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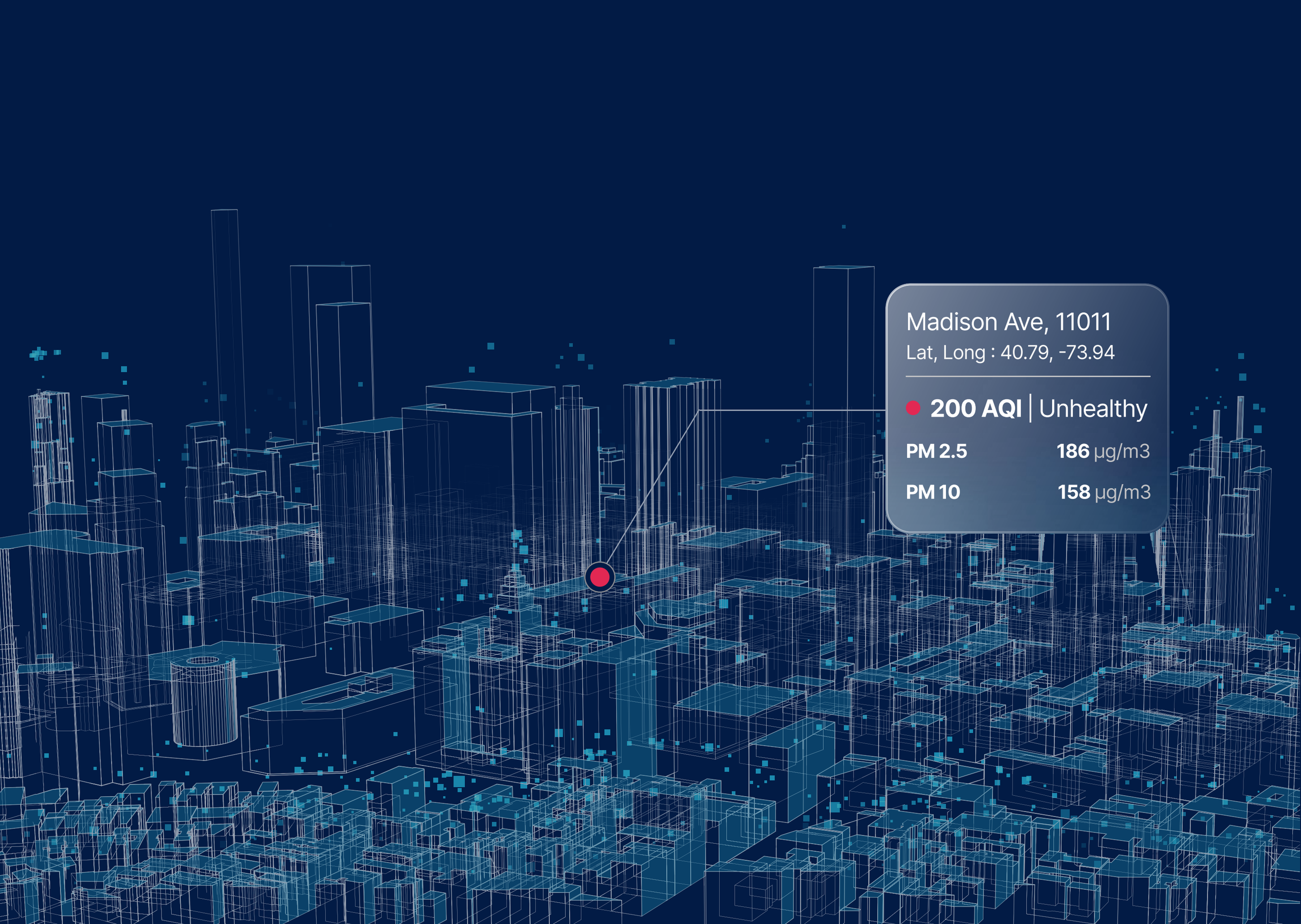
ambee

Air Quality Data Accuracy Report



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01 Introduction

02 Accuracy of Ambee's real-time Air Quality data v/s station v/s Breezometer

03 Accuracy of Ambee's 48-hour Air Quality forecast data v/s on-ground station data

Ambee's air quality dataset

Comprehensive pollution parameters to drive business impact

Parameters	Description
PM 2.5	Particulate matter < 2.5um (ug/m3)
PM 10	Particulate matter < 10um (ug/m3)
SO2	Sulphur dioxide conc. (ppb)
NO2	Nitrogen dioxide conc. (ppb)
OZONE	OZONE conc. (ppb)
CO	Carbon monoxide conc. (ppm)
AQI	Air quality index
updatedAt	ISO timestamp of event in UTC
aqiInfo	Brief info about the effects of the AQI returned

Data specifications

Global
coverage

96 hrs*
Forecast

10+ years
Hourly historical data

JSON
Data format

<1 sqkm
Granularity

*96 hrs available on demand, 48 hrs recommended for optimal accuracy.

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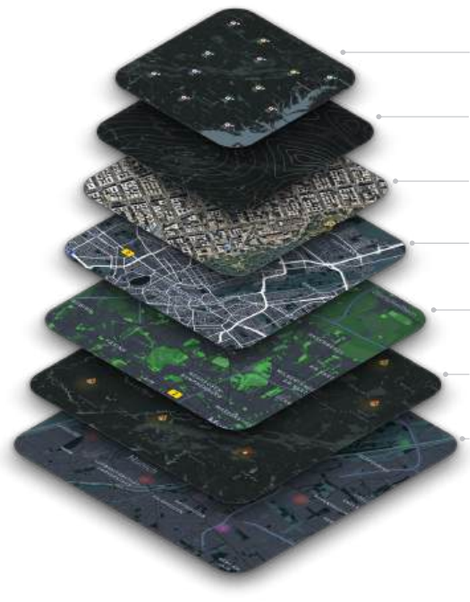
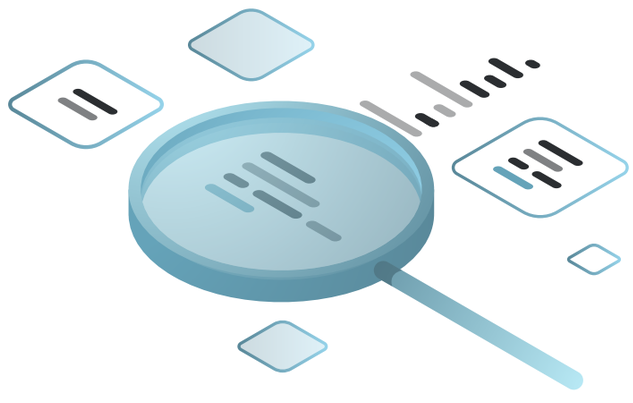
Data architecture

Our patented AI-driven models

Measure & own → **Analyze** → **Drive actionable insights**



- 47000+ sensors
- Meteorology
- Satellites
- Proprietary sensors
- Land vegetation
- Active fires
- Stationary anthropogenic emissions



What makes Ambee data accurate?

- Ensures the integrity of reference-grade sensor data.
- Manages scientific anomalies/errors effectively in reference-grade sensors.
- Implements robust handling of missing values in case the station is offline.
- Deploys AI-based interpolation for precise data extrapolation within a 10km radius of the station.
- Utilizes AI-based calibration to enhance the accuracy of satellite data within a 50km proximity to the station.

Weighted anthropogenic data

Multiple algorithms in play throughout the ETL process

Feature-engineered data

Trained using 10+ years of data for each parameter

Unique model for different geographies

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Accuracy of Ambee's real-time air quality data v/s station v/s Breezometer

Methodology

Model application range: These models work for areas within a 10 km radius from a station.

Testing approach: We employed a 'leave one out' approach for data comparison. Consider a scenario with 5 stations, we temporarily exclude one station and utilize data from the remaining 4 stations to impute the missing station's data. Subsequently, we compare the actual data with this interpolated dataset to assess accuracy and reliability.

Disclaimer :

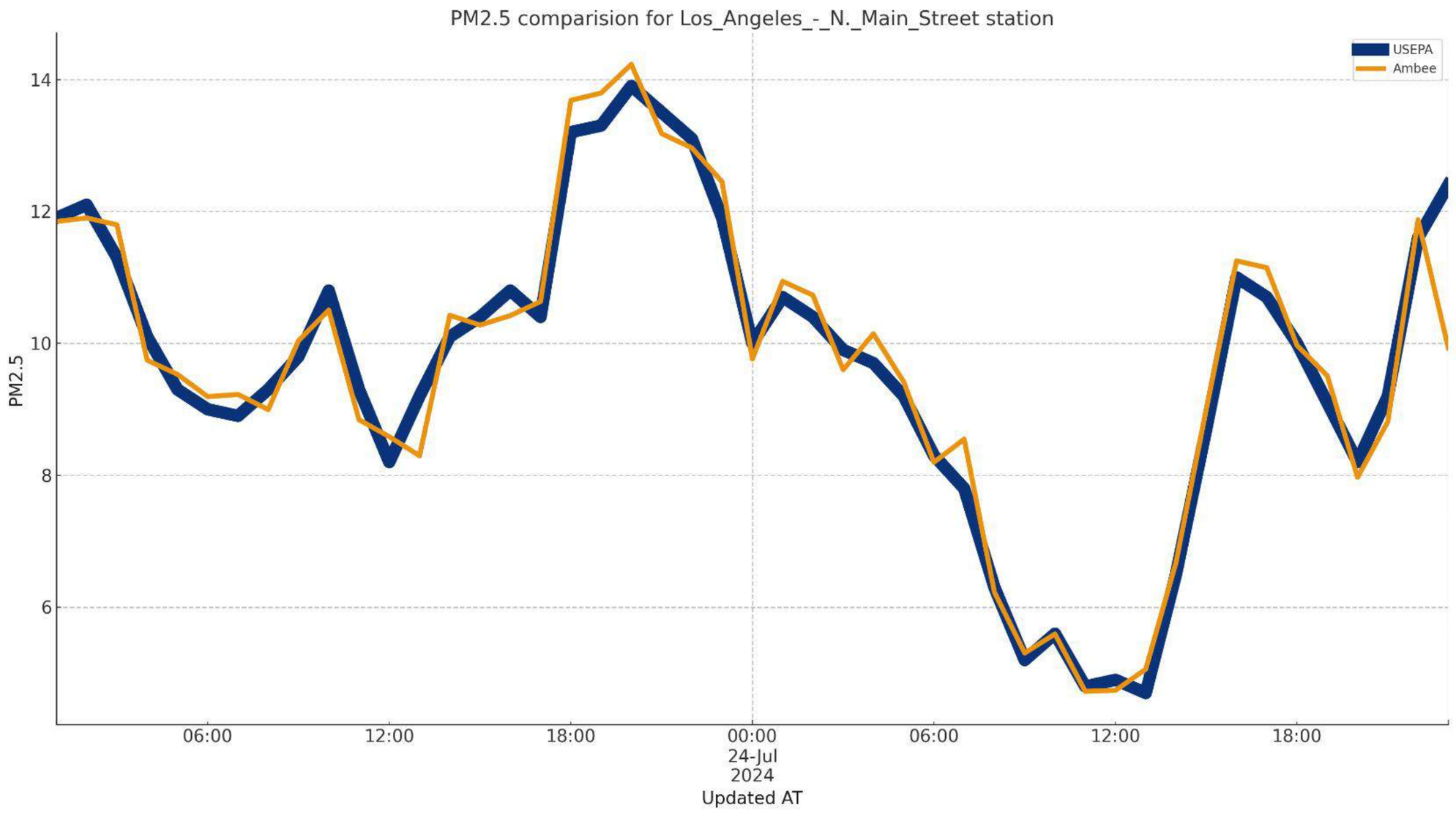
- *Since air quality is spatially correlated, interpolation gives us good results.*
- *In the graphs ahead, we see that for most stations, the air quality trends and values are captured well even if we do not know the actual value.*
- *Any lag in data is due to the station reporting the data late.*

Benchmarking ambee accuracy* against on-ground stations: USA

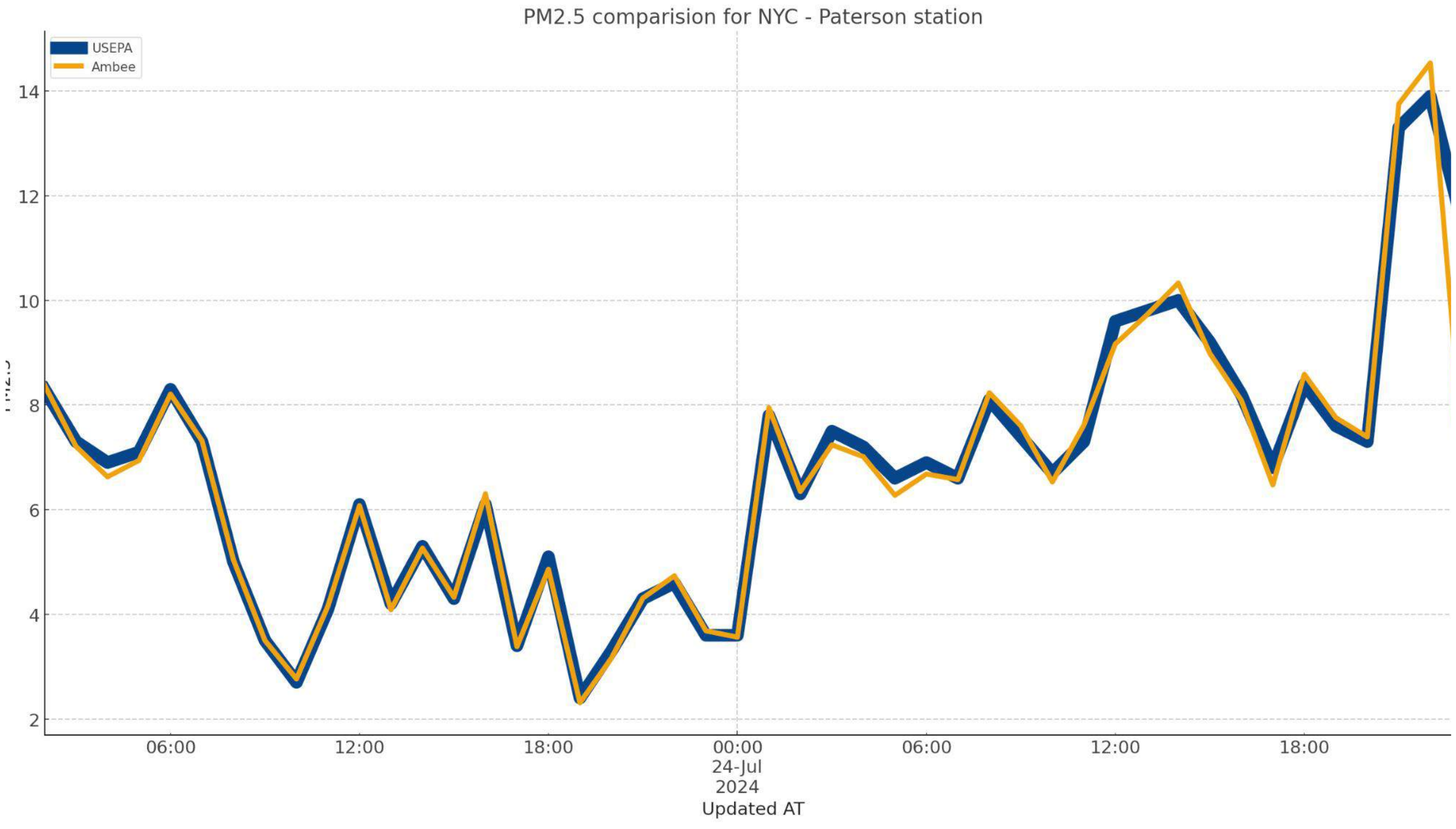
*Accuracy achieved when comparing ground station data with Ambee data for PM2.5 in the 47-48 hour timeframe.

City	Station	Accuracy*
Los Angeles	N Main Street	**93%**
New York	Paterson	**84%**
Chicago	ALSIP	**83%**
Houston	Bayland Park	**87%**
Phoenix	Tempe	**81%**

