SEDDIT Project Workshop

Simulation of Vehicle Fleets for KF-based Spatial Phenomenon Estimation

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Introduction

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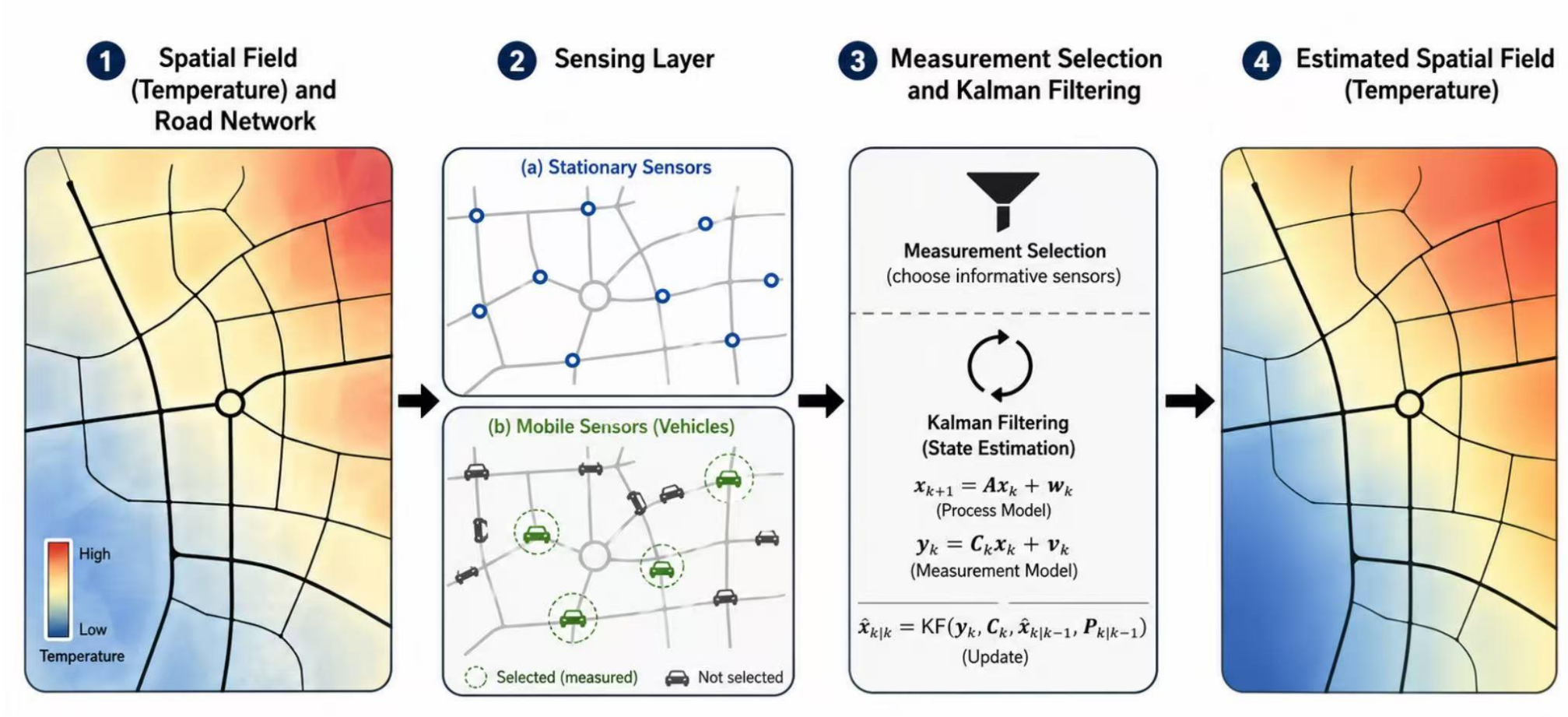
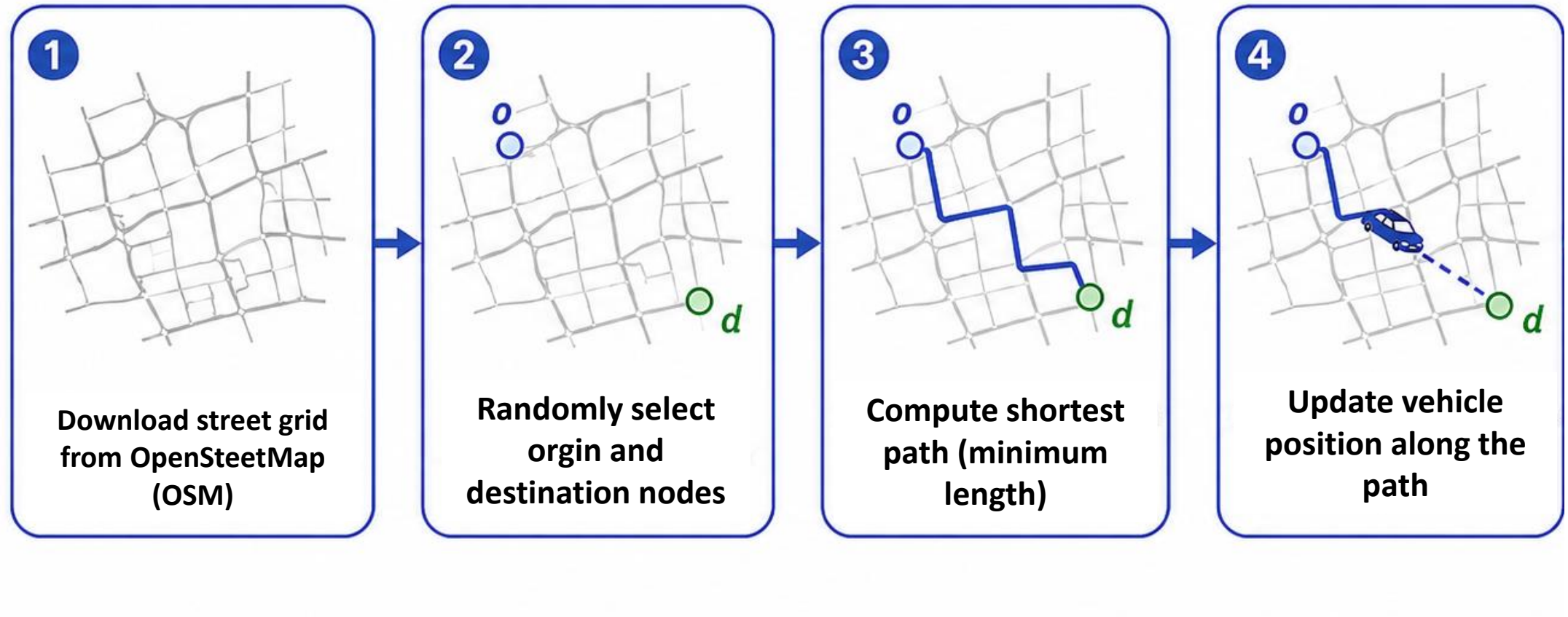
Motivation

