

National Transportation Safety Board

Office of Railroad, Pipeline and Hazardous Materials

Washington, DC 20594



RRD23MR005

METEOROLOGY

Specialist's Factual Report

April 3, 2023

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A. ACCIDENT

Location: East Palestine, Ohio
Date: February 3, 2023
Time: 2055 eastern standard time (EST)
0155 coordinated universal time (UTC) on February 4, 2023
Train: Norfolk Southern freight train derailment with hazardous material

B. METEOROLOGY INVESTIGATOR

Donald Eick
Senior Meteorologist
Operational Factors Division (AS-30)
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Washington, DC

C. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's Senior Meteorologist was not on scene for this investigation and conducted the meteorology phase of the investigation remotely, collecting data from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the Weather Prediction Center (WPC) and the National Center for Environmental Information (NCEI). This report documents the general weather products and forecasts over the region during the period and the pertinent meteorological parameters related to the accident. All times are reported as eastern standard time (EST) based upon the 24-hour clock, local time is -5 hours from UTC, and UTC=Z. Directions are referenced to true north and distances in nautical miles. Heights are in feet (ft) above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles.

The accident site was located at latitude 40.835553° N and longitude 80.531964° W at approximately an elevation of 1020 ft.

D. FACTUAL INFORMATION

1.0 Synoptic Conditions

The National Weather Service (NWS) Surface Analysis Chart for 1900 EST on February 3, 2023, with the approximate derailment site noted by a red star is included

as figure 1. The chart depicted a high pressure system of 1037-hectopascals (hPa)¹ centered over Indiana with a ridge² extending eastward across Ohio and into western Pennsylvania. Further to the east and southeast a cold front was depicted off the East Coast and into South Carolina, having moved through the East Palestine area early that morning at approximately 0100 EST. The station models surrounding the derailment location depicted northwest winds of 10 knots or less, with clear skies, and temperatures in the teens degrees Fahrenheit (F). Several stations to the north and northeast over Canada, Pennsylvania, and New York to the lee of the Great Lakes reported light snow showers.

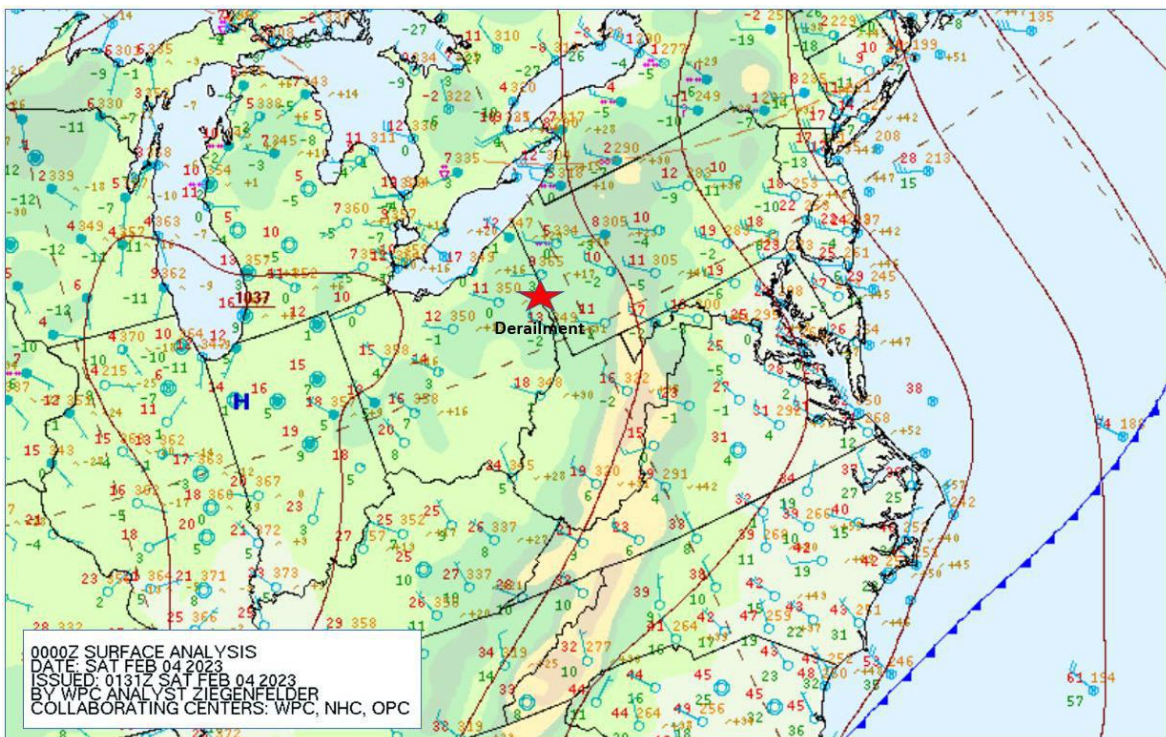


Figure 1 - NWS Surface Analysis Chart for 1900 EST with the approximate derailment location marked by the red star.

Figure 2 is the Regional Composite Radar Mosaic for 2100 EST over the area and depicted no significant meteorological echoes associated with any precipitation over the region during the period. A red star marks the approximate train derailment location.

¹ Hectopascals (hPa) is the standard unit for reporting pressure and is interchangeable with the former term millibar (mb) with the same unit. Standard sea-level pressure is 1013.25-hPa at 59° F.

² A ridge is an elongated area of relatively higher atmospheric pressure, and generally supports clear skies, descending motion over the area.

