February 3 - 4, 2022
Complex Ice, Sleet & Snow Event
NWS Albany

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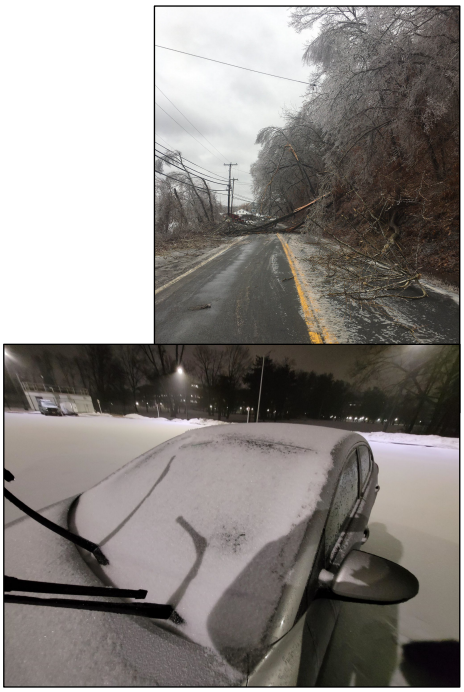
Outline

- Synoptic Overview including Large-Scale Anomalies
- Mesoscale Analysis of Precip Transition Zones
- Evaluation of Model Solutions
- Forecast Headlines (Watch/Warning/Advisories)
- Observations and Impacts
- Verification
- Messaging

In this outline, Tom will cover the Synoptic Overview and Mesoscale Analysis. He will also review a brief evaluation of model solutions. Dan will also review some of these. Tom will also review the forecast headlines. Dan will focus on Observations and Impacts and some verification. Christina's portions will review verification and messaging.

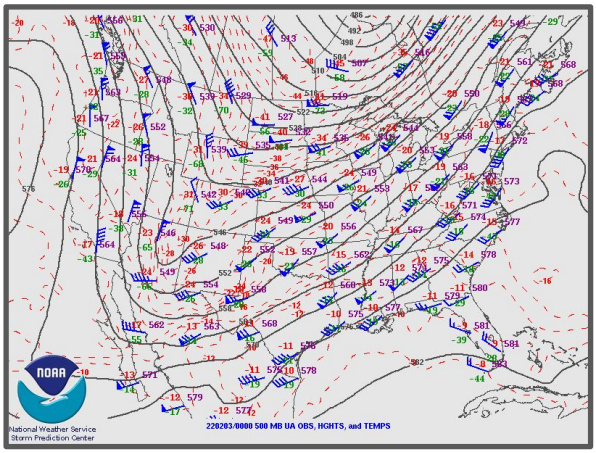
Brief Event Overview

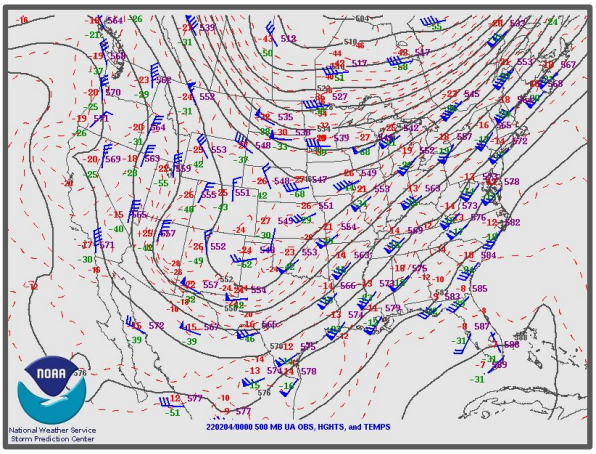
- Prolonged period of significant precipitation 3-4 Feb 2022 with 1-2.5” of liquid equivalent over eastern NY/western New England (more liquid equivalent than received in Jan 2022)
- Rain during the day 3 Feb turned to a variety of wintry precip types during the evening, persisting into the morning hours 4 Feb
- Severe but localized ice storm over portions of the Mid-Hudson Valley
- 16 consecutive hours of sleet at KALB totaling around 2” for the Capital District
- 8-16” snow for the Mohawk Valley, Lake George Area and southern Adirondacks



The event highlights are noted, as this heavy precipitation event with liquid equivalents of 1-2.5” exceeded totals precipitation amounts for the month of January at many sites across eastern NY and western New England. It was very cold and dry with mainly light precipitation event in January 2022 for the ALY forecast area. The localized ice storm for eastern Ulster County, and also eastern Columbia County were severe. However, the widespread heavy sleet accumulations of 1-2+ inches across the Capital Region, Schoharie and eastern Mohawk Valley were extreme. A heavy snow event occurred over the northern tier of the forecast area, and also the western Mohawk Valley.

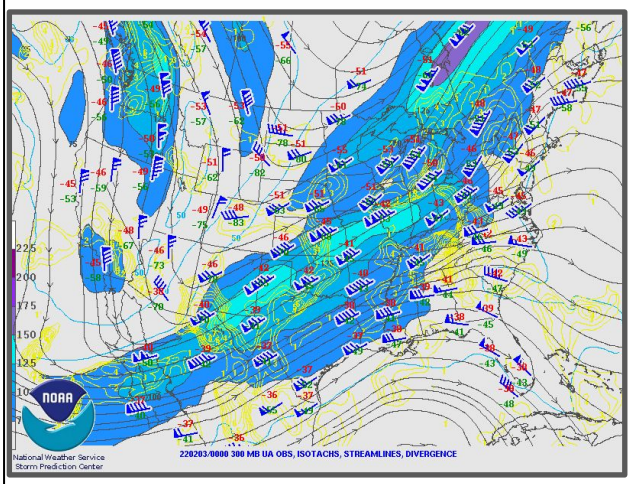
0000 UTC 3 & 4 FEB 2022 500 hPa Analyses

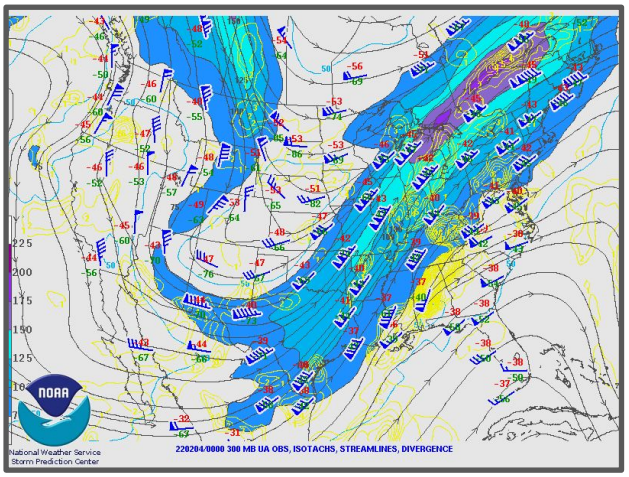




A positively tilted mid and upper level trough extended from the 4-Corners/southern Rockies into the Plains with broad southwest flow over the Northeast. The area of mid-level confluence would strengthen over the Great Lakes Region and Northeast as the positively tilted mid and upper level trough moved slowly eastward. The mid-level jet increased to 80-100 knots over southeast Canada and the Northeast with plenty of Gulf and eastern Pacific moisture that would be utilized ahead of the slow moving cold front.

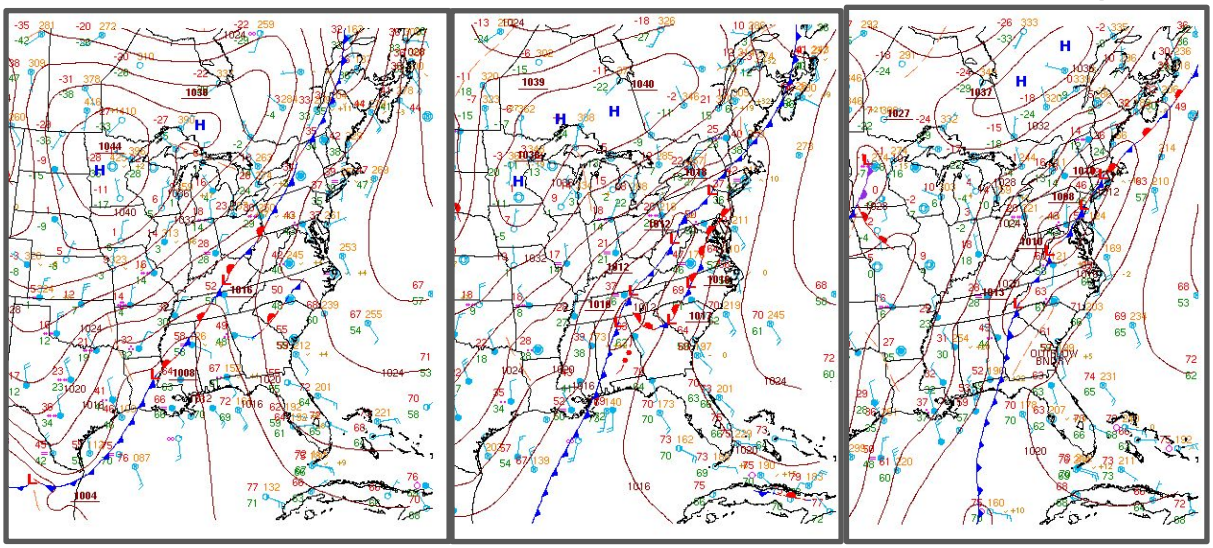
0000 UTC 3 & 4 FEB 2022 300 hPa Isotachs, Streamlines and Divergence





Wednesday night into Thursday morning 0000 UTC 3 Feb 2022 a double jet structure was over eastern Canada and the lower 48. The right entrance of 150-175 knot jet steak would begin to interact with the left front quadrant of the equatorward jet streak over the Midwest. By 000 UTC 4 Feb 2022, a powerful 150-200 knot jet streak would just to the north and west of upstate NY. A corridor of upper level divergence would be located near the right/equatorward entrance region of the jet streak to help provide upper level support for heavy precipitation.

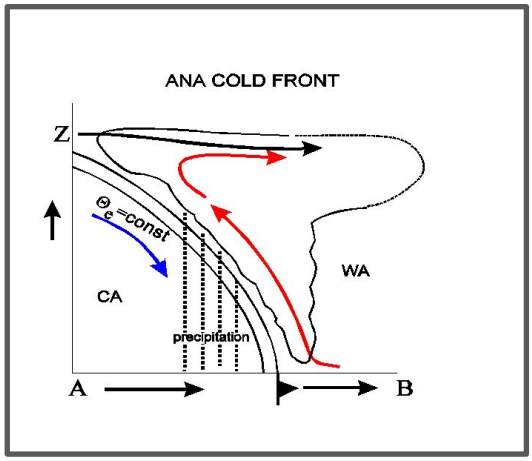
1200 UTC 3 Feb - 1200 UTC 4 Feb 2022 Surface Maps

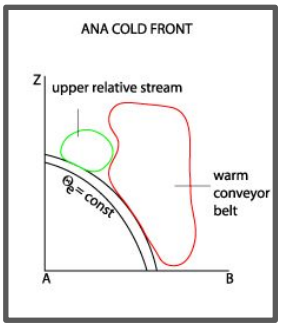


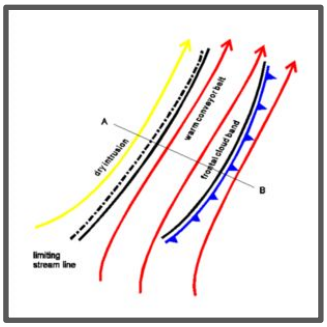
1200 UTC 3 FEB | 0000 UTC 4 FEB | 1200 UTC 4 FEB

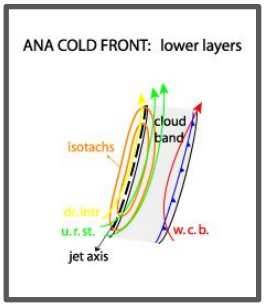
The key take-away is a slow moving cold front that would function more like an ana-cold front with the majority of the precipitation on the back side of the front late Thursday afternoon through Friday morning. Rain would transition to snow, sleet and freezing rain depending on the depth of the sub-freezing air. The 1044 hPa anticyclone near the Upper Midwest and Great Lakes Region would funnel arctic air back towards the Northeast. Multiple waves of low pressure would ride along the front. The shallow cold air would seep down the valley, and the placement of the warm nose and its strength would be critical where snow, sleet, and freezing rain occurred after 0000 UTC 4 FEB.

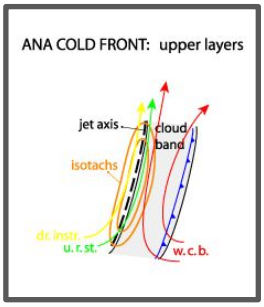
Ana Cold Front Schematics







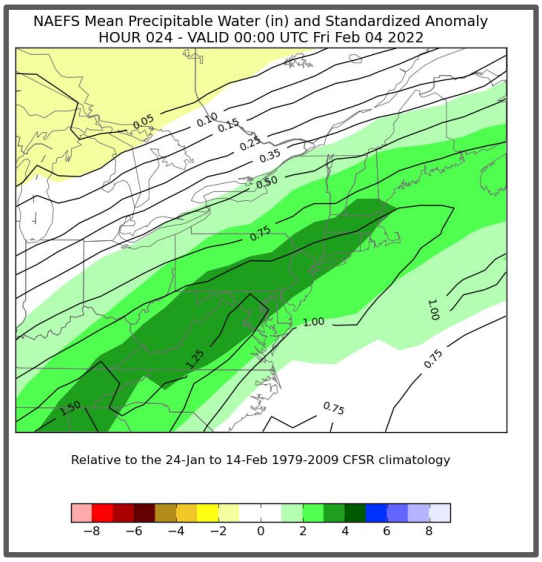


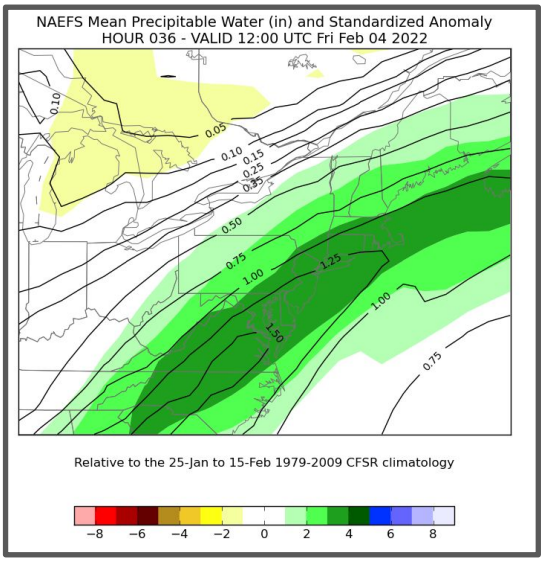


Source:
https://rammb.cira.colostate.edu/wmovl/vrl/tutorials/satmanu-eumetsat/satmanu/cms/cf/backgr.htm

These schematics are fairly self explanatory showing a cross-section or two, and low and upper level imagery of an ana-cold front. The precipitation is wrapped behind the cold front with the wind shift with the boundary. Kata-cold front has a burst of precipitation ahead of the front and then the wind shift. The warm conveyor belt interacts with the upper jet axis. The flow does become a bit parallel with the precipitation training some. This front became ana-frontal with a few weak waves moving along it into Friday morning/early pm.

