Operational Service-Oriented Delivery and Networking of NAAPS Forecasts to the AQ Community

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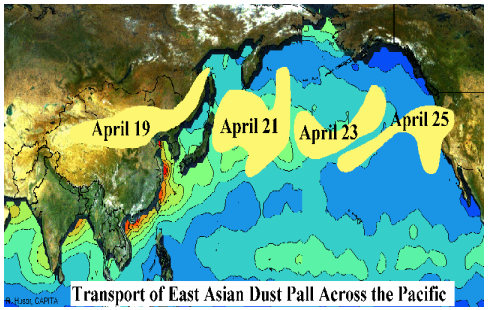
Funding from NASA Applied Sciences, EPA, ONR.

Outline:

1. What is an Exceptional Event?
2. What is the EE DSS (Decision Support System)?
3. Example of investigations aided by EE DSS.
4. What is under the hood?
5. What is the future of EE DSS?

Exceptional Event (EE) is defined by EPA's EE Rule:

The event is not reasonably preventable exceedance of NAAQS



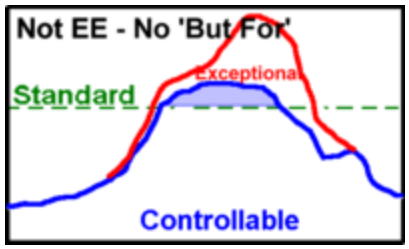
Transported Pollution

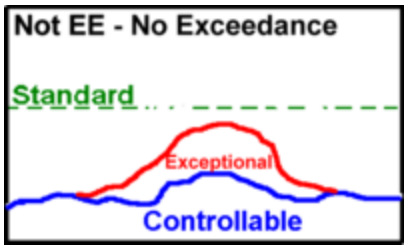
Natural Dust, Smoke Events

Special Human Activities

EE Decision Support System (EE DSS) Provides Evidence for:

- Clear causal relationship between causes and the event
- The event concentration is in excess of the "normal" values
- The exceedance would not have occurred, **But For** the EE





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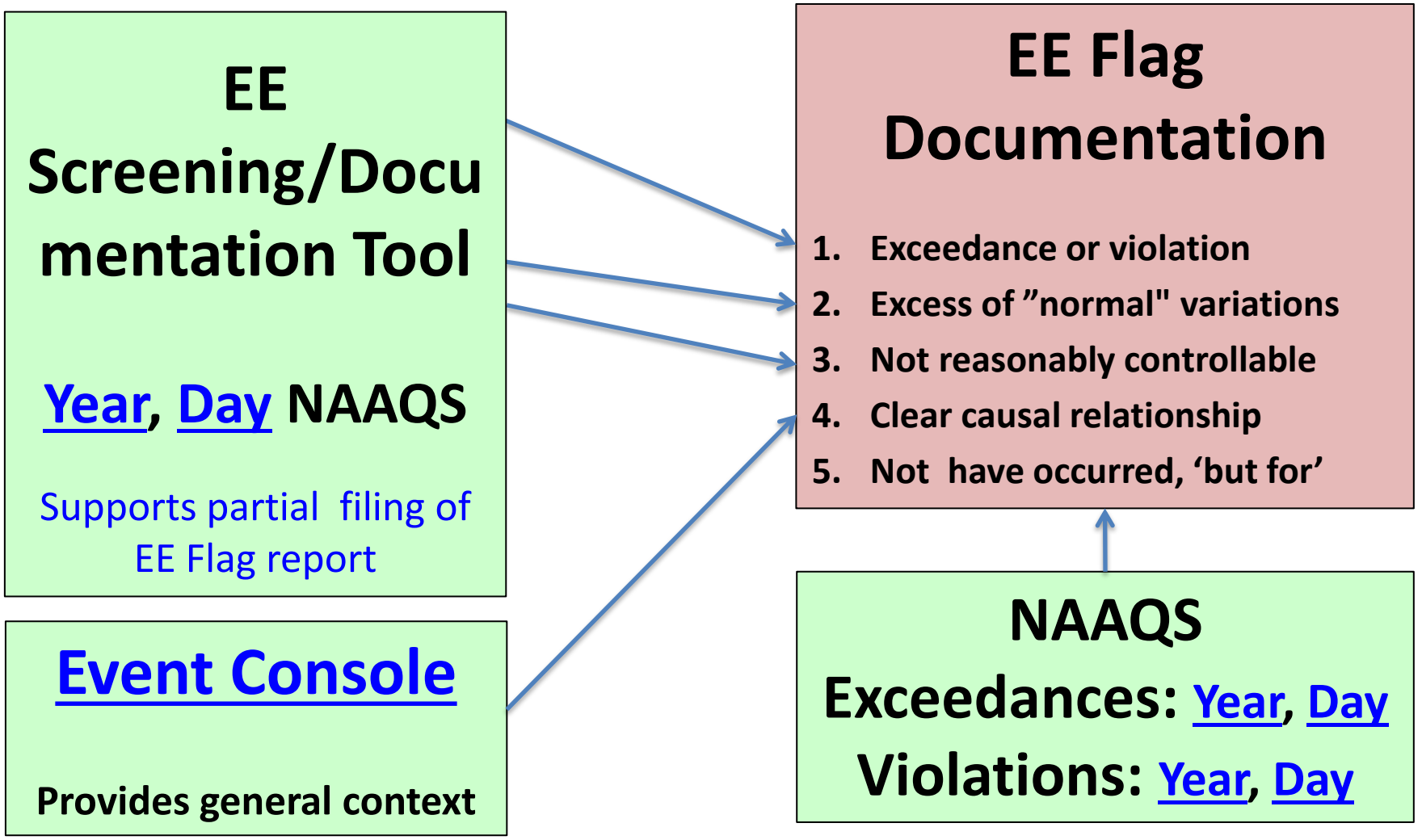
Exceptional Event Decision Support System

