enhance precipitation around the Capital District for a time.**

LONG TERM...Rathbun

Monday 1 January 2024

CSTAR research on Mohawk–Hudson convergence long-term section of the NWS ALY AFD.

FXUS61 KALY 010842

AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
342 AM EST Mon Jan 1 2024

.LONG TERM /THURSDAY THROUGH SUNDAY/...
The extended forecast features some chances for light snow, as we progress through the first week of 2024. A positively tilted mid and upper-level longwave trough will be over the eastern CONUS to begin the long term, as the majority of the ensemble and deterministic medium range guidance keeps a coastal or oceanic cyclone well off the East Coast on Thursday. However, as some northern stream short-wave energy attempts to merge with the coastal system some light snow or snow showers could break out. Some Great Lakes moisture will be tapped and some upper-level deformation snowfall Thu pm. **As the strengthening wave goes through rapid cyclogenesis east of Cape Cod some upslope snowfall or even mesoscale or localized Mohawk-Hudson Convergence (MHC) which is documented in CSTAR research with UAlbany may occur.** The MHC was noted well in the previous long term AFD. The MHC could enhance snowfall around the Capital District and northern Taconics for a time for at least light snow accums of a few inches or less into early Thu evening. Ridging builds in quickly late Thu night into Fri. Highs for both days look to be in the lower to mid 30s in the valleys, and 20s to around 30F over the hills and mtns. Lows will be seasonably cold with the anticyclone building in with single digits to teens.

LONG TERM...Wasula

Friday 5 January 2024

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

FXUS61 KALY 050926
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
426 AM EST Fri Jan 5 2024

.SHORT TERM /6 PM THIS EVENING THROUGH SUNDAY NIGHT/...
SREF/GEFS Plume diagrams for KALB support about 6-8" of snow. The pcpn efficiency might not maximize until the early to mid-morning. **Some mesoscale snow banding looks possible per the CSTAR research with some characteristics of a Laterally Translating Band Conceptual Model.** Overall, the heaviest snow looks to set up from the Capital Region, southern VT, and northern Catskills south and east with 6-12" possible. Some upslope enhancement is possible over eastern Catskills. WPC Winter guidance continued to be aggressive with a north and west

enhancement this cycle with a little bit with the snow. We agreed with WPC and WFO BTV to add in northern Washington Co. Some 6-8" are possible. Lows will be mainly in the 20s.

SHORT TERM...Wasula

Friday 5 January 2024

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

FXUS61 KALY 052159
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
459 PM EST Fri Jan 5 2024

.SHORT TERM /6 PM SATURDAY NIGHT THROUGH MONDAY NIGHT/...
Shortly after onset, snow will likely turn steady/moderate quickly as strong lift intersects the dendritic snow growth zone as seen in forecast soundings with frontogenesis within the 700 to 500hPa and even 850 - 700hPa layer strengthening. **Given our parent trough remains an open wave, the set-up favors a quasi-stationary band as identified in the Kenyon CSTAR research.** The HREF probabilistic guidance even show 60% probabilities for >1" per hour snowfall rates through 06 UTC Sunday as far north as the Greater Capital District and southern VT. The forecast therefore maintains "heavy snow possible" wording for Saturday night to account for enhanced snowfall rates with SLR around climatology (10 - 13:1). The 12 UTC guidance trended the coastal low track slightly further north and west closer to the Long Island and slightly north of the 40/70 benchmark. This has therefore shifted the warm nose a bit north as well and we now show the potential for initial moderate snow to mix with sleet in parts of Dutchess, Litchfield, and Berkshire County overnight Saturday which will act to reduce SLRs and overall snowfall totals. Further north, SLRs likely remain near climo overnight. Total snowfall amounts by 12 UTC Sunday likely range from 5–10 inches for much of eastern NY and western New England. Given some uncertainty in how far north and west the strong bands extends, we maintained the watch in southern Adirondacks and Upper Hudson Valley. Areas west of the southern Green Mountains into Bennington/Washington County likely will lower amounts due to precipitation shadowing.

SHORT TERM...Speciale

Friday 12 January 2024

CSTAR research on cold-season wind events was cited in the short-term section of the NWS ALY AFD.

