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## Optimal Strategy for Spatial Inference of Speed Profiles on Large Scale Road Network: OSSI-SPLN

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## Introduction

### Problem statement

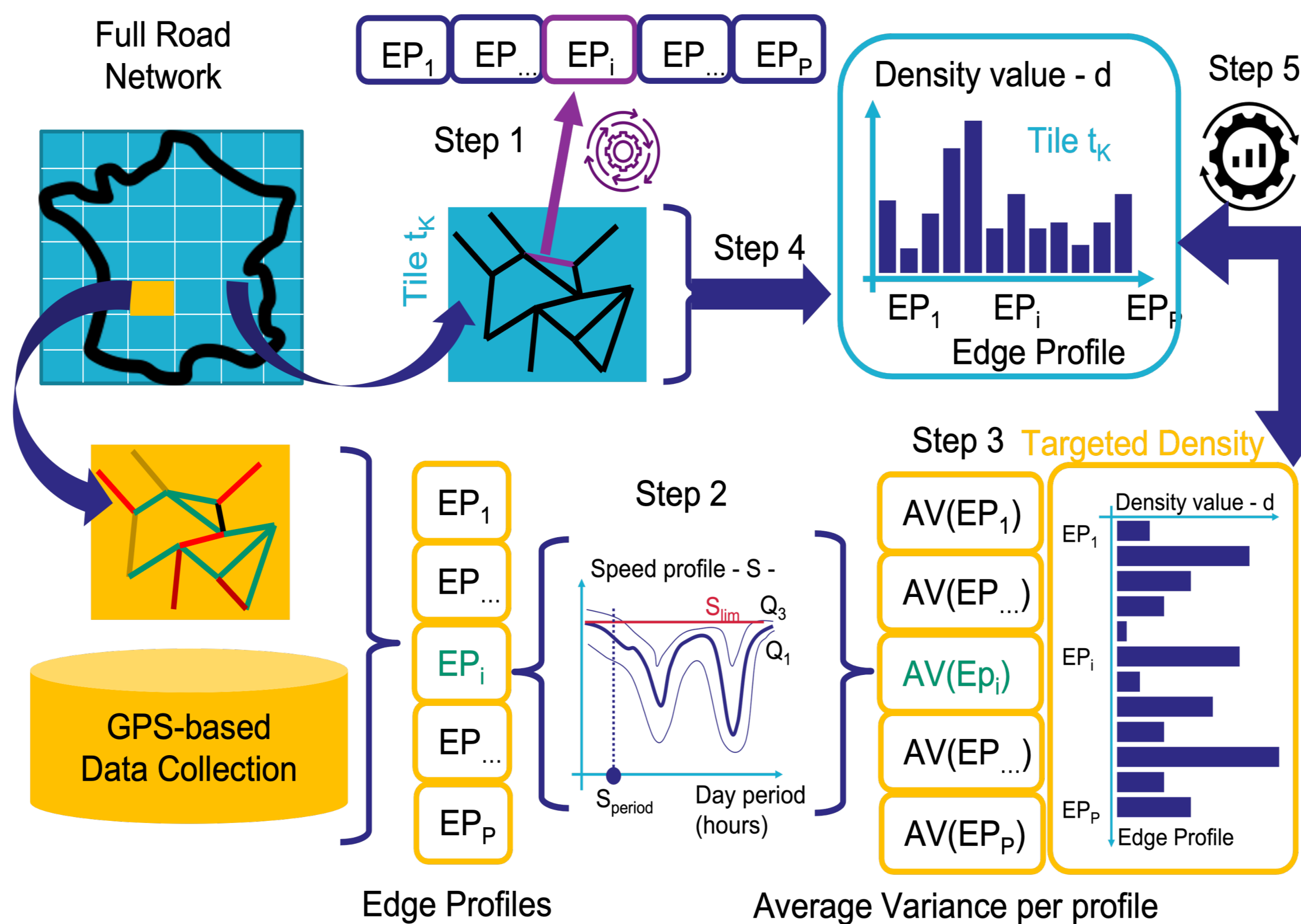
Floating Car Data (FCD) is a usual and convenient resource to generate traffic speed indicators, but it comes with an expensive cost to cover large road networks.