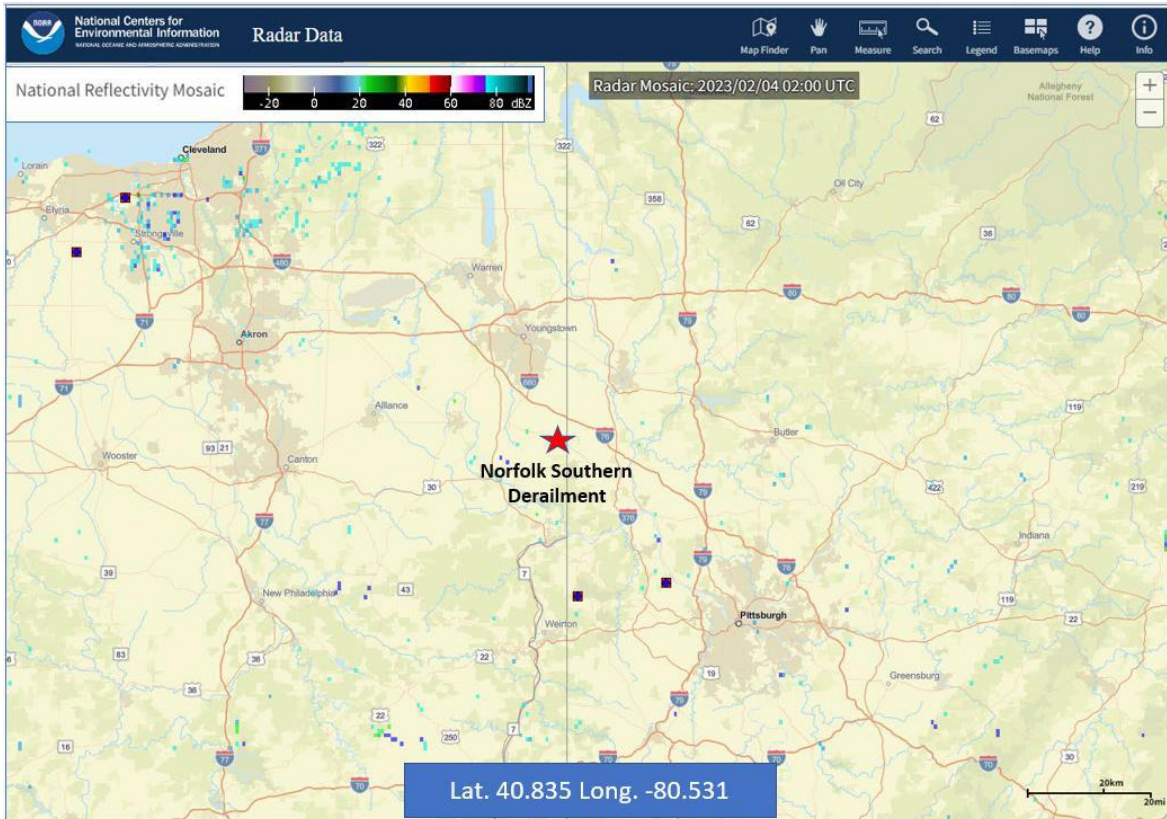


Figure 2 - NWS Regional Composite Radar Mosaic valid for 2100 EST over the area with the red star marking the approximate derailment location.

2.0 Surface Observations

The closest official weather reporting location to the accident site was from Beaver County Airport (BVI), Beaver Falls, Pennsylvania, located about 8 miles southeast of the accident site at an elevation of 1,253 ft. The airport had an Automated Weather Observation System (AWOS) and disseminated observations every 20-minutes. At the time of the accident the following conditions were reported.

Beaver Falls weather observation at 2055 EST, automated, wind from 320° at 3 mph, visibility 10 statute miles or more, clear skies, temperature of 10° F (-12.5° Celsius), dew point temperature of 2° F (-16.5° C), and an altimeter setting 30.49 inches of mercury.

A table of the conditions with time descending is included below with time reported in EST. The observation at the time of the accident is indicated in bold blue type.

STN	TIME	ALTM	T	Td	RH	WIND	VIS	CLOUDS	Weather
	DD/HHMM	inHg	°F	°F	%	deg/kt	mile		
BVI	04/0715	30.47	9	2	75	190/ 4	10.0	OVC070	
BVI	04/0655	30.47	9	3	78	190/ 4	10.0	OVC070	
BVI	04/0635	30.47	8	3	79	190/ 4	10.0	BKN080	
BVI	04/0615	30.48	7	3	81	190/ 4	10.0	CLR	
BVI	04/0555	30.48	7	3	82	190/ 4	10.0	CLR	
BVI	04/0535	30.48	7	3	81	190/ 4	10.0	CLR	
BVI	04/0515	30.48	8	2	78	190/ 4	10.0	CLR	
BVI	04/0455	30.46	8	1	76	160/ 3	10.0	CLR	
BVI	04/0435	30.47	7	1	75	150/ 3	10.0	CLR	
BVI	04/0415	30.49	7	1	76	200/ 3	10.0	CLR	
BVI	04/0355	30.50	8	1	72	0/ 0	10.0	CLR	
BVI	04/0335	30.50	8	1	71	0/ 0	10.0	CLR	
BVI	04/0315	30.50	9	1	70	0/ 0	10.0	CLR	
BVI	04/0255	30.50	8	1	73	0/ 0	10.0	CLR	
BVI	04/0235	30.50	8	1	72	0/ 0	10.0	CLR	
BVI	04/0215	30.50	9	1	69	0/ 0	10.0	CLR	
BVI	04/0155	30.51	9	1	70	0/ 0	10.0	CLR	
BVI	04/0135	30.50	9	1	70	0/ 0	10.0	CLR	
BVI	04/0115	30.51	8	1	71	0/ 0	10.0	CLR	
BVI	04/0055	30.51	8	1	70	0/ 0	10.0	CLR	
BVI	04/0035	30.51	8	1	72	0/ 0	10.0	CLR	
BVI	04/0015	30.51	8	1	72	0/ 0	10.0	CLR	
BVI	03/2355	30.51	8	2	73	0/ 0	10.0	CLR	
BVI	03/2335	30.50	8	2	76	0/ 0	10.0	CLR	
BVI	03/2315	30.51	7	1	77	0/ 0	10.0	SCT015	
BVI	03/2255	30.52	7	1	75	0/ 0	10.0	CLR	
BVI	03/2235	30.52	8	1	75	280/ 3	10.0	CLR	
BVI	03/2215	30.51	8	2	75	0/ 0	10.0	CLR	
BVI	03/2155	30.51	9	3	77	0/ 0	10.0	CLR	
BVI	03/2135	30.50	8	3	78	0/ 0	10.0	CLR	
BVI	03/2115	30.50	9	2	75	290/ 3	10.0	CLR	
BVI	03/2055	30.49	10	2	72	320/ 3	10.0	CLR	DERAILMENT
BVI	03/2035	30.49	10	2	70	330/ 4	10.0	CLR	
BVI	03/2015	30.49	10	2	68	330/ 5	10.0	CLR	
BVI	03/1955	30.48	10	1	67	330/ 5	10.0	CLR	
BVI	03/1935	30.49	10	1	66	320/ 4	10.0	CLR	
BVI	03/1915	30.48	11	2	66	320/ 5	10.0	CLR	
BVI	03/1847	30.47	12	1	61	340/ 8	10.0	SCT021 SCT042	
BVI	03/1835	30.46	12	4	71	320/ 9	10.0	SCT014 SCT021 BKN029	
BVI	03/1815	30.46	12	5	72	310/ 5	5.0	SCT012 BKN031 OVC038	-SN
BVI	03/1747	30.44	12	0	56	340/10G15	10.0	BKN033 BKN042	
BVI	03/1735	30.44	13	0	56	320/10G16	10.0	SCT030 BKN036 OVC045	
BVI	03/1715	30.43	14	-1	50	320/ 8G15	10.0	SCT024 BKN037 OVC045	
BVI	03/1647	30.41	16	3	57	320/13G19	10.0	SCT024 BKN030 OVC039	
BVI	03/1635	30.41	16	3	57	320/12G17	7.0	SCT024 BKN030 OVC043	
BVI	03/1615	30.39	15	2	57	320/ 9G16	10.0	SCT016 BKN034 OVC043	
BVI	03/1547	30.38	16	-2	44	350/14G19	10.0	SCT014 BKN033 OVC050	
BVI	03/1535	30.37	15	2	56	330/ 7G17	7.0	SCT013 BKN035 OVC050	
BVI	03/1515	30.36	16	0	49	320/13G20	10.0	SCT026 BKN034 OVC042	
BVI	03/1447	30.34	18	0	44	330/11G22	10.0	BKN037 OVC045	
BVI	03/1435	30.34	16	-4	41	330/10G20	10.0	SCT034 BKN041 BKN047	
BVI	03/1415	30.33	18	-1	42	300/19G24	10.0	SCT023 BKN040 OVC049	
BVI	03/1347	30.32	18	3	53	320/11G24	5.0	SCT023 OVC030	-SN
BVI	03/1335	30.31	18	3	51	320/12G22	10.0	SCT023 BKN030 OVC046	
BVI	03/1315	30.31	17	4	56	320/ 9G14	10.0	SCT018 BKN028 OVC049	