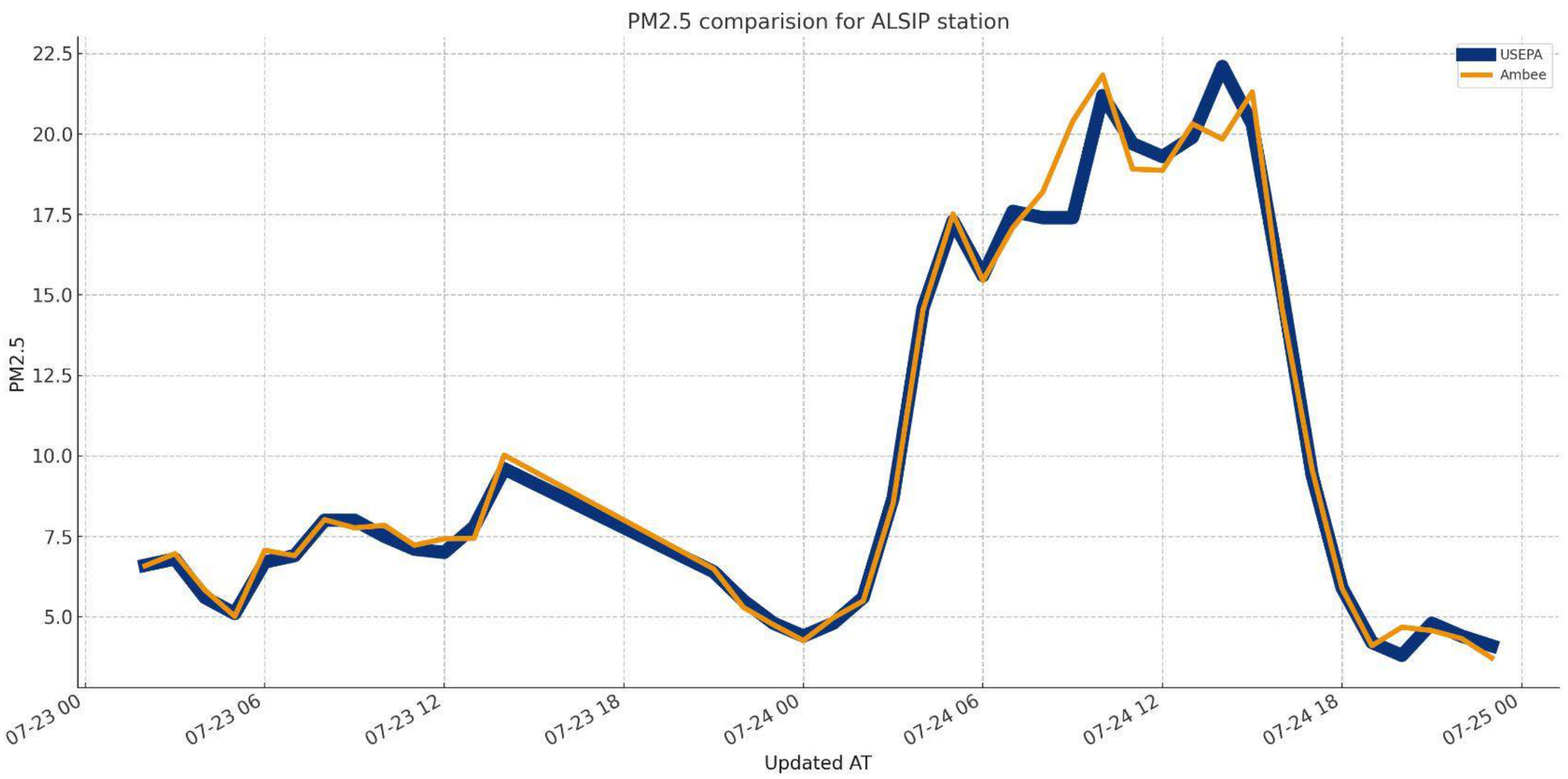
Los Angeles, N Main Street



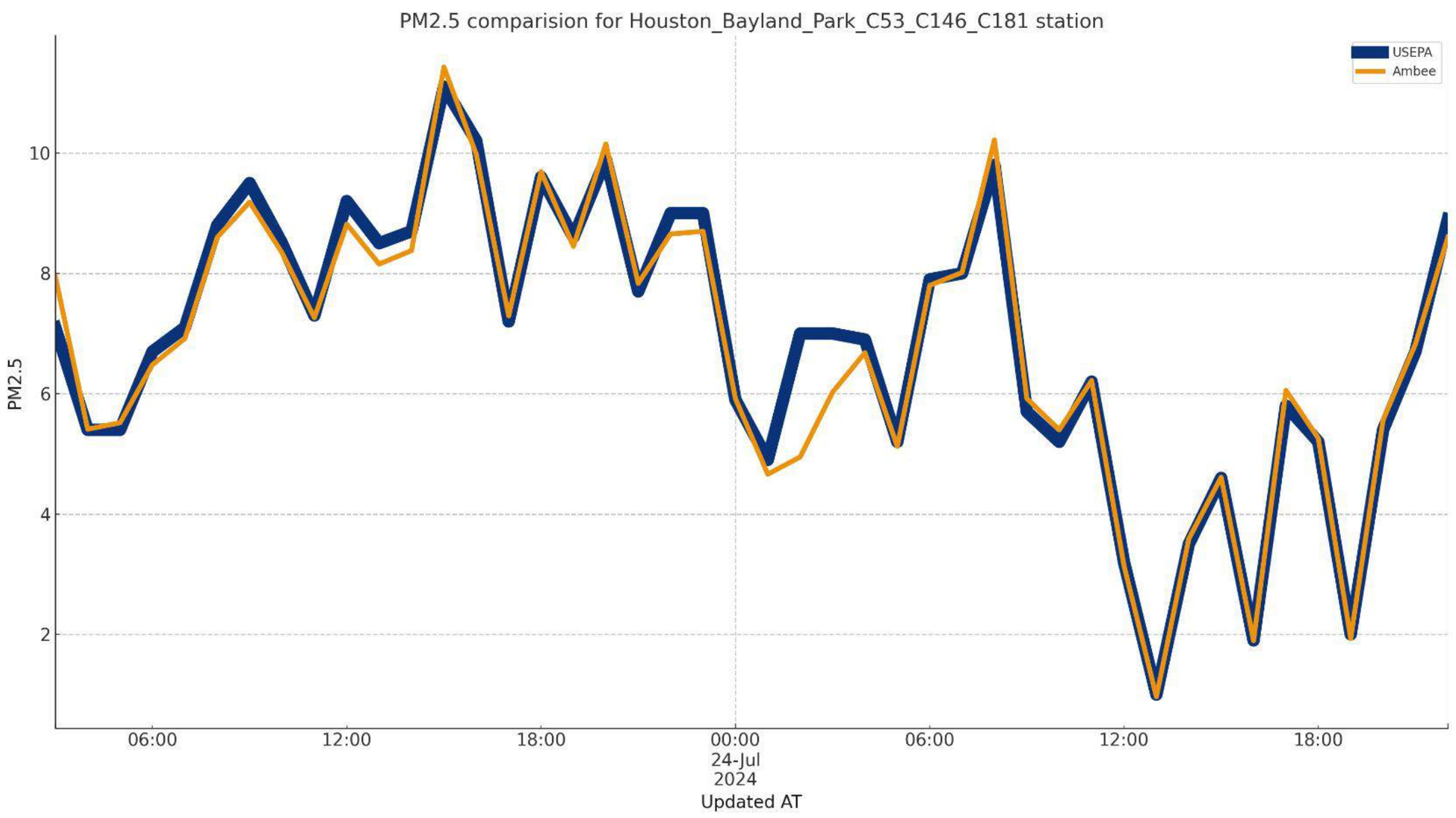
New York, Paterson



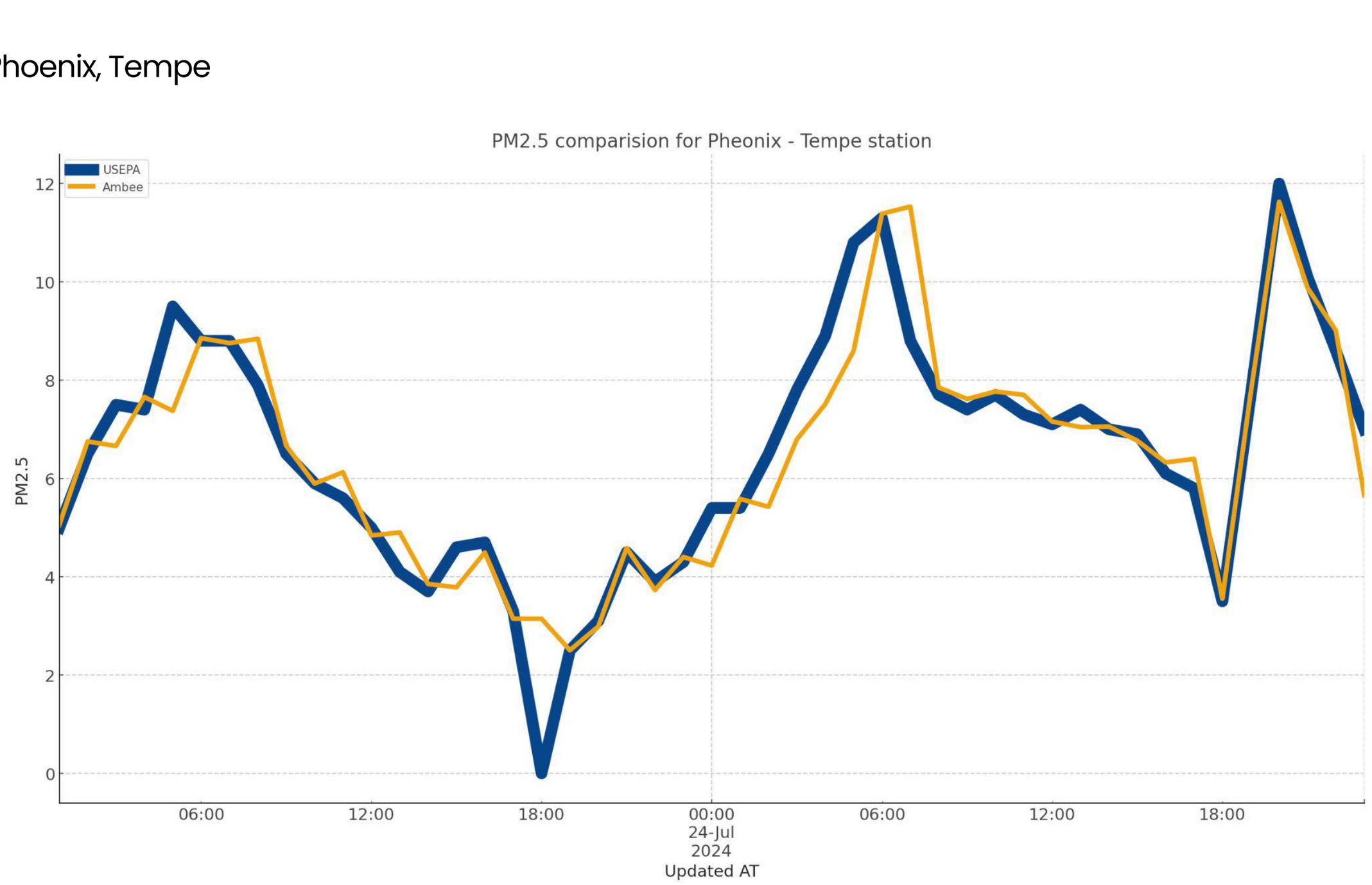
Chicago, ALSIP



Houston, Bayland Park



Phoenix, Tempe



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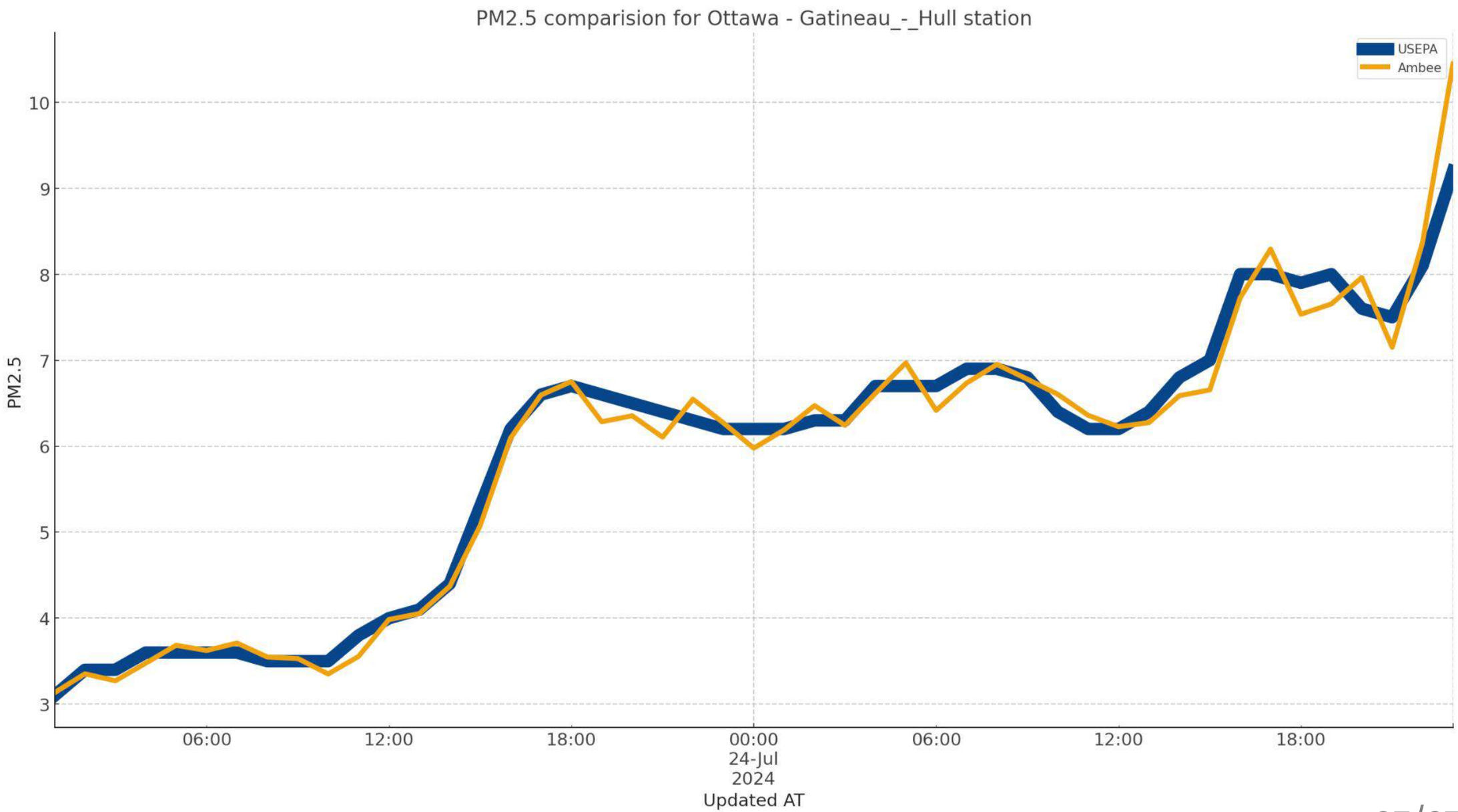
Benchmarking ambee accuracy* against on-ground stations: Canada

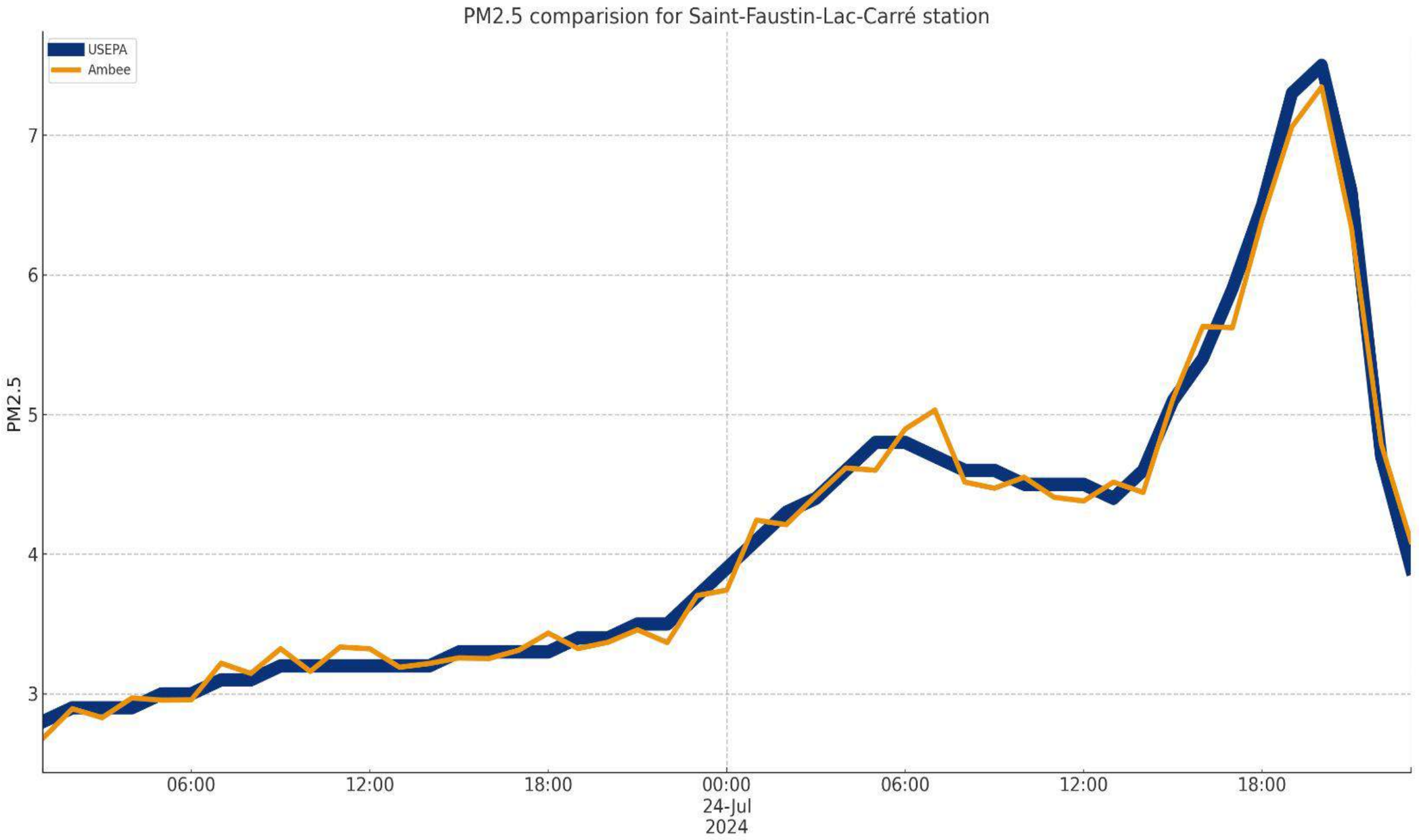
*Accuracy achieved when comparing ground station data with Ambee data for PM2.5 in the 47-48 hour timeframe.

City	Station	Accuracy*
Ottawa	Gatineau Hull	**80%**
Montreal	Saint-Faustin-Lac-Carré	**88%**
Edmonton	Androssan	**85%**
Vancouver	Rocky Point Park	**94%**
Toronto	New Market	**86%**