Need	Accurate environmental information for energy-efficient vehicle operation
Impact	Sensing accuracy affects energy estimation and control decisions
Opportunity	Truck fleets as distributed mobile sensors
Limitation	Communication bandwidth restricts data transmission
Goal	Select informative measurements for spatial field estimation

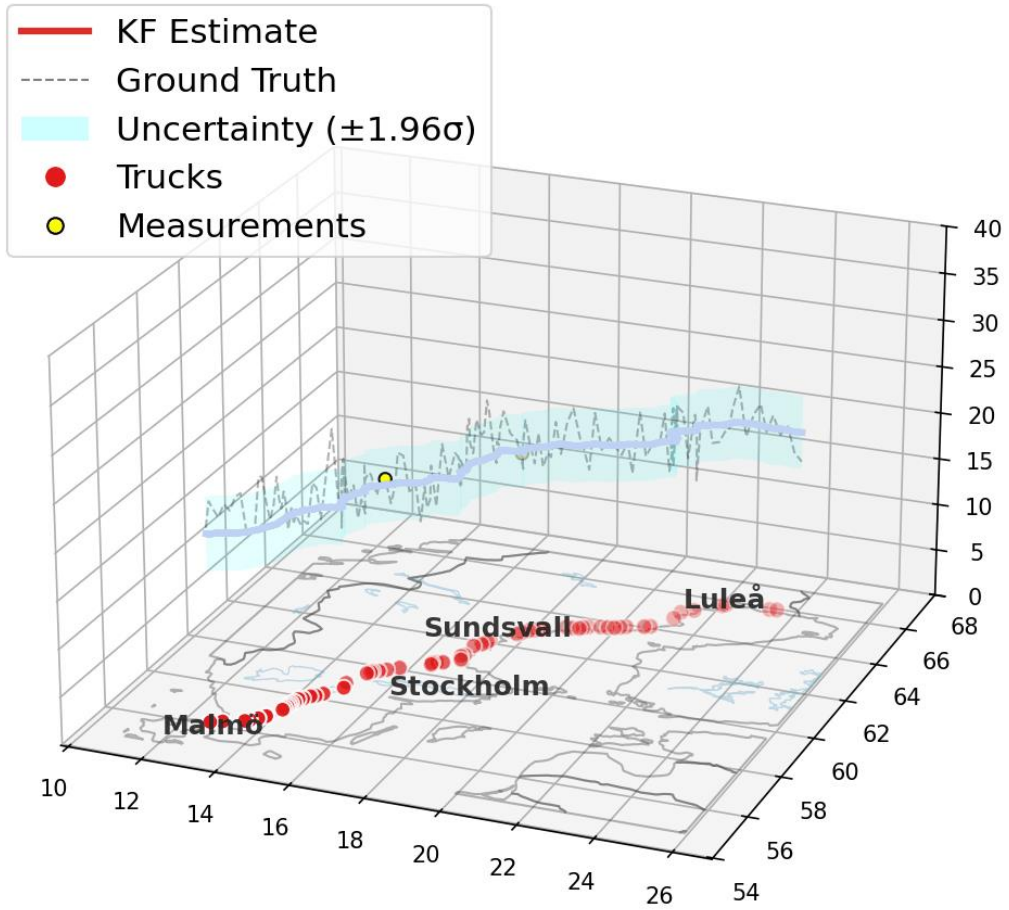
Methodology Overview

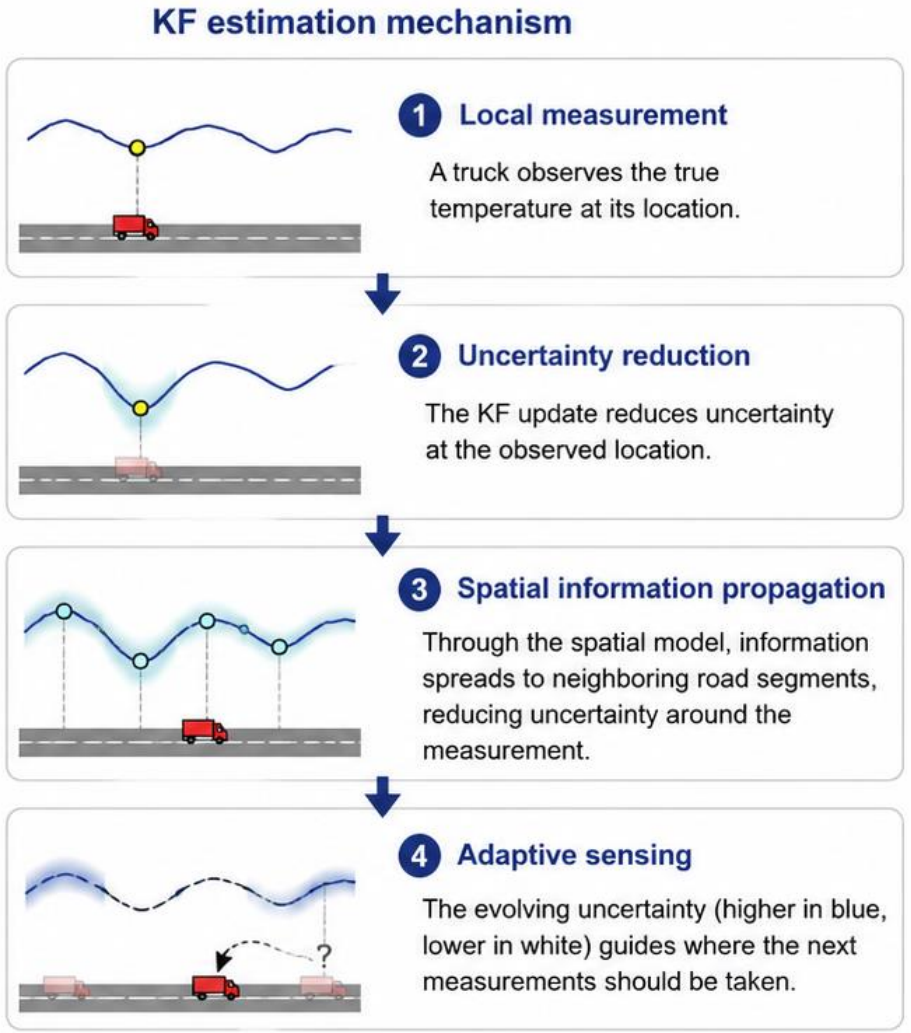


Vehicle Fleet Simulation



How the KF Estimates On-road Temperature

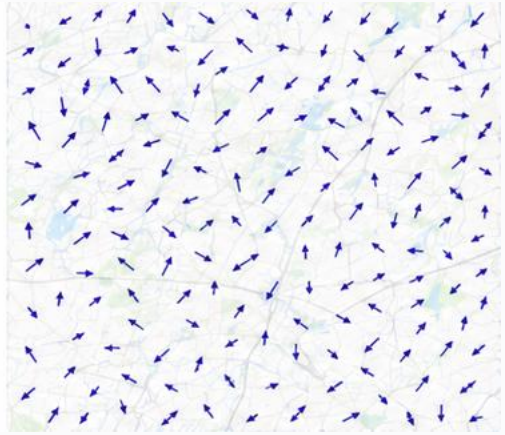


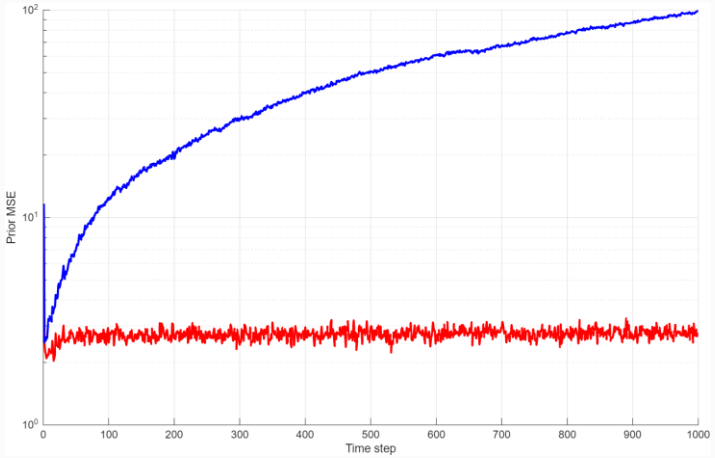


Effect of Spatial Correlation