Where should we focus the data collection when reproducing speed profiles for any road section on an extensively large road network with limited resources?

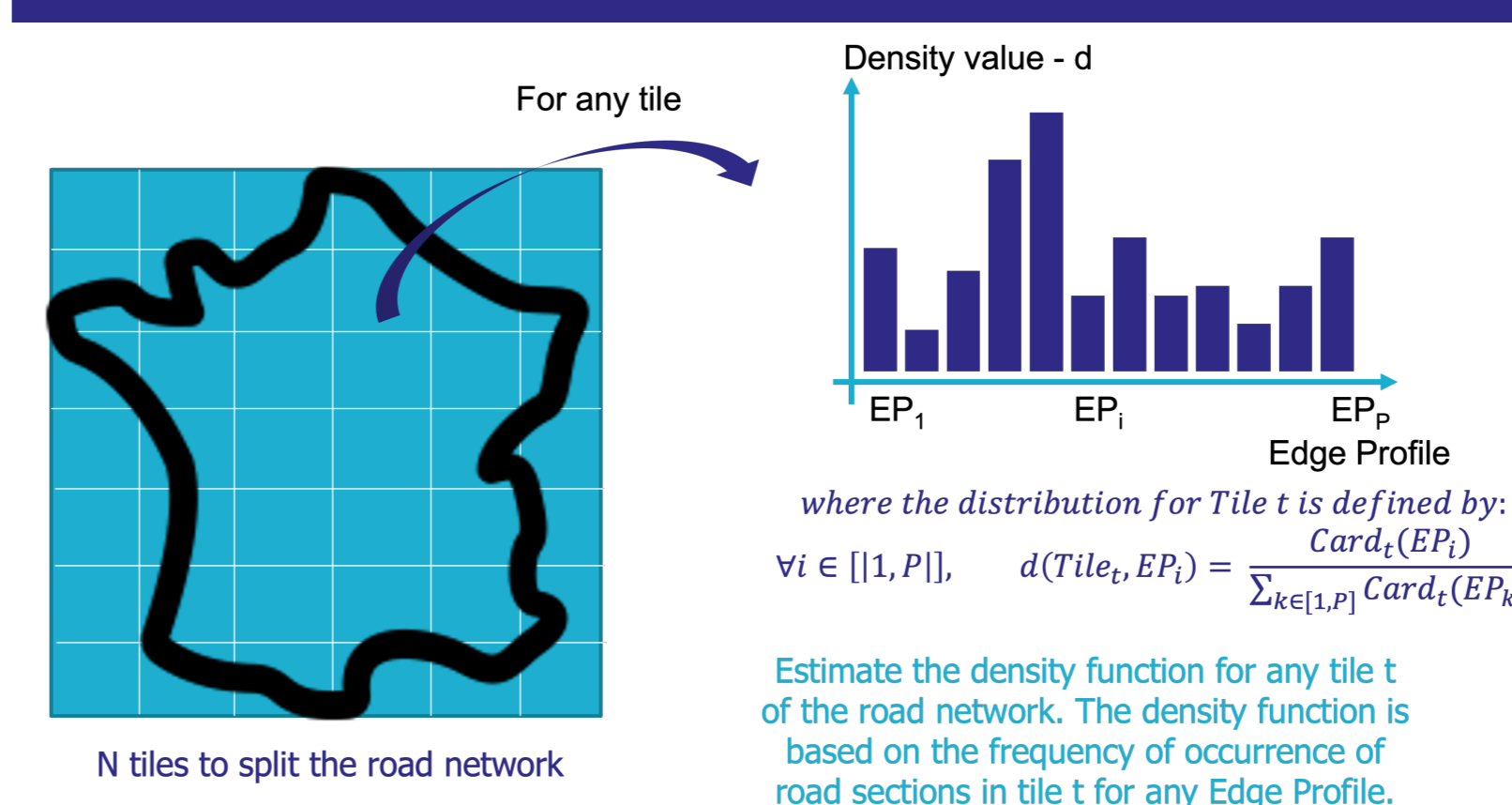
Most studies involving FCD focus on issues related to sparse data collection, and the Sensor Location Problem is only considered from the road manager's perspective, assuming controlled Mobile Sensors.

