



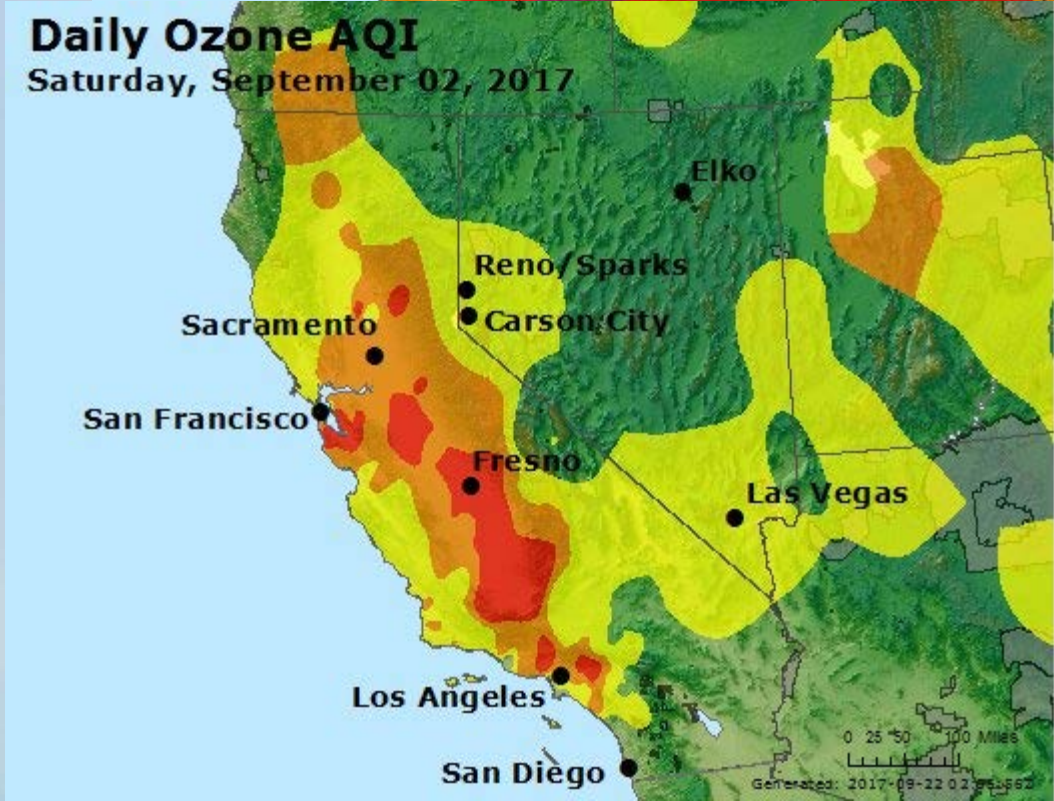
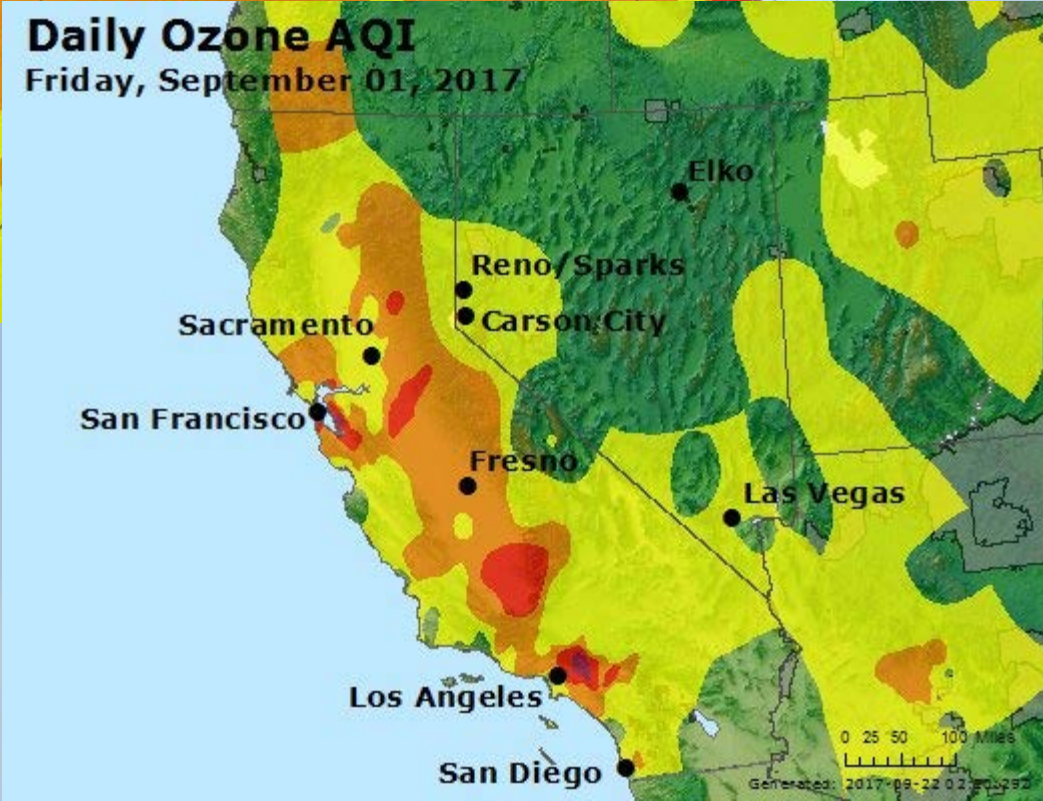
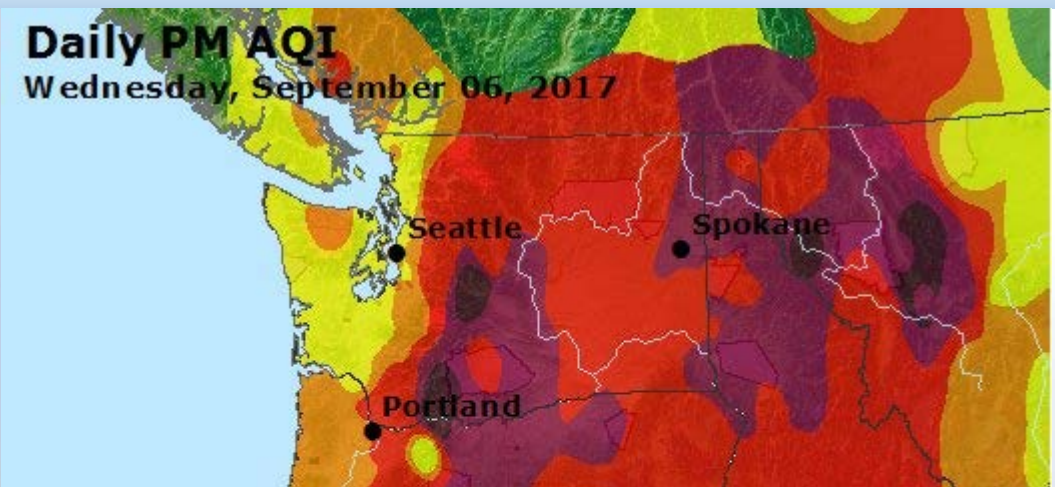
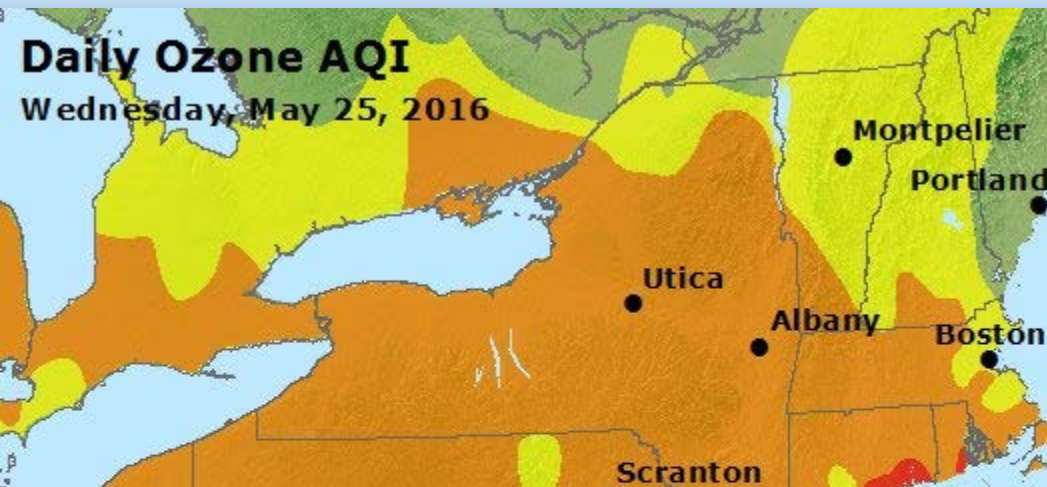
Connecticut Department of
**ENERGY &
ENVIRONMENTAL
PROTECTION**

Guidance for Submitting Exceptional Event Demonstrations

Michael Geigert CTDEEP



Are You Ready for an Exceptional Event?



Do You Really Need To Do This?

The Exceptional Events Rule clarifies that it applies to the treatment of data showing exceedances or violations for the following types of regulatory actions:

- An action to designate or redesignate an area as attainment, unclassifiable/ attainment, nonattainment or unclassifiable for a particular NAAQS. Such designations rely on a violation at a monitoring site in or near the area being designated;
- **The assignment or re-assignment of a classification category (marginal, moderate, serious, etc.) to a nonattainment area to the extent this is based on a comparison of its “design value” to the established framework for such classifications;**
- A determination regarding whether a nonattainment area has attained a NAAQS by its CAA deadline. This type of determination includes “clean data determinations;
- A determination that an area has data for the specific NAAQS, which qualify the area for an attainment date extension under the CAA provisions for the applicable pollutant;
- A finding of SIP inadequacy leading to a SIP call to the extent the finding hinges on a determination that the area is violating a NAAQS; and
- Other actions on a case-by-case basis if determined by the EPA to have regulatory significance based on discussions between the air agency and the EPA Regional office during the Initial Notification of Potential Exceptional Event process.

Attainment Status for Connecticut was Affected

Comparison of 2016 Design Values with and without May 25 and 26, 2016 Data, and Corresponding 2017 Critical 4th High Values at the Four Sites Proposed for Exclusion.

Critical 4th high is the value at which the monitor will exceed the NAAQS (in parenthesis) for the 2017 season.

Current Values						Revised Values Excluding May 25-26, 2016		
Site Name	4th high 2014	4th high 2015	4th high 2016	2014-2016 DV	2017 Critical 4 th High Value (NAAQS Standard)	4th high 2016	2014-2016 DV	2017 Critical 4 th High Value (NAAQS Standard)
Abington	67	70	74	70	69 (70 ppb NAAQS)	67	68	76 (70)
Westport	81	87	87	85	81 (84 ppb NAAQS)	81	83	87 (84)
Cornwall	68	76	78	74	74 (75 ppb NAAQS)	74	72	78 (75)
East Hartford	77	75	75	75	78 (75 ppb NAAQS)	72	74	81 (75)

The Final 2016 Exceptional Events Rule, Supporting Guidance Documents

Guidance Documents and FAQs Updated April 2019

- **High Winds:** [Guidance on the Preparation of Demonstrations in Support of Requests to Exclude Air Quality Data Influenced by High Wind Dust Events Under the 2016 Exceptional Events Rule](#) (April 2019)
- **Data Modification:** [Clarification Memo on additional Methods, Determinations and Analyses to Modify Air Quality Beyond Exceptional Events](#) (April 2019)
- **Stratospheric Ozone:** [Guidance on the Preparation of Exceptional Events Demonstrations for Stratospheric Ozone Intrusions](#) (November 2018)
 - [Forecasting Tools for Stratospheric Ozone Intrusions](#) (PDF)
 - [Forecasting Tools for Stratospheric Ozone Intrusions \(PPTX\)](#) (23 pp, 19 MB, 11/6/2018)
- **Wildfire:** [Final Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations](#) (September 2016)
- [Updated Exceptional Events Rule FAQs](#) (July 2018)

Other EPA-Developed Rule Implementation Documents

- [Best Practices for Preparation of Multi-Agency Exceptional Events Demonstrations](#)
- [2007 to 2016 Exceptional Events Rule Crosswalk](#)
- [Mitigation Plan Checklist \(DOCX\)](#) (7 pp, 28 K, 3/29/2018)
- [EPA Review Technical Support Document Template for Wildfire/Ozone Events](#)
- [Fact Sheet – Wildland Fire and Air Quality](#)

What Elements are required for the Demonstration?