BVI	03/1247	30.30	18	3	53	350/13G22	4.0	SCT019	SCT027	BKN036	-SN
BVI	03/1235	30.30	18	3	52	340/ 8G17	10.0	SCT015	SCT026	BKN042	
BVI	03/1215	30.30	16	3	56	320/12G21	7.0	SCT009	BKN036	OVC045	
BVI	03/1147	30.30	16	3	57	360/ 9G21	3.0	SCT022	BKN032	OVC038	-SN
BVI	03/1135	30.29	17	0	46	360/ 9G16	10.0	BKN037	OVC044		
BVI	03/1115	30.29	18	0	45	010/10G20	10.0	SCT034	OVC042		
BVI	03/1047	30.28	16	1	52	350/11G20	10.0	BKN034	OVC040		
BVI	03/1035	30.27	16	0	49	350/10G21	10.0	BKN034	OVC042		
BVI	03/1015	30.27	16	1	50	340/12G19	10.0	OVC037			
BVI	03/0947	30.26	16	1	52	350/13G19	10.0	SCT031	OVC039		
BVI	03/0935	30.25	16	2	54	350/ 9G18	10.0	OVC036			
BVI	03/0915	30.24	16	2	53	350/13G19	10.0	BKN034	BKN050		
BVI	03/0847	30.22	14	1	57	340/11G16	10.0	SCT029	BKN037	BKN046	
BVI	03/0835	30.22	15	2	57	340/10G17	10.0	SCT029	OVC037		
BVI	03/0815	30.21	15	4	62	340/ 9G16	10.0	BKN029	OVC035		
BVI	03/0747	30.20	14	3	62	350/ 5G14	10.0	SCT027	SCT033	OVC048	
BVI	03/0730	30.19	14	3	62	010/ 7G14	10.0	OVC048			
BVI	03/0715	30.18	15	2	55	360/10G18	10.0	OVC048			
BVI	03/0655	30.18	15	1	54	350/ 9G18	10.0	OVC048			
BVI	03/0635	30.17	15	0	51	350/12G18	10.0	SCT042	OVC048		
BVI	03/0615	30.16	15	0	49	350/12G18	10.0	SCT035	SCT041	OVC048	
BVI	03/0555	30.15	15	0	50	350/12G16	10.0	SCT038	BKN049		
BVI	03/0535	30.14	16	1	50	350/ 9G15	10.0	SCT036	SCT043	OVC049	
BVI	03/0515	30.13	17	2	51	360/ 9G18	10.0	OVC045			
BVI	03/0455	30.12	18	2	50	350/11G22	10.0	OVC044			
BVI	03/0435	30.10	18	5	54	350/11G20	10.0	OVC046			
BVI	03/0415	30.09	19	6	56	010/ 9G17	10.0	SCT026	OVC048		
BVI	03/0355	30.09	20	7	58	350/12G19	10.0	SCT026	OVC050		
BVI	03/0335	30.08	20	9	61	010/ 8G18	10.0	SCT028	OVC050		
BVI	03/0315	30.07	20	8	58	010/12G23	10.0	OVC050			
BVI	03/0255	30.06	21	9	60	360/13G18	10.0	SCT027	OVC050		
BVI	03/0235	30.05	22	11	62	010/14G19	10.0	SCT022	SCT028	OVC055	
BVI	03/0215	30.03	23	14	66	010/ 9G19	10.0	SCT016	BKN027	OVC055	
BVI	03/0155	30.02	25	18	75	010/ 9G22	5.0	BKN016	OVC025		-SN
BVI	03/0135	30.00	26	18	73	010/ 9G20	7.0	BKN016	BKN024	OVC048	-SN
BVI	03/0115	29.99	26	19	77	010/ 9G18	4.0	SCT014	BKN023	OVC048	-SN
BVI	03/0055	29.99	27	20	76	010/ 9G21	3.0	BKN010	BKN015	OVC040	-SN
BVI	03/0035	29.98	28	22	80	040/12G17	2.5	BKN010	OVC016		-SN
BVI	03/0015	29.98	30	22	71	020/10G24	3.0	SCT015	BKN024	OVC030	-SN
BVI	02/2355	29.96	32	22	65	340/ 9G16	10.0	BKN025	OVC030		-SN
BVI	02/2335	29.95	32	21	64	340/ 9G15	7.0	OVC025			-SN
BVI	02/2315	29.95	33	19	58	350/10G16	10.0	OVC029			-SN
BVI	02/2255	29.95	33	18	54	330/10G20	10.0	OVC033			
BVI	02/2235	29.95	33	17	52	320/10G21	10.0	OVC037			
BVI	02/2215	29.95	33	17	50	310/10G17	10.0	OVC039			
BVI	02/2155	29.95	33	15	48	300/11G15	10.0	OVC041			
BVI	02/2135	29.95	33	15	46	300/12G19	10.0	OVC043			
BVI	02/2115	29.95	33	14	45	300/ 8G19	10.0	SCT043	BKN050	OVC065	
BVI	02/2055	29.95	33	13	44	290/10G17	10.0	BKN065			

The high temperature for BVI of 18°F was reported between 1400-1500 EST on February 3, 2023. The 24-hour history indicated overcast clouds and light snow reported over the area during the morning and afternoon on February 3rd with clear

conditions reported at the time of the accident. There was no reported accumulation³ of snow reported during the period. Calm winds were reported after the accident through about 0500 EST on February 4, 2023.

3.0 Astronomical Conditions

The United States Naval Observatory's website⁴ provided the following astronomical conditions for East Palestine, Ohio on February 3, 2023. The time of the derailment has been added for reference in bold blue italic type.

<u>Sun</u>	<u>Time (EST)</u>
Begin civil twilight	0702
Sunrise	0731
Upper Transit	1236
Sunset	1742
End civil twilight	1811
<i>Derailment</i>	<i>2054</i>

<u>Moon</u>	<u>Time (EST)</u>
Moonset	0639
Moonrise	1535
<i>Derailment</i>	<i>2054</i>
Upper transit	2330

At the time of the derailment the Sun was more than 15° below the horizon. The Moon was about 55° above the horizon at an azimuth of 104°, with the phase of the Moon was a Waxing Gibbous with 97% of the moon's disk visible.

4.0 Sounding

A High Resolution Rapid Refresh (HRRR)⁵ numerical model data was obtained from the NOAA Air Resources Laboratory's (ARL) website using the closest grid point to the accident site. The data was then plotted on a standard Skew T log P diagram⁶

³ Snow accumulations are reported in inches. Only a dusting of snow likely occurred during the period.

⁴ <https://aa.usno.navy.mil/data/index>

⁵ The HRRR is a NOAA real-time three-kilometer resolution, hourly-updated, cloud-resolving, convection-allowing atmospheric model, initialized by three-kilometer grids with three-kilometer radar assimilation. Radar data is assimilated in the HRRR every 15 minutes over a one-hour period.

⁶ Skew T log P diagram - is a standard meteorological plot or thermodynamic diagram using temperature and the logarithmic of pressure as coordinates, used to display winds, temperature, dew point, and various indices used to define the vertical structure of the atmosphere.

using the RAOB Analyst software⁷. Soundings were plotted at the approximate time of the derailment and at the time of the controlled burn of the hazardous chemicals.

4.1 Sounding at Time of Derailment

The HRRR sounding for 2100 EST on February 3, 2023, is included as figure 3. The sounding indicated a defined temperature inversion (green shaded area) between 5,000 ft with a top near 11,575 ft, where the temperature increased with height and resulted in a stable atmosphere with a Lifted Index (LI)⁸ of 28.0. An inversion can restrict the vertical transport of the hazardous material being burned from being dispersed to great heights in the atmosphere. The wind profile indicated a surface wind from about 300° at 3 knots with winds slowly veering⁹ to the northwest with height, and increasing wind speeds of 25 knots or more above 5,000 ft.

