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NWS Internship Case Study

LATE SEASON

NOR'EASTER

**APRIL 18<sup>TH</sup> – 19<sup>TH</sup>, 2022**

# OUTLINE

- 1. BACKGROUND**
- 2. SYNOPTIC SCALE ANALYSIS**
- 3. MESOSCALE ANALYSIS**
- 4. SUMMARY**



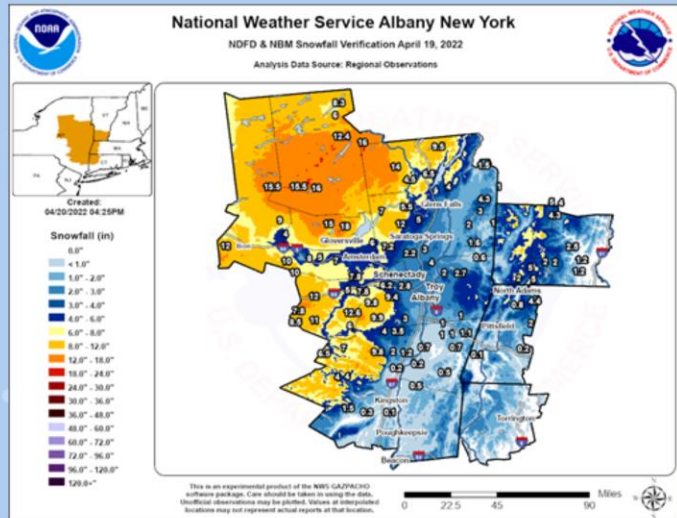
1



**BACKGROUND**

# What Happened?

- Late winter storm passed over the Northeast including eastern New York and western New England.
- Most of the snow accumulation fell over the western Mohawk Valley in addition to higher terrain areas such as the southern Adirondacks and northern/eastern Catskills where totals reached 7 to 15 inches.
- Lower snowfall totals fell in the valleys and ranged between coatings to 4 inches.
- The wet heavy snow caused many trees to be damaged resulting in nearly 200,000 New York residents to loss power.