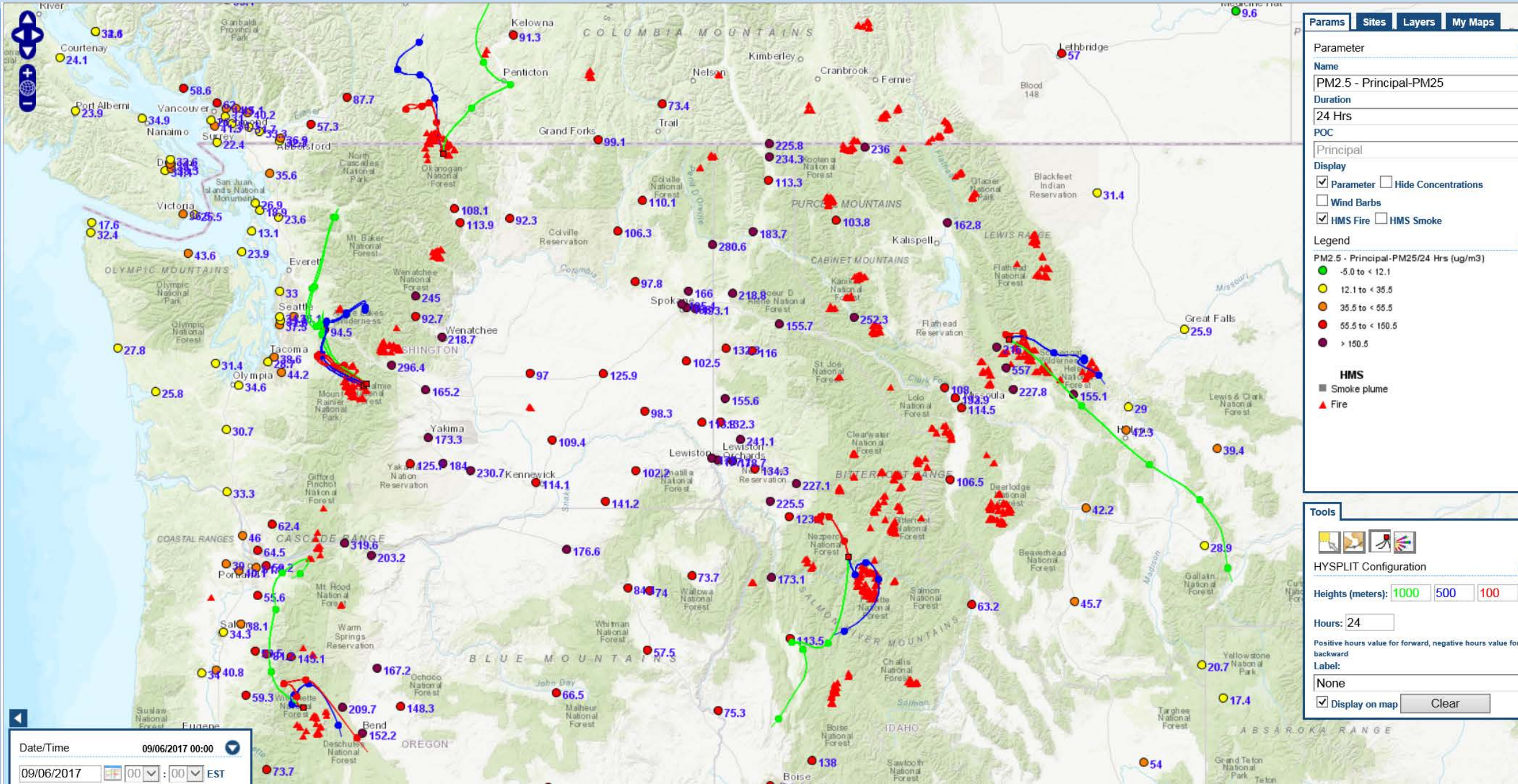
- 1) A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);
- 2) A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;
- 3) Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times. The Administrator shall not require a State to prove a specific percentile point in the distribution of data;
- 4) A demonstration that the event was both not reasonably controllable and not reasonably preventable;
- 5) A demonstration that the event was caused by human activity that is unlikely to recur at a particular location or was a natural event; and
- 6) Documentation that the submitting air agency followed the public comment process.

A Tale of Tiers

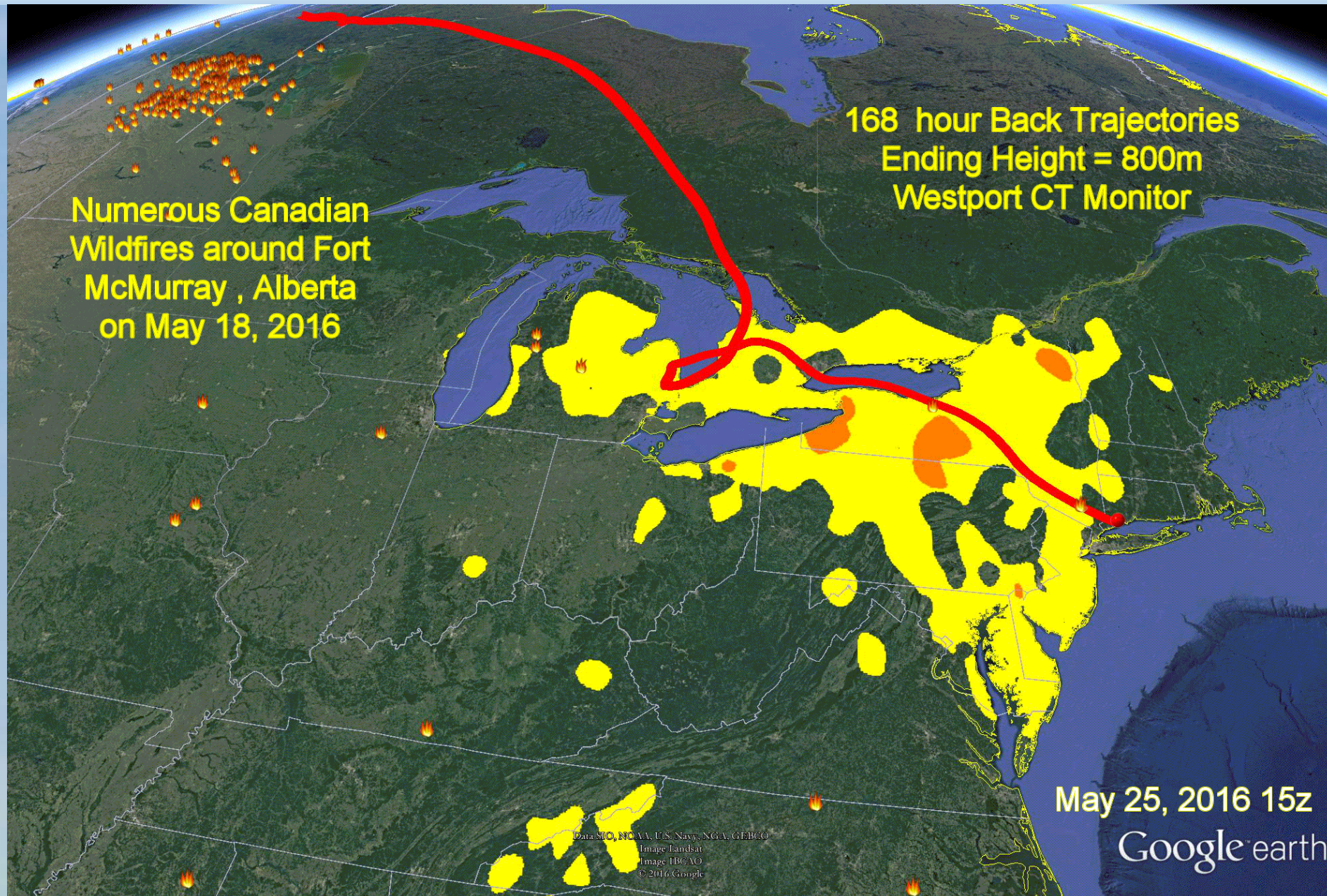
The demonstration must establish a clear causal relationship between the specific event and the monitored concentration. Tier 3 is a ‘heavy lift’ because of the weight of evidence required, so strive for Tier 1!

Tier 1: Section 3.4	Tier 2: Section 3.5	Tier 3: Section 3.6
Wildfires that clearly influence monitored O3 exceedances or violations when they occur in an area that typically experiences lower O3 concentrations. This tier is associated with an O3 concentration that is clearly higher than non-event related concentrations, or occur outside of the area’s normal O3 season.	The wildfire event’s O3 influences are higher than non-event related concentrations, and fire emissions compared to the fire’s distance from the affected monitor indicate a clear causal relationship.	The wildfire does not fall into the specific scenarios that qualify for Tier 1 or Tier 2, but the clear causal relationship criterion can still be satisfied by a weight of evidence showing.

September 6, 2017- Tier 1?



May 25, 2016- Tier 3 was Required!



Are your Q's and D's in Order?

- EPA guidance recommends conducting a fire emissions / transport distance ratio (Q/d) analysis as a rough assessment of the ability of a wildfire to cause increased ozone concentrations (For Tier 2 or 3 determination).
- The Q/d analysis is simply a comparison of the ratio of Q, the daily tons of VOC and NOx emitted from the fire, to d, the distance in kilometers from the fire to the point of concern.
- If the Q/d value compares favorably to analytical data from other fires, then the fire can be presumed to have had a causal effect on ozone concentrations at the point of concern.
- EPA guidance indicates that a fire should have a **Q/d in excess of 100 tons per day per kilometer (tpd/km)** in order to be considered to have a clear causal impact on ozone.

Q/d Estimates for the Fort McMurray Fire

Step 1: Estimate the emissions from the fire (Q): ([BlueSky Playground](#))

$F_i = P_i * L$ (Equation 1)

$E_i = F_i * A$ (Equation 2)

F_i = emission factor (mass of pollutant/unit area of forest consumed)

P_i = yield for pollutant "i" (mass of pollutant/unit mass of forest fuel consumed)

= 12 kg/Mg (24 lb/ton) for total hydrocarbon (as CH₄)

= 2 kg/Mg (4 lb/ton) for nitrogen oxides (NO_x)

L = fuel loading consumed (mass of forest fuel/unit land area burned)

A = land area burned

E_i = total emissions of pollutant "i" (mass pollutant)

Combining equations 1 and 2, we have:

$$E_i = P_i * L * A$$

Q is the total daily emission rate in tons per day of reactive hydrocarbons and nitrogen oxides. EPA recommends, in the exceptional events guidance, that only 60% of the hydrocarbons should be considered reactive. Therefore the reactive hydrocarbon emissions become $rHC = 0.6 * E_{hc}$ or $0.6 * 17,991 = 10,794$ tons of reactive HC emitted during the period of interest. No adjustments are suggested for the NO_x emissions (2967 tons). Therefore the total rHC and NO_x emissions over the period are $10794 + 2965$, or 13,759 tons over the six days.

On average this resulted in a daily emission rate, or Q, of 2293 tons per day.

Q/d Estimates for the Fort McMurray Fire

Step 2: Estimate the distance from the fire (d).

Based on the large distance, we did not present individual analyses for each monitor in Connecticut but estimated the distance from the Fort McMurray fire to the most distant point in Connecticut. We used a value of **d of 3286 kilometers**, the flight distance from Fort McMurray to Stonington, CT.

