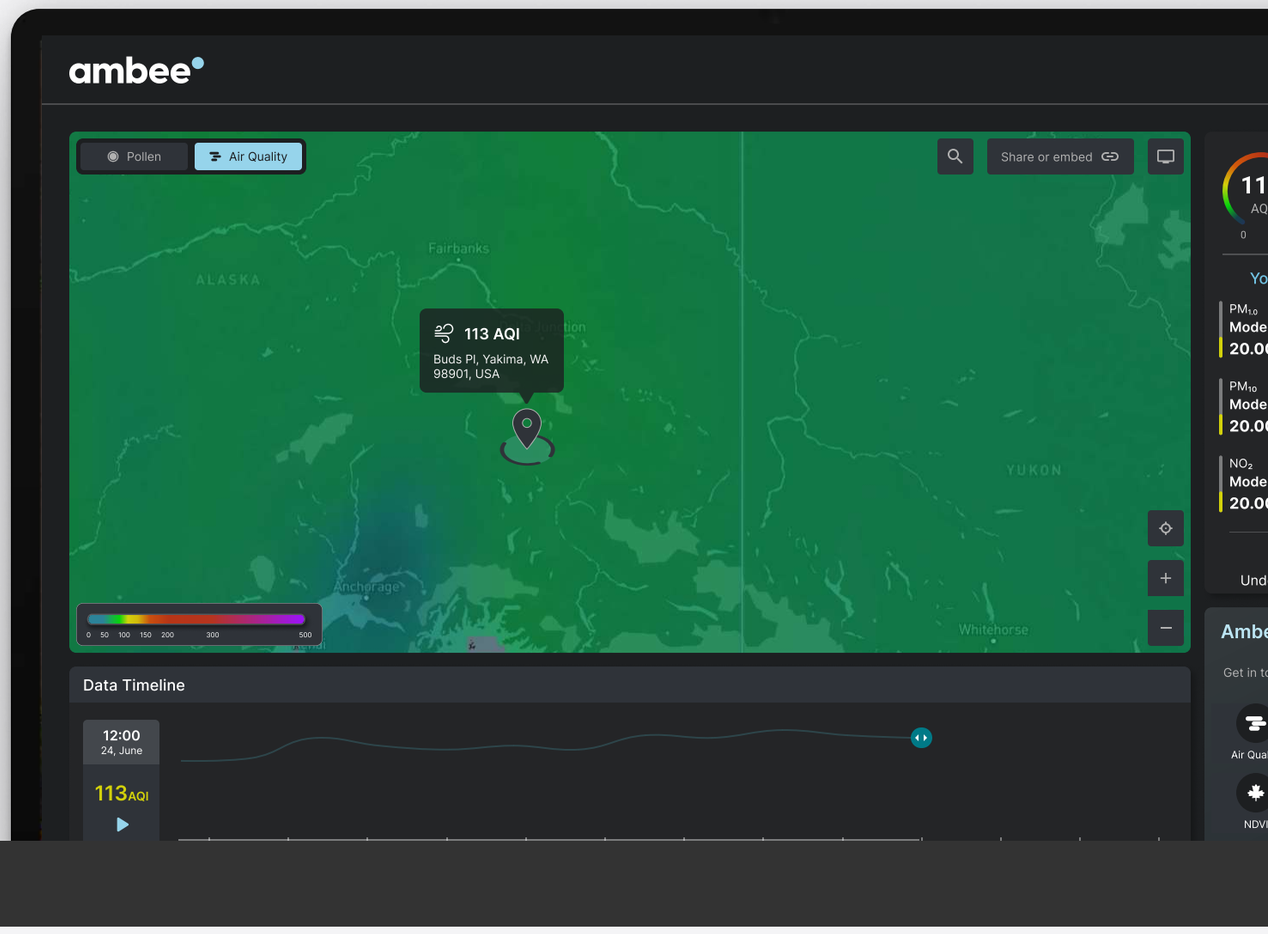
The Complete Guide To Ambee's Air Quality Technology

Ambee Maps Dashboard



About this Guide

Air quality has a very important place in Ambee's history. The first Ambee product was built to discover why an infant was experiencing breathlessness after moving to a new neighborhood. That catalyzed a journey that began in 2017. In the years that have followed, our air quality data has changed lives around the world by helping leading organizations revolutionize their products.

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This could only happen because of our belief in constant innovation and our determination to achieve the highest possible accuracy. 99% of the world breathes harmful air. But not everyone is breathing the same quality of air. Knowing this, we've made it our mission to deliver extremely localized and accurate air quality data to the world.

In this guide, we will explain the innovative approach that Ambee has taken to revolutionize air quality monitoring and reporting. By the end of this guide, you will understand the A to Z of how Ambee's AQ technology works, the challenges it overcomes, and how it empowers individuals, businesses, and communities to lead safer lives with accurate air quality insights.

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Abbreviations used

AQ - Air quality

AQI - Air quality index

PM - Particulate matter

WHO - World Health Organization

lat long - Latitude and Longitude

API - Application programming interface

US EPA - United States

Introduction

This guide is designed to shed light on the pressing issue of air pollution and how Ambee is actively working to address it. Our approach goes beyond conventional methods, aiming to provide real-time, hyper-localized air quality data to individuals and businesses. In today's world, tracking air quality has never been more critical. Bad air can have far-reaching consequences– from making people severely sick to seriously harming the planet.

According to The World Health Organization (WHO), air pollution is linked to around **7 million early deaths every year.** That compares to wiping out a whole big city of people annually. Breathing in dirty air can cause serious health issues like heart problems, lung diseases, and even cancer.

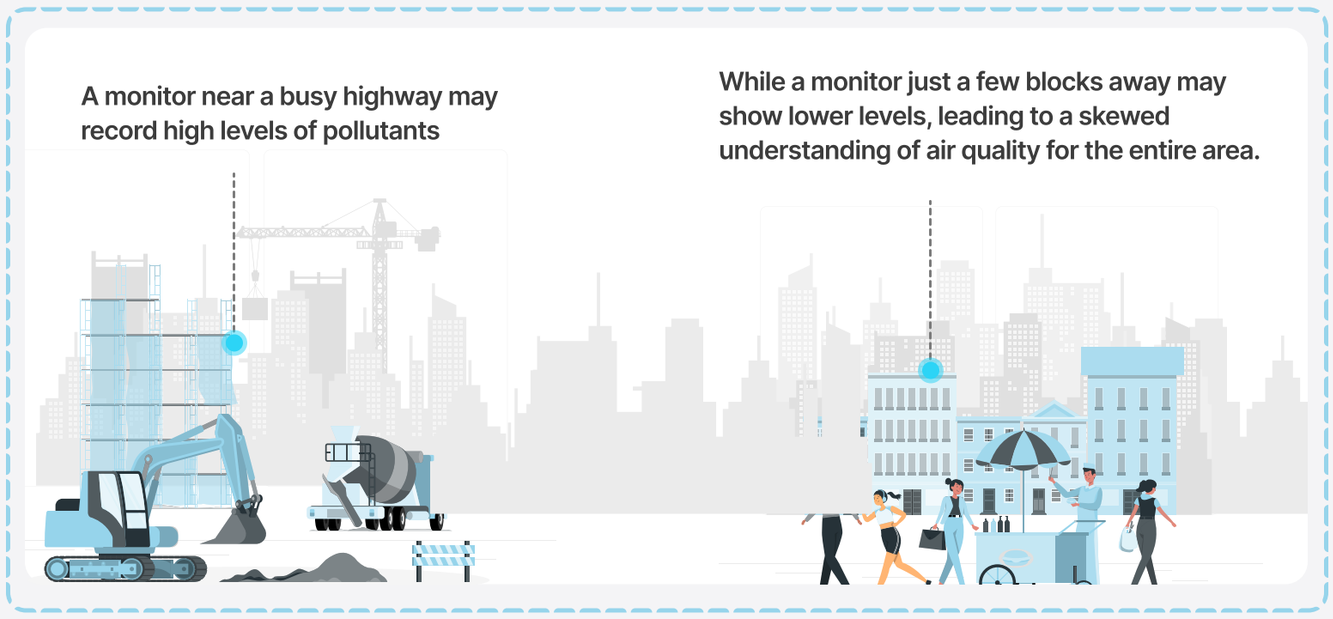
But the damage isn't just to our health – The World Bank says air pollution costs us over $5 trillion each year in healthcare and lost income, putting more pressure on an already struggling worldwide healthcare ecosystem.

