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DEPARTMENT OF THE ENVIRONMENT

East Coast AQ Forecasting Considerations (Maryland Perspective)

Duc Nguyen, Senior Meteorologist

Presented at:
NOAA AQPG Advisory Group Workshop
UMBC
September 14, 2010

Outline

- History of AQ Forecasting in MD
- How an AQ Forecast is Produced.
- Usages of Satellite Data

MDE

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History of AQ Forecasting in MD

1994
- Ozone forecasting program initiated (MDE, UMD)
- Color-coded reporting developed for mapping & forecasting (MDE, ALA)

1995
1st ozone map created for Baltimore-DC region

1996
1st Ozone Action Day began to promote voluntary actions to reduce air pollution and protect public health

1997
- Ozone Pollution Map broadcasted in 15 NE states (MARAMA, NESCAUM, OTC, EPA, respective state agencies)
- EPA created AIRNow program

1998
EPA Adopted color-code reporting and developed Air Quality Index (AQI) as a standard metric to report air quality information & forecast

…
- MDE expanded AQ forecasting to include particle pollution
- NOAA started providing AQ model guidance products

2004
- NWS started working with respective agencies to disseminate Air Quality Alert
- EPA-NWS started AQ Awareness Week

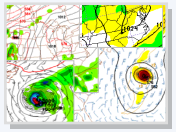
…
Development of International Air Quality Index?

2010
- EPA & Shanghai EPB launched AIRNow-I
- EPA integrated new technology into the AIRNow program
- NWS AQ Alert adopted in DC-MD-VA