Step 3: Calculate Q/d.

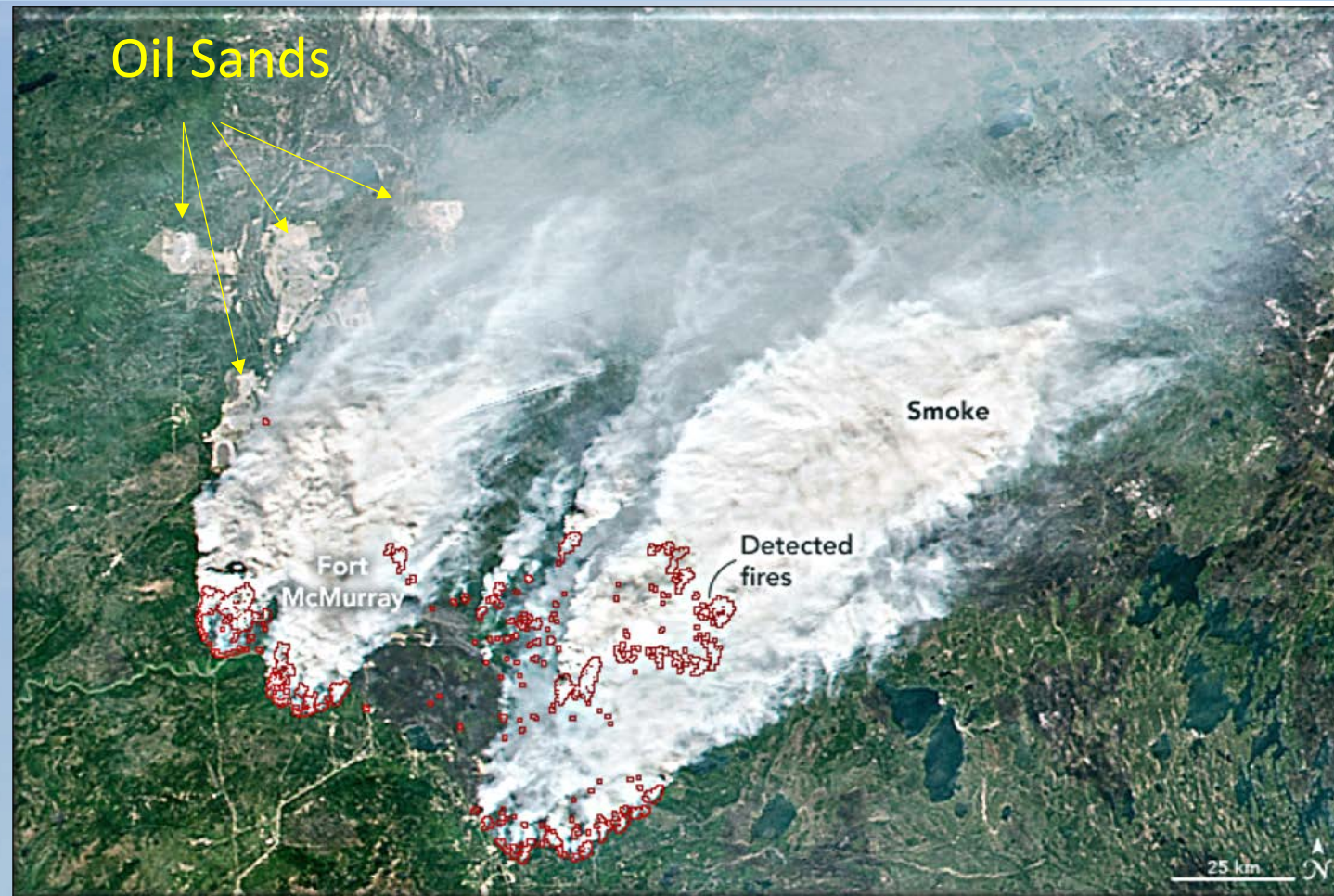
Using the values determined above, $Q/d = 2293 \text{ tpd divided by } 3286 \text{ km} = \mathbf{0.69 \text{ tpd/km}}$. This value is well below the EPA recommended level of **100 tpd/km** indicating clear causality.

Step 4: Choose your Tier!

Available Tools for Weight of Evidence Analysis

- [NOAA Model Forecasts](#) and [Airnow AQI maps](#);
- [NOAA OSPO](#) analyzed smoke plume coverage;
- [MODIS/ VIIRS Satellite with AOD estimations](#) (Worldview);
- [Calipso satellite](#) aerosol analysis;
- [Airnowtech Navigator](#) trajectory analysis;
- [Hysplit](#) trajectory analysis;
- [NOAA Aerosol Watch](#);
- [Bluesky Smoke Model Runs](#);
- [EPA Remote Sensing Information Gateway](#) (RSIG);
- [Guide to Using Satellite Images in Support of Exceptional Event Demonstrations](#) (HAQAST).

2016 Fort McMurray, Alberta Wildfire



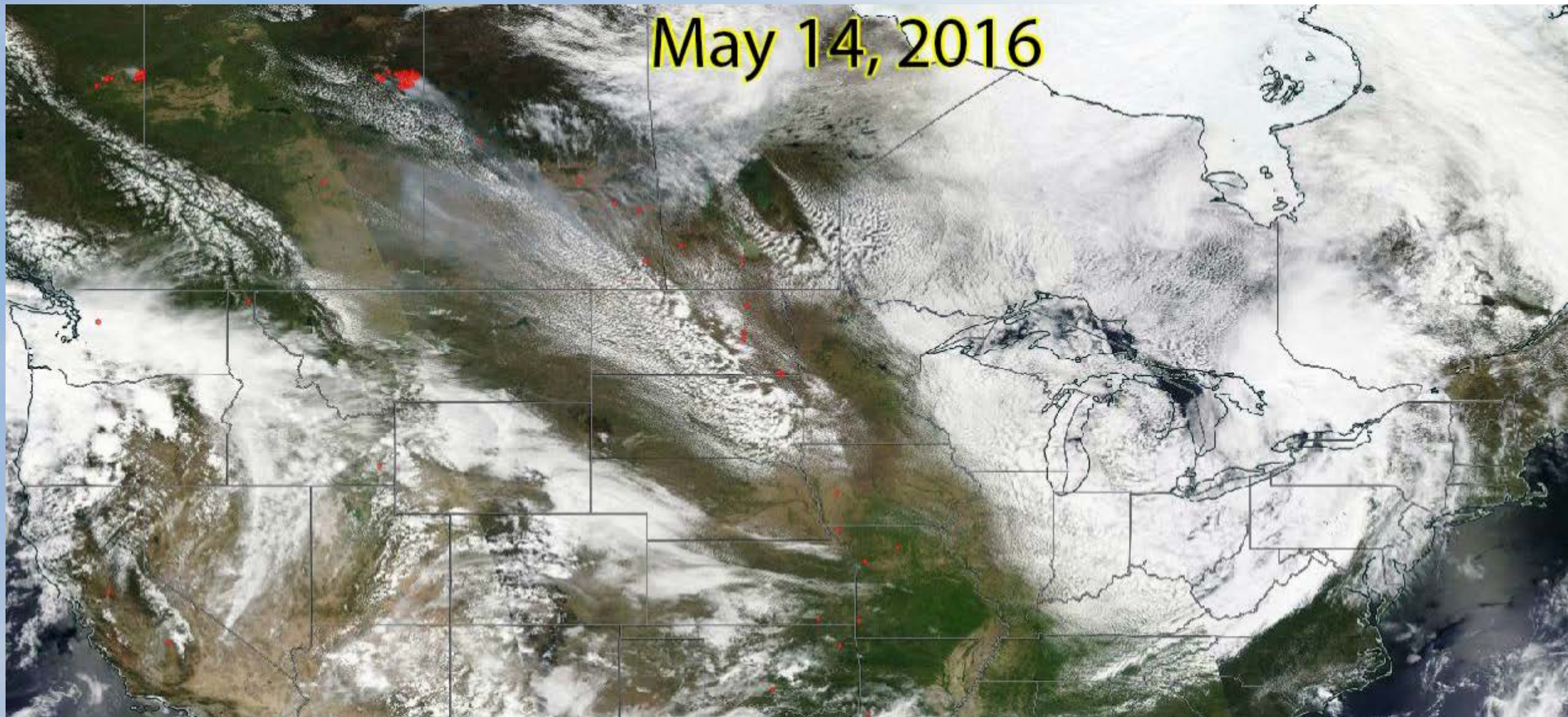
On May 1, 2016, a wildfire began southwest of Fort McMurray, Alberta, Canada. On May 3, it swept through the community, destroying approximately 2,400 homes and buildings and forcing the largest wildfire evacuation in Albertan history. The fire spread across approximately 590,000 hectares (1,500,000 acres) before it was declared to be under control on July 5, 2016.

Fort McMurray Wildfire Images (from Press Coverage)



[Click for
More!](#)

MODIS/ VIIRS Satellite with AOD estimations



Links to CT DEEP Exceptional Event Web Page

Fort McMurray, Alberta, Wildfire Exceptional Event Request for May 25-26, 2016 Connecticut Ozone Monitor Data

On May 25, 2016, An unusual area of elevated ozone concentrations over the upper Midwest and New York State moved into New England. This was unusual this early in the season and with the meteorological conditions present. It became apparent that the elevated ozone was likely due to the persistent Fort McMurray wildfire smoke plume that had been moving toward New England for several days. Therefore, in accordance with 40CFR 50.14, CT DEEP has flagged its ozone monitoring data for the period lasting from May 25, 2016 through May 28, 2016 for treatment as influenced by an exceptional event.

CT DEEP announced a 'Notice of Intent to Submit an Exceptional Event Demonstration to EPA and Opportunity for Public Comment' on April 18, 2017, which lasted through May 1, 2017. No comments were received except for a letter from EPA Region 1 stating that they had no further comments at this time. On May 23, 2017 the final version of the Exceptional Event Demonstration was electronically sent to EPA Region 1 for their review. On July 31, 2017, CT DEEP received a letter of concurrence from EPA Region 1 approving our Exceptional Event Demonstration.



Image of the wildfire as it approaches Fort McMurray Alberta in early May, 2016

[EPA Concurrence Letter and TSD Approving the Exceptional Event Demonstration](#)

[Cover Letter submitted with the May 23, 2017 Exceptional Request Demonstration](#)

[Final Submittal of the Exceptional Event Demonstration, May 23, 2017](#)

[EPA Letter- Acknowledging Review of Draft Demonstration, May 19, 2017](#)

[Notice of Intent to Submit an Exceptional Event Demonstration to EPA and Opportunity for Public Comment](#)

[Technical Support Document for Exceptional Event Analysis- DRAFT FOR PUBLIC COMMENT \(.pdf\)](#)

[EPA Response to CT Exceptional Event Request \(.pdf\)](#)

[Notification Letter to EPA Region 1, for May 2016 Potential Exceptional Event \(.pdf\)](#)

[Supplemental Materials](#)

[Presentation of Exceptional Event Analysis \(pptx\)](#)

[Animation of Ozone AQI Levels \(.wmv\)](#)