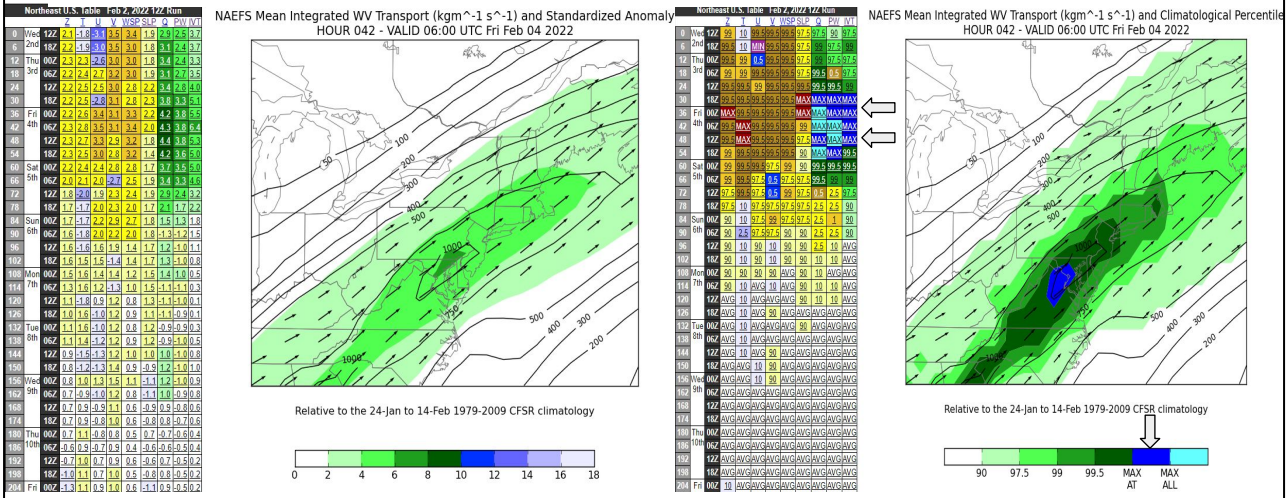
0000 UTC 3 Feb 2002 NAEFS PWAT Anomalies





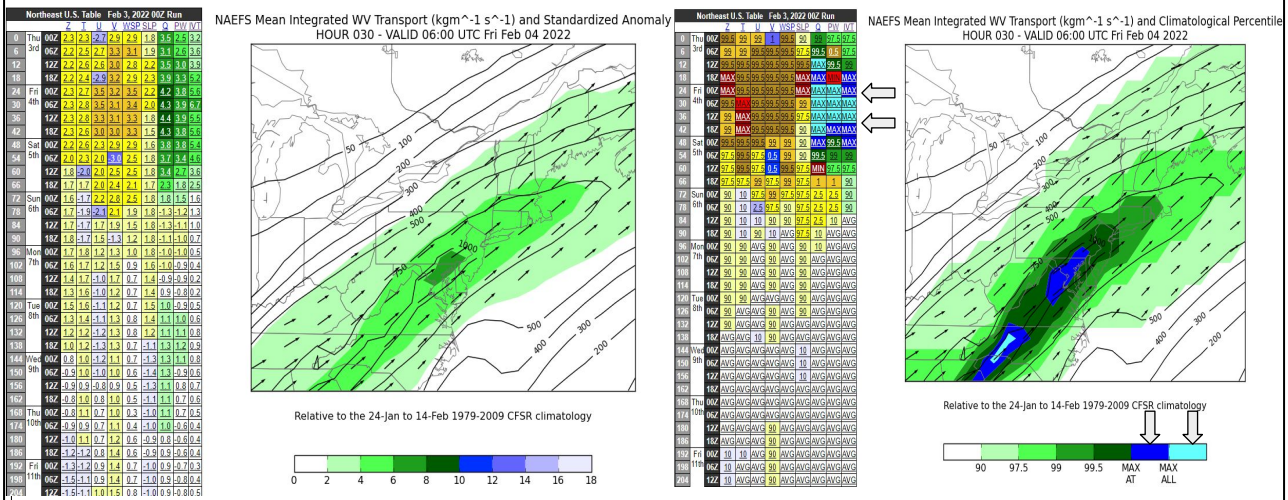
The NAEFS comprised of 20 Canadian Ensemble members and 20 GFS Ensemble members consistently showed a plume of anomalous PWAT air moving across most of the forecast area. PWAT anomalies were +2 to +5 stand deviations above normal. The axis of the greatest anomalies was from the Capital Region, Berkshires, and northern Catskills south and east 0000 and 1200 UTC FRI based on the NAEFS Thursday morning.

12 UTC Feb 2 Moisture Anomalies per the NAEFS



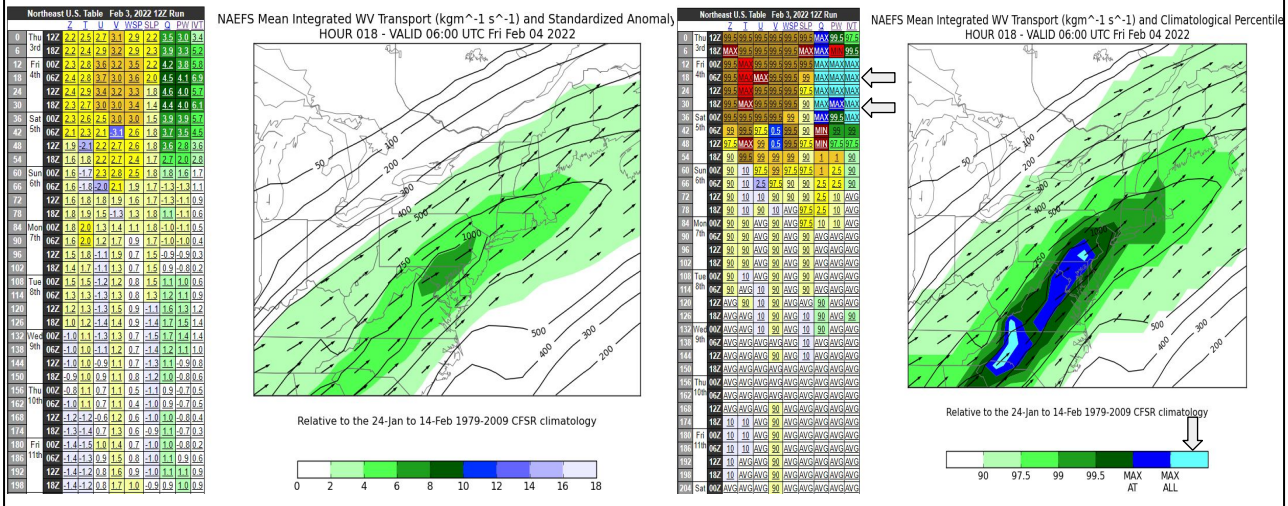
The NAEFS depicted a few days in advance (as early as 12 UTC Feb 2 2022) an increase in integrated water vapor transport anomalies for Thursday night into Friday morning. These anomalies were +2 to +6 standard deviations above normal. The climate percentiles were in the 97.5% to MAX All time range.

00 UTC Feb 3 Moisture Anomalies per the NAEFS



The NAEFS continued an anomalous moisture flux trend 00 UTC Feb 3 2022. Integrated water vapor transport anomalies for Thursday night into Friday morning were steady at +2 to +6 standard deviations above normal for the ALY forecast area. The climate percentiles were in the 97.5% to MAX All time range.

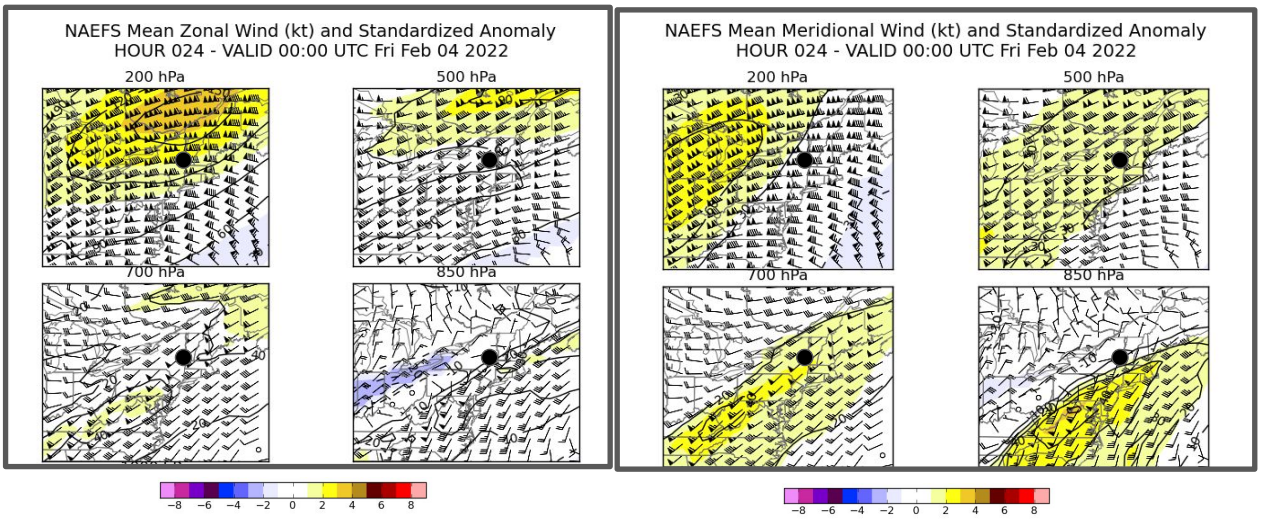
12 UTC Feb 3 Moisture Anomalies per the NAEFS



Finally, the NAEFS continued an anomalous moisture flux trend 12 UTC Feb 3 2022. Integrated water vapor transport anomalies for Thursday night into Friday morning were steady at +2 to +6 standard deviations above normal for the ALY forecast area. The climate percentiles were in the 97.5% to even above the MAX All time range (lightly shaded blue on the color bar).

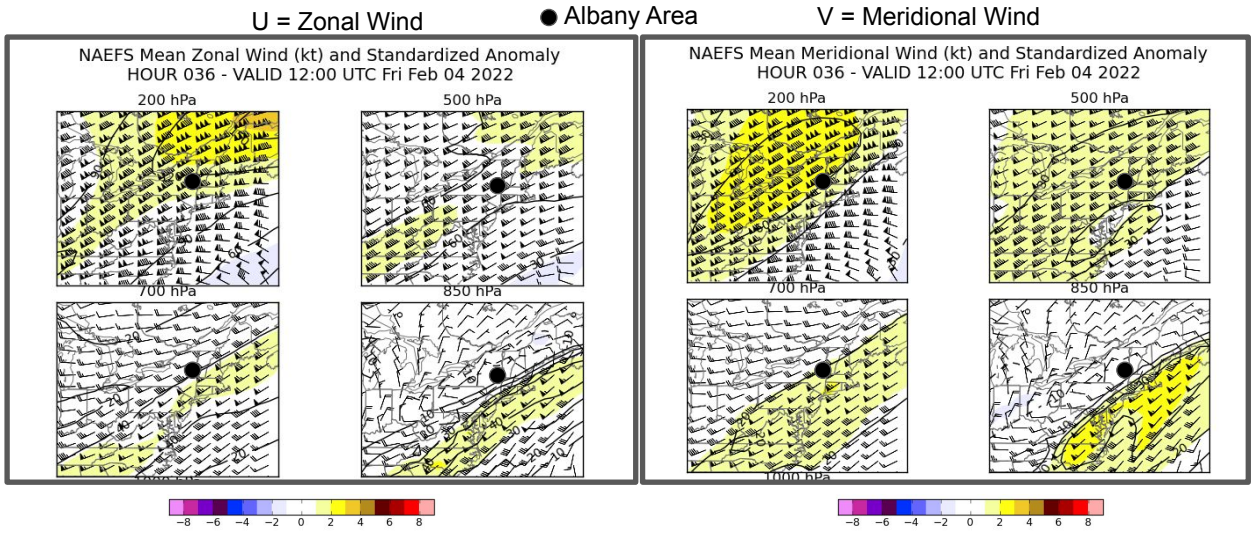
0000 UTC 3 Feb 2022 NAEFS U and V-Wind Anomalies