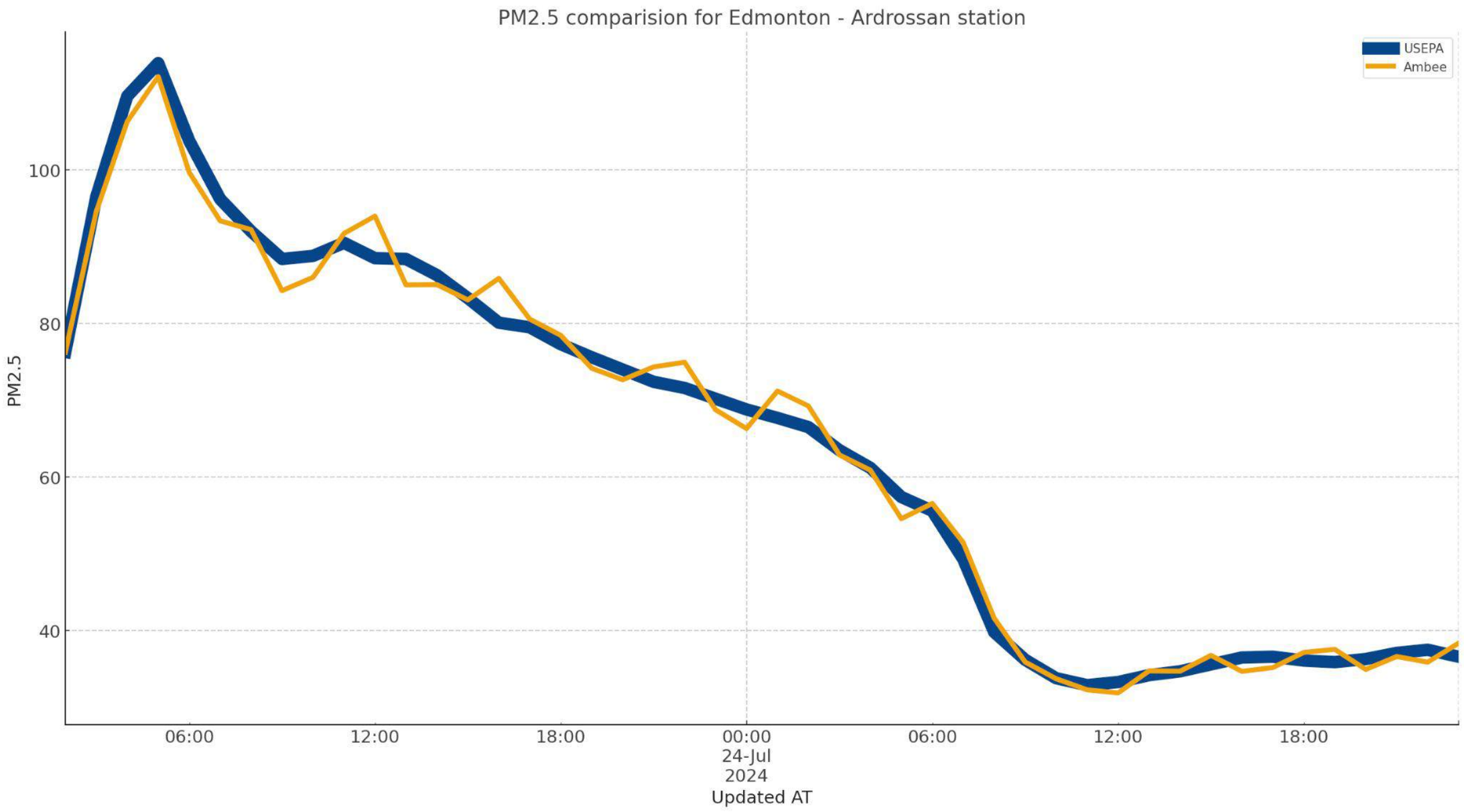
Ottawa, Gatineau Hull



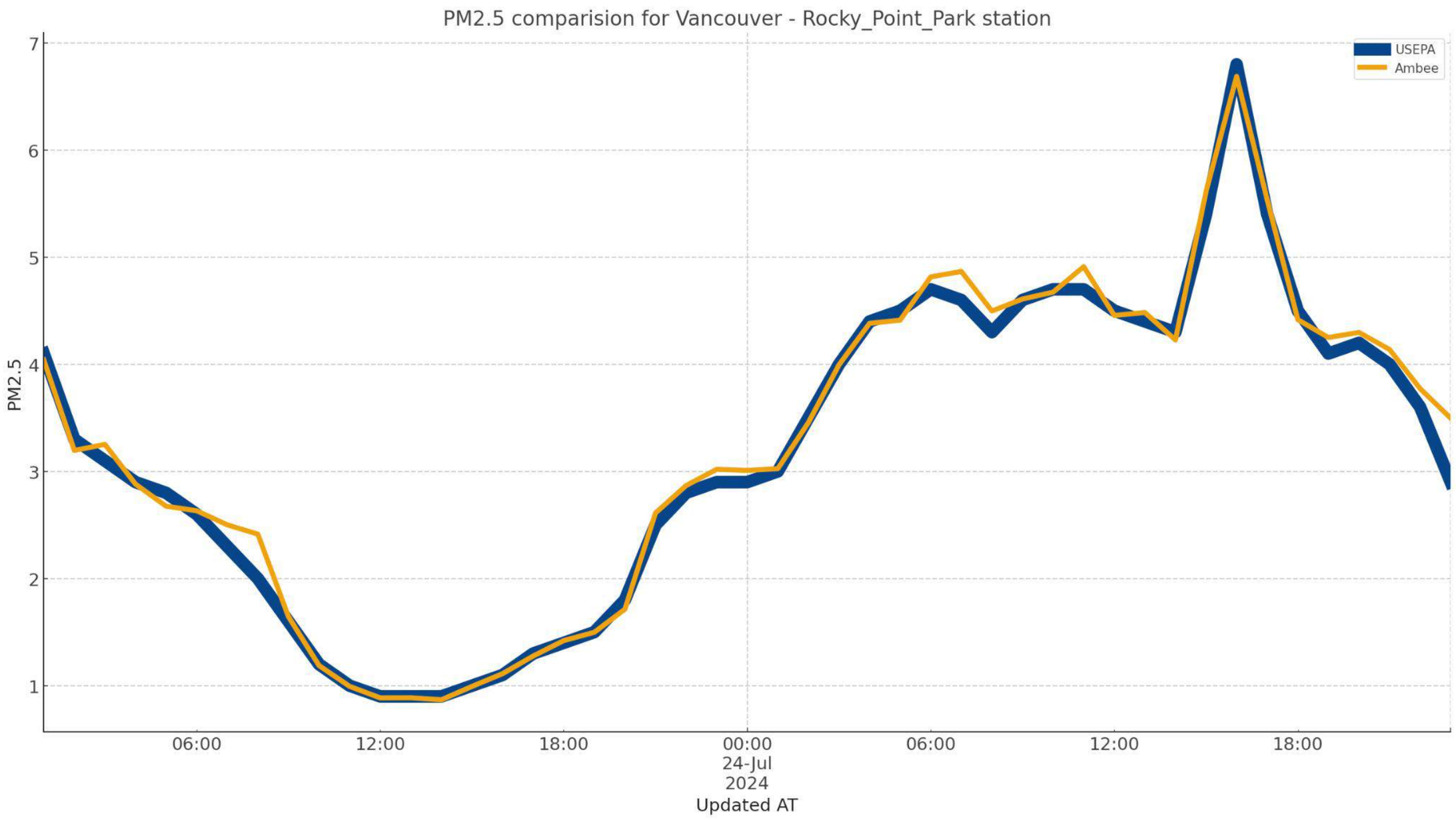
Montreal, Saint-Faustin-Lac-Carré



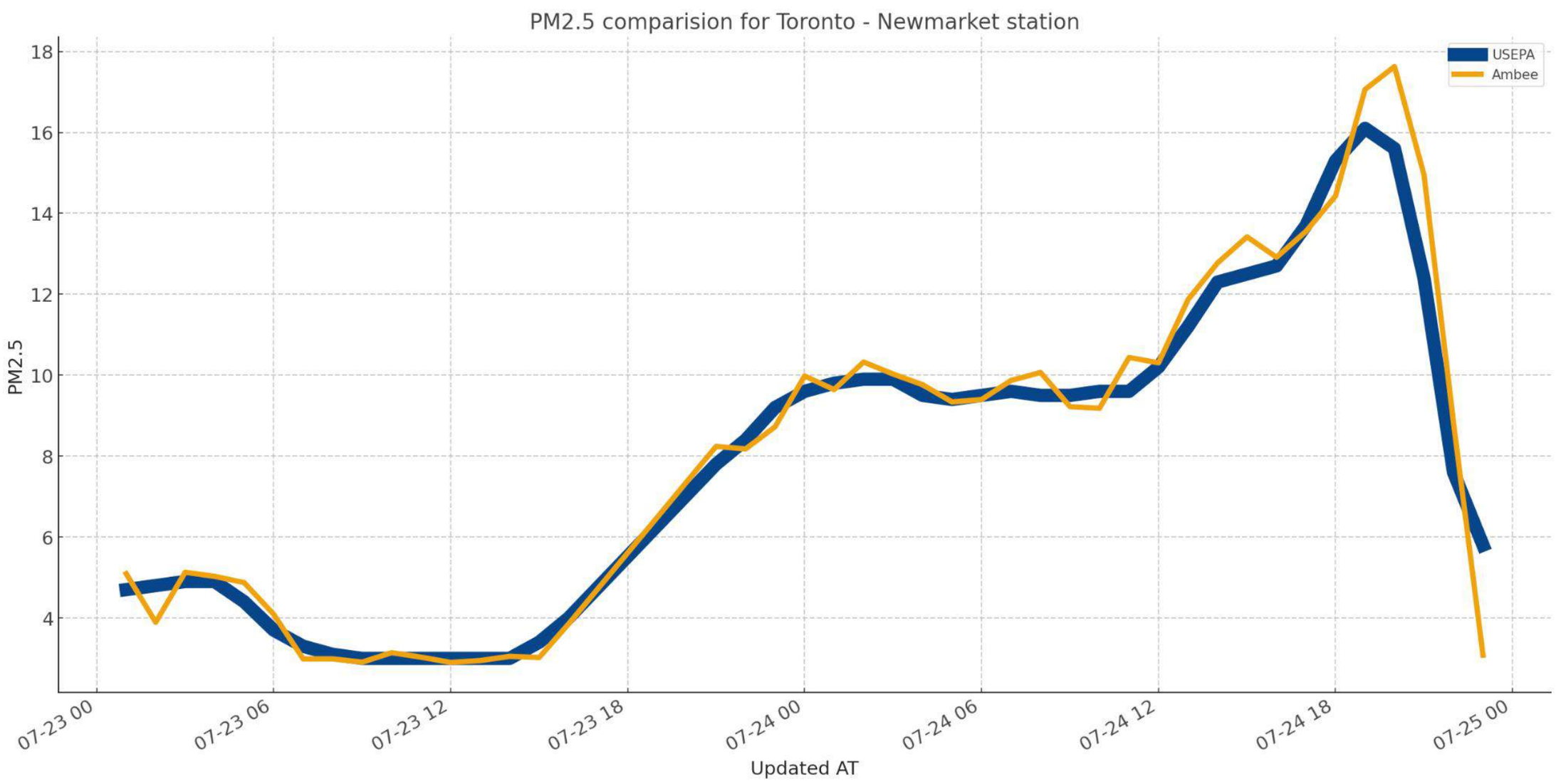
Edmonton, Androssan



Vancouver, Rocky Point Park



Toronto, Wellington St.



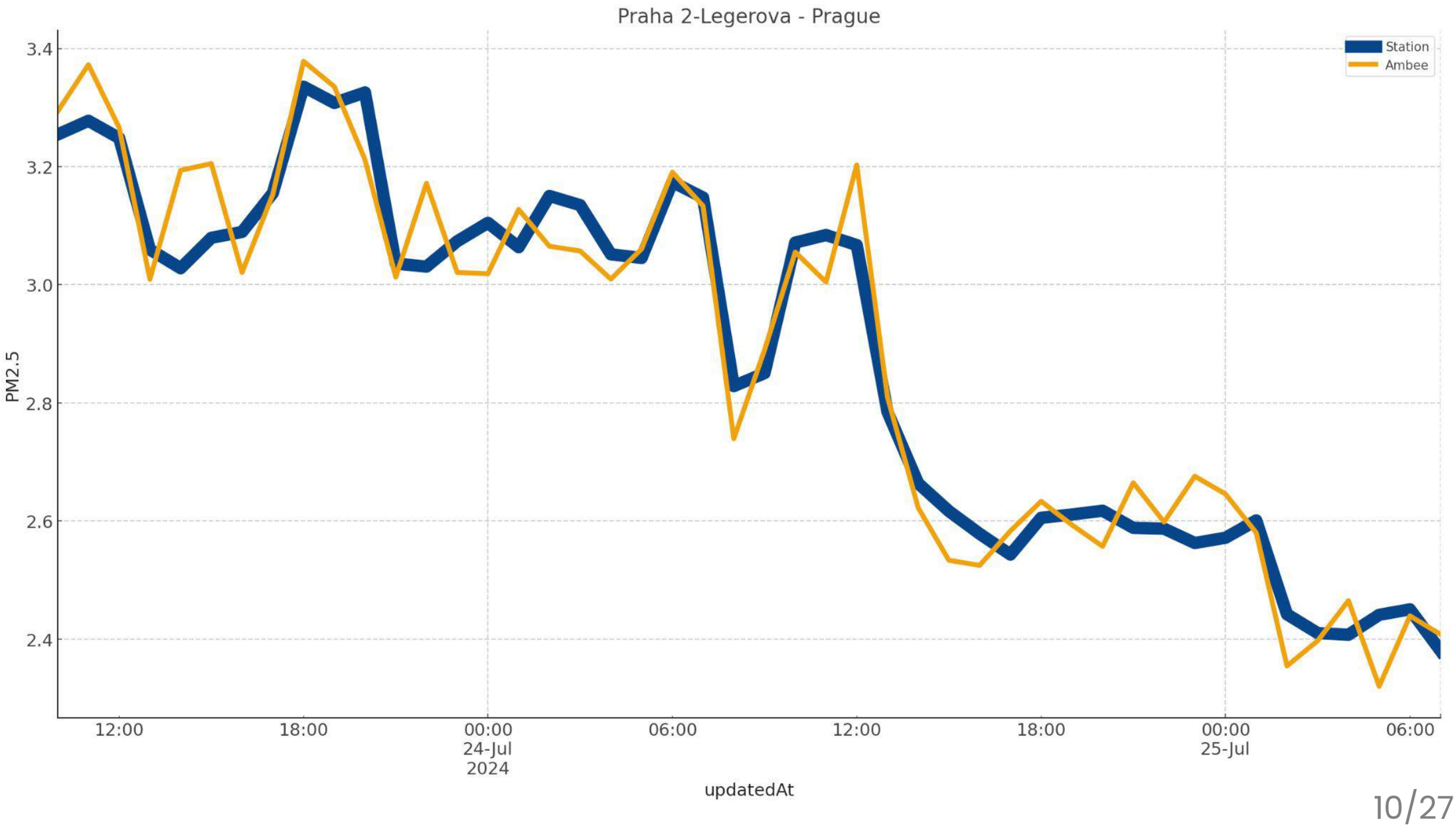
Benchmarking ambee accuracy* against on-ground stations: Europe

*Accuracy achieved when comparing ground station data with Ambee data for PM2.5 in the 47-48 hour timeframe.

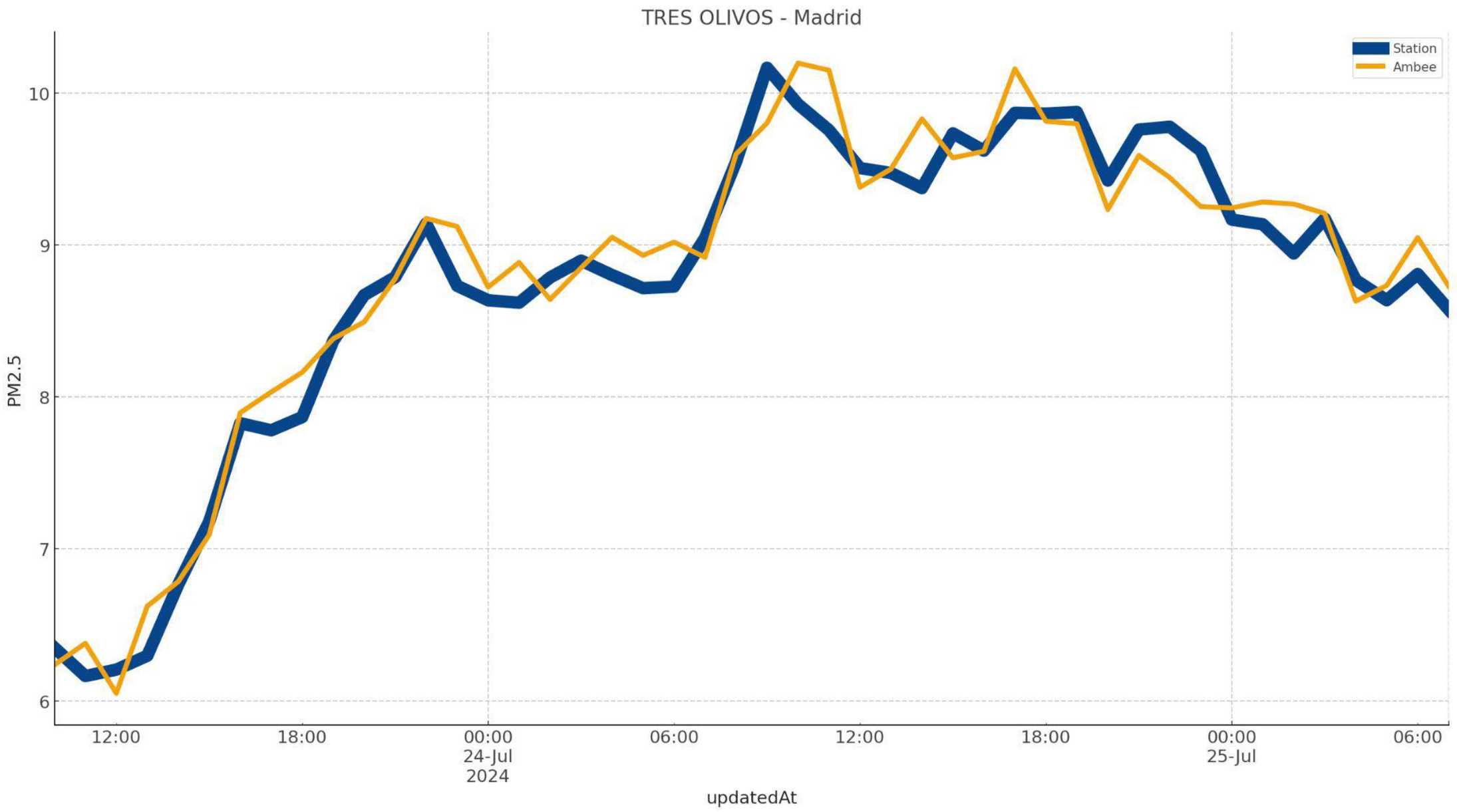
City	Station	Accuracy*
Prague	Legerova	**92%**
Madrid	Tres Olivos	**92%**
Brussels	Meudon	**94%**
Berlin	Frankfurter Allee	**89%**
Paris	Boulevard Haussmann	**95%**