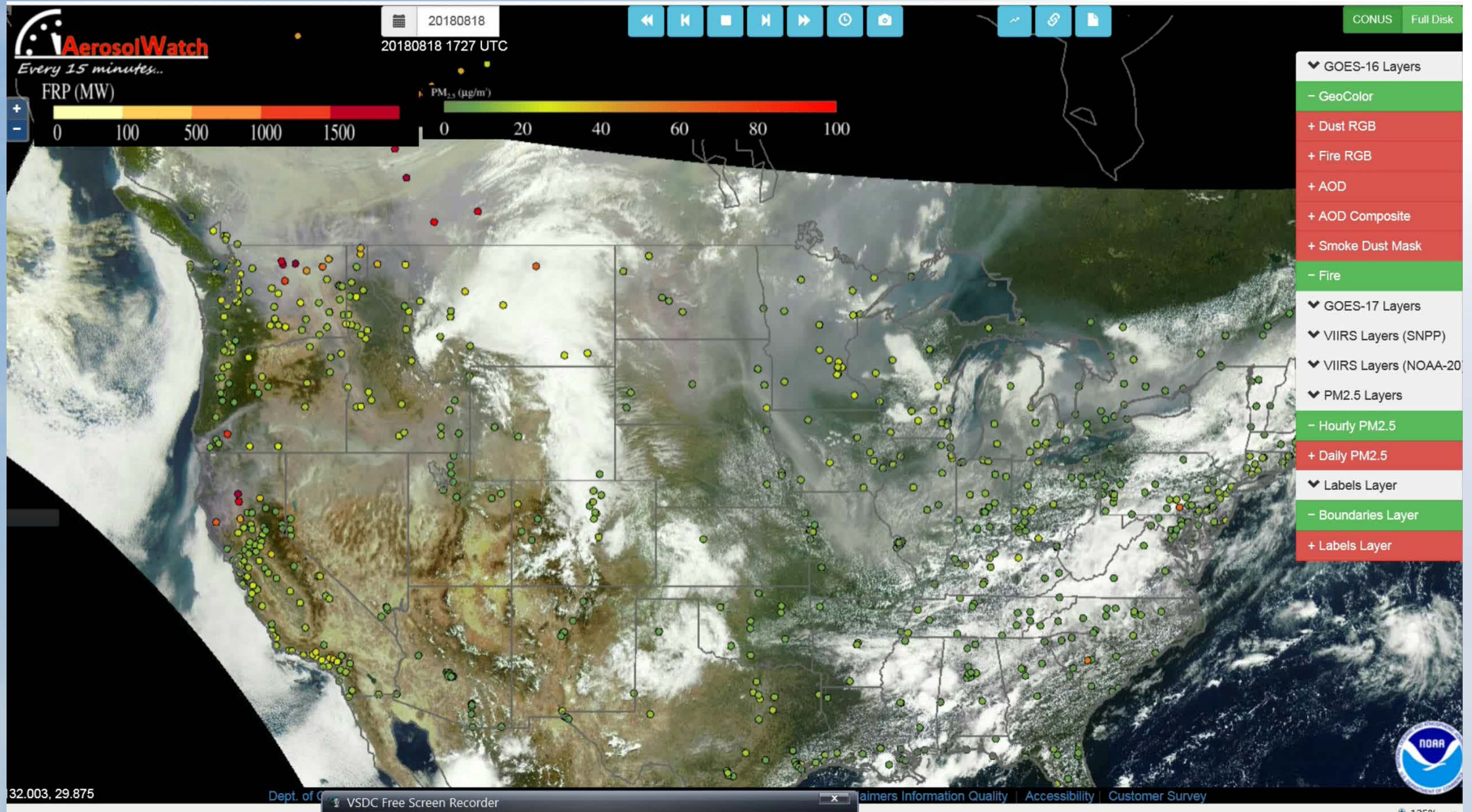
[Animation of Fort McMurray Wildfire Smoke Plume \(.wmv\)](#)

[Animation of Carbon Monoxide \(CO\) Plume \(.gif\)](#)

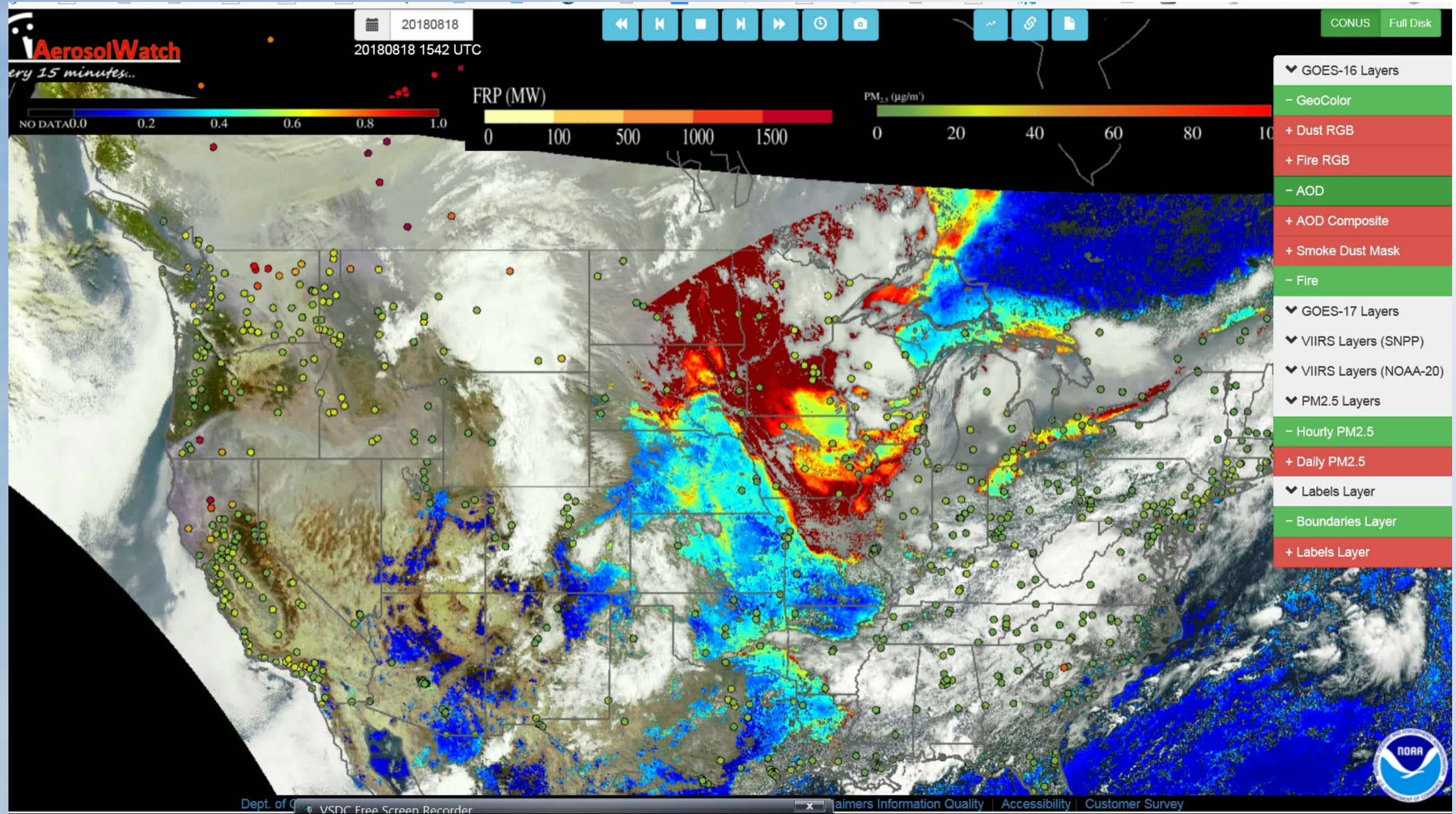
[Animation of Black Carbon \(BC\) Plume \(.gif\)](#)

[Animation of Aerosol Optical Depth \(AOD\) Plume \(.gif\)](#)

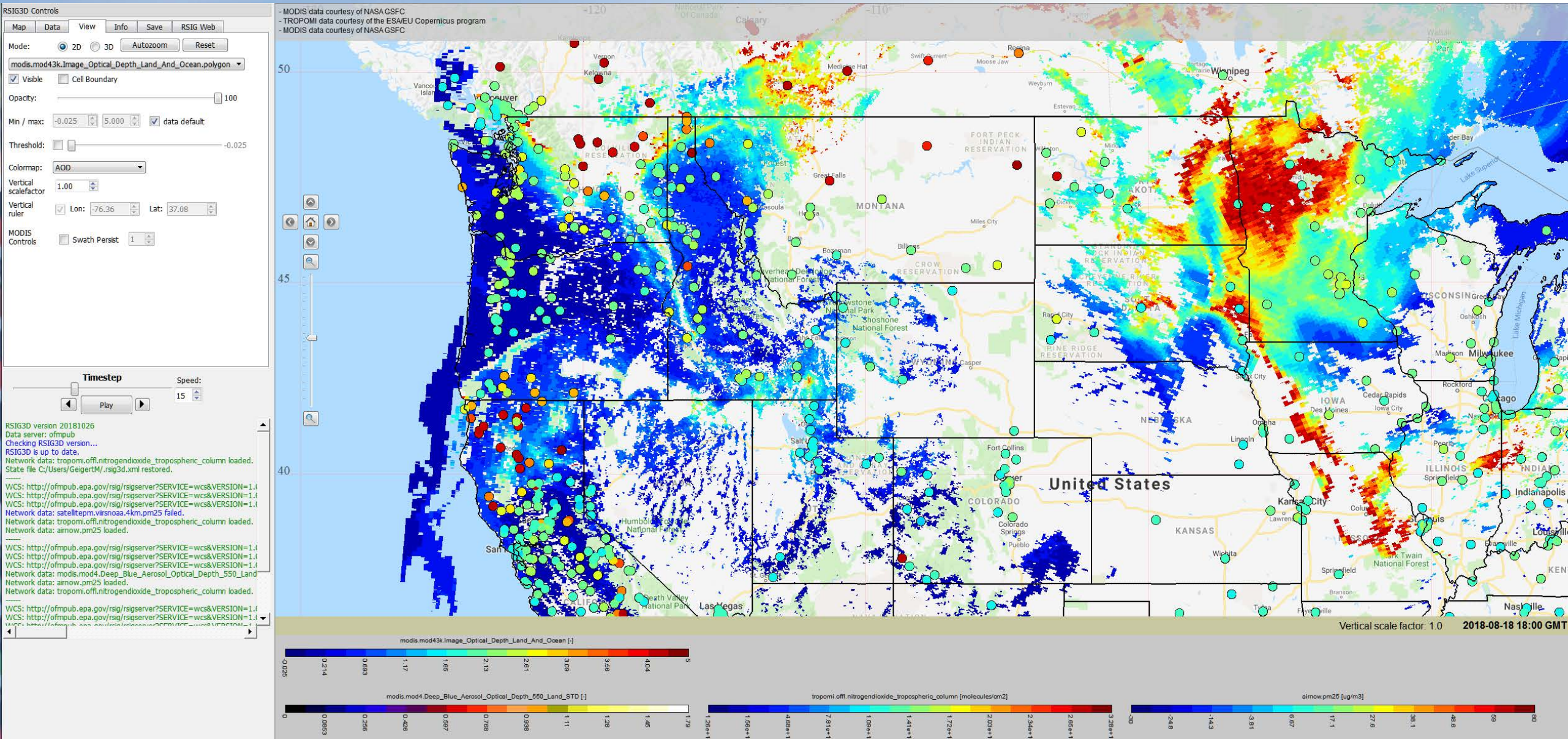
NOAA Aerosol Watch August 18, 2018



NOAA Aerosol Watch August 18, 2018 AOD



EPA Remote Sensing Information Gateway (RSIG)