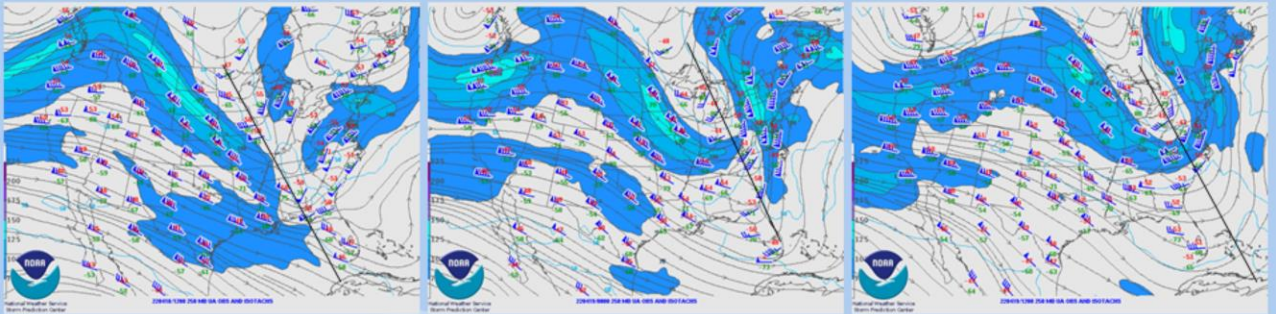


# 2



## **SYNOPTIC ANALYSIS**

## 250-hPa Analysis



**18 April 2022 12z**

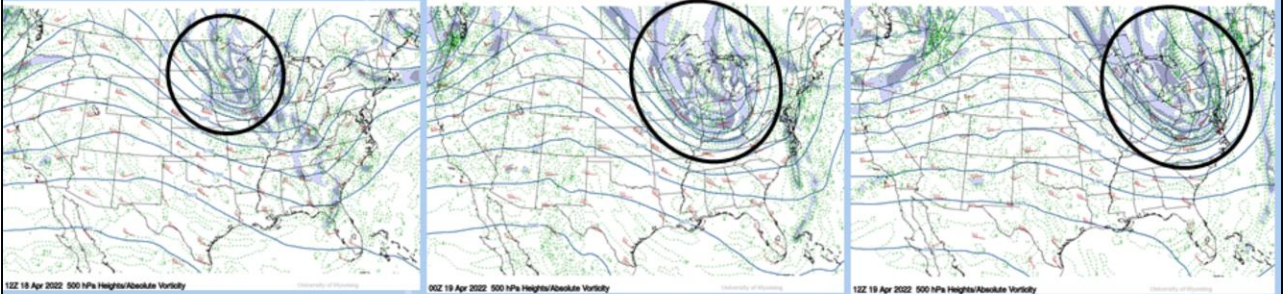
**19 April 2022 00z**

**19 April 2022 12z**

- Large negatively tilted trough deepened and moved over the Central Plains to the Midwest into the Ohio Valley
- Divergence in the poleward exit region over the Central Plains and Ohio Valley suggests converging winds at the surface forcing air to rise

Throughout the period, a large negatively tilted trough moved through the Central Plains into the Midwest and Ohio Valley. A jet streak of 125-150kts extended from the Central Plains down towards the Ohio Valley which resulted in upper level divergence in its poleward exit region positioned over the Great Lakes. In addition, upper level divergence enhanced downstream troughing with wind speeds increasing at the entrance of a newly developed jet streak over New York and New England. The equatorward entrance region present north of New England promoted lift. This set-up resulted in a dual jet structure by 00 - 12 UTC 19 April and led to strong forcing for ascent.

## 500-hPa Analysis



**18 April 2022 12z**

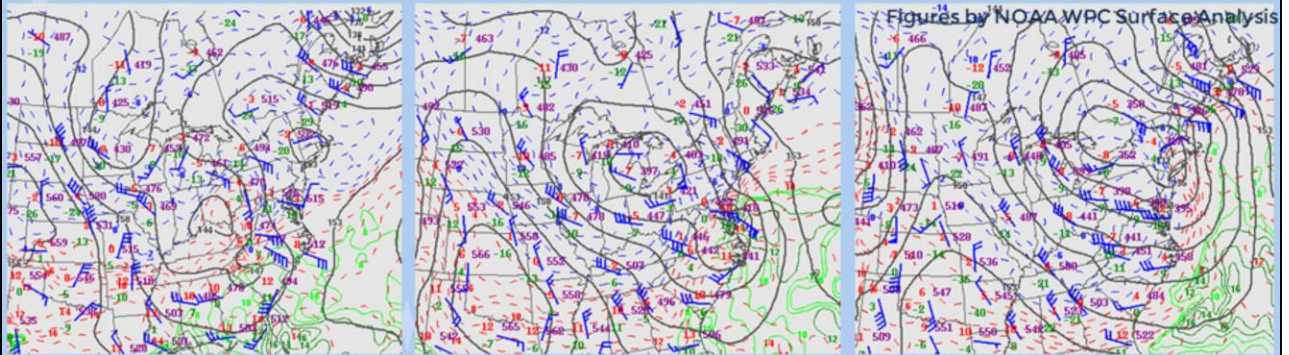
**19 April 2022 00z**

**19 April 2022 12z**

- Shortwave over the Central Plains amplified and trended towards a negative tilt by 12 UTC 18 April resulting in increased upward vertical motion over the Upper Midwest
- Downstream ridging over the Northeast amplified by 00 UTC 19 April in response to the amplifying trough, resulting in stronger southwesterly winds and favoring warm air advection into the Northeast
- Strong cyclonic vorticity advection into the Northeast 00 - 12 UTC 19 April

Cyclonic (positive) vorticity advection increased as heights fell and the trough deepened through the Midwest into the Ohio Valley and the Northeast. Downstream ridge off the New England coast amplified resulting in strong southwesterly winds that favored warm air advection that was directed into the Northeast.

