FASM Air Sensor Network Data Acceptance Protocol

Draft V1.0 (June 2026)

Overview

This document describes the requirements for acceptance and display of new air sensor networks onto the joint U.S. Department of Agriculture (USDA) Forest Service (USFS) – U.S. Environmental Protection Agency (EPA) AirNow Fire and Smoke Map (FASM). Interested data providers must follow this protocol to be considered for inclusion on the map. The core principle driving the decision to include a sensor network to FASM is whether the additional $PM_{2.5}$ data provide value (e.g. the data are reliable for real-time public health messaging and give additional information for areas that lack monitoring) to users during smoke episodes. A sensor network would be prioritized if it adds new insights or extends coverage to the map.

This protocol reflects the informational needs, analyses, and best practices gathered through pilot processes used to bring new air sensor network data onto the FASM. If new needs are identified while working with interested data providers, this protocol may be updated. EPA is committed to keeping potential data providers who have started this process informed about updates to the protocol.

Background

The Fire and Smoke Map (FASM) provides a trustworthy source of real-time particle pollution data (specifically fine particles or $PM_{2.5}$) to the public during wildland fire smoke events. The map brings together ground-based air quality observations of $PM_{2.5}$ from permanent monitors that report to AirNow, temporary monitors deployed by agencies for smoke events, and air sensor networks. During these fire and smoke events, specific features of the map are available to help with public response, including the display of hotspots showing where the active fire is located, smoke plume overlays, and smoke outlook statements. We are aware of other use cases of the FASM including tracking prescribed burns, visualizing inversions, and deciding whether or not to hold outdoor public events. Maintaining the user's trust is paramount to the FASM team and is heavily weighted when considering changes to the map and its data feeds.

The FASM currently displays select air sensor types that have undergone testing and evaluation using data analyses similar to those outlined in this protocol. The FASM team has reviewed this information to ensure accuracy, data timeliness, data quality control and assurance, and proper data transfer for incorporation into the FASM technical system. Adding sensor networks can help improve coverage on the FASM, but careful consideration is needed to ensure the sensor types and associated data meet requirements regarding sensor and network performance. This protocol is designed to lay out those specific requirements.

Data providers should establish data feeds that:

- Deliver accurate sensor data that has undergone documented quality assurance processes to the map;

- Serve real-time data (sub-hourly preferred) that is timely (delivered within 5 minutes of measurement), reliable (infrequent, small-scale outages), and stable (consistent methodology);
- Maintain a method for data retrieval, both current and historical, directly from the sensor network; and
- Monitor and evaluate the sensors' performance over time.

There are three levels of FASM products that sensors may be displayed on including the sandbox, limited access evaluation, or public versions. The sandbox is where testing occurs before the data becomes publicly available. The limited access evaluation version (future development) will provide data to air quality professionals (e.g., Air Resource Advisors) for use and further evaluation. The public map is publicly available on the web and designed for non-technical users.

Application Process & Requirements

The process for acceptance and display of new sensor networks on the FASM is briefly summarized in Figure 1. Estimated timing of this process will vary.

STEP 1: Express Interest and Initial Discussion	•Data provider expresses interest to the FASM team, provides basic information about their sensor network (Table 1), reviews requirements/data feed specifications/generic MTA, and engages in an intial discussion with the FASM team.
STEP 2: Approve Data Feed and Sign Material Transfer Agreement (MTA)	•Following review and acceptance of the data feed format, EPA, USFS, and the data provider will sign an MTA allowing use and display of data.
STEP 3: Submit a Complete Application	•Data provider submits an application outlining their analysis of the sensor and network performance and how the network meets the specified data requirements (Tables 2-4).
STEP 4: Display on FASM Sandbox for Testing	•Following review and informal acceptance of an application, setup will occur to feed data to the FASM sandbox for ongoing testing/review.
STEP 5: Display on Limited Access Evaluation Sites and Public Documentation	•After demonstrating adequate performance in the sandbox and following review and acceptance of QA and data processing documentation, data will be fed to limited-access evaluation sites (future development).
STEP 6: Periodic Review Including Updates	•The data provider will engage in periodic review of network performance and public documentation and will support FASM in the investigation of interesting observations/situations.
STEP 7: Sensor Network Displayed on Public FASM	•Following the completion of all steps and after demonstrating adequate performance, the data provider and the FASM team will agree upon a date to push the accepted sensor network to the public FASM.