U = Zonal Wind ● Albany Area V = Meridional Wind



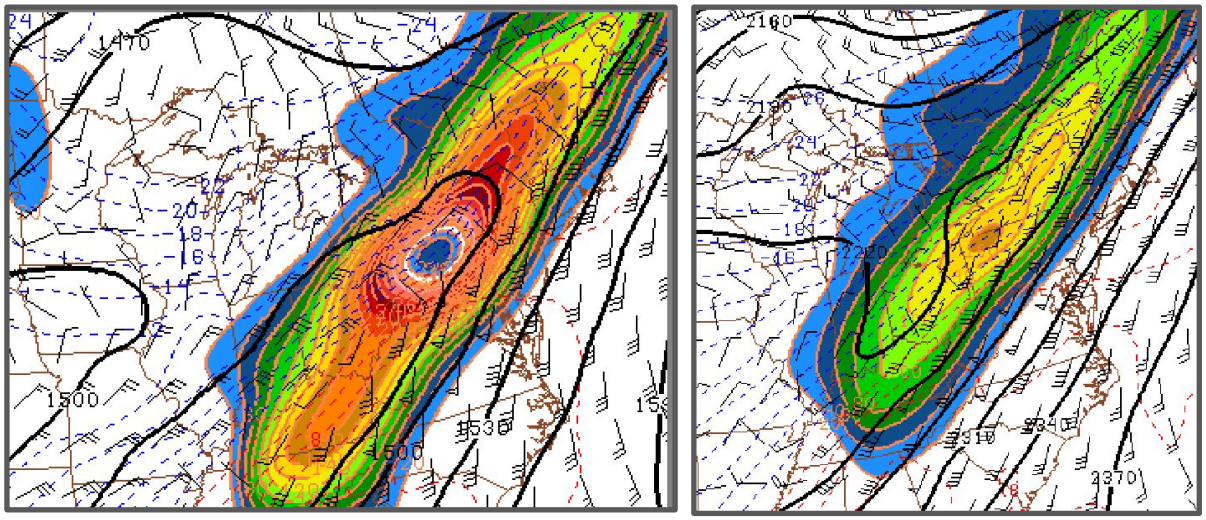
The 0000 UTC 3 FEB 2022 U (zonal) and V (meridional) wind anomalies are shown from 0000 UTC 4 Feb 2022. The southwesterly flow showed contributions from both components, though the 850/700 hPa +V component anomalies (southerlies) were +1 to +3 standard deviations above normal which helped focused the copious moisture. Also, the right entrance of the upper jet in terms of the zonal wind or U-component is show at 500/200 hPa. The dot is where Albany is roughly located.

0000 UTC 3 Feb 2022 NAEFS U and V-Wind Anomalies



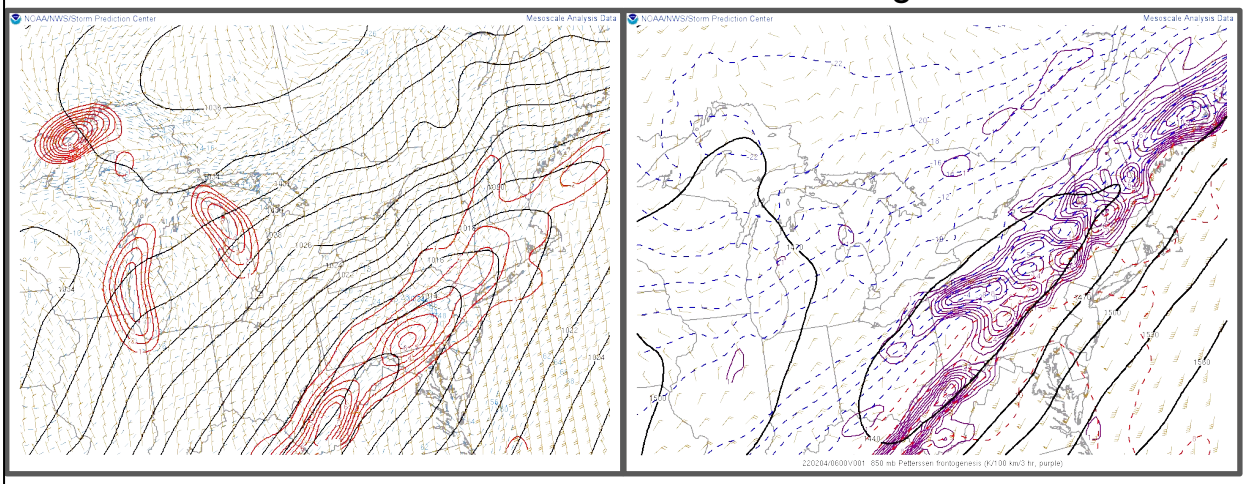
The 0000 UTC 3 FEB 2022 U (zonal) and V (meridional) wind anomalies are shown from 1200 UTC 4 Feb 2022. The southwesterly flow showed contributions from both components, though the 850/700 hPa +V component (southerlies) anomalies were +1 to +3 standard deviations above normal which helped focused the copious moisture and they slowly migrated southward. Also, the right entrance of the upper jet in terms of the zonal wind or U-component is show at 500/200 hPa. The dot is where Albany is roughly located.

0000 UTC 4 FEB 2022 RAPID REFRESH
850 hPa & 850-700 hPa Petterssen Frontogenesis, Temp and Wind



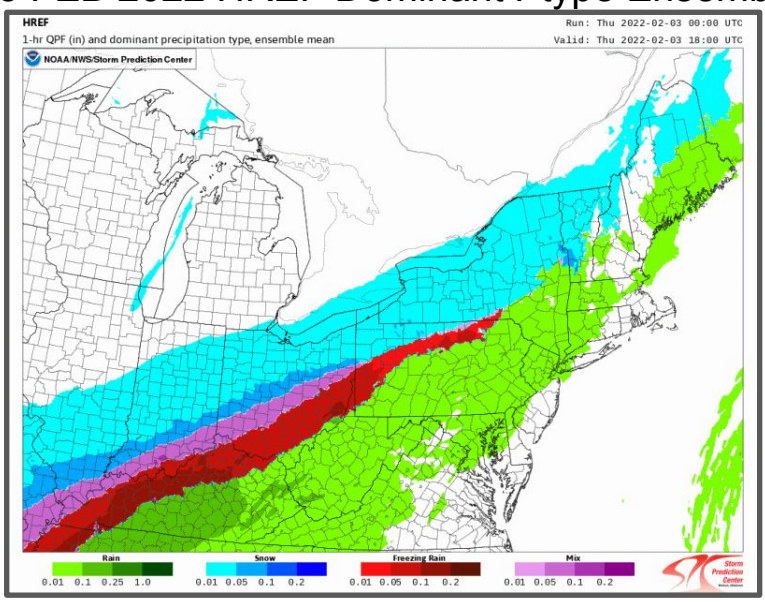
The 2-D Petterssen frontogenesis was impressive at 850 hPa (left image), and in a layer formar from 850-700 hPa with wind overlaid (right image). These images are from the Rapid Refresh mesoanalysis. The maximum in low to mid level FGEN slides across the heart of the forecast with the ana-cold front, and then slid southward Thu night into Friday morning.

0600 UTC 4 FEB 2022 RAPID REFRESH
Surface & 850 hPa Petterssen Frontogenesis



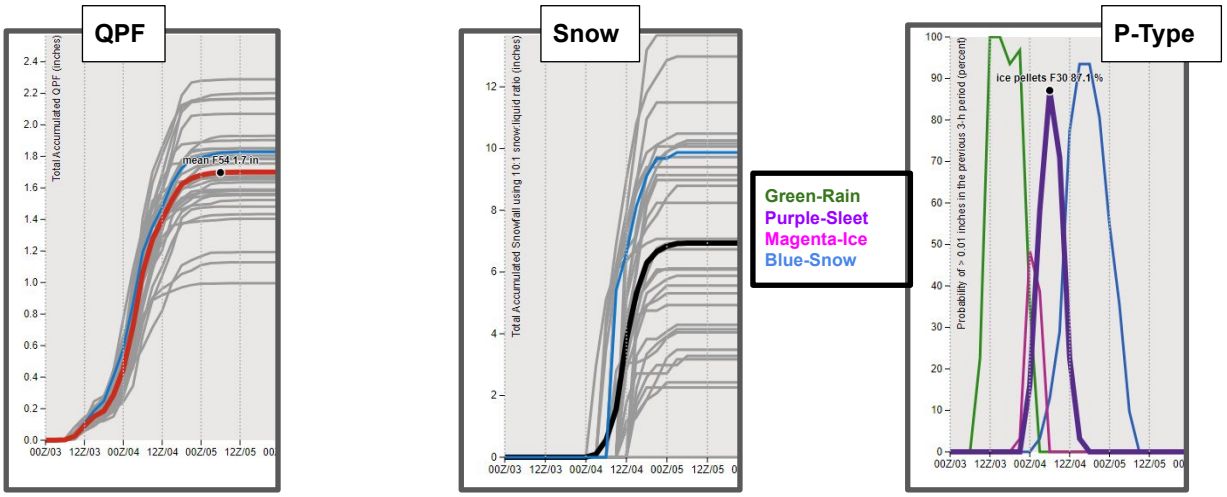
The 0600 UTC 4 FEB 2022 Rapid Refresh continued to show a low-level frontogenetical (FGEN) ribbon along and south of Albany and New England at the surface at this time (left image). The 850 hPa Petterssen FGEN was even more pronounced (purple contours) on the right image.

0000 UTC 3 FEB 2022 HREF Dominant Ptype Ensemble Mean



The 0000 UTC 3 FEB 2022 HREF dominant ptype loop is shown from 1800 UTC 3 Feb 2022 to 2100 UTC 4 Feb 2022. The transition to snow is shown north of the Capital Region in the early to mid afternoon, then to sleet and freezing rain in the late afternoon into the early evening for southern VT, the Capital Region, northern Taconics, and northern Catskills. The transition to snow was expected shortly before 1200 UTC for most of the Capital Region. The icing zone would move southward into the eastern Catskills, mid Hudson Valley, southern Taconics and NW CT around midnight and then transition to sleet shortly before or just after daybreak. One can see the intrusion of shallow cold air down the Hudson River Valley with the p-type transition Thursday night into Friday morning.

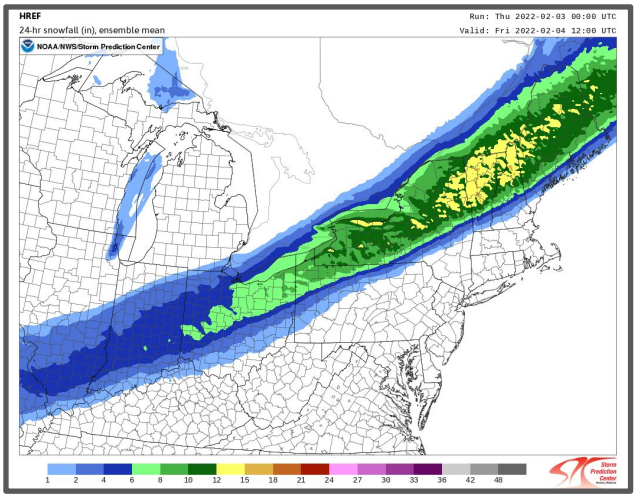
00 UTC 3 FEB 2022 GEFS KALB PLUMES: Lost or Not?



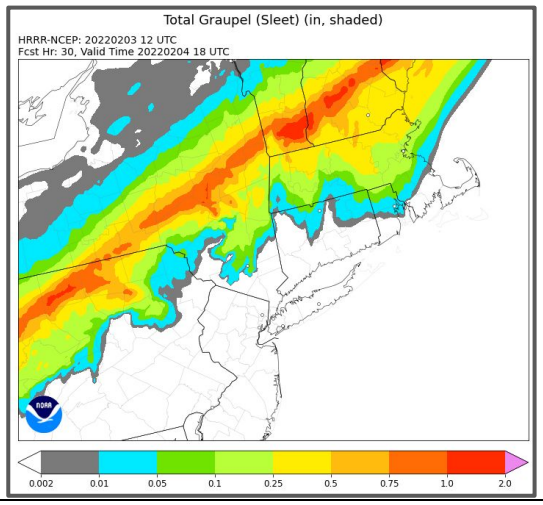
QPF mean was on target, snow mean around 7” (too high by double) and sleet probabilities were high for a 6-hr period. Too cold low-level thermal profiles and not enough sleet accumulation!!

The 00 UTC 3 FEB 2022 KALB GEFS plume diagram is shown. The GFS and and its plume members were on the cold side with this event, as this run the GEFS mean snowfall was 7” and the operational member was around 10”. Albany received 3.3” of snow and sleet. The forecast was around 4.5” of snow and sleet issued at 4 am 3 Feb 2022 for Albany. The total QPF was not far off with 1.7” in the mean, as KALB had 1.58”. The sleet probabilities were high at 87%, but a quicker transition to snow was anticipated by Friday morning. The bottom line was the GFS low-level thermal profiles were too cold, and not enough sleet accumulation was accounted for during this event.

0000 UTC 3 FEB 2022 HREF Ensemble Mean Snowfall



1200 UTC 3 FEB 2022 HRRR Total Accumulated Sleet



The 0000 UTC 3 FEB 2022 HREF ensemble mean snow (left side) and sleet accumulations (right side) are shown. The snow amounts were pretty good along the northern zones, and the gradient of snowfall along the Capital Region, northern Catskills and southern VT was tight at 1-6". The sleet accumulations were too low over the Capital Region with a 0.25-1.0 only. The sleet accumulations were too high over southern VT and parts of the mid Hudson Valley where the localized ice storm occurred. The Capital Region had a widespread 1-2+ inches of heavy sleet.

3 Feb 2022 4 AM Forecast Headlines

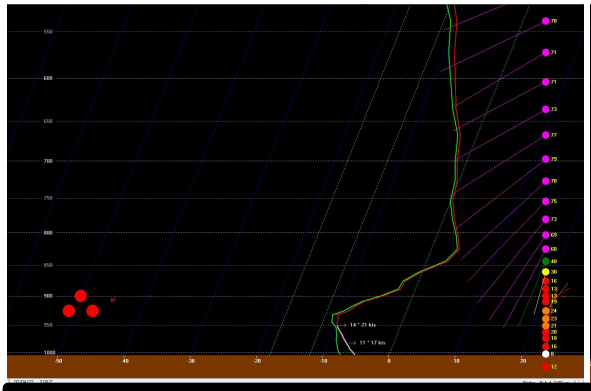
Winter Storm Warning: Severe winter weather that could make travel dangerous is expected or occurring.
Local criteria for snow (NY):
> 7” in 12h or > 9” in 24h **or a combination of winter elements (sleet, snow and ice quantified)**

Winter Weather Advisory: Snow, sleet, and/or freezing rain are expected to cause significant inconvenience. Walking and driving could be difficult.