## 850-hPa Analysis



**18 April 2022 12z**

**19 April 2022 00z**

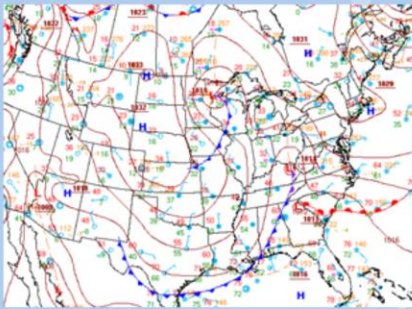
**19 April 2022 12z**

- A secondary low developed off the Carolina coast by 00 UTC 19 April and became the primary low with the mid-level jet strengthening and winds reaching 30 - 50kts.
- Winds enhanced the warm air and moisture advection directed into the Northeast
- Strong winds induced a moisture fetch from the Caribbean, supplying ample moisture for this storm

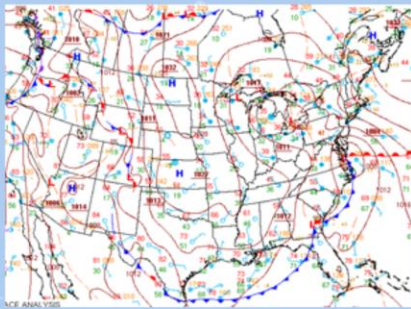
A primary low-pressure system from the Central Plains weakened as it moved eastward. A secondary low from the Gulf of Mexico developed and strengthened as it moved up the East Coast. Southeasterly winds associated with secondary low pressure induced strong warm air and moisture advection from the Caribbean/Atlantic Ocean. The pressure gradient tightened over the New England coast as the secondary low tracked up the eastern seaboard by 00 - 12 UTC 19 April. This resulted in strengthening easterly winds up to 60 - 70 kts and helped induce an additional moisture fetch off the Atlantic Ocean.



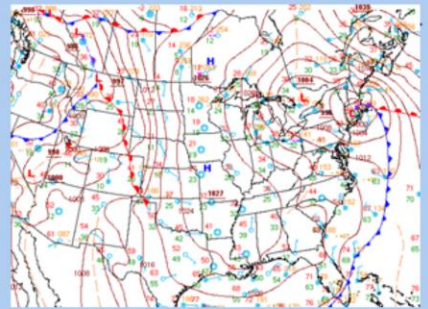
# Surface Analysis



**18 April 2022 12z**



**19 April 2022 00z**

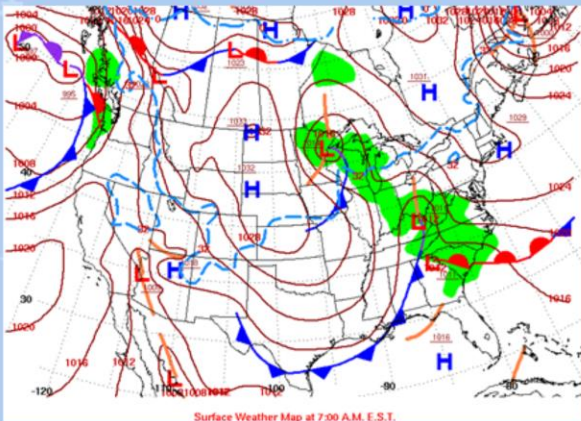


**19 April 2022 12z**

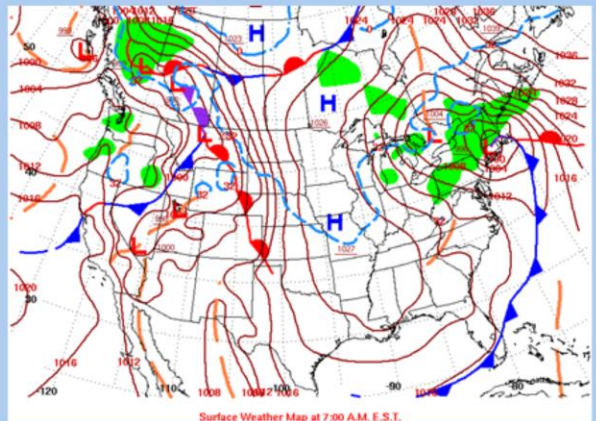
- High pressure positioned over Ontario, Canada served as a source of cold air ahead of the incoming secondary coastal low.
- By 12 UTC 19 April, the secondary coastal low occludes and begins to weaken, however, cyclonic circulation of the winds still promoted warm air and moisture advection into the Northeast, further supporting precipitation