The old-school way of air quality monitoring with a few stationary sensors is not cutting it anymore. We need more advanced solutions like satellites, mobile sensors, and intuitive algorithms to give us real-time information on air quality

This helps us fight pollution better, warns us when it's dangerous, and helps us see if our anti-pollution plans are actually working. These advanced monitors and techniques can be deployed worldwide, making sure we all breathe easier and the planet stays healthier.

The Limitations of Traditional Approaches

Traditional air quality monitoring methods, including government stations and low-cost sensors, suffer from many drawbacks, including– coverage, lack of real-time data, restricted pollutant measurements, sensor downtime, and inaccurate sensor measurements. For example, in the United States of America, the Environmental Protection Agency (EPA) monitors around **4000 AQ monitoring stations.** While this is extremely valuable, it isn't enough for a country with thousands of cities and towns.
Traditional monitors are also fixed in one location, which means they may not capture localized sources of pollution accurately. For instance -



Many conventional monitoring stations provide data at hourly or daily intervals, which can make it challenging to respond quickly to rapidly changing air quality conditions. In situations where air quality can deteriorate rapidly–such as during wildfires or industrial accidents– this delay in data reporting can be problematic, to say the least.

Due to these challenges, air quality data collected solely from sensors fail to incorporate the full impact of extreme weather events and, hence, fail to provide a holistic picture of any location.

We at Ambee recognize these challenges and have created pipelines to overcome them by combining multiple data sources, advanced algorithms, and machine learning techniques to deliver a holistic and reliable air quality monitoring solution.

Have a look at how it all works.

The Science Behind Ambee's Technology

Ambee's air quality technology is built upon a robust scientific foundation that addresses the limitations of traditional air quality reporting methods. Our approach combines cutting-edge data processing techniques, advanced algorithms, and innovative solutions to provide accurate and actionable air quality insights. Here's a closer look at the science behind Ambee's technology:

Data Sourcing

Our data sources serve as the foundation upon which Ambee's rich and accurate AQ API is built. Ambee's air quality API is sourced from over 60+ satellite and station data sources–that are thoroughly skimmed and processed with proprietary algorithms and techniques to ensure maximum accuracy for every location on Earth. **Have a look here** for a detailed list of all the stations and satellites from which we source data for our AQ API.

Data Processing And Outlier Treatment

One of the challenges in air quality reporting is dealing with outliers. Ambee's technology incorporates sophisticated outlier treatment methods during data processing. Outliers and anomalies are common in both low-cost and high-quality sensors. They can occur for various reasons, such as sensor malfunctions or missing data.

For example, we might observe unusually high values, negative values, or instances where the PM2.5 levels (fine particulate matter) are greater than PM10 levels (larger particulate matter), which is not the norm.

Even reference-grade sensors, designed for accuracy, can sometimes exhibit these anomalies due to factors like environmental conditions or sensor glitches. Managing these outlier readings is essential to ensure the accuracy and reliability of the collected sensor data. We need effective techniques to identify and handle these unusual values for accurate sensor data analysis. 'Outliers' or anomalies in the pollutant measurements of the sensors are identified using historical air quality data of each geolocation. Unlike traditional approaches of 'removing anomalies in the data', Ambee utilizes a better approach to solving this challenge.

Handling Missing Data

Missing data values can cause a lot of hindrances. Ambee recognizes the limitations posed by missing data values, especially when relying solely on raw satellite data. In our new pipeline, a robust strategy is employed to address missing values effectively:

Historical trends

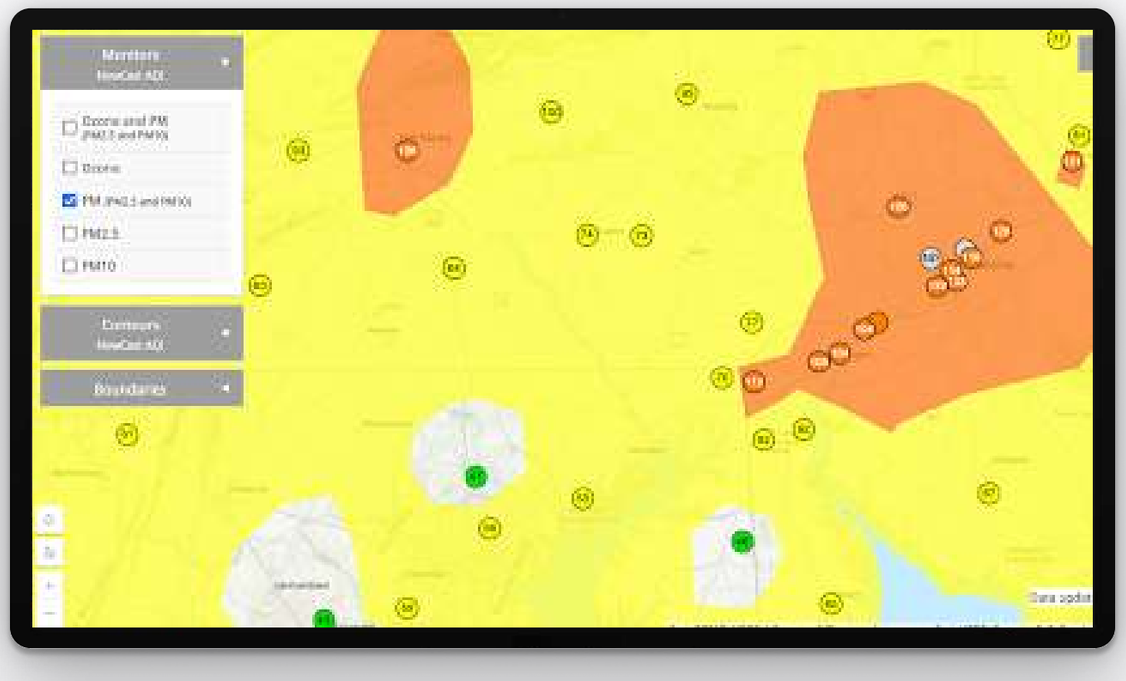
Historical trend analysis to fill in for missing values for each geolocation - In cases where data for a specific geolocation is missing, we leverage historical trend analysis to estimate the missing values intelligently. By examining the past patterns and trends of pollutant levels for that location, we can create a reasonable approximation of what the missing data might have been. This approach ensures that our predictions remain accurate and representative even in the absence of real-time data.