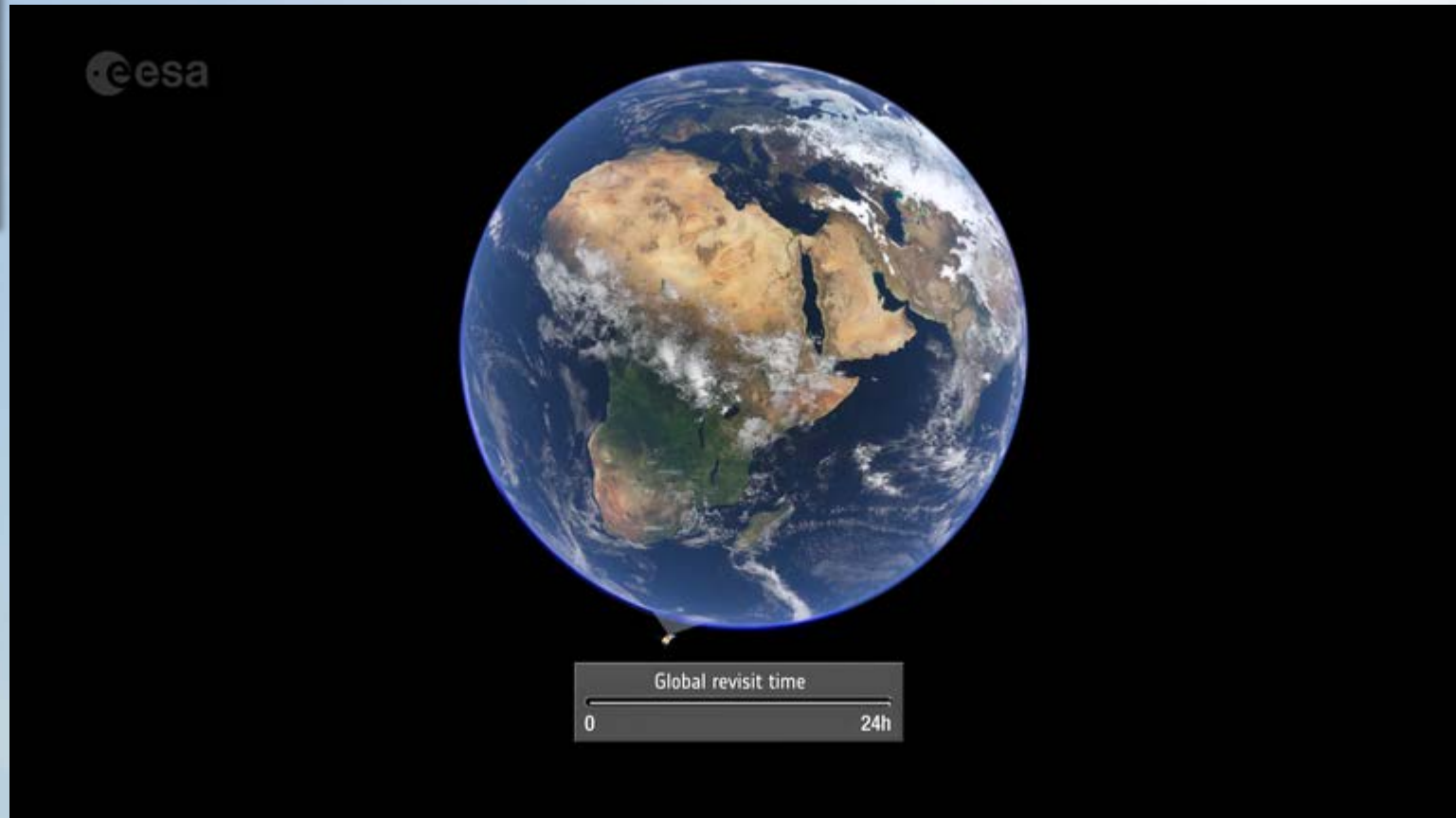
TROPOMI NO₂ Data Available Since July 2018



- The European Space Agency TROPOMI instrument produced NO₂ images showing the magnitude of NYC NO₂ sources (3x7 km).
- The previous OMI satellite NO₂ images did not have sufficient grid resolution for this, but were useful for trends.

List of S5P/TROPOMI Level 2 Data Products

Product	Main Parameter	Data file descriptor	Developers	(Planned) Release
UV Aerosol Index	aerosol index	AER_AI	KNMI	Released
Aerosol Layer Height	mid-level pressure	AER_LH	KNMI	2019
Carbon monoxide (CO)	total column	CO_	SRON	Released
Cloud	fraction, albedo, top pressure	CLOUD_	DLR	Released
Formaldehyde (HCHO)	total column	HCHO_	BIRA-IASB	Released
Methane (CH₄)	total column	CH4_	SRON	Dec 2018
Nitrogen oxide (NO₂)	total column	NO2_	KNMI	Released
Ozone profiles	total and tropospheric profiles	O3_PR_ O3_TPR	KNMI	2019
Sulphur dioxide (SO₂)	total column	SO2_	BIRA-IASB	Released
Ozone (O₃)	total column	O3_	DLR	Released
Tropospheric Ozone (O₃)	tropospheric column	O3_TCL	DLR	2018
UV¹	surface irradiance erythral dose	-----	FMI	-----



Using Open Access Hub for TROPOMI Retrievals



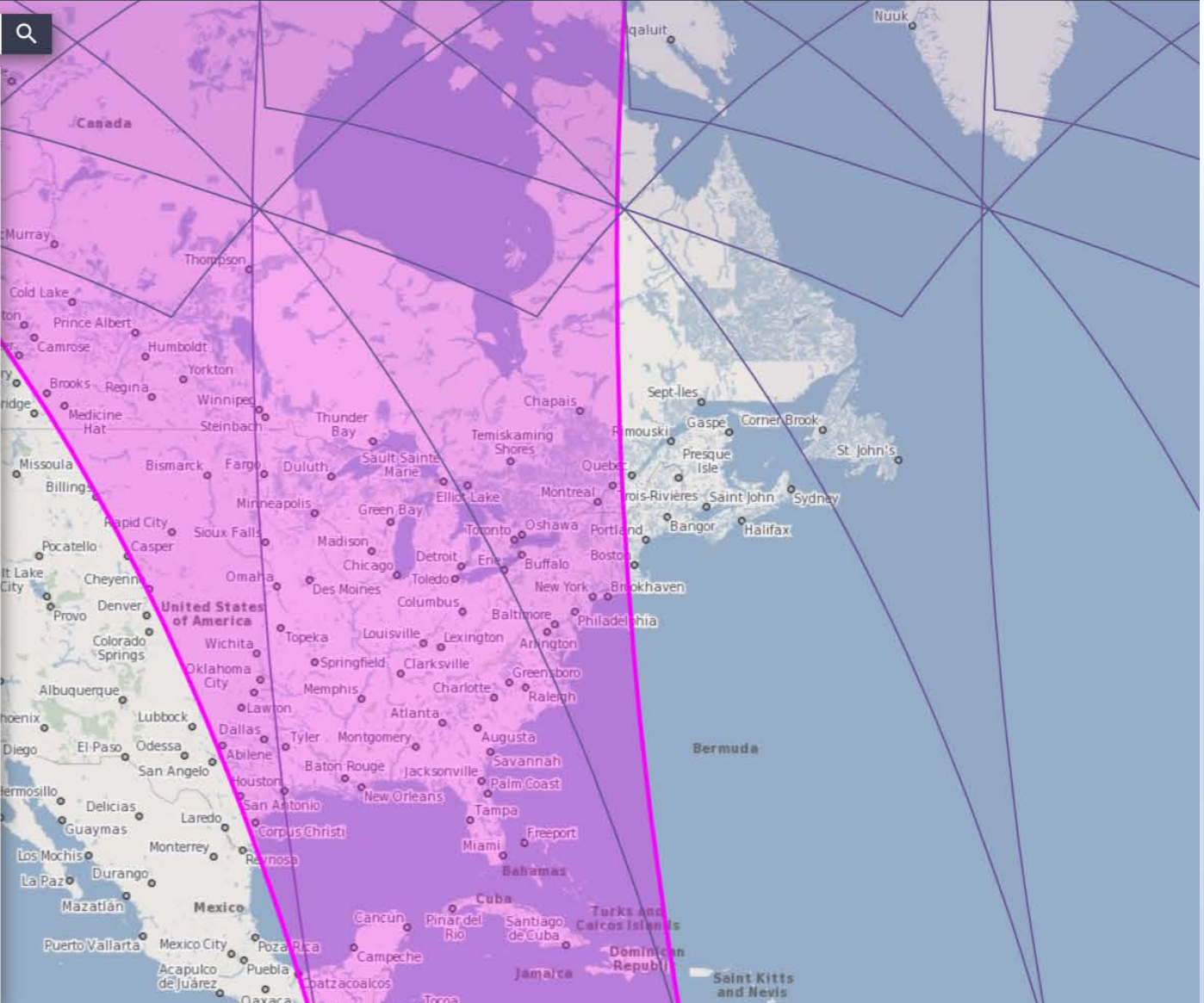
Sentinel-5P Pre-Operations Data Hub

Display 1 to 13 of 13 products.

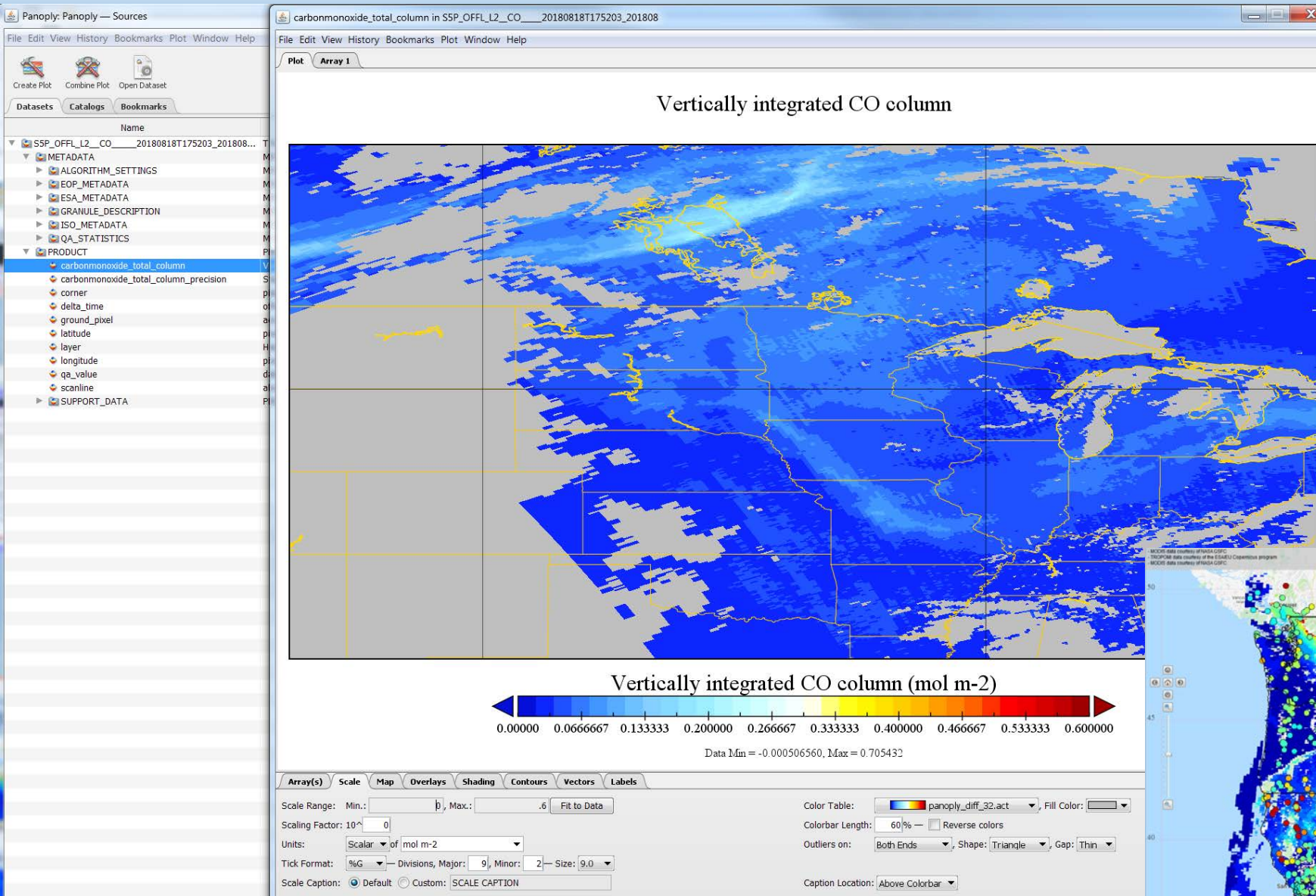
Order By: Ingestion Date

Request Done: (beginPosition:[2018-08-18T00:00:00.000Z TO 2018-08-18T23:59:59.999Z] AND endPosition:[2018-08-18T00:00:00.000Z TO 2018-08-18T23:59:59.999Z]) AND ((platformname:Sentinel-5 AND producttype:L2_CO____))