A Miller Type-B Nor'easter set-up with a pre-existing low-pressure system coming from the west moving east, and a secondary low-pressure system developing from an old cold front that tracks up the Eastern Seaboard. High pressure system enhanced over Ontario, Canada into the Maritime Provinces. Pressure gradient increased as the secondary-low moved towards the Northeast resulting in stronger southeasterly winds supporting warm air advection moving into New England.

# Surface Analysis



**18 April 2022 12z**



**19 April 2022 12z**

Figures by NOAA WPC  
Surface Analysis.

- Overrunning precipitation was observed in regions of favorable upward vertical motion and strong warm air and moisture advection by 00 - 12 UTC 19 April.
- 1030 hPa high pressure centered in Ontario, Canada provided an antecedent chilly air mass ahead of precipitation to support a transition from rain to heavy, wet snow.

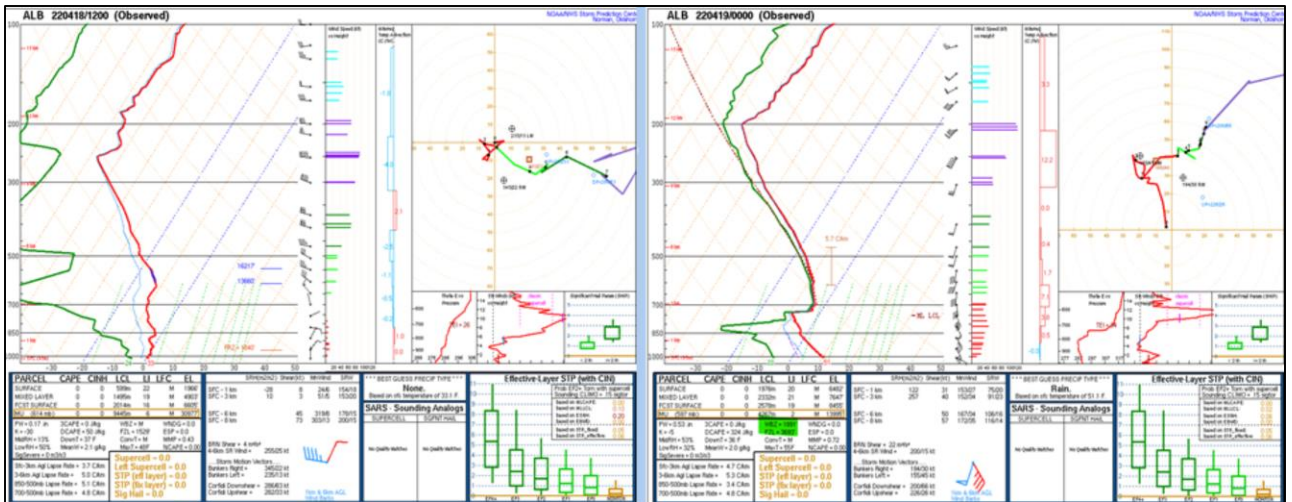
Precipitation is observed to be in locations favorable for upward vertical motion, such as upper-level divergence (indicative of surface convergence), cyclonic vorticity advection, and increasing temperature gradient. Antecedent high pressure system over Ontario, Canada provided a cold air mass that set the stage for wintry (mixed) precipitation.



