Alaska Community Air Sensor Network
1st Interim Report

State of Alaska
Department of Environmental Conservation
Division of Air Quality

333 Willoughby Ave. Suite 800
PO Box 111800
Juneau, Alaska 99811-1800

December 2024

1. Executive Summary

The Alaska Department of Environmental Conservation's Air Monitoring and Quality Assurance Program is in the process of establishing a community-based ambient air quality sensor network using QuantAQ Modulair™ sensor pods. This sensor network is intended to provide a network of publicly available air quality data across Alaska, to help understand impacts and sources of air pollution on historically underserved communities, and to make the data easily available to the communities themselves. This project aims to install sensors in communities throughout Alaska, and provide outreach, education, and assistance to the communities with sensors. This interim document records the progress of the low-cost air sensor program during the 6-month period between October 2023 and March 2024.

Table of Contents

List of Figures

Abbreviations, Terms, and Definitions

Abbreviation/Term	Definition
AMQA	Air Monitoring and Quality Assurance Program of DEC. Responsible for coordinating all aspects (quality assurance, data collection, and data processing) with respect to ambient air quality and meteorological monitoring of the DEC Division of Air Quality.
AQI	Air Quality Index. The AQI is an index for reporting daily air quality and what associated health concerns the public should be aware of. The AQI focuses on health effects that might happen within a few hours or days of breathing polluted air. The AQI rates the air quality in 6 steps from good to hazardous.
AQMesh	AQMesh brand ambient air quality sensor that monitors particulate matter and gaseous pollutants, meteorology is optional. Distributed by Ambilabs in the United States.
ARP	American Rescue Plan
°C	Degrees Celsius
CAA	Clean Air Act
Criteria Pollutant	Any air pollutant for which the EPA has established a National Ambient Air Quality Standard for regulation under the Clean Air Act.
CO	Carbon monoxide
DEC	Alaska Department of Environmental Conservation. The department of state government with primary responsibility for management and oversight of provisions of the Clean Air Act, including EPA's National Ambient Air Quality Standards.
EPA	U.S. Environmental Protection Agency
FEM	Federal Equivalent Method
FNSB	Fairbanks North Star Borough
FRM	Federal Reference Method
LCS	Low-cost sensor
$\mu g/m^3$	Microgram per cubic meter
MOA	Memorandum of Agreement
MODULAIR™	Ambient air quality sensor by QuantAQ that monitors particulate matter and gaseous pollutants, meteorology is optional.
NAAQS	National Ambient Air Quality Standards
NO	Nitric oxide
NO_2	Nitrogen dioxide
OPC	Optical particle counter
O_3	Ozone

%	Percentage
+/-	Plus or minus
PM_{10}	Particulate matter less than or equal to 10 microns in size.
$PM_{2.5}$	Particulate matter less than or equal to 2.5 microns in size.
ppb	Part per billion
PSD	Prevention of Significant Deterioration
QA	Quality Assurance
QAPP	Quality Assurance Project Plan. A plan which identifies data quality goals and identifies pollutant-specific data quality assessment criteria.
QC	Quality Control
QuantAQ	Manufacturer of MODULAIR™ ambient air quality sensor
R^2	Coefficient of determination (R-squared)
RH	Relative Humidity
SIP	State Implementation Plan
SLAMS	State and Local Monitoring Station. The SLAMS network consists of roughly 4000 monitoring stations nationwide. Distribution depends largely on the needs of the State and local air pollution control agencies to meet their respective SIP requirements. The SIPs provide for the implementation, maintenance and enforcement of the NAAQS in each air quality control region within a state. The State of Alaska monitoring network currently has eight SLAMS sites for CO and PM.

2. Introduction

Air pollution is broadly defined by the World Health Organization as any kind of "chemical, physical, or biological agent" that contaminates and alters the natural composition of the atmosphere[1]. Air pollution poses a serious risk to the health of humans and the environment. Regulatory efforts typically focus on fuel quality and emissions standards for vehicle engines and industrial facilities, as these are the primary sources of anthropogenic air pollution. The goal of these regulatory efforts is to develop practical standards, limits, and enforcement mechanisms that maintain public health and welfare.

In time, the federal response to air pollution expanded in scope and function, with the passage of the Clean Air Act (CAA) in 1963 and the formation of the U.S. Environmental Protection Agency (EPA) in 1970. That same year, the CAA was expanded to include the National Ambient Air Quality Standards (NAAQS), which sought to aggressively reduce air pollution with strict regulations and efficiency standards on industrial processes and combustion engines. The NAAQS are applied geographically, with areas either attaining the specified air quality standards or not, referred to as attainment and non-attainment areas, respectively. As states and the EPA developed a technical understanding of their regional air quality and emissions sources, state-level regulations and implementation plans (SIPs) were developed. In Alaska, this manifests as updates to regulations under Title 18, Chapter 50 of the Alaska Administrative Code dealing with Air Quality Control, which came into effect in 2011, with amendments and expansions added over the following decade.

The Air Monitoring and Quality Assurance Program (AMQA) in the Alaska Department of Environmental Conservation (DEC) Air Quality Division operates and maintains the State's air monitoring network; regulatory monitoring sites are established in the Municipality of Anchorage and Matanuska Susitna (Mat-Su) Borough, the Fairbanks North Star Borough (FNSB), and the City and Borough of Juneau. The regulatory network uses Federal Reference Method (FRM) and Federal Equivalent Method (FEM) instrumentation to monitor air pollutants; FRM and FEM instruments can be very expensive, follow strict performance requirements, are used to make regulatory decisions, and are considered the gold standard for air quality monitoring. Low-cost sensors (LCS) are non-regulatory instruments, often much cheaper than FRM/FEM instruments, and are generally easier to operate than regulatory-grade instruments. LCS technology is a rapidly evolving field, with new sensors introduced on a regular basis. Because of this, capabilities of the sensors and quality of the data is variable.