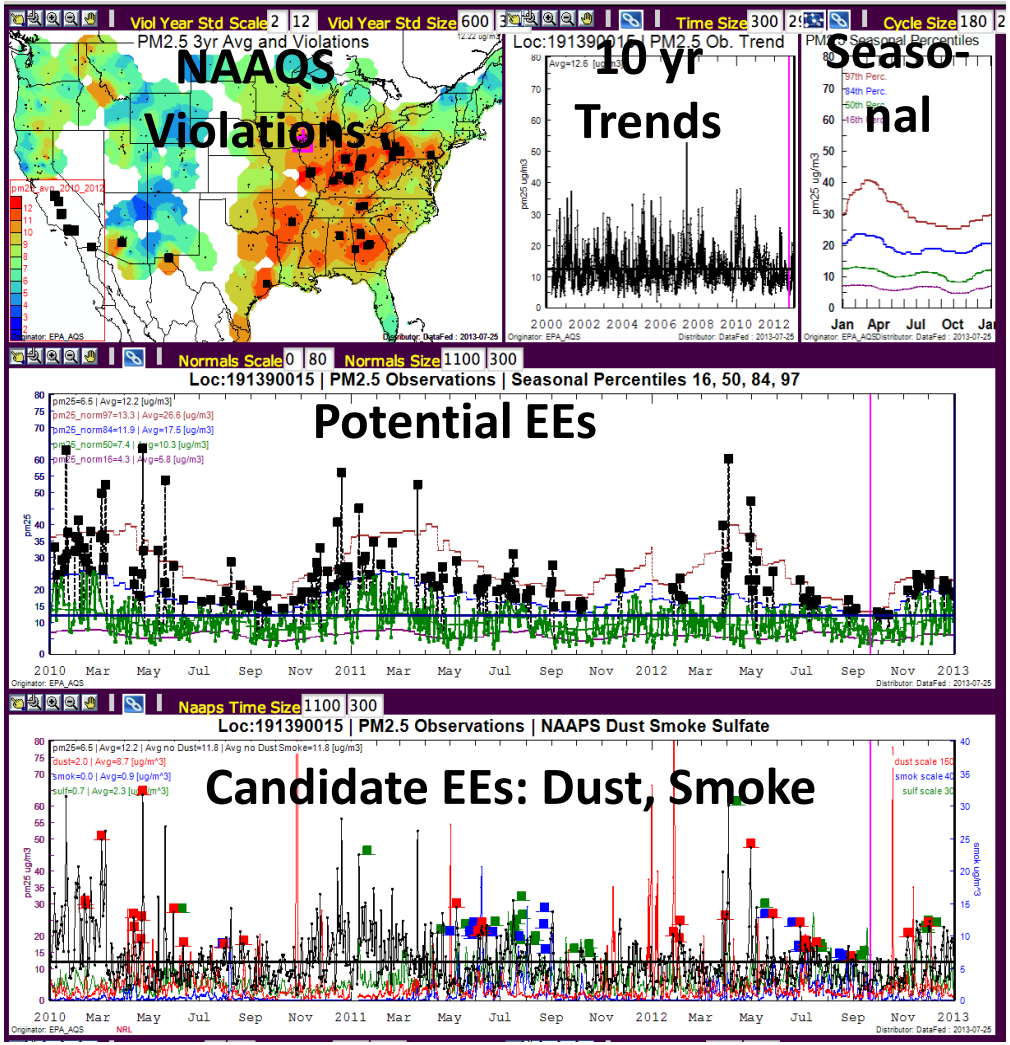
Follows the EPA EE Rule to identify and partially document exceptional samples



Aims of the EE DSS

- Facilitate screening of AQS regulatory data for **candidate EE samples** following the EE Rule
- Providing **resources for EE flag documentation**: model simulations, satellite, surface and other data.
- Estimate the impact of EE samples on **compliance with the Daily and Yearly NAAQS** for PM2.5

EE Screening/Documentation Tool

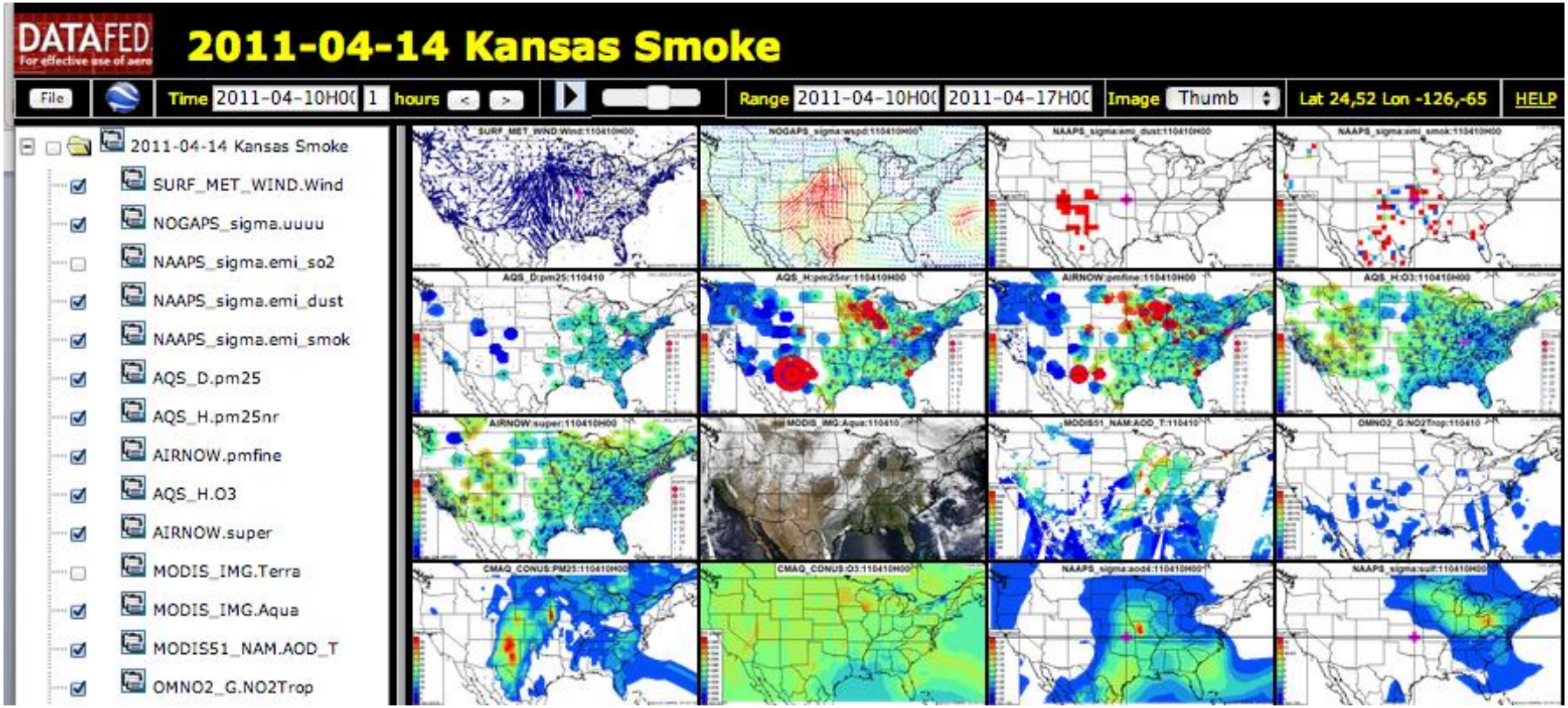


Muscatine, IA
3-yr averages and violations, 10-yr trends, seasonal

VIEWS data – Black boxes are cases that exceed 97th percentile.

Red/Blue/Green boxes are cases where NAAPS dust/smoke/sulfate exceed thresholds.