FXUS61 KALY 120949
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
449 AM EST Fri Jan 12 2024

.SHORT TERM /6 AM THIS MORNING THROUGH SUNDAY/...
A low pressure system will deepen and intensify, as it moves into the Midwest around 00Z/SAT and then lifts north/northeast to eastern MI and Georgian Bay by 12Z/SAT. A 925 hPa low-level jet will crank up ahead of the warm front with east/southeast winds increasing to 40-60+ KTS over the Taconics and the western New England higher terrain between 03Z-09Z/SAT. In fact, the U-wind anomalies will be -3 to -5 STDEVs above normal based on the latest NAEFS. The screaming easterlies could produce enough downsloping over the Greens, Berkshires and Taconics to reduce the pcpn quite a bit. **We are also concerned from past climo studies and cool season CSTAR research that some damaging winds could occur in a concentrated area over and just west of the Berkshires, southern Greens in Bennington Co, and the northern Taconics of eastern Rensselaer and eastern Columbia Counties.** We converted the High Wind Watch to a High Wind Warning and added in a few zones. Really tough to figure out exactly where the better gusts will penetrate to the sfc in portions of the area overnight with an advancing pcpn shield. Our greatest confidence was the eastern Catskills, Washington County, the southern Adirondacks and the eastern part of the Capital Region. We included most locations for gusts 40-50 mph, except the mid-Hudson River Valley.

NEAR TERM...Wasula

Friday 19 January 2024

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

FXUS61 KALY 190832
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
332 AM EST Fri Jan 19 2024

.NEAR TERM /UNTIL 6 PM THIS EVENING/...
The snow should start to overspread southwestern portions of our cwa as we head towards sunrise, and will gradually expand northwards through the morning, potentially reaching the Capital District by late morning or early afternoon. The snow showers should taper off as we head towards sunset this evening. **There is a chance that we could see some local enhancement/prolonging of the snow showers here in the Capital District due to Mohawk Hudson Convergence this**

evening. CAMs (HRRR, NAMNEST) have been hinting at this, and while there is a question of how much moisture will be trapped beneath the low- level inversion, other factors identified by CSTAR collaborative research with SUNY Albany (cold advection, surface low passing south of the 40/70 benchmark, weak synoptic forcing) look to be present this afternoon. Today will be chilly with mostly cloudy skies and highs ranging from the 10s in the high terrain to 20s elsewhere.

NEAR TERM...Main/Wasula

Friday 19 January 2024

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

FXUS61 KALY 192109
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
409 PM EST Fri Jan 19 2024

.NEAR TERM /THROUGH SATURDAY/...
Light snow that overspread areas from Interstate 90 southward during the day today from the inverted trough and offshore coastal low will continue to weaken and diminish by 20 to 23 UTC from north to south late this afternoon into early evening. Ground truth observations show accumulations range from coatings in the Mohawk Valley up to 1 to 1.5 inches in the mid-Hudson Valley per the NYS Mesonet observations. High-res guidance continues to hint that some Mohawk Hudson Convergence (MHC) may occur this evening as the weak shortwave trough tracks overhead, resulting in snow showers redeveloping over the central Mohawk Valley into the Capital District as northerly winds down the Hudson Valley converge with westerly winds down the Mohawk River. The 3km NAM and, to a lesser degree, the CMC- Reg have shown these snow showers developing while the HRRR is much weaker. **Given that many of necessary ingredients per the CSTAR research are in place (coastal low tracking well south of the 40N/70W benchmark and weak forcing aloft and at the sfc), we maintained slight chance POPs through 03 UTC for the Mohawk Valley into the Capital District southward, but we will monitor trends and adjust as needed.** The one "fly in the ointment" is the fact that high-res guidance shows winds down the Mohawk River being oriented more from the north northwest instead of northwest in the wake of the shortwave this evening which may reduce the potential for any snow showers to develop.

NEAR TERM...Speciale

Sunday 11 February 2024

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

FXUS61 KALY 110832
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
332 AM EST Sun Feb 11 2024

.SHORT TERM /MONDAY NIGHT THROUGH TUESDAY/...
Deterministic and ensemble guidance(especially GEFS/EPS) have come into better agreement regarding the significant winter storm approaching from the central Appalachians and mid-Atlantic region Monday night into Tuesday. Surface cyclone deepening to ~980 mb or even sub-980 mb is expected as the cyclone center tracks E-NE from near the Delmarva Mon night off the coast to just south of Long Island and southern New England on Tue. While still a progressive system, the upper trough is forecast to become negatively tilted at 500 mb as the storm tracks just SE of Cape Cod. Significant F-Gen NW of the cyclone should result in pronounced mesoscale banding. **Local CSTAR research from UAlbany on mesoscale band movement resembles characteristics of a pivoting band with a closed upper low and dual upper jet structure.** Typically pivoting bands can result in extreme snowfall. However, the greatest challenge with this storm is the anticipated relatively fast movement of this system, so extreme snowfall rates would have to be realized for higher end accumulations to occur since the residence time will not be as long as storms with slower movement. Where the banding sets up will be the location of the heaviest swath of snow, which could be in the 12+", as evidenced by the high end (90%) probabilities. The most favored areas are south/east of Albany. Time frame is still just outside the scope of hi-res guidance, so mesoscale details such as max snowfall rates will come into better focus later today into tonight.

