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Modeling of Methane Emission Dynamics in Complex Aerodynamic Conditions

Current Project Overview

This project aims to model methane emission in a complex aerodynamic condition. Anything that obstructs the smooth flow of gas, influencing the dynamic variations that influence emission dispersion is known as aerodynamic conditions. The disturbance may arise from factors like obstruction height. So, this study integrates the aerodynamic conditions to model the dispersion of methane emissions.

The objective of this study is to quantify the impact of complex aerodynamic conditions on methene dispersion patterns which helps to evaluate the effectiveness of different sensor placement strategies so that the sensor placement can be optimized.

Measurement

The data are collected from the Methane Emission Technology Evaluation Center (METEC). The methane concentration is measured using either MGGA or AERIS. The concentration is measured by positioning sensors at a set distance from the point source and incrementally moving them further away to increase the distance between the sensor and the source with each measurement with no significant obstruction in between them.

Modeling

The concentration and meteorological data are acquired such that they can be fit into different modeling approaches like Lagrangian Stochastic (LS) and Gaussian Plume (GP) models. This model helps to predict the emission rate from the source. So, the predicted or calculated emission is then compared with the known emission rate to quantify the reliability of various modeling approaches.

Research Progress

Among many experiments, one demonstration shows that it had sensor placement at seven different points from a point source in the same direction. The concentration data is taken from those points and quantified using LS and GP models and plotted against the known emission.

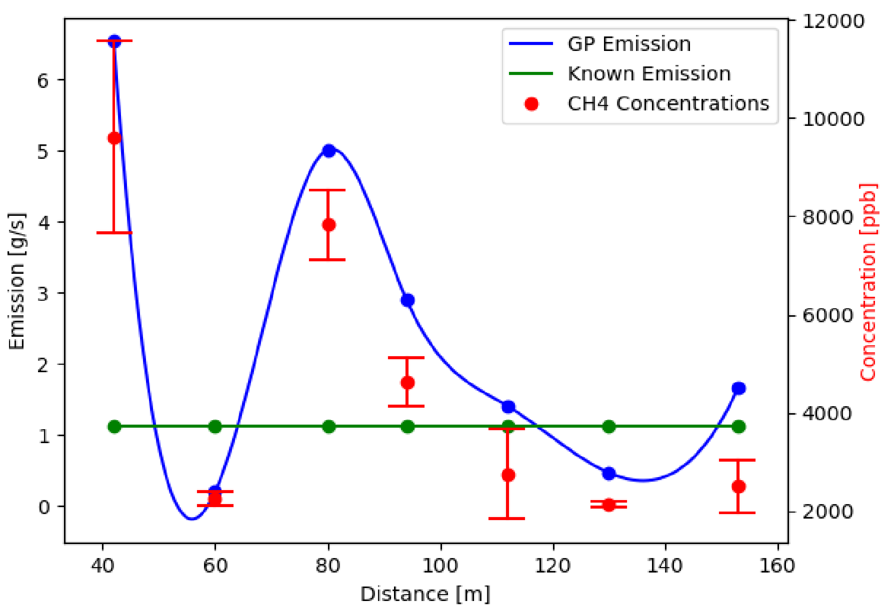

Fig: Known and calculated emission rates at different distances: Gaussian Plume Model