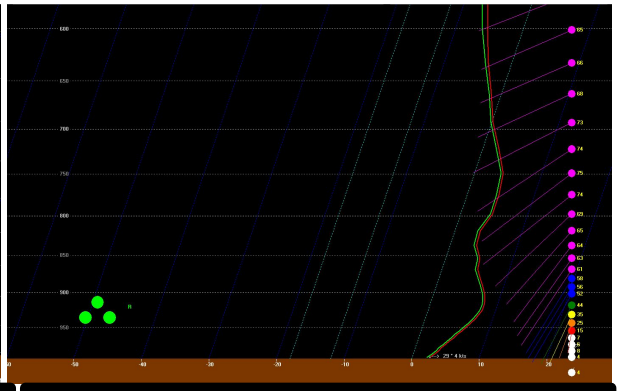
Local criteria for snow (NY):
4-7” in 12h
Local criteria for ice:
trace to < 0.50” flat ice

The Winter Weather headlines are shown. The northern-most zones were in a warning already. The rest of the central and eastern Mohawk Valley, Capital Region, Saratoga Region, northern Catskills,northern Taconics, northern Berkshires and southern VT had the Watch converted to a warning. The eastern Catskills, upper Mid Hudson Valley, and central Taconics and southern Berkshires were converted to advisories from the watch due to questions in ptype, less snow and sleet amounts, more plain rain and ice amounts of 1 to 3 tenths of an inch of ice. The rest of the mid Hudson Valley, southern Taconics, and NW CT were placed in an advisory, as little snow and sleet accumulation was was expected with ice accretions of one to three tenths (short of warning combination verification - Maglaras method). There was time to upgrade portions of the Advisory area (if needed) Thursday/Thursday night and the uncertainty was relayed to the day crew. Due to the heavy QPF of 1-2.5” and a combination of the winter elements warning criteria was achievable, as the AFD mentioned 0.50-2.0” inches of sleet (sleet bomb). 2” of sleet with 1-3” of snow and up to a tenth of an inch of ice with the total QPF verifies warnings. The amount of ice accretion was challenging outside the warning area (i.e. some areas would stay plain rain).

00Z NAM BUFKIT Soundings: KALB vs KPOU: F07Z 4 FEB 2022



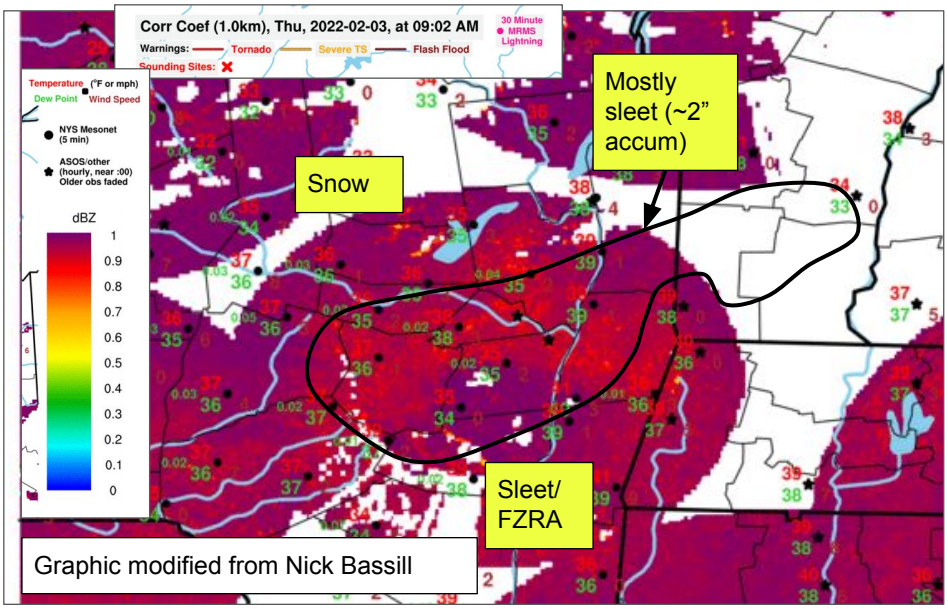
"Sleet bomb" for KALB, as several hours occurred



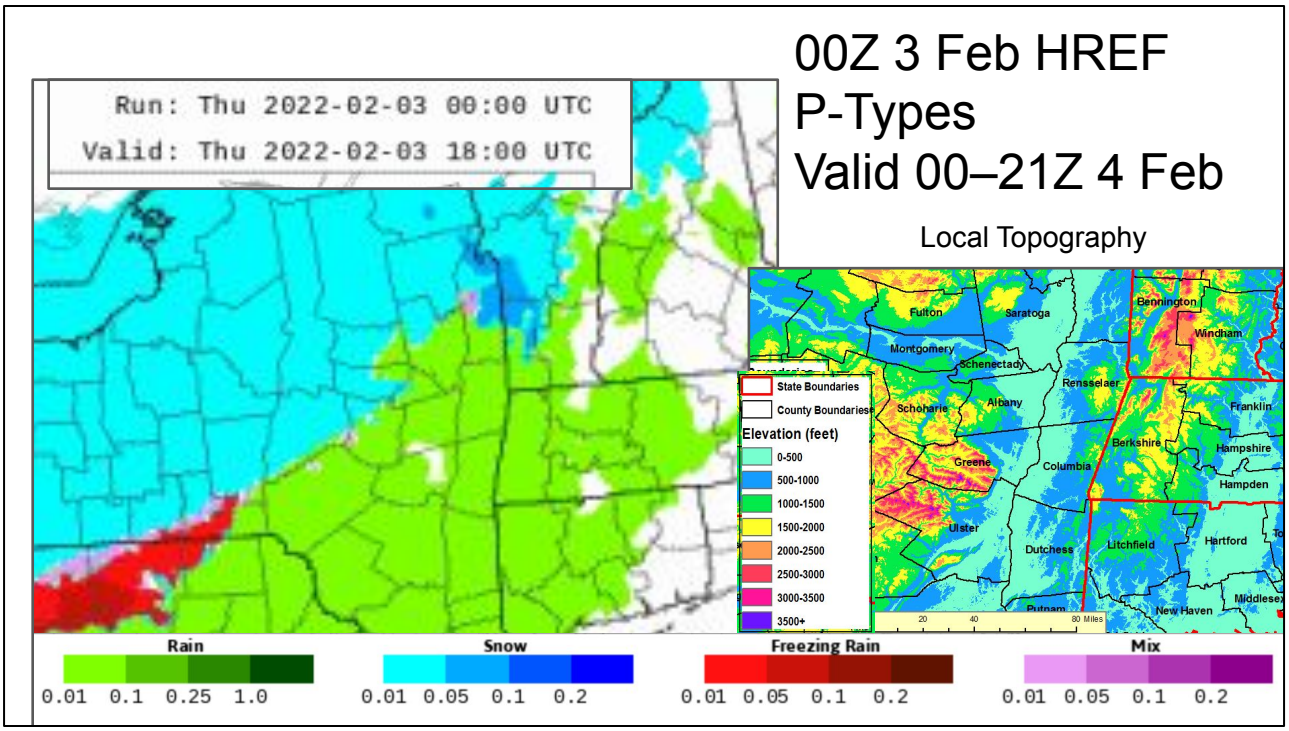
Rain forecasted at KPOU, with a transition to FZRA by 1000 UTC

The 00Z NAM BUKIT on 3 FEB 2022 for 07Z 4 FEB showed the heavy sleet with subfreezing temps below 850 hPa at Albany. The warm nose was about +2 to +3C. The sleet zone remained over the Capital Region for 12-16 hours. Further south KPOU still had plain rain forecasted at 07Z 4 FEB 2022, and then a transition to freezing rain by 1000 UTC 4 FEB 2022. The freezing rain actually occurred much sooner.

Correlation Coefficient and Obs



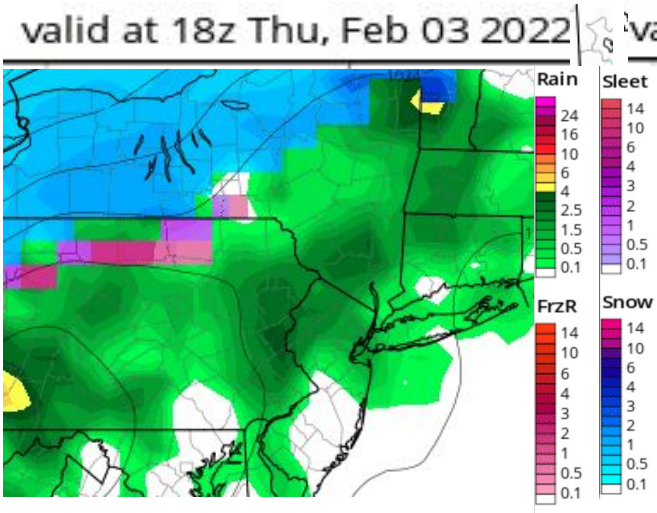
The KENX correlation coefficient imagery for several hours of the event (Around 10 am 3 Feb 2022 to 1 pm 4 Feb 2022) is overlaid in this loop with temps, dewpoints and hourly pcpn from the NYS mesonet sites. The low CC values nicely showed the sleet zone with mixed hydrometeors. The area in black highlighted is the sleet zone with around 2 inches.. Areas to north have higher CC values with more uniform hydrometeors (0.97-0.99) with the snow flakes. The sleet/freezing rain transition zone showed mixed hydrometeors with a lower CC values with combination of rain droplets and ice pellets



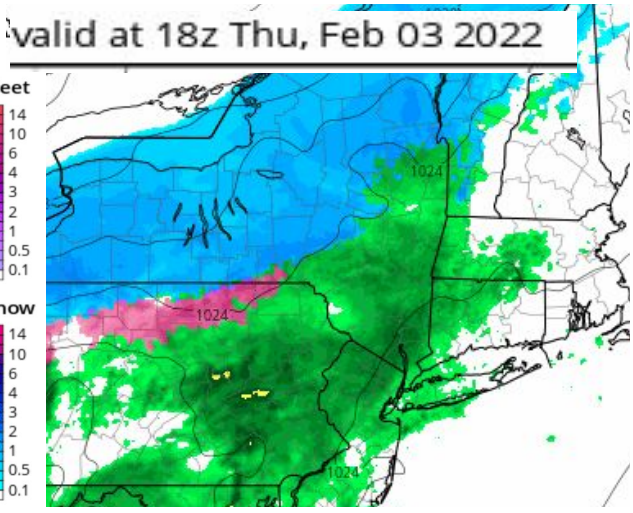
The 00Z 3 Feb run of the HREF showed rain turning to sleet and snow from north to south down the Hudson Valley during the period of heaviest precipitation.

