METHANE EMISSIONS ANALYSIS AT BERLIN WASTEWATER FACILITY

Methane is a potent greenhouse gas, with a global warming potential approximately 8 times higher than that of carbon dioxide. Monitoring methane emissions is crucial for understanding and mitigating climate change, as it helps identify sources and quantify the impact of these emissions on the atmosphere. Given its significant role in contributing to climate change, reducing methane emissions, particularly from municipal wastewater treatment plants, is crucial for a more sustainable approach to urban water management.

In collaboration with the Berlin wastewater facility, DEUS-Pollutrack conducted a study to understand and assess methane emissions from wastewater facilities. The study aimed to establish correlations between methane emissions and various meteorological variables. The data collected spanned from June 15, 2023, to November 15, 2023, incorporating meteorological information and methane measurements from a sewage treatment plant situated south-southeast of the sensor's position.

Figure 1: DEUS-Pollutrack measurement units (four modules, the first module from the top: measuring wind speed and direction as well as precipitation, the second: CH_4, the third: CO_2, NO_2, and VOCs, and on the bottom: particulate matter (PM 1, 2.5, 10)

Materials and methods:

The methane concentration is monitored by a tunable diode laser spectrometer (TDLS) (Axetris LGD Compact-A CH4). Linear correlation models were developed to analyze the relationship between methane concentrations and meteorological variables. Notably, a trigonometric model was employed to study the influence of wind direction. The time course of methane concentration suggested a potential positive correlation between temperature and methane concentration despite data few gaps in August and September.

Modeling Challenges:

A quasi-linear model was examined to validate the correlation, albeit restricted to non-negative values (y = max (0, a*x + b)). However, the parameters of this model exhibited considerable uncertainties, introducing the possibility of independence from temperature. If the correlation holds, an increase in biological reactions with temperature might offer a plausible explanation.

Wind Direction Influence:

Given the sewage treatment plant's southern proximity to the sensor, a dependence on wind direction was assumed. A trigonometric model (y = a + sin (x + b)) revealed a weak dependence. It was evident that wind direction played a role, though not a dominant one.

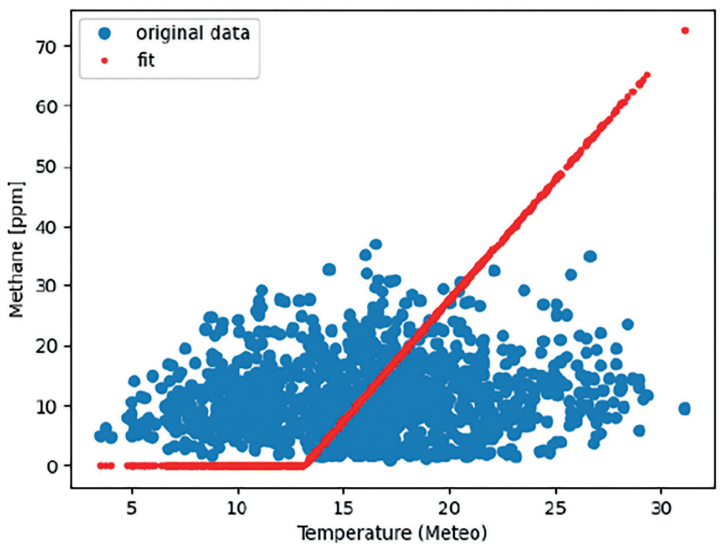


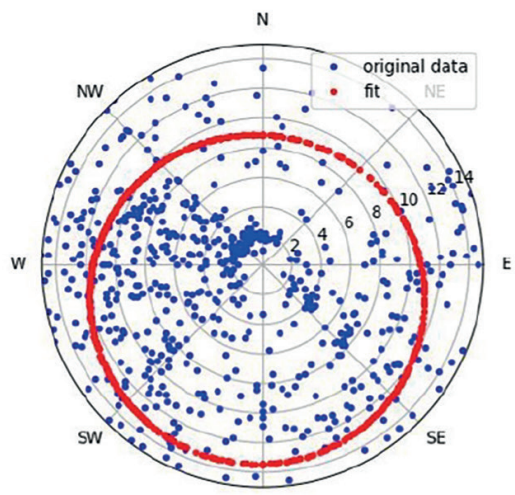
Figure 2: Methane concentration and temperature correlation

Wind Speed and Other Variables:

Wind speed showed only a weak correlation with methane emissions, mirroring the temperature's independence. The variance in model parameters suggested potential independence, emphasizing the need for further investigation.