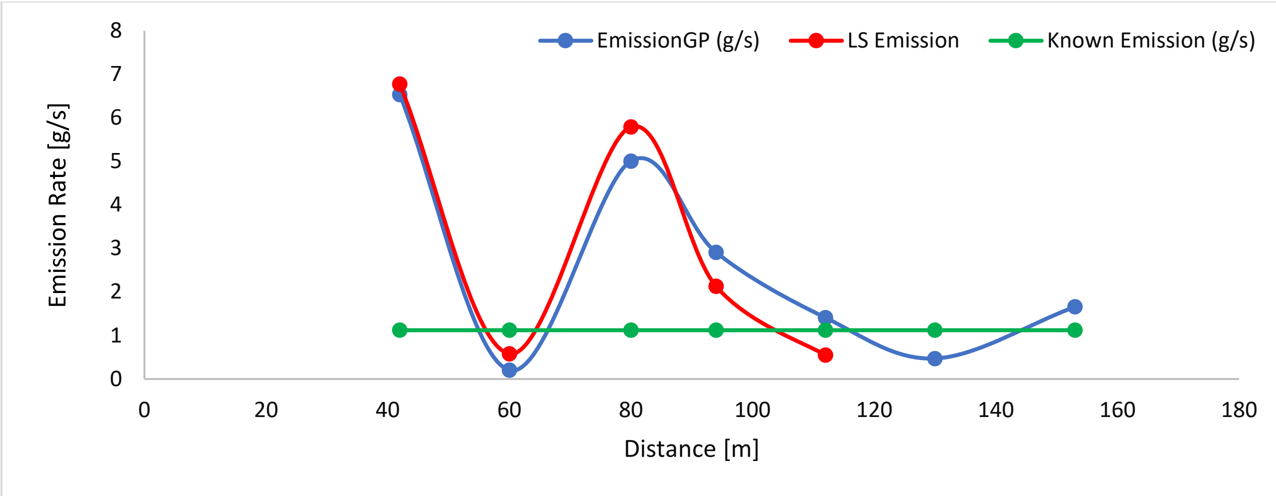

Fig: Calculated emission rate from GP and LS model with increment in distance from source to sensor

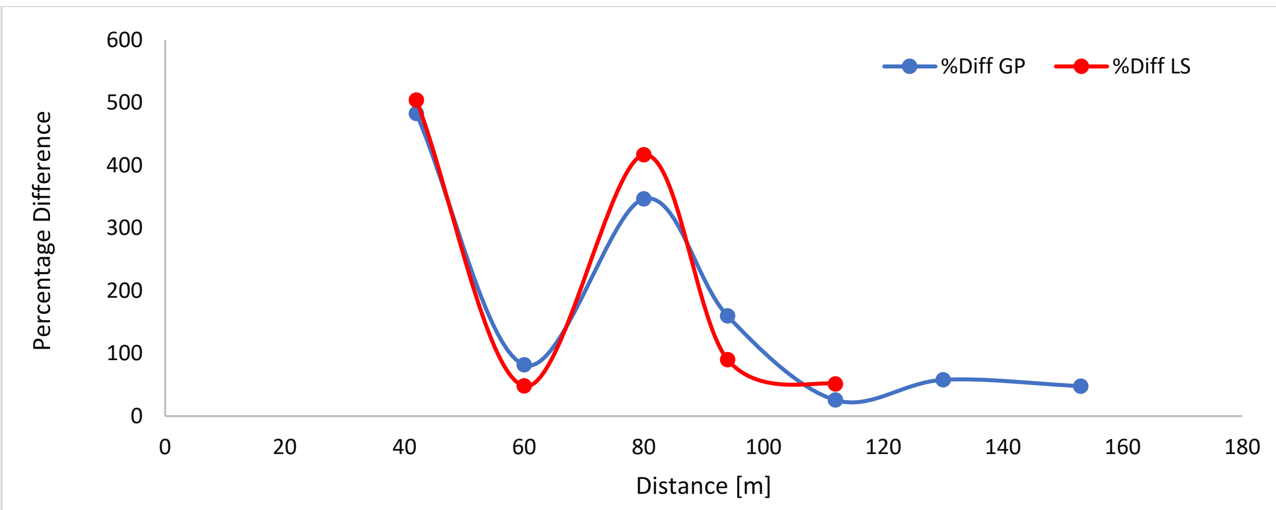

Fig: Percentage difference between known and calculated emission rates from GP and LS model

Research plan

1. To gather as much data as possible, ensuring sufficient availability for quantification.
2. Quantify the data using not only Lagrangian Stochastic and Gaussian Plume models but also incorporating Gaussian Puff and CALPUFF models.
3. Compare all the models to determine which is most effective for this specific condition.

Publications

No publication yet.

Literature Cited

No citation yet.