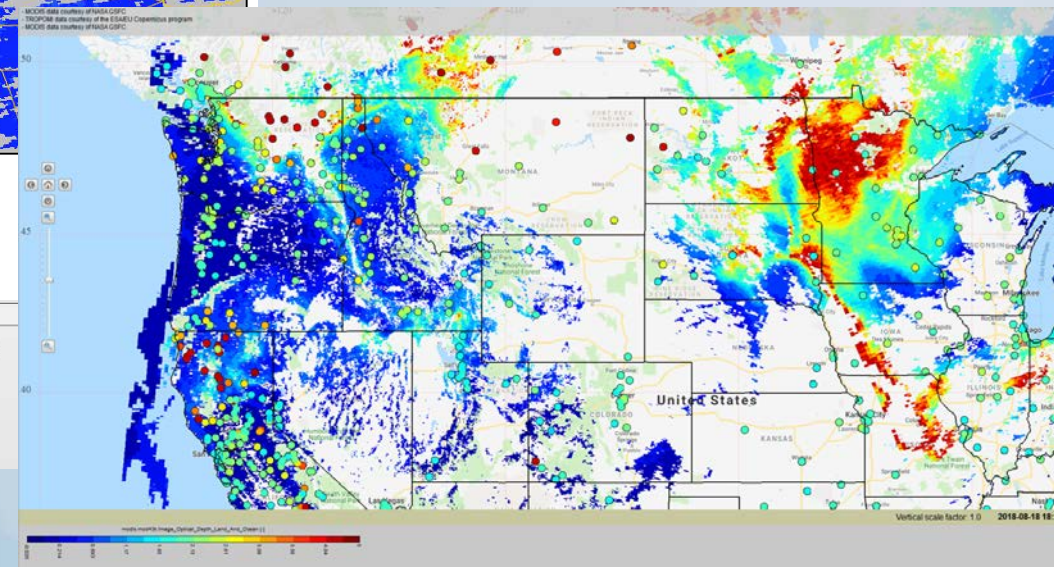
S5P TROPOMI S5P_OFFL_L2_CO____ 20180818T175203_20180818T193333_04389_01_010100_2...	Download URL: https://s5phub.copernicus.eu/dhus/odata/v1/Products('f3854f72-edd5-464a-b09f-...') Mission: Sentinel-5 P Instrument: TROPOMI Sensing Date: 2018-08-18T18:13:37.000Z Size: 12
S5P TROPOMI S5P_OFFL_L2_CO____ 20180818T161034_20180818T175203_04388_01_010100_2...	Download URL: https://s5phub.copernicus.eu/dhus/odata/v1/Products('defa954e-cbc8-423d-9a2b-...') Mission: Sentinel-5 P Instrument: TROPOMI Sensing Date: 2018-08-18T16:32:08.000Z Size: 11
S5P TROPOMI S5P_OFFL_L2_CO____ 20180818T142904_20180818T161034_04387_01_010100_2...	Download URL: https://s5phub.copernicus.eu/dhus/odata/v1/Products('06417b1c-28d1-459d-bd2f-...') Mission: Sentinel-5 P Instrument: TROPOMI Sensing Date: 2018-08-18T14:50:39.000Z Size: 11
S5P TROPOMI S5P_OFFL_L2_CO____ 20180818T124735_20180818T142904_04386_01_010100_2...	Download URL: https://s5phub.copernicus.eu/dhus/odata/v1/Products('bbceb8e5-160d-4542-90f7-...') Mission: Sentinel-5 P Instrument: TROPOMI Sensing Date: 2018-08-18T13:09:10.000Z Size: 12
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Using Panoply to Display Satellite Data

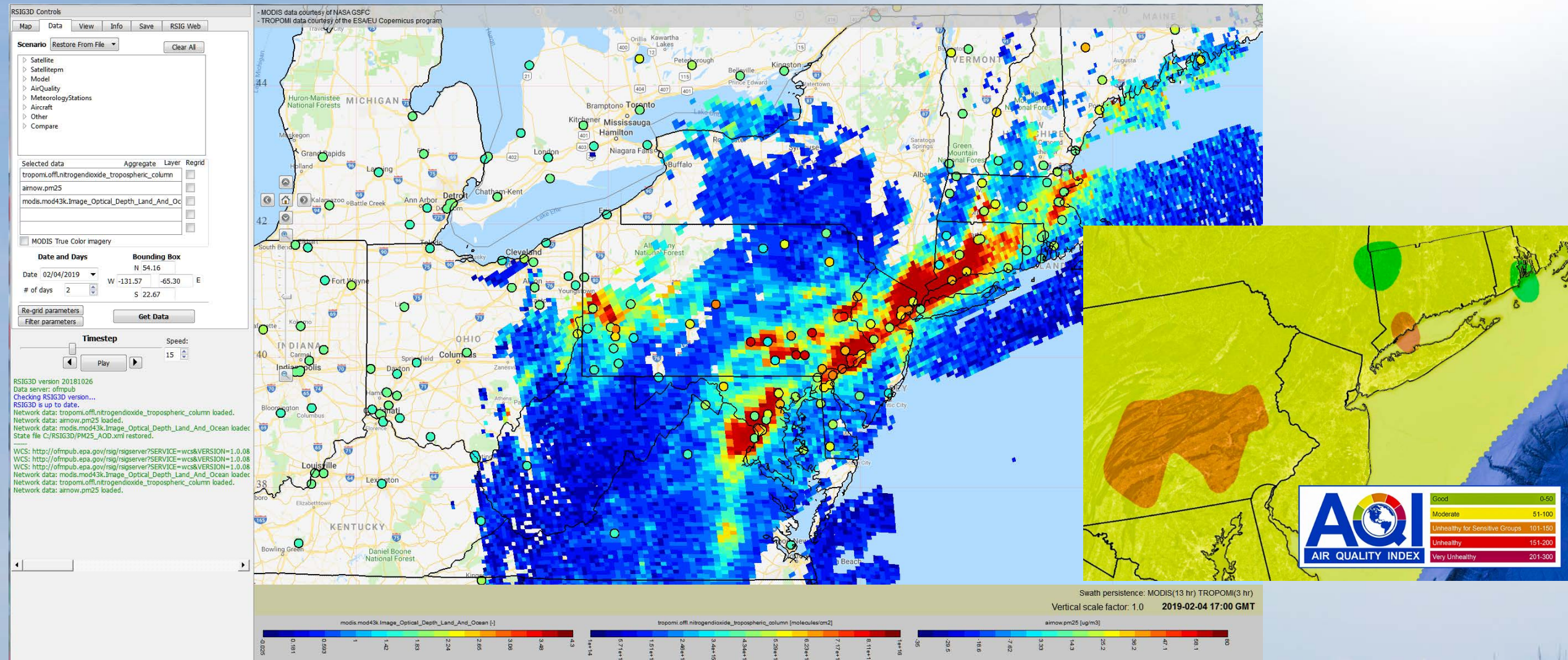


- **Comparing the TROPOMI CO column with the MODIS AOD is useful in determining whether the aerosols are the product of dust or wildfires.**

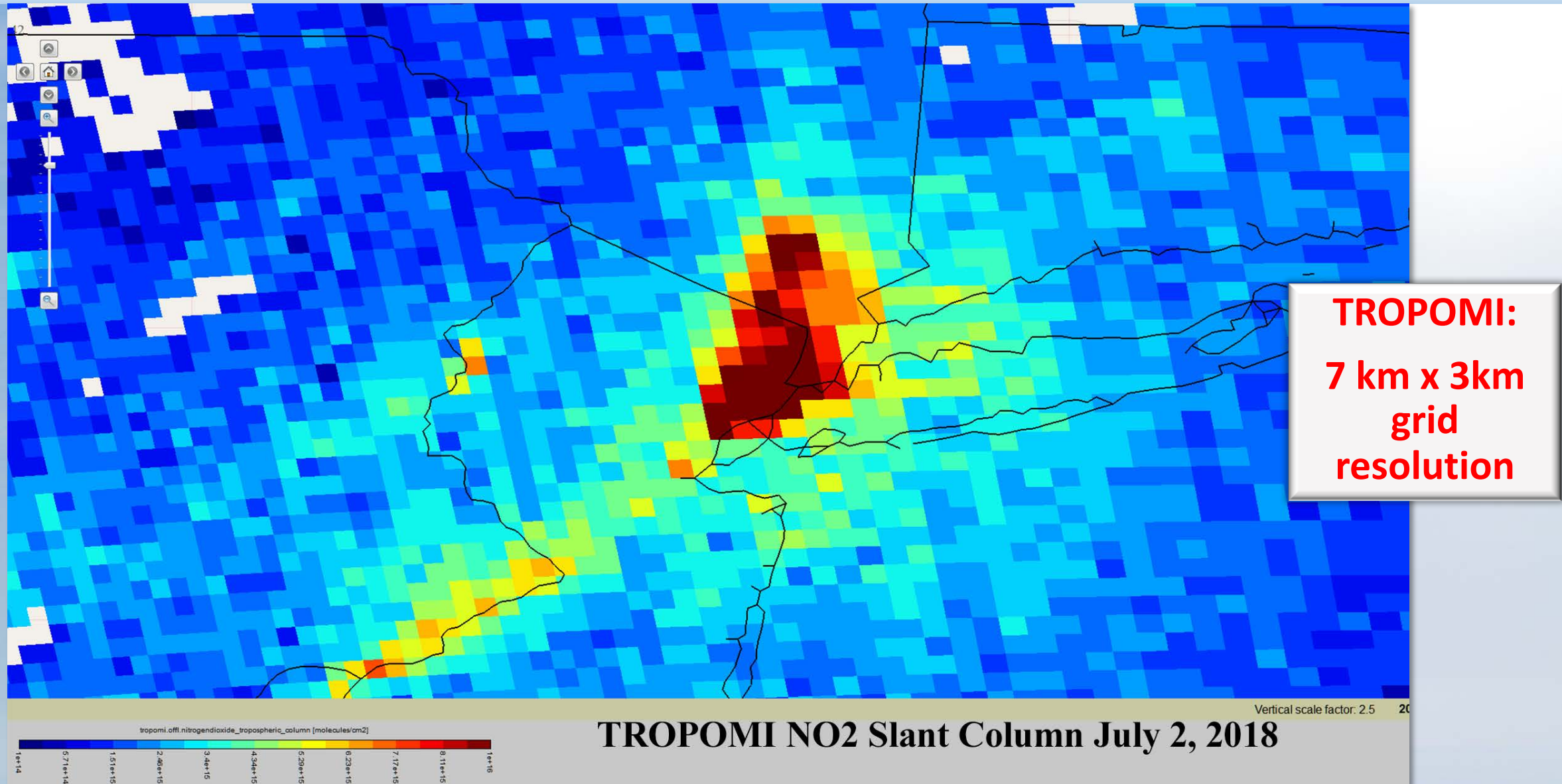


RSIG Image on February 4, 2019 Elevated NO₂

Widespread temperature inversion caused PM2.5 levels to elevate over the entire Northeast and also trapped NO₂ in the lower boundary layer along the river basins and urban corridors. Could we be seeing NO₂ from the mobile sources along the highways?