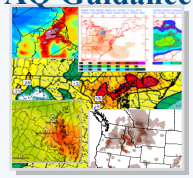
How an AQ Forecast is Produced

INPUT PRODUCTS

Met Guidance

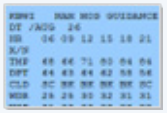


AQ Guidance



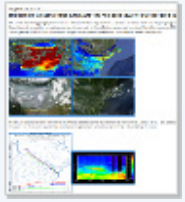
Regression

MOS

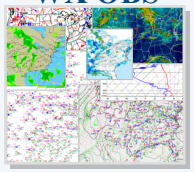


AQMOS

Smog Blog

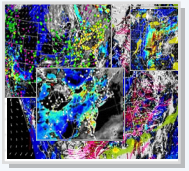


WX OBS

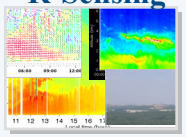


AQ OBS

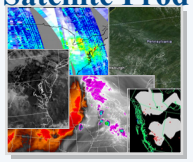
IDEA Prod



G-Based R-Sensing

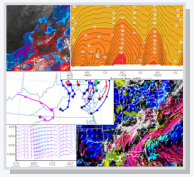


Satellite Prod



WX Fcst/Disc

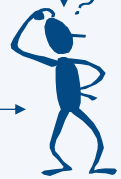
Others



FUTURE NEEDS

GENERATING AQ FORECAST

Colleagues



On-Duty Meteorologist

STATE/LOCAL AQ Meteorologists

AIRNOW PORTAL

DISSEMINATION TO PUBLIC

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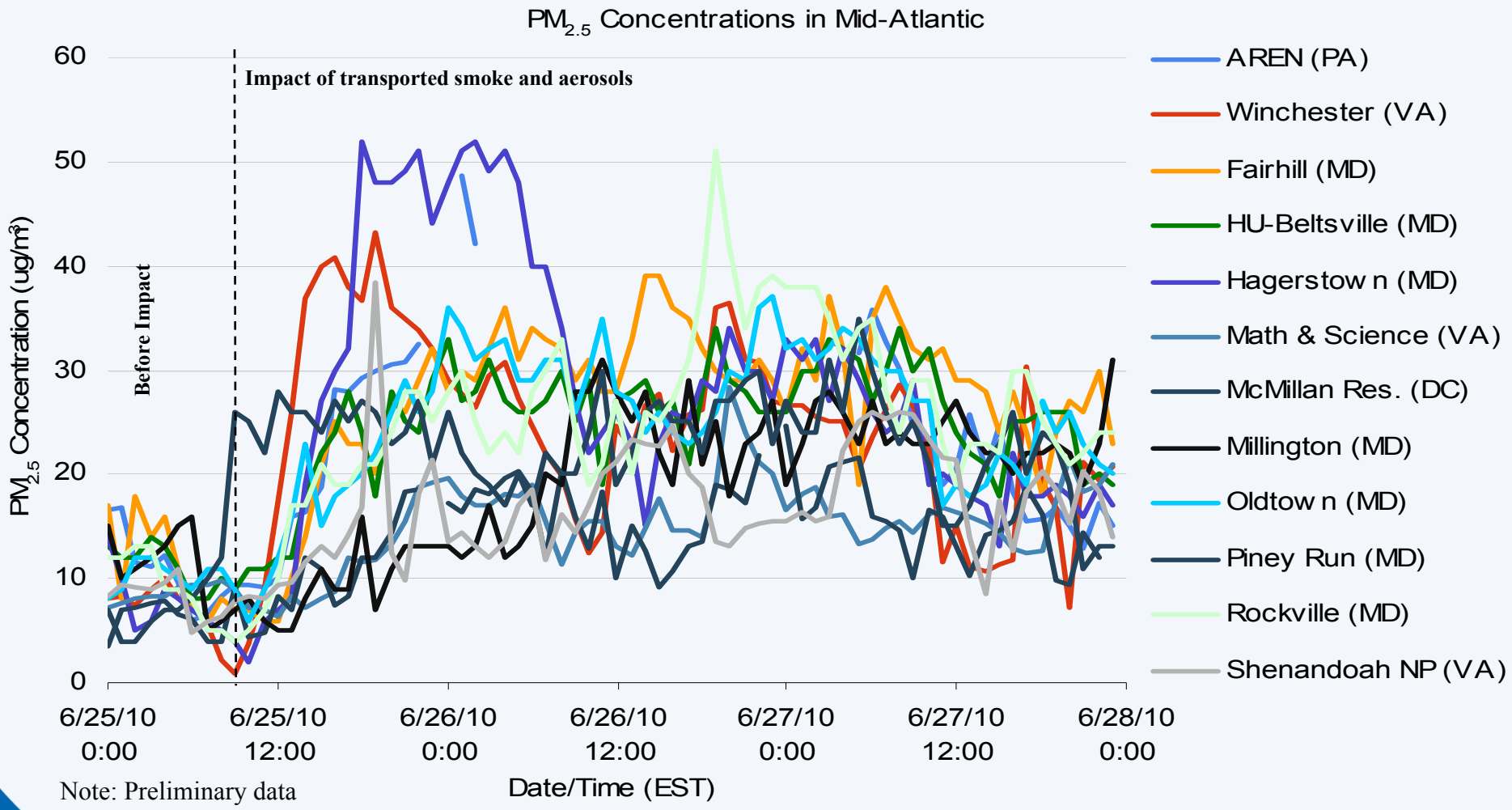
Usages of Satellite Data

- Excellent for retrospective analyses of air pollution events
  - Documenting and visualizing large-scale (not so good for small-scale) transport pollution events
  - Documenting exceptional events (need to quantitatively answer cause and effect questions)
- Air quality forecast
  - Help determine potential upwind particles and carryover pollutants for the following day
  - Help validate model guidance performance
  - Help track transport of smoke, aerosols, dust, etc.