Station
Ambee

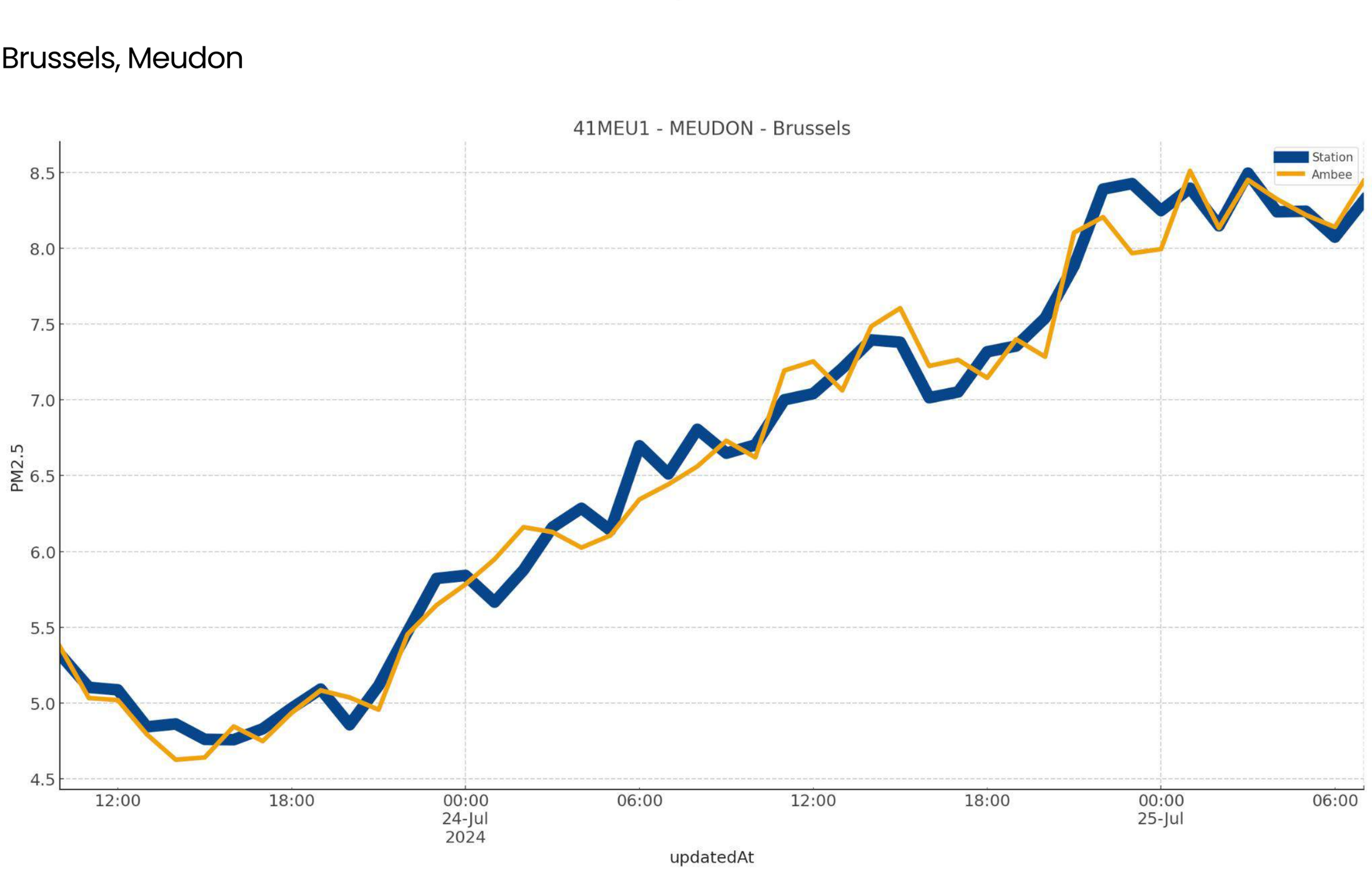
Prague, Legerova



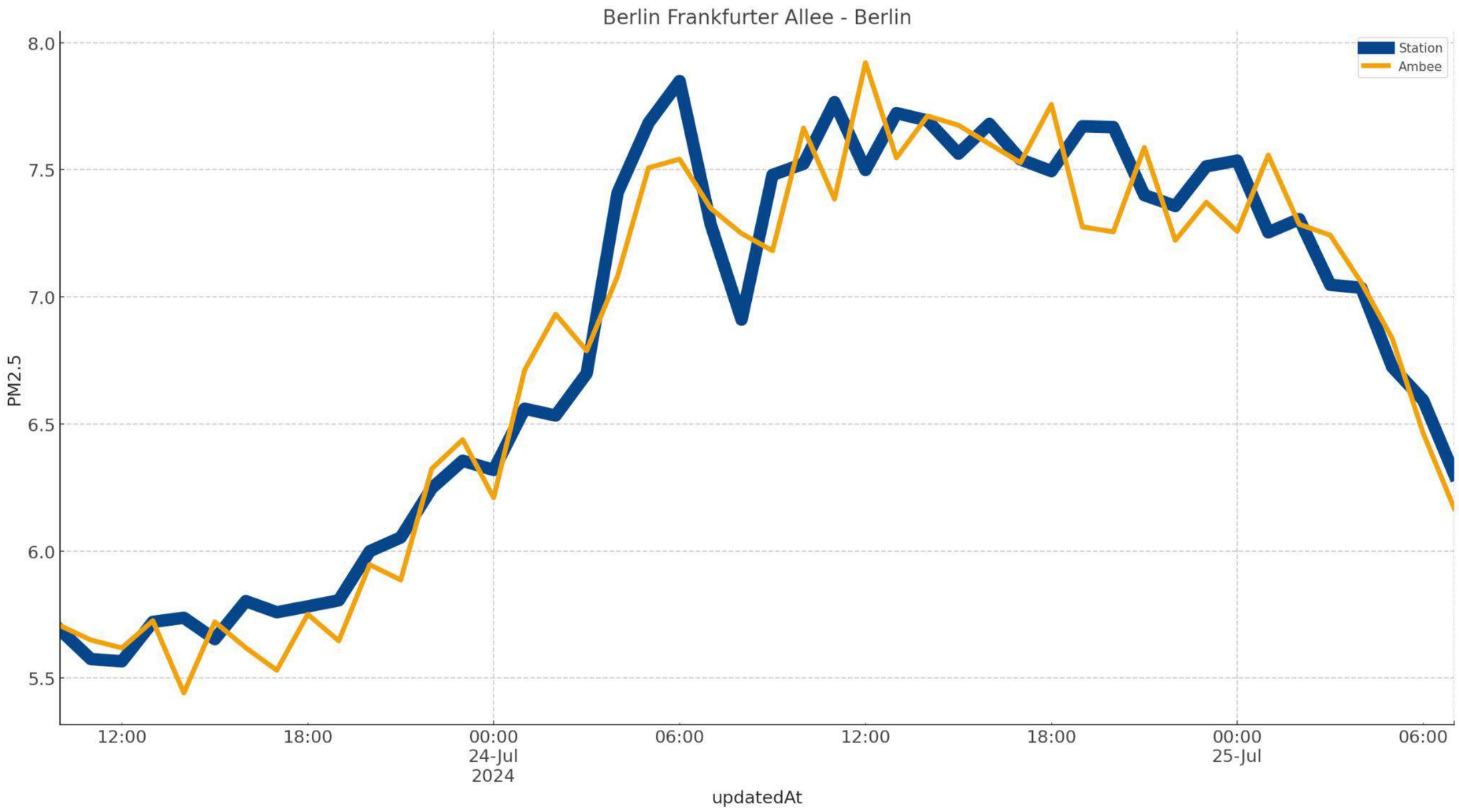
Madrid, Tres Olivos



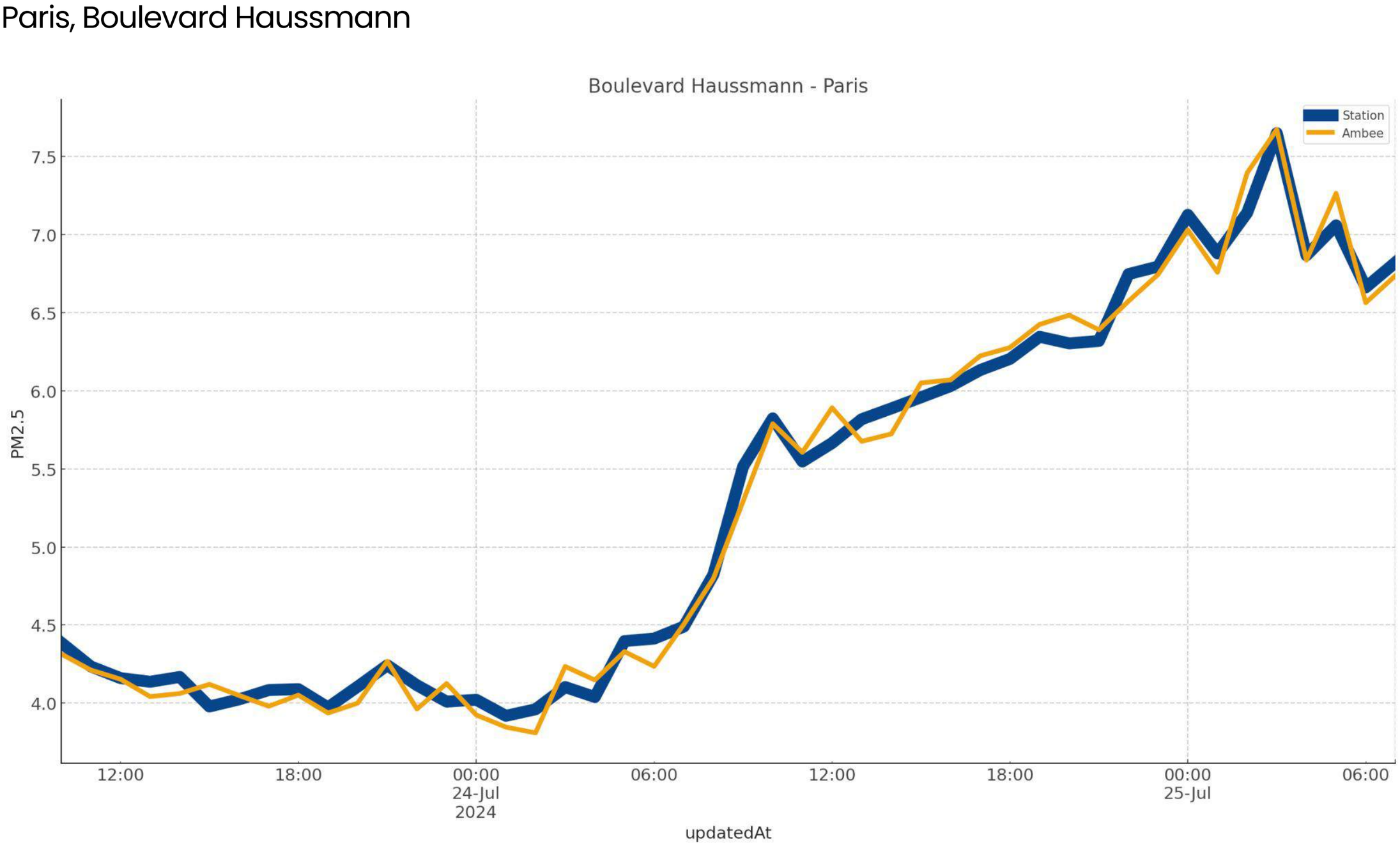
Brussels, Meudon



Berlin, Frankfurter Allee,

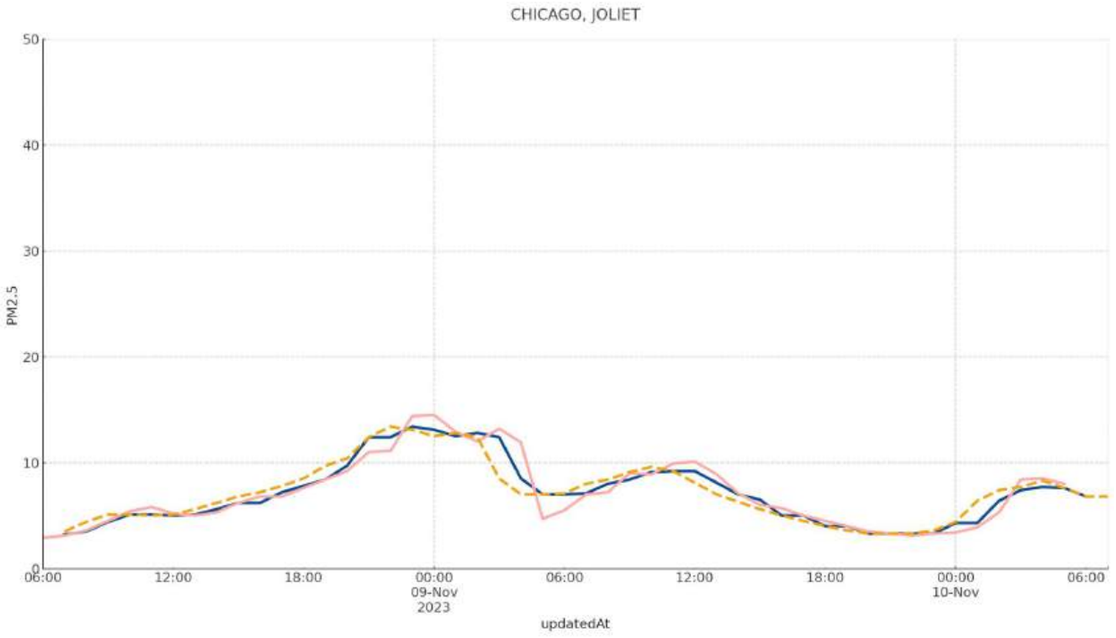


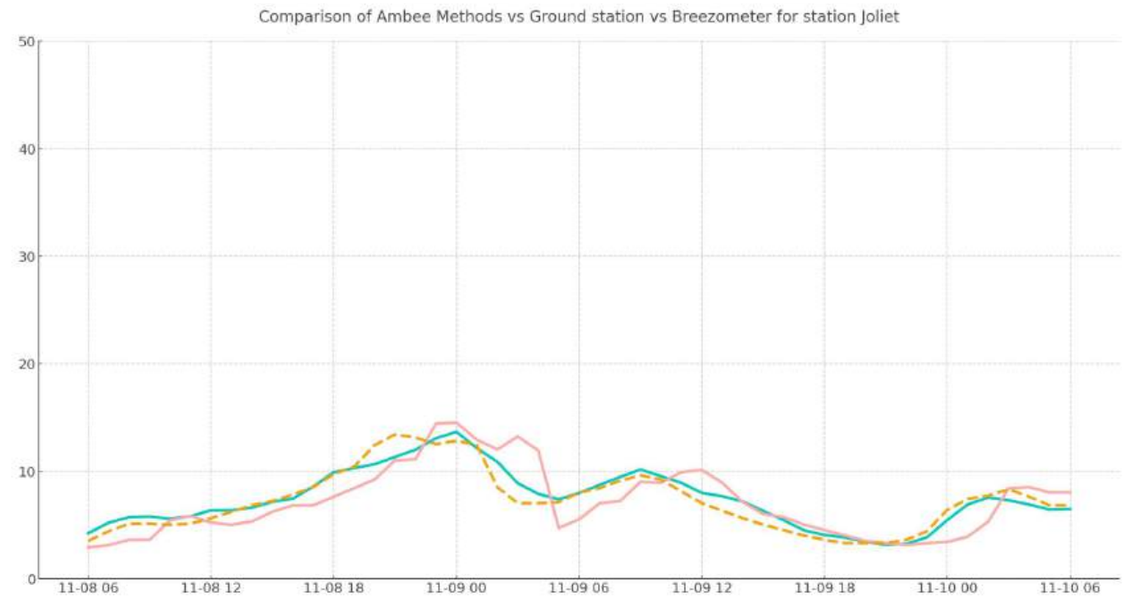
Paris, Boulevard Haussmann

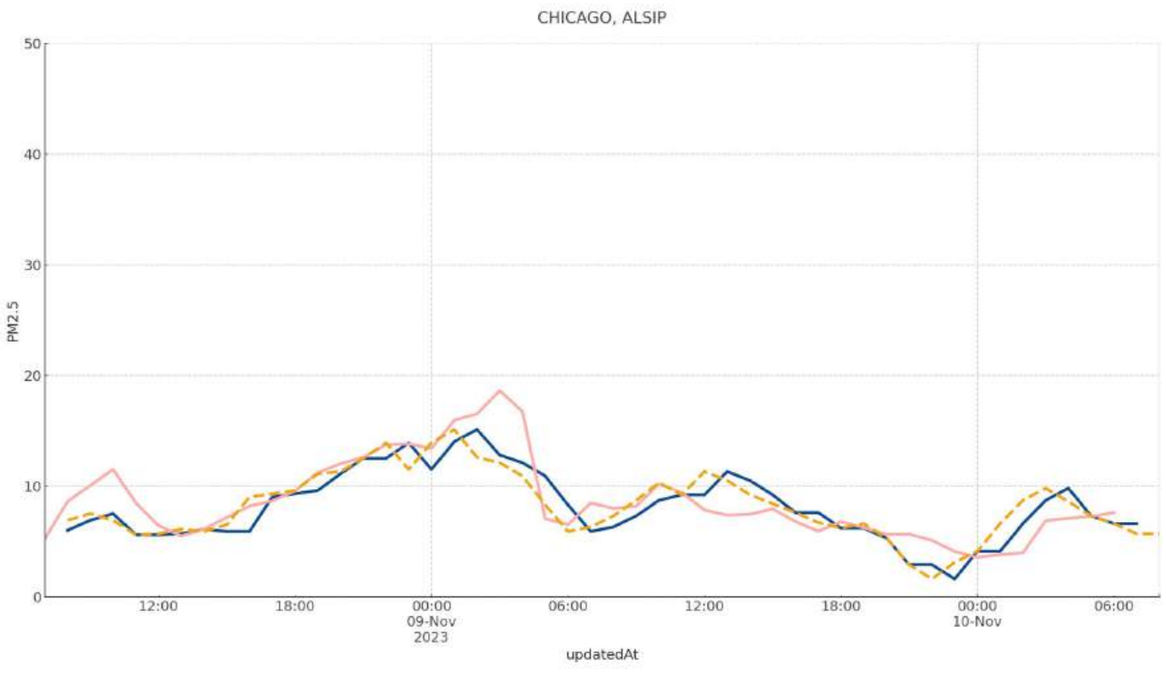


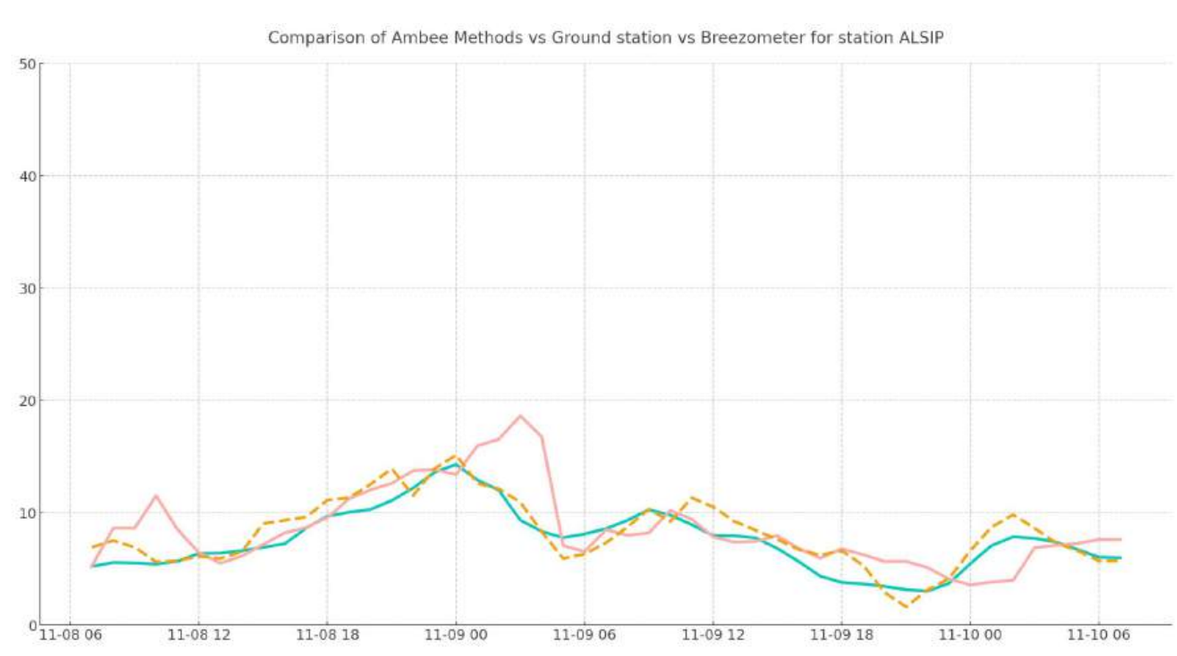
Benchmarking ambee accuracy* against Breezometer: USA

*Accuracy achieved when comparing Ambee data with Breezometer data for PM2.5 in the 47-48 hour timeframe.