Our problem statement and formulation are distinct as it aims at optimizing the spatial coverage to achieve high representativeness of the diversity of road link speed profiles. Consequently, our methodology is inspired by Optimal Spatial Coverage strategies for Sensor Networks, developed in distinct domains, especially the works developed by Hoffman *et al* (2013).

## Methodology overview



## STEP 4: Computation of tile's utility



## STEP 5: Optimization to select K tiles

$$\min \left( \sum_{j \in [1, P]} A_j \right)$$

subject to:

$$A_j \geq Ref_{EP_j} - P_j$$

$$A_j \geq P_j - Ref_{EP_j}$$

$$K \times P_j = \sum_{i \in [1, N]} x_i \times \frac{Card(Tile_i, EP_j)}{Card(Tile_i)}$$

$$\sum_{i \in [1, N]} x_i = K$$

$$\left( \sum_{i \in [1, N]} x_i \times Card(Tile_i) \right) \geq \left( \sum_{i \in [1, N]} Card(Tile_i) \right) \times \frac{K}{N}$$

To linearized the problem formulation with an absolute value (L1-norm to compute the error)

$$\min \left( \sum_{j \in [1, P]} |P_j - Ref_{EP_j}| \right)$$

$P_j$  is the probability for Edge Profile  $EP_j$  resulting from the average over the K selected Tiles