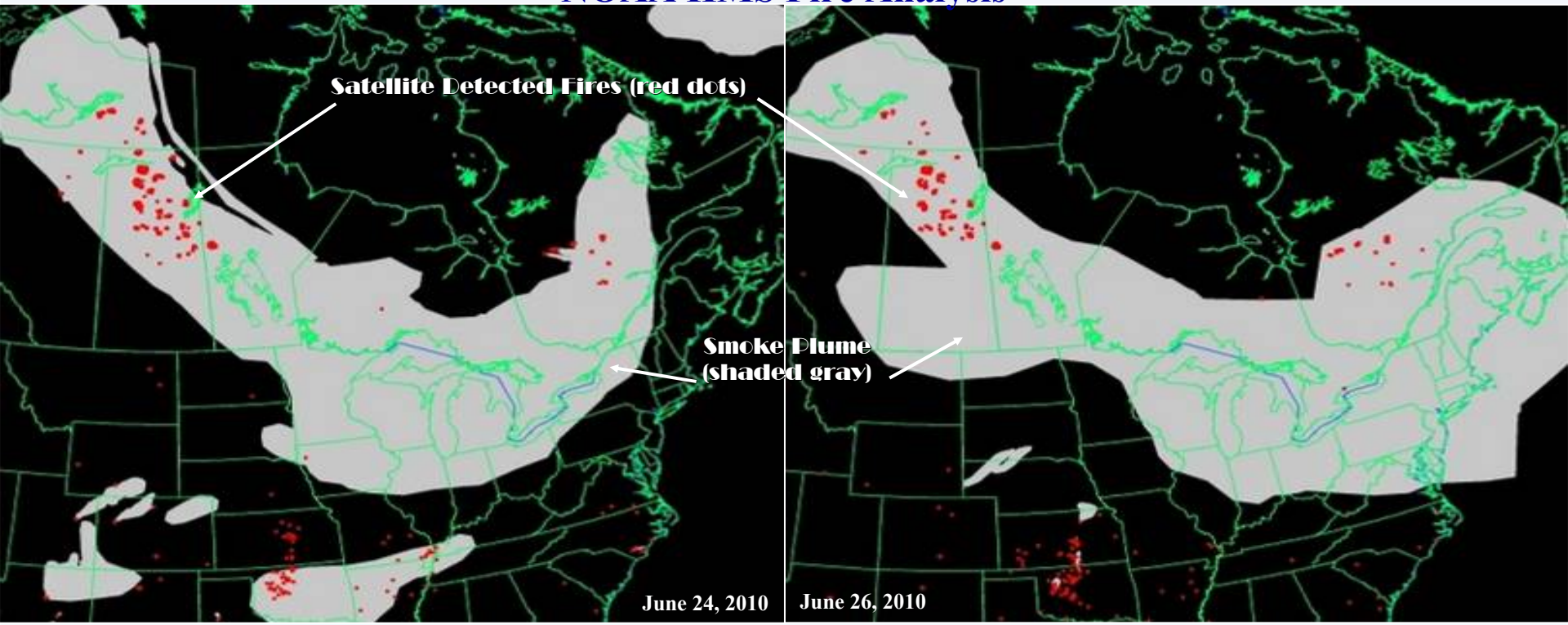
Smoke/Aerosol Transport (1 of 6)



Note: Preliminary data

Smoke/Aerosol Transport (2 of 6)

