DEQ
VIRGINIA DEPARTMENT OF
ENVIRONMENTAL QUALITY

Making a Real-time Air Quality Forecast for Richmond, Virginia

MARAMA Air Quality Monitoring Workshop

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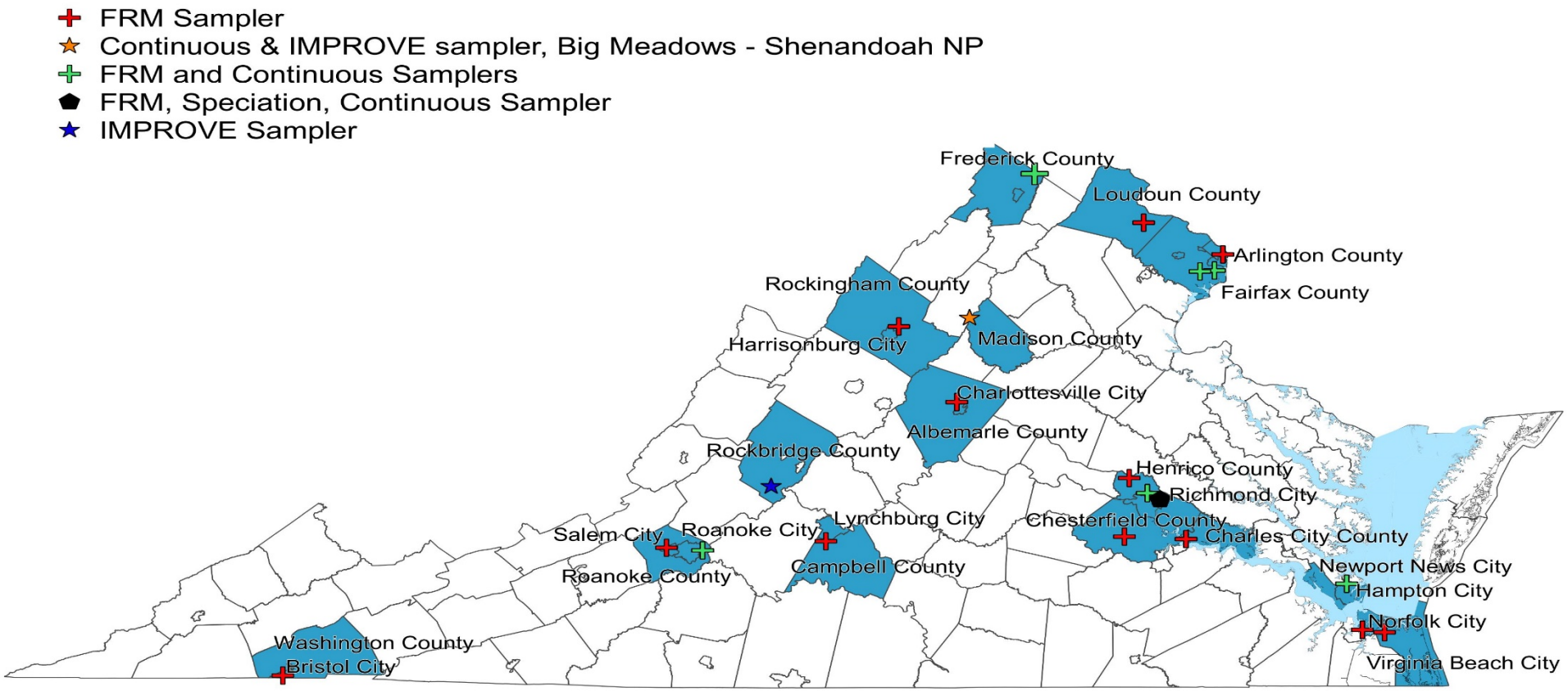
The Virginia Department of Environmental Quality (DEQ) issues daily air quality forecasts to the public and media via “DEQCast” emails and Airnow.gov for:

- Richmond
- Hampton Roads
- Roanoke
- Winchester (in conjunction with Maryland)
- Northern Virginia (forecasts made by Washington, DC Council of Governments and Maryland Department of the Environment).

Virginia Fine Particle (PM2.5) Monitoring Network



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- Air quality forecasts, especially “Air Quality Action Days” (AQAs), are important to those with existing lung or heart ailments (“sensitive groups”) in order for them to plan their daily activities accordingly.
- Forecasts are issued for ground-level ozone and fine particles (less than 2.5 microns; “PM2.5”) in the warmer months.
- Only PM2.5 forecasts are made in the cooler months because ozone is a photochemical pollutant; it only peaks in Virginia when it is warmer and there is more daylight.
- Today I’m going to concentrate on a PM2.5 forecast for Richmond, Virginia.

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What goes into an air quality forecast?

- Meteorology: Need to make a weather forecast
- Air quality data: Current data, regional data, upwind data
- Air quality models: From National Oceanic and Atmospheric Administration (NOAA) and, for us, North Carolina Department of Environment and Natural Resources
- Experience!