Figure 1. ***Overview of the FASM Application Process***

These steps are described in more detail as follows:

(1) Express Interest and Initial Discussion

After reviewing this website, data providers can express interest by emailing the FASM team (firesmokemap@epa.gov). The email should contain basic information on their sensor and network as summarized in Table 1. It may be most efficient for the data provider to provide slides containing this information which can be incorporated into their complete application slide set (see example slides).

Table 1. ***Background Information Required for Email Expressing Interest***

Category/Attribute	Required Description	Notes & Requirements for Inclusion on the FASM	Corresponding Slide in Example Application
Hardware and Measurement Needs	• Hardware components (e.g., sensor make(s) & model(s)). • Basic operational needs (e.g., power – solar or wall, communication/connectivity – wi-fi, cellular).		Slide 8
Data Reporting and Retrieval	• Sampling and data reporting intervals. • Measurements and averages. • Data retrieval options (e.g., API with parameter list). • How power/communication interruptions influence the data. • Interdependencies.	• Sub-hourly sampling and data reporting intervals strongly preferred; < 15 min true averages* preferred. • Continuous** measurements and true averages are preferred. • Timely and reliable delivery required; delivered within 5 min of sampling; no frequent or widespread data outages expected. • Sensors must be reliable on their own with no dependence on neighboring sensors/reference monitors.	Slide 9
Network Location and Size	• A map of approximate sensor locations.	• Networks of > 100 sensors are preferred.	Slide 10

	• Size of the network and geographic extent.	• Networks that cover multiple states or larger geographic areas are preferred.	
Data Deserts Description	• Map of sensor coverage in locations that have little to no current FASM data (i.e., data deserts or areas with no observations within 5 miles). • Any information regarding where network sensors can provide coverage to the map where no coverage currently exists.	• Encourage additional coverage for areas with unique terrain (e.g. valleys). • More coverage of FASM data deserts is preferred. Data deserts with human occupants are a priority for public FASM's goals (i.e., sensors in remote locations without any human inhabitants even if a data desert may not be as helpful).	Slide 11
Typical Sensor Owners and Data Users	• Typical sensor owners. • Typical data users.		Slide 12

True averages*– reported averages consider data collected over the entire sampling period
Continuous** – samples without interruption

Data transfer is to occur using the FASM standard data transfer protocol (see FASM Standard Data Transfer Protocol document) that involves the creation, on the data provider side, of a web-accessible API with certain standards that can be routinely queried by FASM to obtain the data. Alternative data transfer methodologies can be used, provided they are mutually acceptable by FASM and the data provider, but these will require discussion and agreement by the FASM team. Incumbent on any system are data availability and uptime requirements as well as mechanisms to communicate both to machine systems and to personnel when there is an issue with the data transfer system being used. Applicants must provide documentation of their data transfer process as part of their initial submission.

After reviewing this initial submission, and based on available resources, the FASM team will schedule a follow-up call with the data provider. The FASM team will communicate any follow-up questions from the data provider's submission, discuss data feed specifications and requirements, and supply a draft Material Transfer Agreement (MTA) for the data provider to review (see Step 2). This primary interaction will help address data provider's questions prior to proceeding with the full application in Step 3.

In preparation for the follow-up call, data providers should prepare responses to any FASM team questions, review the draft MTA, review all the steps for the application process, and prepare a list of questions. Any questions about the application, data feed requirements, and MTA will be

addressed during or following the call and may help a data provider make an informed decision about proceeding with a complete application.