NOAA HMS Fire Analysis

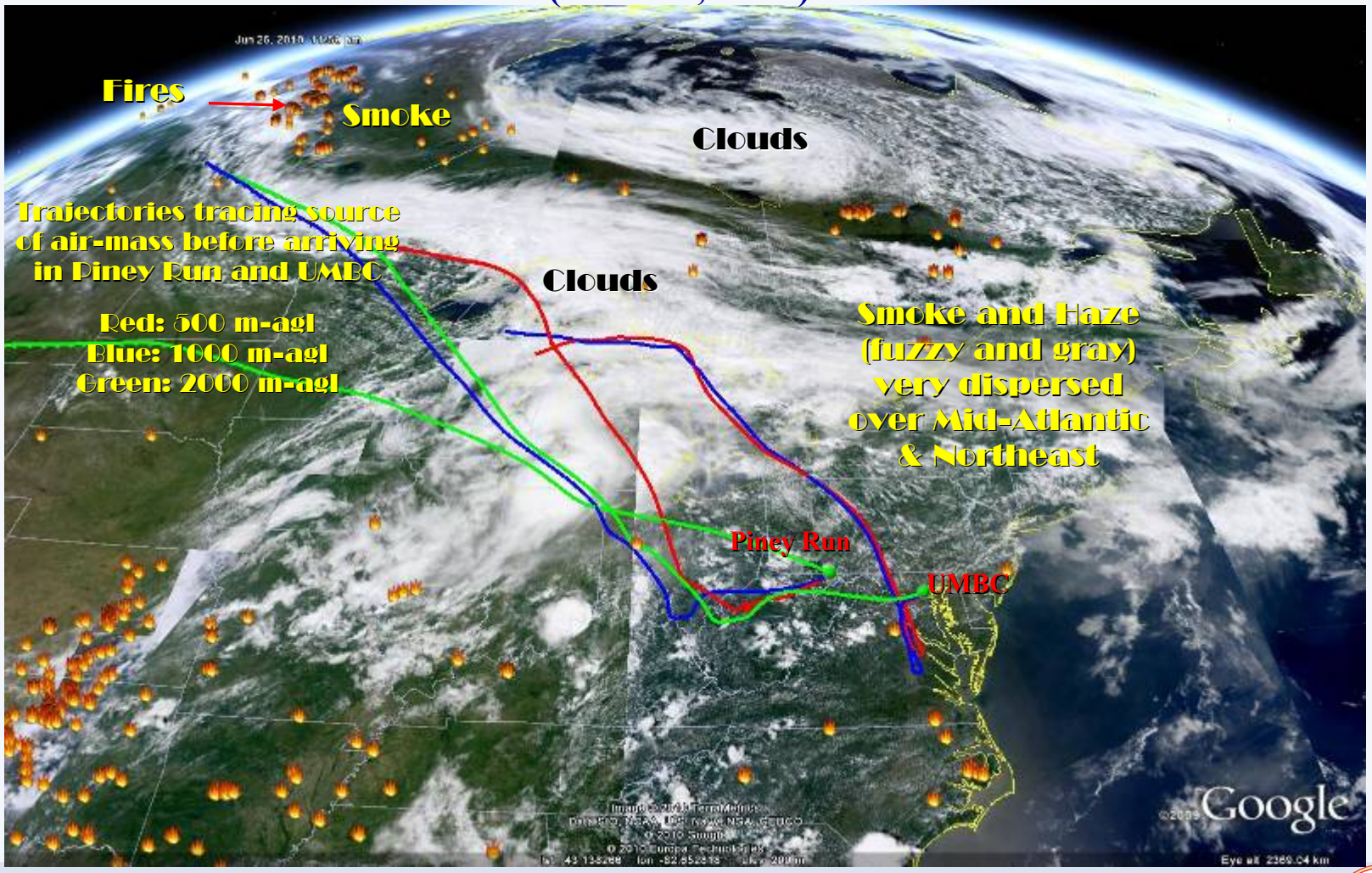


HMS Fire Analysis maps clearly show the intrusion of smoke into the Mid-Atlantic/Northeast.

Data Source: NOAA HMS Fire and Smoke products

Smoke/Aerosol Transport (3 of 6)

MODIS High-Resolution Visible-Satellite Imagery (June 26, 2010)



Data Sources: NOAA HMS Fire and Smoke products | NOAA ARL HYSPLIT Model | NASA OnEarth JPL WMS Server