Alaska's ambient air quality issues focus on particulate matter. Summertime wildland fires, road dust, and wood stove emissions are critical issues for Alaskan air quality; these sources may produce high levels of particulate pollution, which, in combination with lower access to medical resources, have been linked to higher levels of respiratory illnesses in rural communities and Alaska Native populations[2]. Thus, there is strong demand and critical need for improved air quality monitoring in rural Alaskan communities. To address this, DEC has established a network of low-cost air monitoring sensors in communities across Alaska.

---

[1] https://www.who.int/health-topics/air-pollution

[2] Nelson et al., Environmental Health Consults in Children Hospitalized with Respiratory Infections (April 2021)

1. Goals of the Study

The goal of DEC's community-based air quality sensor network is to provide a baseline of non-regulatory air quality data to communities not covered by the State's regulatory monitoring network, to help understand the impacts and sources of air pollution on historically underserved communities, and to make that information easily available to the communities themselves. This network is composed of multiple low-cost air monitor pods, each equipped with multiple sensors to measure a variety of air pollutants. The sensors are distributed across the state to cover as many people and be as representative as possible. In total, DEC has 55 QuantAQ Modulair™ pods; 40 are intended for community deployments, six are for quality assurance (QA) purposes, and nine are reserved for back-ups and replacements[3].

The project is partially funded through a three-year American Rescue Plan (ARP) grant that start in spring 2023. The anticipated data users include community leaders, and community members including concerned adults with health conditions, those who are elderly or pregnant, DEC AMQA, and students performing air quality research. By engaging with tribes and rural communities, DEC intends to continue developing a network of ambient air monitoring sensors to provide air quality data that serves Alaska residents. In addition to public awareness, DEC's ambient air monitoring contributes to our knowledge of local and regional differences in air quality and helps Alaska residents understand changes in their local air quality. This interim document records the progress of the AMQA low-cost air sensor program during the six-month period between October 2023 and March 2024.

2. Methods

2.1 Sensor Technology

While low-cost air monitors are not as robust or accurate as FRM and FEM air monitoring instruments, they are reliable enough to be used in a non-regulatory capacity for measuring local air quality. In the context of DEC's air monitoring project, low-cost air quality monitors are being purchased and deployed in communities across the state. The term 'low-cost' is a relative term but refers to relatively new air sensor technology that is portable and generally less than $20,000; in comparison, regulatory-grade instruments can range in cost from $25,000 to $100,000.

DEC's community-based sensor network currently uses the QuantAQ Modulair™. AQMesh sensors were used in the network previously but have been phased out due to high maintenance costs, prolonged downtime when a sensor needed factory maintenance in the United Kingdom, and overall poor data capture. The QuantAQ Modulair™ pods measure particulate matter ($PM_{2.5}$ and PM_{10}), carbon monoxide (CO), nitric oxide (NO), nitrogen dioxide (NO_2), and ozone (O_3), as well as temperature (°C) and relative humidity (RH). The QuantAQ Modulair™ pods take measurements every 5 seconds and reports 1-minute averages.

[3] Low-cost sensors are not as reliable as regulatory sensors. To have fewer data gaps in the low-cost sensor network, it is vital to have replacement sensors on hand for when a deployed sensor needs to be swapped out of the field.

For gaseous measurements, QuantAQ Modulair™ pods utilize Alphasense electrochemical sensors and QuantAQ proprietary data processing algorithms. The surface of the electrochemical sensor reacts with the target gas and produces an electrical output that corresponds to the concentration of gas present. The sensors have an electrode that measures the reaction from environmental effects that subsequently mitigates the effects of temperature and humidity on the resultant gas concentration. QuantAQ utilizes these two outputs in their algorithm to produce a gas concentration measured in parts per billion (ppb).

To measure particulate matter, the QuantAQ Modulair™ pods utilize a nephelometer (Plantower PMS5003) and an optical particle counter (OPC) (Alphasense OPC-N3) for particulate matter measurements. An OPC detects and sizes particles by measuring the amount of light scattered by individual particles as they pass through a beam of light. The nephelometer detects particles by measuring the total amount of light they scatter. When used together, they provide a greater measurement range than either device individually. The QuantAQ Modulair™ does not utilize a heated inlet, but data is corrected for environmental factors during automated data processing by use of mathematical correction factors that account for density of water, density of the aerosol, and water activity (quantified by the sensor's relative humidity metric).

2.2 Siting Criteria

Installation sites for the QuantAQ Modulair™ pods must meet the siting criteria for optimal sensor performance, including being at least 10 feet away from air outlets, fans, exhaust ports, and pollutant sources including chimneys, smoking areas, and roads or parking lots with frequent vehicle idling. The QuantAQ Modulair™ intake port is positioned on the bottom of the device, and requires 180° of unobstructed air flow, necessitating installation at least 10 feet off the ground. The QuantAQ Modulair™ communications relies on the AT&T and T-Mobile cellular networks, which is suitable for the more urbanized regions of Alaska but not in many rural parts of the state. Alternative sensors technologies are being explored that work with other cellular networks, or with satellite and Wi-Fi.

3. Quality Assurance

DEC employs a number of quality assurance strategies to ensure the data collected is valid and representative. DEC's Community-Based Air Sensor Network Quality Assurance Project Plan (QAPP)[4] provides details on the QA and quality control (QC) procedures. Prior to deployment, all sensors undergo a collocation study at a DEC regulatory site. Data from the collocation period is analyzed for accuracy and precision of the pods. Refer to Section 3.1 for further information on collocation procedures.

[4] DEC, Quality Assurance Project Plan, Community-Based Air Sensor Network (December 2023). https://dec.alaska.gov/air/air-monitoring/guidance/quality-assurance-plans/

3.1 Collocation

Before deployment, the LCS are collocated with FRM or FEM sensors at one of DEC's regulatory sites for a minimum of 10 days. A collocation is defined as "the process by which a reference monitor, FRM/FEM, and non-reference monitor (sensor) are operated at the same time and place under real world conditions for a defined evaluation period. Sensor performance can be evaluated, and data accuracy improved by comparing sensor data with reference monitor data"[5] .