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**MESOSCALE  
ANALYSIS**



### 18 April 2022 12z

- Dry column that was mainly below freezing
- Low surface dew points
- Backing winds between 1.5-5km indicated cold air advection which was likely due to the Canadian high pressure in place ahead of the coastal low

### 19 April 2022 00z

- Saturated column aloft but a noticeable low-level dry pocket
- Surface dew points still in the low 20s with wet-bulb zero height (WBZ) at ~1900'
- WBZ represents the height of the freezing level due to evaporative cooling in the low-level dry pocket

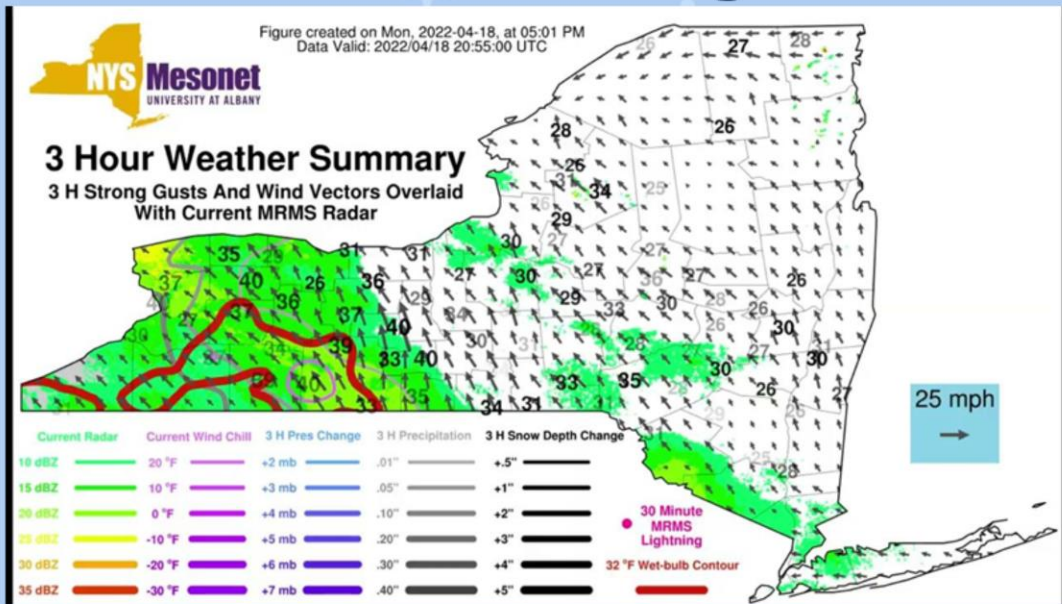
### 12 UTC 18 April 2022:

High pressure over Ontario, Canada resulted in northeasterly winds seen in the low-levels of the 12 UTC 18 April sounding. This provided an antecedent cold air mass.

### 00 UTC 19 April 2022:

As the system moved into the Northeast, the column saturated from the top down. WBZ was initially high mainly from the dry column but the dry low-levels also provided a deep layer for falling precipitation to cool the column via evaporative cooling and thus support a transition from rain to snow.

