The May 8-9 snowfall in eastern New York and southern Vermont

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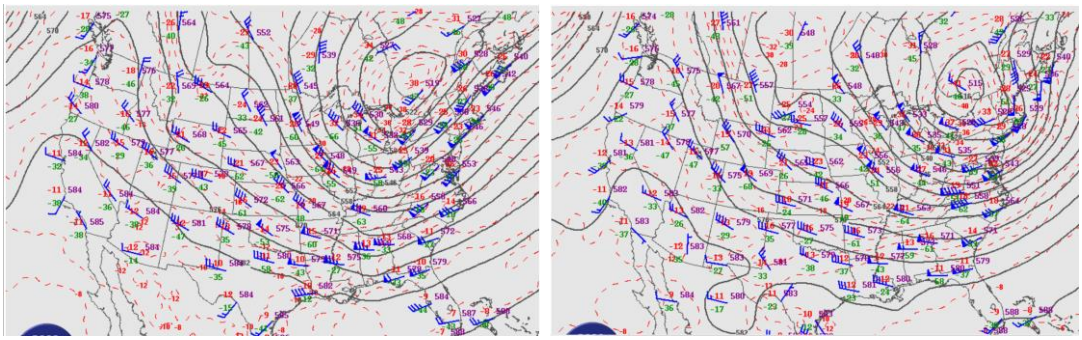
Outline

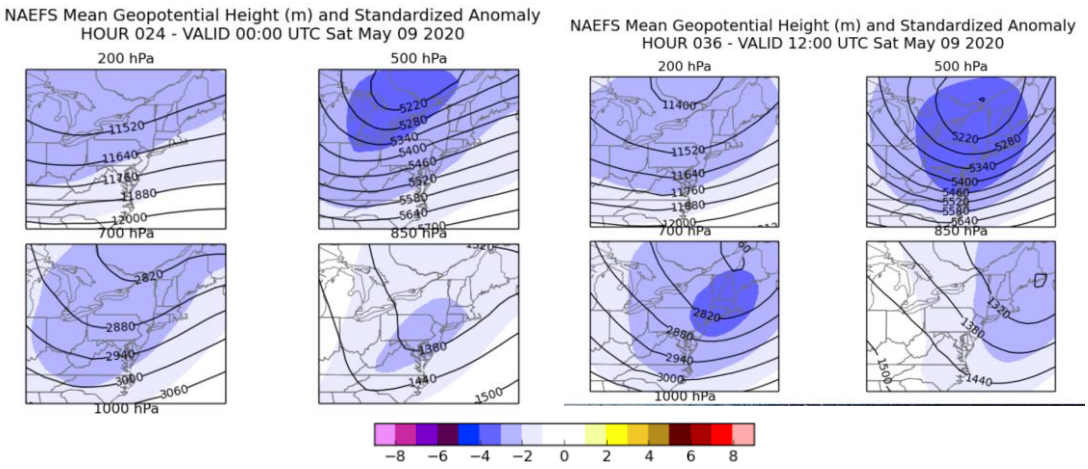
- Large-scale pattern
- Meso-scale pattern
- Model forecasts
- Radar / Satellite
- Observed snowfall

500 mb heights



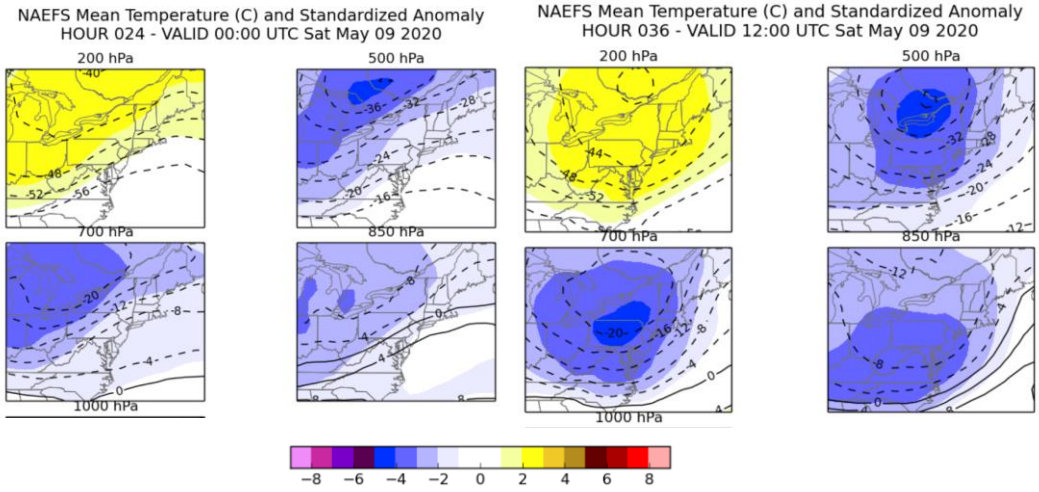
An unseasonably cold mid-to-upper level trough rotated eastward across southeast Canada and the northeast CONUS on May 8th and 9th.

Geopotential height anomalies



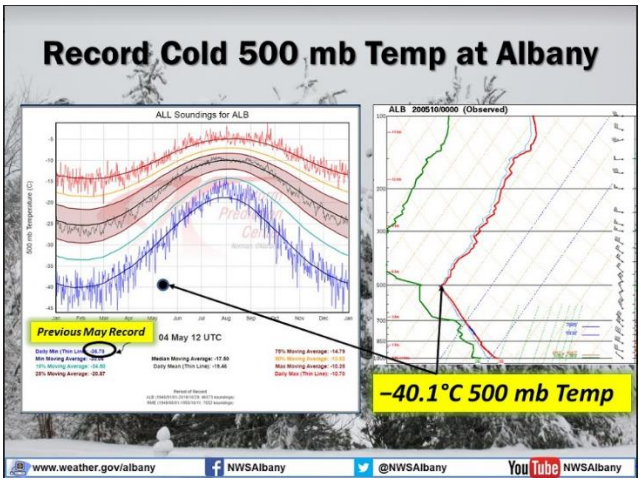
850-200 hPa heights were well below normal, with anomalies of 2 to 4 standard deviations below normal.