⁷ RAOB -The Complete RAwinsonde OBservation program is an interactive sounding analysis program developed by Eosonde Research Services (ERS) previously known as Environmental Research Services, The Villages, Florida.

⁸ Lifted Index (LI) - A common measure of atmospheric instability. Its value is obtained by computing the temperature that air near the ground would have if it were lifted to 500-hPa or approximately 18,000 feet and comparing that temperature to the actual temperature at that level. Negative values indicate instability - the more negative, the more unstable the air is, and the stronger the updrafts are likely to be with any developing thunderstorms.

⁹ Veering refers to a general clockwise change in wind with height.

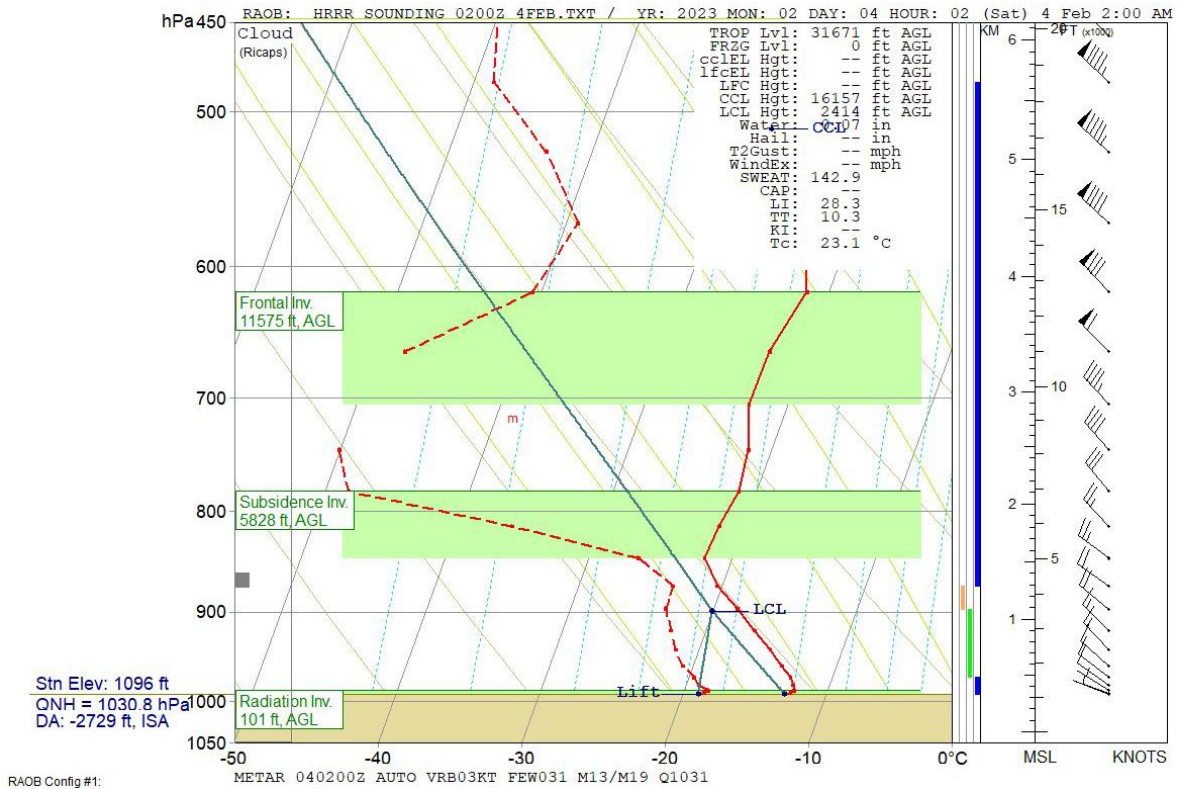


Figure 3 - High-Resolution Rapid Refresh (HRRR) numerical model sounding for 2100 EST over the derailment site depicting the vertical structure of the atmosphere.

4.2 Sounding at Time of Controlled Burn

A HRRR sounding for 1700 EST on February 6, 2023, at the time of the controlled burning of the hazardous chemicals is included as Figure 4. The sounding again depicted a defined temperature inversion between 3,600 and 5,100 ft, with a LI of 19.1 and indicated a stable atmosphere. The sounding indicated a lifted condensation level (LCL)¹⁰ and a level of free convection (LFC)¹¹ at 1,267 ft agl, and a convective condensation level (CCL)¹² at 1,793 ft agl and RAOB supported a broken to overcast layer of stratiform clouds from the LCL with tops near 4,000 ft. The precipitable water content was 0.21 inches. The wind profile indicated a near surface wind from 340° at 2 knots with winds less than 10 knots through 5,000 ft.

¹⁰ Lifted Condensation Level (LCL) - the level at which a lifted parcel becomes saturated. The LCL height corresponds to cloud base height for forced ascent.

¹¹ Level of Free Convection (LFC) - the level where a parcel becomes buoyant, or "warmer" than the environmental temperature at the same level. The LFC represents the bottom of the layer containing Convective Available Potential Energy.

¹² Convective Condensation Level (CCL) - the level in the atmosphere to which an air parcel, if heated from below, will rise dry adiabatically, without becoming colder than its environment just before the parcel becomes saturated.