Sources of PM2.5 Emissions

Motor vehicles

Power plants

Residential wood burning

Forest fires

Agricultural burning

Some industrial processes

Other combustion processes

Air Quality Index

TABLE 2—BREAKPOINTS FOR THE AQI

These breakpoints							Equal these AQI's	
O_3 (ppm) 8-hour	O_3 (ppm) 1-hour[1]	$PM_{2.5}$ (µg/m³) 24-hour	PM_{10} (µg/m³) 24-hour	CO (ppm) 8-hour	SO_2 (ppb) 1-hour	NO_2 (ppb) 1-hour	AQI	Category
0.000–0.054	—	0.0—12.0	0–54	0.0–4.4	0–35	0–53	0–50	Good.
0.055–0.070	—	12.1—35.4	55–154	4.5–9.4	36–75	54–100	51–100	Moderate.
0.071–0.085	0.125–0.164	35.5—55.4	155–254	9.5–12.4	76–185	101–360	101–150	Unhealthy for Sensitive Groups.
0.086–0.105	0.165–0.204	[3]55.5—150.4	255–354	12.5–15.4	[4]186–304	361–649	151–200	Unhealthy.
0.106–0.200	0.205–0.404	[3]150.5—250.4	355–424	15.5–30.4	[4]305–604	650–1249	201–300	Very Unhealthy.
0.201-([2])	0.405–0.504	[3]250.5—350.4	425–504	30.5–40.4	[4]605–804	1250–1649	301–400	Hazardous.
([2])	0.505–0.604	[3]350.5—500.4	505–604	40.5–50.4	[4]805–1004	1650–2049	401–500	

[1] Areas are generally required to report the AQI based on 8-hour ozone values. However, there are a small number of areas where an AQI based on 1-hour ozone values would be more precautionary. In these cases, in addition to calculating the 8-hour ozone index value, the 1-hour ozone index value may be calculated, and the maximum of the two values reported.

[2] 8-hour O_3 values do not define higher AQI values (>301). AQI values > 301 are calculated with 1-hour O_3 concentrations.

[3] If a different SHL for $PM_{2.5}$ is promulgated, these numbers will change accordingly.

[4] 1-hr SO_2 values do not define higher AQI values (≥200). AQI values of 200 or greater are calculated with 24-hour SO_2 concentration.

"AQAs"

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The World's Worst PowerPoint Slide! (Some Air Quality Forecasting Web Sites)

- **AirnowTech: www.airnowtech.org (password protected)**
- **Airnow.gov: www.airnow.gov**
- **College of DuPage GOES-16: https://weather.cod.edu/satrad/exper/?parms=subregional-Virginias-01-24-1-100-1&checked=usint-map&colorbar=undefined**
- **NOAA HYSPLIT (Hybrid Single-Particle Lagrangian Integrated Trajectory) model: http://ready.arl.noaa.gov/HYSPLIT.php (password protected)**
- **National Weather Service (NWS) Environmental Modeling Center (EMC) Mesoscale Modeling Branch for Ozone/PM2.5 model charts/text files: http://www.emc.ncep.noaa.gov/mmb/aq/**
- **NWS EMC Mesoscale Modeling Branch CMAQ Ozone and PM2.5 Forecast Page: https://www.emc.ncep.noaa.gov/mmb/aq/**
- **NWS EMC Model Output Text Files: http://www.emc.ncep.noaa.gov/mmb/aq/sv/grib/**
- **NC DENR CAMx Model: http://www2.ncair.org/airaware/forecast/Models/camx.php**
- **Weather Prediction Center forecast maps: https://www.wpc.ncep.noaa.gov/basicwx/basicwx_ndfd.php**
- **National Centers for Environmental Protection models: http://mag.ncep.noaa.gov/model-guidance-model-area.php?group=Model%20Guidance&model=nam&area=wnatl&ps=area**
- **NWS Model Output Statistics via Texas A&M University: http://leonardo.met.tamu.edu/Weather_Interface/**
- **Virginia DEQ forecast page: https://www.deq.virginia.gov/air/air-quality-monitoring-assessments/current-air-quality**
- **High Resolution Rapid Refresh Smoke Model: https://rapidrefresh.noaa.gov/hrrr/HRRRsmoke/**
- **Aerosol Watch: https://www.star.nesdis.noaa.gov/smcd/spb/aq/AerosolWatch/**
- **PM2.5 Model from the European Center for Medium-Range Weather Forecasts (ECMWF): https://weather.us/model-charts/euro**