00Z 3 Feb Model P-Types
Valid 18Z 3 Feb through 18Z 4 Feb

GFS20



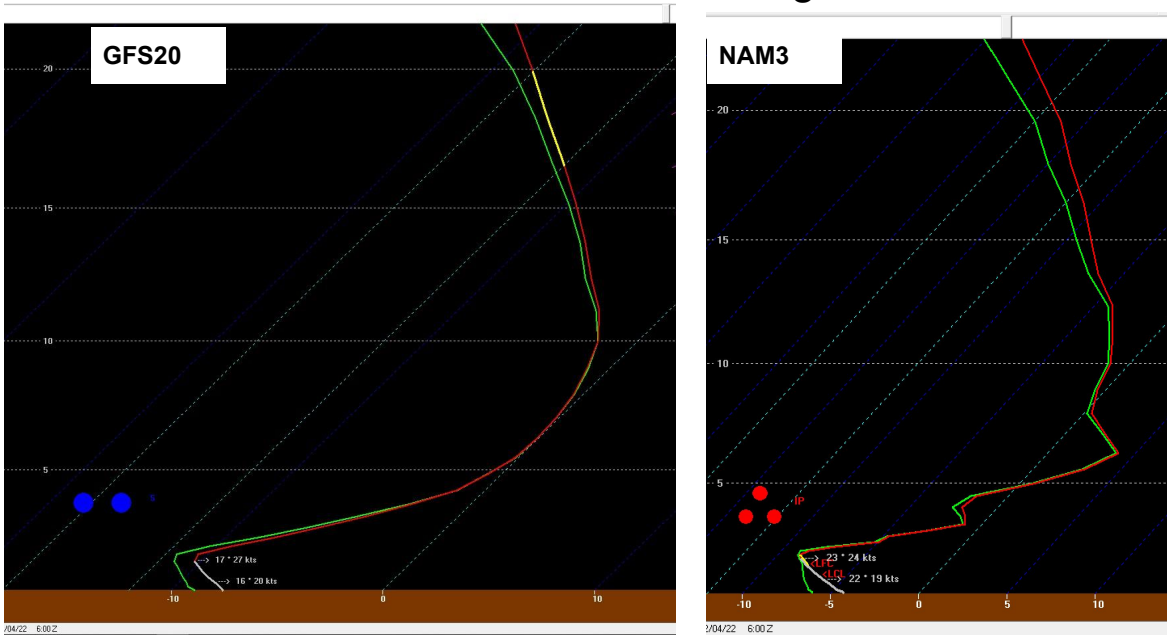
NAM3



Graphics from tropicaltidbits.com

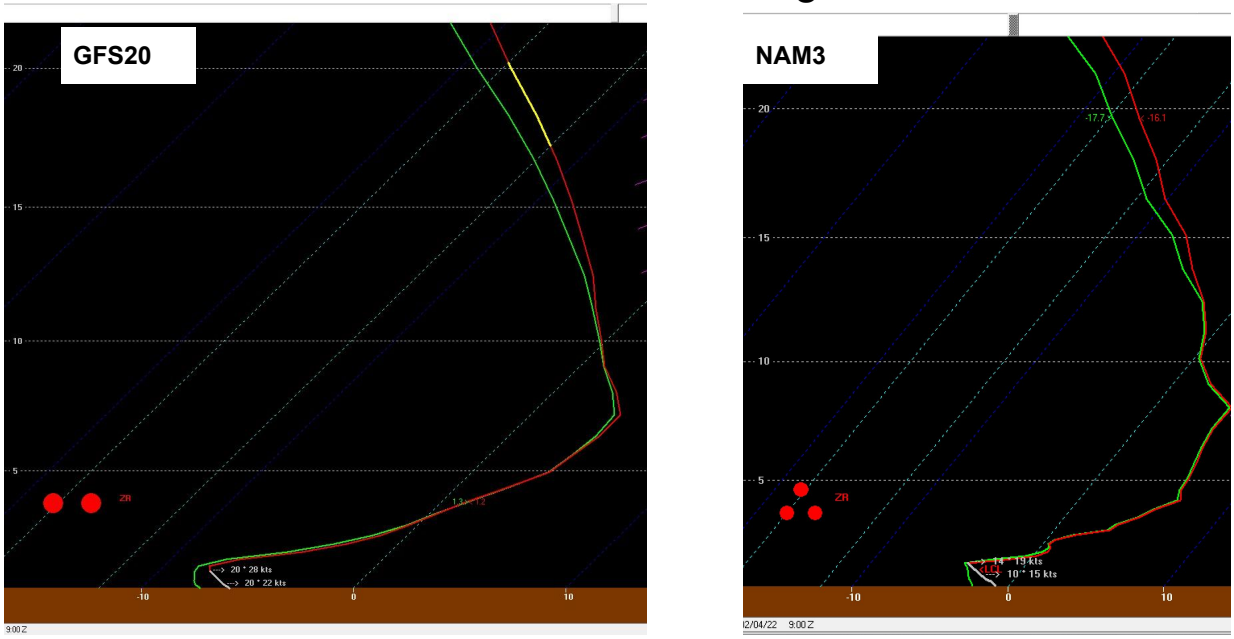
Differences between the GFS20 and NAM3 precip types were notable. The GFS generally had a narrower freezing rain zone compared with the NAM. The following slides will examine why this was the case.

00Z 3 Feb KALB BUFKIT Soundings valid 06Z 4 Feb



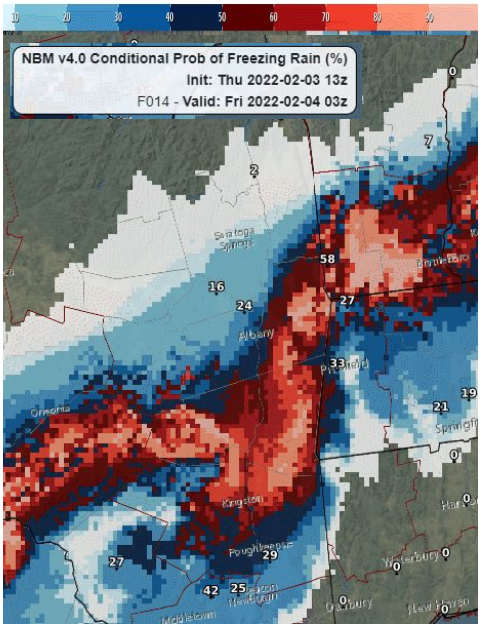
The 00Z 3 Feb KALB forecast soundings valid at 06Z 4 Feb showed that the NAM3 had a stronger warm nose aloft, implying partial melting of hydrometeors. The deep and strong subfreezing cold wedge implied re-freezing of hydrometeors, leading to sleet as the dominant p-type. The GFS20 depicted a temperature profile that was at or below freezing through the depth of the column, implying snow as the dominant p-type. The NAM3 verified better here.

00Z 3 Feb KPOU BUFKIT Soundings valid 09Z 4 Feb

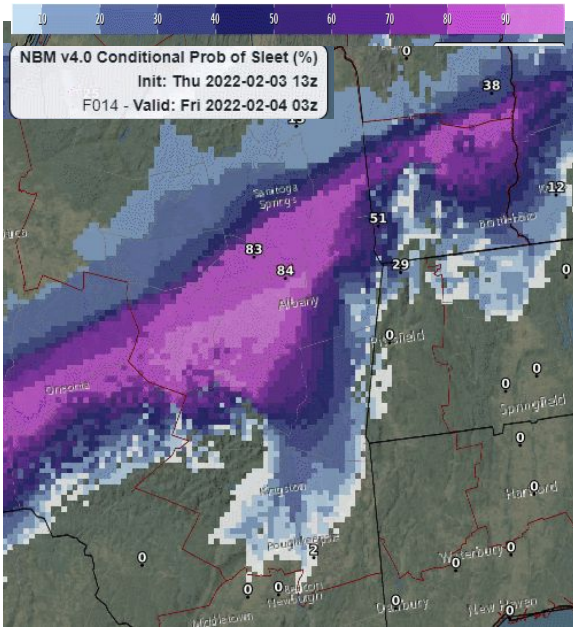


The 00Z 3 Feb KPOU forecast soundings valid at 09Z 4 Feb again showed that the NAM3 had a stronger and deeper warm nose aloft, implying complete melting of hydrometeors. The subfreezing cold wedge near the surface was shallower in the NAM compared with the GFS, with the former implying freezing rain as the dominant p-type, and the latter likely deep enough to imply sleet. The NAM3 verified better here as well.

13Z 3 Feb NBM Conditional Probs of P-Type



03-15Z
4 Feb 2022



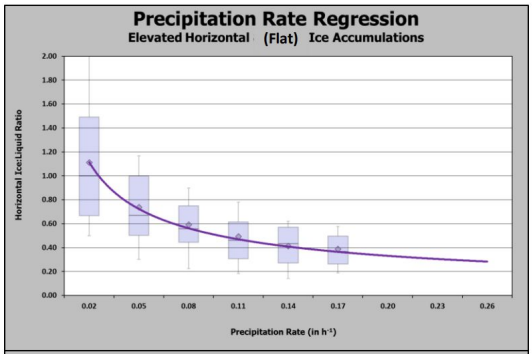
The National Blend of Models (NBM) conditional probability of precip type showed a progression from rain to freezing rain to sleet from north to south. One of the key sources of uncertainty was how quickly the subfreezing wedge of air just above the surface would deepen, resulting in the melted hydrometeors refreezing into sleet.

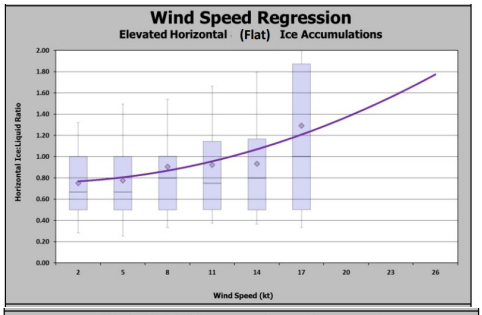
P-Type Uncertainties

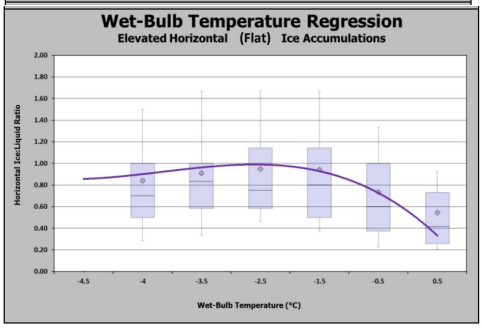
- How far north would the warm nose get?
- How quickly would a shallow subfreezing near-surface air drain southward down the Hudson Valley to result in a change from rain to freezing rain?
- How quickly would that subfreezing layer deepen, resulting in a change from freezing rain to sleet?

Background - Freezing Rain Accumulation Model (FRAM)

- Developed by Sanders and Barjenbruch (2016)
- Predicts ice accretion using regression equations relating precip rate, wet bulb temp, and wind speed to ice to liquid ratio





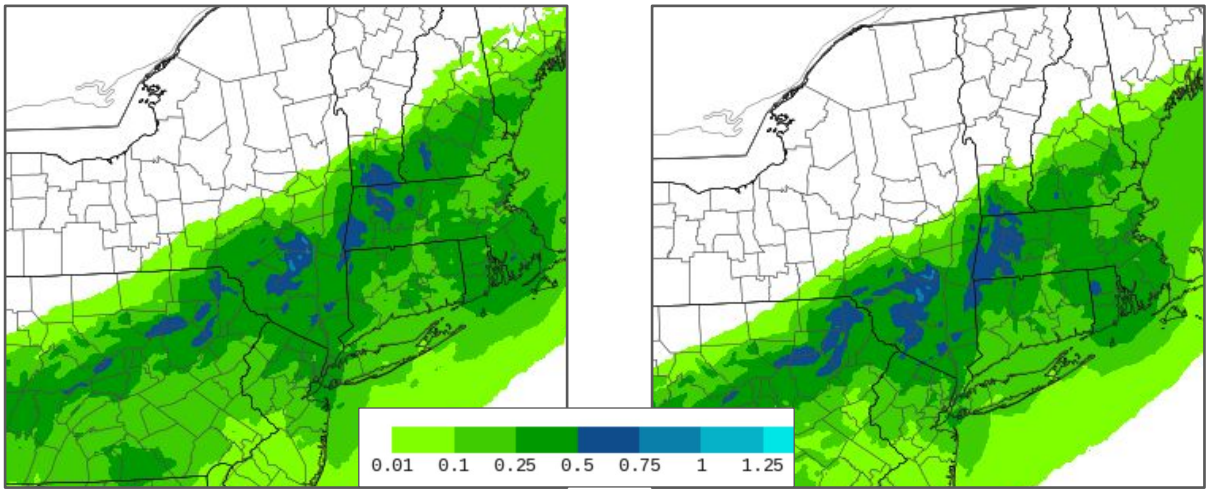


The FRAM is widely used to compute ice accretion forecasts at National Weather Service Forecast Offices.

HREF Mean Event Total FRAM Flat Ice Accretion

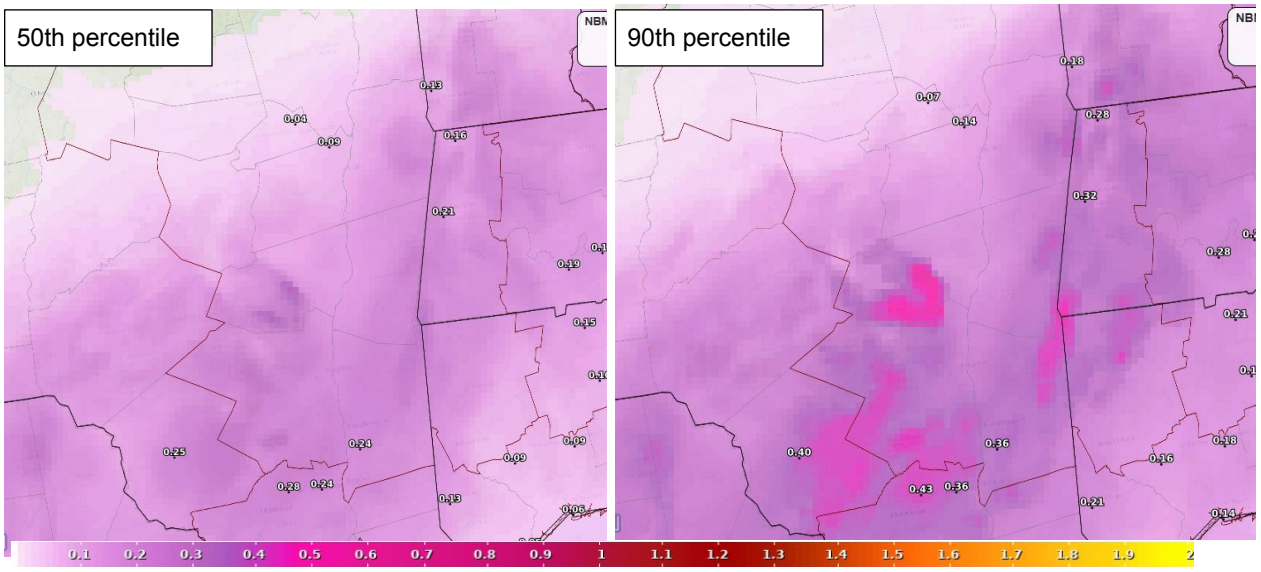
00Z 3 Feb Run

12Z 3 Feb Run



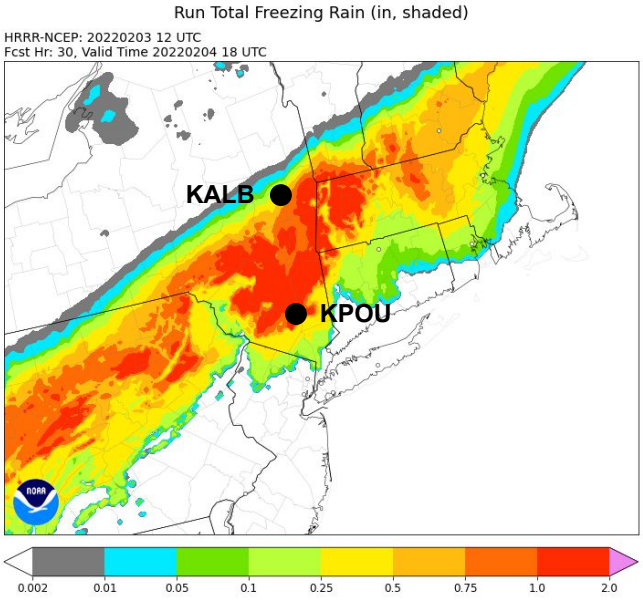
Forecasts from two different runs of the HREF showed generally 0.25-0.50 inches of flat ice accretion over the Mid-Hudson Valley, with amounts exceeding 0.50 inches mainly confined to higher elevations of the Catskills, Taconics, and Berkshires. The 0.50 inch threshold is important as it is the threshold above which the NWS would issue Ice Storm Warnings. Expected ice accretion below this threshold would trigger Winter Weather Advisories. The two different products use different wording describing the severity of anticipated icing events, and may trigger different actions among partners in the emergency management and utility fields.