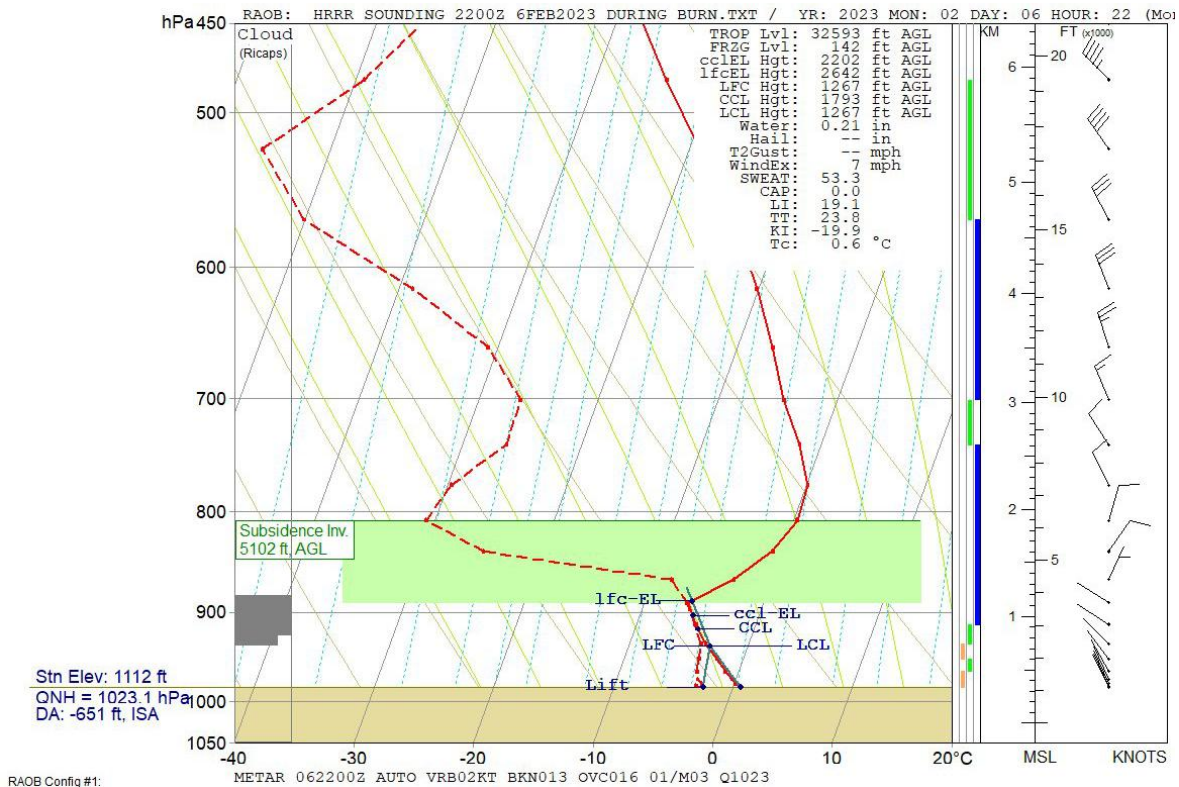


Figure 4 - HRRR sounding for 1700 EST on February 6, 2023, at the time of the controlled burn.

5.0 Controlled Burn Photographs

The controlled burn of the hazardous chemicals, specifically the vinyl chloride¹³ occurred on Monday afternoon at 1737 EST on February 6, 2023. Figure 5 are images of the plume from the fire during the first minute after ignition. The image depicts two defined burn areas initiated with a near vertical column of dark smoke rising, that merges with little drift. The fire and smoke plume lasted for an estimated 3 hours.



Figure 5 - Drone photography of the control burn of chemicals at 1637 EST on February 6, 2023.

¹³ Vinyl chloride is defined as an organochloride with the formula $H_2C=CHCl$. It is a colorless compound that is stored as a liquid under pressure. OSHA classifies it as a Class 1A Flammable Liquid, similar to butane.

The conditions reported at BVI at the start of the controlled burn were as follows.

Beaver Falls weather observation at 1635 EST, automated, wind calm, visibility 10 miles or more, ceiling¹⁴ overcast at 1,300 feet agl, temperature 33° F (0.5° C), dew point temperature 26° F (-3.6° C), altimeter 30.25 inches of mercury.

Other images of the controlled burn smoke plume also showed the plume rising vertically and spread out under the overcast cloud layer, as shown in figures 6 and 7.



Figure 6 - East Palestine, Ohio, smoke plume from controlled burn on February 6, 2023.

¹⁴ Ceiling is defined as the lowest layer of clouds reported as broken, overcast, or the vertical visibility into a surface based obscuration.



Figure 7 - Drone image of controlled burn on February 6, 2023.

6.0 Weather Radar Imagery

The closest NWS Weather Surveillance Radar 1988 Doppler (WSR-88D) was located 23 miles southeast of the derailment in Pittsburgh (KPBZ), Pennsylvania. The level II archive radar data were obtained from the National Center for Environmental Information (NCEI) using the Hierarchical Data Storage System and displayed using the NWS NEXRAD Interactive Viewer and Data Exporter software¹⁵. The radar was documented during the burning of the hazardous material at approximately 1637 EST on February 6, 2023, where the radar was able to track the larger particulate matter.

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors¹⁶, it is a function of the drop size distribution, number of particles per unit volume, physical state (ice or water), shape, and aspect. Reflectivity is normally displayed in decibels (dBZ)¹⁷ and is a general measure of echo intensity. The FAA Aviation Weather Handbook¹⁸ defines echoes less

¹⁵ <https://www.ncdc.noaa.gov/wct/>

¹⁶ Hydrometeors are any product of condensation or sublimation of atmospheric water vapor, whether formed in the free atmosphere or at the earth's surface. Hydrometeors are classified as; (a) Liquid or solid water particles suspended in the air: cloud, water droplets, mist or fog. (b) Liquid precipitation: drizzle and rain. (c) Freezing precipitation: freezing drizzle and freezing rain. (d) Solid (frozen) precipitation: ice pellets, hail, snow, snow pellets, and ice crystals.

¹⁷ dBZ - Nondimensional "unit" of radar reflectivity which represents a logarithmic power ratio (in decibels, or dB) with respect to radar reflectivity factor, Z.

¹⁸ FAA Aviation Weather Handbook - WSR-88D Radar Precipitation Intensity Terminology (Table 24-8),

than 30 dBZ as "light" in intensity, "moderate" echoes 30-40 dBZ, "heavy" with echoes of >40-50 dBZ, and "extreme" intensity with echoes above >50 dBZ.

During the period between 1600 and 1717 EST the KPBZ WSR-88D was operating in the clear air mode, volume scanning pattern VCP-35¹⁹ and then switched to the precipitation mode VCP-212²⁰ between 1723 and 1740 EST, and then back to VCP-35 after 1743 EST.

Figures 8-10 are the KPBZ WSR-88D 0.53° base reflectivity images of the plume detected at 1639 through 1920 EST, the train derailment location is noted in the upper left corner of the image with the observation site BVI also located in the right lower corner. Assuming a standard refraction of the radar beam, the 0.53° beam was scanning the atmosphere between approximately 1,750 through 4,070 ft over the area. The smoke plume is observed to about 3 miles east of the derailment location during the period before dissipating.

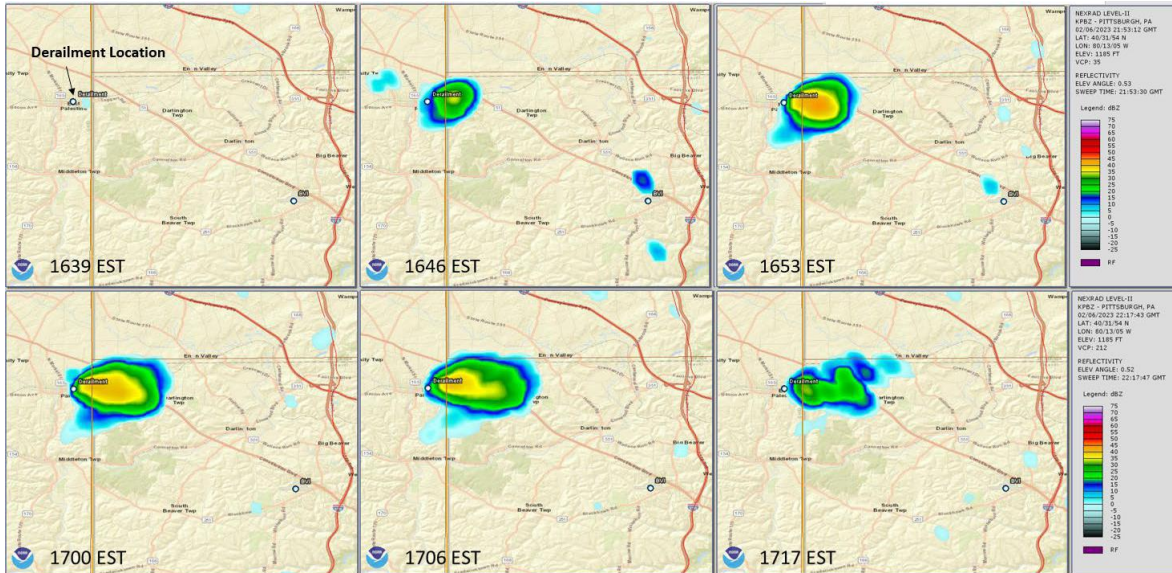


Figure 8 - NWS KPBZ WSR-88D 0.53° base reflectivity images from 1639 through 1717 EST.

available at; <https://www.faa.gov/regulationspolicies/handbooksmanuals/aviation/faq-h-8083-28-aviation-weather-handbook>

¹⁹VCP-35 clear air mode the radar makes 9 different elevation scans during an approximately 7-minute volume scans and is typically used during periods of light precipitation and for snow detection.