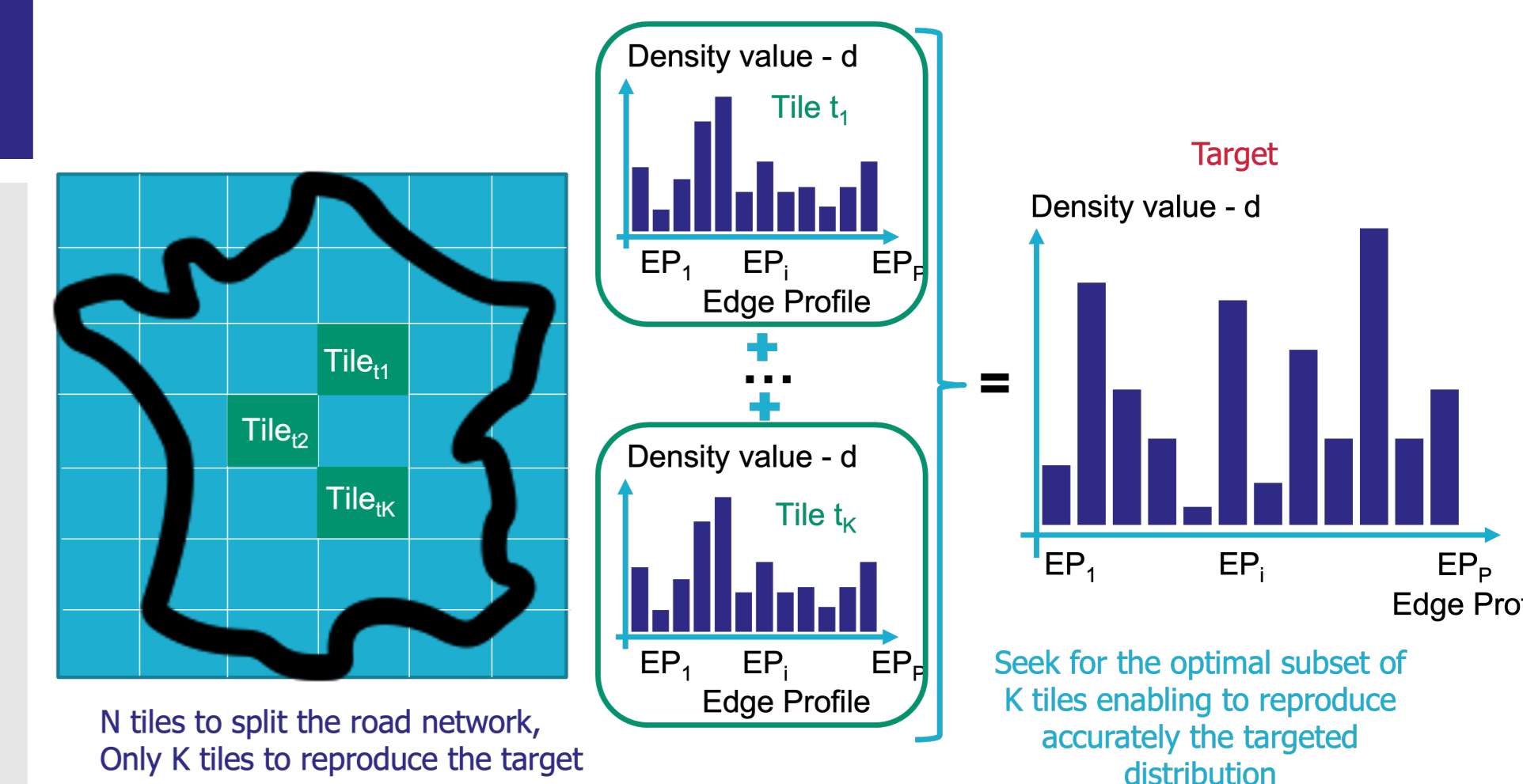
$$x_i = \begin{cases} 1 & \text{if the tile } i \text{ is kept as input} \\ 0 & \text{else} \end{cases}$$

The quantity of road sections in the K selected Tiles has to be higher than  $K/N$  percent of the global quantity of sections