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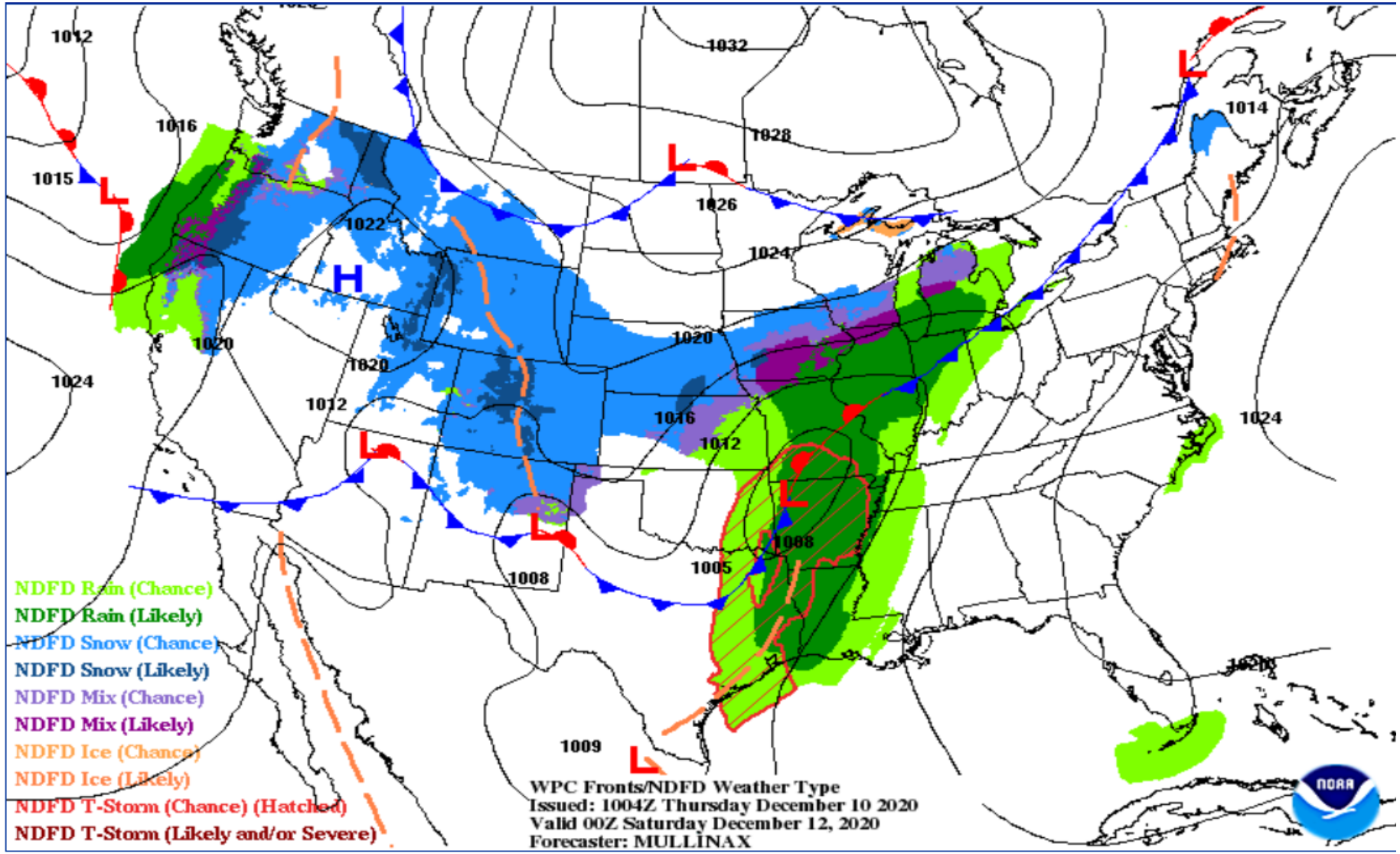
December 11th Evening Surface Forecast Map



10z National Blend of Models (NBM) Model Output Statistics for Richmond

KRIC NBM V4.0 NBS GUIDANCE 12/10/2020 1000 UTC

DT	/DEC	10		/DEC	11					/DEC	12						/DEC	13			
UTC	15	18	21	00	03	06	09	12	15	18	21	00	03	06	09	12	15	18	21	00	03	06	09
FHR	05	08	11	14	17	20	23	26	29	32	35	38	41	44	47	50	53	56	59	62	65	68	71
TXN				55				35				62				46				64			
XND				1				2				3				2				3			
TMP	44	52	52	43	40	39	38	37	49	59	59	52	50	49	49	48	56	61	62	55	54	54	53
TSD	2	1	1	2	2	2	2	2	2	2	3	2	2	3	3	2	2	3	3	3	3	3	3
DPT	33	34	35	36	35	35	35	35	40	44	46	47	47	47	47	48	50	49	48	48	48	49	49
DSD	2	1	1	1	2	2	2	2	2	2	3	2	2	3	3	2	2	2	3	2	2	2	2
SKY	3	19	39	30	44	48	28	12	6	20	18	28	55	76	84	85	75	44	36	28	49	70	69
SSD	5	35	40	39	31	36	32	20	23	31	33	28	25	18	10	5	13	24	22	30	23	15	18
WDR	3	6	14	15	15	17	18	18	20	20	19	18	18	18	19	20	20	21	20	20	20	21	21
WSP	3	4	4	2	3	4	4	4	6	8	7	4	4	4	4	4	7	10	9	7	8	9	9
WSD	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1
GST	5	5	4	3	5	7	8	7	10	14	12	7	5	5	6	7	11	15	14	10	10	12	11
GSD	3	3	3	2	2	3	3	3	2	3	3	2	3	3	2	2	2	4	3	3	3	3	2
P06		0		0		0		1		0		0		0		3		5		3		9	
P12				0				1				0				3				8			
Q06		0		0		0		0		0		0		0		0		0		0		0	
Q12				0				0				0				0				0			
DUR				0				0				0				0				0			
T03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
T06		0		0		0		0		0		0		0		0		0		0		2	
T12				0				0				0				0				0			
PZR	0	0	0	0	0	1	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PSN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PPL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PRA	100	100	100	100	100	99	98	96	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
S06		0		0		0		0		0		0		0		0		0		0		0	
SLV	32	34	36	38	40	53	68	67	74	78	84	82	79	82	76	68	58	52	58	79	97	95	93
I06		0		0		0		0		0		0		0		0		0		0		0	
CIG	-88	-88	-88	-88	-88	-88	-88	-88	-88	-88	-88	-88	-88	29	28	29	60	-88	-88	-88	-88	60	28
IFC	0	0	0	0	0	1	0	5	4	0	0	9	16	25	25	26	21	18	6	7	10	20	22
LCB	90	170	170	230	200	160	210	220	150	38	10	5	9	7	21	25	60	140	60	110	42	27	24
VIS	100	100	100	100	100	100	100	90	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
IFV	0	0	0	0	2	6	9	11	3	0	0	0	7	12	15	11	7	0	0	0	3	6	7
MHT	7	21	13	4	3	3	3	3	9	18	11	3	4	4	4	4	12	27	15	6	6	6	6
TWD	36	35	18	15	15	17	18	18	19	19	19	18	19	18	20	21	22	21	21	19	20	21	21
TWS	2	2	1	3	3	6	6	6	7	11	10	6	6	6	6	6	9	13	12	10	10	10	11
HID		4		4		4		4		4		4		4		3		4		4		4	
SOL	33	45	12	3	0	0	0	0	32	33	13	4	0	0	0	0	14	29	29	15	0	0	0