Marrying satellite and ground stations

Calibrating satellite sources with ground station sensors to provide ground-level pollutant measurements - The synergy between satellite data and ground station sensors is pivotal in our methodology. We calibrate satellite measurements with ground-level pollutant measurements obtained from reliable station sensors. This calibration process enables us to align the satellite-derived data with the ground-truth measurements, thereby improving the accuracy of our predictions. This calibrated data acts as a bridge between space-borne observations and on-ground realities.

Neighborhood events

Using neighborhood events to 'estimate' their impact on each location - the key idea behind this is that the air quality of a specific location is not only determined by local emissions but is also influenced by the air quality of its surrounding areas. This influence occurs due to the movement of air masses, wind patterns, topography, and other meteorological factors that can carry pollutants from one location to another. For example, if there is a source of pollution, such as a factory emitting pollutants, in the vicinity of a residential area, the pollutants released from that source can be carried by the wind to nearby neighborhoods. This means that the air quality of these neighborhoods will be impacted not only by their local emissions but also by the pollutants transported from nearby pollution sources. This trend can be seen in various USEPA heatmaps as well.



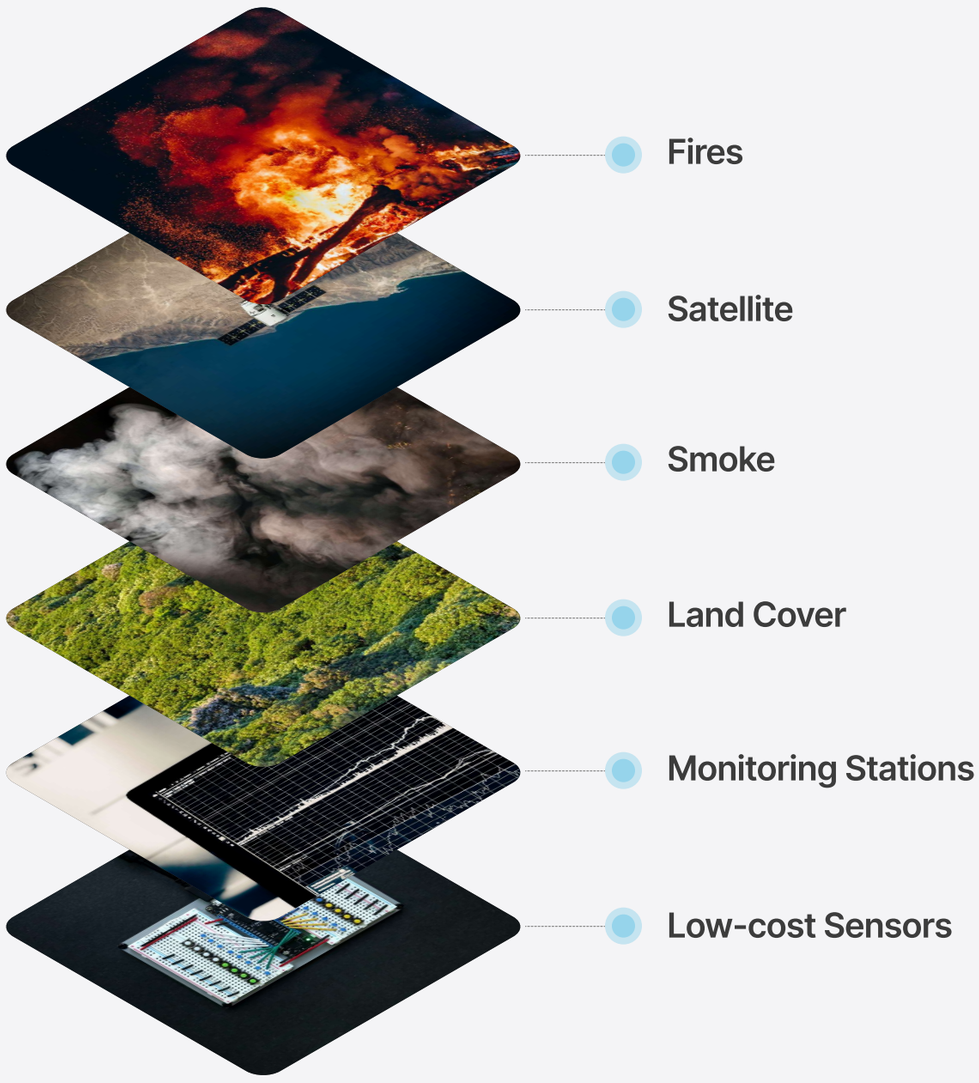
Calibration Models Enhanced with Fire, Smoke, and Weather Parameters (coming soon)

Think of a situation where a wildfire spreads throughout a region. AQI prediction becomes difficult in such cases because the resulting smoke plumes can drastically change how pollutants disperse.

By incorporating fire events, smoke plumes, and weather parameters, our technology enhances the precision of calibration models. This integration will ensure that the air quality index provided is not only accurate but will also take into account these dynamic factors.

Our calibration models will, therefore, become more adaptable after including the fire data and its related smoke plumes. In order to account for the changing pollutant distribution patterns brought on by the fire and smoke, the model would then modify its projections.

In addition to that, factors like wind direction and speed also have a significant impact on how pollutants move through the atmosphere. The behavior of pollutants can diverge from normal conditions during extreme weather conditions, such as high winds or temperature inversions. Our models will incorporate these variances before reporting air quality indices



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Using emission inventory

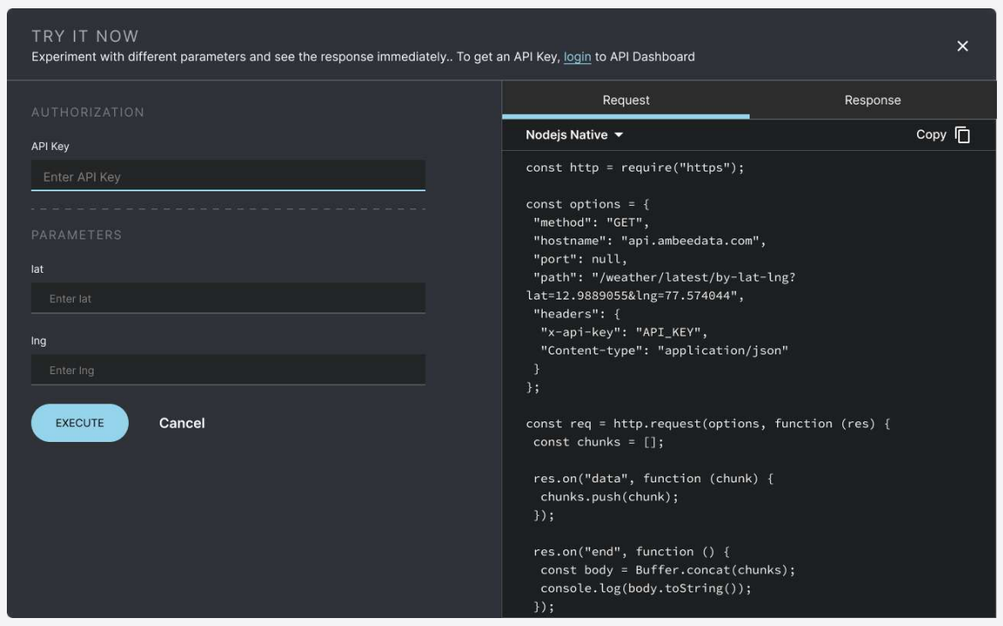
Ambee's strength lies in its ability to fuse and analyze vast amounts of data from its other APIs. By combining information from government monitoring stations, satellites, population, vehicle density, road density, static sources of pollutants such as industries, mines, powerplants, and transport hubs along with its own proprietary near real-time Weather data, Disaster Data, Smoke Data, we create a comprehensive air quality picture.