(2) Approve Data Feed and Sign Material Transfer Agreement (MTA)

Following review and acceptance of the data feed format, EPA, USFS, and the data provider will sign an MTA allowing use and display of data. A signed MTA is required before display of a sensor network on the FASM (sandbox, limited access evaluation, or public versions). An MTA covers the transfer of the sensor network data to the EPA, USFS, and their partners on the FASM and the USFS-led Interagency Wildland Fire Air Quality Response Program. The MTA provides for use of the data by the government, use on the public FASM website, but not distribution to third parties. It specifically covers attribution of the data and governmental limitations around endorsements of specific companies.

(3) Submit a Complete Application

The data provider will complete and document additional information on their network (Table 2) and their analysis of performance showing how the sensor and network meet the requirements detailed in Tables 3 and 4, respectively. We recommend that the information is provided in a slide format so that it can be easily presented to stakeholders as needed. An example slide set showing the level of detail requested is provided here. Once this documentation is provided to the FASM team, the team will conduct a technical review. Following review, an informal acceptance or rejection will be communicated by the FASM team to the data provider. An informal acceptance would allow the data provider to proceed to the next steps in the protocol. If the application is rejected, the data provider has the option to discuss with the FASM team, which may inform a future, updated application. Incomplete submissions cannot be reviewed. Note that depending on the goals of the data provider (e.g., not to be on public FASM) and the FASM team, step 4 may occur before step 3.

Table 2. ***Quality Assurance, Quality Control, and Correction Details***

Additional background information required to understand network and sensor performance.

Requirement Description	Requirement	Notes	Corresponding Slide in Example Application
Quality Assurance and Quality Control (QA/QC) Description	Applicants must document the data quality assurance and control applied.	• Consider how QA/QC is used in network setup, sensor design, and the data stream. • The QA/QC applied to the data presented in response to Tables 3 & 4 and should reflect procedures that can be applied to real-time data feeding the FASM.	Slides 14-16

Correction Description	Applicants must document the data correction methodology or equation.	• Do not provide confidential business information.
		• Describe the data correction approach (if applicable), including:
		  • Procedure used to correct the data including:
		  ▪ [a] how the data are corrected (e.g., manufacturer derived multilinear correction),
		  ▪ [b] variables used to correct the data (e.g., RH, T),
		  ▪ [c] where the correction variable(s) comes from (e.g., on-board RH sensor), and
		  ▪ [d] how the data are validated or calibrated (e.g., RH sensor is calibrated by the manufacturer).
		  • If the way data are corrected does not change and is static, record this information and any mathematical approaches used.
		  • If the way data are corrected changes or is a dynamic process, record the following:
		  ▪ (a) when the process changes,
		  ▪ (b) why the process changes,
		  ▪ (c) how/where changes are recorded, and
		  ▪ (d) how the correction method is validated.
		• Local, regional, or project specific corrections need to be validated over
			Slide 17

		the full range of concentrations, documented, and traceable.	
Correction Development Range	Documentation should include the range of conditions (e.g., concentration, T, and RH) and combination of conditions the data correction was developed over.	• Describe how the dataset used for correction development is related to the dataset used for evaluation. The evaluation dataset should be independent from the evaluation dataset. The same sites may be used but different distinct time periods. • For example, the data from X sites during year 202X was used for development and 202Y was used for evaluation but it would not be acceptable to use a random sample of hours from 202X to train and then the other random sample of hours to test. • Should include additional visualizations illustrating the interactive terms to show the range of conditions the correction was developed over (e.g., PM*RH = plot of PM vs. RH) if applicable.	Slide 18
<u>Performance</u>: Correction Extrapolation	Plot of the correction equation (sensor vs. reference) over a 0-1500 $\mu g/m^3$ concentration range.	• Use the range of possible outcomes for the full range of variables included in the correction methodology (e.g., -25 to 43°C temperature range, 5-100% relative humidity range).	Slide 19
Data Flow and Timing	Provide a diagram that illustrates the data flow, timing, and location of QA process steps.	• The diagram should describe 1) the data flow and timing to understand the time between the measurement and the final QC data point being available on the API, 2) what QC takes place on the device, and 3) what QC takes place on the cloud.	Slide 20