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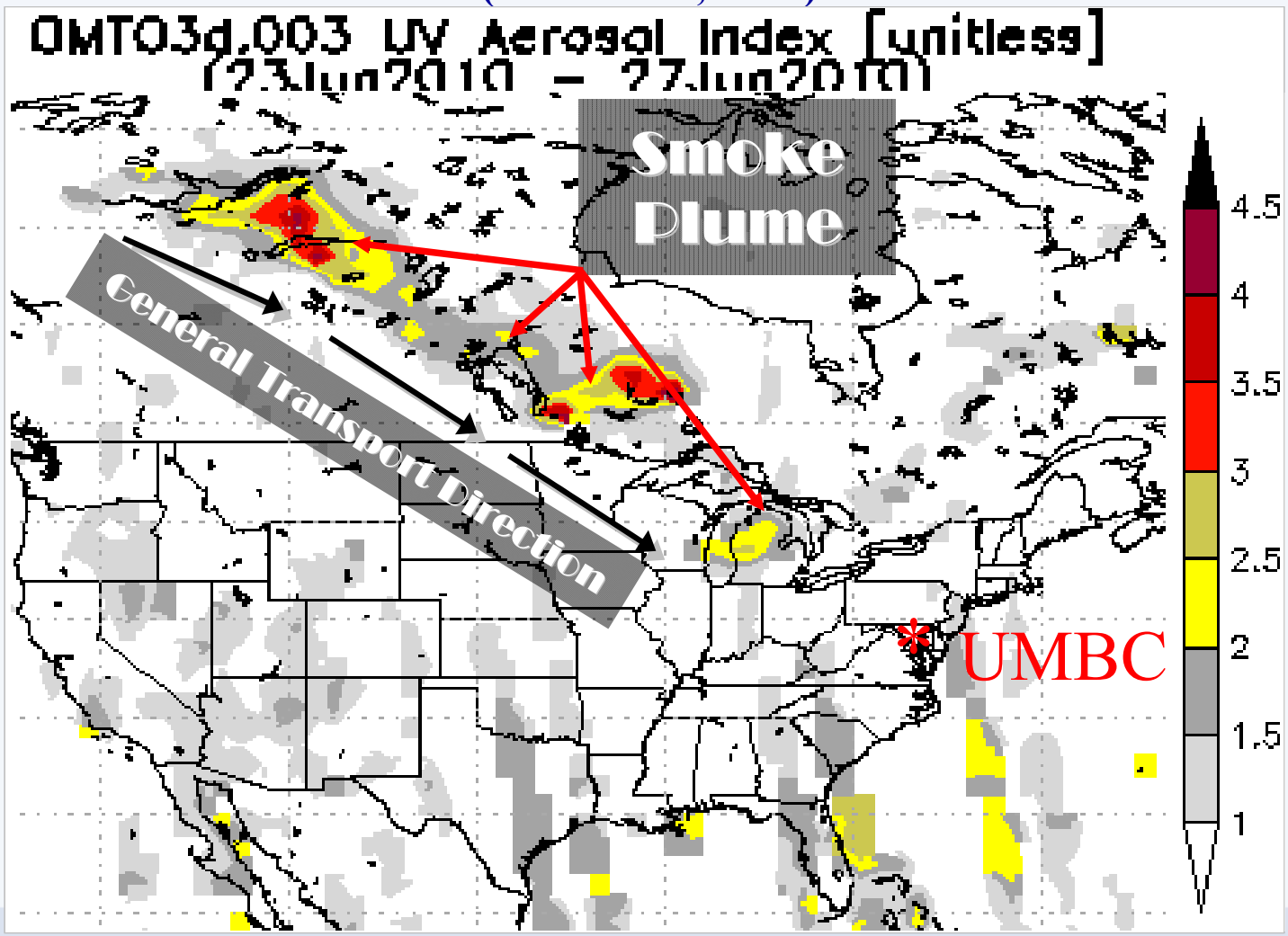
Smoke/Aerosol Transport (4 of 6)

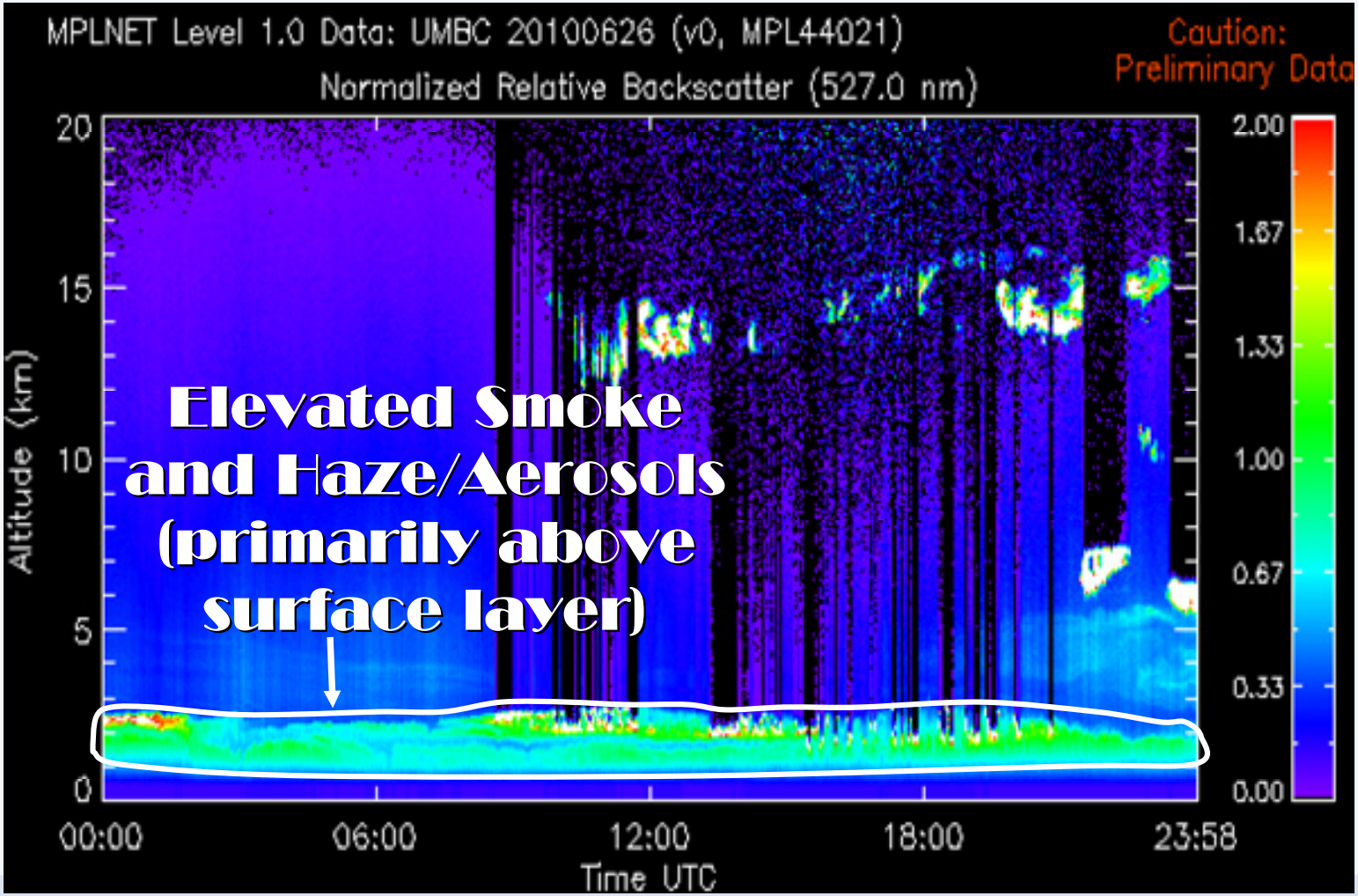
Satellite Detected Aerosols Above Boundary Layer
(June 23-27, 2010)