²⁰ VCP-212 precipitation mode the radar makes 14 different elevation scans during approximately 4 ½ - minute volume scans and is typically used in monitoring distant precipitation echoes.

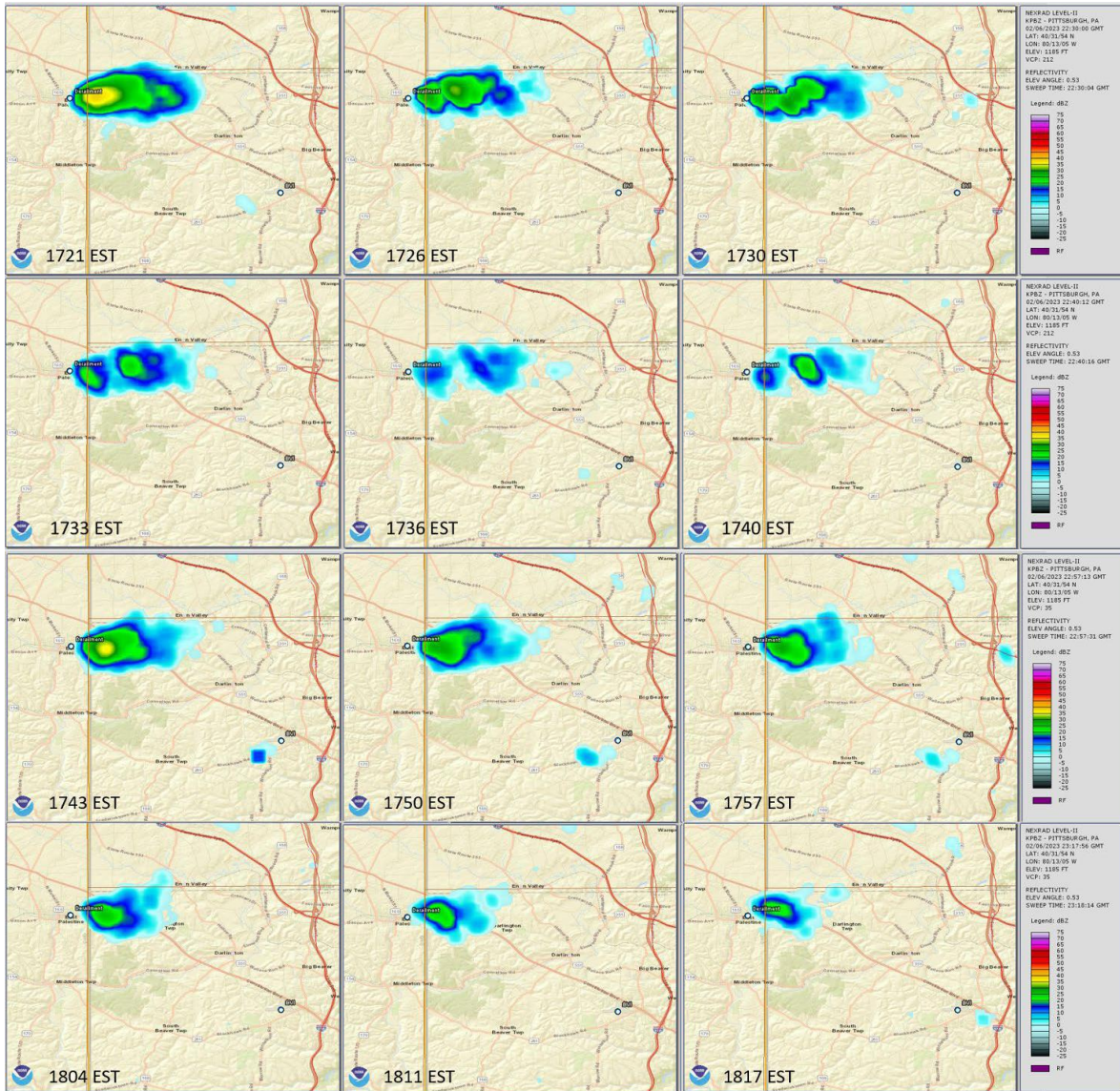


Figure 9 - KP82 WSR-88D 0.53° base reflectivity images from 1721 through 1817 EST.

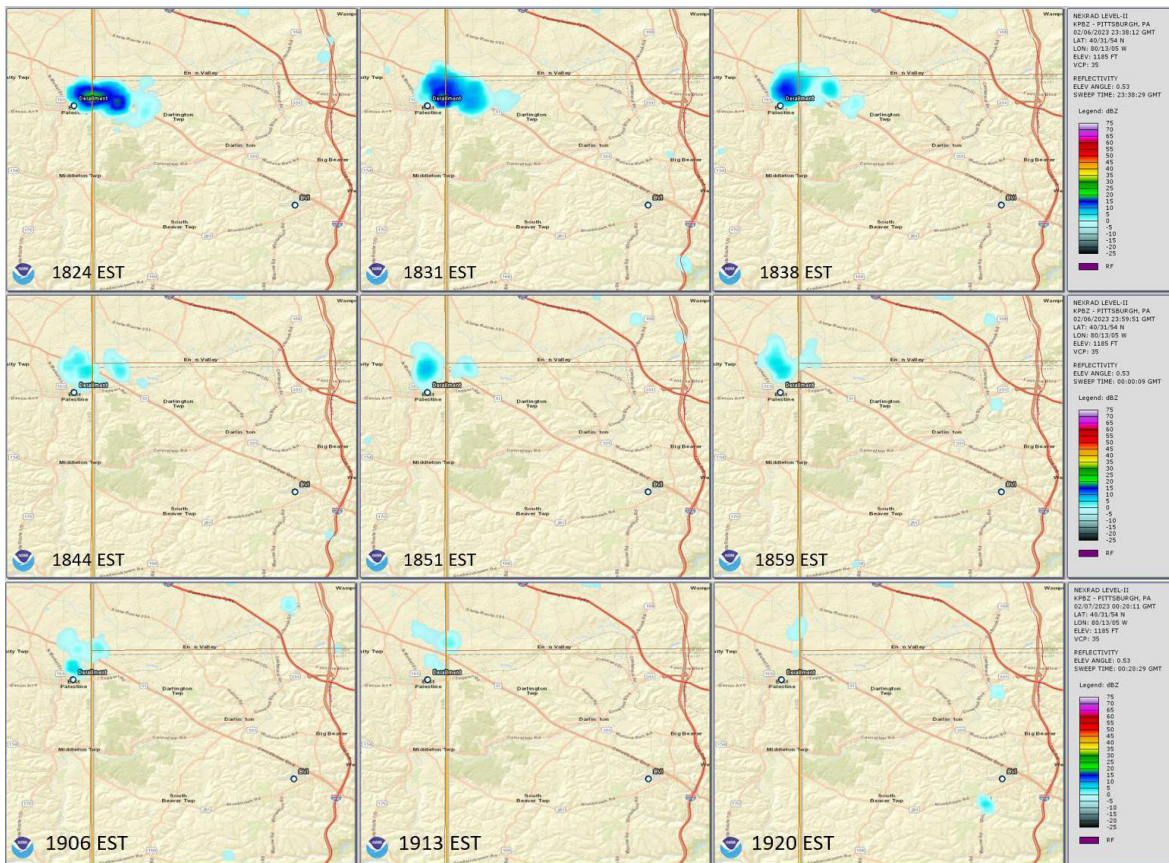


Figure 10 - KPZB WSR-88D 0.53° base reflectivity images from 1824 through 1920 EST.