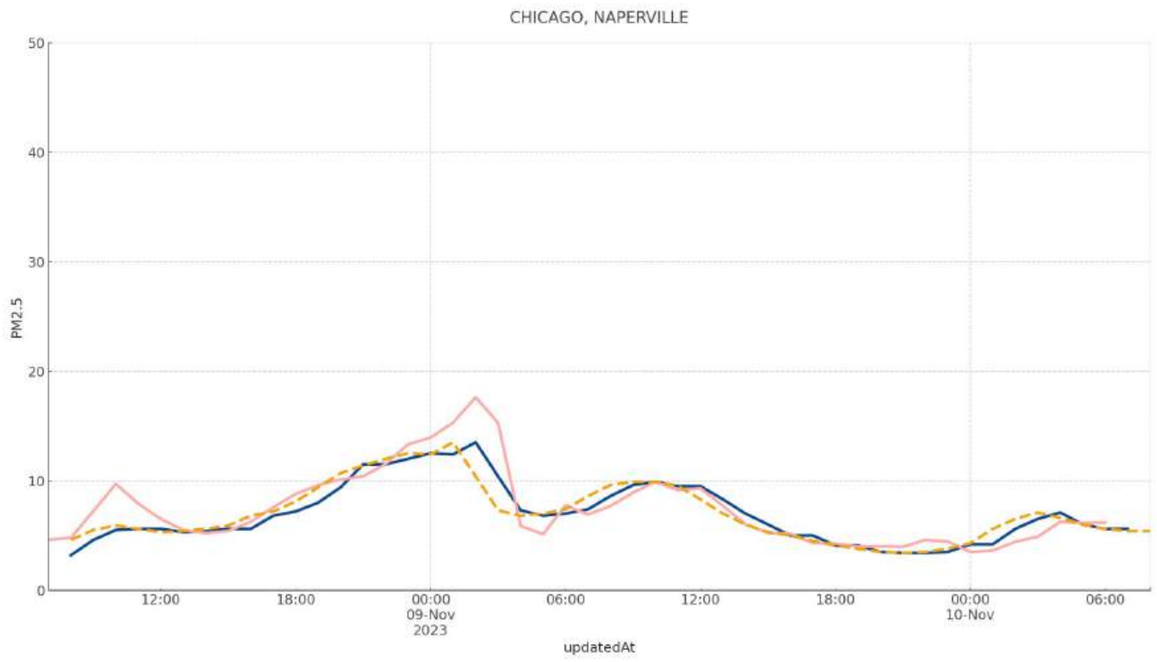


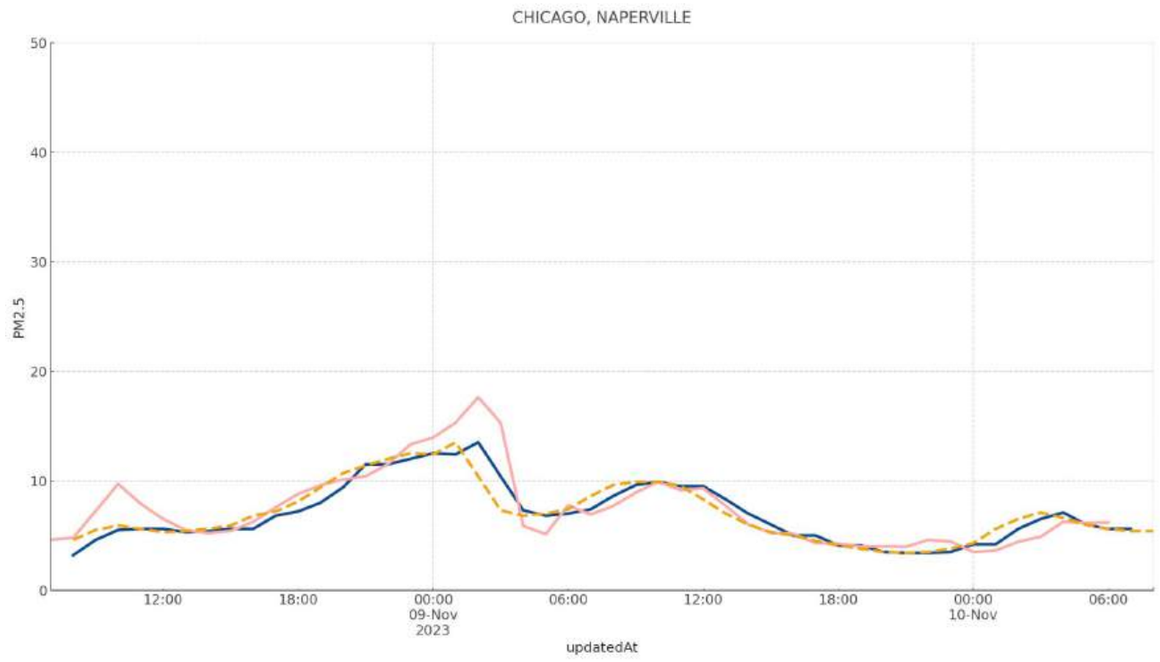
Ambee's data output using station data

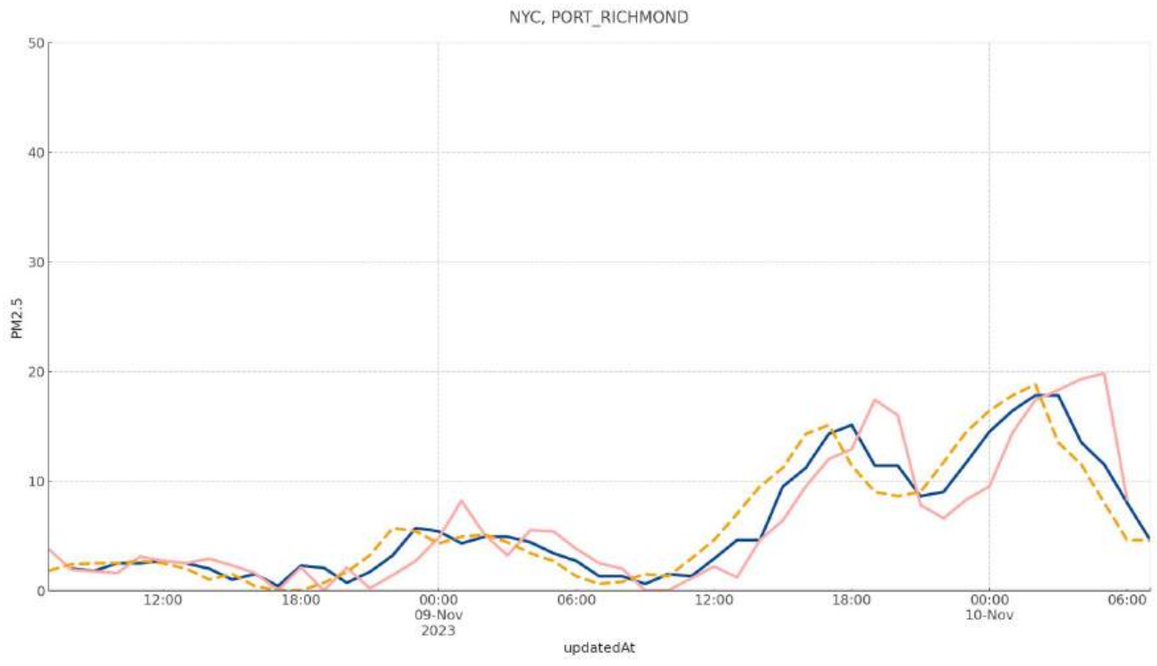
Ambee's modeled data output without using station data

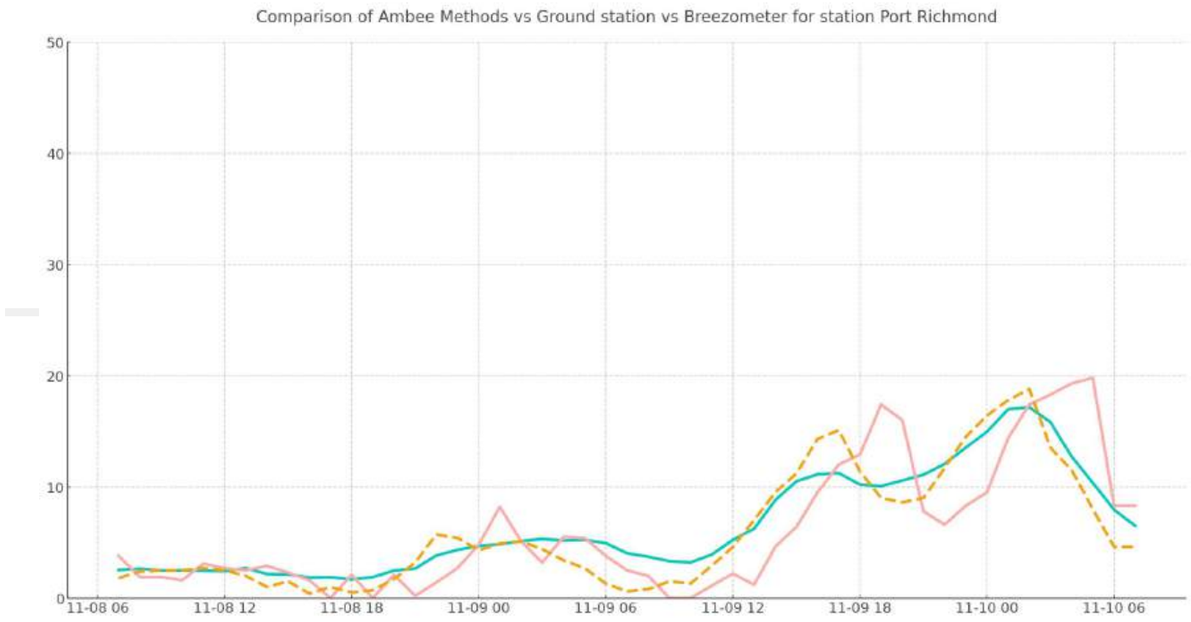
Breezometer's data output using station data

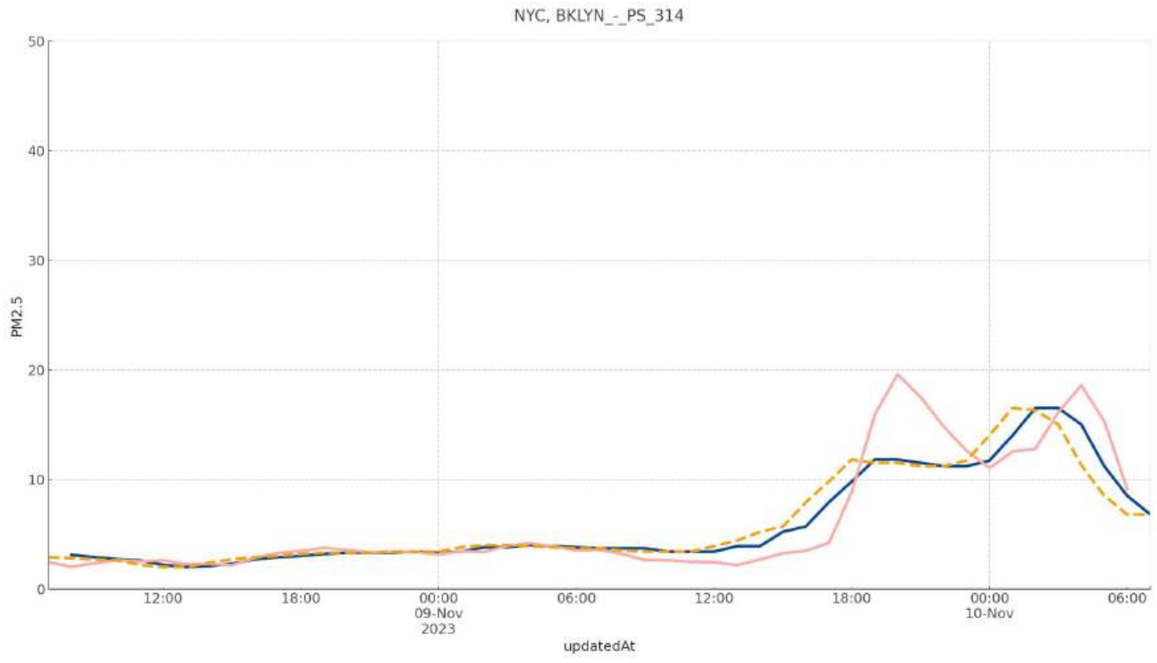
Station data

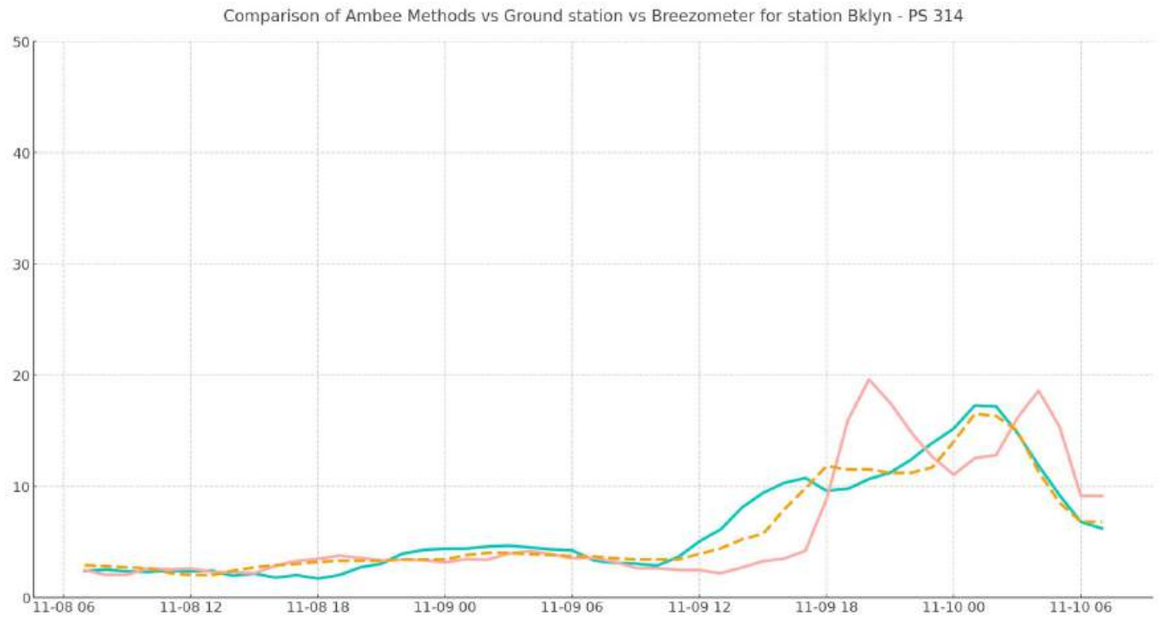










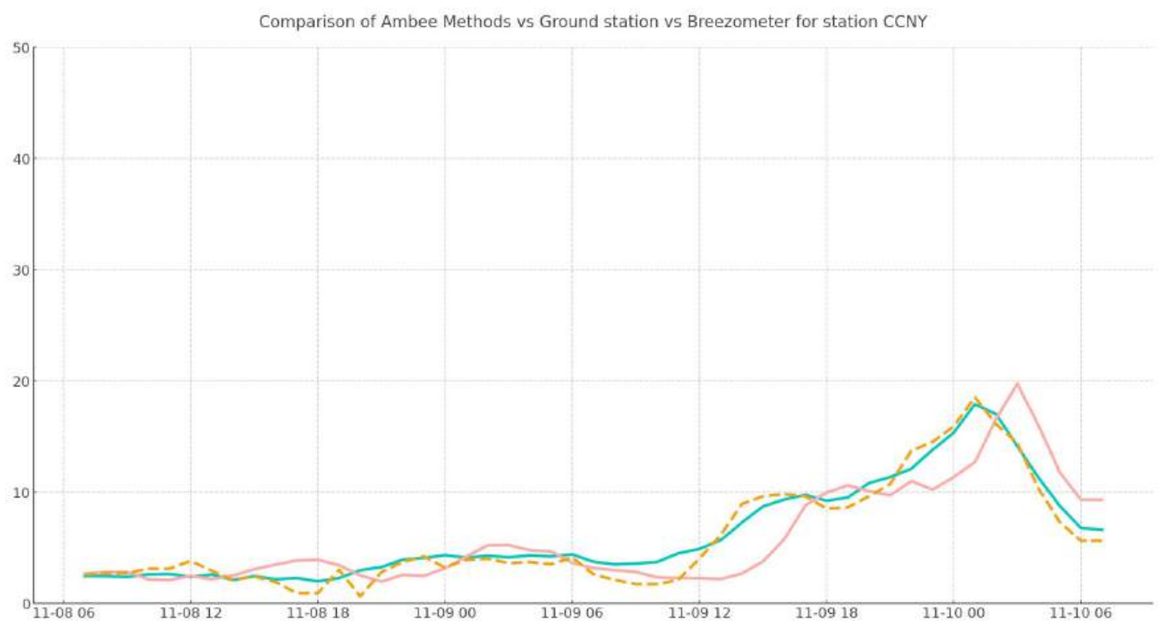


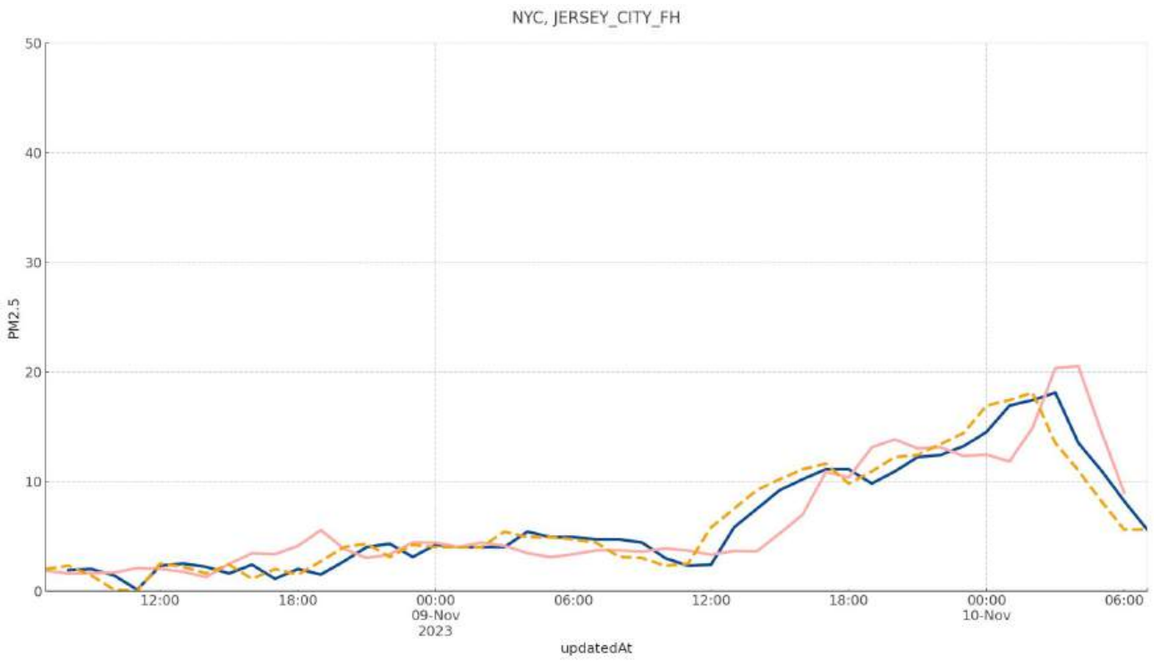
Ambee's data output using station data

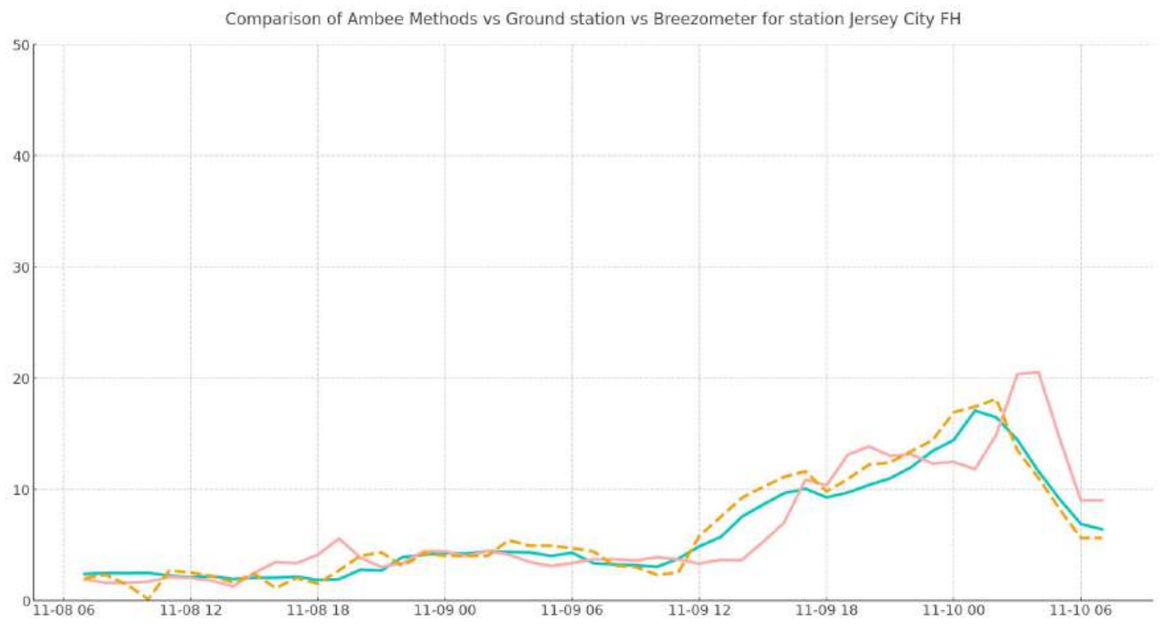
Ambee's modeled data output without using station data

Breezometer's data output using station data

Station data







Ambee's data output using station data

Ambee's modeled data output without using station data

Breezometer's data output using station data

Station data

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Accuracy of Ambee's 48-hour air quality forecast data versus on-ground station data

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Metrics used

Mean absolute error: Mean Absolute Error (MAE) is a way to measure how far off, on average, your predictions are from the actual values.