Temperature anomalies



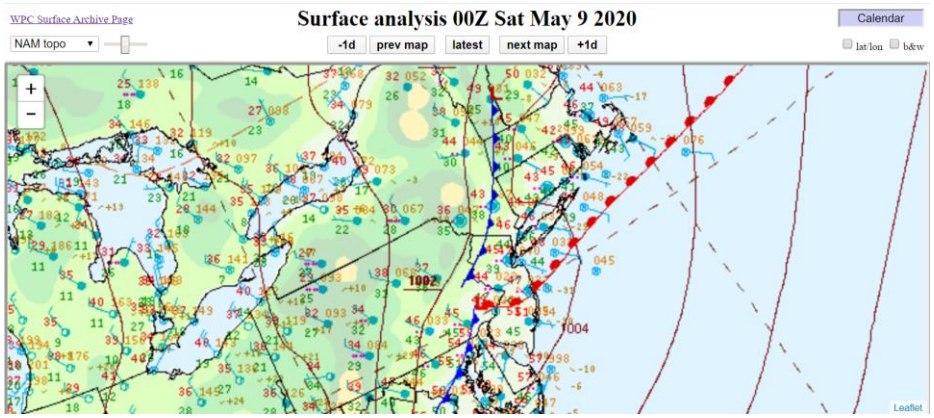
Temperature anomalies from 850-500 mb were also 2 to 4 standard deviations below normal.

500 mb temperature record – 00z 10th



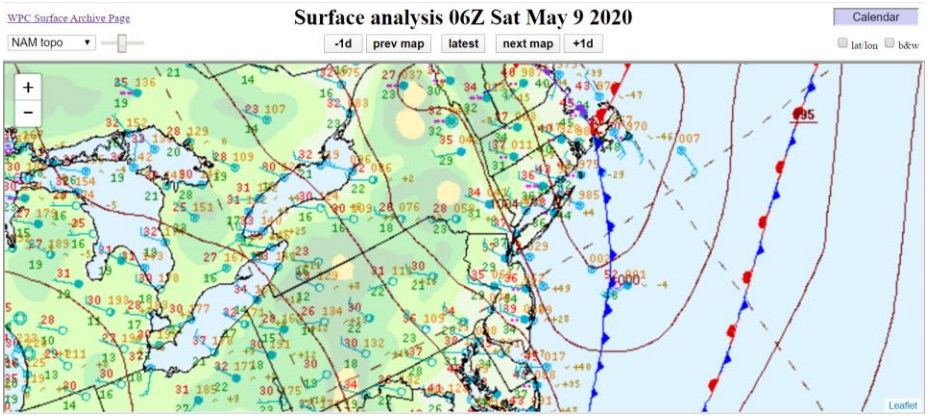
The 500 mb temperature at Albany was -40 C, which set a record for the month of May.

Surface plot – 00z May 9th



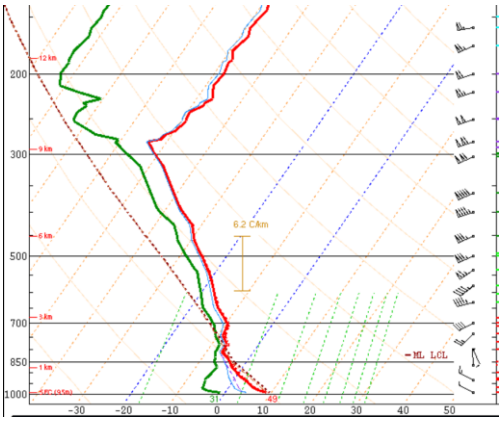
Surface low pressure developed over southeast Pennsylvania at 00z on the 9th.

Surface plot – 06z May 9th

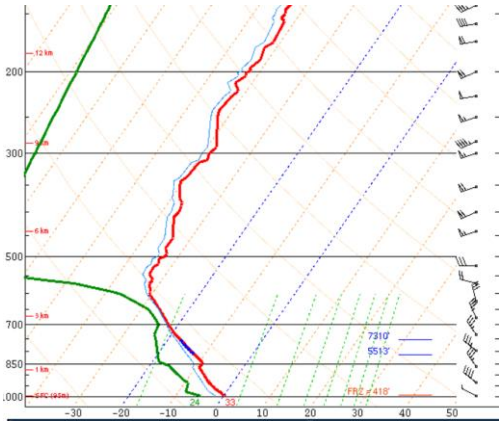


The surface low tracked toward Cape Cod overnight, with surface temperatures north and west of the low track in the 30s and dew points in the 20s.