Table 3. ***Data Requirements to Evaluate and Present Sensor Performance from True Collocation Results.*** *Hourly data should be used for all calculations in this Table.*

Criteria Description	Requirement	Notes	Corresponding Slide in Example Application
Sites: True Collocation	Performance data is collected through collocation at an air monitoring site with federal equivalent monitors (FEMs) and/or temporary smoke monitors reporting hourly $PM_{2.5}$ average concentrations. Triplicate or greater sensors are collocated at a minimum of 2 sites in different climates.	• Applicants may need to coordinate with State, local, or Tribal air monitoring agencies to install sensors on-site or at the fenceline of the monitoring site for collocation. • Applicants may operate their own reference/FEM, but sufficient documentation detailing the data quality of the reference must be provided. • If the reference is a regulatory monitor, the existing network plan, quality assurance project plan (QAPP), and Standard Operating Procedures (SOPs) provide sufficient documentation. • Applicants should include a map of the testing locations and a table which summarizes the site name, location, number of sensors tested at the site, FEM and temporary smoke monitor reference type, collocation time frame, and range of $PM_{2.5}$ concentrations observed. • See "Air Sensor Performance Targets and Testing Protocols" for guidance on collocation testing protocols, metric calculations, target values, and recommended visualizations. • Optically based monitors (e.g., Teledyne T640 or T640x, Ambilabs Model 2WIN) may have increased bias at high concentrations (e.g., > 35 $\mu g/m^3$) and high concentration data should be used with caution for sensor correction/calibration and evaluation purposes. Beta Attenuation monitors (e.g., BAMs, E-BAMs) are more accurate at high concentrations but their hourly data has more noise at low concentrations (e.g., < 35 $\mu g/m^{3)}$.	Slides 22-23

		This may lead to better agreement between optical sensors and optical monitors at low concentrations than between optical sensors and non-optical monitors at low concentration. Resources: • FEM designated methods • Air Quality System (AQS) • AirNow Data Management Center (DMC) API • Temporary smoke monitors • AirData Interactive Map For assistance in identifying the State, Local, or Tribal air agency providing data, please contact the FASM team (firesmokemap@epa.gov).	
Sites: Range of Locations	Performance testing conducted at 4 or more locations for 3 months or more representing the full range of network coverage considering geographic extent, PM source types, and the concentration and climate range.	• More sites would be ideal for large networks. • Consider the current and future network extent when determining locations. • Performance should represent variable climate and concentration conditions, and pollutant sources experienced within the network. • Applicants must justify why the chosen locations represent the range of network coverage in terms of extent, PM source types, and concentration and climate range or why having less coverage is acceptable. • If sensors are approved based on data from only one part of the U.S. (e.g., West) sensors will not automatically be added from other parts of the U.S. if the network expands (e.g., Northeast). Further evaluation may be needed on the part of EPA or the data provider. Resource: • U.S. Climate Regions	Slides 23-25
Data Range: Smoke Concentration	Performance testing should include at least two real-world wood/wildland fire smoke events that last a day	• The FASM has many uses requiring accuracy in reporting all AQI categories, including very high smoke concentrations.	Slide 23-24

	or more and should include high concentrations (> 250 $\mu g/m^3$), though concentrations do not need to be that high for the full event.	• Applicants must report the maximum observed concentration and provide a bulleted list of high concentration events listing the site impacted, date range for the event, maximum concentrations observed during that event, and the smoke source (e.g., Canadian wildfires, local prescribed burn). • If more than 10 events were captured, it is sufficient to list the 10 that resulted in the highest observed concentrations. • The FASM or local media may be good sources of fire information.	
Data Range: Temperature	Preference for conditions to cover the range -25°C to 43°C.	• If geographic coverage is limited, data providers can include justification of a narrower range of temperatures. • If sensors are approved based on data from a limited range of environmental conditions, sensors will not automatically be added from other parts of the U.S. if the network expands. Further evaluation may be needed on the part of EPA or the data provider.	Slide 23, 25
Data Range: Relative Humidity (RH)	Preference for RH to cover the range 5-100%.	• If geographic coverage is more limited than nationwide, data providers can include justification of a narrower range of RH conditions. • If sensors are approved based on data from a limited range of environmental conditions, sensors will not automatically be added from other parts of the U.S. if the network expands. Further evaluation may be needed on the part of EPA or the data provider.	Slide 23, 25
Performance: Precision*	Standard Deviation (SD) ≤ 5 $\mu g/m^3$ or Coefficient of Variation (CV) ≤ 30%, met at all sites.	• Calculated separately for locations where sensors are operating in triplicate or larger numbers. Should be met at all collocation sites (a minimum of 2 sites in different climates).	Slide 26
Performance: Bias*	Slope = 1.0 ± 0.35; met for 90% of sensors.	• Applicants should include a scatterplot color-coded by testing site. Optionally: the plot may be dynamic, allowing	Slide 27, 28