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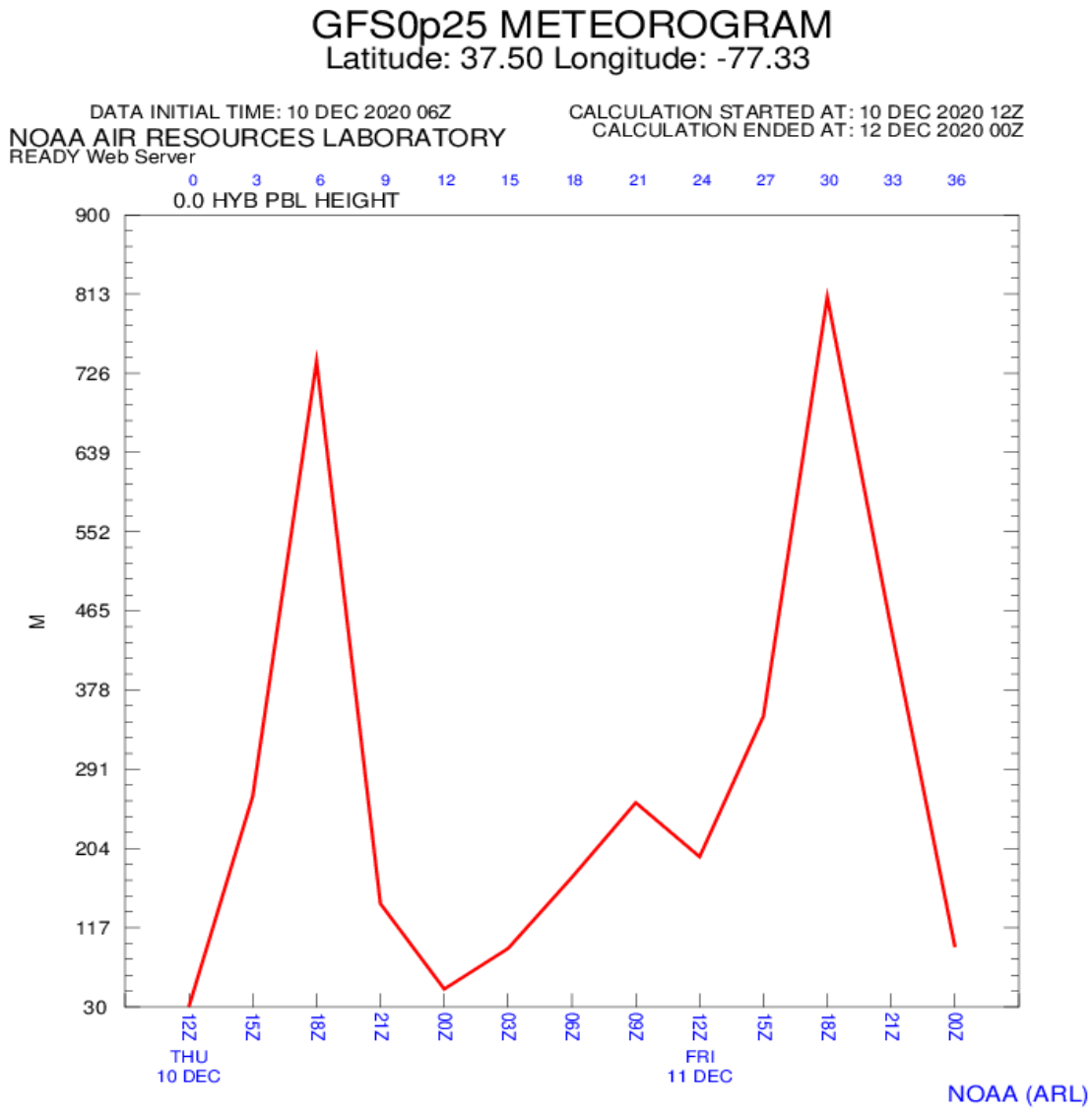
GFS Model Predicted Mixed Layer Depth



HYSPLIT (Hybrid Single-Particle Lagrangian Integrated Trajectory) Model Parameters

Model Run Details

Request trajectory

The current GFS model has archive data beginning at 12/02/20 0600 UTC and 180 hours of forecast data beginning at 12/10/20 0600 UTC.

Model Parameters

Trajectory direction:
- ○ Forward
- ◉ Backward (Change the default start time!)