Unit - ug/m3

Categorical accuracy: Categorical Accuracy measures how accurately our predictions match the actual categories. Each prediction is given a score: 100% if it's an exact match, 66% if it's off by one level, 33% if it's off by two levels, and 0% if it's off by more than two levels.

Example: Actual - Good, Prediction - Good: Categorical Accuracy - 100%

Actual - Good, Prediction - Moderate: Categorical Accuracy - 66%

Unit - %

Why these metrics?

- Mean absolute error is for people with statistical knowledge to know how close we are to actual data in terms of raw numbers.
- However, mean absolute error is hard to interpret without context. For example, MAE of 8 is extremely poor if the value ranges between 0-5 but very good if the value ranges between 100-150.
- To put things into context, we created categorical accuracy. The values are binned into categories based on USEPA Standards and this metric will check if the values are in the same range/category.
- When the average person checks the air quality, they care more about whether it's good or bad rather than the specific details, like a 3.23% error in PM2.5 predictions. By combining both these metrics with visual graphs, we can provide a comprehensive and easy-to-understand overview of our forecasts.

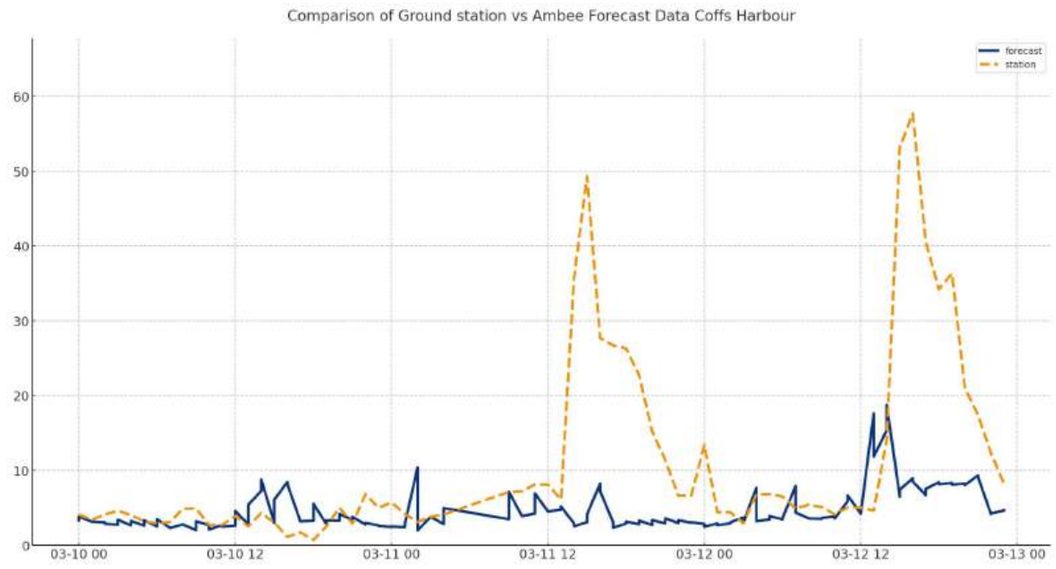
USEPA PM2.5 thresholds for binning

AQI Category	Index Values	Revised Breakpoints (ug/m³, 24-hour average)
Good	0-50	0.0-12.0
Moderate	51-100	12.1-35.4
Unhealthy for Sensitive Groups	101-150	35.5-55.4
Unhealthy	151-200	55.5-150.4
Very Unhealthy	201-300	150.5-250.4
Hazardous	301-400 401-500	250.5-350.4 350.5-500

Disclaimer

The accuracy is measured for a period of 48 hours. Accuracy might change for the same location later. The accuracy value should be treated as an estimate. A comparison for a period of 96 hours is possible upon request.

Air quality depends on a lot of real time factors such as human activities, fires etc hence, sudden changes in air quality cannot be predicted ahead of time. (see the image on the right for an example)



Here, the station data shows two sudden spikes that were not forecasted. Despite this, the overall categorical accuracy remains at 87%.

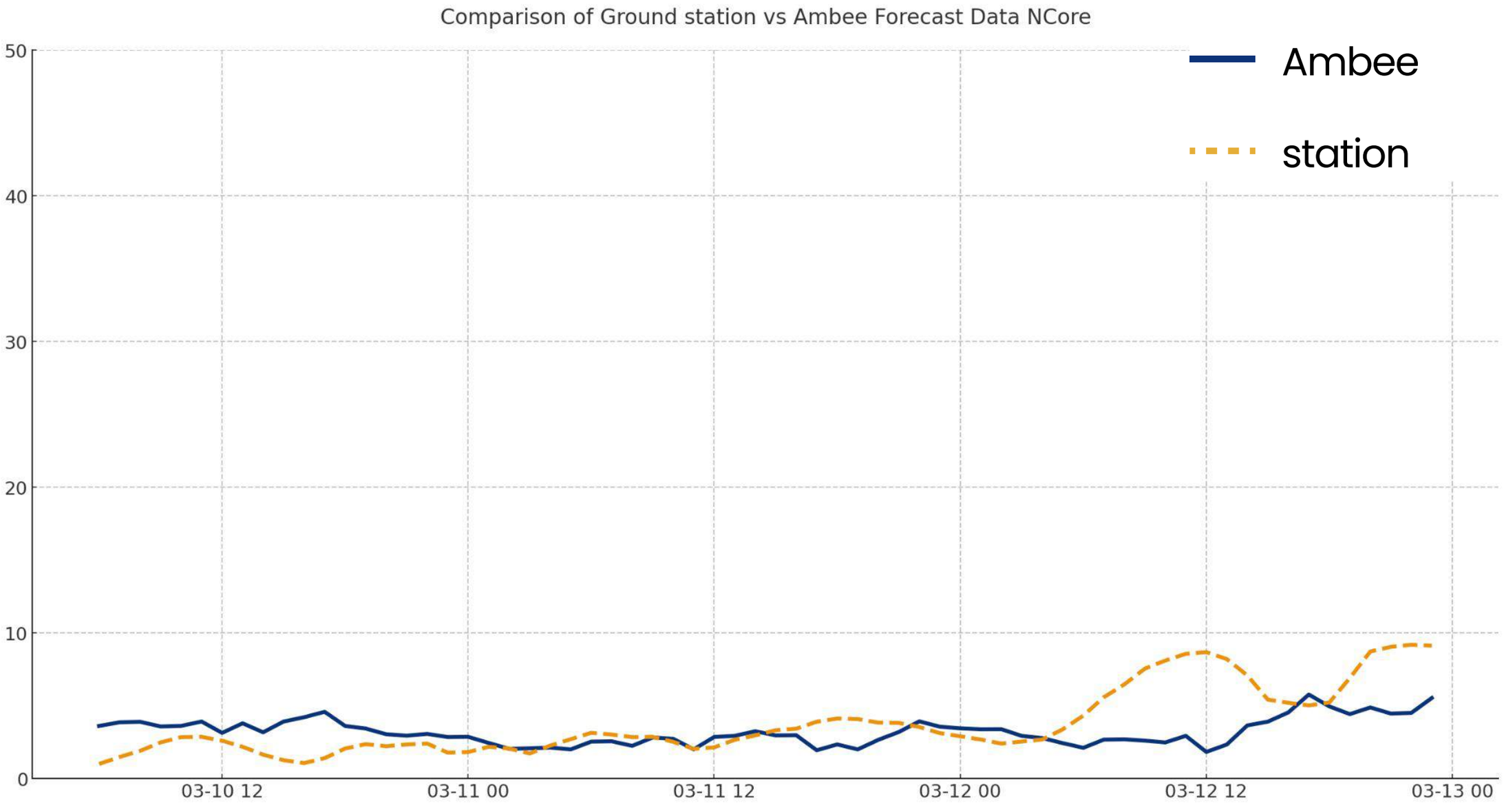
Summary

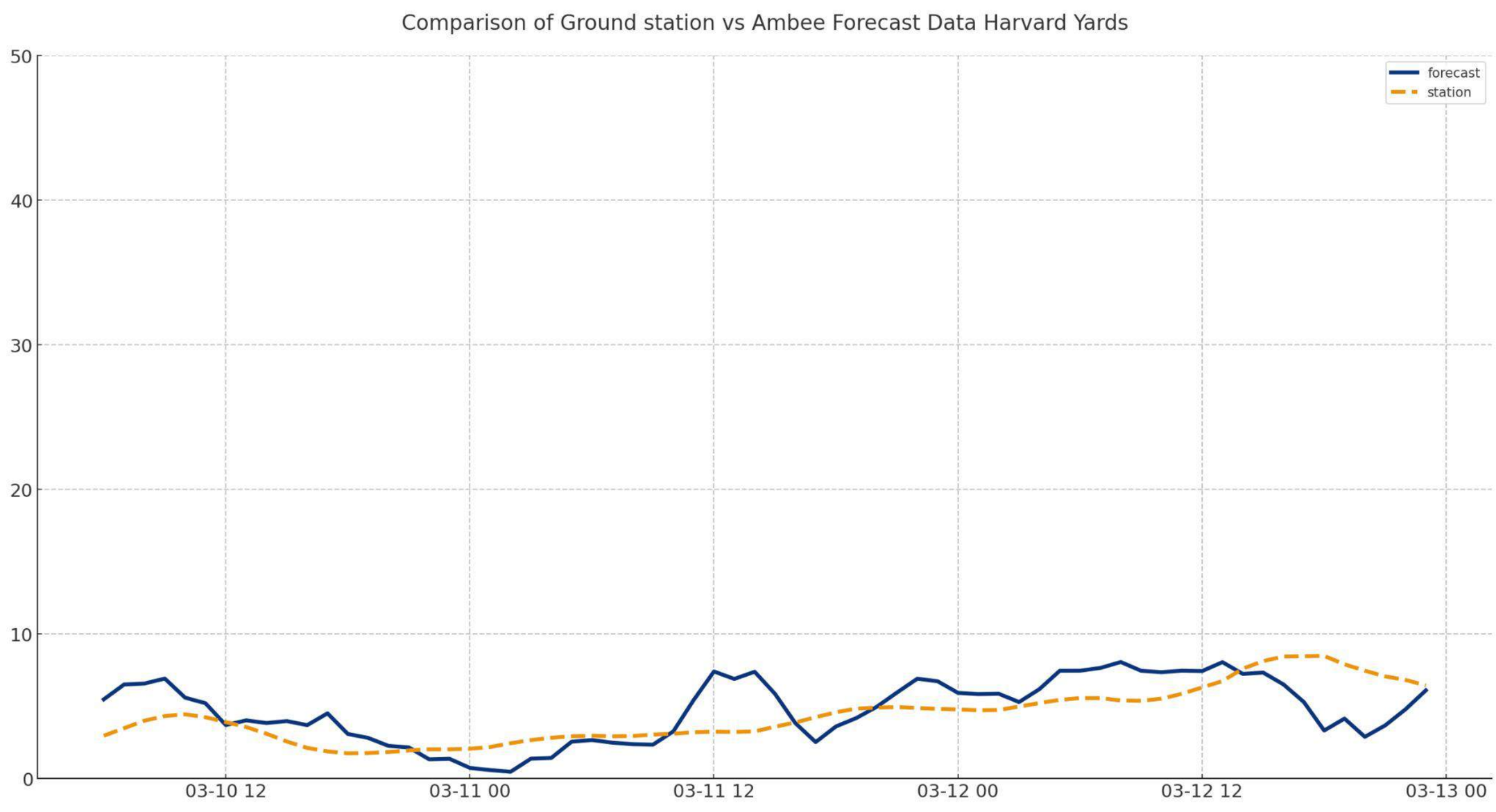
Region	Average MAE	50th% MAE	Average Cat. Accuracy	50th% Cat. Accuracy
Australia	3.60	3.35	97.56	98.61
Europe	8.82	8.04	83.60	83.79
North America	3.92	3.41	97.02	98.57
Asia	16.13	10.80	74.89	80.75
Overall	8.12	6.4	88.26	90.43

Benchmarking ambee forecast accuracy* against on-ground stations: North America

*Accuracy achieved when comparing ground station data with Ambee data for PM2.5 in the 47-48 hour timeframe.

Region	MAE	MAE (0-6 hrs)	MAE (7-12 hrs)	MAE (13 -24 hrs)	MAE (25 -48 hrs)	Cat. Acc	Cat. Acc (0-6 hrs)	Cat. Acc (7-12 hrs)	Cat. Acc (13 -24 hrs)	Cat. Acc (25 -48 hrs)
Ncore	2.38	1.27	1.67	1.59	3.46	100.0	100.0	100.0	100.0	100.0
Harvard Yards	2.41	2.15	4.45	2.33	2.51	100.0	100.0	100.0	100.0	100.0
Austin North	4.26	4.12	5.05	5.81	3.28	88.09	95.24	85.71	82.05	87.5




Comparison of Ground station vs Ambee Forecast Data Harvard Yards
forecast
station
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03-11 12
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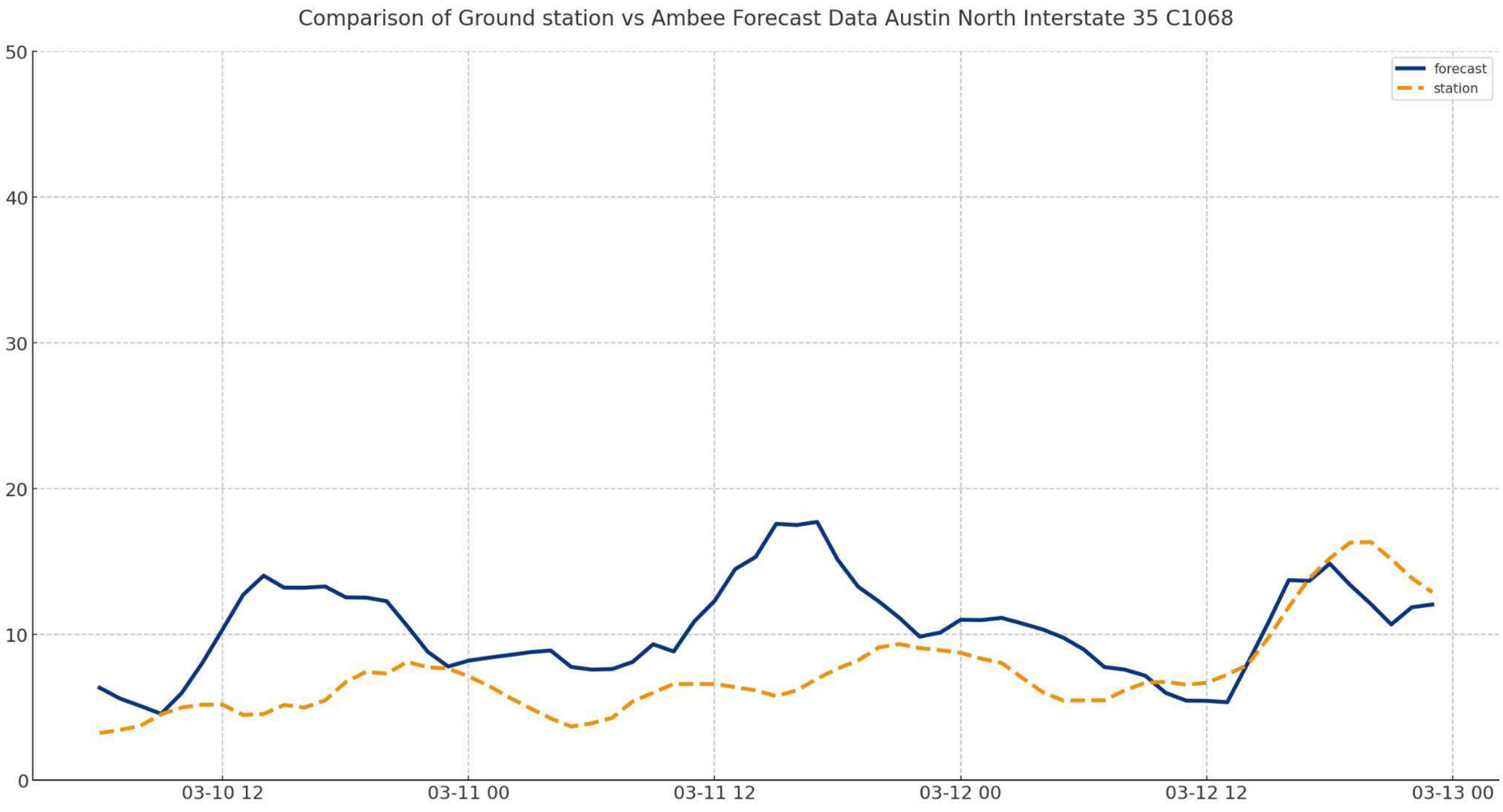
03-12 12
03-13 00