Our advanced algorithms process this data to generate precise predictions, enabling users to make informed decisions. In summary, Ambee's air quality technology is underpinned by innovative solutions that tackle challenges in data processing, missing values, and calibration. By using raw station data, advanced techniques, and real-time integration of fire events, smoke, traffic, and weather parameters, Ambee provides users with actionable and precise air quality insights for healthier environments.

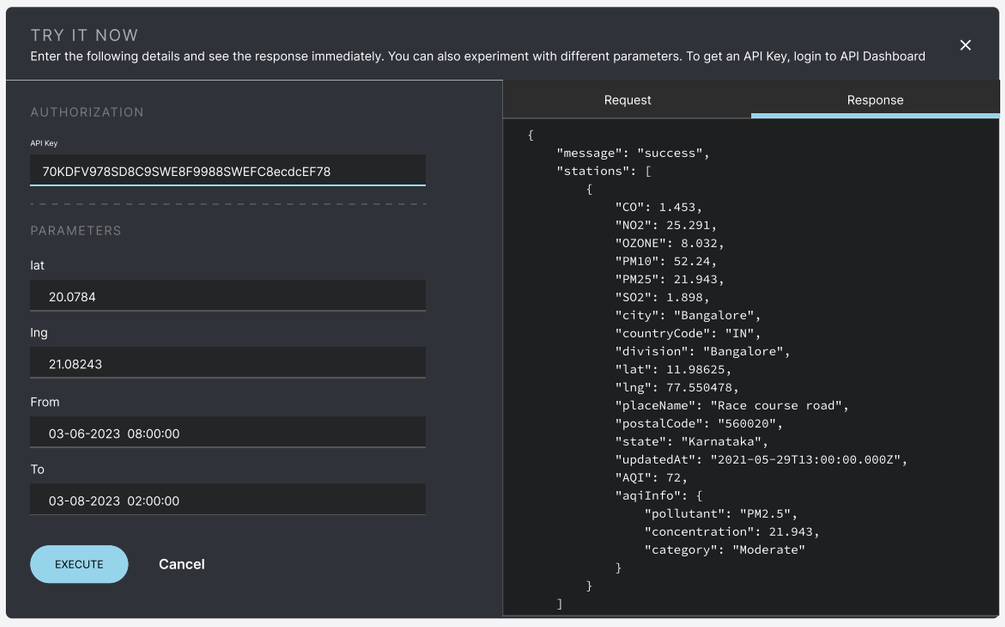
Data Delivery and Accuracy

Monitoring the performance of our pipeline and APIs is perhaps the most crucial part of the entire process. By making periodic improvements and adding more parameters & features, we aim to give our users and clients the most seamless experience. **Have a look at** our AQ documentation to get a complete understanding of the parameters we offer. As such, the main endpoints of the are:

Search by lat long to get the latest AQ information



Access historical air quality information for a particular lat long



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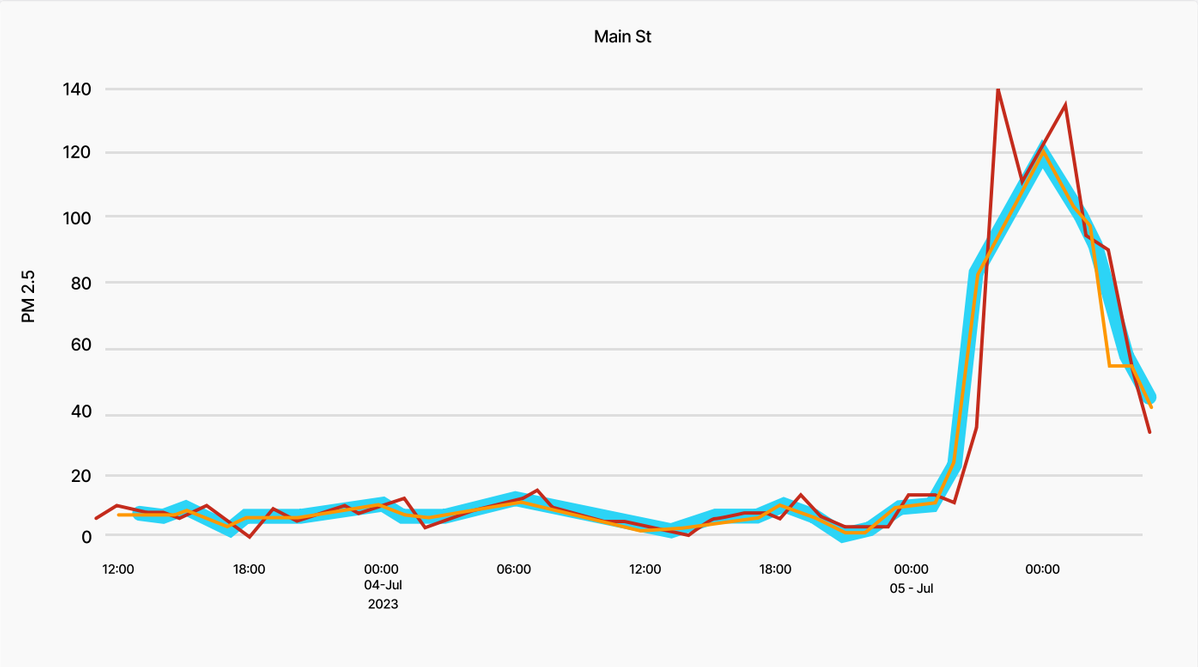
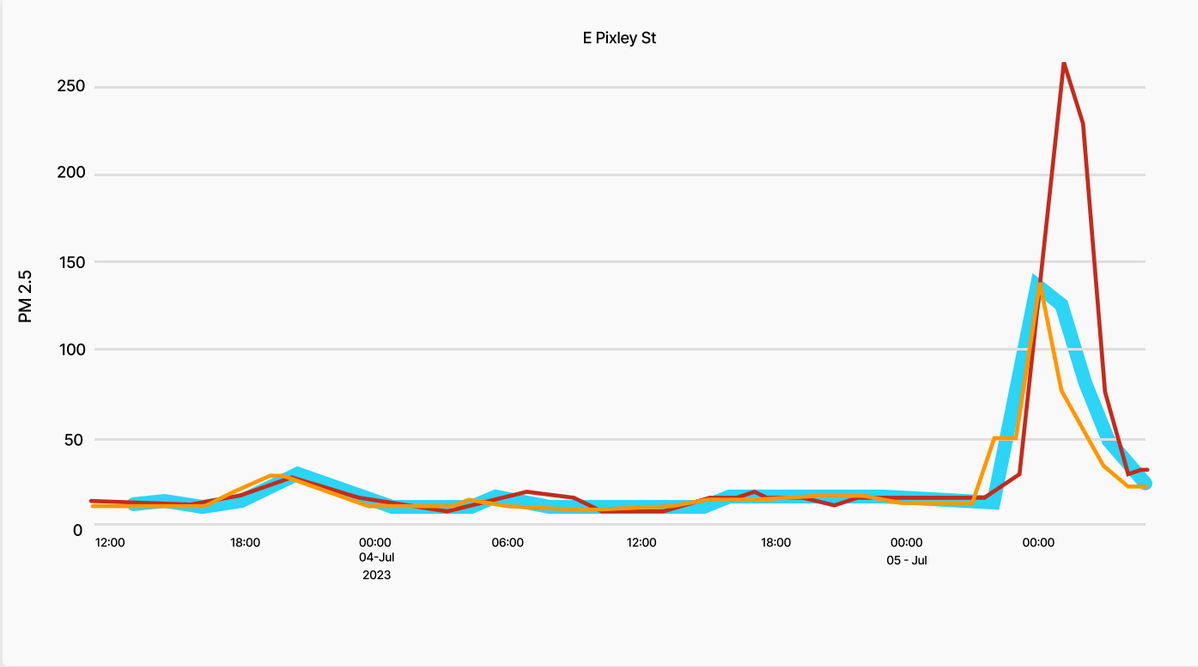
As far as the accuracy of our data is concerned. Our datasets are US EPA and NAB-compliant, ensuring maximum accuracy in the entire market. Here's how Ambee's data fares against station data and a competing AQ provider in terms of accuracy.