NBM v4.0 Event Total FRAM Ice Accretion



The 50th and 90th percentiles of the NBM FRAM flat ice accretion forecasts from the 13Z 3 Feb run showed amounts generally 0.25-0.50 inches over the mid-Hudson Valley. The 90th percentile showed some areas > 0.50 inches mainly over the higher terrain of the eastern Catskills.

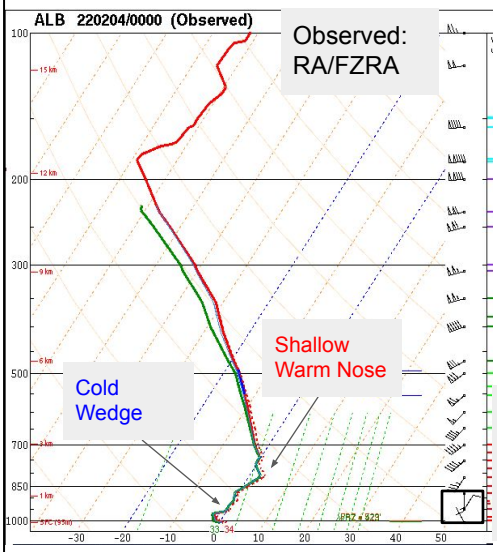
12Z 3 Feb HRRR Accumulated Freezing Rain

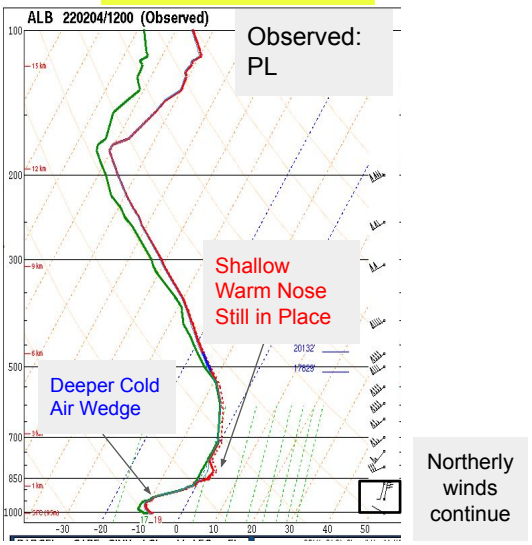


Contrasting with the lower ice accretion forecasts from the HREF and NBM, the 12Z 3 Feb HRRR showed a broad swath of > 1.0 inches of ice accretion between KALB and KPOU, although it is unclear if these graphics use the FRAM or a different method to compute ice accretion.

ALY Sounding Analysis

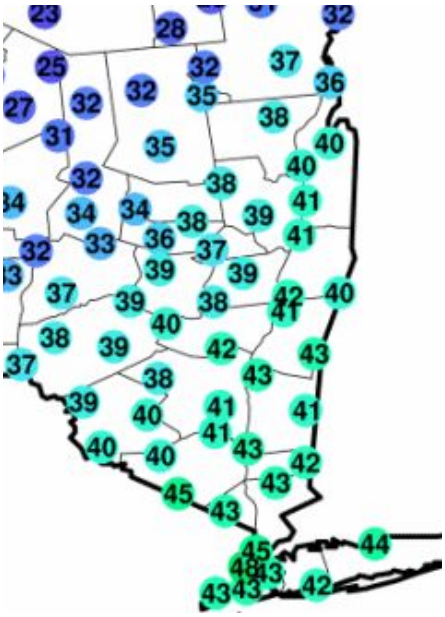
Cold wedge depth ~3300ft & extended to about -12C…sufficient to refreeze partially melted hydrometeors to sleet





The 00Z 4 Feb KALY sounding showed both a weak warm nose and cold wedge. The observed p-type at the time of this sounding was rain changing to freezing rain. Northerly winds below 850 mb deepened the cold wedge with time through the night while strong southwesterly winds above this layer maintained a shallow warm nose. This led to a prolonged period of sleet through the night in the Capital District.

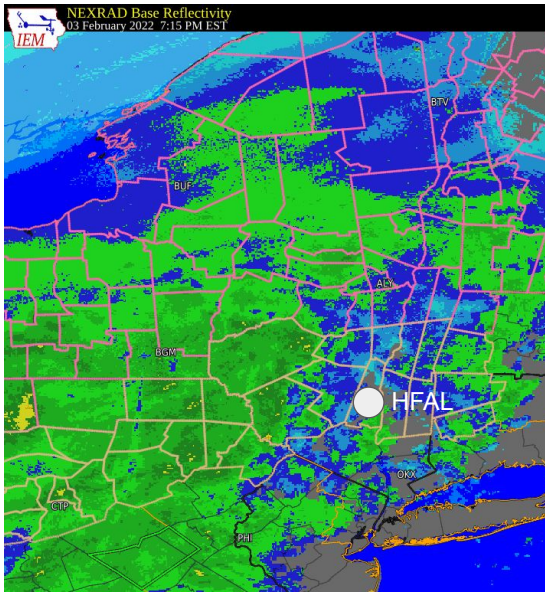
Temperature (°F)
Thursday, 2022-02-03
At 12:00 PM

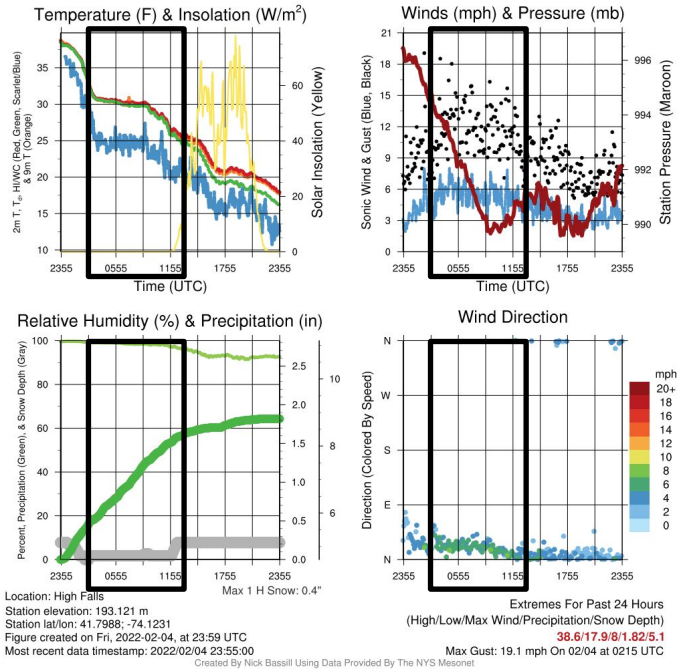


Initially mild air mass on Thursday Feb 3 before a cold front gradually tracked southward and allowed much colder air to filter southward, causing all of eastern NY to drop below freezing by Thurs evening. Temperatures remained in the 20s into Friday Feb 4.

The surge of low-level cold air down the Hudson Valley during the late evening of 3 Feb into the early morning hours of 4 Feb was evident in New York State Mesonet observations. Note that sites at lower elevations near the Ulster/Dutchess County line cooled faster than sites at similar latitude but higher elevation in western Ulster County and eastern Dutchess County.

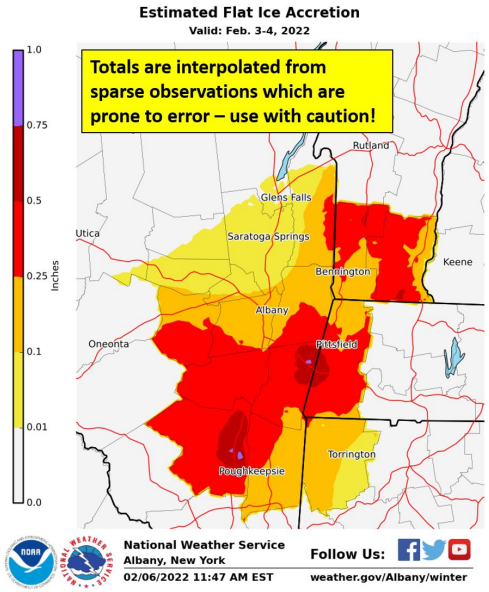
Obs: Radar & HFAL Meteogram



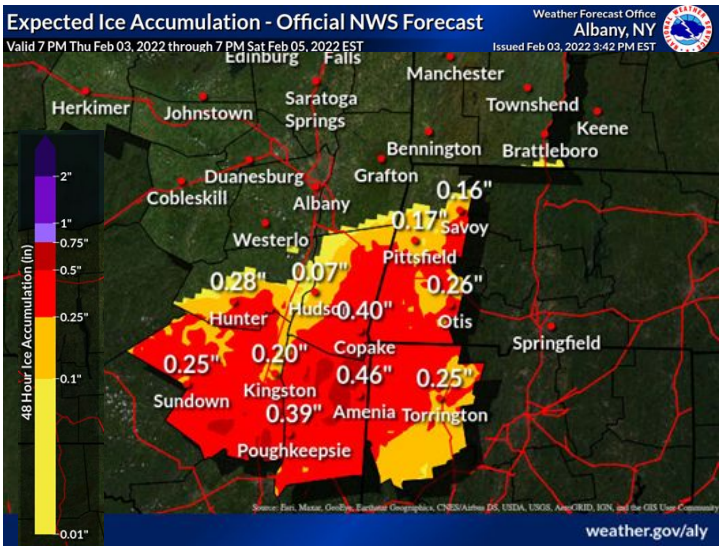


Around an inch of precipitation fell at the High Falls New York State Mesonet site while the surface temperature was below freezing, with all of this occurring as freezing rain. The wind was modest at around 5-10 mph through the night.

Ice Accretion Map Produced from Spotter Observations



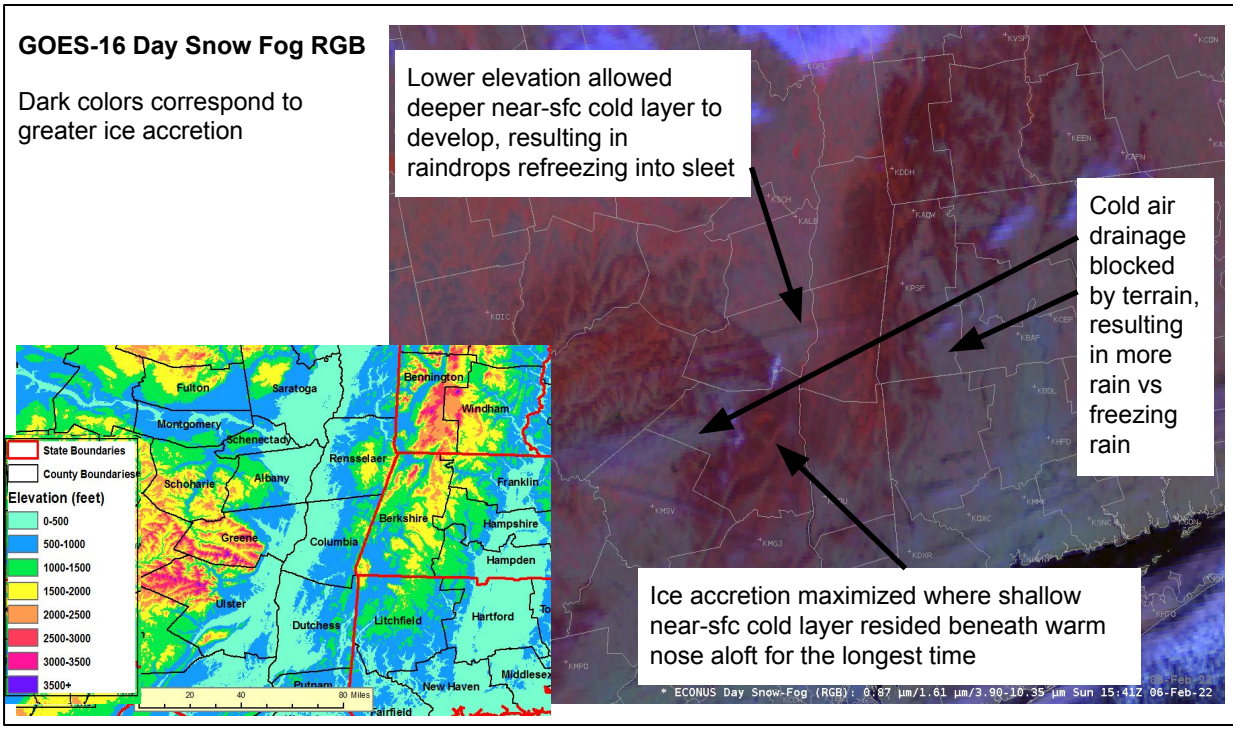
NWS Forecast Issued 4 pm 3 Feb 2022



A map of estimated flat ice accretion produced from spotter observations is shown at left. This can be compared with the NWS forecast issued the afternoon prior to the event at right. NWS forecasted and messaged generally 0.25-0.50 inches of flat ice accretion south of the Capital District. The magnitude of the forecast ice accretion matched the observations for the most part, but there were a few errors. First, the freezing rain extended more northward than the forecast indicated. This error was likely due to an underestimate of the northward extent of the warm nose aloft. Second, the icing totals were underforecast in eastern Ulster County, especially around the Kingston area, which was hit the hardest by the ice storm. There were reports of 0.50-0.75 inches of ice accretion in this area. This error was likely due to an overestimate of the speed at which the subfreezing layer near the surface would deepen and allow freezing rain to turn to sleet.