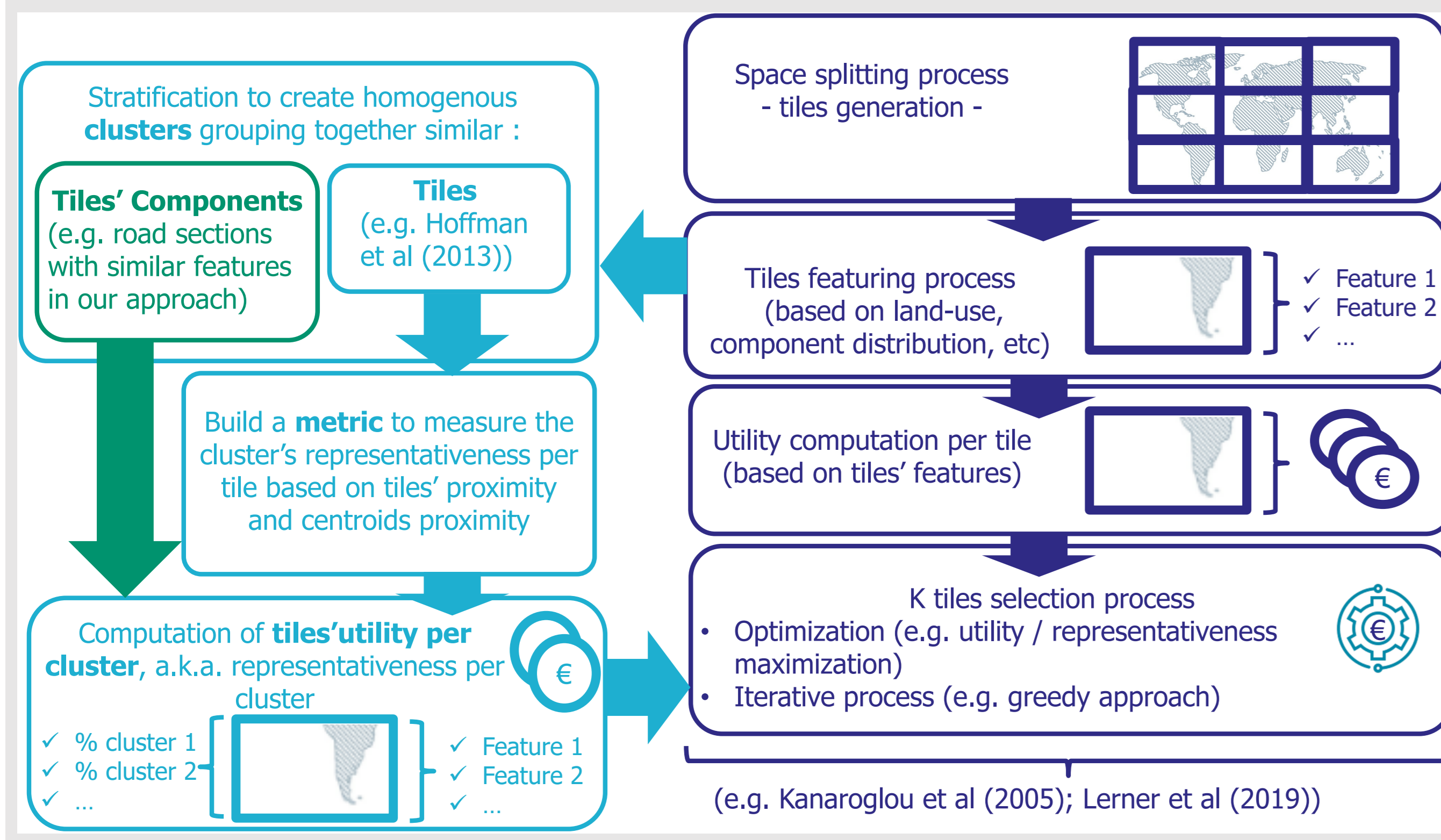