NYC



LA



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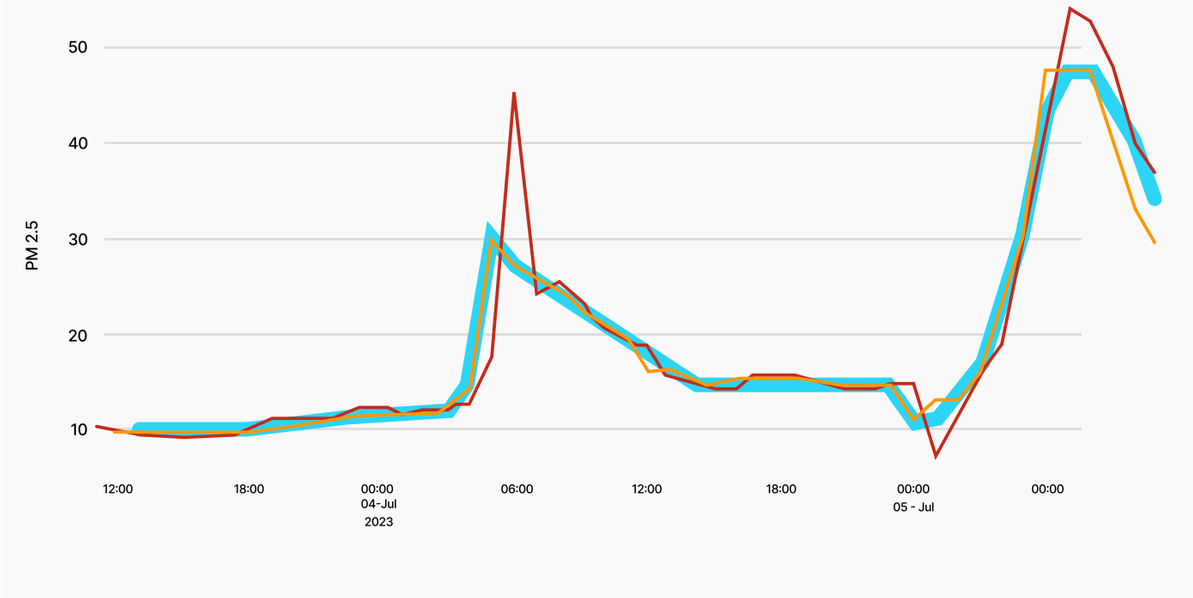
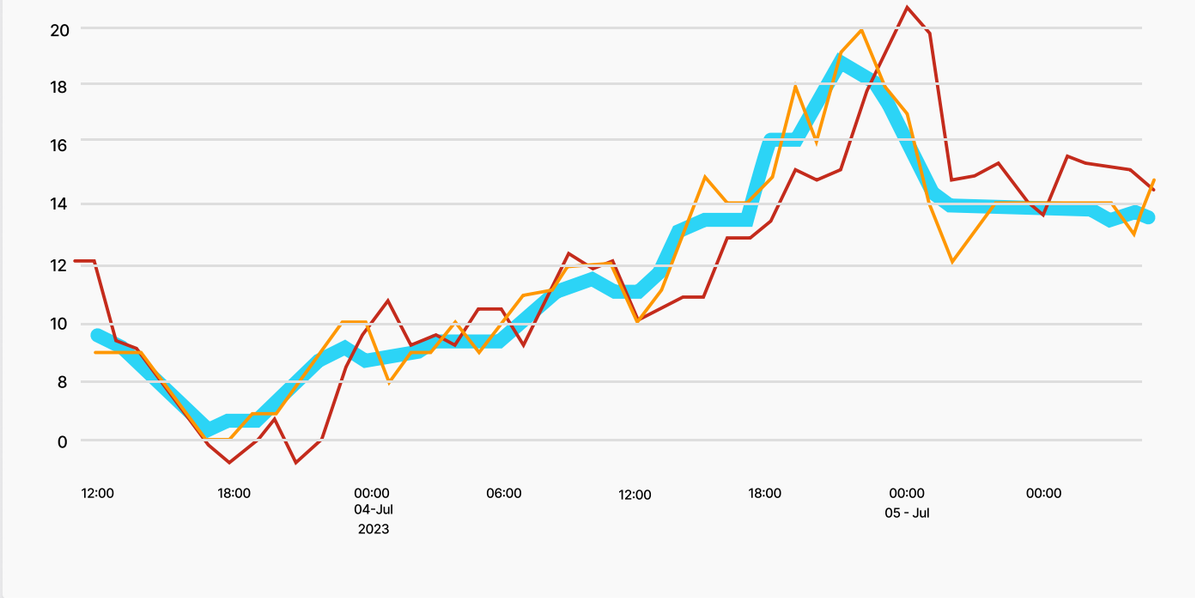
Chicago