Observed soundings at Albany



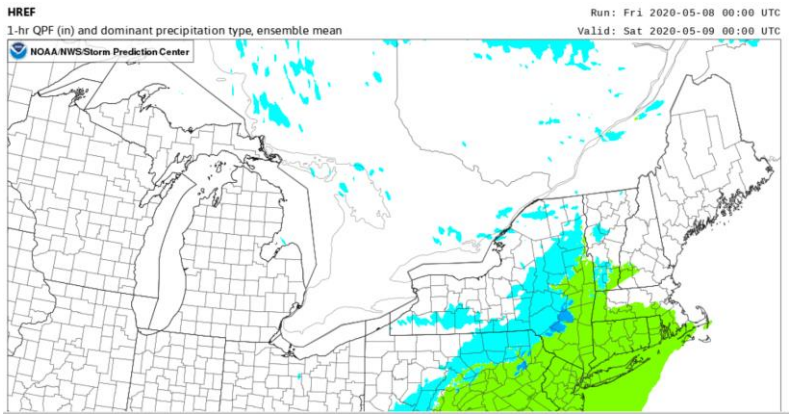
00z May 9th



12z May 9th

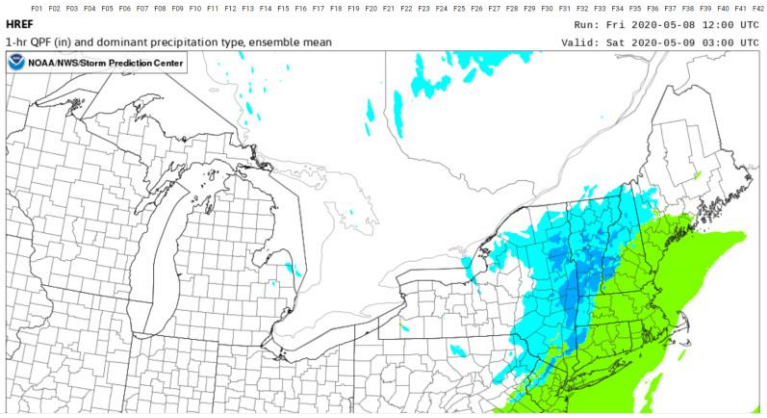
Temperatures at 00z on the 9th were still well above freezing at Albany, however temperatures from 850 mb and above were below freezing. Temperatures fell through the night.

HREF – 00z May 8 run valid 00z May 9th



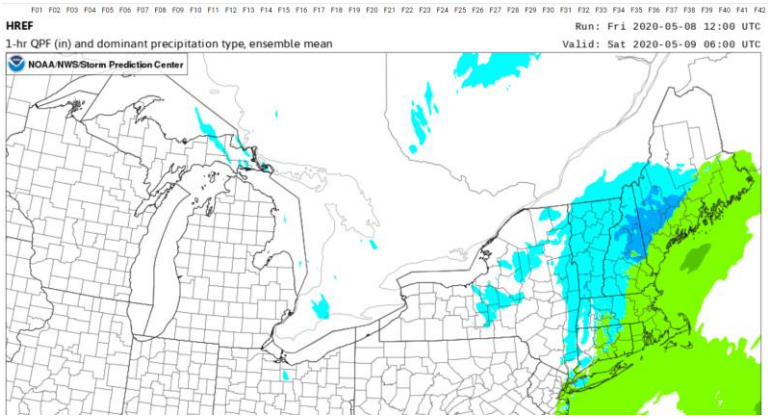
HREF precipitation type forecasts showed rain in the Hudson Valley at 00z on the 9th, with snow over higher elevations to the west. Precipitation type from the HREF is determined from the type indicated by the majority of the models within the ensemble. P-type from the models in the ensemble are determined by a variety of methods; most models determine the p-type from a mini-ensemble of precipitation-type algorithms based on the wet bulb profile. The HRRR determines precipitation type explicitly.

HREF – 00z May 8th run valid 03z May 9th



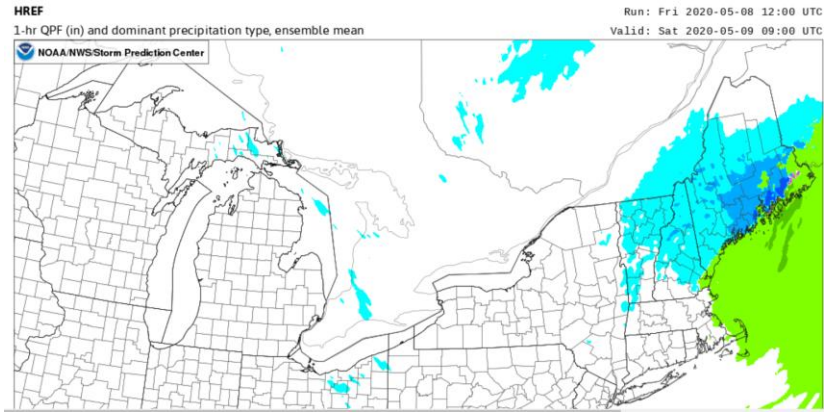
Rain was forecast to change to snow even in the Hudson Valley by 03z.

HREF – 00z May 8th run valid 06z May 9th



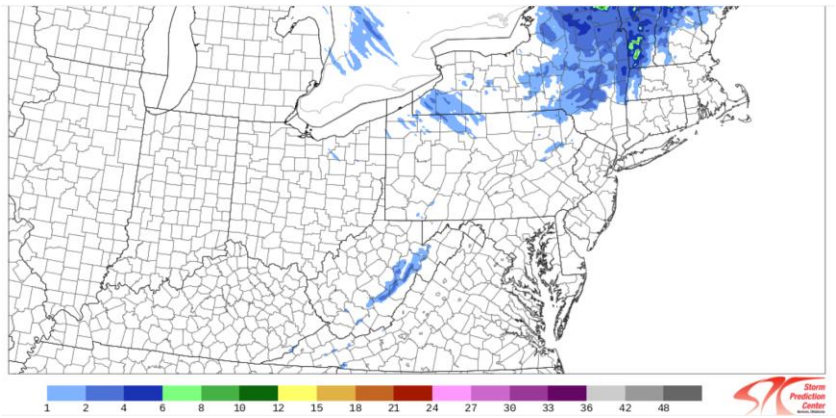
The precipitation was forecast to end rapidly around 06z.