Data Source: NASA GES DISC GIOVANI

Smoke/Aerosol Transport (5 of 6)

Lidar Measuring Aerosol Column over UMBC, Catonsville, Baltimore County (June 26, 2010)



Data Source: NASA Micro-pulse Lidar Network MPLNET

Smoke/Aerosol Transport (6 of 6)

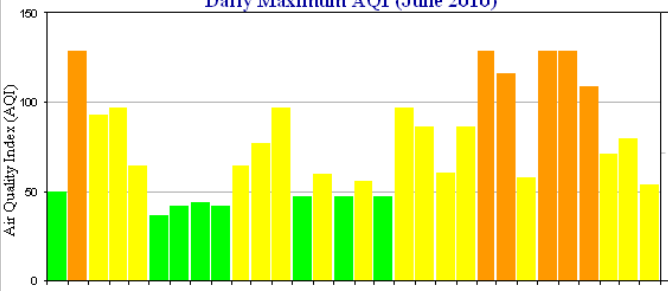
MDE

Quality of Air

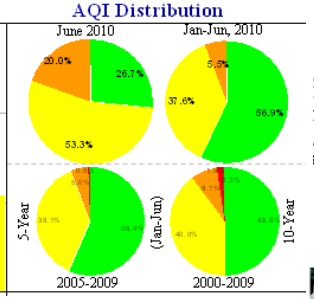
MARYLAND Department of the Environment

for Baltimore Forecast Region, June 2010

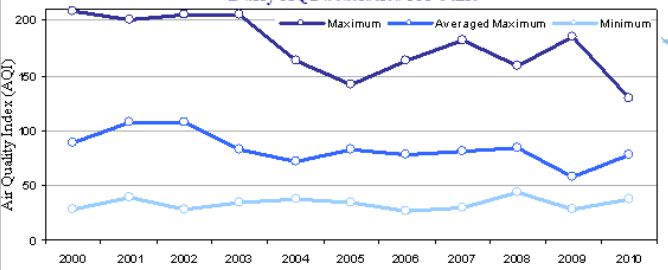
Daily Maximum AQI (June 2010)