The data from the LCS is then compared to the state regulatory sensor data and processed with a statistical regression analysis to determine its accuracy and precision. The regression analysis generates an R^2 value that quantifies sensor performance and can be compared against a minimum threshold. A LCS will only be deployed in a community after it has undergone a collocation period and has met the minimum threshold of accuracy and precision as determined by the QA/QC detailed in the project QAPP.

These pods have undergone a collocation period, and the collocation data is being analyzed to determine sensor accuracy and potential correction factors. Pods that meet accuracy thresholds outlined in the project QAPP were allocated to a potential community and prepared for deployment. Sensors that are experiencing data quality issues or mechanical issues can be brought back to a DEC regulatory site for another collocation period to assess its performance. Collocations are also performed on all LCS following any major maintenance or repairs. Please refer to Section 3.2 for information on correction factors.

3.2 Correction Factors

Following the collocation period, the LCS data is evaluated to determine its accuracy compared to an FRM/FEM instrument. Using scatter plots, the reference data and LCS data can be compared for agreement or bias. If the comparison shows bias, a correction factor may be required to correct the LCS sensor's data. The EPA's Enhanced Air Sensor Guidebook[6] provides directions on the basic regression equation. DEC is in the process of determining correction factors for the QuantAQ Modulair™ pods, as the collocation data shows bias between the QuantAQ Modulair™ pods and the FRM/FEM instruments. DEC has found that the QuantAQ Modulair™ pods experience a degradation in data when temperatures dip below freezing and is investigating if the correction factor would also need to incorporate dew point and seasonality. DEC continues to analyze collocation data to develop correction factors, though this is very time consuming and there is limited guidance available from the manufacturer or other sources.

3.3 Data Collection

Data generated by the QuantAQ Modulair™ pods are reported to the QuantAQ cloud. Data is then requested from the QuantAQ cloud and collected into AirVision (Agilaire LLC), a data acquisition system used by DEC. Using AirVision, DEC can house and manage the LCS data. AirVision automatically flags or

[5] https://www.epa.gov/air-sensor-toolbox/air-sensor-collocation-instruction-guide
[6] EPA, The Enhanced Air Sensor Guidebook (September 2022)

invalidates erroneous or suspect data points and performs automatic data averaging from one-minute data points to hourly data points.

DEC's ambient air quality monitoring data is publicly accessible, with data presented on DEC's Air Quality Index (AQI) online map[7]. The AQI is an EPA-developed tool that displays outdoor air quality based on six color-coded categories: the scale ranges from green for "good" air quality to maroon for "hazardous" air quality. Furthermore, DEC presents a sample of the air quality monitoring data and project progress to participating communities in a quarterly video call meeting. Individual contacts from participating communities are encouraged to ask questions about all aspects of the project, including the sensor technology, planned installations, local air quality, and state and federal laws and regulations. More information on community outreach can be found in Section 3.6.

3.4 Locations and Partners

To build the community-based air monitoring network across Alaska, DEC partners with rural and tribal communities, as well as borough officials, government staff, and private citizens. DEC aims to create a network that covers as many people as possible, throughout communities that do not have access to local air quality information. Much of the state is not covered by cellular networks or the cellular networks available are not compatible with the QuantAQ Modulair™ pods. Because of this, DEC has had to find alternative communities where the correct cellular service is available. Further discussion on cellular connectivity issues can be found in Section 4.1.

This process begins with DEC reaching out to public officials or residents in a community and briefly describing the ambient air monitoring project. If the community contact consents to hosting an air monitoring pod at some appropriate location on their facilities or properties, they are sent a package of documents including a one-page summary of the project, siting criteria for mounting the sensor, and a memorandum of agreement to formalize approval for hosting a sensor. Once an appropriate site has been identified (typically on a wall or support column of a public building such as a library, administrative office, or community gathering location) and the formal agreement document has been signed, DEC employees will usually travel to the community to meet the contact in person and install the sensor. On occasion, a sensor may be shipped out to a community and installed by the contact, using the siting criteria document and technical guidance from DEC employees.

3.5 Deployment History

Previously, DEC initiated the LCS project by installing AQMesh pods in Bethel, Fairbanks, Juneau, Homer, Ketchikan, Kodiak, Kotzebue, Nome, Seward, and Sitka. Although their data performance was acceptable, the AQMesh sensors were difficult to repair and were phased out in preference for the QuantAQ Modulair™. During the interim period described in this report (October 1, 2023, to March 31, 2024),

[7] https://dec.alaska.gov/air/air-monitoring/responsibilities/database-management/alaska-air-quality-real-time-data/

AMQA staff prioritized the installation of QuantAQ Modulair™ pods in new communities as well as replacements for communities that had an AQMesh sensor.

Table 1. Deployment History from October 1, 2023 to March 31, 2024

Sensor ID	Community	Install Date	Notes
QuantAQ 471	Anchorage	10/3/2023	Permanent monitor at Garden regulatory site.
QuantAQ 444	Tok	10/26/2023	
QuantAQ 447	Delta Junction	11/2/2023	
QuantAQ 443	Fairbanks	11/20/2023	Permanent monitor at NCore regulatory site.
QuantAQ 455	Juneau	1/29/2024	Swap out AQMesh with QuantAQ
QuantAQ 456	Juneau	1/29/2024	Swap out AQMesh with QuantAQ
QuantAQ 450	Haines	1/30/2024	
QuantAQ 452	Hoonah	1/30/2024	
QuantAQ 449	Ketchikan	1/31/2024	Swap out AQMesh with QuantAQ
QuantAQ 453	Skagway	1/31/2024	
QuantAQ 451	Wrangell	2/1/2024	
QuantAQ 448	Goldstream	2/20/2024	Swap out AQMesh with QuantAQ
QuantAQ 445	Badger	3/21/2024	
QuantAQ 454	Sitka	3/21/2024	Swap out AQMesh with QuantAQ

3.6 Community Outreach

Part of the process of establishing a state-wide low-cost air sensor network involves making contact with rural communities and engaging local residents in constructive and mutually beneficial ways. Community members may be involved to some degree in negotiations over community participation, site selection, sensor installation, and on-going sensor maintenance. During community visits and sensor installation, the DEC team can provide educational materials (such as fliers, pamphlets, and brochures) on air pollution, safe wood burning and stove use, dust control measures, and other air quality topics. Our community contacts often become an informal point person for questions from their community members about the air monitoring program or local air quality conditions. These efforts help build trust with Alaska residents.