HREF – 00z May 8th run valid 09z May 9th



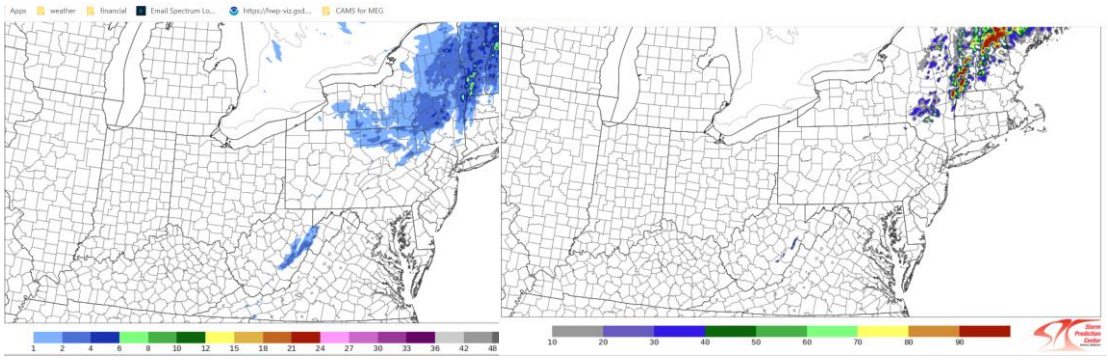
By 09z, the only precipitation forecast to remain in western New England would be over southern Vermont.

HREF – 00z 8th run snowfall forecast



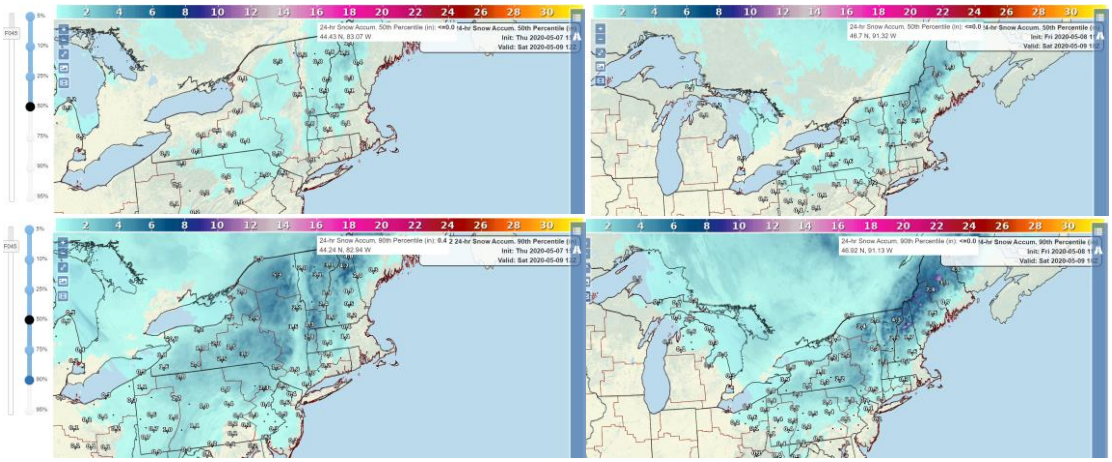
HREF snowfall forecasts ranged from less than an inch in the Hudson Valley south of Albany, to 1 to 2 inches in the Capital District, to 2 to 4 inches for higher terrain west and east of the Capital District. Some 6 to 8 inch amounts were forecast over the Green Mountains in southern Vermont.

HREF – 12z run snowfall forecast and probability of 4 inches or more of snow



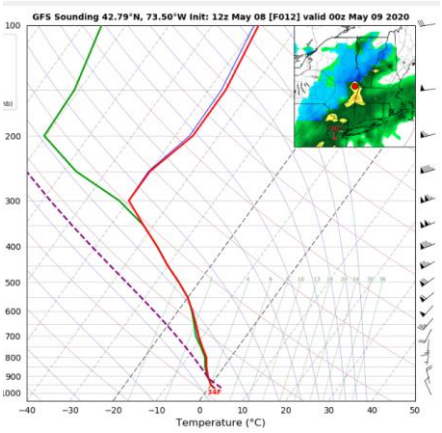
Snowfall forecasts from the 12z run on the 8th did not change much from the 00z run. Probabilities for more than 4 inches of snow were confined to the higher elevations west and east of the Hudson River, with high probabilities of over 80 percent indicated for the higher terrain in the Green Mountains of southern Vermont.

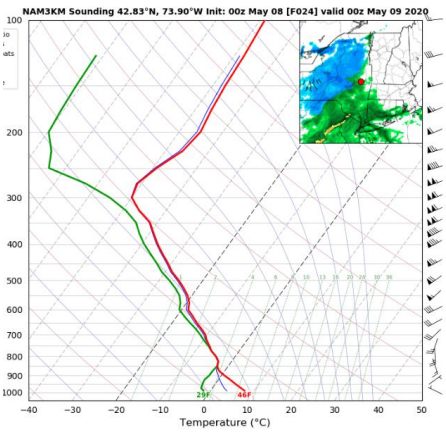
NBM snowfall – May 7,8th – 50th and 90th percentile



The 50th percentile, or median snowfall amount, from the National Blend of Models ensemble, from runs on 00z on the 7th and 8th are shown on the top of this slide. Accumulating snowfall was shown for much of the northeast CONUS away from the coast, with a slight increase in the snowfall forecast from the 7th to the 8th. The 90th percentile, or "worst-case scenario" is shown in the bottom. These forecasts indicated up to 2 inches of snow was possible in the Hudson Valley with as much as 4 to 6 inches over higher terrain in eastern New York and western New England.