Comparison of Ground station vs Ambee Forecast Data Austin North Interstate 35 C1068
forecast
station
50
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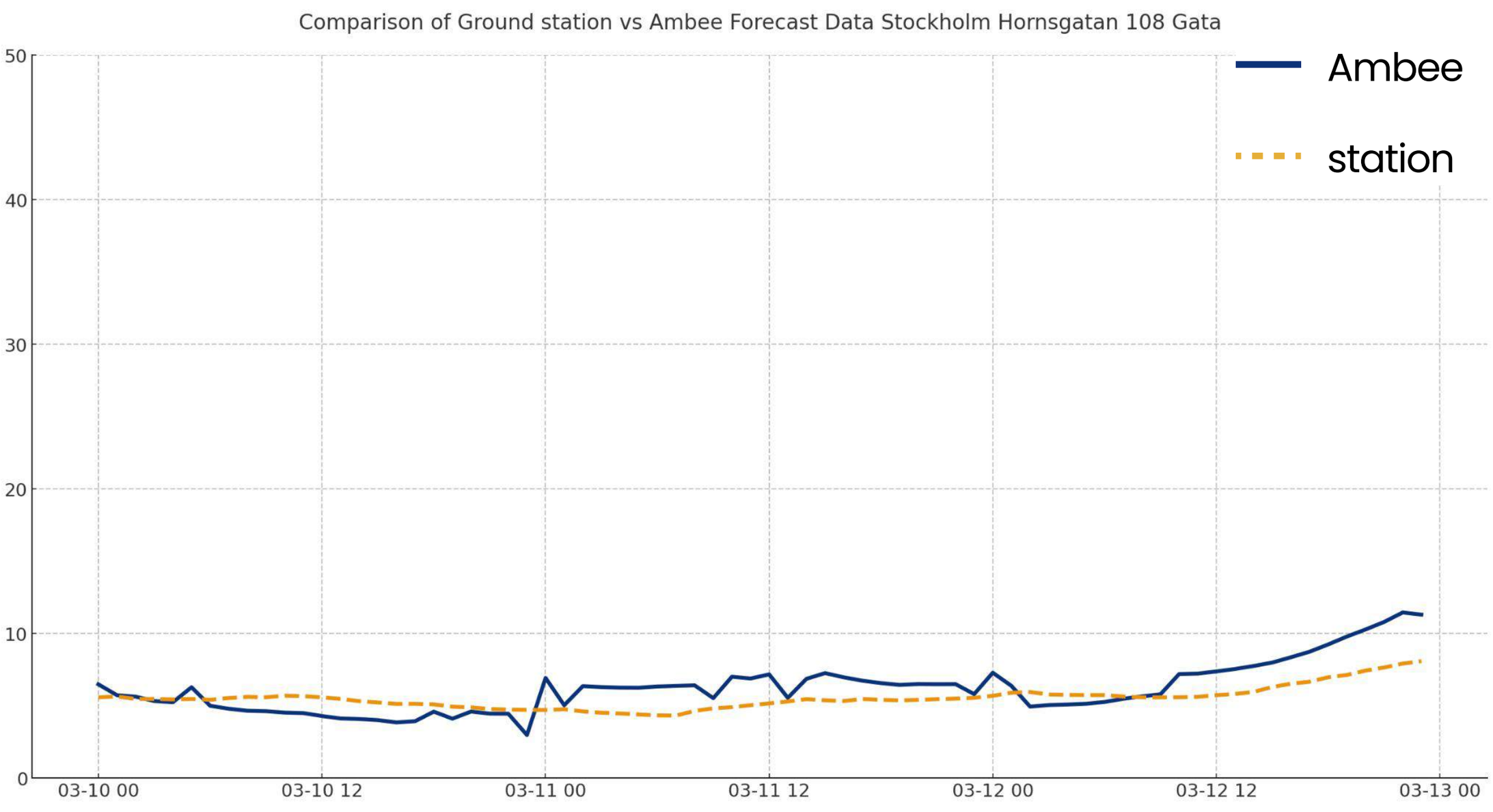
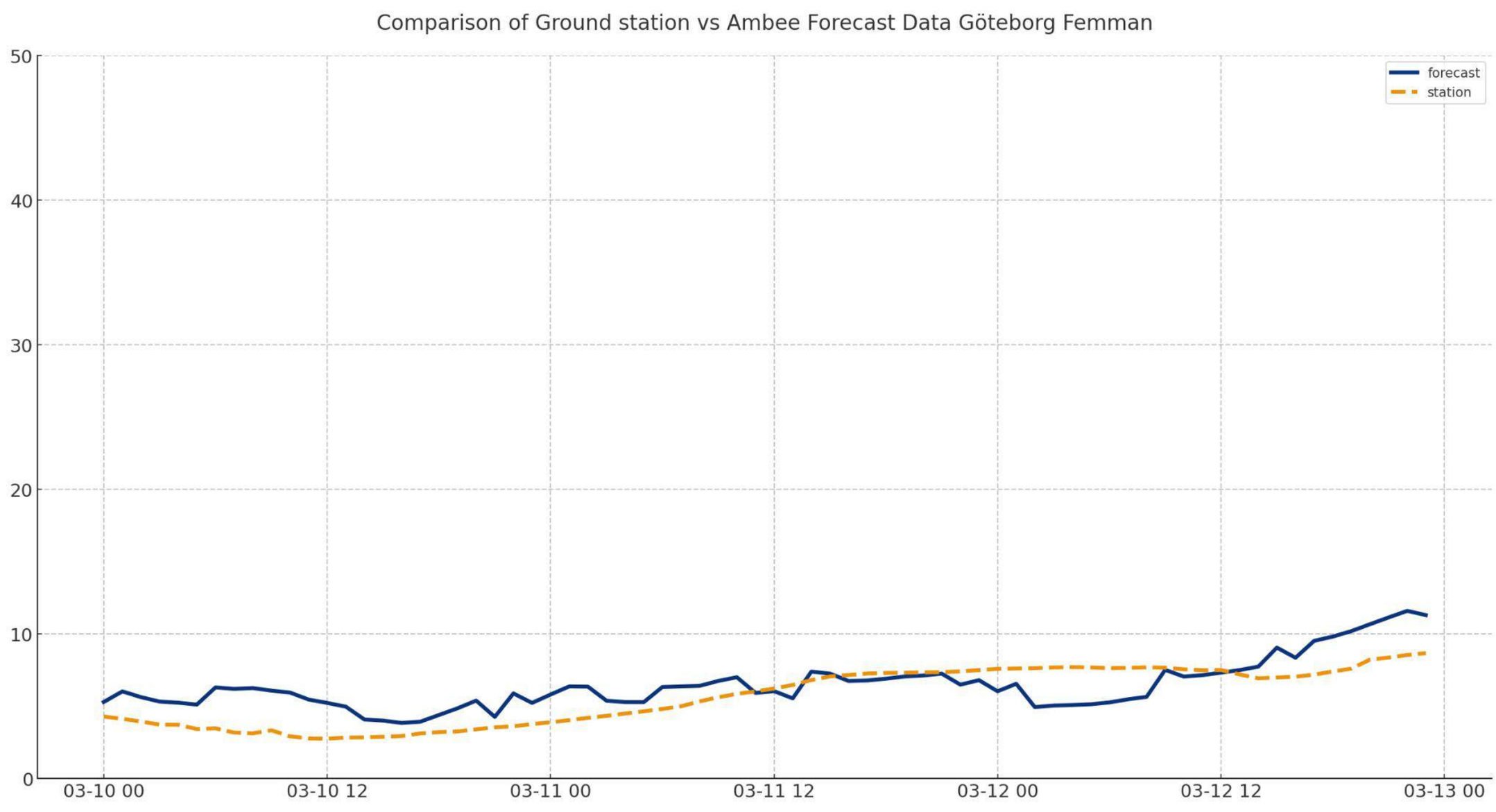
03-10 12
03-11 00
03-11 12
03-12 00
03-12 12
03-13 00

Benchmarking ambee forecast accuracy* against on-ground stations: Europe

*Accuracy achieved when comparing ground station data with Ambee data for PM2.5 in the 47-48 hour timeframe.

Region	MAE	MAE (0-6 hrs)	MAE (7-12 hrs)	MAE (13 -24 hrs)	MAE (25 -48 hrs)	Cat. Acc	Cat. Acc (0-6 hrs)	Cat. Acc (7-12 hrs)	Cat. Acc (13 -24 hrs)	Cat. Acc (25 -48 hrs)
Stockholm	1.27	1.66	1.78	1.20	1.57	100.0	100.0	100.0	100.0	100.0
Goteborg	1.51	1.49	0.93	0.53	1.82	100.0	100.0	100.0	100.0	100.0
Plzen	3.51	4.23	3.41	2.96	1.08	89.81	80.95	76.19	100.0	100.0




Comparison of Ground station vs Ambee Forecast Data Göteborg Femman
forecast
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50
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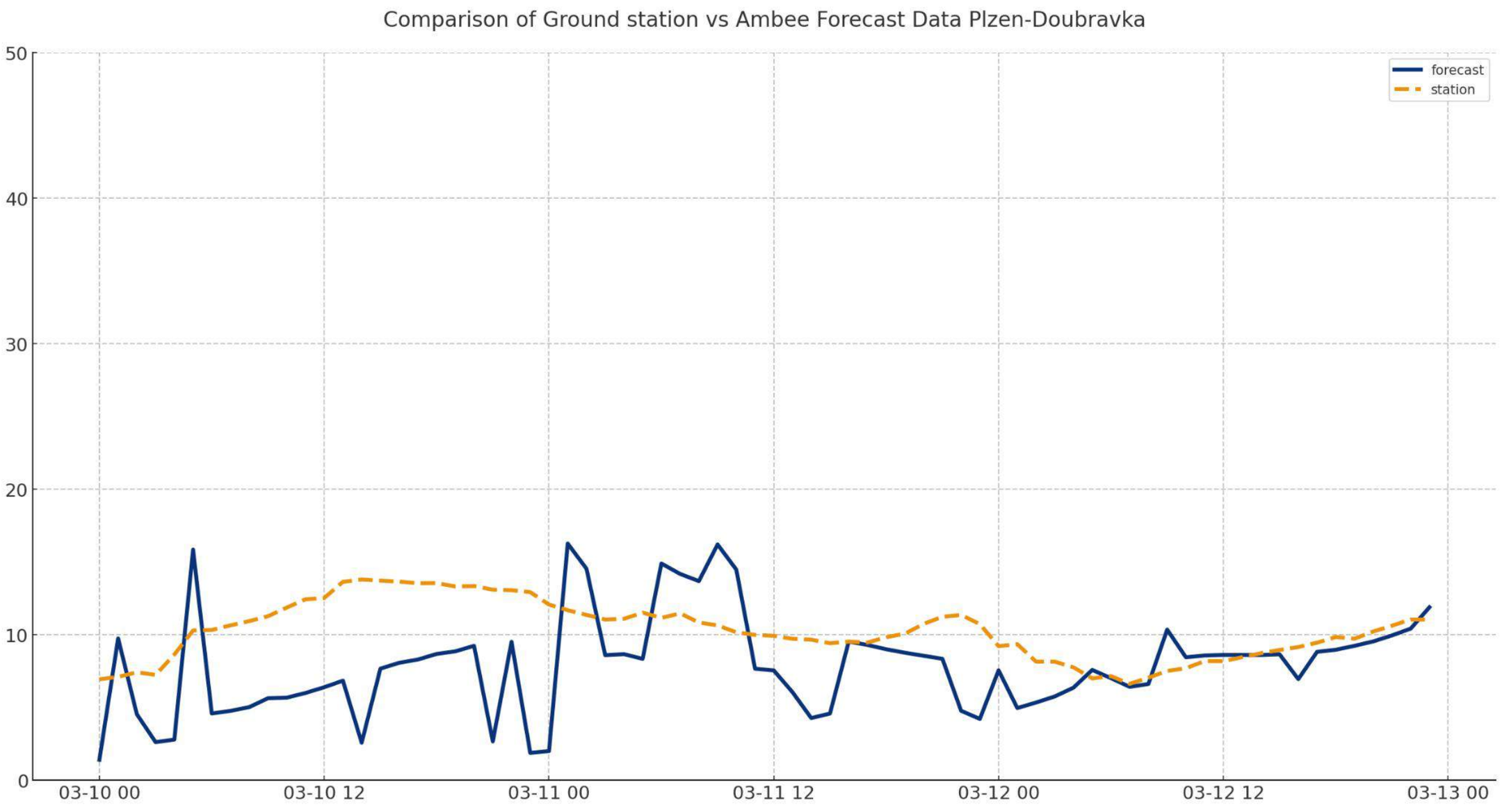
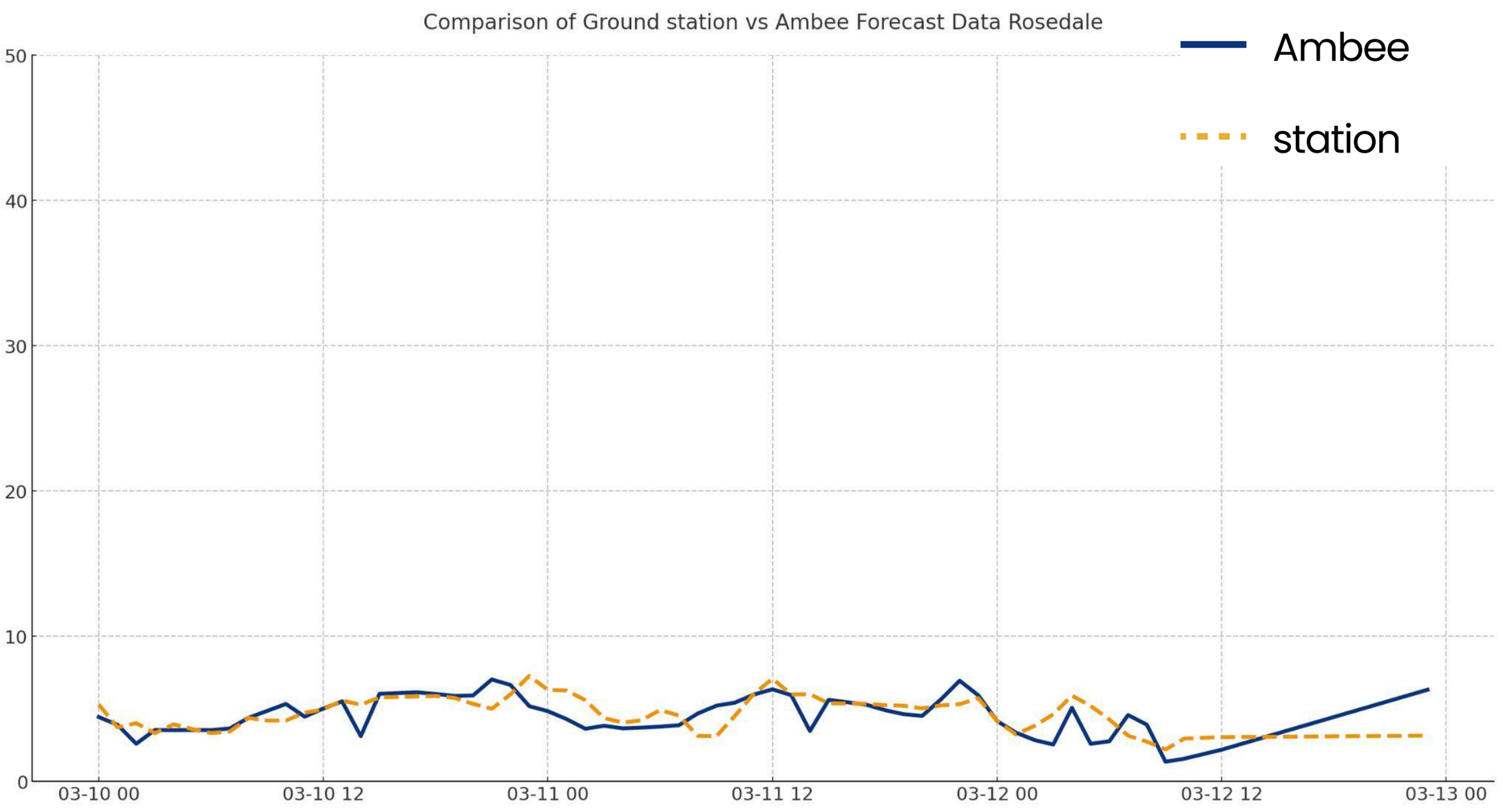
03-10 00
03-10 12
03-11 00
03-11 12
03-12 00
03-12 12
03-13 00

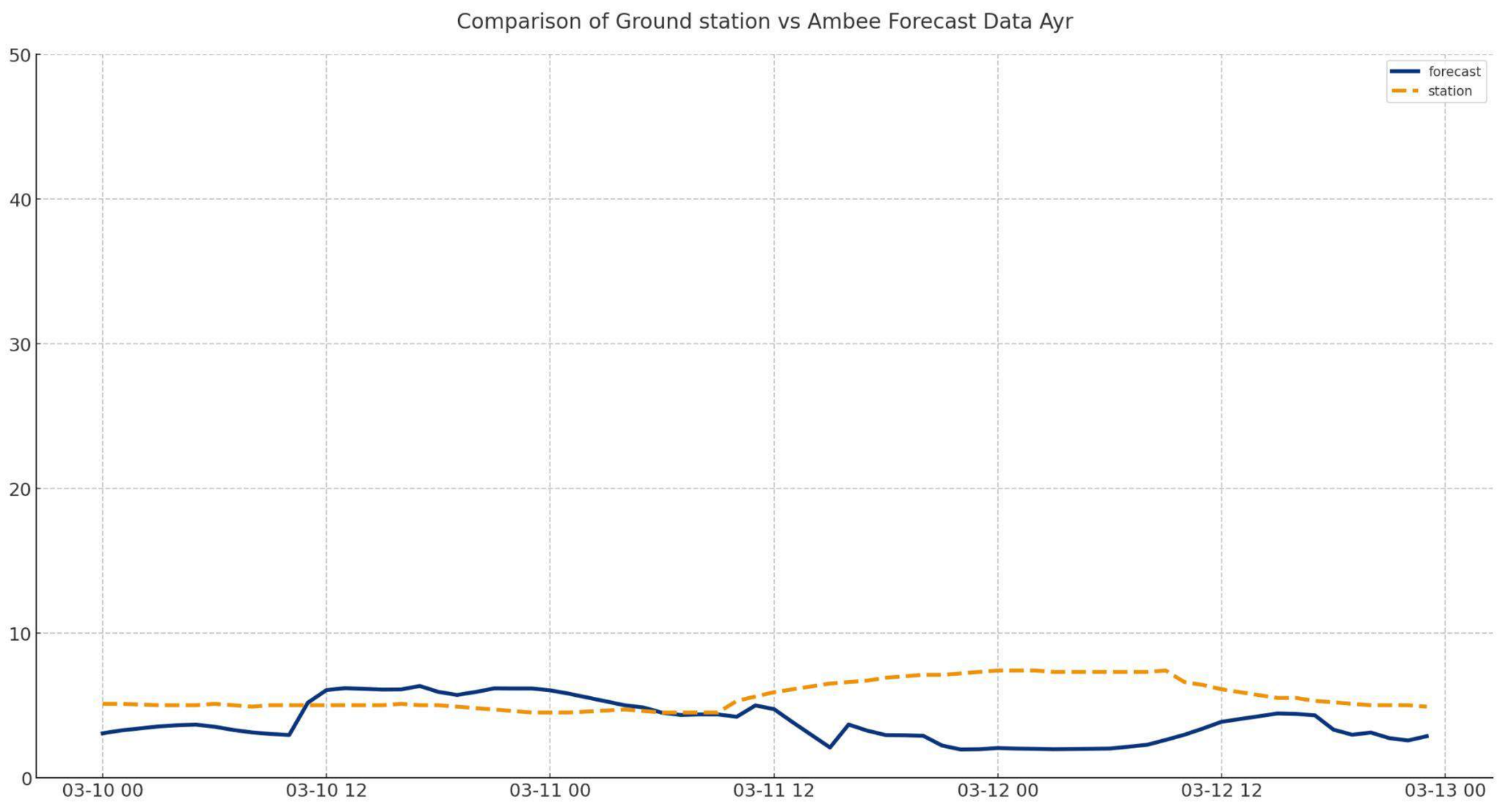

Comparison of Ground station vs Ambee Forecast Data Plzen-Doubravka
forecast
station
50
40
30
20
10
0
03-10 00
03-10 12
03-11 00
03-11 12
03-12 00
03-12 12
03-13 00