DEC hosts quarterly community engagement calls, where contacts in participating communities are invited to a presentation with updates on the strategies and goals of the project, the LCS technology being used or considered, an updated history of pod deployments with maps and photos of locally installed pods, and a summary of important or interesting data trends seen over the previous three months. This information is particularly important for communities that regularly or seasonally experience poor air quality due wildland fires, road dust, or combustion emissions such as wood-fired stoves used in winter or idling cruise ships in summer.

In addition to these outreach efforts, DEC maintains a publicly accessible map that displays real-time air quality data throughout Alaska (https://dec.alaska.gov/air/air-monitoring/responsibilities/database-management/alaska-air-quality-real-time-data/). The website displays the current AQI values and the past

12 hours of data points for all sensors in the community-based sensor network as well as DEC's regulatory network.

DEC has found fostering community engagement and feedback to be challenging. The quarterly community engagement calls often have low attendance and feedback is sparse. DEC would like to provide meaningful data analysis and data visualizations to communities in the network. DEC will continue to publish semiannual data reports and data analysis/visualization tools on its website, as well as prepare and present data findings at air quality conferences. Community members can request data from DEC at any time.

4. Interim Results

4.1 Challenges and Successes

The DEC ambient air quality monitoring program initially used AQMesh pods but was in the process of transitioning to the QuantAQ Modulair™ pods at the beginning of this interim period. The AQMesh pods are prone to malfunctions and other technical issues, and support and repair services are logistically burdensome. Malfunctioning AQMesh pods must be sent back to the parent company in the United Kingdom, which increases costs and sensor down-time considerably. Due to these issues, DEC has adopted the QuantAQ Modulair™ pod, which measures a diverse range of pollutants and offers greater data resolution than the AQMesh sensor. In addition, QuantAQ is a U.S.-based company that can provide live technical support calls and sensor repair services in a timely manner.

The QuantAQ pods transmit data over the AT&T and T-Mobile cellular networks. Many rural communities, and much of the interior of the state, do not have cellular network coverage or the type of cellular network that QuantAQ Modulair™ pods; DEC has had to find alternative communities where QuantAQ Modulair™ pods can connect to the cellular network. DEC is currently researching pods that use different methods of data transmission, such as Wi-Fi or satellite communications. Efforts to identify and purchase alternative air monitoring pods are ongoing.

Another challenge DEC has faced is troubleshooting sensors in remote communities. Due to the vast size of Alaska and road-system limitations, troubleshooting sensors in rural communities can take much longer than troubleshooting sensors on the road-system. The community contacts often wear many hats and are busy with their day-to-day duties and cannot assist with troubleshooting activities.

4.2 Data Findings

Communities in the community-based sensor network are organized according to general ecoregion. These include the Interior, Western, Southeastern or Panhandle, and South Central ecoregions. By grouping sensors into ecoregions, DEC can identify weather and pollution trends affecting one or several ecoregions. Data from sensors can be presented in a time-wise manner, to illustrate changes in pollutant concentration over the course of a day, week, month, and year. The following graphs and figures are all generated with QuantAQ Modulair™ data and represent a sampling of the different data visualizations used during the June 11, 2024 quarterly engagement call.