GOES-16 Day Snow Fog RGB

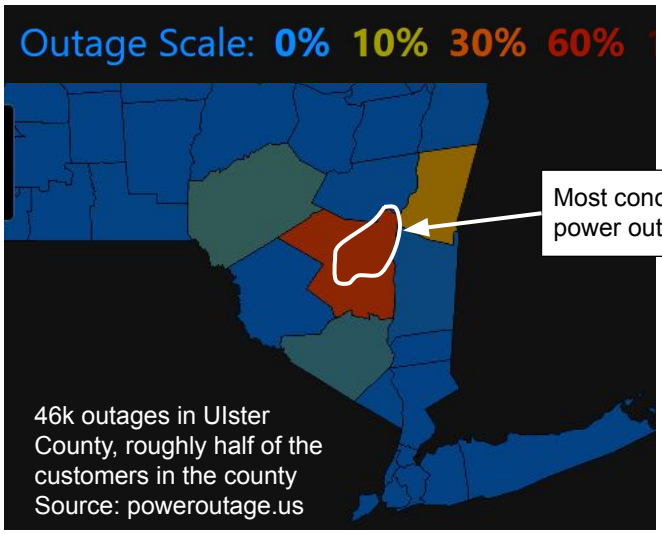
Dark colors correspond to greater ice accretion

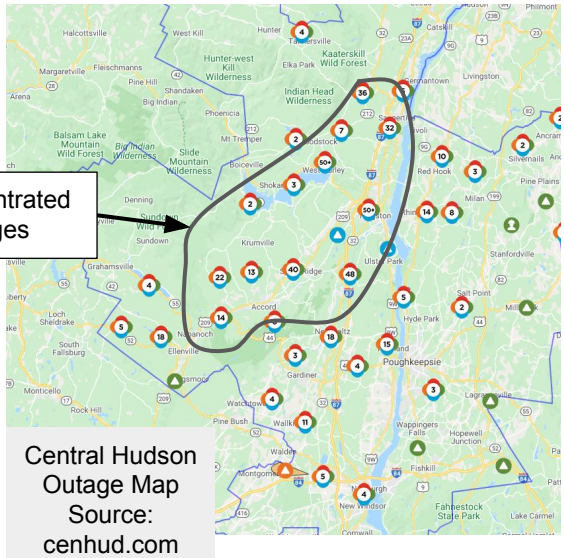


The actual distribution of the ice accretion was much more complex than the map on the previous slide was able to depict. The GOES-16 Day Snow Fog RGB, shown here during a clear day on 6 Feb, shows this well, with the darker colors corresponding to greater ice accretion. Over Greene and Columbia Counties, the ice accretion gradient was the same sign as the elevation gradient, with the highest icing totals over the higher elevations both west and east of the Hudson Valley (see topo map inset). The opposite occurred over Ulster County, where portions of the county had the ice accretion gradient be the opposite sign as the elevation gradient. Here, the shallow subfreezing layer near the surface moved southward through the lower/eastern portion of the county faster than the western portion. In the western portion, the cold air was blocked by the higher terrain, leading to mainly rain for most of the event. Areas downwind of the higher terrain of the Berkshires and Litchfield Hills also saw little to no ice accretion due to the higher terrain blocking the southward flow of subfreezing air.

Greater ice accretion at lower elevations could also be inferred from New York State Mesonet cameras. Lower elevation sites (left) were iced over, while higher elevations (right) were not.

Impacts - Power Outages





Power outage maps alerted NWS forecasters to the high impacts from freezing rain that occurred in the mid-Hudson Valley. These maps serve as a great situational awareness tool especially in data sparse areas.

Impacts

- Central Hudson: 44 utility poles and 900 wires down
- State of Emergency in Ulster County; Governor Hochul on hand for press conference
- 27k customers remained without power the night following the storm
- Lows in the single digits during the two nights following the storm prompted several warming centers to open

Ruby, NY
Source: Kingston Daily Freeman

Kingston, NY
Source: Kingston Daily Freeman

High impacts from freezing rain and ice accretion occurred in eastern Ulster and Columbia counties resulting in widespread power outages that lasted for days. Cold temperatures that followed forced warming centers to open. Governor of New York even hosted a press conference from Ulster County due to the high impacts.

Warning Decision

Ice Storm Warning: Issued when damaging accumulations of ice are expected. Downed trees and wires resulting in widespread power outages. Walking and driving extremely dangerous.
Local criteria: 0.50” flat ice

Winter Weather Advisory: Issued when snow, sleet, and/or freezing rain are expected to cause significant inconvenience. Downed trees and wires possible resulting in isolated to scattered power outages. Walking and driving could be difficult.
Local criteria: trace to < 0.50” flat ice

Icing obs and impacts supported Ice Storm Warning in eastern Ulster and eastern Columbia Counties. However, it was not a slam dunk for multiple reasons.

- Pros for Ice Storm Warning:
  - CAMs depicted several hours of icing as cold near-surface temps surged down Hudson Valley while warm air aloft was maintained
  - HRRR depicted widespread ice storm with 1” ice accretion
- Cons for Ice Storm Warning:
  - NBM/HREF supported sub-warning criteria, expected in higher elevations
  - Uncertainty about how quickly a deep sub-freezing layer would develop, resulting in liquid drops refreezing to sleet
  - If Warning was issued, there would have been several false alarms
  - Surrounding WFOs were not issuing

It was a challenging decision whether to go with an ice storm warning or maintain a winter weather advisory in the mid-Hudson Valley before actually observing the impacts. In hindsight, an ice storm warning would have been appropriate for parts of Ulster and Columbia counties; however, due to the localized nature of extreme ice impacts, there would have been a high amount of false alarms since it would have been too challenging to only issue ice storm warnings for a subset of the zones where a winter weather advisory was issued. Some of the main uncertainties that factored into NOT issuing an ice storm warning include the depth of the sub-freezing cold wedge in the mid-Hudson Valley, how efficiently ice would accrete onto trees/powerlines (ice to liquid ratios or ILR) and how long freezing rain would last before transitioning to sleet.

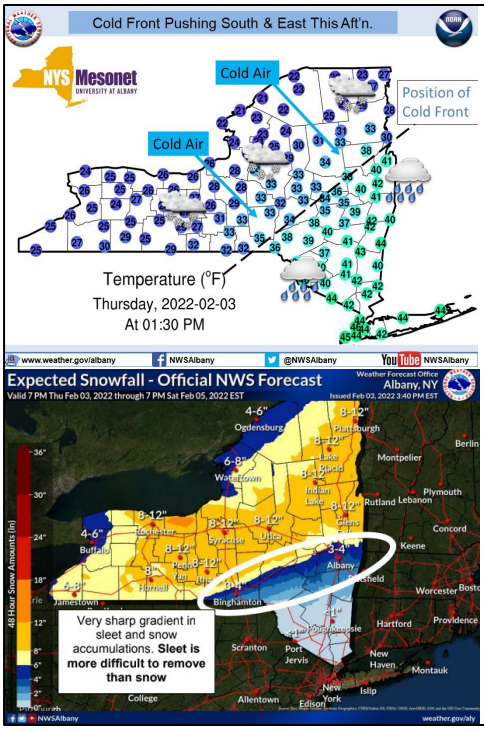
NWS Messaging Methods & Challenges

What does the NWS Issue?

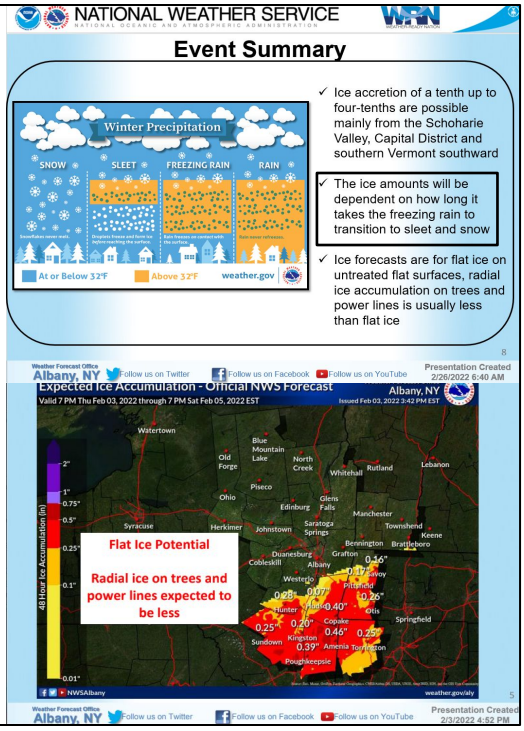
- Social Media (at least once per shift)
- Weather Stories on NWS Albany webpage (at least once per day)
- Partner Briefings (typically 5AM and 5PM)
- Statewide written and verbal briefings
- Partner Conference Calls (Webex, Microsoft Teams, etc)

What are the Challenges?

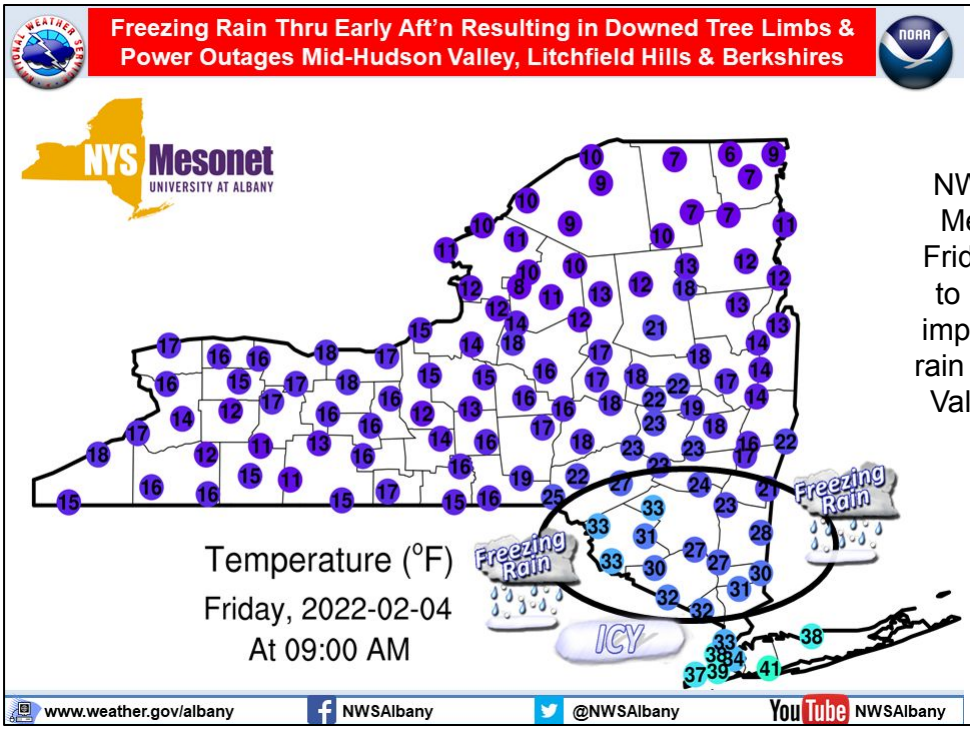
- Difference background knowledge
- Know your audience
- Explaining a complex forecast in as few words/images as possible
- Impacts vary depending on precip type, duration, terrain, etc



Examples of NWS Messaging Efforts



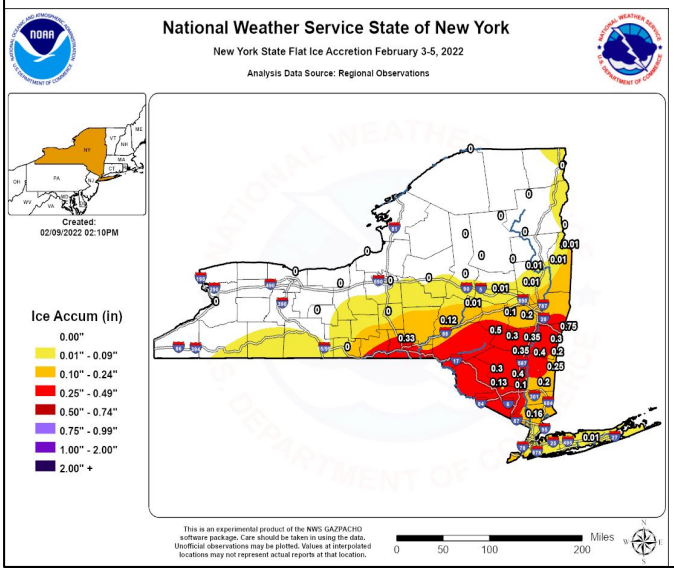
Examples of graphics the NWS issued in the days leading up to this event. Notice how the NWS annotates graphics with additional details to highlight key features such as tight gradients or if a product reflect flat or radial ice. It also uses these graphics as an opportunity to show how sleet/snow ratios or density differs to alert partners/followers where clean up efforts may be more challenging.

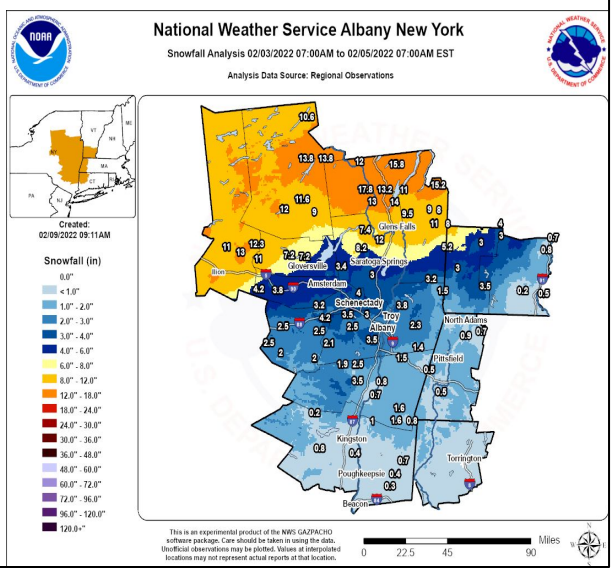


NWS Albany Twitter Mesoanalysis Post Friday morning Feb 4 to highlight the high impacts from freezing rain in the mid-Hudson Valley and Taconics.