		reviewers to select the sites individually. • The metric should be calculated individually for each sensor and met by 90% of sensors. • Optionally: The applicant can also include time series of the sensors collocated at each site.	
Performance: Linearity*	Coefficient of Determination (R^2) ≥ 0.70; met for 90% of sensors.	• Calculated individually for each sensor. Should be met for 90% of sensors.	Slide 28

Performance: Normalized Mean Bias Error (NMBE) at AQI Breakpoints	Absolute value of the NMBE must be ≤ 10% for all AQI breakpoints and 500 µg/m^3 or the absolute value of the MBE must be ≤ 1.5 µg/m3.	• Bin data within ± 20% of each current AQI breakpoint as measured by the reference and evaluate the NMBE.
		  • MBE= (Average sensor – average monitor)
		  • NMBE = MBE/average monitor
		
		Resources:
		• Current AQI breakpoints (AQS documentation)
		• Current AQI breakpoints (AirNow-Tech documentation)
			Slide 29

Performance: Influence of RH (optional)	Ratio of hourly sensor $PM_{2.5}$/monitor $PM_{2.5}$ in the 90-100% RH bin is not more than 2 times higher or lower than the ratio in the 0-30% RH bin.	• Provide a plot showing the ratio of hourly sensor/reference monitor $PM_{2.5}$ versus RH.	Slide 30

*See "Performance Testing Protocols, Metrics, and Target Values for Fine Particulate Matter Air Sensors: Use in Ambient, Outdoor, Fixed Site, Non-Regulatory Supplemental and Informational Monitoring Applications" for explicit formulas for calculating these metrics.

Table 4. ***Data Requirements to Evaluate and Present Network Performance from Nearby (up to 1000 m) Sensor-Monitor Pairs.*** All calculations in this table use NowCast AQI.

Criteria Description	Requirement	Notes	Corresponding Slide in Example Application
NowCast AQI Category Comparison	Network performance over the course of at least 1 full year should be evaluated by comparison with FEMs (permanent monitors) and temporary smoke monitors (optional but strongly encouraged) appearing on the FASM. Sensor-monitor pairs within no more than 1000 m in distance should be compared using the NowCast AQI categories.	• Analysis includes creation of a NowCast AQI agreement category plot comparing the NowCast AQI reported by sensor to the NowCast AQI reported by the FEM. • See FASM-sensor-AQI-analysis for guidance on network performance analysis, visualization, and interpretation. • Applicants must look at performance across the entire network and may look at comparison distances up to 1000 m. Larger distances can be biased by real differences in pollution, but smaller distances may not provide an adequate quantity of data for more sparse data sets. Applicants must balance higher accuracy at smaller distances with potentially more data available at larger distances. • Applicants must justify any sensor/monitor pairs (or data points) excluded from the analysis. • Note that AirNow and AQS latitude and longitude reported may not have perfect precision so some collocations may be slightly closer/further than the calculation implies. While most sites should be reported with accuracy to 3 m the coordinates are for the site and not for the individual monitors and a small number of sites may only be accurate to 10-100 m. Resources: • Current AQI breakpoints (AQS documentation)	Slides 34-37