Toronto





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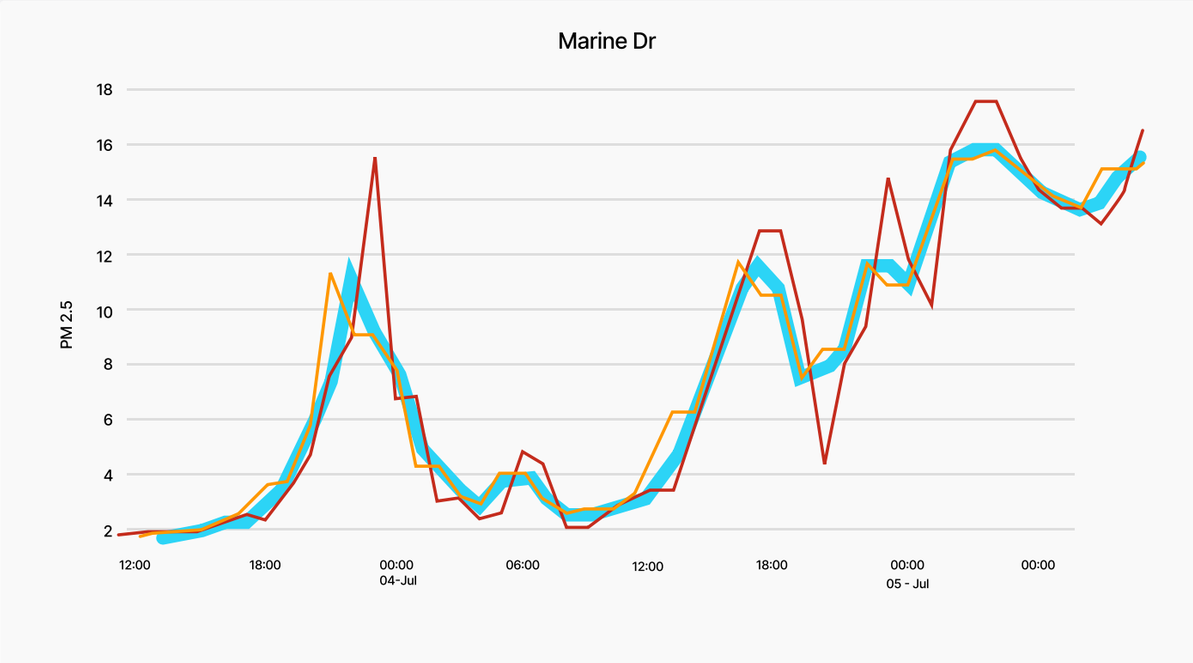
- Competitor A
- Ambee