SHORT TERM...JPV

Sunday 11 February 2024

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

FXUS61 KALY 112116
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
416 PM EST Sun Feb 11 2024

.SHORT TERM /MONDAY NIGHT THROUGH TUESDAY NIGHT/...

The strong dynamics will support impressive forcing for ascent and the development of a mesoscale snowband within the northwest quadrant of our cyclone as FGEN within the 700 - 500hPa layer intensifies late Monday night into Tuesday morning. Forecast soundings show the classic cross hair signatures with strong omega intersecting the dendritic snow growth zone so snowfall rates ranging 1 to 2 inches per hour are likely within this mesoscale band. Exactly where this band track is still a bit uncertain but traditionally, we see the band develop a bit displaced north and west of where model guidance shows the strongest 700 - 500hPa FGEN. This would place the band mainly between Poughkeepsie and Albany and the WPC snowband tracker lines up with this thinking as well. SLRs during this event should also be rather high ranging 13 to 15:1 leading to a lighter/fluffy type of snow. **Since we are dealing with a cut-off low, the Kenyon CSTAR conceptual model for mesoscale snowband research shows this matching up with a pivoting band structure so even higher snowfall are possible and areas impacted by this band will see the highest snowfall totals.** The overall residence time of the pivoting band, however, is rather short-lived since this storm is progressive/fast moving and looks to mainly occur Tuesday morning through midday Tuesday. This means hazardous travel conditions for the Tuesday morning commute are likely, especially from the Capital District southward.

SHORT TERM...Speciale

Monday 12 February 2024

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

FXUS61 KALY 120909
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
409 AM EST Mon Feb 12 2024

.SHORT TERM /6 PM THIS EVENING THROUGH WEDNESDAY/...
The feature bringing this snowfall will begin to lift east-northeastward from the southern Plains today and will quickly reach the mid-Atlantic states tonight into early Tuesday. Less phasing with a northern stream trough digging into the Upper Great Lakes will quickly send this and the surface low out to sea by Tuesday afternoon. Strong upper-level divergent flow will cause this surface low to quickly intensify into a sub-980hPa low as it exits the coast. A zone of moderate to heavy precipitation is expected on the colder, northwestern quadrant of this low and, as noted above, now looks to cross across areas mainly south and east of Albany. Within these zones, snowfall rates up to around 2 inches per hour will be possible within any heavy mesoscale snow bands. **The overall synoptic pattern of this event would favor pivoting snowbands per CSTAR research.** With the sharper cut- off in precipitation on its northern edge, snow chances have decreased from the Capital District and points north and west.

SHORT TERM...Rathbun

Wednesday 14 February 2024

CSTAR research on orographically-enhanced snowfall was cited in the short-term section of the NWS ALY AFD.

FXUS61 KALY 140839
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
339 AM EST Wed Feb 14 2024

.SHORT TERM /6 PM THIS EVENING THROUGH FRIDAY NIGHT/...
Thu night into Friday morning the isentropic lift increases on the 285/290K surfaces with the sfc cyclone and its warm or occluded front impacting the region. The southwest flow will enhance the snowfall off the southwest corridor of the southern Adirondacks. **This is documented research from CSTAR by Villani on local flows enhancing snowfall in favored orographic areas in Albany County Warning Area.** A great example of research to operations to improve ops and forecasting due to the strong multi-decadal collaborative partnership with UAlbany. We will have to be vigilant for localized warning level snowfall for north-central Herkimer and western Hamilton counties. We may need to raise some flags high for advisory level snow tallies for the western Mohawk Valley, southern and western Adirondacks, and the southern Greens and northern Berkshires of MA for 3-7" of snow with perhaps 7"+ in the west/southwest Adirondacks/isolated warnings/. The Capital Region and northern and eastern Catskills may have 1-4"...with as much as 2-4" in the northern Taconics and the Upper Hudson and Lake George Corridor. A coating to a few inches in the mid-Hudson Valley, southern Taconics and NW CT. Lows Thu night will be in the teens and 20s.

SHORT TERM...Wasula

Thursday 15 February 2024

CSTAR research on orographically-enhanced snowfall was cited in the short-term section of the NWS ALY AFD.

FXUS61 KALY 150935
AFDALY

.NEAR TERM /UNTIL 6 PM THIS EVENING/...