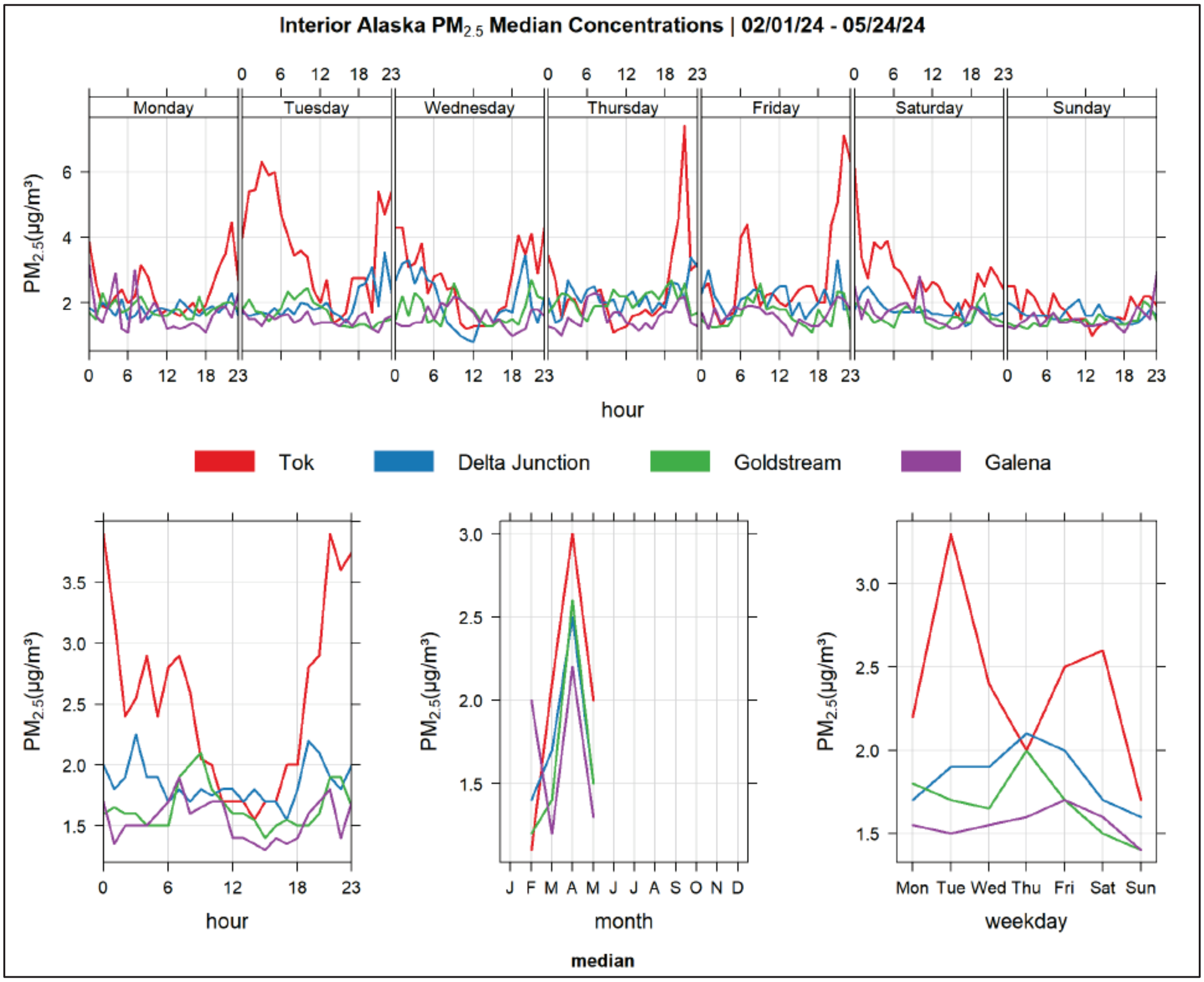

Figure 1. $PM_{2.5}$ Concentrations in the Interior Ecoregion (2/1/2024 – 5/24/2024)

Figure 1 depicts multiple time series and diurnal graphs of $PM_{2.5}$ concentrations in Tok, Delta Junction, Goldstream Valley, and Galena, from February 1, 2024 through May 24, 2024. These interior communities share a similar latitude, experience similar seasonal weather patterns, and belong to the same general temperate continental ecoregion. Data trends displayed in the graphs show a daily spike in $PM_{2.5}$ concentrations in the early mornings and evenings, when residents are heating their homes; the $PM_{2.5}$ concentrations tend to dip during the day when residents are at work. Overall, $PM_{2.5}$ concentrations trend very low, rarely exceeding six µg/m^3.

The top graph shows the diurnal cycle of the median concentration for the roughly three months period between Feb 1 and May 24, 2024, separated by the day of the week. Elevated values compared to the rest of the time seem to occur in the early morning and late afternoon hours. Weekend concentrations seem overall lower. The graph in the lower right shows the diurnal cycle for all days, while the lower middle graph shows the median monthly concentrations. The bottom right graph shows the daily median values.

As can seen in all graphs, median concentrations during this period are typically higher in Tok than in the rest of the Interior communities. Also the diurnal cycle is more pronounced in Tok for the 3 months shown.