Statistical Analysis:

Measured values exhibited significant statistical fluctuations, visually represented as a circle with a slight southward shift in the meteorological wind rose. The sewage treatment plant's location aligned with this model, indicating a correlation between emissions and wind direction.



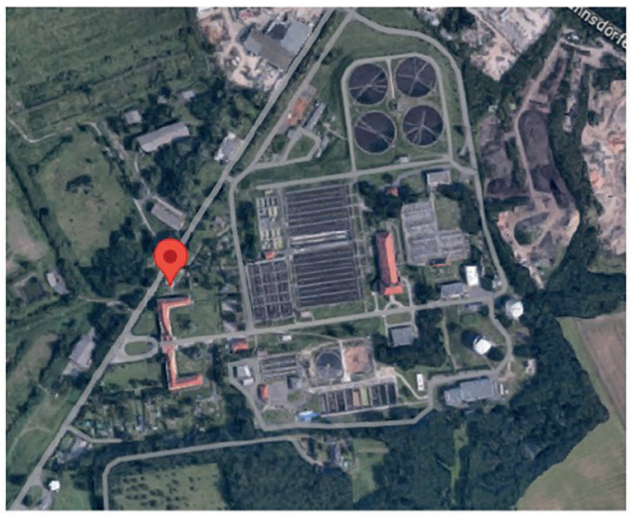


Figure 3: a) Methane concentrations versus wind direction (Meteo) b) the location of the measurement unit installed in the area Berlin wastewater facility

Air Pressure and Relative Humidity Trends:

Observations revealed a downward trend in air pressure corresponding to methane values. This trend suggests a potential hindrance to gas escape in denser air. Similarly, relative humidity exhibited a weak downward trend, hinting at possible impediments to gas release due to higher humidity levels.

Conclusions

The case study provides insights into the complex interplay between methane emissions and meteorological variables at the Berlin wastewater facility. While some correlations were identified, uncertainties and fluctuations necessitate further research to refine models and better understand the factors influencing methane release. The findings underscore the importance of considering multiple variables when assessing emissions from wastewater facilities for effective environmental management.

Next steps:

The study is still ongoing and in February we plan to expand our investigations to include two more sites equipped with methane sensors. We will use a triangulation method developed by the DEUS Scientific expert group to accurately measure and analyze methane emissions. In doing so, we aim to increase the accuracy of our results and gain a more comprehensive understanding of the dynamics of methane release from wastewater treatment plants.

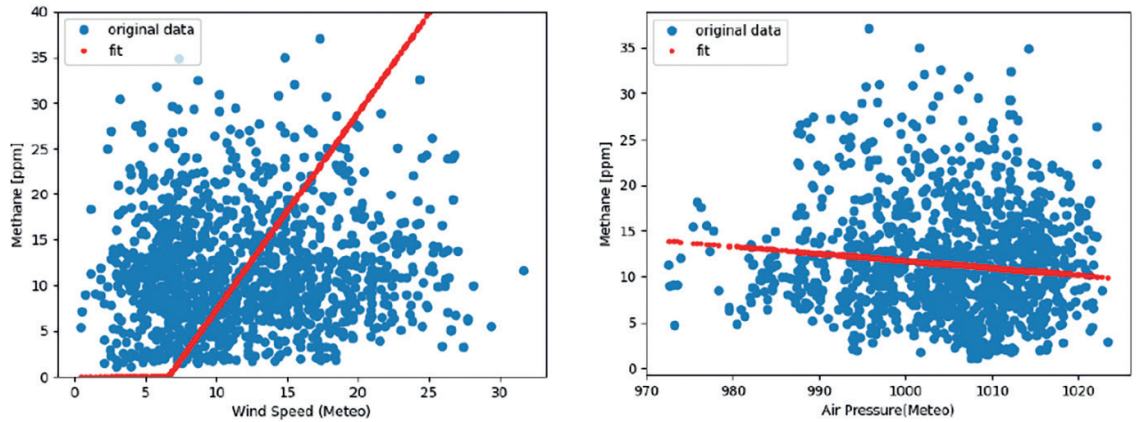


Figure 4: a) Correlation between methane concentration and wind speed b) Correlation between methane concentration and air pressure

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