More info ▶

Vertical Motion:
- ◉ Model vertical velocity
- ○ Isobaric
- ○ Isentropic

More info ▶

Start time (UTC):
Current time: 11:05

year	month	day	hour
20	12	11	21

More info ▶

Total run time (hours): 36 — More info ▶

Start a new trajectory every: 0 hrs — Maximum number of trajectories: 24 — More info ▶

Start 1 latitude (degrees): 37.5 — More info ▶

Start 1 longitude (degrees): -77.33 — More info ▶

Start 2 latitude (degrees):

Start 2 longitude (degrees):

Start 3 latitude (degrees):

Start 3 longitude (degrees):

Automatic mid-boundary layer height? Will override selections below. ○ Yes ◉ No — More info ▶

Level 1 height: 500 — ◉ meters AGL ○ meters AMSL — More info ▶

Level 2 height: 1500

Level 3 height: 10

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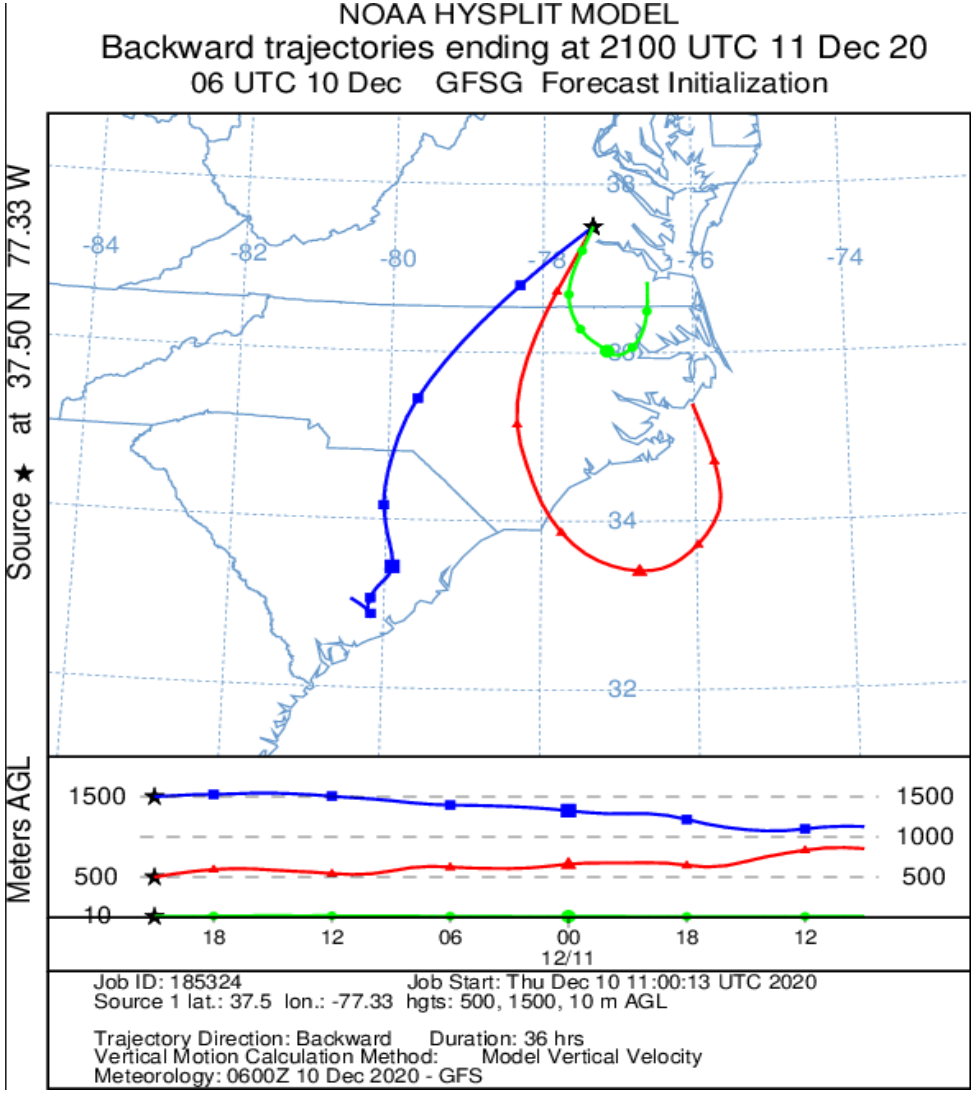
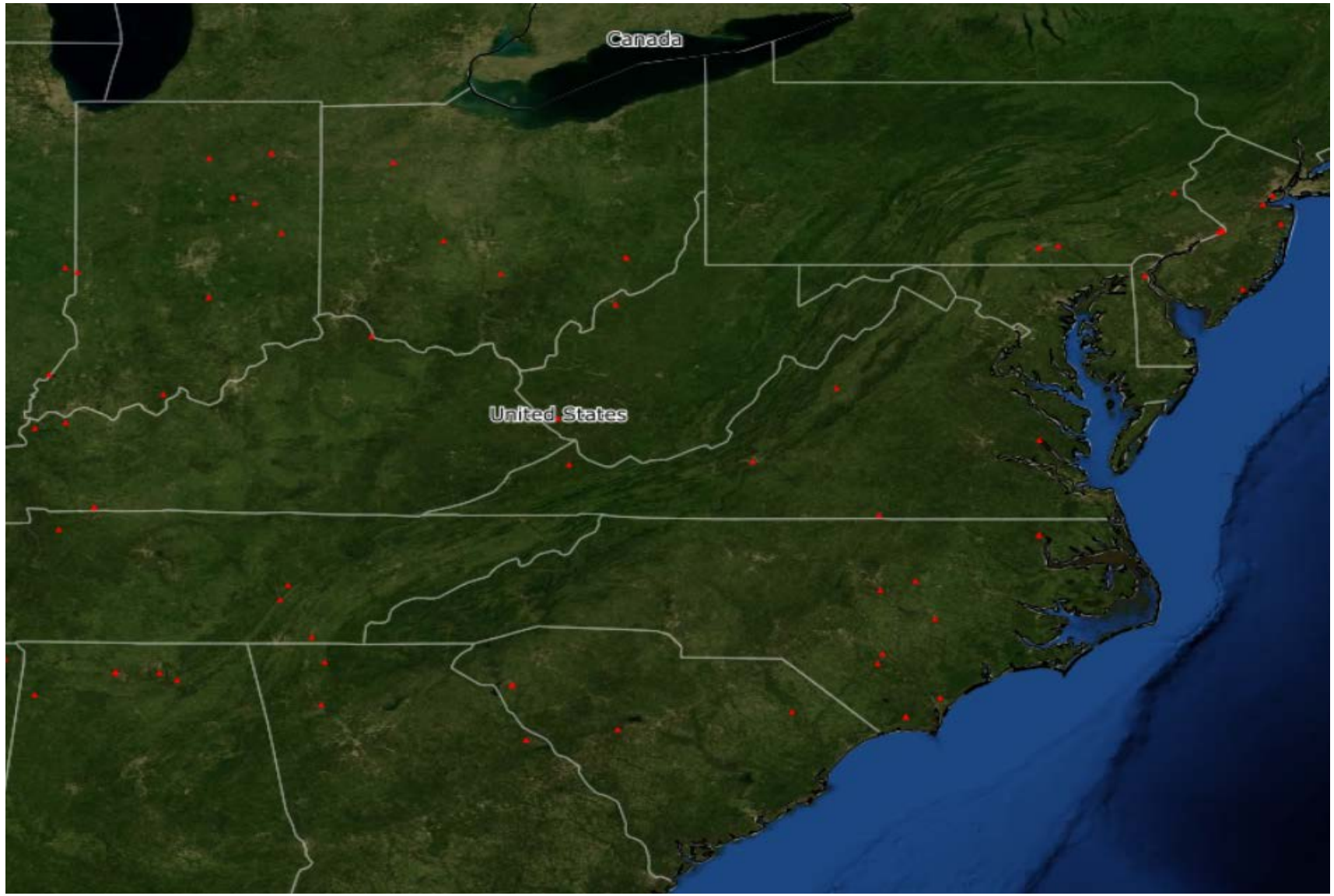
HYSPLIT Back-Trajectories for Richmond, Ending at 21z, December 11th