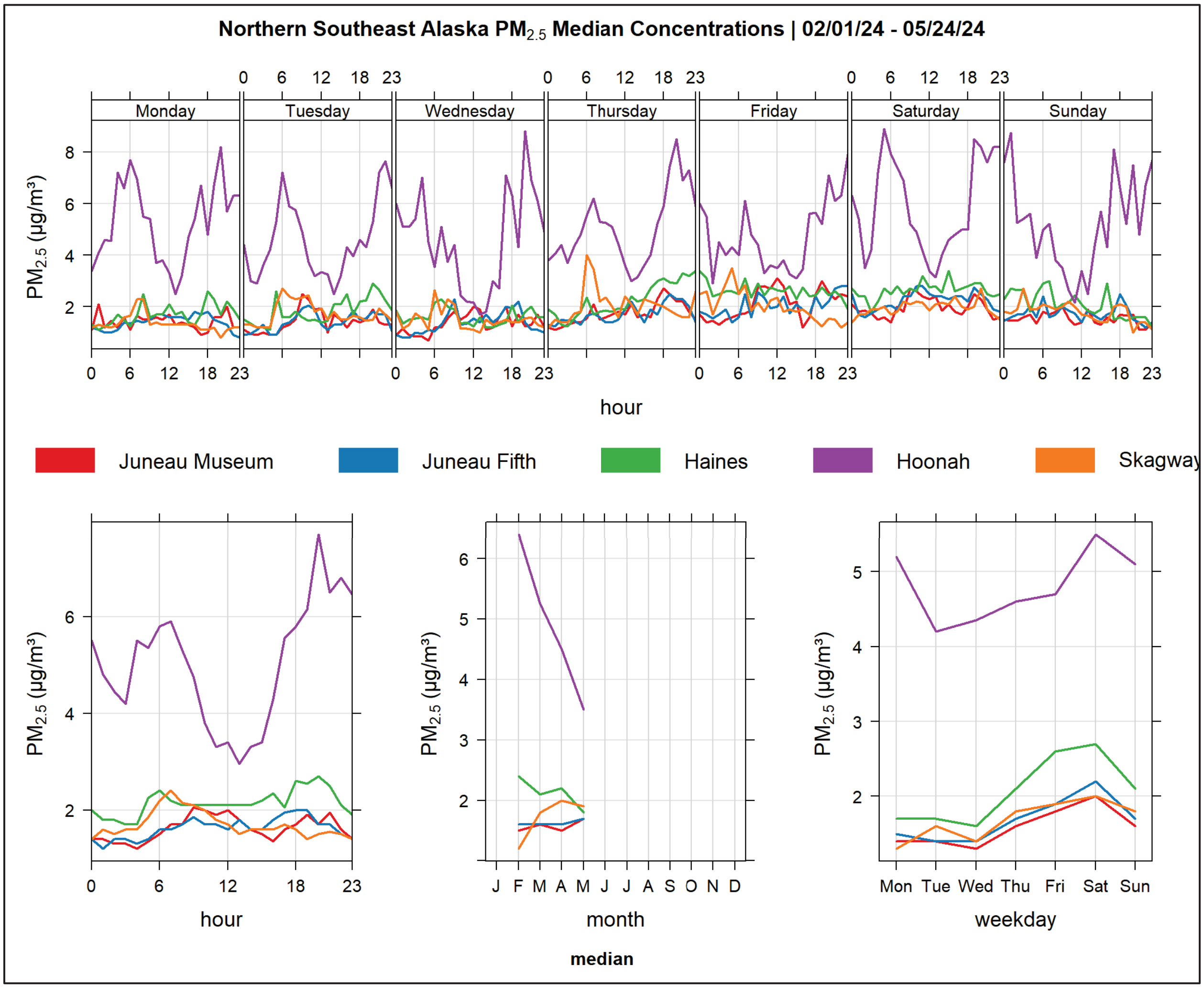

Figure 2. $PM_{2.5}$ Concentrations Northern Southeast Ecoregion (10/3/2023 – 5/24/2024)

Figure 2 depicts multiple time series and diurnal graphs for $PM_{2.5}$ concentrations in the northern panhandle communities of Juneau, Haines, Hoonah, and Skagway, from October 3, 2023, to May 24, 2024. The above plots show that all communities experience a rise in $PM_{2.5}$ concentrations over the week, peaking on Saturdays suggesting behavioral patterns, like for example residents being home and heating their homes more on the weekends. The $PM_{2.5}$ concentrations tend to be slightly elevated in the early morning and evenings; the Hoonah sensor strongly shows this daily trend.

The Hoonah sensor has reported consistently higher $PM_{2.5}$ levels than other northern panhandle communities in the winter and early spring; the community contact stated that there are multiple buildings with woodstoves near the sensor and on days with little or no wind, the woodstove smoke lingers in the area longer. Though the Hoonah sensor's readings are elevated in comparison to the Juneau, Haines, and Skagway sensors, the hourly $PM_{2.5}$ values rarely exceed seven µg/m³.

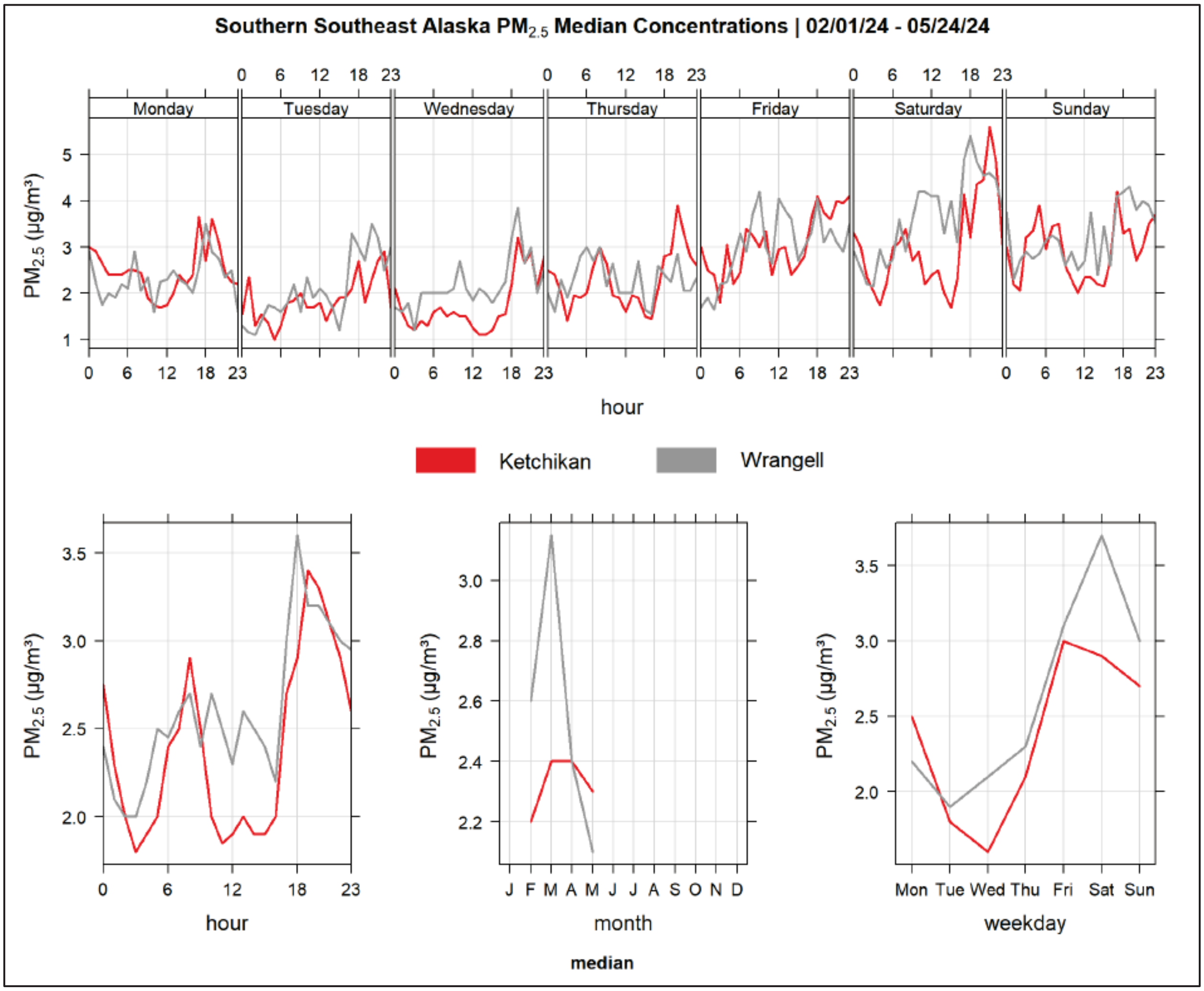

Figure. 3. $PM_{2.5}$ Concentrations Southern Southeast Ecoregion (2/1/2024 – 5/24/2024)

