Improving Air Quality Sensors

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Introduction

While traditional air quality monitoring equipment is both expensive and cumbersome, Sensorbee offers a streamlined and affordable solution. Sensorbee sensors measure key environmental indicators—including gas concentrations, humidity, and temperature—with applications in a wide range of settings.

The sensors used are electrochemical gas sensors, designed to generate a current that is linear to the concentration of a target gas, by letting the gas interact with a working electrode. A critical challenge, however, is maintaining sensor accuracy over time, which is essential for reliable, long-term data collection.

Goals of the Project

This project focuses on developing algorithms and models to enhance sensor accuracy and reliability. By utilizing data from Sensorbee devices alongside reference station data, we trained various models to improve the precision of sensor readings over extended periods.

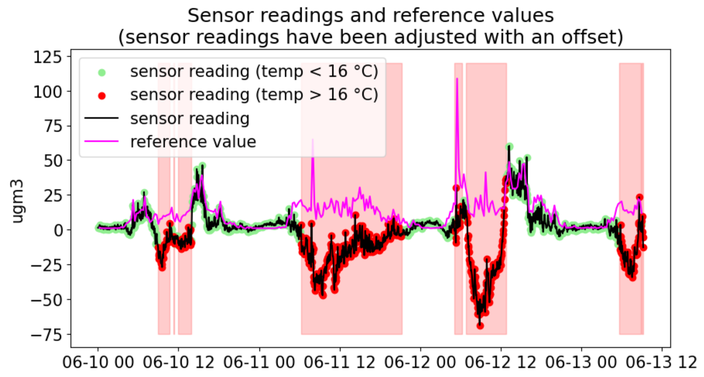
Models

The models we have looked at include:

- Our own temperature correction model
- Random Forest
- XGBoost
- Support Vector Machine
- Gated Recurrent Unit
- Neural Networks

Temperature Dependence

The gas sensor readings are greatly impacted by factors such as temperature, humidity and in some cases other gasses. Simple correction models that work for lower temperatures start to break down at higher temperatures:



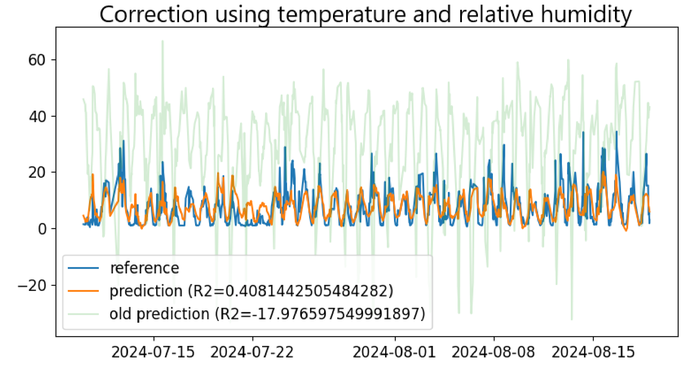
Models trained with temperature data, alongside other factors, tended to overfit, relying predominantly on temperature to estimate gas concentration.

Temperature Correction

The following model was proposed as a way to correct for the impact of different features:

$$y(t) = A(x)\left(V_{WEu} - V_{WEo} f(x)\right)$$

Several different combinations of features was tested as input to the correction polynomial $f(x)$.



Conclusions

In this work, we propose several methods to improve sensor accuracy. To further enhance the results using these methods, additional data is required:

- At least one year of data to capture seasonal variations.
- Data from multiple locations to account for different climate conditions.
- Data from more sources, such as wind speed data.

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