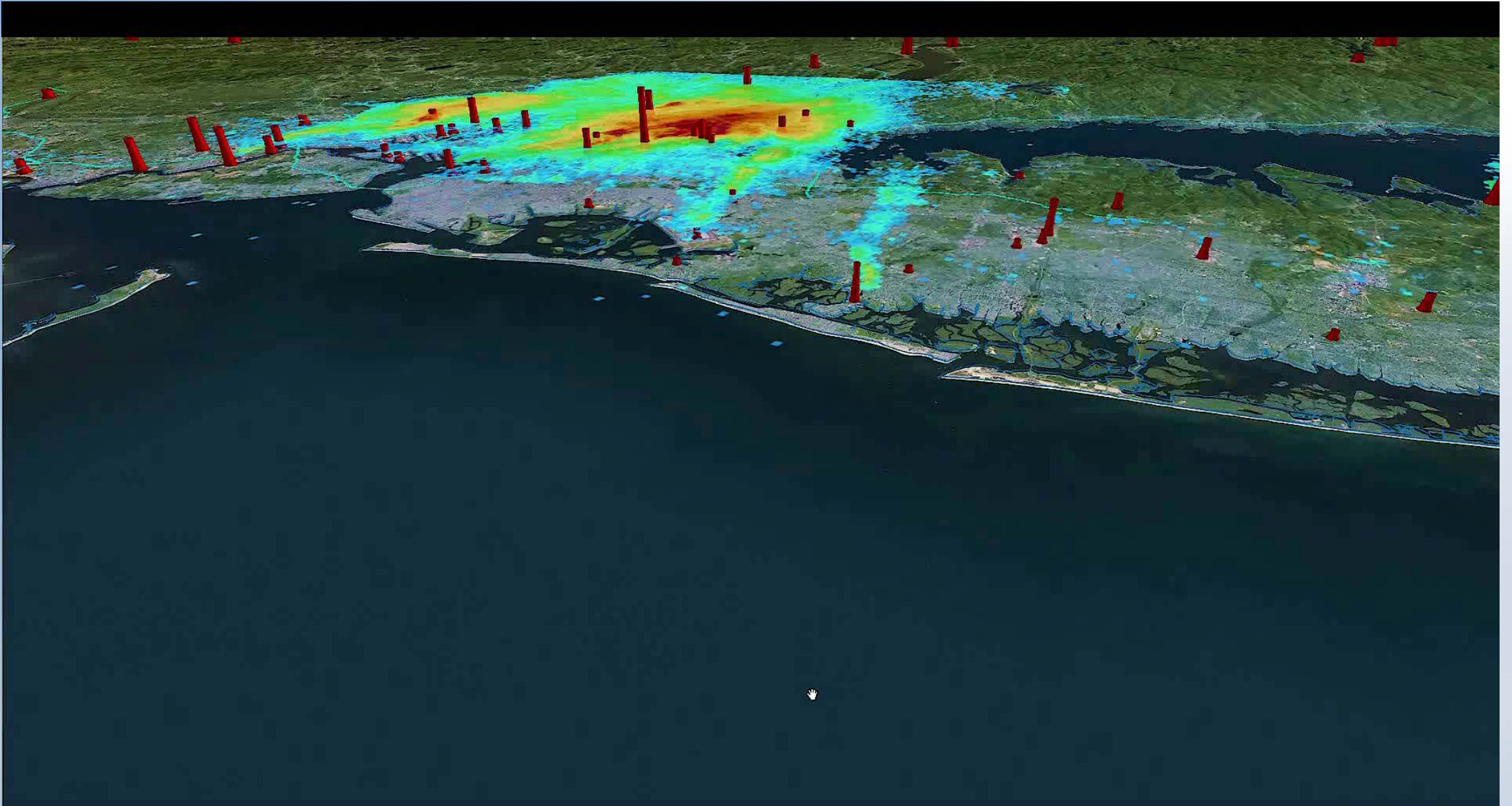


Using RSIG for TROPOMI NO2 Retrievals

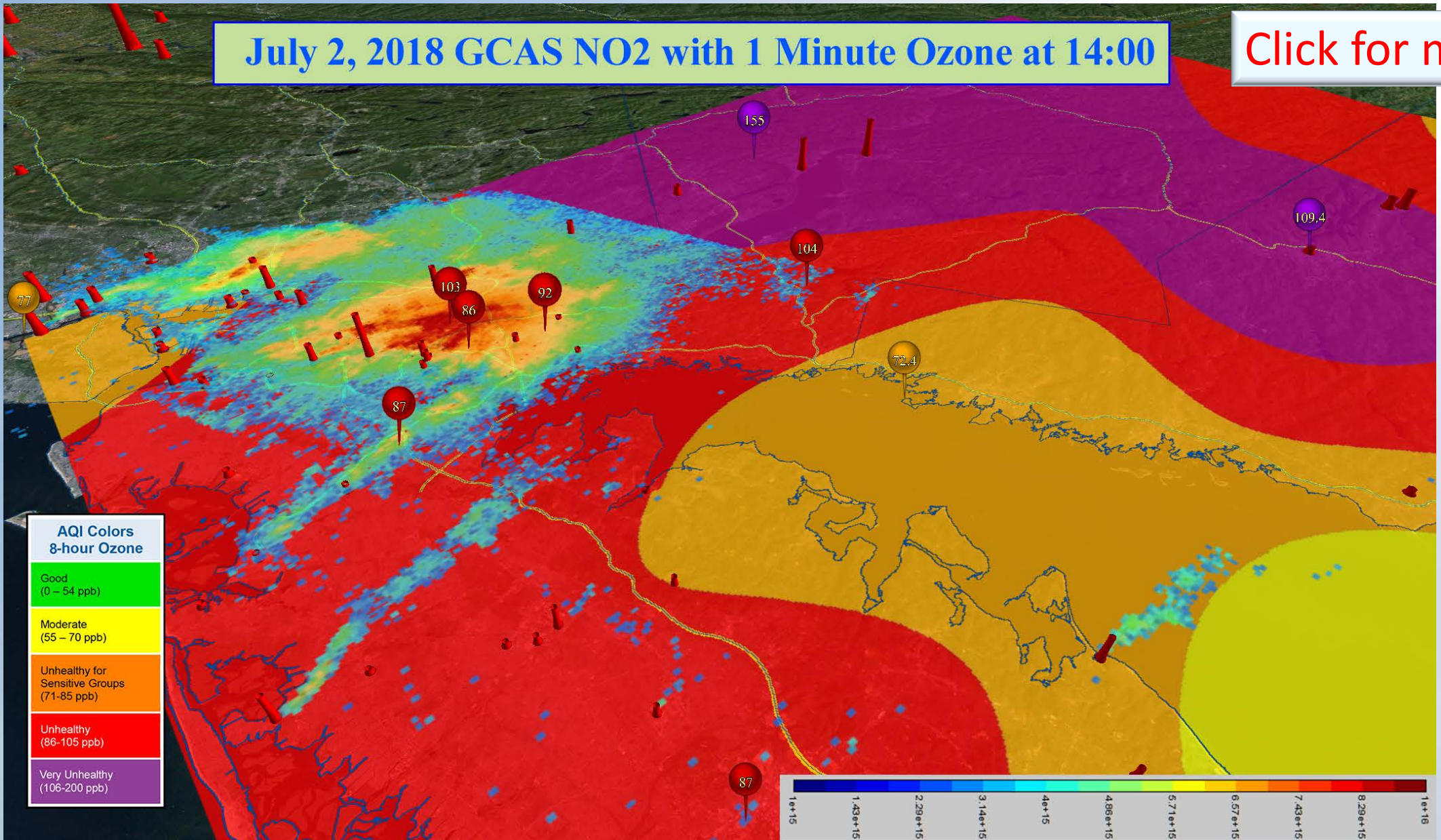


- High resolution satellite images will be critical for future SIP development/ trends.

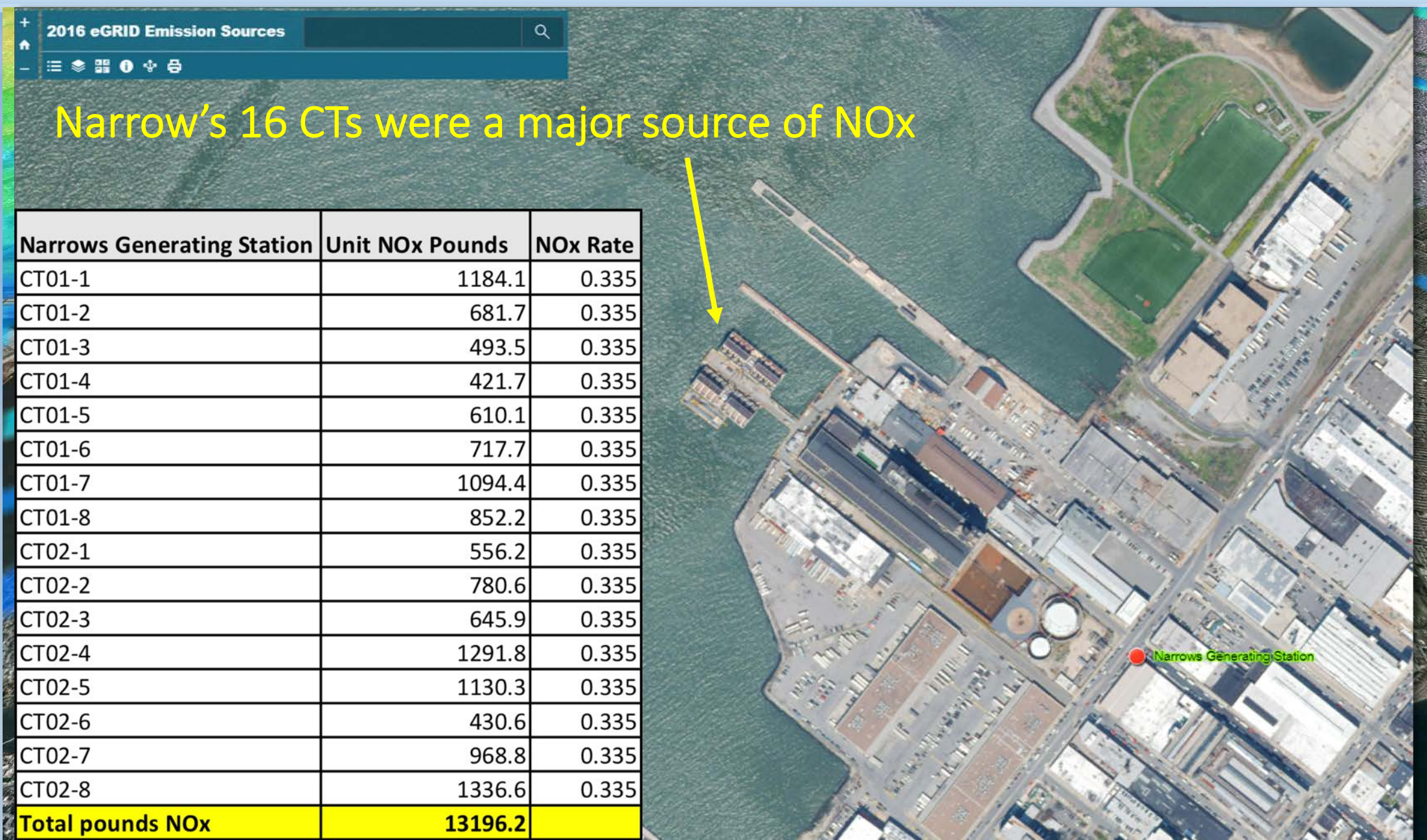
July 2, 2018 GCAS NO₂ NYC Flyover Animation([LISTOS](#))