Figure 3 depicts multiple time series and diurnal graphs for $PM_{2.5}$ concentrations in southern panhandle communities, Ketchikan and Wrangell, from February 1, 2024, through May 24, 2024. The above plots show that both communities experience a rise in $PM_{2.5}$ concentrations over the week, peaking on Friday and Saturday. $PM_{2.5}$ concentrations rise in the morning and evening, potentially corresponding to residents heating their homes with woodstoves in the mornings and evenings when they are home; weekend $PM_{2.5}$ values are higher than weekday values as residents may be home more than during the week.

Calendar plots are useful diagrams for tracking air quality patterns over long periods of time. Each day is represented by a calendar square; daily $PM_{2.5}$ concentration averages are calculated and assigned a color code based on the AQI, where the colors green, yellow, orange, red, purple, and scarlet respectively represent “Good”, “Moderate”, “Poor”, “Unhealthy”, “Very Unhealthy”, and “Hazardous” air quality. Uncolored calendar squares represent days without data or enough sufficient data. By tracking AQI color coding on the calendar plots, DEC can visualize patterns or changes in air quality in specific communities over days, weeks, or months.

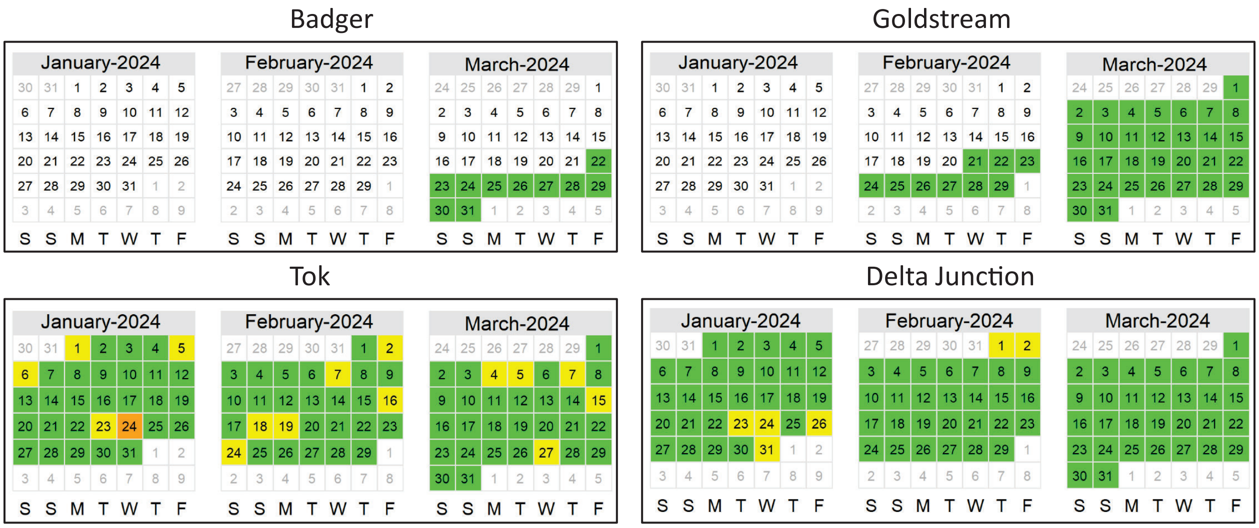

Figure. 4. Calendar Plots for Interior Communities

Figure 4 displays calendar plot data for four interior communities; Badger Road (North Pole area), Goldstream Valley, Delta Junction, and Tok. Overall, most calendar days are in the “good” AQI category. However, several days of moderate air quality were observed in Tok and Delta Junction, particularly in January and February. These are the coldest months of the year, when inversions can trap vehicle exhaust, smoke from wood-fired stoves, and other emissions, to create local increases in $PM_{2.5}$ concentration. Tok also experiences inversions in the wintertime due to the local geography. Frigid temperatures and nearby hills keep air pollution trapped near the ground surface, leading to days with “moderate” or “unhealthy” AQI values.

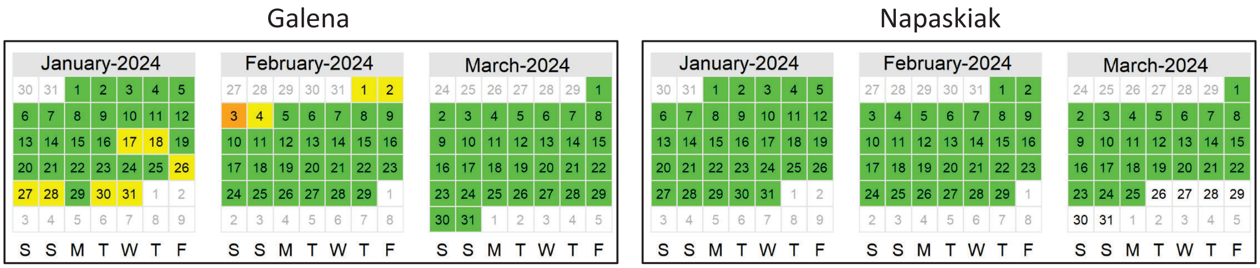

Figure. 5. Calendar Plots for Western Alaska Communities

Figure 5 displays calendar plot data for two western communities: Galena and Napaskiak. Galena experiences a similar inversion phenomenon as Tok; the local geography is a broad valley, with the community situated in the central low area surrounded by higher elevation hills and mountains. Air flow through the valley is restricted and wintertime inversions can lead to an accumulation of trapped $PM_{2.5}$ from vehicle exhaust and wood-fired stove smoke.

