# Optimizing Vehicle Data Transmission for Accurate Regional Temperature Mapping

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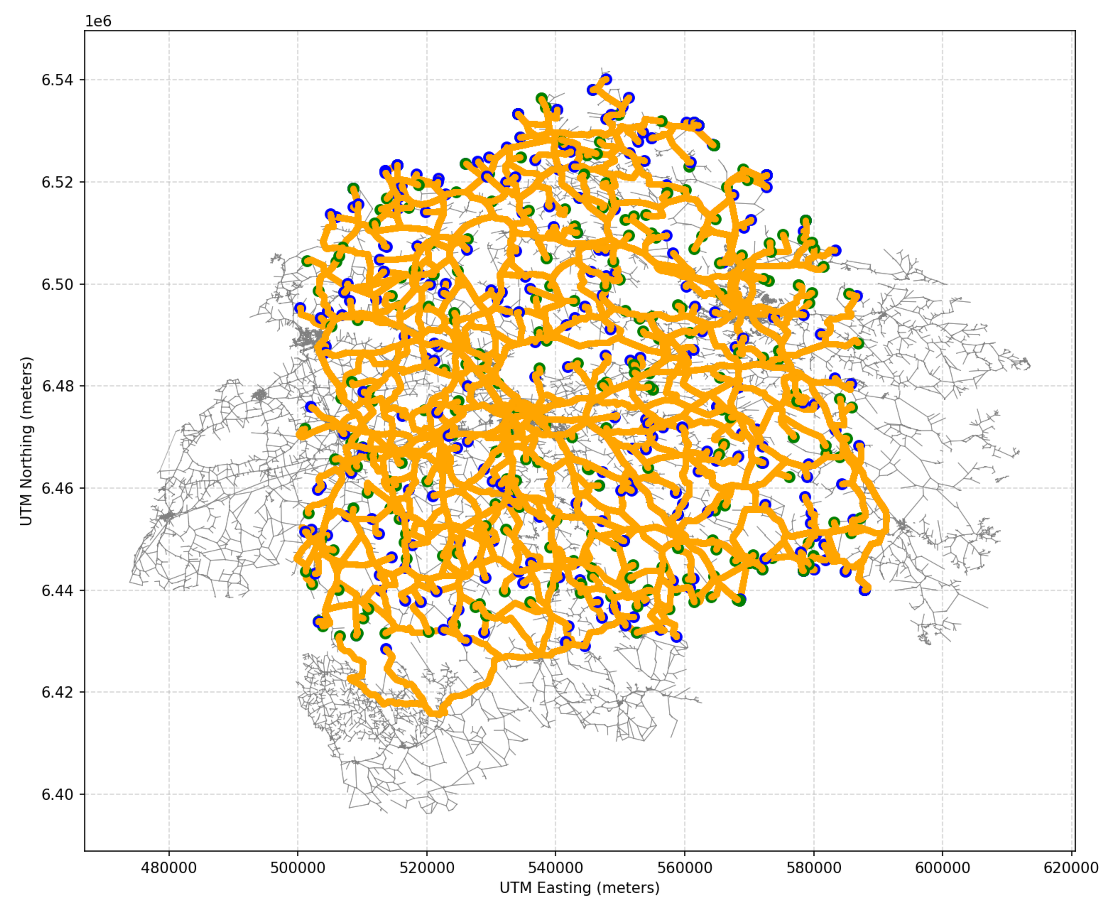
## Abstract

**Problem:** Transmitting all raw sensor data from vehicles to a central cloud is inefficient and impractical. To optimize this process, decisions must be made on:

- What type of data should be transmitted?
- At what frequency?
- How to filter irrelevant or redundant data?

**Objective:** By focusing on temperature signals as a case study, we aim to demonstrate methods for optimizing data transmission while maintaining acceptable accuracy for regional temperature mapping.




The above figure illustrates the transportation routes studied in the Östergötland region. The green points represent starting locations, while the blue points indicate destination locations