# Wet-Bulb Zero Height

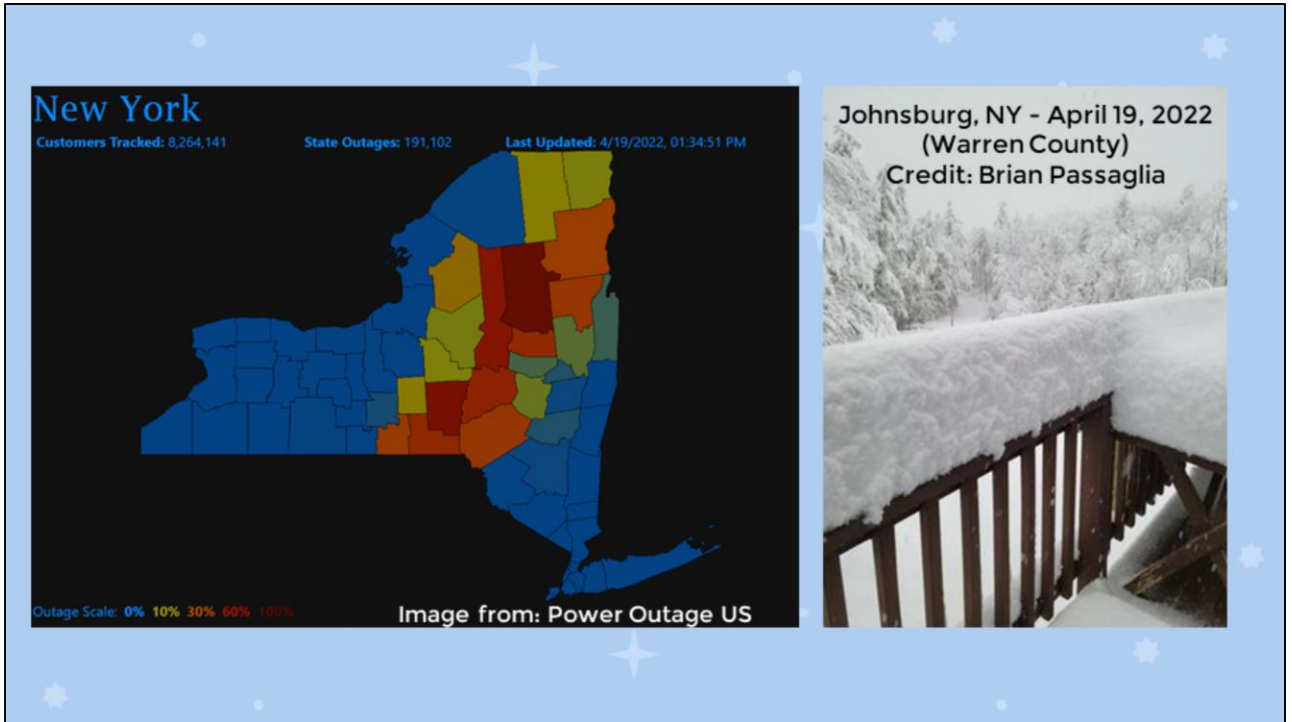


Focusing on the 32F wet-bulb contour (WBZ), we noticed that the WBZ reached into the higher elevation and hill towns overnight 18 April into 19 April but never reached the valley. This explains why the hill towns and higher terrain north and west of the Hudson Valley measured higher wet snow accumulations compared to the valley and why the most power outages occurred there.



# 4

## **SUMMARY**



About 200,000 New York residents lost power for nearly two days. The higher elevations such as the Adirondacks and Catskills experienced most of the snow accumulation and thus led to the most power loss.



A NOAA STAR NESDIS Geocolor image of the Mid-April 2022 Nor'easter at 19:40 UTC (3:40 PM EDT) on April 19, 2022.

- Upper level shortwave(s) deepened with a negative tilt that resulted in favorable regions for upward vertical motion
- Primary low pressure system from the Central Plains moved to the Midwest and Ohio Valley; Cold air advection prevailed southeastward
- Secondary low developed on the East Coast with its strengthening low-level jet supporting warm air and moisture advection into the Northeast
- Tightening temperature gradient ahead of the incoming coastal low and overrunning led to strong frontogenesis and widespread precipitation
- Precipitation started off as rain but transitioned to heavy, wet snow overnight from 00 - 12 UTC 19 April as the atmosphere cooled in response to diabatic cooling processes. Heavy, wet snow resulted in power outages in the high terrain and hill towns around the Capital District.
- Wet-bulb zero height remained near or above 1000ft. Thus, higher accumulations were observed in the hill

In conclusion, a Miller Type-B Nor'Easter impacted eastern NY and western New England 00 - 19 UTC April 2022. An antecedent high pressure over Ontario Canada provided a polar cold air mass over the Northeast, and a secondary low pressure directed a strong fetch of warm and moisture rich air from the Caribbean up the East Coast into the Northeast. Heavy precipitation, that began as rain and later transitioned into heavy, wet snow resulted in widespread power outage, especially in the hill towns and higher terrain areas north and west of the Capital District



# Thank you

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