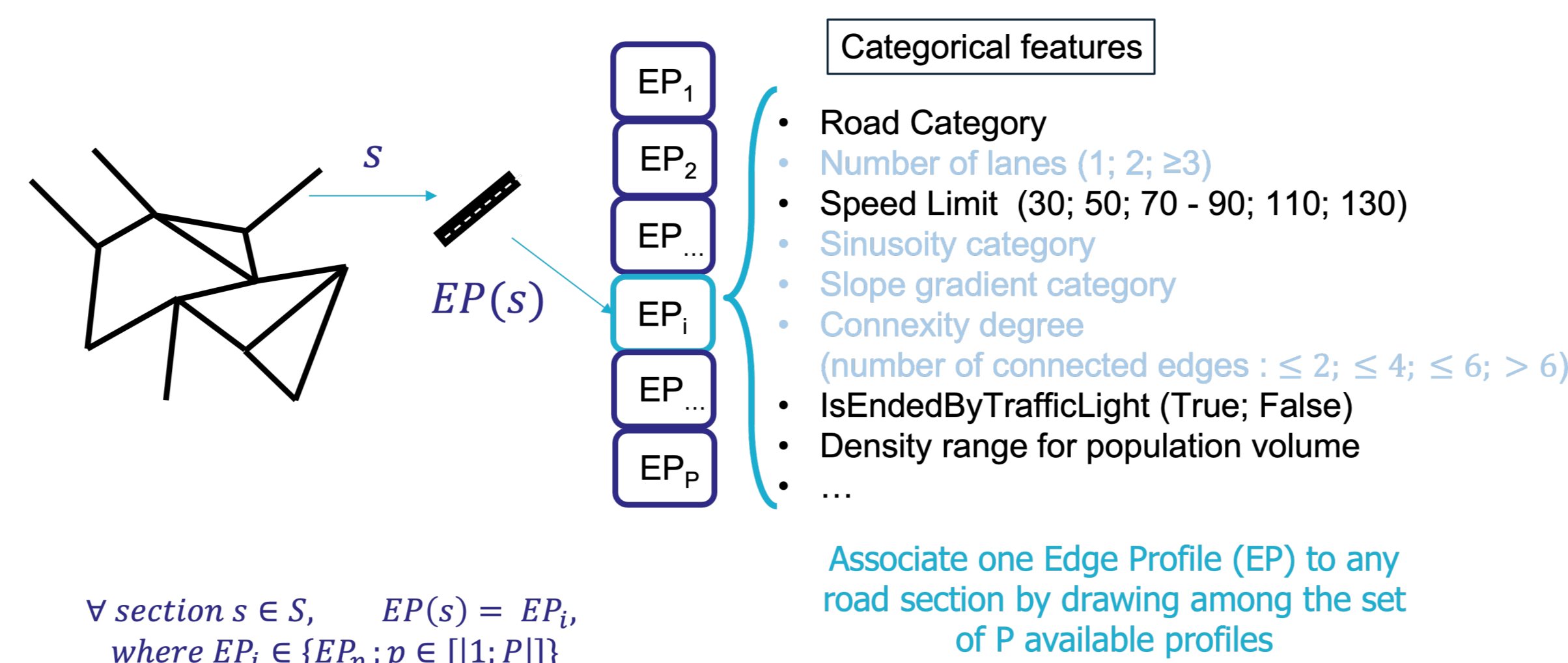
## Results