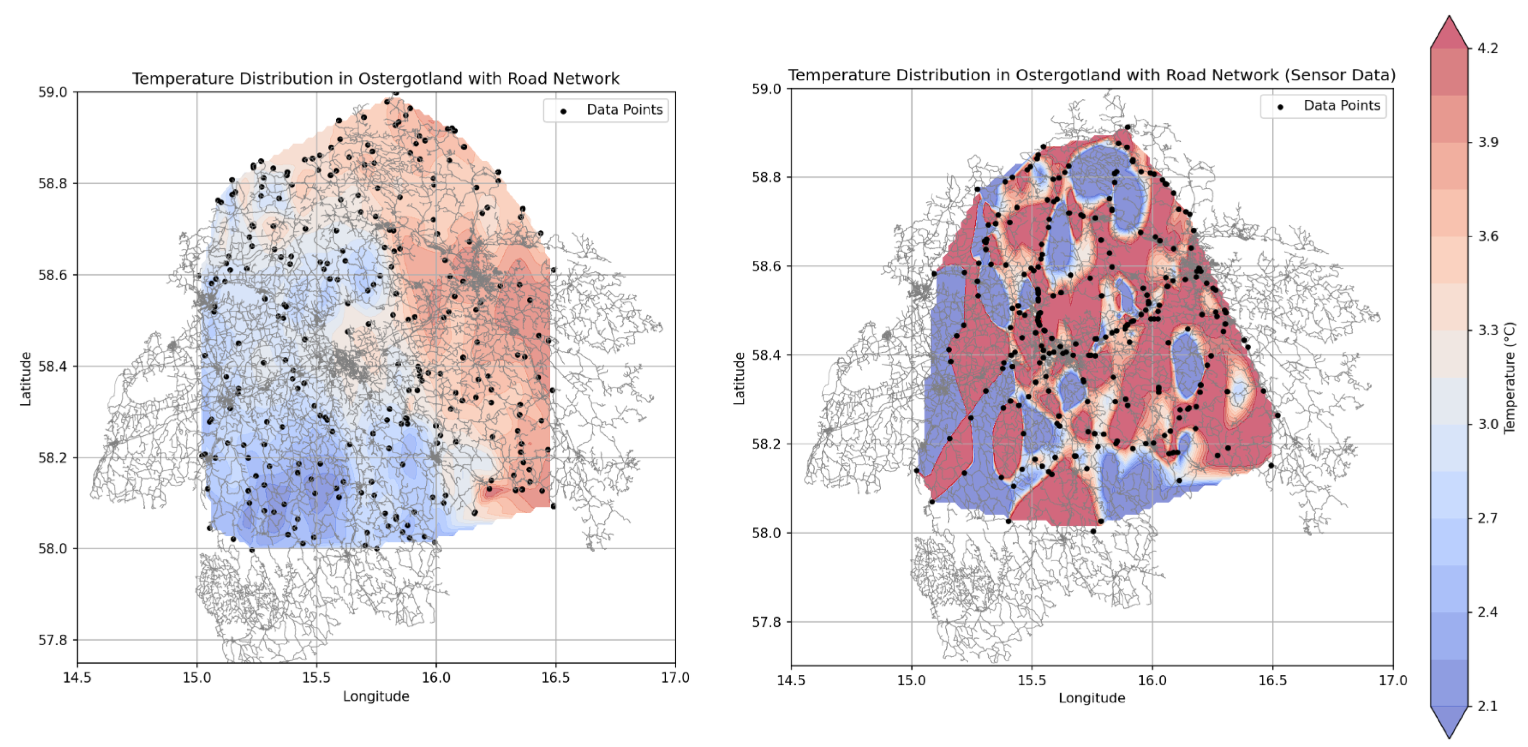
## Introduction

Thousands of vehicles traverse the roads daily, creating an opportunity to collect environmental data. Vehicles equipped with temperature sensors, however, provide readings influenced by:

- Environmental factors: ambient temperature, sunlight intensity
- Vehicle dynamics: speed (forced cooling), engine/motor heat radiation

The figure below shows the real-world temperature data and the simulated sensor data which follows: The sensor model is described by the following equation:

$$C\frac{dT}{dt} = H(v)A(T_{\text{AMB}} - T_{\text{SENSOR}}) + \alpha A I \cos(\theta) + \epsilon_0 A(T^4_{\text{motor}} - T^4_{\text{sensor}}),$$




Vehicles are equipped with onboard algorithms that process and calibrate raw sensor readings to estimate the true ambient temperature. These algorithms take into account various factors such as runtime, speed, sunlight intensity, evaporator temperature, and external temperature sensor readings. However, in Vehicle-to-Cloud (V2Cloud) systems, transmitting all these raw inputs in significant data overhead and reduced efficiency.

## Methodology

**Supervised Feature Selection:** Include similarity-based methods, information-theoretic methods, and statistical-based methods. These are used to prioritize input features, remove redundancies in datasets.

**Unsupervised Feature Selection:** Clustering algorithms preprocess data to reduce redundancy by identifying overlapping or similar data points, thereby improving transmission efficiency.

This study serves as a simplified example to investigate how to improve communication efficiency in vehicle-to-cloud data transmission.

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