Event Console



- Consoles are spatial representations of observations, emissions and models
- All maps are synchronized spatially and temporally, and navigated by the user
- Provide rich multisensory context to illuminate complex atmospheric situations

http://webapps.datafed.net/kmz_player.aspx?kmz=EventConsoles/110410-15_Kansas_Smoke.kmz

Main Datasets used in EE DSS:

EPA Regulatory Monitoring (FRM) Data:

PM2.5, PM10 (daily); Ozone (hourly)

Other Datasets:

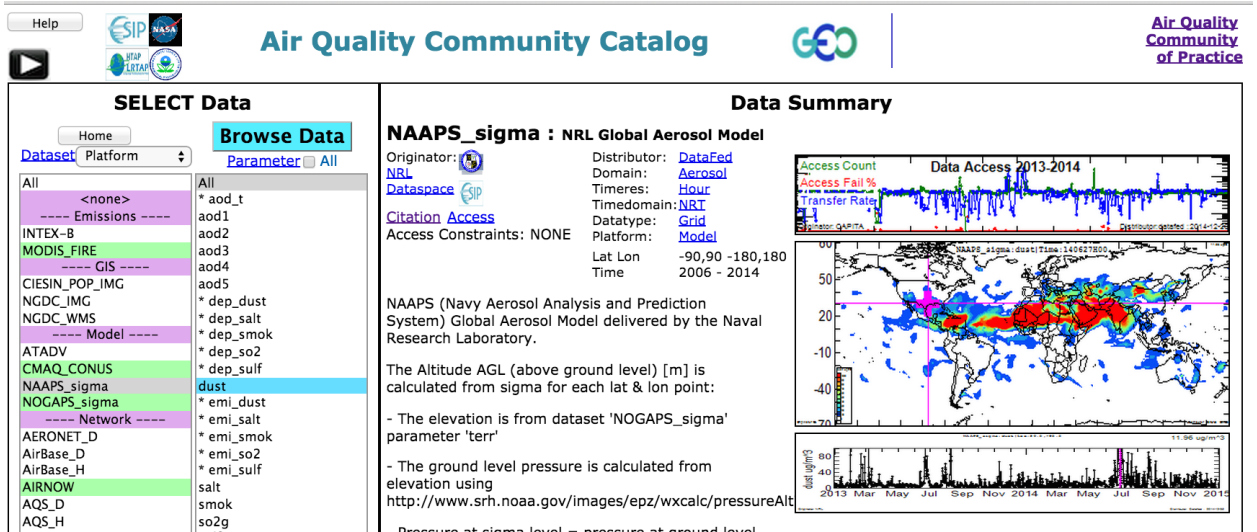
NRL NAAPS aerosol model, dust, smoke

NASA satellite data (MODIS AOD; OMI NO2)

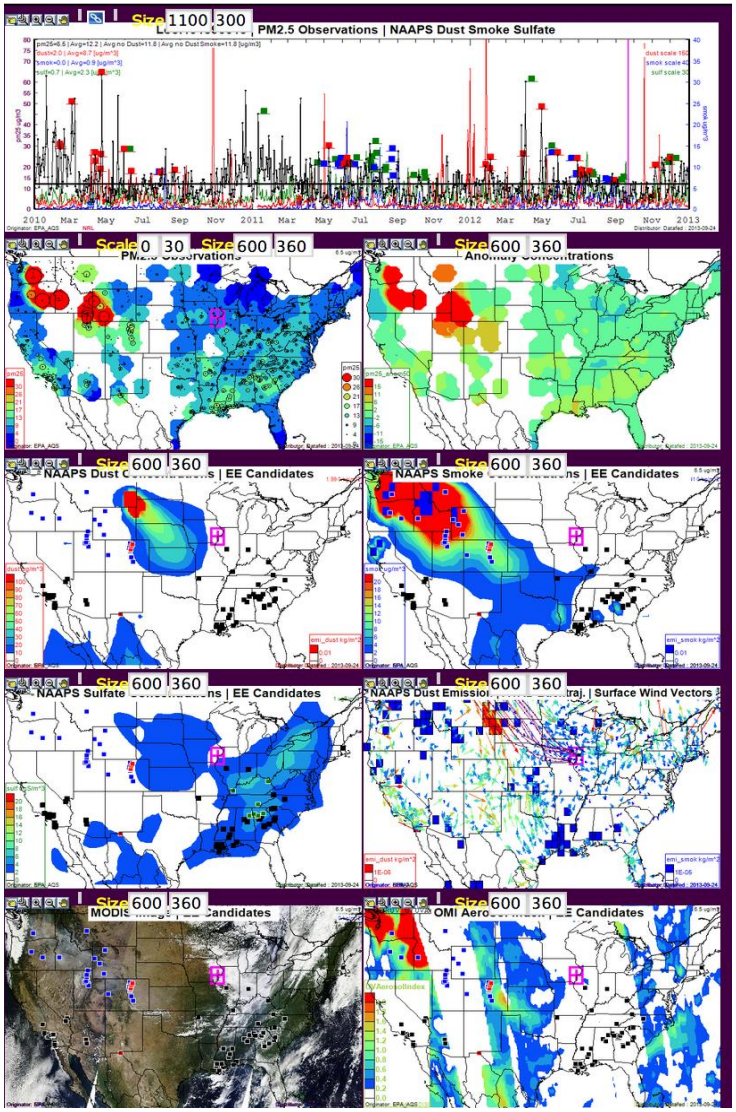
Continuous surface obs. AIRNOW Ozone, PM2.5

NOAA Weather data (Surface Weather, Trajectories)

Access to all data in DataFed using the Catalog:



NAAPS has a key role in EE DSS: Attribution of exceedances to smoke or dust



Relevant NAAPS Qualities

1. Assimilates satellite aerosol optical thickness and fire pixels
2. Provides 4D aerosol structure for dust, smoke, sulfate, sea salt
3. Open access to 10 years of global simulations (via DataFed)

Goals of EE DSS

EE DSS Contribution to EPA and States:

Current EE analysis:

State-by-State; ad hoc, Official EEs

From Local, ad hoc, to national EE detection, analysis, documentation

Final EE analysis:

National EE detection, analysis, documentation; forecast, NRT, post analysis

EE DSS Contribution to NASA Applied Sciences

Current Readiness Level 7:

DSS Functionality Demonstrated

From demonstrated functionality to proven functionality of EE DSS

Final Readiness Level 8:

DSS Functionality Proven; NASA satellite and NAAPS products in use for smoke & dust events