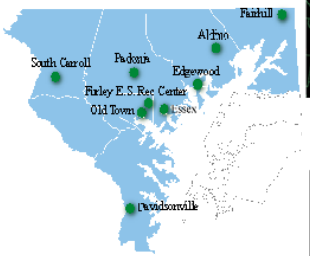
AQI Distribution



Daily AQI Statistics for June



Baltimore Forecast Region and Monitors



Number of Days Above 100 AQI vs Days ≥ 90° F at BWI (2010 Data)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
8-hour Ozone	0	0	0	0	4	6	n/a	n/a	n/a	n/a	n/a	n/a	10
24-hour PM Fine	0	0	0	0	0	0	n/a	n/a	n/a	n/a	n/a	n/a	0
Both Pollutants[1]	0	0	0	0	4	6	n/a	n/a	n/a	n/a	n/a	n/a	10
Days ≥ 90° F	0	0	0	2	3	16	n/a	n/a	n/a	n/a	n/a	n/a	21

AQI Climatological Report

	Observed Value	Normal[2]	Departure
Averaged Maximum	77	99	-22
USG+ Day(s)	0	13.6	-7.6
Record AQI	219 (6/15/1988)		

In June 2010, the air quality in the Baltimore Forecast Region (BFR) was Good on 8 days (26.7%), Moderate on 16 days (53.3%) and Unhealthy for Sensitive Groups (USG) on 6 days (20.0%). There was an extended period of air pollution event from the 21st - 27th as AQI levels reached USG on 5 out of 7 days. This event began on the 21st with a high pressure that extends over the Northeast and northern Mid-Atlantic regions and a cold front was located over the VA-NC border. This high pressure system brought warm temperatures, mostly clear skies and light re-circulating winds which caused several monitors in southern Maryland (part of Washington DC Forecast Region) to reach USG. On the 22nd, the frontal boundary over the VA-NC border lifted north as a warm front and allowed a hot and humid air-mass into the region. This along with mostly clear skies, light winds, and transported pollutants caused widespread USG ozone levels throughout the Baltimore-Washington corridor. On the 23rd, a broad high pressure system moved into the Southeast and Mid-Atlantic regions, which once again caused another bad air day although the spatial extend was somewhat limited due to stronger winds which helped disperse pollutants. The 24th was one of the hottest and muggiest day of the month with temperatures reaching as high as 100F at BWI. On this day, ozone levels were limited due to widespread cloud cover associated with a cold front that moved across the area during the late afternoon. From the 25th - 27th, another high pressure system built into the region and remained in place through the period and resulted in a replay of bad air quality along the Baltimore-Washington corridor. The main difference for this period was the influence of smoke being transported into the region from Canada forest fires (see next page). How is the air quality thus far in 2010 compared to recent years? Historical data showed USG AQI levels or above occurred on approximately 5.6% and 10.3% of the days based on the 5-year (Jan-Jun, 2005-2009) and 10-year (Jan-Jun, 2000-2009) running mean, respectively. Thus far in 2010, USG AQI levels or above occurred on 5.5% of the days. This resulted in a decrease of 0.1% and 4.8% of USG AQI levels or above days as compared to 5-year and 10-year historical data, respectively. Visit www.mde.state.md.us/air or www.cleanairpartners.net for current air quality conditions and forecasts or call the air quality hotline at 410-537-3247.

Air Quality Index (AQI)

0-50 Good	51-100 Moderate	101-150 USG	151-200 Unhealthy	201-300 Very Unhealthy	301-500 Hazardous

Note: Either one or both pollutants are USG or above.
Climatological Normal Period 1981 to 2005. Unhealthy for Sensitive Groups. Data presented for 2010 are preliminary.
Climate stats are courtesy of the NWS.

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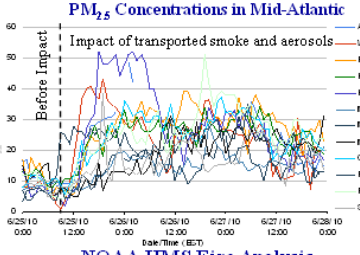
Quality of Air