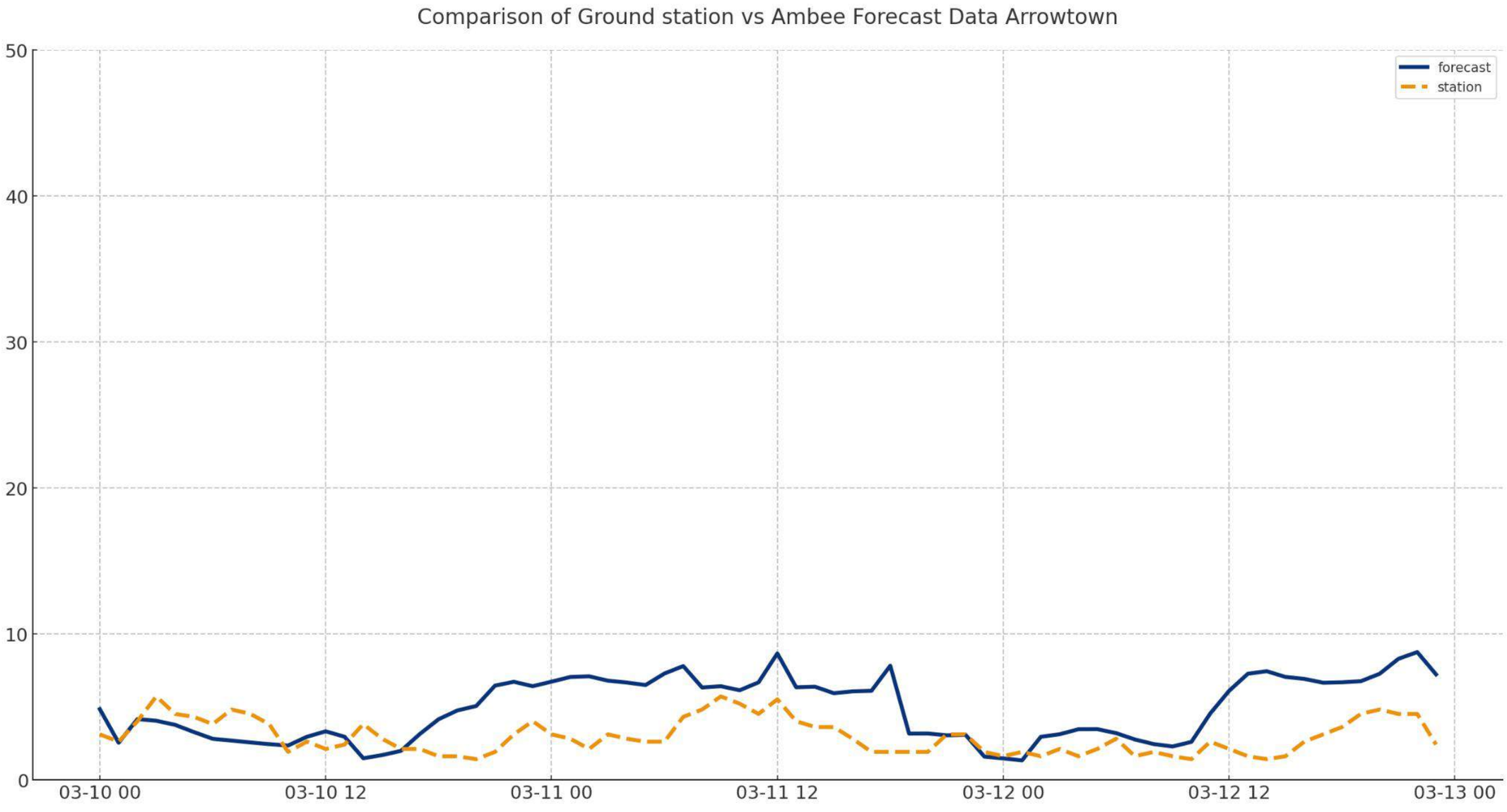
Benchmarking ambee forecast accuracy* against on-ground stations: Australia

*Accuracy achieved when comparing ground station data with Ambee data for PM2.5 in the 47-48 hour timeframe.

Region	MAE	MAE (0-6 hrs)	MAE (7-12 hrs)	MAE (13 -24 hrs)	MAE (25 -48 hrs)	Cat. Acc	Cat. Acc (0-6 hrs)	Cat. Acc (7-12 hrs)	Cat. Acc (13 -24 hrs)	Cat. Acc (25 -48 hrs)
Rosedale	0.87	1.14	1.02	0.61	1.30	100.0	100.0	100.0	100.0	100.0
Ayr	2.30	0.68	0.48	3.95	3.33	100.0	100.0	100.0	100.0	100.0
Arrowtown	2.29	4.13	2.37	2.07	2.57	100.0	100.0	100.0	100.0	100.0



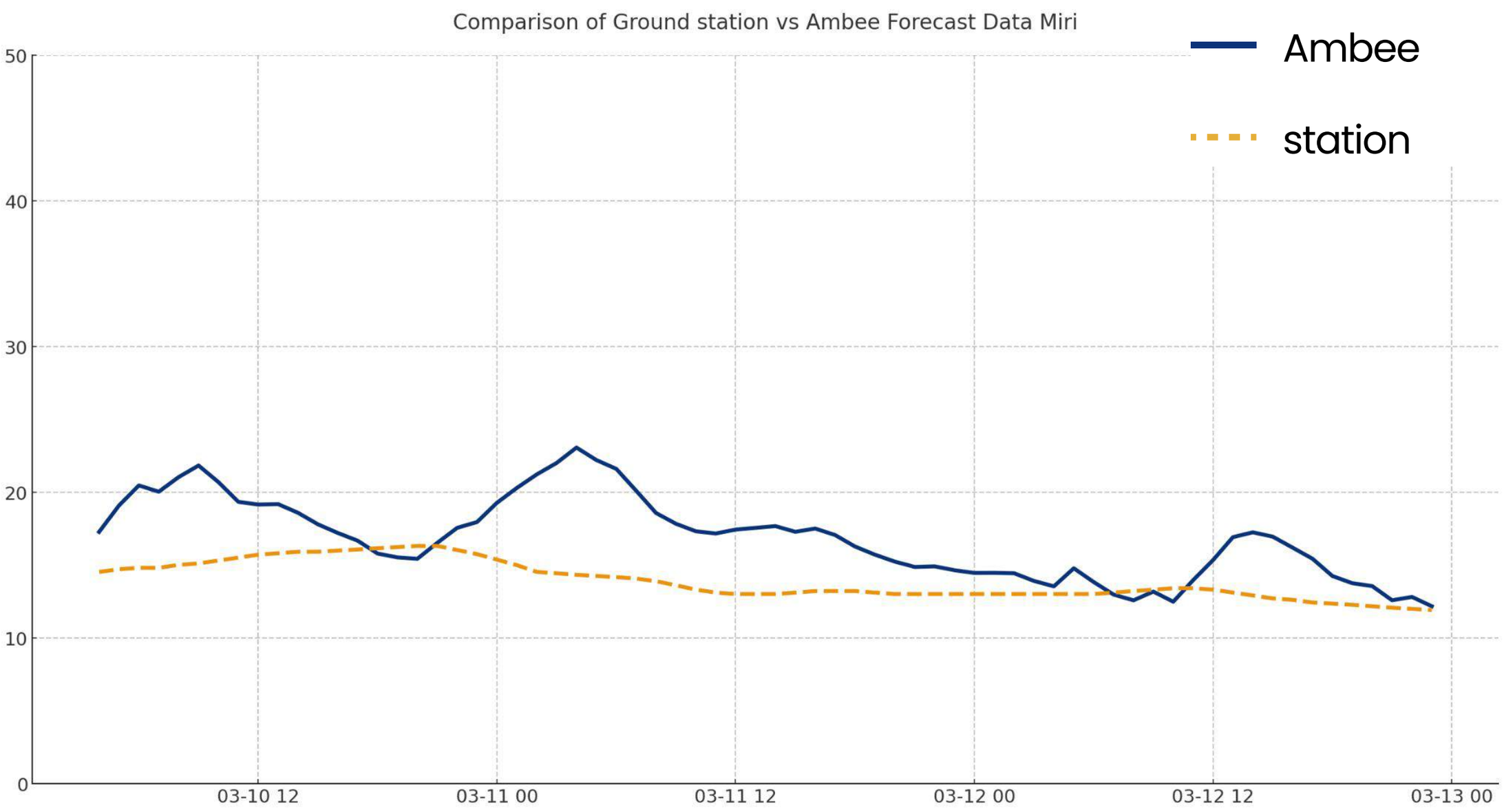

Comparison of Ground station vs Ambee Forecast Data Ayr
forecast
station
50
40
30
20
10
0
03-10 00
03-10 12
03-11 00
03-11 12
03-12 00
03-12 12
03-13 00

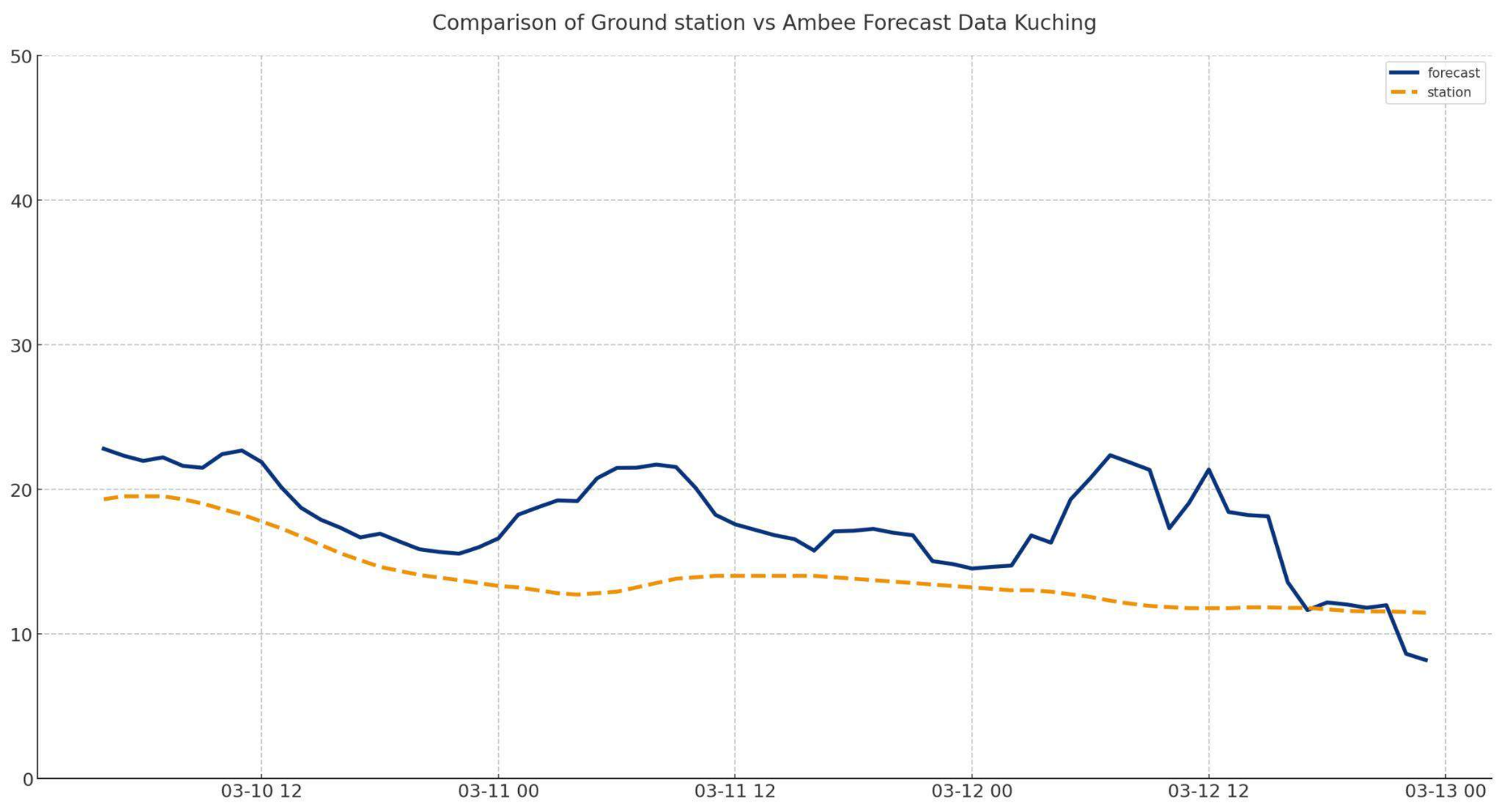

Comparison of Ground station vs Ambee Forecast Data Arrowtown
forecast
station
50
40
30
20
10
0
03-10 00
03-10 12
03-11 00
03-11 12
03-12 00
03-12 12
03-13 00

Benchmarking ambee forecast accuracy* against on-ground stations: Asia

*Accuracy achieved when comparing ground station data with Ambee data for PM2.5 in the 47-48 hour timeframe.

Region	MAE	MAE (0-6 hrs)	MAE (7-12 hrs)	MAE (13 -24 hrs)	MAE (25 -48 hrs)	Cat. Acc	Cat. Acc (0-6 hrs)	Cat. Acc (7-12 hrs)	Cat. Acc (13 -24 hrs)	Cat. Acc (25 -48 hrs)
Miri	3.46	7.23	4.30	2.61	2.77	96.71	100.0	100.0	100.0	100.0
Kuching	4.68	8.33	5.11	2.25	6.49	97.65	100.0	100.0	100.0	100.0
632171, Pyeongchang -eup	6.36	10.55	9.18	5.66	6.83	95.77	95.24	90.47	97.22	94.44




Comparison of Ground station vs Ambee Forecast Data Kuching
forecast
station
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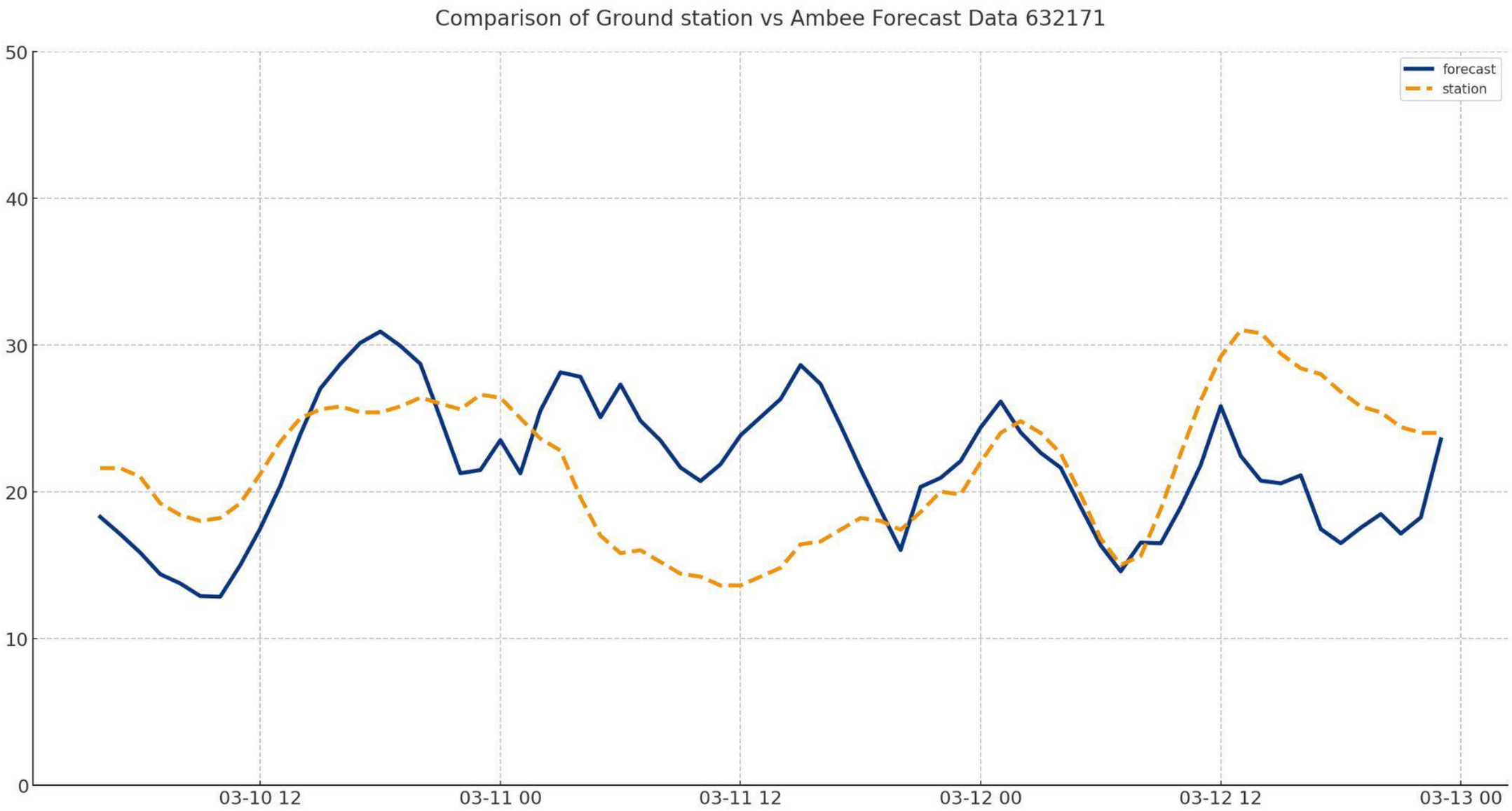
40
30
20
10
0
03-10 12
03-11 00
03-11 12
03-12 00
03-12 12
03-13 00


Comparison of Ground station vs Ambee Forecast Data 632171
forecast
station
50
40
30
20
10
0
03-10 12
03-11 00
03-11 12
03-12 00
03-12 12
03-13 00

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