1 Spatially uncorrelated scenario

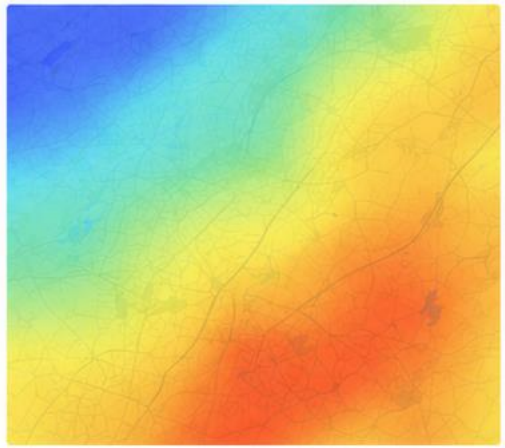
Example: wind direction

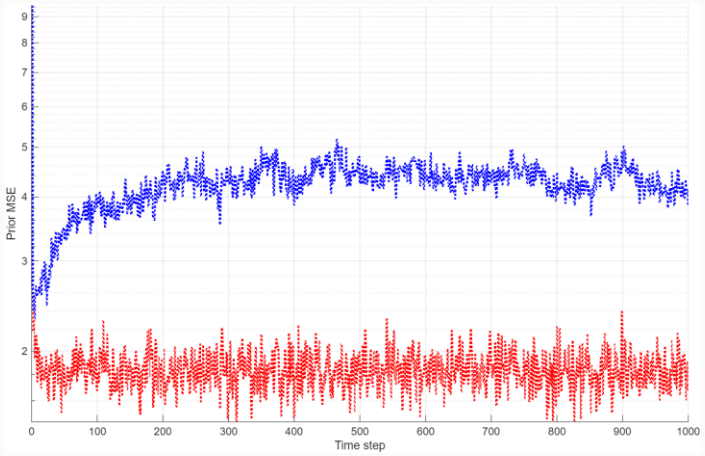




2 Spatially correlated scenario

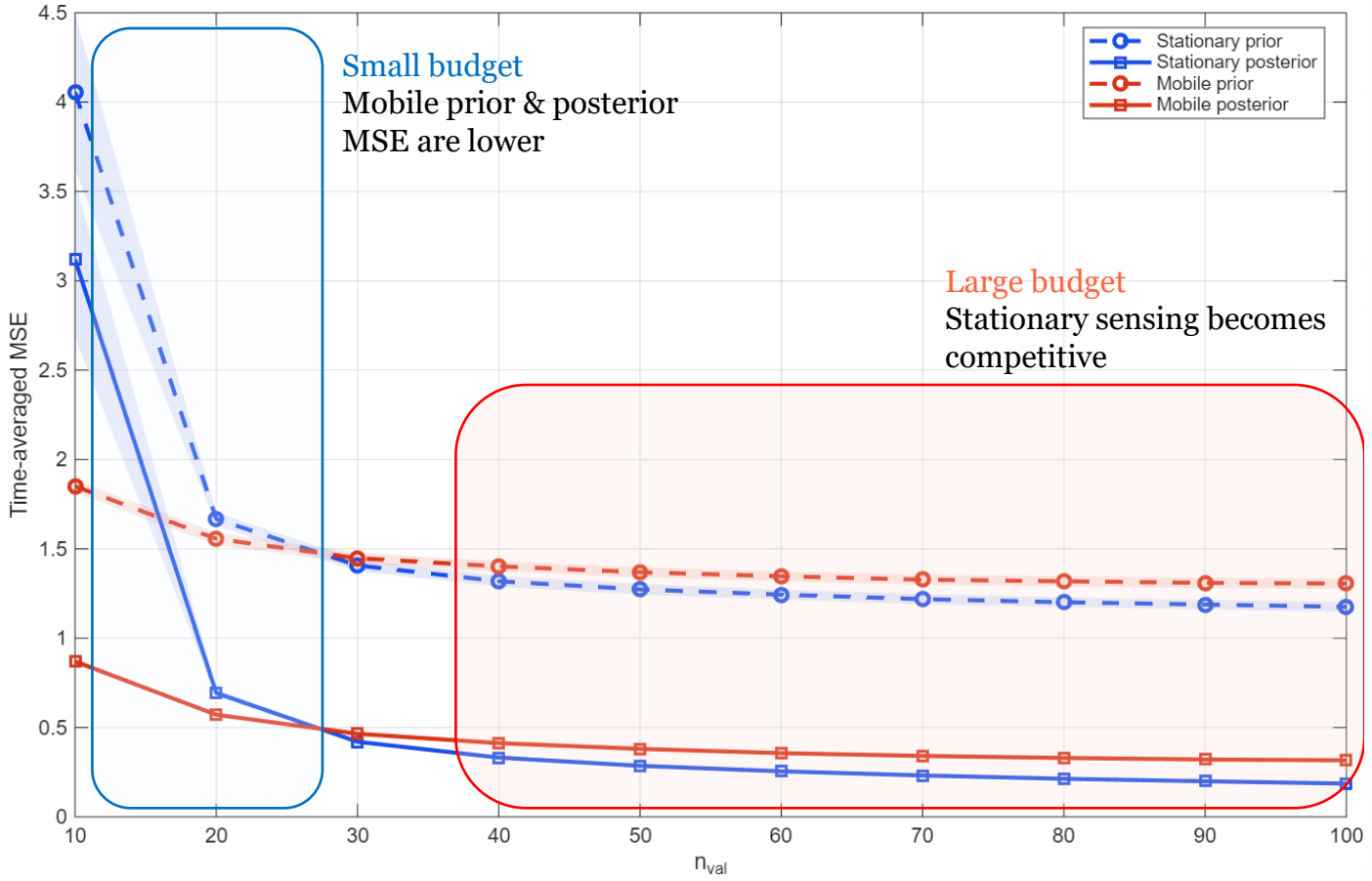
Example: temperature





Mobile sensing has a larger advantage when the spatial correlation is weak.