July 2, 2018pm GCAS NO₂ with Maximum 8-hour Ozone AQI

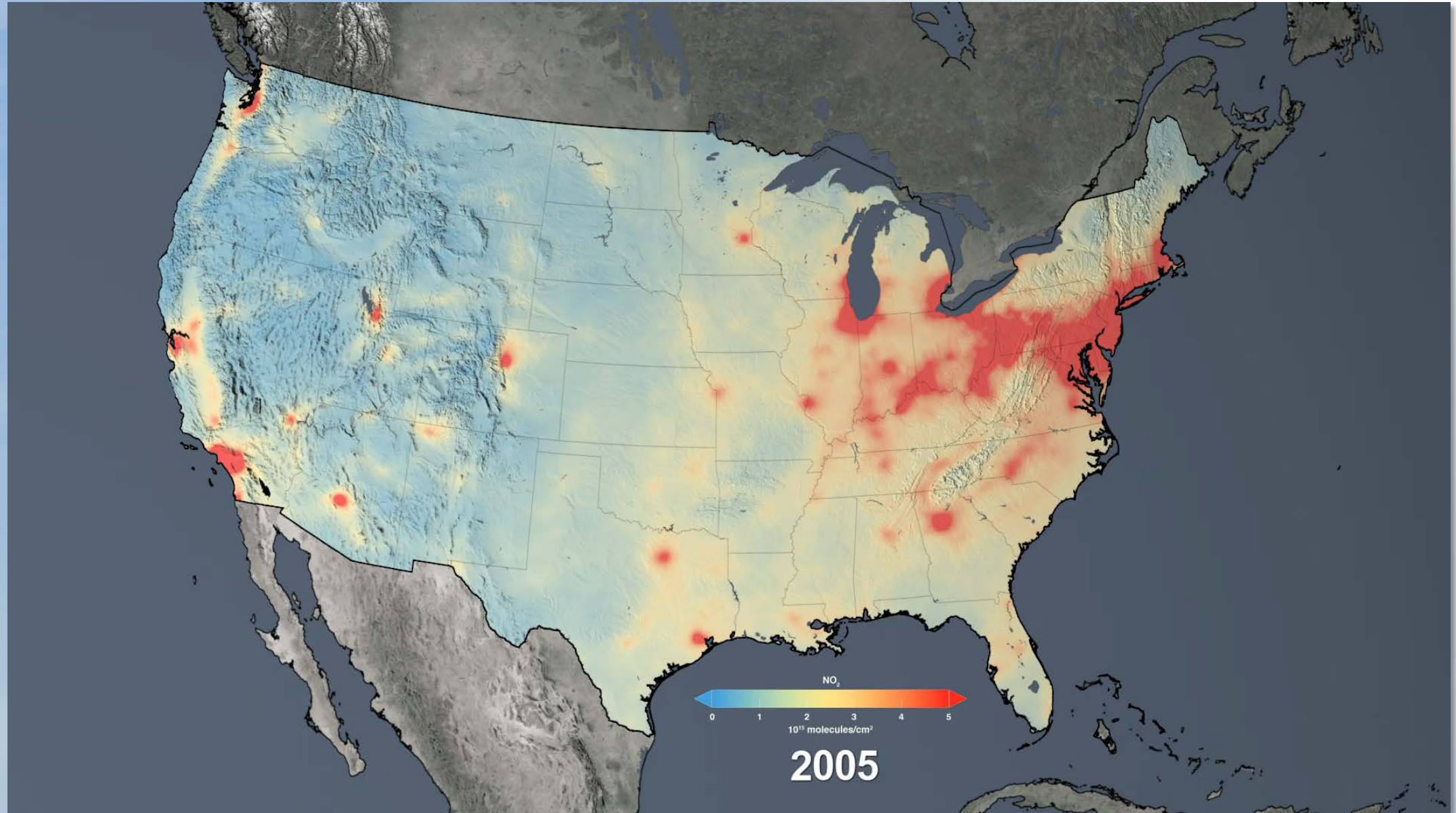


July 2, 2018 (pm) GCAS NO₂ Slant Column With EGU Units



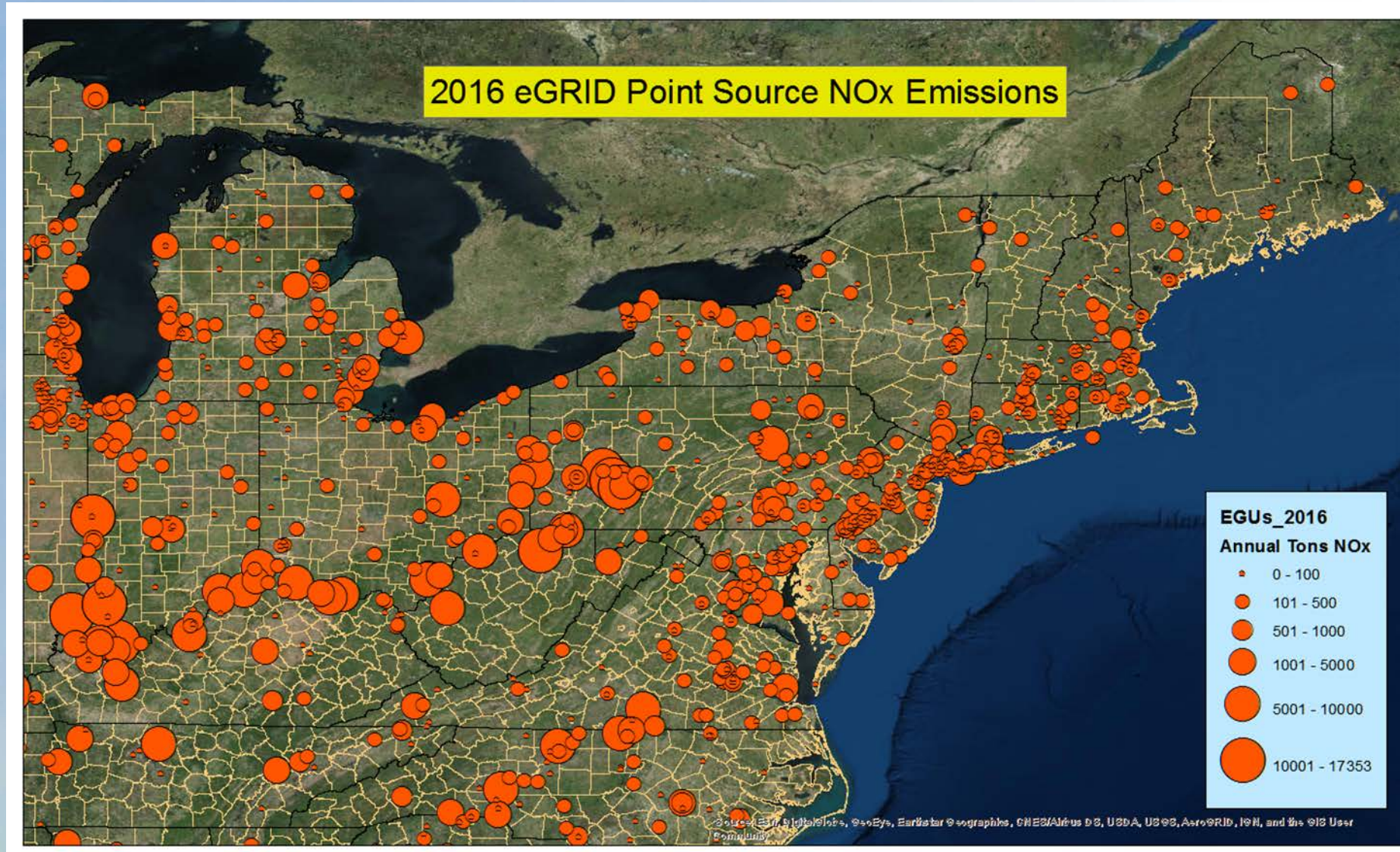
OMI Satellite Animation NO₂ Trend 2005-2016

[Video Credit: NASA Goddard Space Flight Center](#)



2004/2016 eGRID NOx Point Source Emissions

- Note the abundance of 10,000+ tons annual NOx sources upwind of CT in 2004 (reported to EPA).

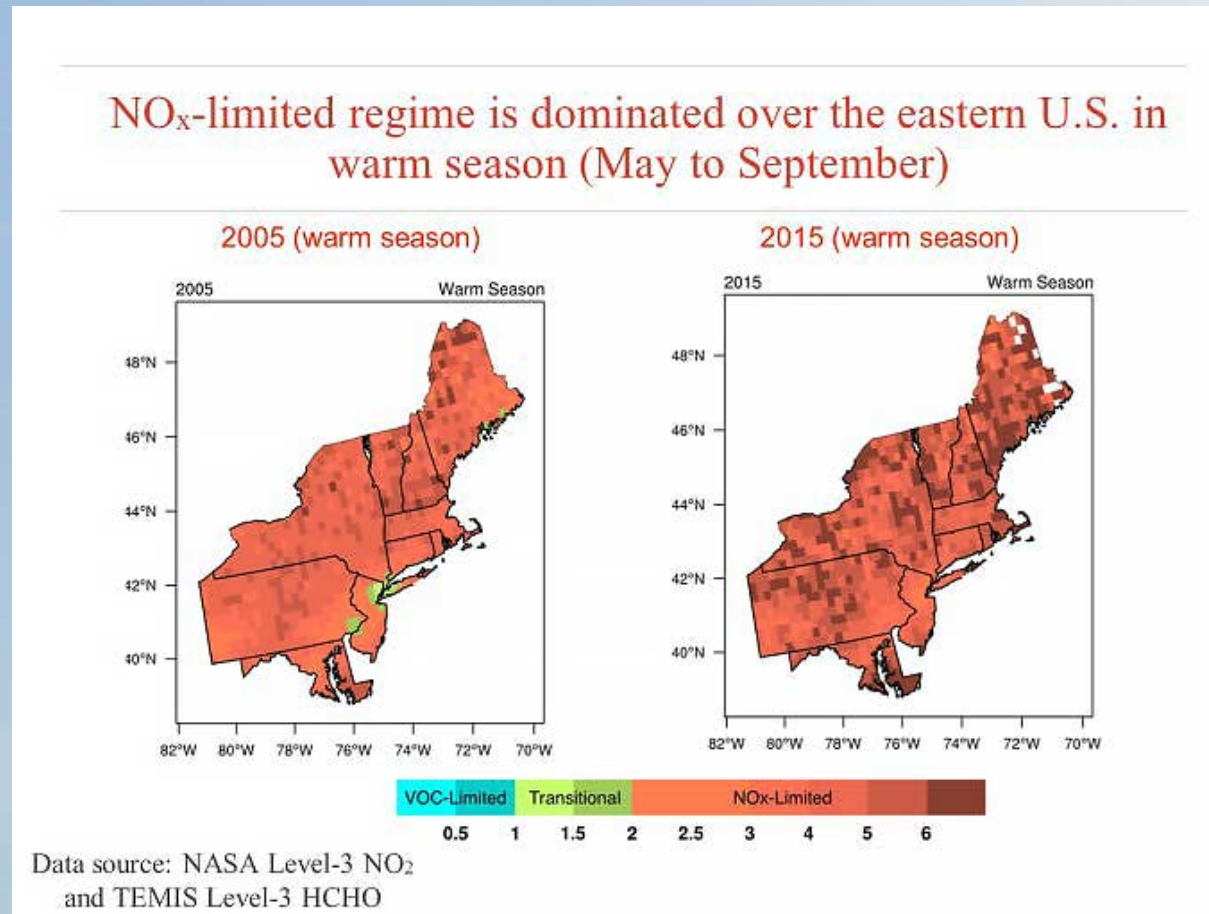


**Click for
2016**

CT Attainment Demonstrations for the 2008 Ozone NAAQS

A study conducted by the Lamont-Doherty Earth Observatory at Columbia University makes use of two NASA satellite products: measured tropospheric air column NO_2 (a surrogate for NO_x) and formaldehyde (as a surrogate for VOC). As depicted in Figure 2-13, Jin *et al.*'s findings indicate that on a regional scale, summertime ozone formation in the Northeast tends to be more NO_x limited. Therefore, it is appropriate to favor NO_x control strategies on a regional basis.

Figure 2-13. Ratio of formaldehyde in the air column, as surrogate for VOC, to tropospheric column NO_2 indicate that ozone formation in the warm season tends to be NO_x limited in the northeast region of the United States. (Jin *et al.*)



Suggestions

- Can Worldview integrate the GOES16/17 images into layers, similar to what Aerosol Watch has done?
- RSIG application needs more TROPOMI data and wind vector analysis.
- Looking forward to future launch of the geostationary TEMPO instrument. Make sure Connecticut (and other States) are involved.