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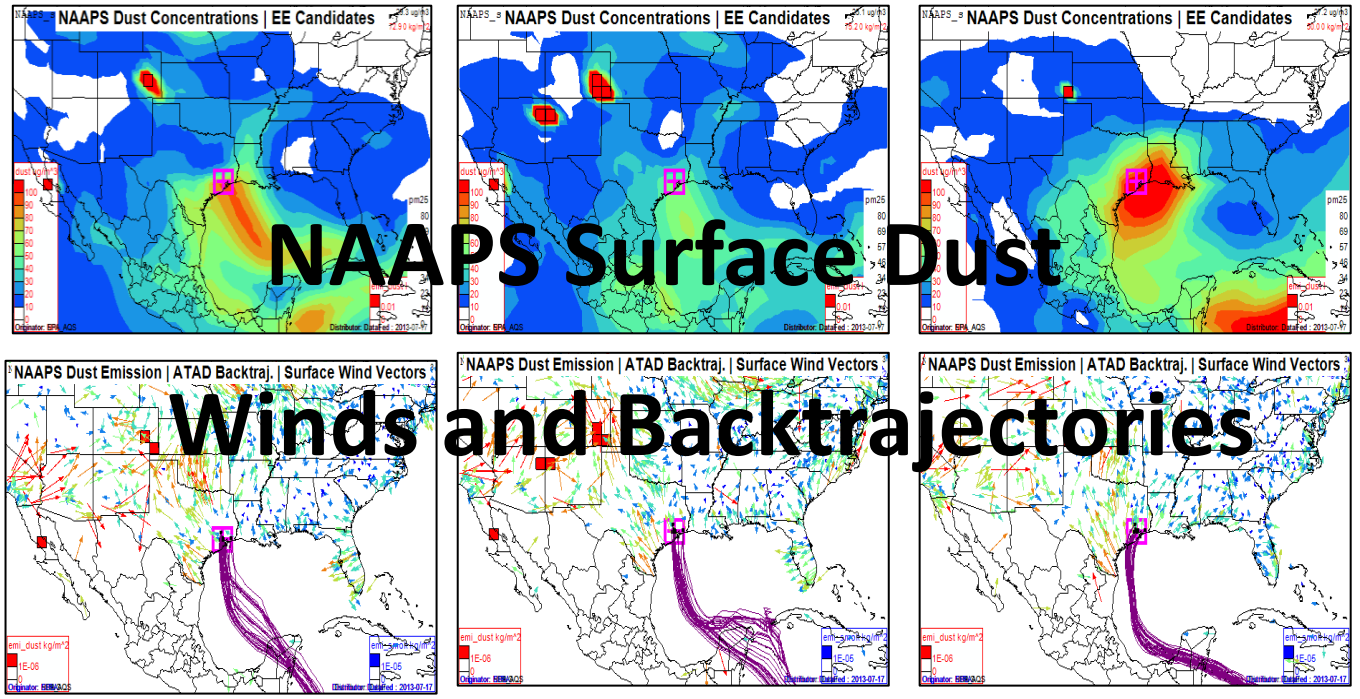
Yearly PM2.5 NAAQS Violation 482011035, Houston/Clinton

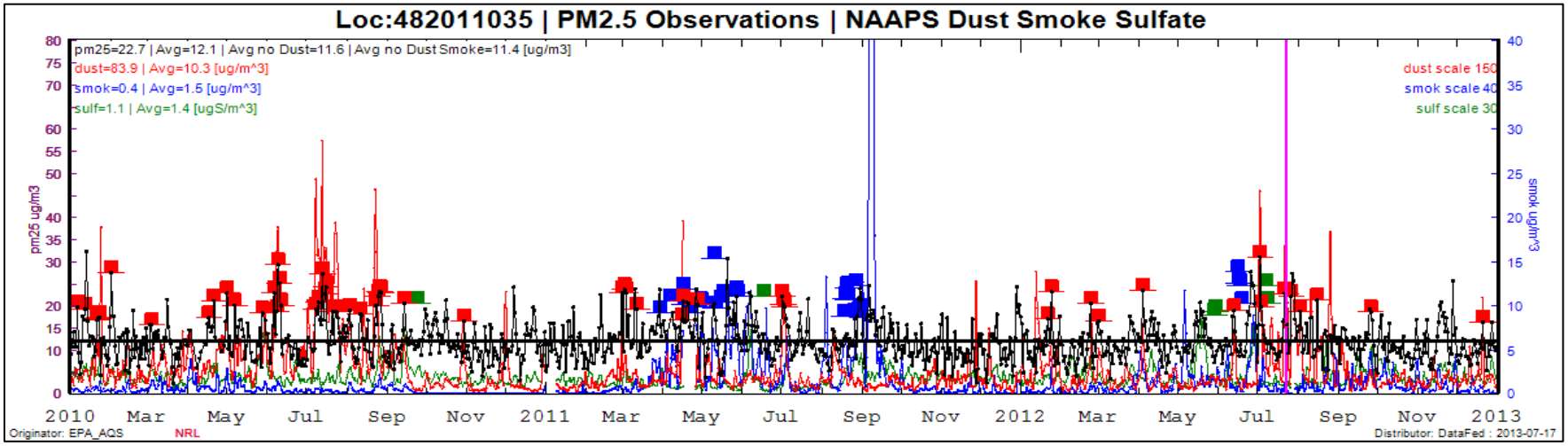
Houston site 482011035 is one of the ~70 sites potentially violating Yearly PM2.5 NAAQS (3yr Avg=~12.1). The Daily NAAQS is not violated. TCEQ Has prepared an excellent doc for 3 African Dust EEs

Each flagged sample (June 9, 10 and Jul 13 2010) is well documented and based on the EE DSS, the samples are well qualified for concurrence (below)



However, removing the 3 EE samples will not bring the site into Yearly NAQS compliance

Yearly PM2.5 NAAQS EE Analysis –Houston/Clinton 482011035 Based on the EE DSS



Time series shows AQS FRM PM2.5, along with NAAPS surface Dust, Smoke and Sulfate

Based on set triggers (NAAPS Dust>10 and Smoke>5 µg m^{-3}) there are 58 Dust samples (red rectangles and 26 Smoke impacted samples (blue rectangles) during the 3yr period. These counts depend on the trigger settings.

In other words there are 84 EE samples or about 8% of the 1055 3yr total. Removing ALL the dust/smoke-impacted samples reduces the 3yr average to 11.4 ug/m3, i.e. below the Yearly NAAQS. (Note: 8% EE is much higher than any other site we have examined)