### Key Performance Indicators

- Systematic bias = gap between the ground-truth median speed profile & the one issued by the k selected tiles;
- Coverage bias = gap between the ground-truth variance and the one issued by the k selected tiles.



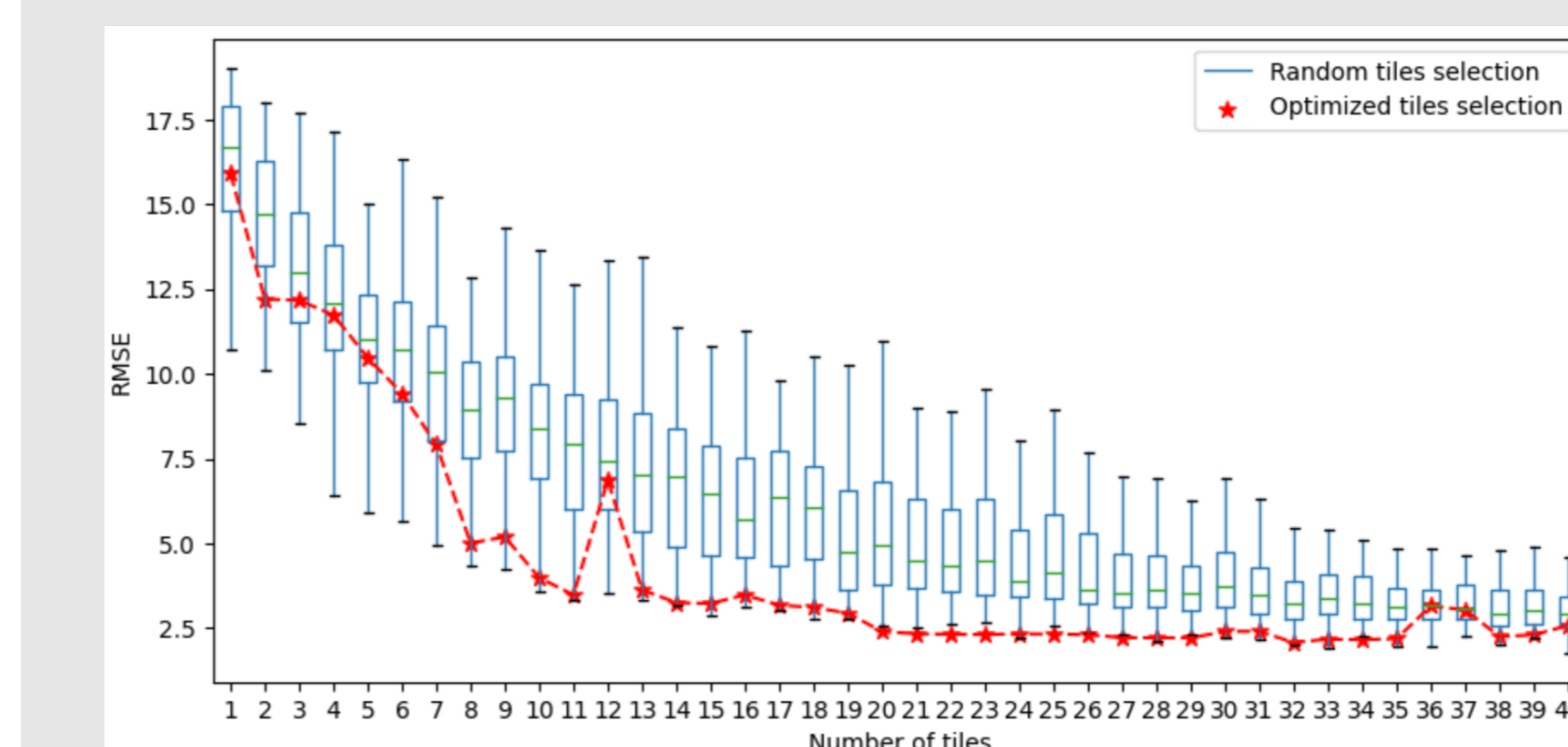
## STEP 1: Edge Profiles definition and road sections clustering