Current Agricultural and/or Wildfires Detected by Satellite



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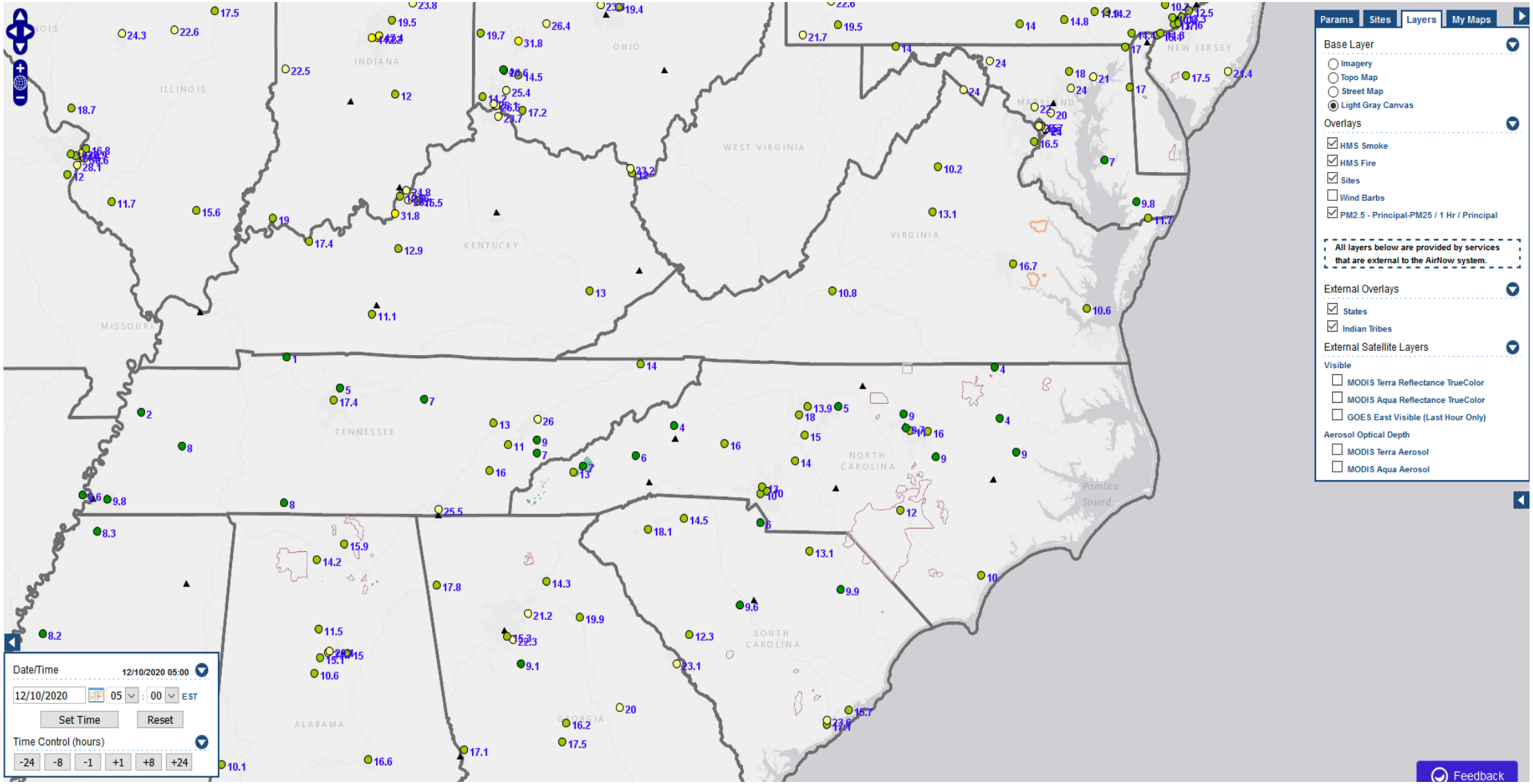