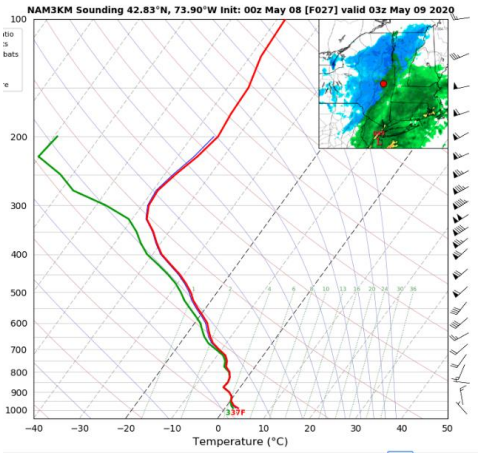
GFS vs NAM forecast sounding valid 00z





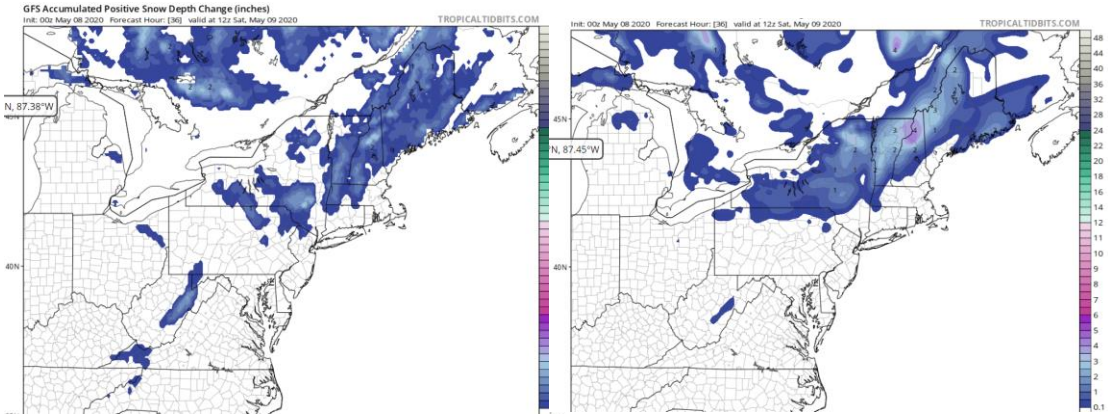
The data on this slide shows comparisons between 12 hour GFS (left) vs. NAM (right) forecasts valid at Albany at 00z on the 9th. The GFS had faster timing with the onset of the precipitation, and showed the low-levels saturating and cooling by 00z, while the NAM was still indicating a dryer, warmer boundary layer.

NAM forecast sounding valid 03z



By 03z, the NAM had forecast the boundary layer to cool and saturate, with a forecast surface temperature of 33 degrees.

GFS (left) vs. NAM (right) forecast snow depth change



GFS vs NAM forecast snow depth change through 12z on the 9th is shown on this slide. The NAM forecast slightly more snow in the Hudson Valley around Albany, however overall the snow depth change forecasts were rather similar, indicating maximum totals of 2 to 4 inches for higher elevations east and west of the Hudson Valley.

MOS forecast surface temperatures at Albany

GFS MOS Surface Temperature

Model Run Initialized at:	05/12Z	05/18Z	06/00Z	06/06Z	06/12Z	06/18Z	07/00Z	07/06Z	07/12Z	07/18Z	08/00Z	08/06Z	08/12Z	08/18Z
09/00Z			48	45	47	49	50	49	51	47	46	46	44	
09/03Z						42	45	43	45	43	41	39	40	
09/06Z				39	38	37	41	40	41	38	36	35	37	
09/09Z							38	37	38	36	32	32	34	
09/12Z					38	36	39	39	40	37	35	34	36	

NAM MOS Surface Temperature

09/00Z		45	46	44	46	47	49	
09/03Z				33	39	43	39	
09/06Z			35	26	33	39	34	
09/09Z				21	30	36	31	
09/12Z			35	26	35	39	33	

The numbers on this slide are MOS forecast temperatures at Albany from forecast runs from 12z on the 5th through 12z on the 8th. The circled time are forecasts valid at 03z, around the time of change-over from rain to snow at Albany. The GFS was forecasting temperatures from 40 to 45 at that time, with a slow trend toward lower temperatures with decreasing lead time. The NAM was forecasting a temperature as low as 33 degrees on the 00z 7th run, when no precipitation was being forecast by that model. Forecast temperatures increased to around 40 once precipitation was being forecast. Note that MOS transitioned to spring equations on April 1st.

MOS forecast dew point temperatures at Albany

GFS MOS Dew Point Temperatures

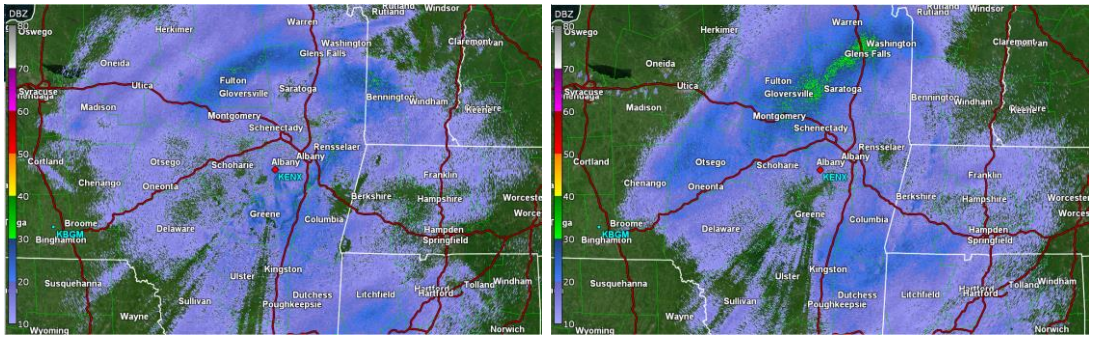
Model Run Initialized at:	05/12Z	05/18Z	06/00Z	06/06Z	06/12Z	06/18Z	07/00Z	07/06Z	07/12Z	07/18Z	08/00Z	08/06Z	08/12Z	08/18Z
09/00Z			20	19	23	21	24	23	22	28	28	28	29	
09/03Z						25	28	26	28	28	27	27	25	
09/06Z				22	25	24	29	26	28	27	23	23	22	
09/09Z							28	26	27	25	21	21	21	
09/12Z					25	23	28	27	27	25	20	20	21	