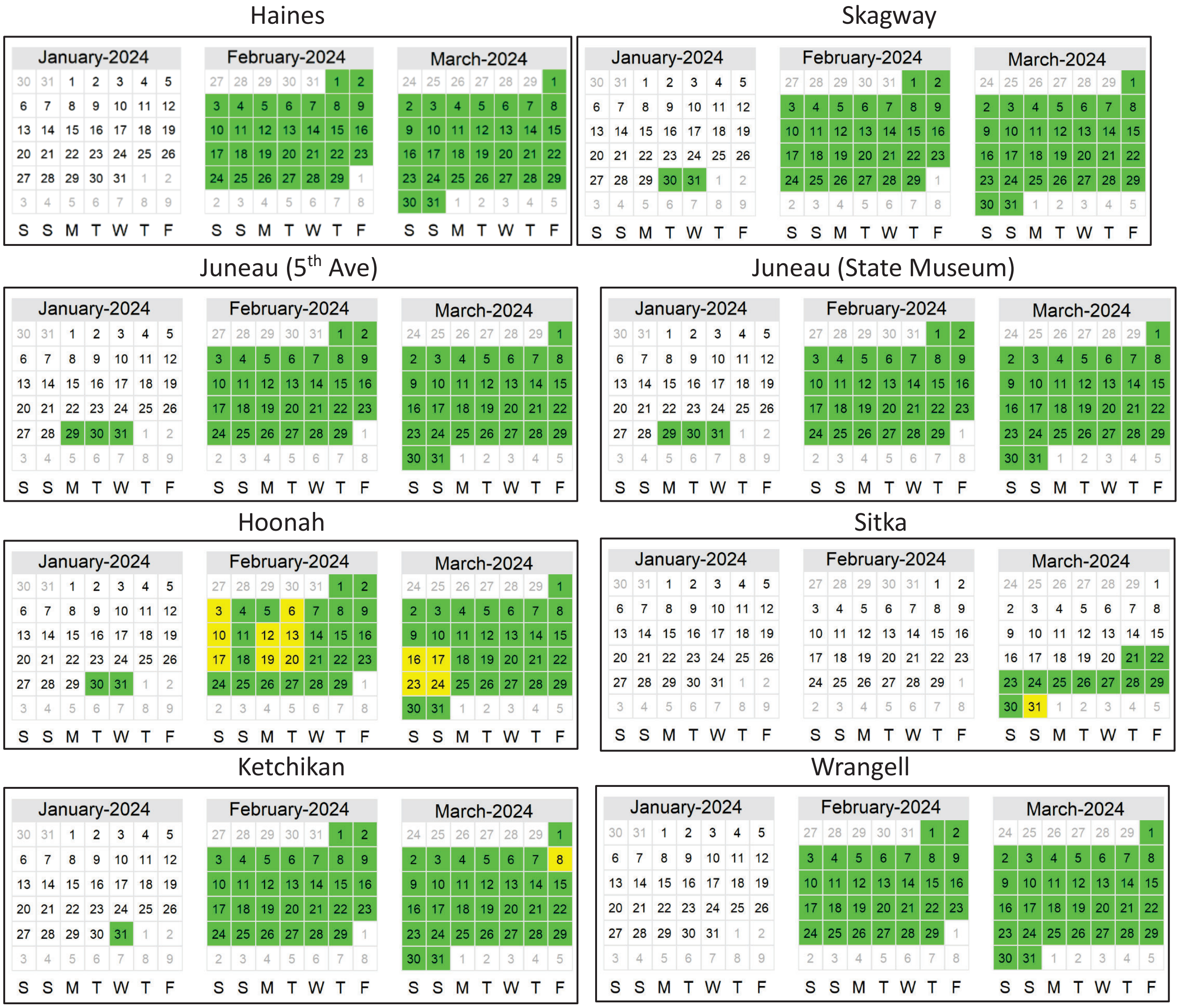

Fig. 6. Calendar Plots for Panhandle Region Communities

Figure 6 displays calendar plot data for eight air sensors installed in seven communities across the southeast panhandle region: Haines, Skagway, Juneau, Hoonah, Sitka, Ketchikan, and Wrangell. Air quality during this time period is generally good. In contrast, Hoonah has experienced several days with "Moderate" air quality throughout February and the second half of March. The Hoonah sensor has reported consistently higher $PM_{2.5}$ levels than other northern panhandle communities in the winter and early spring; the community contact stated that there are multiple buildings with woodstoves near the sensor and on days with little or no wind, the woodstove smoke lingers in the area longer.

5. Future Plans

In total, DEC plans to deploy 40 QuantAQ Modulair™ sensors in communities throughout Alaska, with six pods used for QA purposes. Once the majority of the sensors are deployed, the focus of the project will transition from deployment to data analysis, maintenance, and community outreach. These efforts include monitoring pod data feeds and identifying signs of misreads and hardware issues, working with QuantAQ tech support to address sensor issues and updating malfunctioning sensors with corrective resets, cycling out old pods for new pods, and performing on-site collocations or bringing pods back to a state monitoring site for collocation. Furthermore, knowing the QuantAQ Modulair™ pods lose accuracy at temperatures below freezing, DEC will analyze multi-year data sets to observe seasonal trends in pod performance, and make adjustments and repairs as necessary.

Lastly, DEC will continue to engage in community outreach with the goal of providing meaningful data analysis and visualizations to communities and community members. DEC will continue to post sensor data on the publicly accessible AQI website and continue hosting quarterly community engagement calls. The community engagement calls are currently the main method by which DEC shares data visualizations with participating and interested communities. These calls serve as opportunities for community feedback, which will allow DEC to improve its public communication and provide answers for requests for or questions about specific data sets from communities or time ranges. It has been difficult to get feedback from participating communities on what data analysis or outreach communities would like to see; DEC is evaluating how to increase participation. The next interim report will include data from communities incorporated after April 1st and before September 30th, 2024.