7.0 NWS HYSPLIT Model

The NOAA’s Air Resources Laboratory’s Hybrid Single-Particle Lagrangian Integrated Trajectory model (HYSPLIT)²¹ was run, which is one of the most widely used models for atmospheric trajectory and dispersion calculations. Attachment 1 is the HYSPLIT model concentration in mass per cubic meter (mass/m³) from the surface to approximately 300 ft (100 m) for the 24 hour period for the initial accident and any chemical breach from 2100 EST on February 3, 2023, through 2100 EST on February 4, 2023.

The HYSPLIT model for 1800 EST on February 7, 2023, is included as Figure 11. The image depicts the plume dispersion every 2 hours through 24 hours, which moves east southeastward over Pennsylvania, New Jersey, Maryland, Delaware and into the Atlantic Ocean. The total distance the cloud reached ending the 24-hour period was about 680 miles from the initial control burn.

²¹ <https://www.ready.noaa.gov/HYSPLIT.php>

Figures 12-15 are the HYSPLIT run at 1733 EST for the time of arrival of the plume cloud every 5-hours beginning at 2300 on February 7th through 0400, 0900, and 1400 EST on February 8th of the burn plume. The range scale is set at 100 nm.

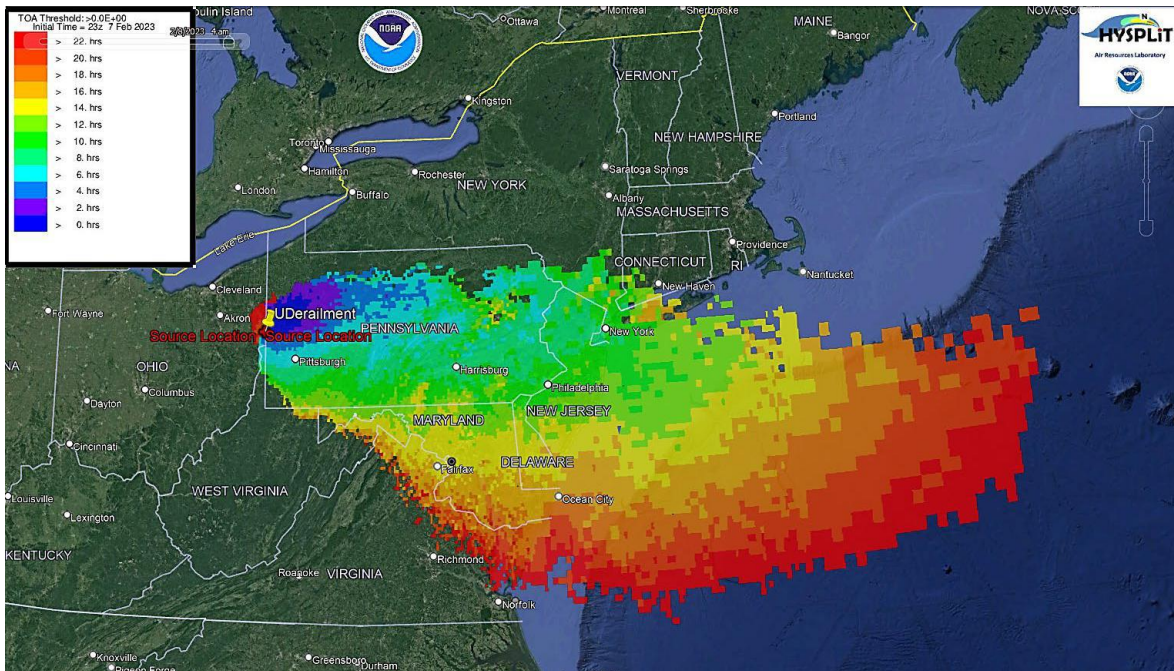


Figure 11 - NOAA HYSPLIT dispersion model for 1800 EST on February 7, 2023.

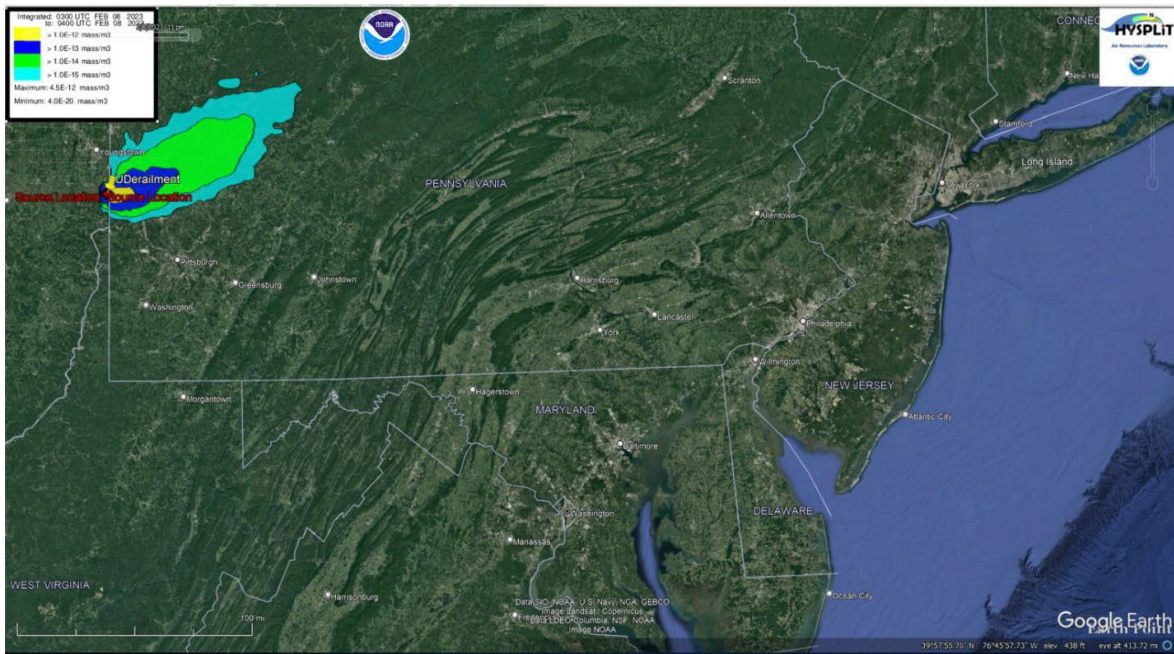


Figure 12 - HYSPLIT concentration at 2300 EST on February 7, 2023.