		• Current AQI breakpoints (AirNow-Tech documentation) • NowCast Technical Paper • AQS data • AirNow DMC API • Temporary smoke monitors • FASM-sensor-AQI-analysis: R code to create visualization. • Air Sensor Network Analysis Tool (ASNAT): R shiny app that can also be used to generate NowCast AQI plots • Additional tools are under development to support this analysis.	
NowCast AQI Minimum Data per Category	At least 30 data points in each NowCast AQI category.	• Substantially more data in each category is preferred.	Slides 37, 38
NowCast AQI Category Agreement: of ± 3 or more categories by category	The number of data points showing a difference of ± 3 or more categories must be approximately zero % in each AQI category.	• Applicants may provide a justification or analysis if the data fail to meet this requirement.	Slides 37, 38, 41
NowCast AQI Category Agreement: of ± 2 categories by category	The number of data points showing a difference of ± 2 categories must be ≤ 1% in each AQI category.	• Applicants may provide a justification or analysis if the data fail to meet this requirement.	Slides 37, 38, 41
NowCast AQI Category Agreement: of ± 1 category by category	The number of data points showing a difference of ± 1 category must be ≤ 30% in each AQI category.	• Applicants may provide a justification or analysis if the data fail to meet this requirement.	Slides 37, 38, 41
NowCast AQI Category Agreement: correct category by category	The number of data points showing the correct category must be ≥ 70% for each category.	• Applicants may provide justification or analysis if the data fail to meet this requirement.	Slides 37, 38, 41
Overall NowCast AQI Category Agreement: of ± 3 or more categories	The number of data points showing a difference of + 3 or more categories must be approximately zero % summed across all AQI categories and the	• Applicants may provide a justification or analysis if the data fail to meet this requirement.	Slides 39-41

	number of data points showing a difference of –3 or more categories must be approximately zero % summed across all AQI.		
Overall NowCast AQI Category Agreement: of ± 2 categories	The number of data points showing a difference of + 2 categories must be ≤ 1% combined across all categories and the number of data points showing a difference of -2 categories must be ≤ 1% combined across all categories.	• Applicants may provide a justification or analysis if the data fail to meet this requirement.	Slides 39-41
Overall NowCast AQI Category Agreement: of ± 1 category	The number of data points showing a difference of + 1 category must be ≤ 5% combined across all categories and the number of data points showing a difference of - 1 category must be ≤ 5% combined across all categories.	• Applicants may provide a justification or analysis if the data fail to meet this requirement.	Slides 39-41

(4) Display on FASM Sandbox for Testing

After the technical review and informal acceptance of a complete application, discussion will occur between the FASM team and the data provider to review topics including, but not limited to, data transmittal issues, quality assurance questions or issues, documentation needs, and procedures and points of contact for communication and documentation of any future changes to the data feed and processing. During this step, an online, private, password-protected FASM "sandbox" test application showing the sensor network will be set up. This test application will be shared with the data provider and may be shared with the FASM team and partners for review and assessment. Applicants will keep the FASM team up to date on any changes made since the application was submitted (e.g., data processing, hardware).

(5) Display on Limited Access Evaluation Sites and Public Documentation

After demonstrating adequate performance in the FASM sandbox and following review and acceptance of quality assurance and data processing documentation, the data provider will be given a formal acceptance for inclusion on limited access evaluation sites. These sites may be operated by USFS or EPA and will be limited access to select groups of technical users (e.g., Air

Resource Advisors or State/Local/Tribal air monitoring agencies). At this time, documentation of the data correction and data processing, including QA methods, needs to be available on a public website for these users to easily access. Documentation for existing sensors (https://www.epa.gov/air-sensor-toolbox/technical-approaches-sensor-data-airnow-fire-and-smoke-map) can be used as an example of the level of detail desired. Additionally, the data provider's application slides should be finalized and available for public distribution.