NAM MOS Dew Point Temperatures

09/00Z	21	27	22	17	24	26	
09/03Z			12	18	25	24	
09/06Z		27	10	18	26	21	
09/09Z			7	18	25	18	
09/12Z		22	9	19	25	17	

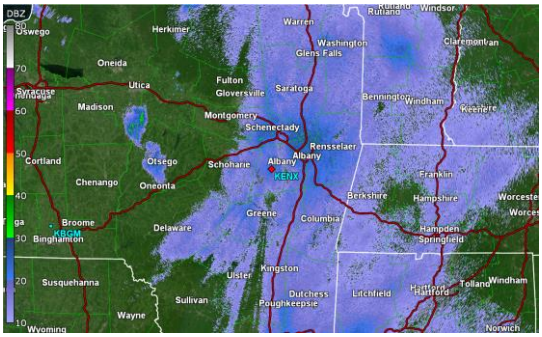
MOS dew point temperatures at Albany are shown on this slide. Note that in contrast to the temperature forecasts, the dew point temperatures were forecast to be below freezing from both model outputs. Note also the very low NAM dew points on the 00z and 06z 7th runs, when precipitation was being forecast to remain to the south of Albany.

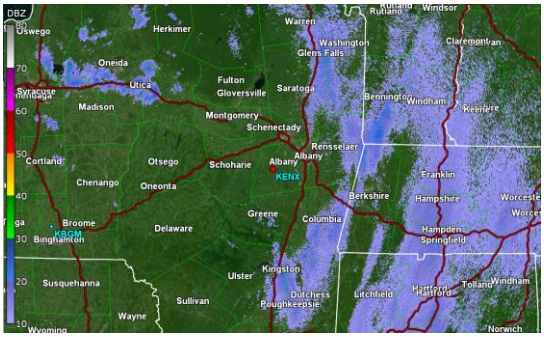
Radar – 00z and 02z



Radar at 00z indicated that light precipitation had overspread much of the area. By 02z, a band of stronger returns can be seen north and west of Albany. Some of these stronger returns may have been melting precipitation, along with heavier precipitation in that area.

Radar – 04z and 06z



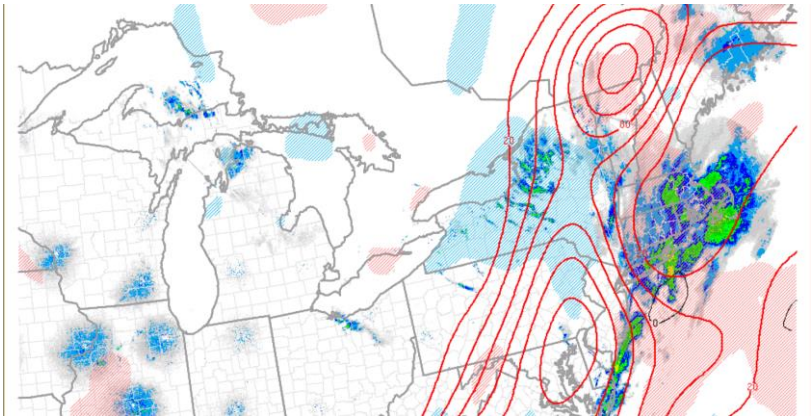


Between 04z and 06z precipitation, in the form of wet snow, was moving east of the Hudson River Valley.

Radar – 08z and 10z

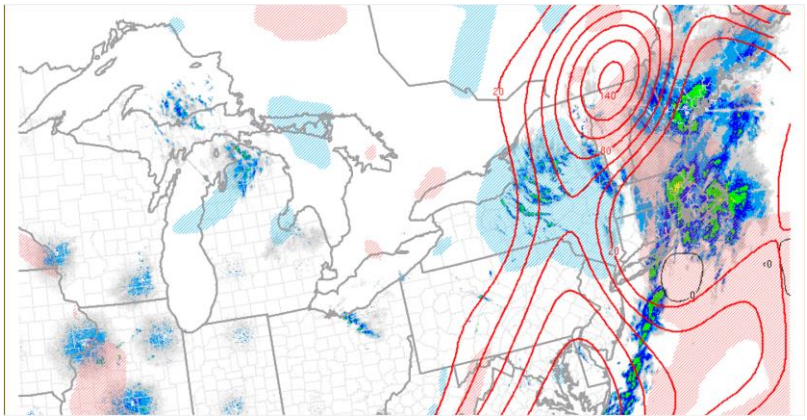
At 08z and 10z a band of heavier and persistent snowfall could be seen east of the Hudson River from Washington county, New York into southern Vermont.