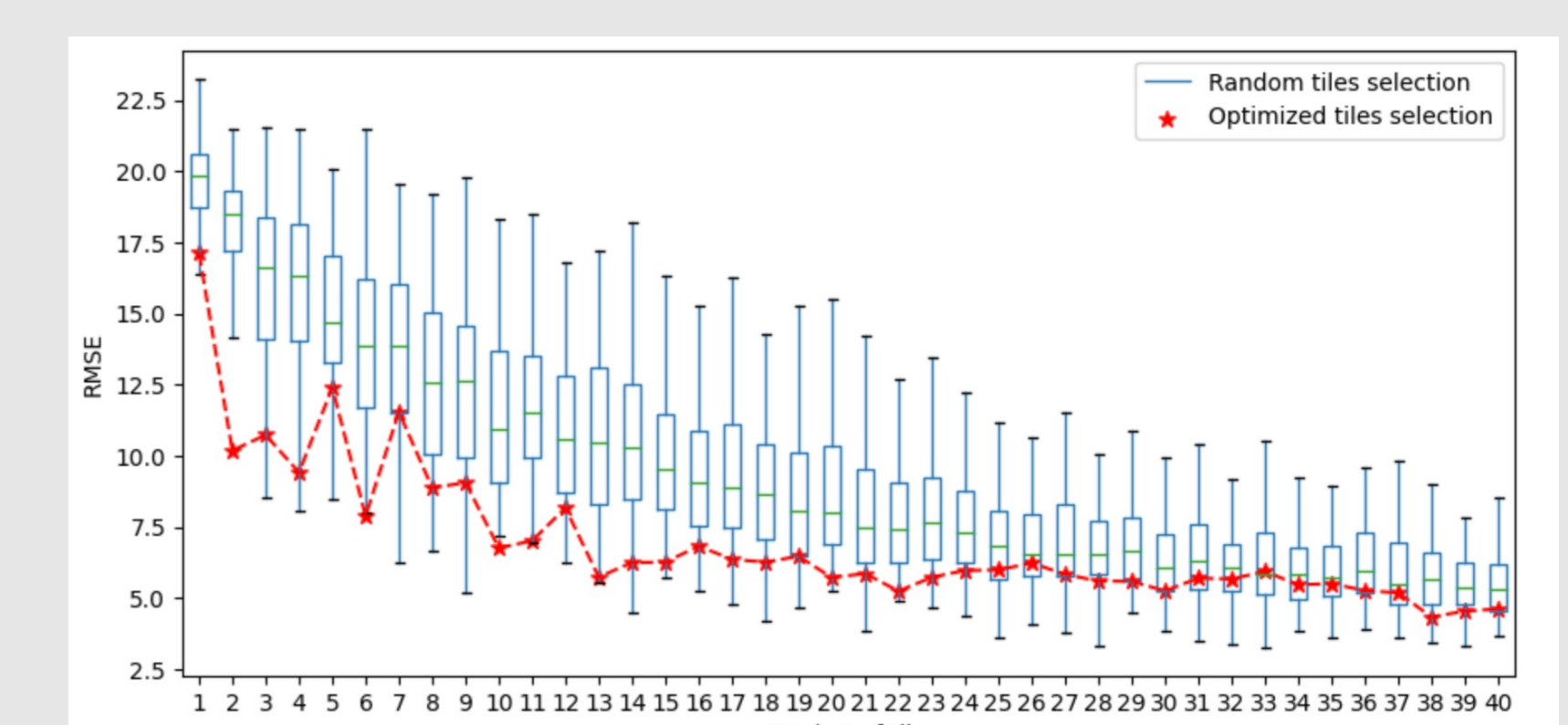
## Case study: city of Lyon



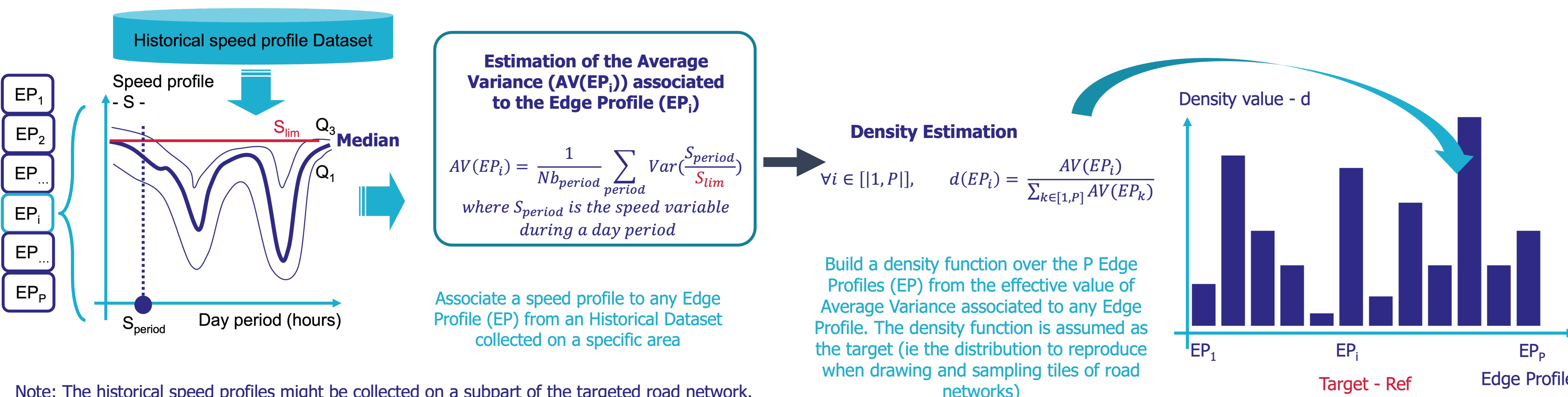
### Coverage bias - RMSE



### Systematic bias - RMSE



## STEP 2 & 3: Determination of the targeted utility per Edge Profile



## Bibliography

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