Example of a mesoanalysis post the morning of 4 February when the NWS learned of high impacts from freezing rain. NWS often issues mesoanalysis posts as an event is unfolding to provide partners and followers with more details that are hard to provide before an event is actually occurring. This gives decision makers the latest information to ensure they can take appropriate action to ensure the safety of life and property. The NYS mesonet is frequently used to create mesoanalysis posts as an event is underway.

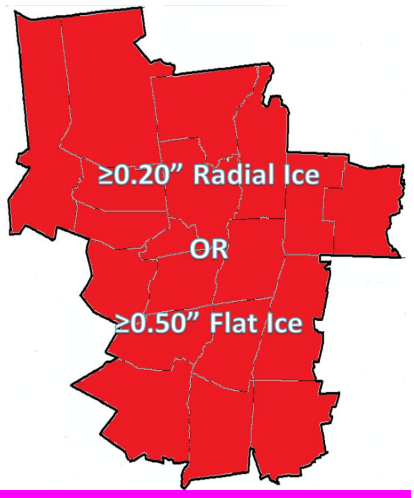
GAZPACHO Snow, Sleet and Ice **Verification Maps**





GAZPACHO maps reflect storm total flat ice (left) and snow/sleet amounts (right).

Freezing Rain **Verification** Challenges: Flat v Radial Ice



Ice Storm Warning Criteria - 0.50" Flat Ice!

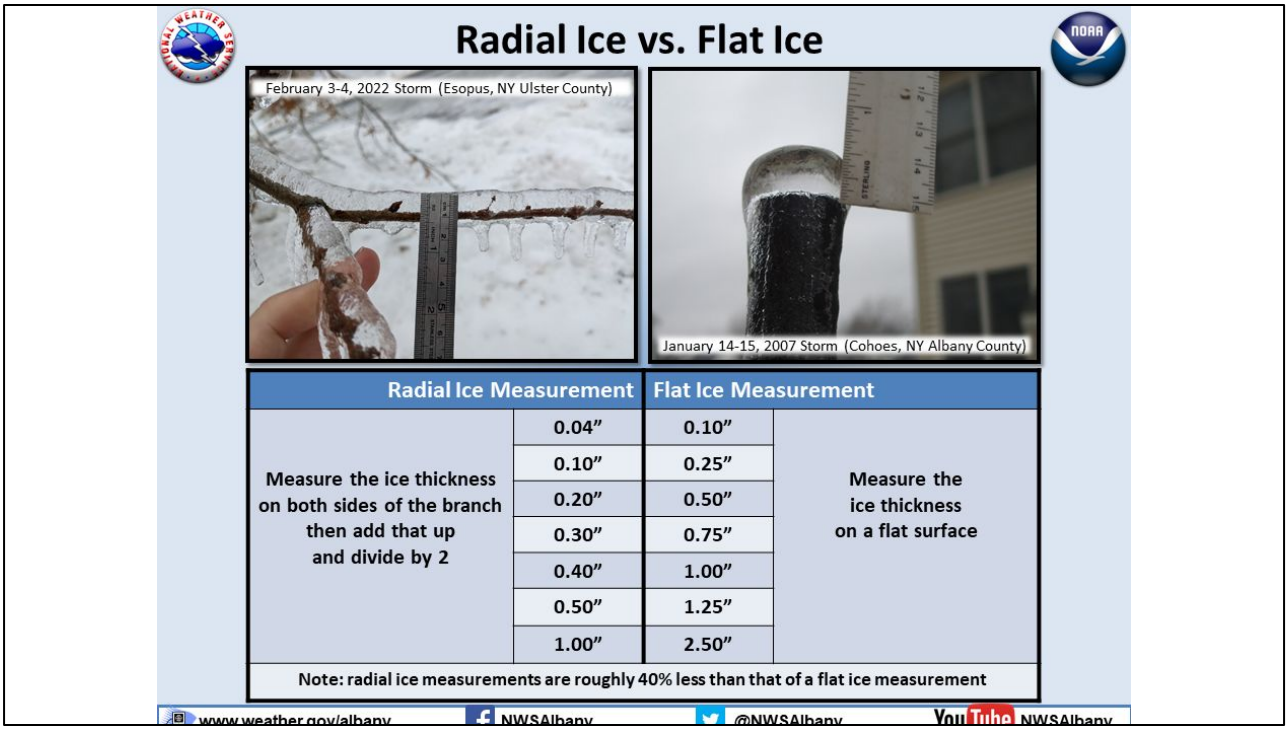
Dutchess County CoCoRaHS Ice Report…Flat or radial?

.3 ice accretion. So far rain, freezing rain and sleet from the storm. Low spot in yard flooding typical of heavy rain on frozen ground. Up to 4th raised bed about24 linear feet in shallow depression.

Verification Sources:

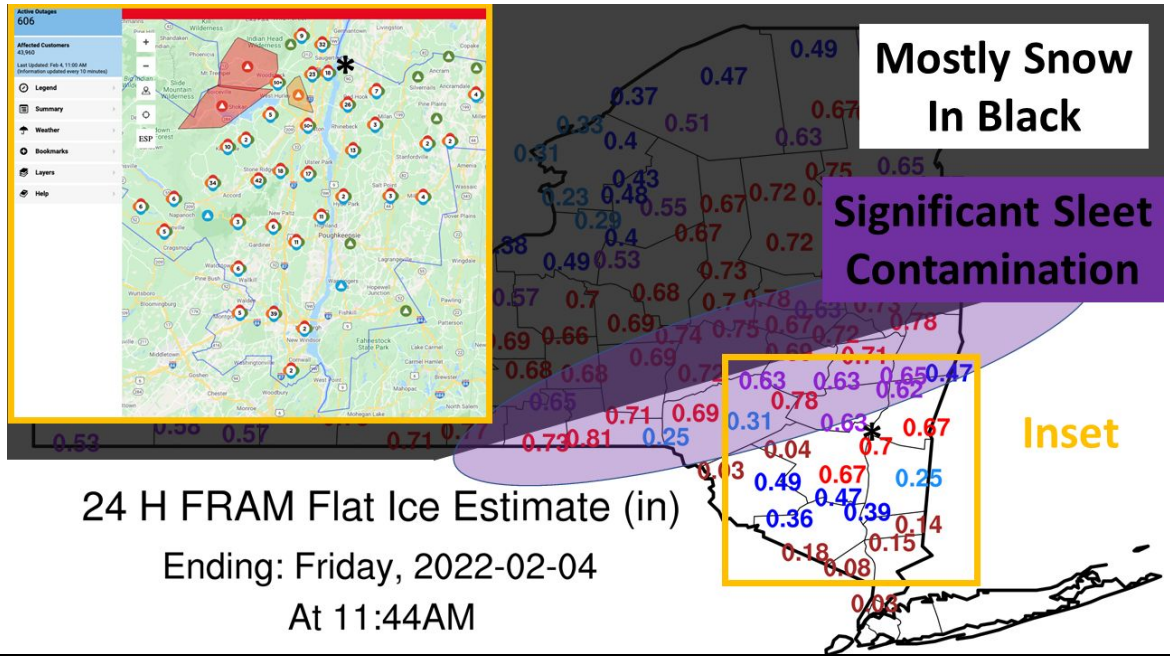
- Trained Spotters
- Social Media
- NYS mesonet (cameras!)
- Broadcast Media
- CoCoRaHS
- ASOS (I Group)
- 911 Centers

NWS forecasts and ice storm warnings reflect FLAT ice (not radial ice) although the NWS often provides radial ice amounts alongside flat ice since utility partners rely on radial ice for decision making. Knowing if trained weather spotters, social media reports, or ice measurements from other sources reflect radial or flat ice is challenging and often requires the NWS to educate followers on the difference as events are underway. Forecasters even have to follow up with spotters who submit ice reports to learn if their measurements reflects flat or radial ice.

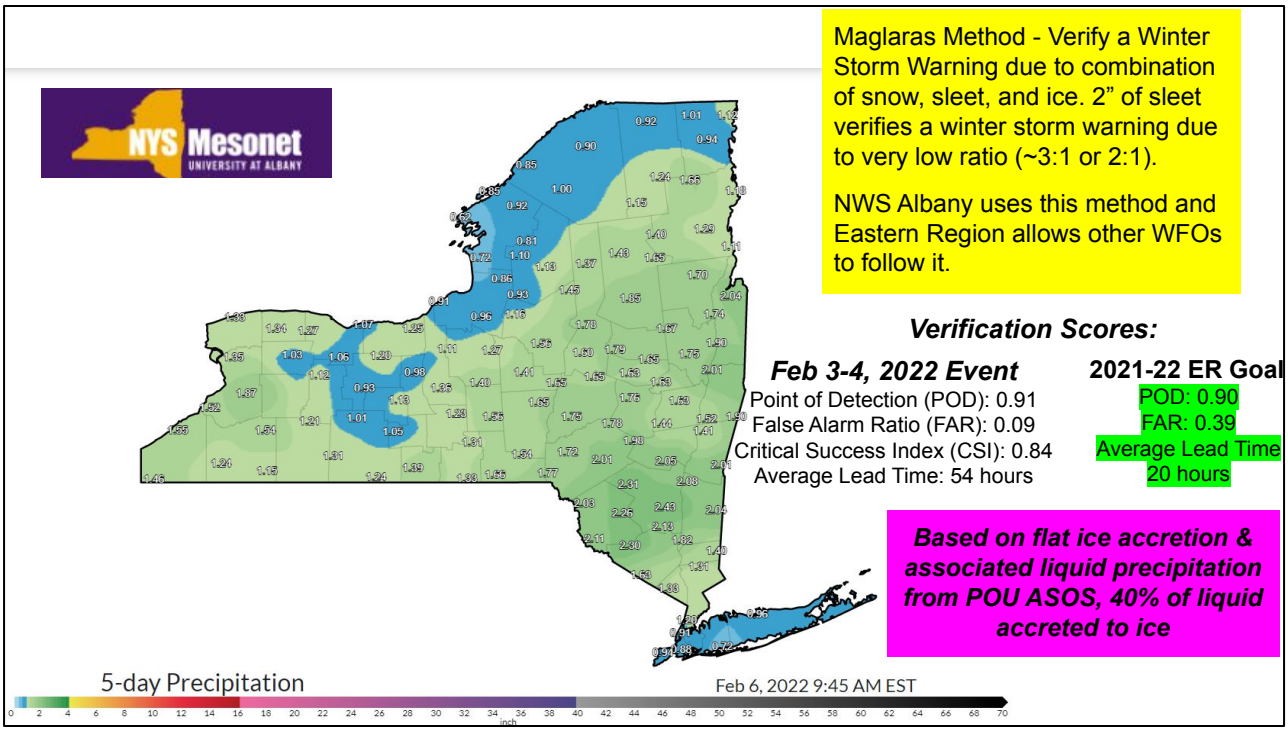


Comparison of flat ice to radial ice measurements. Radial ice is 40% less than flat ice.

FRAM & NYS Mesonet (Courtesy Nick Bassill)



Using the NYS mesonet observations as input into the FRAM provided very realistic ice accretion amounts in the mid-Hudson Valley, Taconics and eastern Catskills. This tool is especially useful in data sparse areas.



NYS mesonet sites show the 3-4 Feb event produced high liquid equivalent precipitation across ALY CWA ranging 1.25 to 2.50”. Even though traditional winter storm warning criteria threshold for snow in 12 hours (7”) or 24 hours (9”) was not met, NWS Albany can still verify a winter storm warning using the “Maglaras Method”. This is a local policy adopted by ER where a WFO can verify a winter storm warning when multiple precipitation types occur and when added up together, either the 7”/9” criteria or 2” sleet is satisfied.

WFO Albany verified most of its winter storm warnings using the Maglaras Method where a combination of sleet and/or snow occurred and the traditional 7”/9” snow criteria where mainly snow fell. NWS does not verify winter weather advisories so POD (Point of Detection) is only based on where winter storm warnings were issued. Therefore, this resulted in a high POD (point of detection) that exceed the ER Goal of 0.90. FAR (False Alarm Ratio) well exceeded ER Goal since most of our warnings met criteria. FAR can also be viewed as where we “cried wolf” but warning criteria did not occur.

Looking at the POU ASOS, we see that ice accreted very efficiently with 40% of the liquid that fell as freezing rain accreted into ice. High ILR (ice to liquid ratios) supports the high impacts that were observed.

Conclusions & Lessons Learned

- A plume of highly anomalous moisture persisted over the Northeast for nearly 48 hours resulting in a prolonged period of heavy precipitation 3 - 4 Feb 2022.
- An initially mild thermal profile supported rain but an ana cold front late P.M./early evening 3 Feb resulted in a northerly wind shift in the low-levels with cold air draining southward. As sfc temperatures quickly dropped, anything wet quickly turned icy.
- Prominent southwest flow aloft continued overnight 3 Feb and the warm nose aloft combined with a deepening sub-freezing cold wedge to support sleet (I-90/Capital District) and freezing rain (mid-Hudson Valley, NW CT, southern Taconics). Morning AFD 3 FEB 2022 mentioned sleet accums 0.50 - 2.0” & partner briefings and social media posts on 3 Feb highlighted sleet impacts.

Conclusions & Lessons Learned

- Delineating between sleet & freezing rain and predicting exact amounts were challenging due to uncertainty in the depth/extent of sub-freezing cold wedge, longevity of each p-type and estimating ice to liquid ratios (ILR)
- NWS Albany correctly increased ice accretion amounts in the mid-Hudson Valley in the 3 Feb P.M. forecast update. Flat ice amounts did not meet ice storm warning criteria and therefore advisory was maintained.
- Learned of extreme yet localized ice impacts in eastern Ulster & in Columbia County early Fri A.M. This led to two missed events. **Improved communication between NWS & locals EMs needed when extreme impacts are underway. Sleet infographics requested**
- NWS Albany created a detailed quality assurance (QA) report following this event to improve training & future messaging efforts in complex wintry mix events