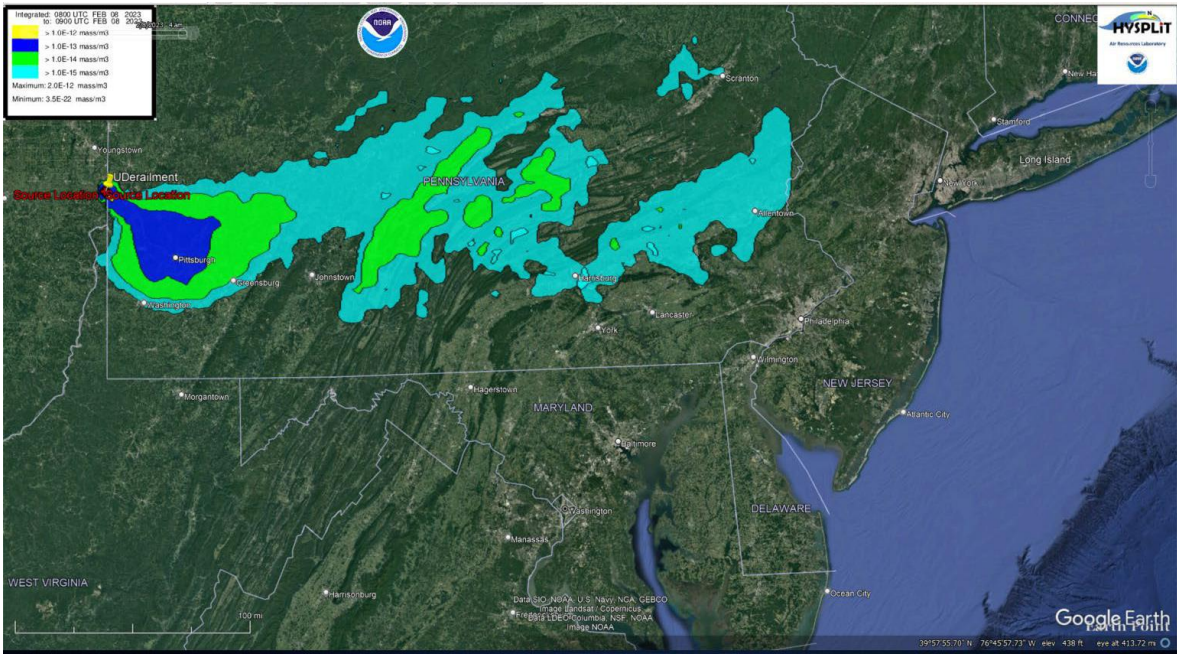


Figure 13 - HYSPLIT concentration 0400 EST on February 8, 2023.

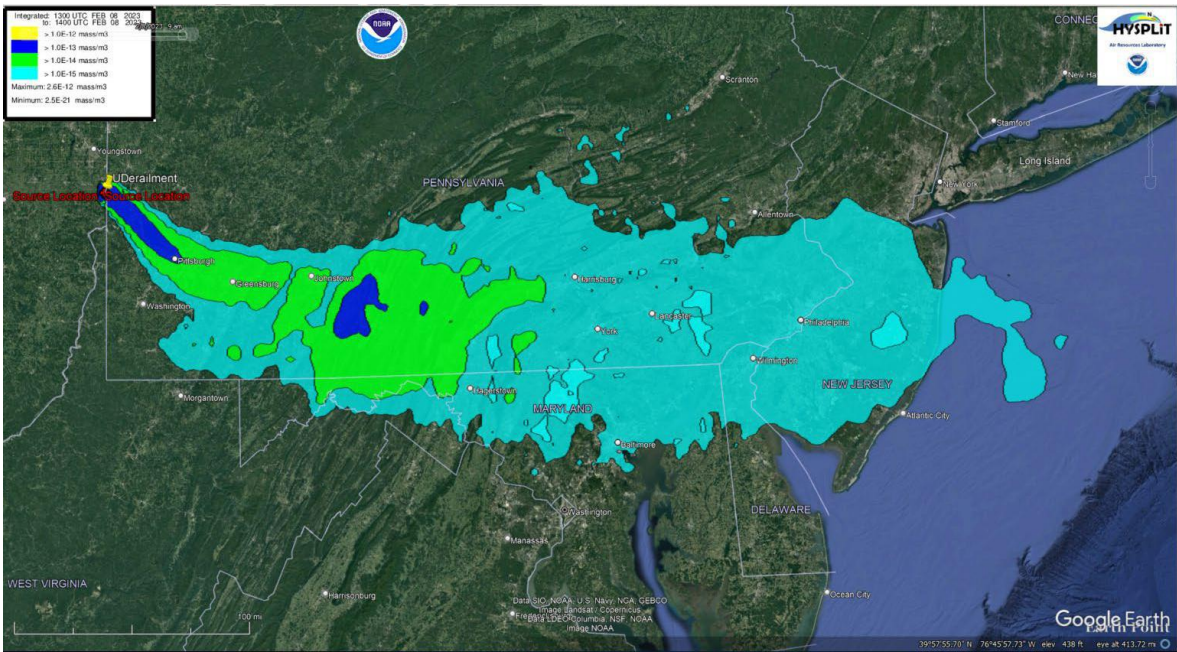


Figure 14 - HYSPLIT concentration 0900 EST on February 8, 2023.

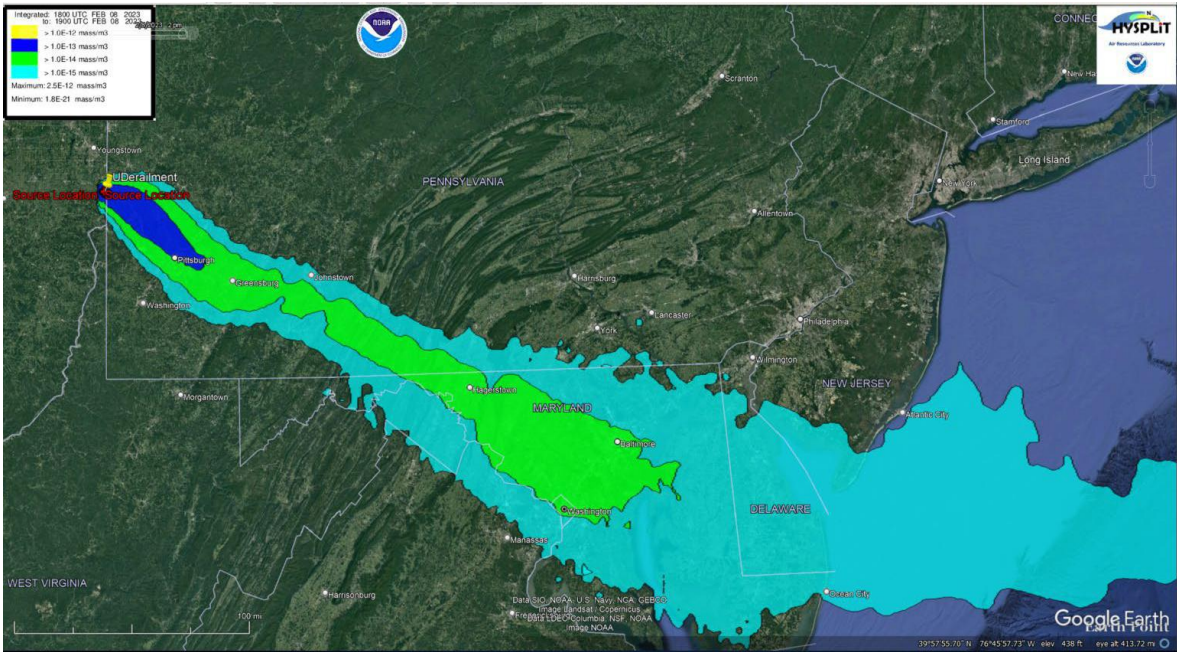


Figure 15 - HYSPLIT concentration 1400 EST on February 8, 2023.

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