07z SPC meso-analysis – 700 mb fgen and 650-500 EPV



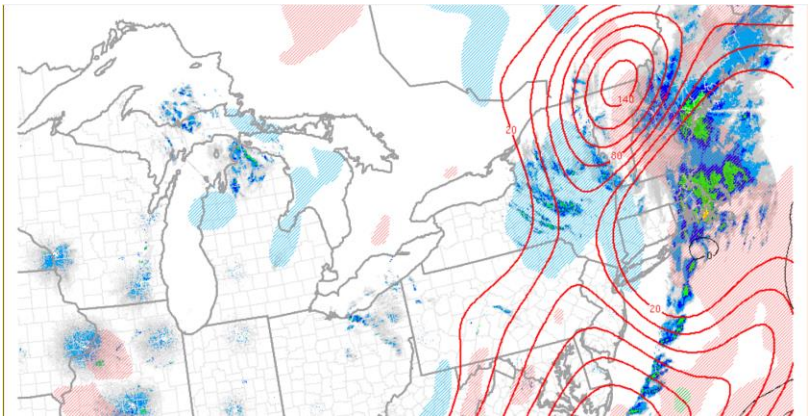
A band of 700 mb frontogenesis can be seen on the SPC meso-analysis from northern Vermont to eastern Pennsylvania at 07z, with one maxima to the north over northern Vermont, and a second maxima further south.

08z SPC meso-analysis – 700 fgen and 650-500 EPV



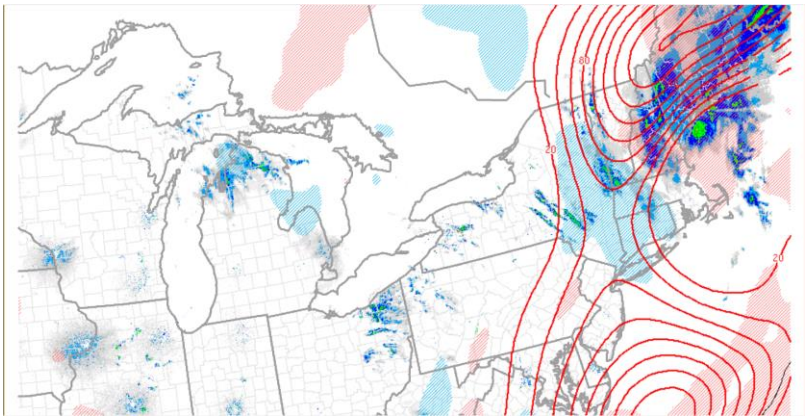
At 08z, the maxima over northern Vermont can be seen extending southward toward the upper Hudson Valley and southern Vermont. The light red shading on this graphic shows areas of reduced stability (negative EPV) in the layer above the frontagenesis (650-500 mb).

09z SPC meso-analysis – 700 fgen and 650-500 EPV



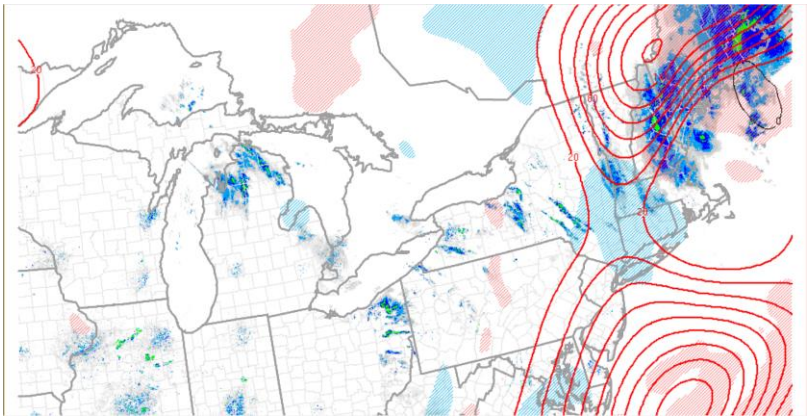
At 09z, the axis of maximum frontogenesis can be seen sweeping east across Vermont.

10z SPC meso-analysis – 700 fgen and 650-500 EPV



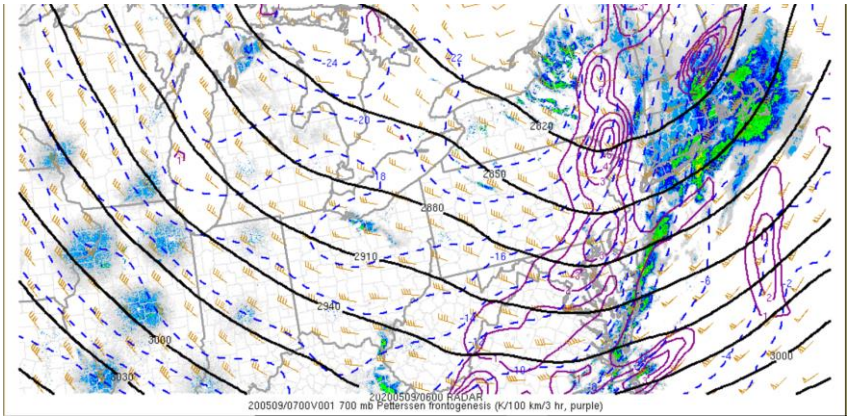
At 10z, the maximum of frontogenesis remains across Vermont, extending northeast toward northern Maine.

11z SPC meso-analysis – 700 fgen and 650-500 EPV



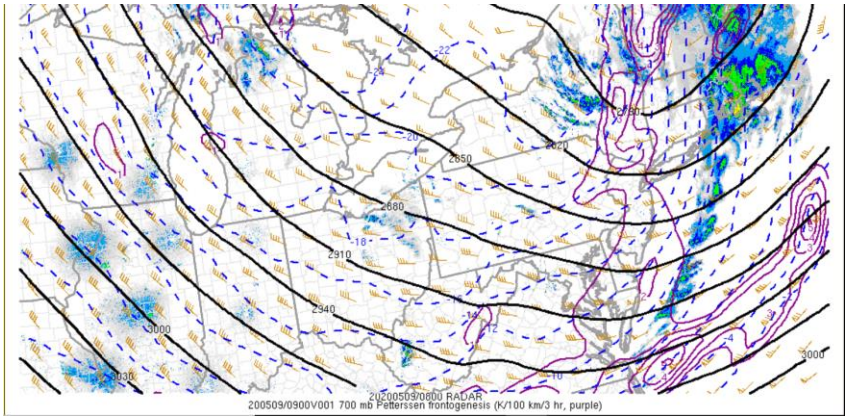
At 11z, the maxima of frontogenesis remains across Vermont.