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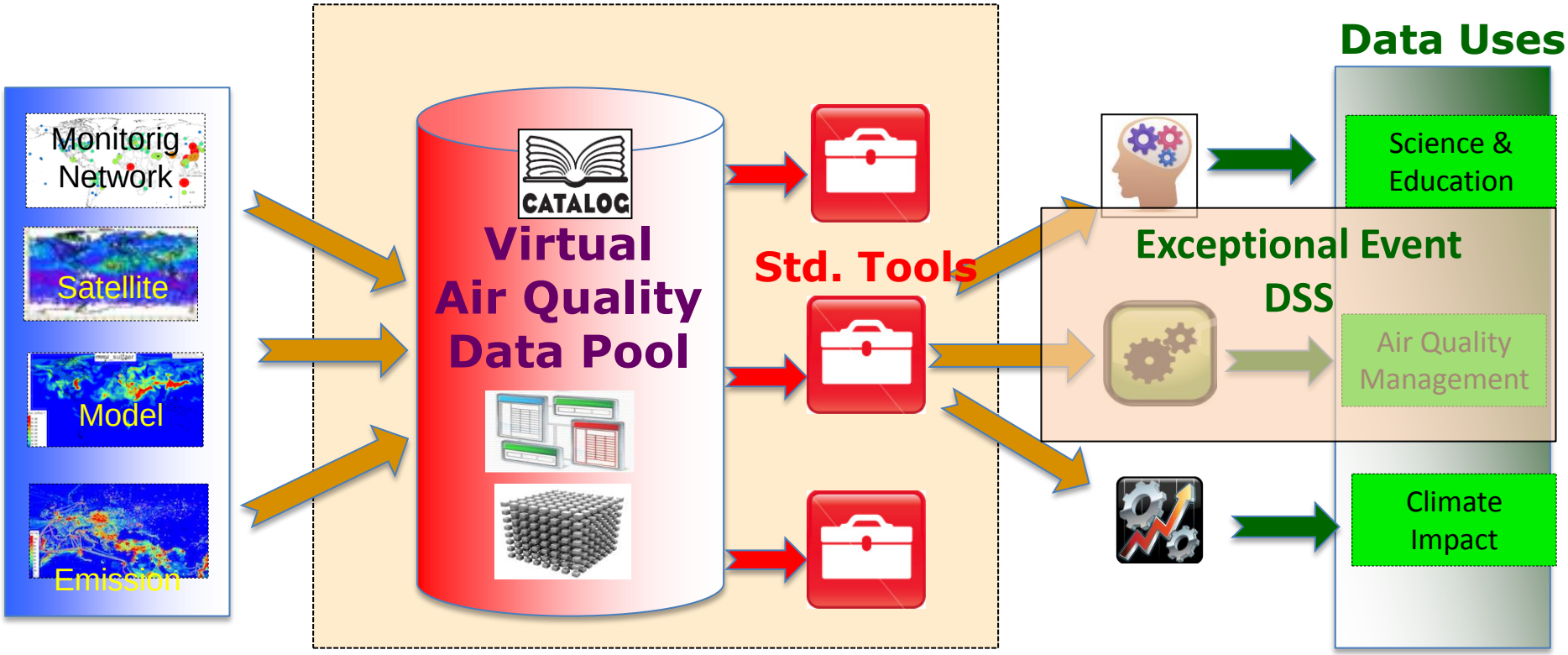
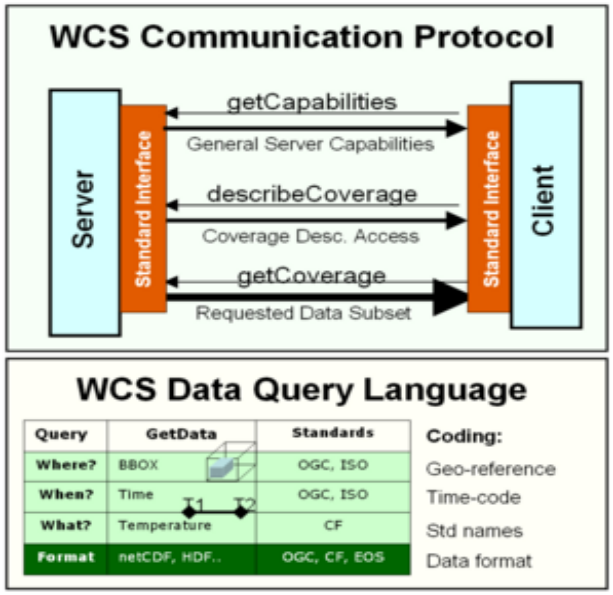
EE DSS Tool Set is built on the Distributed DataFed Infrastructure