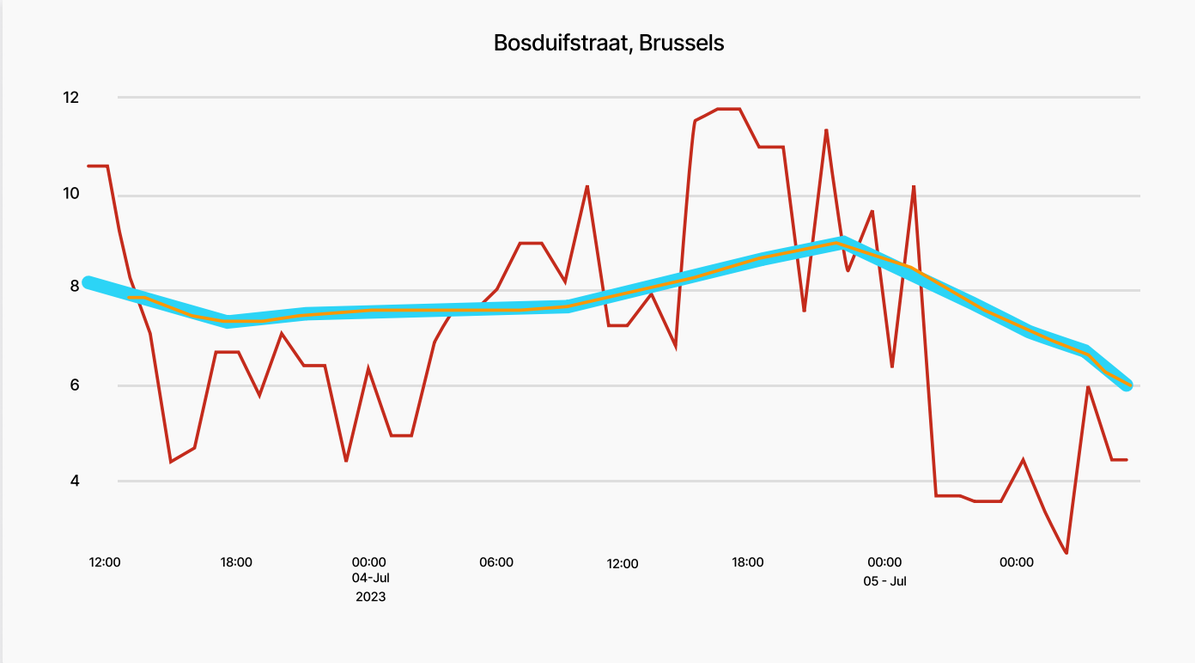
- Station
- Competitor A
- Ambee

Vancouver



- Station
- Competitor A
- Ambee

Brussels



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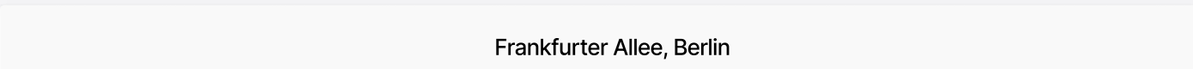
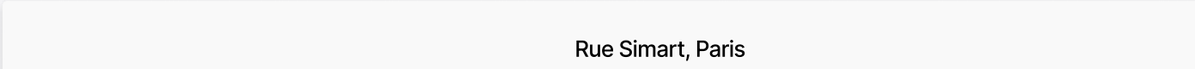
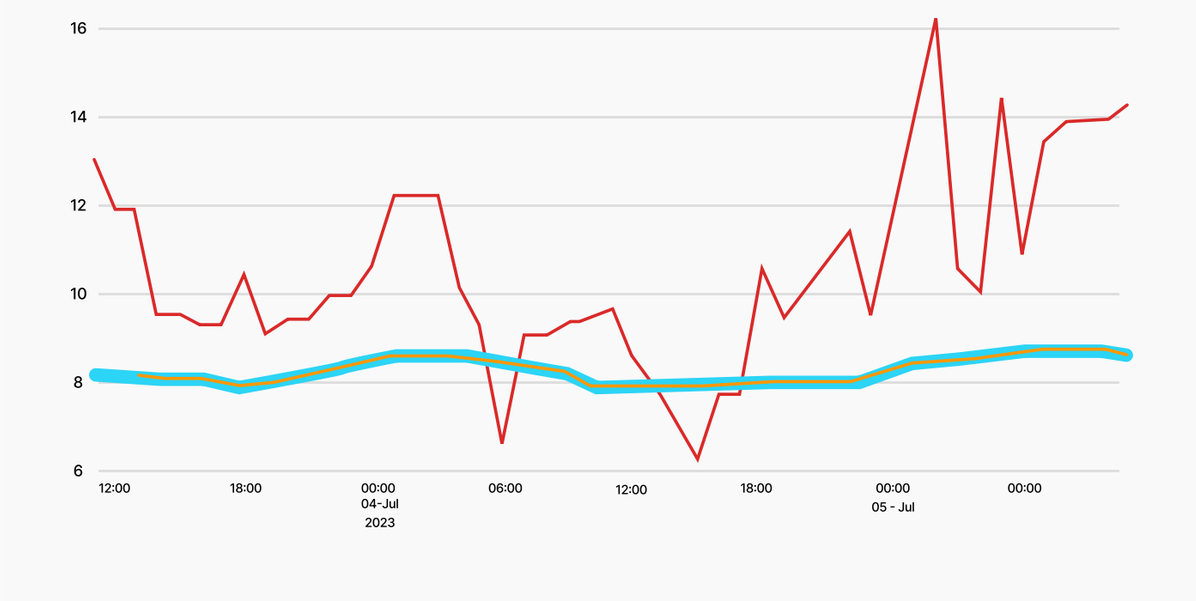
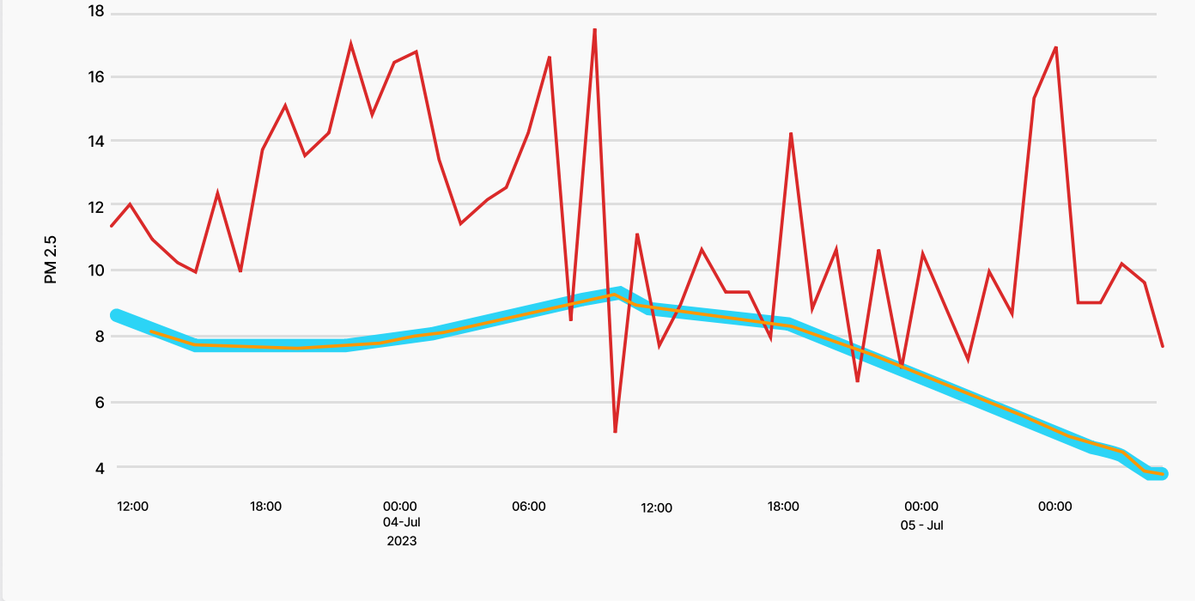
Berlin



Paris







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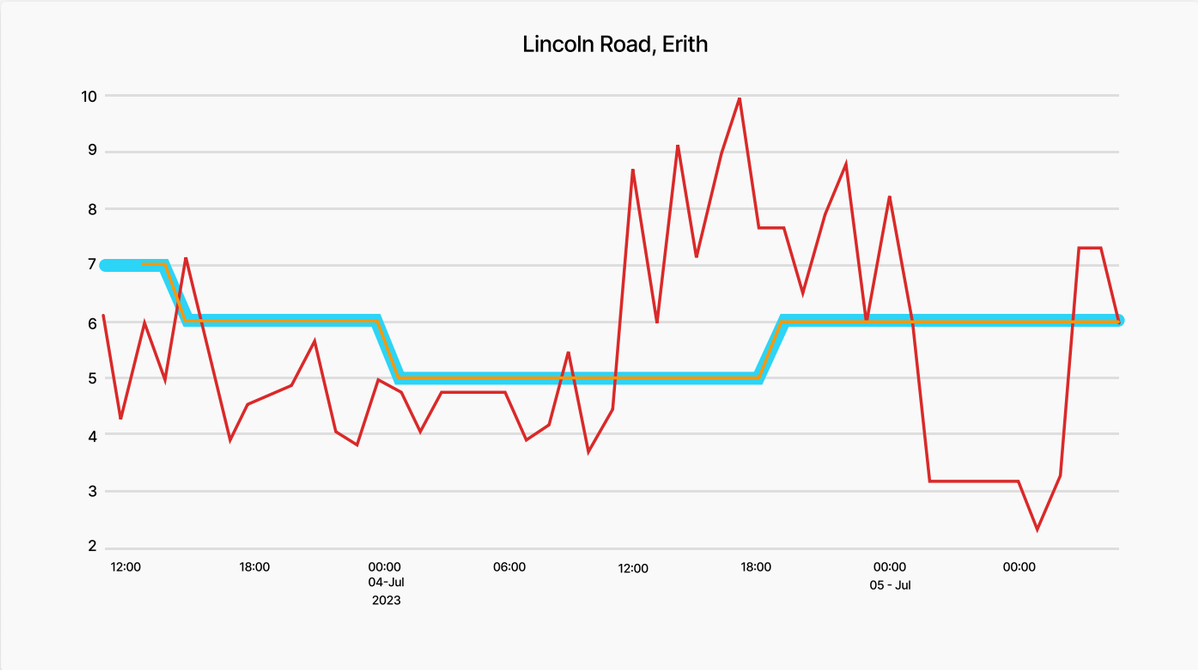
- Ambee

- Station
- Competitor A
- Ambee

London



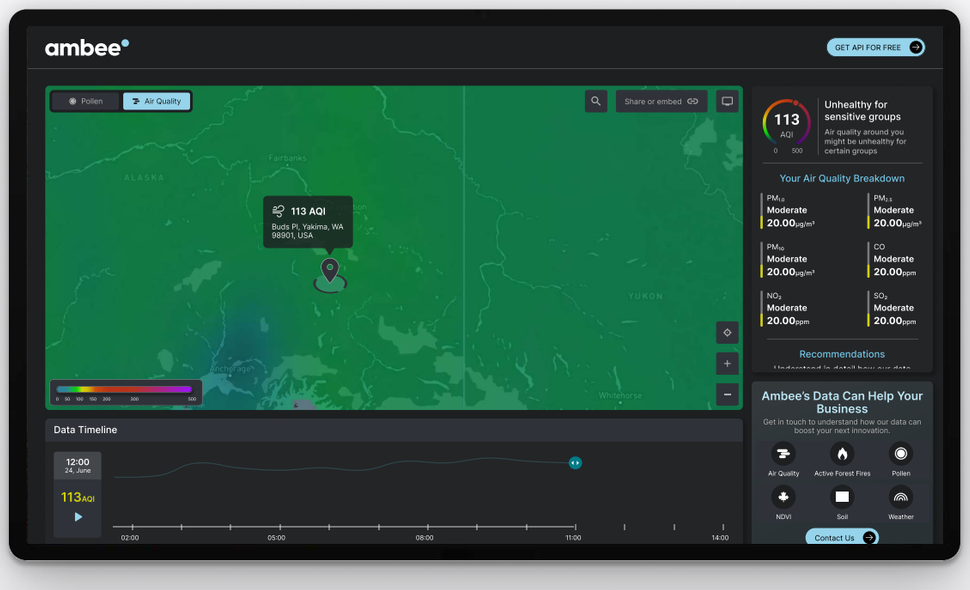
- Station
- Competitor A
- Ambee

Additional capabilities of Ambee AQI

Making sure that our data is actionable is as important to us as its accuracy. With that philosophy, we've built several interfaces and products for our users that are built atop our AQ data. Here's a look at some of them:

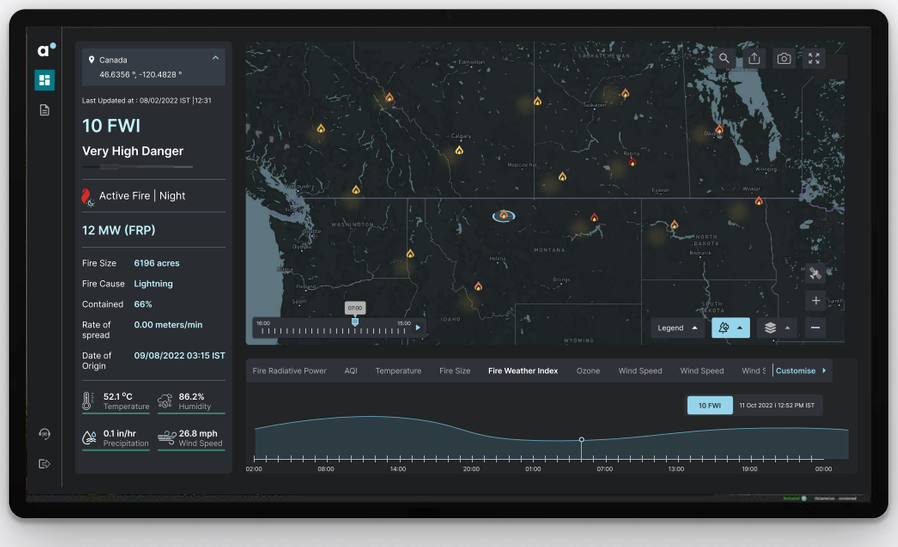
Real-Time AQ Maps

Ambee's air quality map offers an unparalleled visual depiction of hyperlocal air quality data, providing the most granular insights into pollution patterns. Ambee's air quality map ensures easy accessibility and accuracy of our data while facilitating seamless integration into solutions. Users can gain access to comprehensive and accurate environmental information to make informed decisions and drive positive change using this interactive map.



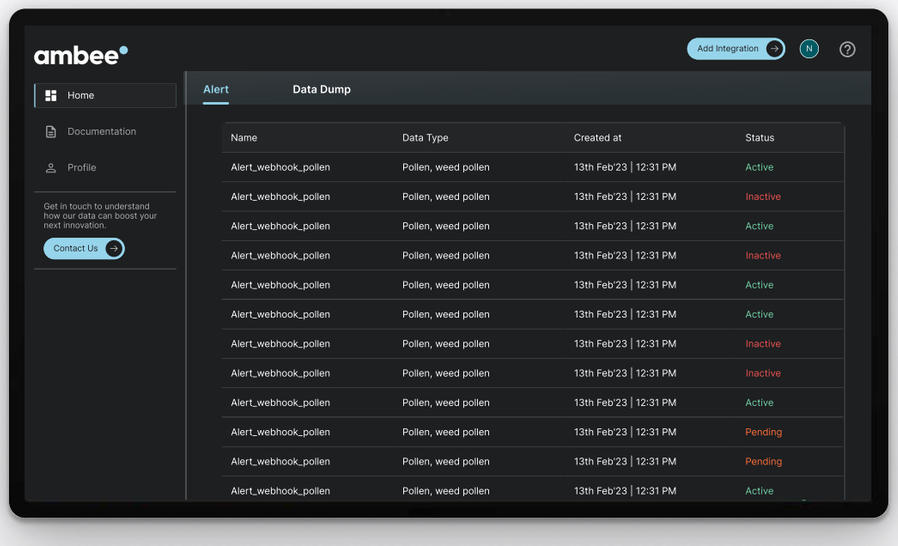
F3 - Wildfire Risk Analytics Tool

Ambee's Wildfire Risk Analytics Tool, F3, uses current and local environmental factors and predictive analytics of fire behavior to provide near real-time active forest fire data visualized through a forest fire map. Refreshed hourly, the tool offers detailed information on fire risk levels, rate of spread, size, cause, and more. In addition, F3 also provides added data on various AQ parameters to analyze fire-AQ correlations.



Ambee Webhooks

Ambee Webhooks, developed by Ambee, is an advanced push-based data delivery platform that empowers users with real-time alerts and notifications triggered by dynamic changes in environmental conditions. For example, users can get tailored alerts about spikes in air pollution via an automated webhooks alerts system.



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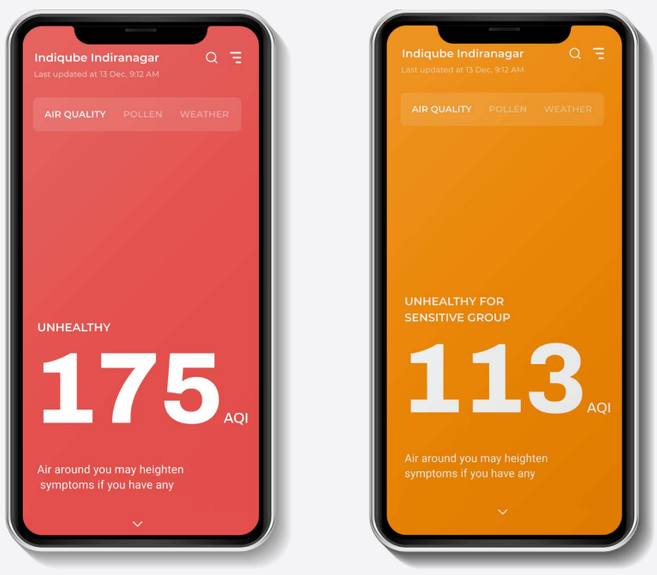
Ambee Mobile App

Ambee's AQ, Pollen, and Weather app is a versatile and user-friendly tool designed to empower individuals and communities with real-time environmental information. This app allows users to easily access hyperlocal air quality data tailored to their specific location. Users can easily interpret and utilize this valuable information to make informed decisions about their health and well-being. Whether concerned about air pollution, allergies, or planning outdoor activities, the Ambee mobile app provides the insights needed for a healthier, more informed lifestyle.



This was a complete and comprehensive guide to Ambee's AQ technology. However, we're constantly deliberating, brainstorming, and adding more capabilities with planetary health as the end goal. If you'd like to stay updated on the kind of products that we're building and the kind of technology we're using, here's how we can stay in touch–

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