SPC meso-analysis - 700 mb fgen hi res 07z



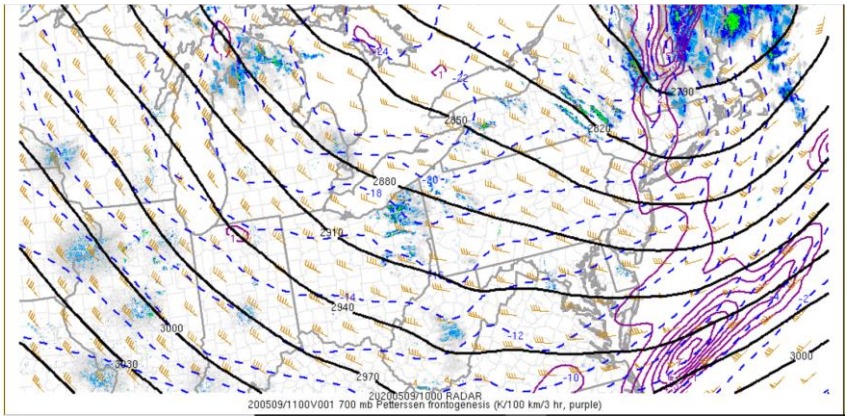
The next few slides show higher resolution graphics of frontogenesis at 700 mb, along with 700 mb temperatures and radar reflectivity overlayed. At 07z, the band of 700 mb frontogenesis can be seen near to just west of the Hudson Valley.

SPC meso-analysis – 700 mb fgen hi res 09z



At 09z, the band was shifting east of the Hudson Valley, and a band of enhanced snowfall can be seen on the southern edge of the maximum over Vermont.

SPC meso-analysis – 700 fgen – hi res – 11z

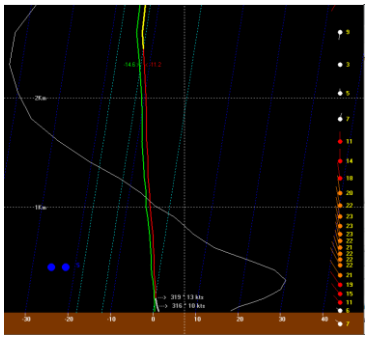


At 11z, the band is shifting east across Vermont.

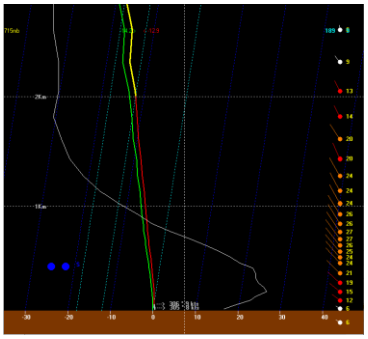
Flow blocking potential

- Froude numbers at GFL (U / NH from 3-9 hour NAM forecast soundings)

- 03z – 0.360
- 06z – 0.643
- 09z – 1.305



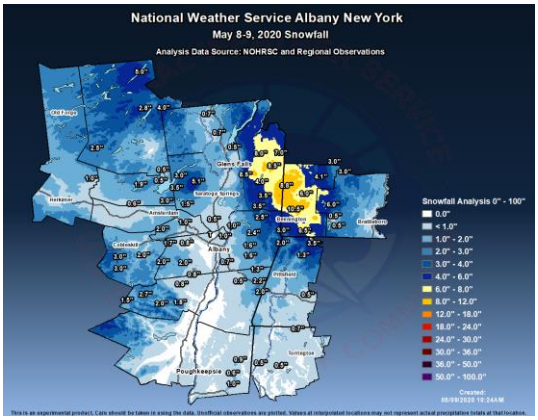
03z forecast sounding at GFL



06z forecast sounding at GFL

The enhanced snowfall over extreme eastern New York and southern Vermont was likely forced by a combination of frontogenesis on the northwest flank of low pressure developing east of Maine, and also by flow blocking along the west slopes of the Taconic and Green Mountains. The numbers on this slide show Froude numbers calculated from NAM model forecast soundings at Glens Falls at 03z, 06z and 09z. Values below 1.00 indicate blocked flow, which would indicate enhanced potential for upward vertical motion upstream from the mountain crests. Blocked flow potential at Glens Falls at 03z and 06z likely translated into blocked flow potential downstream over southern Vermont and extreme eastern New York after 06z.

Observed snowfall



Observed snowfall from this very unusual case is shown on this slide. Snowfall amounts ranged from mostly an inch or less in the Hudson Valley, to 2 to 4 inches over higher terrain to the west. To the east, there was a band of enhanced snowfall that developed over Washington County, NY and also southern Vermont, with amounts of up to 10 inches. Amounts of over 6 inches were observed even at relatively lower elevations in Washington County, as well as in Bennington county in the valley between the Taconic and Green Mountains.

Summary

- A very unusual May snow event occurred over portions of eastern New York and western New England on May 8-9, 2020.
- Many sources of model guidance indicated the potential for some snowfall, however forecasting accumulations was very difficult due to an expected boundary layer near or just above freezing, and the expected elevation-dependence of the event.
- Snowfall amounts were mostly light, however a band of heavy snow developed in New York east of the Hudson Valley into southern Vermont.
- The snow band appeared to result from enhanced precipitation rates due to a maxima of frontogenesis that affected the area, along with some northwesterly flow blocking upstream from the west slopes of the Taconic and Green Mountains.