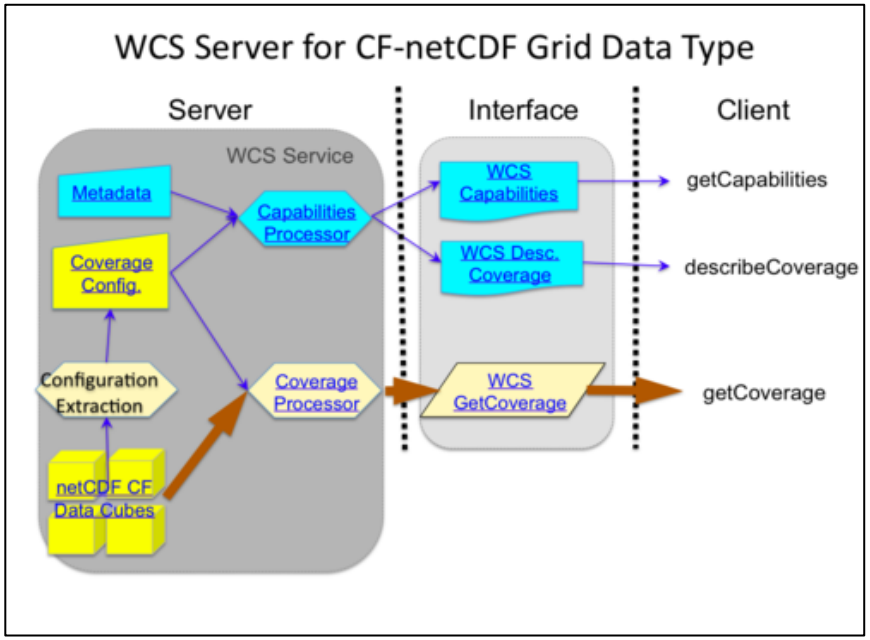


Data are federated using Service Oriented Architecture

Tools built on SOA (Service Oriented Architecture

Web Coverage Service (WCS) Server software

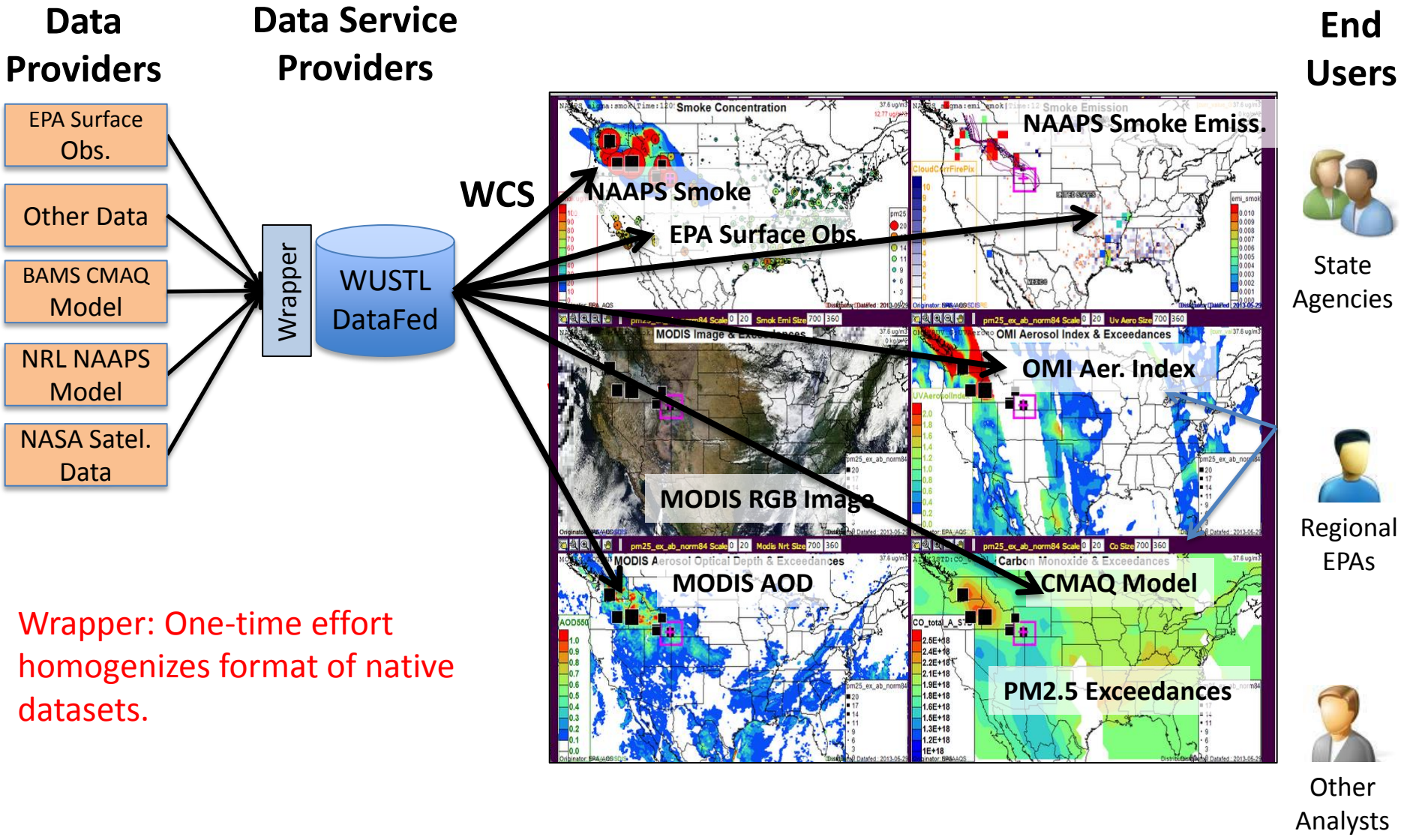




- Server software developed, and used by the GEOSS Air quality Community of Practice Development supported by NASA, EPA, 2006-2010
- Server software described, documented
- Open software is shared through Source forge

Sample WCS 'getCoverage' call returns data to Client:
https://portal.fnmoc.navy.mil/geoserver/FAROP/wcs?service=WCS&version=1.0.0&request=getCoverage&coverage=FAROP:global_360x181.aero_extinct_lw.surface&time=2015-8-24T6:00:00.000Z&crs=EPSG:4326&bbox=-180.5,-90.5,180.5,90.5&width=360&height=181&format=image/grib

Current EPA Exceptional Event Decision Support System



Wrapper: One-time effort homogenizes format of native datasets.

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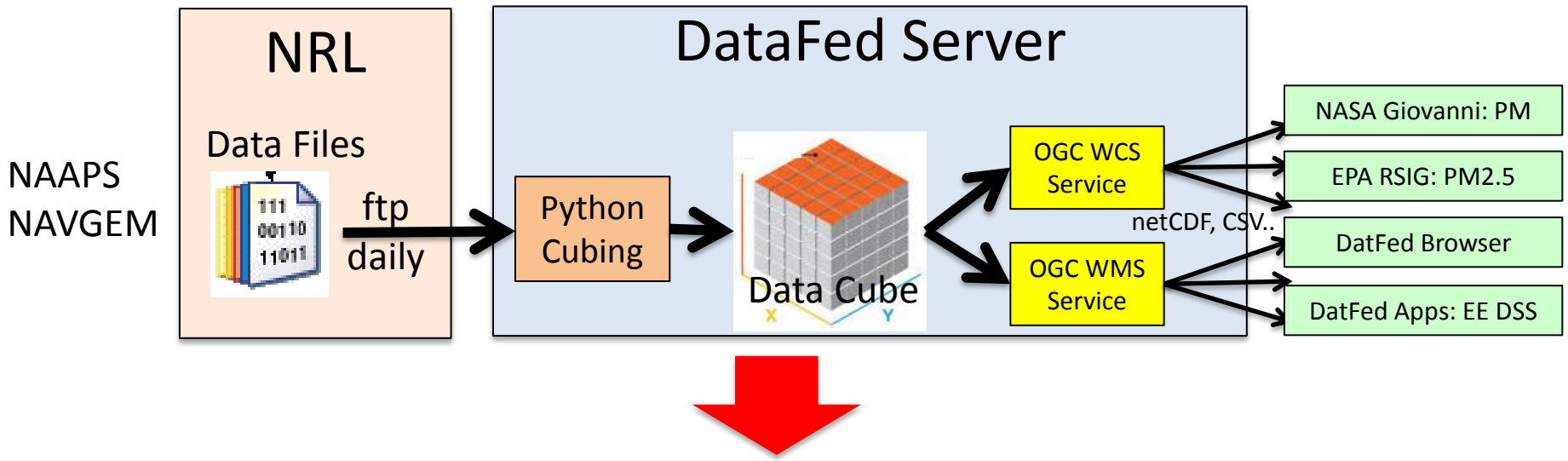
NAAPS Data Delivery Service: Now

Now: NAAPS data harmonization and the service is through DataFed



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(OGC - Open Geospatial Consortium; WMS –Web mapping service)

Plans:

1. Distribute NAAPS data directly from server at NRL with an OGC WCS/WMS standards-based data server that allows loose connection to software clients at NASA, EPA and other mediator and user sites.
2. Implement EE DSS client software at NRL for visualization, exploration and analysis of the 5-dimensional aerosol data using software based on WCS/WMS and Processing services.
3. Collaborate with operational data hubs, such as the NASA GIBS and the EPA RSIG to create a data sharing network through service oriented architecture (SAO)
4. Work with EPA and States to fine tune the EE DSS so that the operational system can effectively support air quality management for the next decade or more.

NAAPS Data Delivery Service: Now, Planned

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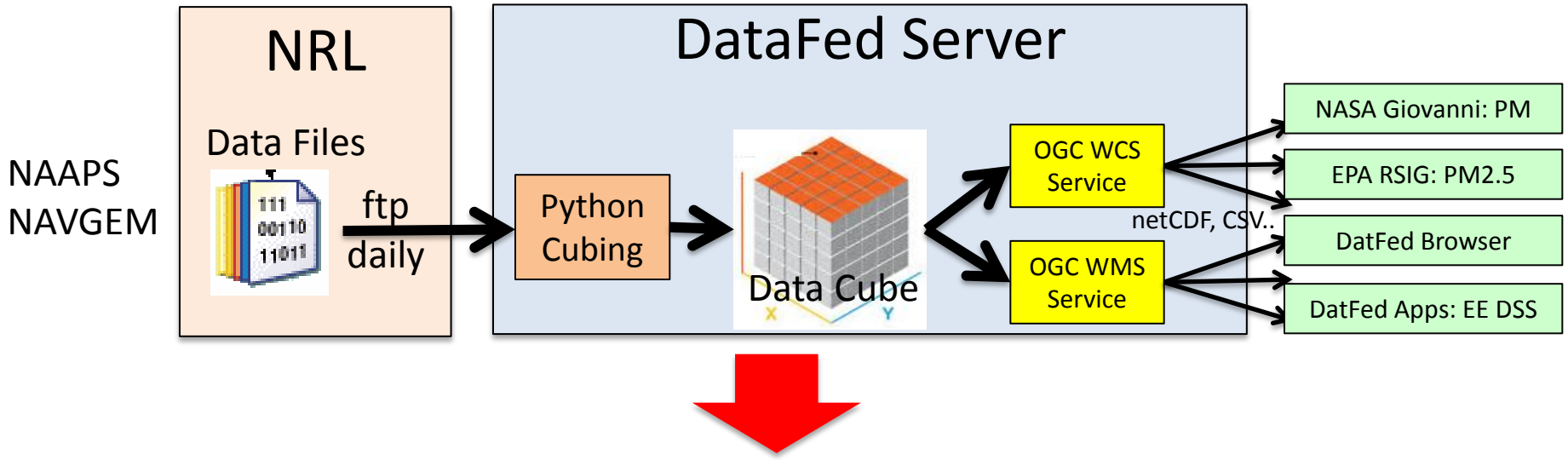
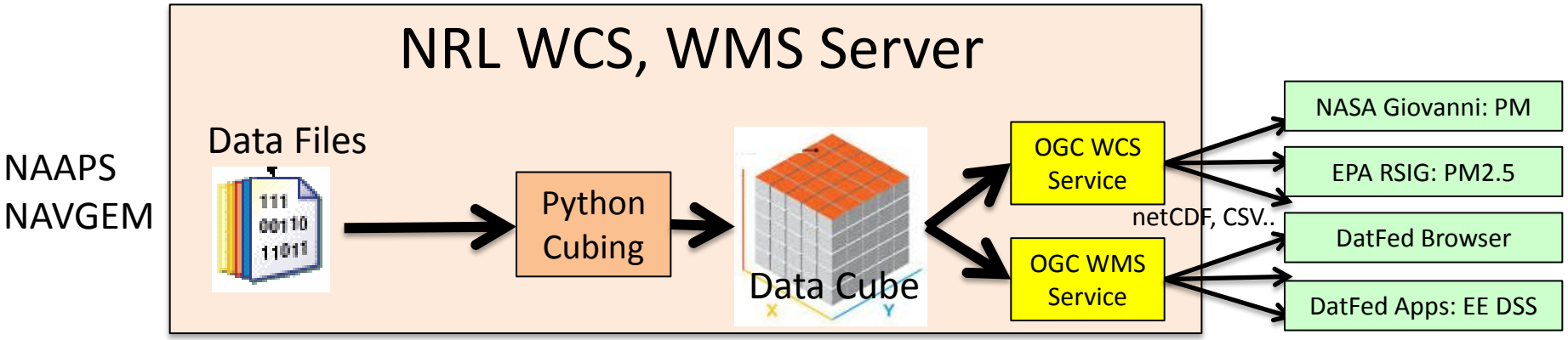