(6) Periodic Review Including Documentation Updates

All sensor network data accepted for display on limited access evaluation sites (and Public FASM) will undergo a periodic review by the data provider through the lifetime of the sensor network's display on FASM and the limited access evaluation sites. The purpose of this review is to inform the FASM team of any changes to the data source since its initial acceptance. At a minimum, the review should provide information on the following:

- Updates to the sensors used by the data provider (e.g., hardware changes),
- Updates to the data provider's QA/QC,
- Updates to the data correction, and
- An AQI categorization analysis using the FASM-sensor-AQI-analysis, or similar code.

Ultimately, the periodic review serves to keep both parties up to date on issues related to accuracy, data transfer and reliability, and communication, while ensuring that data displayed on the FASM are trustworthy. The timing of the periodic review will be determined in consultation with the FASM team (e.g., checks may be performed soon after the beginning of wildfire season, within the season as issues are identified, after wildfire season, and/or when changes to the AQI breakpoints occur). At a minimum, data providers should expect to perform one review per year, particularly after the wildfire season to review their network's performance. Additional issues may result in additional, periodic review. Data providers will engage in on-going support of the FASM team with investigations of interesting observations, situations, or events. Additional tools are under development to support a more automated periodic review.

The data provider should be prepared to answer questions related to their sensor and network performance analyses from air agency partners or the public. Even after inclusion of a sensor network onto the limited access evaluation sites and Public FASM, the FASM team reserves the right to perform its own quality control and assurance checks, to identify problematic sensors, to take actions to limit the display of potentially inaccurate data, and to control the overall real-time decision-making over the FASM data streams.

(7) Sensor Network Displayed on Public FASM

Following successful completion of the previous steps and demonstrating adequate performance, the parties will agree upon a timely date to push the new version of the Public FASM that includes the accepted sensor network to the public website.

Contact Information & Acknowledgements

To contact the FASM team, email firesmokemap@epa.gov.

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Acronyms and Abbreviations

API	Application Programming Interface
AQI	Air Quality Index
AQS	Air Quality System
ASNAT	Air Sensor Network Analysis Tool
BAM	Beta Attenuation monitor
°C	Degrees Celsius
CV	Coefficient of Variation
DMC	(AirNow) Data Management Center
E-BAM	Environmental Beta Attenuation monitor
EPA	U.S. Environmental Protection Agency
FASM	Fire and Smoke Map
FEM	Federal Equivalent Method
MBE	Mean Bias Error
MTA	Material Transfer Agreement
NMBE	Normalized Mean Bias Error
PM	Particulate Matter
$PM_{2.5}$	Fine Particulate Matter
PM_{10}	Particulate matter with aerodynamic diameter ≤ 10 µm
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
R^2	Coefficient of Determination
RH	Relative Humidity
SD	Standard Deviation
SOP	Standard Operating Procedure
T	Temperature
U.S.	United States
USDA	U.S. Department of Agriculture
USFS	USDA Forest Service
µg/m3	Micrograms per Cubic Meter

Resources

1. Performance Testing Protocols, Metrics, and Target Values for Fine Particulate Matter Air Sensors: Use in Ambient, Outdoor, Fixed Site, Non-Regulatory Supplemental and Informational Monitoring Applications.
2. FEM designated methods
3. Air Quality System (AQS)
    a. Refer to the AQS Primer document for an overview of the structure and contents of the EPA's Air Quality System (AQS) database. This document provides information about the availability of data, data timeliness, the geographic and temporal scope, and how it's organized and processed. Note: EPA regulations give reporting organizations (states, tribes, and local agencies) 90 days following the end of a calendar quarter to submit their data to AQS. For Q4 data, reporting organizations have until the end of Q1 (March 31) in the next year to submit to AQS. Agencies also have until May 1 to certify their data for the previous year.
4. AirNow Data Management Center (DMC) API
5. The NowCast for PM2.5 and PM10
6. Temporary smoke monitors
7. AirData Interactive Map
8. U.S. Climate Regions
9. Barkjohn et al 2022
10. Barkjohn et al 2025
11. FASM-sensor-AQI-analysis
12. NowCast Technical Paper
13. Air Sensor Network Analysis Tool

Appendix A: Document Changelog

Version	Date	Summary of Changes
1.0	June 2026	Initial release.