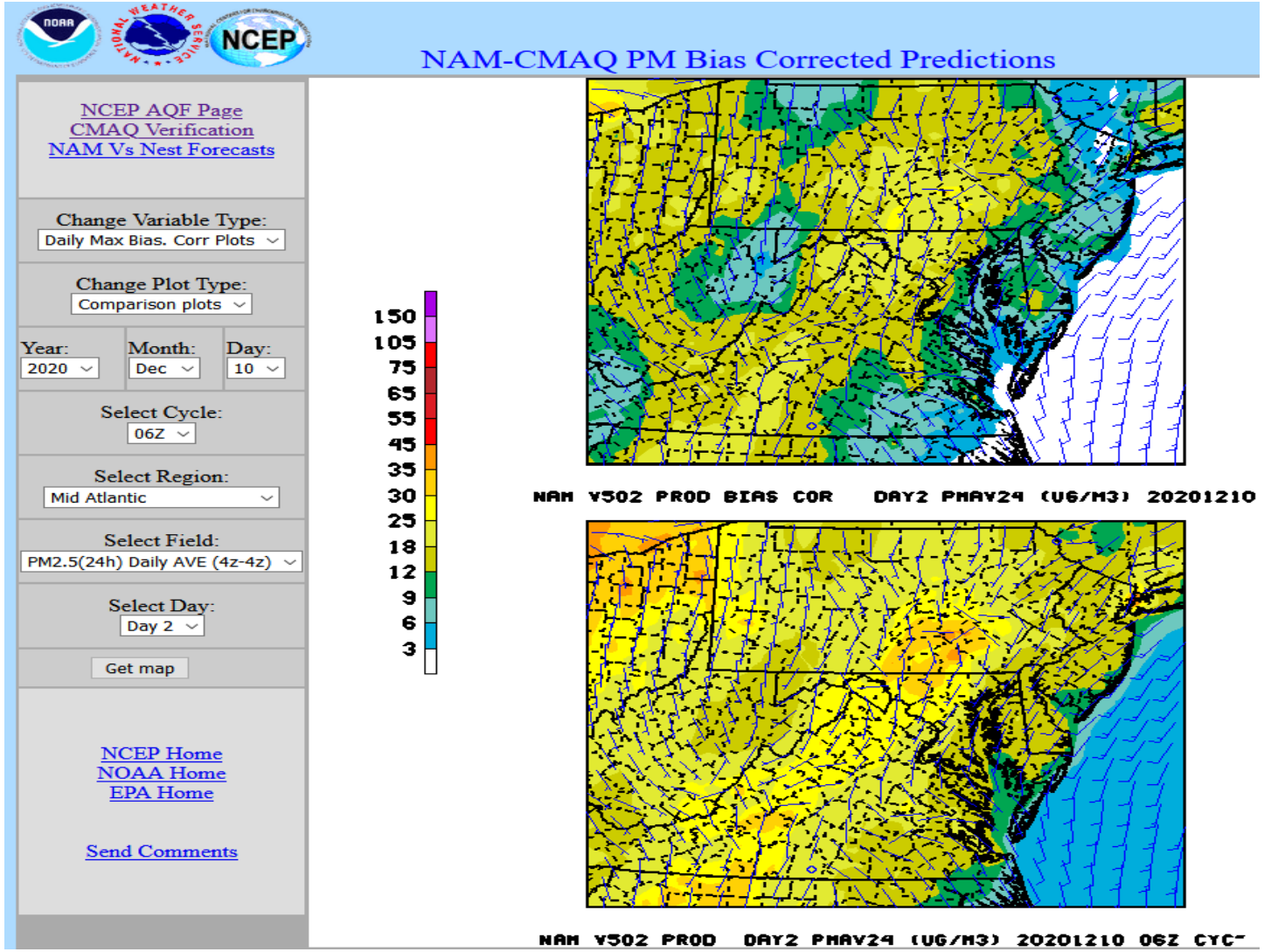
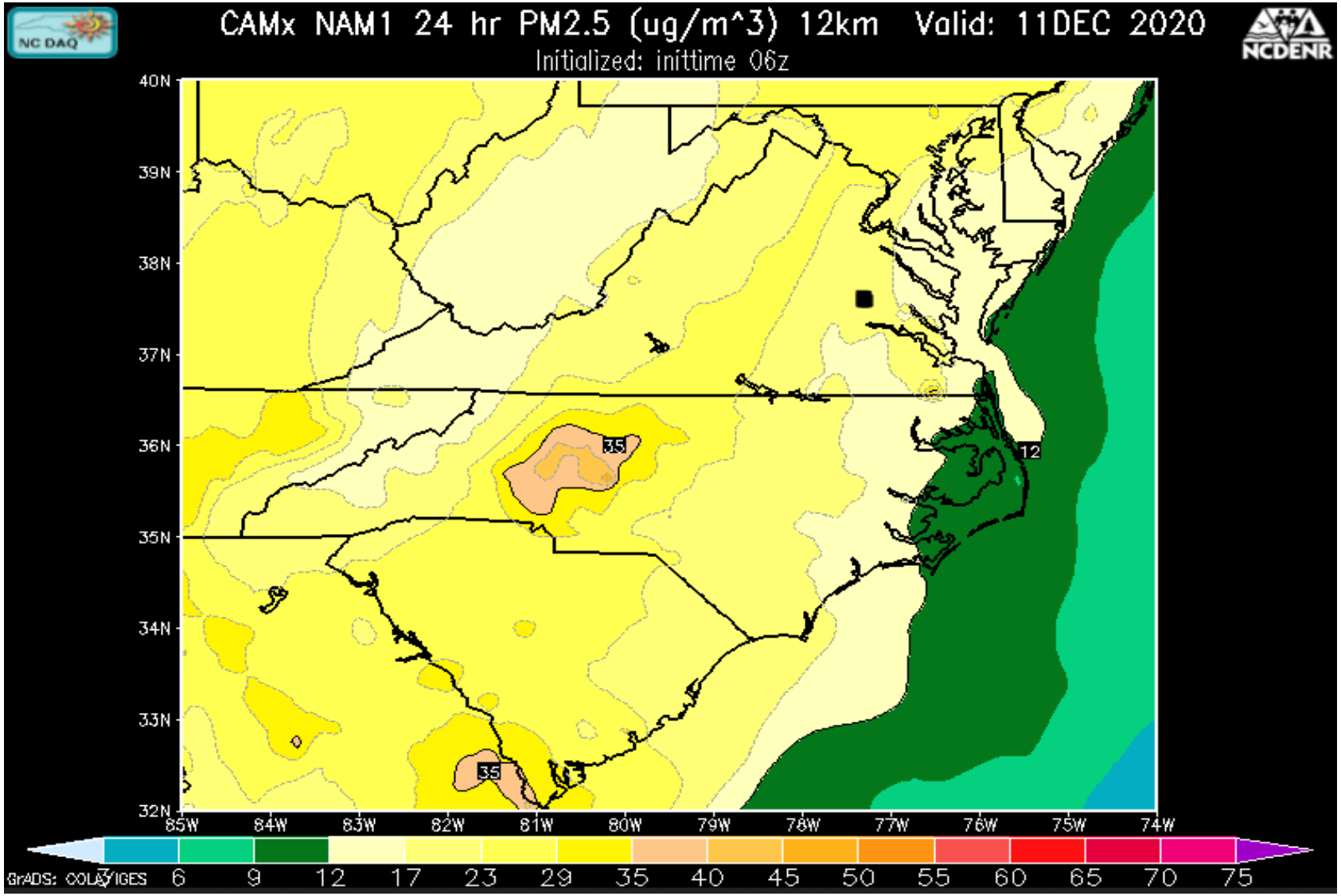
AirNowTech Hourly PM2.5 Concentrations