Planned: Port the data harmonization service software to NRL



Plans:

1. Augment the NAAPS server at NRL with an OGC WCS/WMS standards-based data server that allows loose connection to software clients at NASA, EPA and other mediator and user sites.
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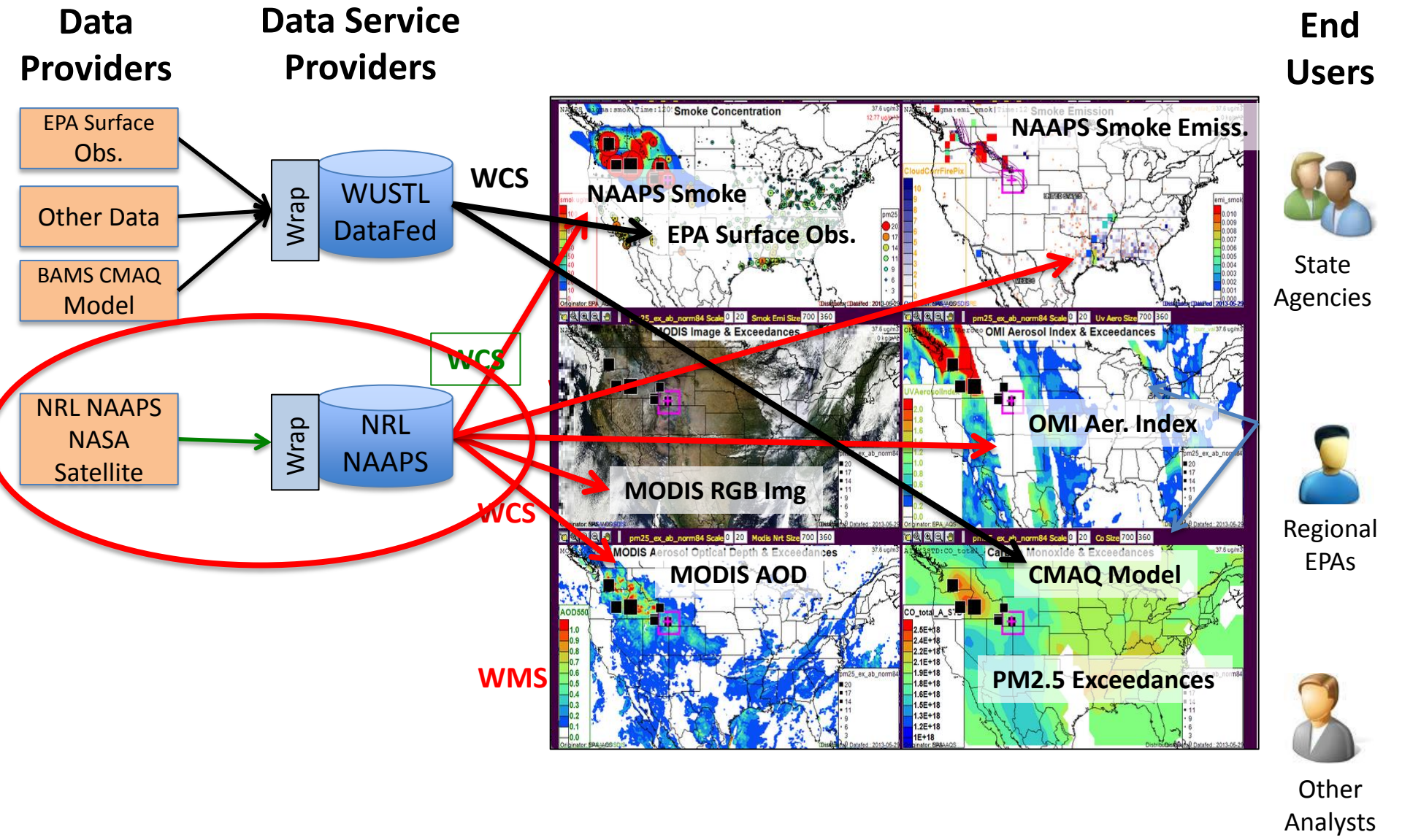
Planned Exceptional Event Decision Support System