MARYLAND Department of the Environment

for Baltimore Forecast Region, June 2010

$PM_{2.5}$ Concentrations in Mid-Atlantic



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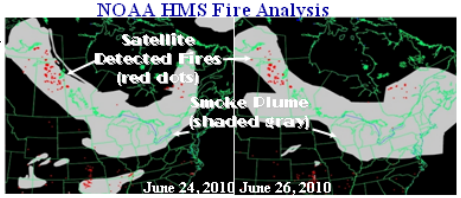
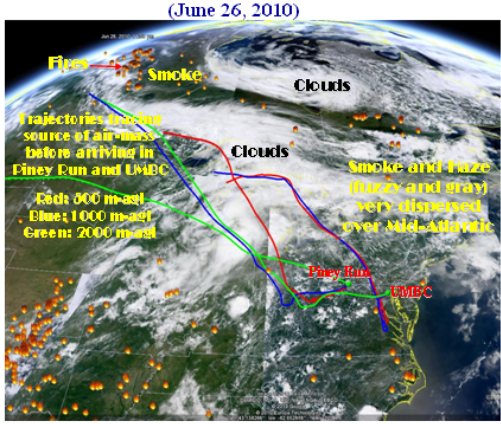


MODIS High-Resolution Visible-Satellite Imagery (June 26, 2010)



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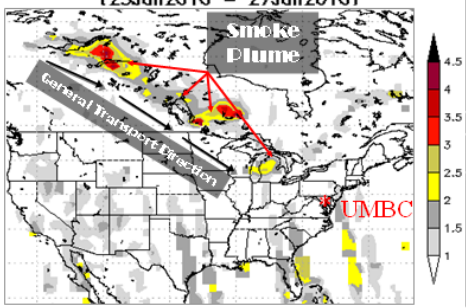
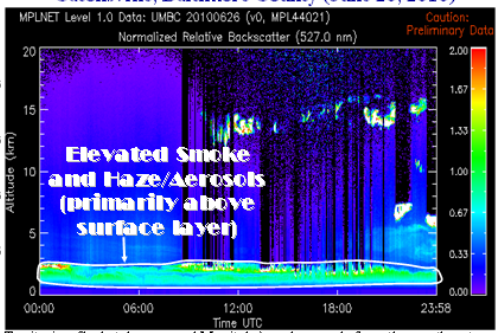


Lidar Measuring Aerosol Column over UMBC, Catonsville, Baltimore County (June 26, 2010)



Transported smoke from the forest fires in Canada (primarily Northeast Territories, Saskatchewan and Manitoba) and aerosols from the southeastern U.S. caused elevated particle pollution across the Mid-Atlantic. A time-series of the hourly $PM_{2.5}$ concentrations for monitors across the region showed a sharp increase toward the evening of June 25th with the highest observed concentrations occurring on the 25th - 26th at various monitors. The NOAA Hazard Mapping system analyzed a large smoke plume extending from the source of the forest fires in Canada through the Great Lakes, Plains, Mid-Atlantic and Northeast. The smoke plume reached the Plains on the 24th and the Mid-Atlantic on the 25th and remained in place though the period. Again, this coincided with the rapid increase in particle pollution across the region. Further analysis using high-resolution satellite imagery showed a diffused and dispersed smoke and haze plume over the Mid-Atlantic. OMI aerosol index data further confirmed the presence of a smoke plume above the boundary layer resulting from the forest fires in Canada. This plume was transported by the aloft winds in the general direction towards the Mid-Atlantic. Fortunately, the smoke plume was fairly dispersed by the time it arrived in the Mid-Atlantic. In addition, it remained primarily above the surface layer and thus did not fully impact the air quality in the region. In fact, the micro-pulse Lidar located at UMBC Catonsville, MD campus confirmed that a layer of smoke and haze/aerosols remained about 1-3 km agl on the 26th which means surface $PM_{2.5}$ monitors were not impacted as much as they could have been.

Data Sources: EPA AIRNowTech | NOAA HMS Fire and Smoke products | NOAA ARL HYSPLIT Model | UMBC U.S. Air Quality Smog Blog | NASA GES DISC GIOVANNI | NASA Micro-pulse Lidar Network: MPLNET | NASA OnEarth JPL WMS Server

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Take-Home Messages

- Strides have been made during the past few years to make satellite products relevant to air quality applications.
- Need real-time reliable satellite products with high spatial and temporal resolution to track transport pollutions (short-range, 'long-range' and likely 'inter-continental' transport issues in coming decades).
- Need satellite products that connect (qualitatively and quantitatively) with ground-based measurements to be better utilized for AQ forecasting & policy-relevant activity.

Contact

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