The leading edge of warm advection precipitation tied to the dynamic Clipper low will move towards the western Mohawk Valley and western Adirondack between 1-4 pm. We have the advisories starting in the early afternoon for Mohawk Valley and the warnings for Hamilton and northern Herkimer Counties. We believe 3-6" of snow may occur due to a combination of synoptic lift and some lake effect in the west-central Mohawk Valley. **For the west-southwest Adirondacks orographic enhancement due to the strong south to southwest low-level jet should increase snowfall rates in the southwest Dacks prior to nightfall which was shown with local CSTAR work with UAlbany.** Further east, the snow begins in the Hudson Valley corridor to western New England 4-6 pm. We began the advisories for the northern Saratoga / Warren Counties and southern VT based on collab and the timing of some of the CAMS. It could hold off to around 6 pm. Some snowfall rates up to an inch per hour are possible over the southern Dacks.

NEAR TERM...Wasula

Saturday 24 February 2024

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

FXUS61 KALY 241425
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
925 AM EST Sat Feb 24 2024

.NEAR TERM /UNTIL 6 PM THIS EVENING/...
.UPDATE...As of 925 AM EST, cold front has now crossed the region and cold air advection continues with current temperatures ranging from the lower 30s across the mid-Hudson Valley to the single digits across the Adirondacks. The advancement of drier air has also resulted in a decrease in clouds across many areas but some clouds remain across portions of the Hudson Valley and western New England. **In addition, north/northeasterly winds down the Hudson combined with northwesterly winds down the Mohawk is resulting in some Mohawk-Hudson Convergence (MHC per CSTAR research) which is providing some lift for a few light flurries within the vicinity of the Capital District.** As drier continues to advect in, these clouds and flurries will end and mostly sunny and dry weather then be expected for the remainder of the day.

NEAR TERM...Rathbun/Wasula

Sunday 3 March 2024

CSTAR research on Mohawk–Hudson Convergence was cited in the near-term section of the NWS

ALY AFD.

FXUS61 KALY 031805
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
105 PM EST Sun Mar 3 2024

.NEAR TERM /UNTIL 6 PM THIS EVENING/...
Also noting some weak radar echoes near the Capital District, and a couple sprinkles can`t be ruled out here through the next hour or two. **This is due to low-level convergent flow where the Mohawk and Hudson valleys meet, even though this does not fit the textbook conceptual model for MHC that was developed through CSTAR collaborative research with SUNY Albany.** Other than the temperature and sky adjustments, previous forecast remains on track. Please see the previous discussion below for more details...

NEAR TERM...Main/NAS

Sunday 2 June 2024

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

FXUS61 KALY 021958
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
358 PM EDT Sun Jun 2 2024

.LONG TERM /WEDNESDAY THROUGH SUNDAY/...
A broad mid and upper-level trough sets up over the Great Lakes Region, southeast Canada into the Northeast. The H500 circulation closes off upstream with short-waves moving around it Thu night into the weekend. In the cyclonic flow, periods/bouts of showers and some thunderstorms will be possible Fri and Sat into the afternoon. Depending on the strength of the cold pool some hail may be possible. A few of the thunderstorms may be on the stronger side. The better forcing on Friday may be from the Capital Region north and west. **CSTAR warm season work has documented the sensible and significant weather with closed/cut-off lows, as some locations could receive appreciable rainfall with any showers/thunderstorms moving repeatedly over the same area.** Lows Thu and Fri night will be in the 50s to lower 60s. Highs Friday will be in the mid 60s to upper 70s with cooler readings in the 60s to lower/mid 70s with the upper low coming overhead on Saturday.

LONG TERM...Wasula

Monday 3 June 2024

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

FXUS61 KALY 030839
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
439 AM EDT Mon Jun 3 2024

.LONG TERM /WEDNESDAY NIGHT THROUGH SUNDAY/...
Past CSTAR research suggests that there could be considerable strong thunderstorm activity ahead of the upper low and associated cold front, with strong to severe thunderstorms and locally heavy rain. However, there is a lot of uncertainty about where the upper low will cut off and track.

LONG TERM...NAS

Monday 24 June 2024

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

FXUS61 KALY 242327
AFDALY

AREA FORECAST DISCUSSION
National Weather Service Albany NY
727 PM EDT Mon Jun 24 2024

.NEAR TERM /UNTIL 6 AM TUESDAY MORNING/...
.UPDATE...As of 725 PM EDT, an upper-level low is now located near the coast of Maine and will continue to depart farther to the east tonight. Weak upper-level ridging and surface high pressure then builds into the region by daybreak Tuesday. Showers have been quickly decreasing in coverage over the past hour or so but a few batches still remain, mainly for areas just south and east of the City of Albany. **These showers may be enhanced by Mohawk-Hudson Convergence (MHC) with northerly winds down the Hudson Valley and northwesterly winds down the**

Mohawk Valley (per CSTAR research). These showers will continue to diminish over the next couple of hours with dry weather then expected the rest of the night with decreasing clouds. Some patchy fog will likely develop overnight, especially for areas that saw rain today and where winds trend light to calm.

NEAR TERM...Frugis/Rathbun