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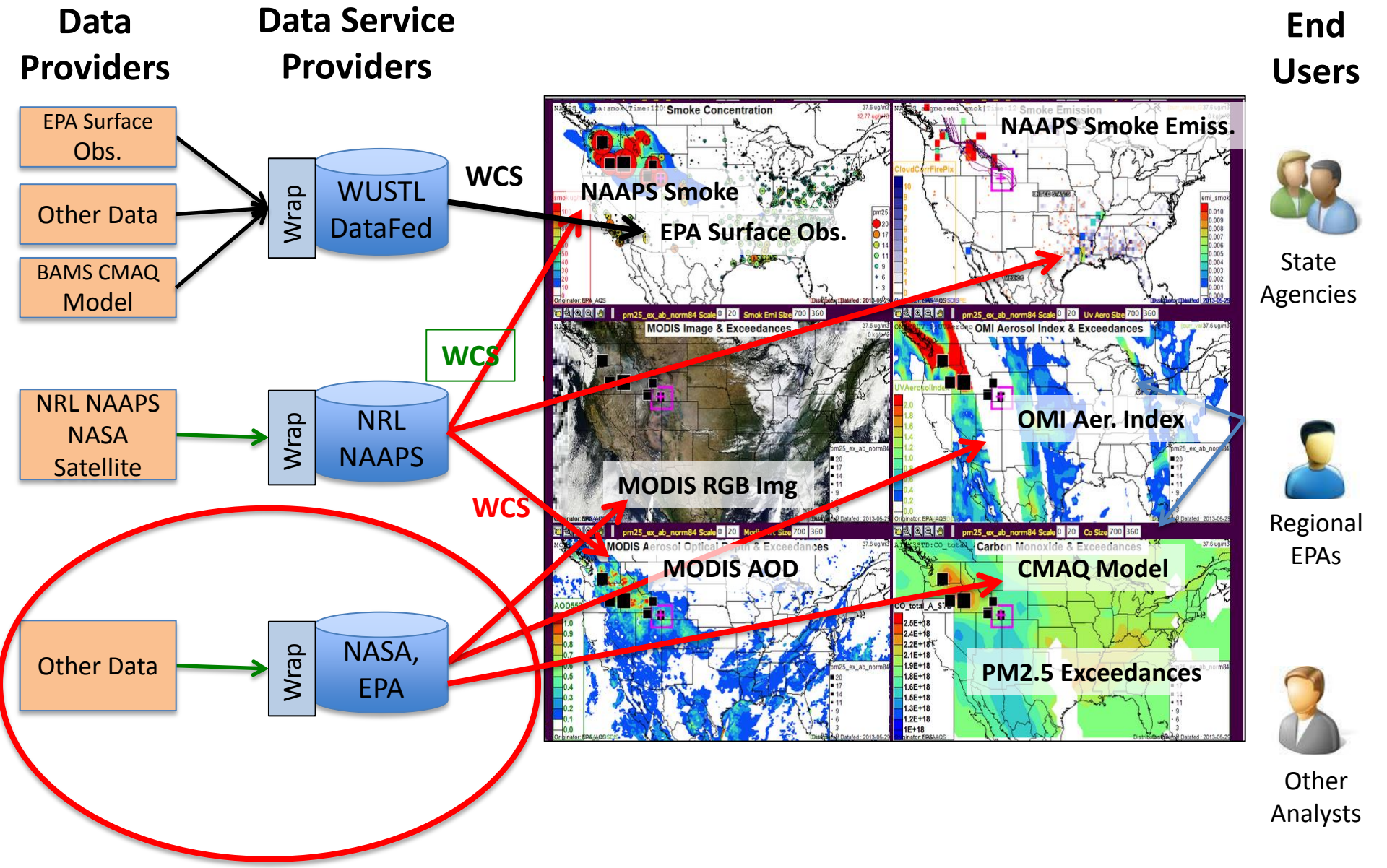
Planned EPA's Exceptional Event Decision Support System



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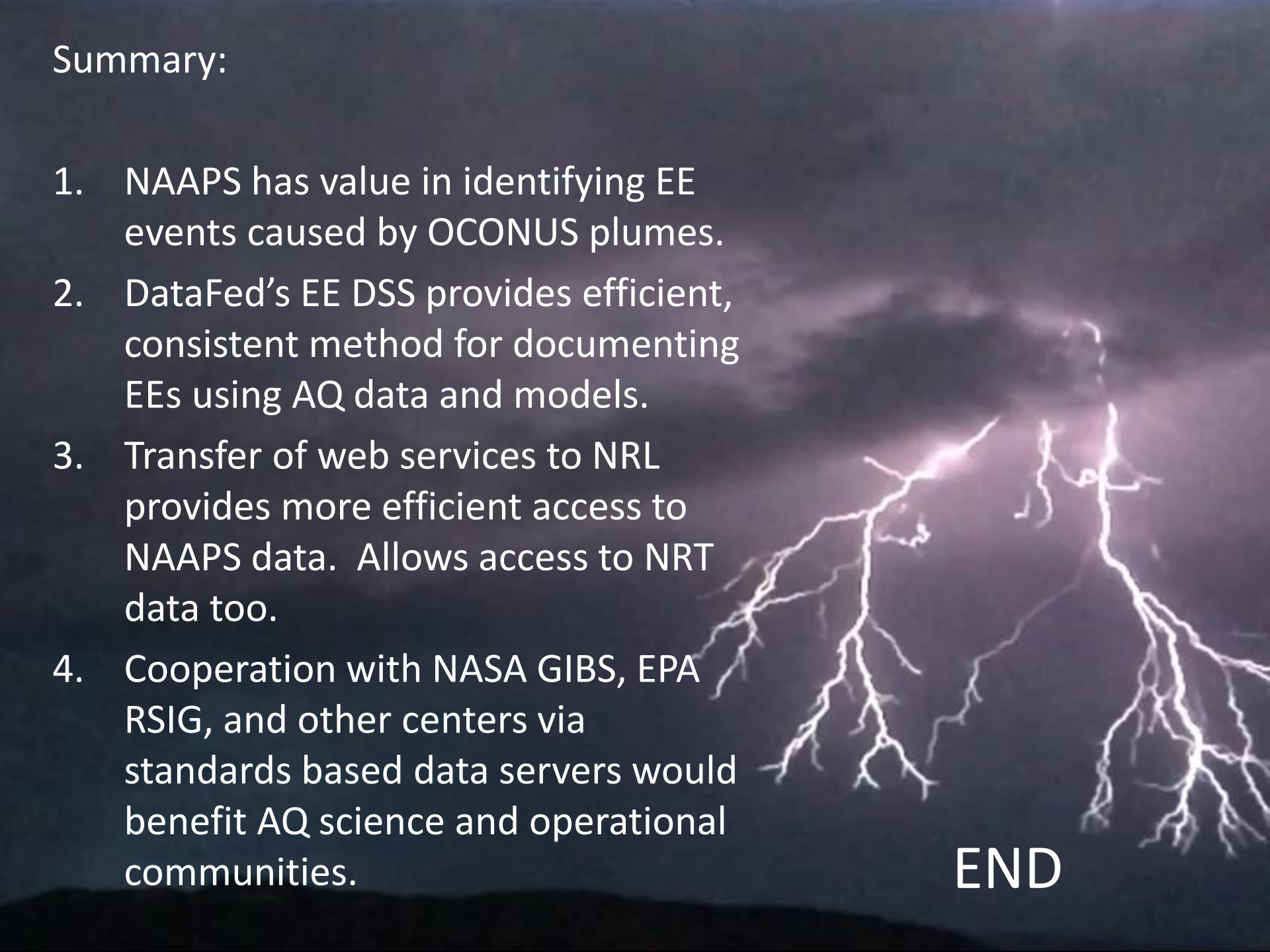
Summary:

1. NAAPS has value in identifying EE events caused by OCONUS plumes.
2. DataFed's EE DSS provides efficient, consistent method for documenting EEs using AQ data and models.
3. Transfer of web services to NRL provides more efficient access to NAAPS data. Allows access to NRT data too.
4. Cooperation with NASA GIBS, EPA RSIG, and other centers via standards based data servers would benefit AQ science and operational communities.



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