Effect of Sensor Budget on Mobile and Stationary Sensing



1. Mobile sensing is more effective with a small sensor budget.

With limited sensors, mobile sensors explore more locations and achieve lower MSE.

2. With more sensors, stationary sensing becomes competitive.

Stable, fixed locations provide better spatial coverage, leading to slightly lower MSE.

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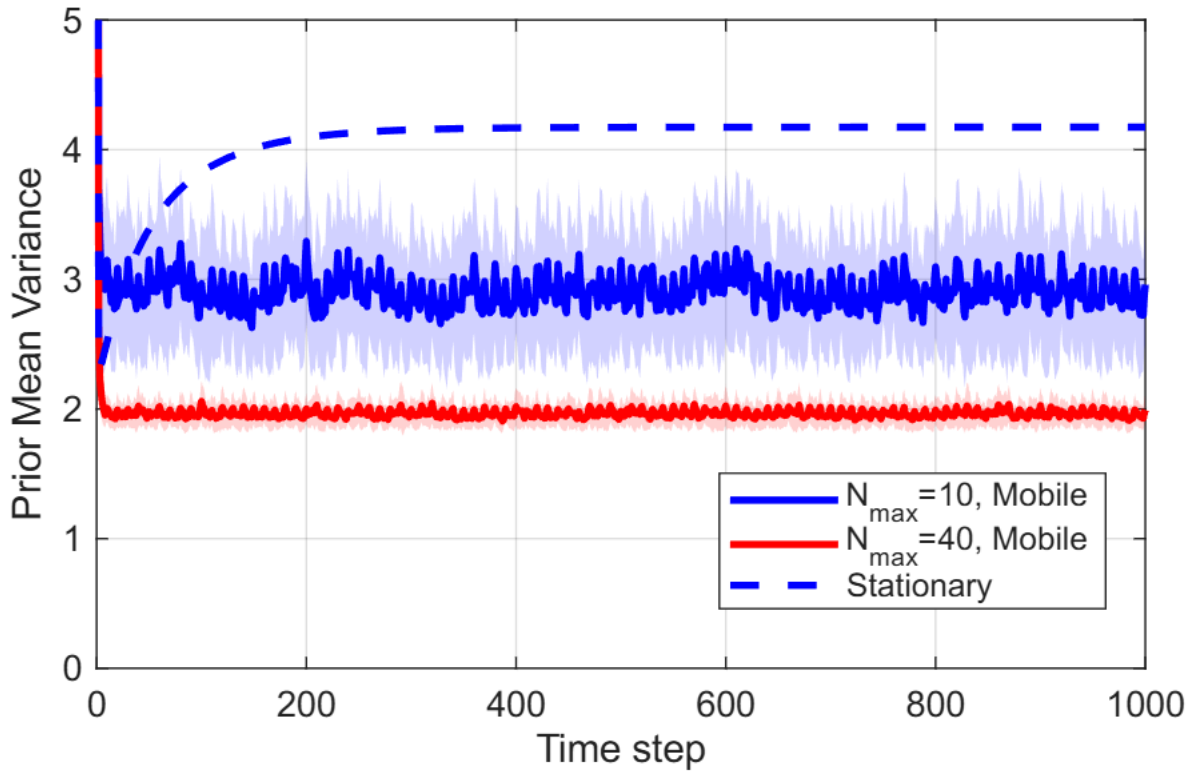
SEDIT
Sensor informatics and Decision-making for the Digital Transformation

TRATON

Effect of Fleet Size on Estimation Performance



1. Even with only 10 active vehicles, **mobile sensing outperforms** stationary sensing in mean variance / MSE.

2. Mobile sensing has more stochastic behavior due to random vehicle positions. This causes **larger temporal fluctuations** and **wider uncertainty bands**, making the results less stable than stationary sensing.

3. Increasing the fleet size **lowers mean variance / MSE** and **reduces variability** across runs.

Thank you

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