06z NOAA Model PM2.5 Model Predictions for December 11th



North Carolina DENR CAMx PM2.5 Model Predictions



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Virginia DEQ Air Quality Forecasts Page

Current Air Quality

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Virginia DEQ monitors pollution at stations around Virginia. At high levels, ground level ozone and particle pollution may raise health concerns in some people. The map below shows the current estimated air quality index, or AQI, which is used to describe how clean the air is, and what health effects might be expected.

Sign up to receive daily Air Quality Forecasts and Health Alerts by email. For the Washington, DC metro area, download the Clean Air Partners' app or sign up on Enviroflash to receive Air Quality Forecasts and Action Day Health Alert Notifications.

Forecast

Today's Forecast						Tomorrow's Forecast				
Region	AQI	Class	Pollutant	Activity Caution	Risk Groups	AQI	Class	Pollutant	Activity Caution	Risk Groups
HAMPTON ROADS	53	Moderate	PM25LC	Unusually sensitive people should consider reducing prolonged or heavy exertion.	People with respiratory or heart disease, the elderly and children are the groups most at risk.		No Forecast			
NORTHERN VIRGINIA	72	Moderate	PM25LC	Unusually sensitive people should consider reducing prolonged or heavy exertion.	People with respiratory or heart disease, the elderly and children are the groups most at risk.		No Forecast			
RICHMOND	57	Moderate	PM25LC	Unusually sensitive people should consider reducing prolonged or heavy exertion.	People with respiratory or heart disease, the elderly and children are the groups most at risk.		No Forecast			
ROANOKE	57	Moderate	PM25LC	Unusually sensitive people should consider reducing prolonged or heavy exertion.	People with respiratory or heart disease, the elderly and children are the groups most at risk.		No Forecast			
WINCHESTER	57	Moderate	PM25LC	Unusually sensitive people should consider reducing prolonged or heavy exertion.	People with respiratory or heart disease, the elderly and children are the groups most at risk.		No Forecast			

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Thanks!

Questions?

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