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FNSNF

Pushing the Spatio-Temporal Resolution Limit of Urban Air Pollution Maps

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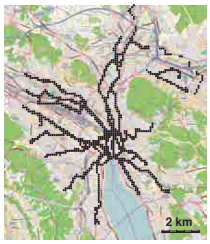
Autonomous Sensing

Data collection using ten mobile sensor nodes on top of public transport vehicles

- Sensors: O_3, NO_2, CO, ultrafine particles
- GPS module, GSM modem

Node with low-cost sensors

Sensor box on top of a tram



Mobile sensor nodes cover a large urban area of 100 km²

Ultrafine Particles (UFPs)

Nanoscale particles with a diameter of less than 100 nanometers

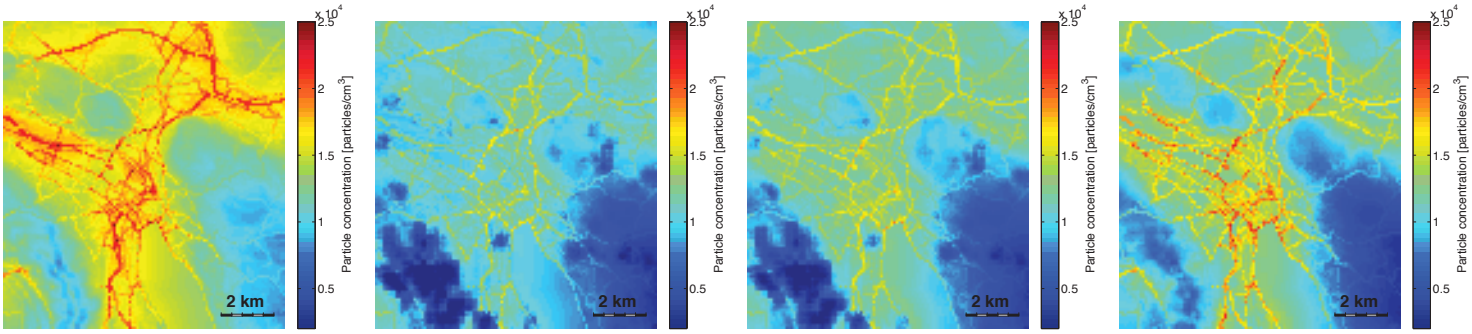
- Believed to have more severe health implications than PM_{10} or $PM_{2.5}$
- Lack of spatially resolved exposure data

MiniDiSC: First compact UFP measurement device suitable for mobile measurements

MiniDiSC device

High-Resolution Pollution Maps of Zurich

The collected measurements are used to develop pollution maps with a high spatio-temporal resolution:



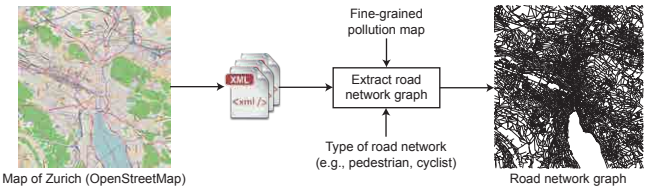
Winter (January–March) | *Spring (April–June)* | *Summer (July–September)* | *Fall (October–December)*

Application Example: Health-Optimal Routing for City Dwellers

Offer route planning service to calculate routes that are health-optimal, i.e., minimize the total number of inhaled particles

Road network graph

Road network of Zurich is based on OpenStreetMap data



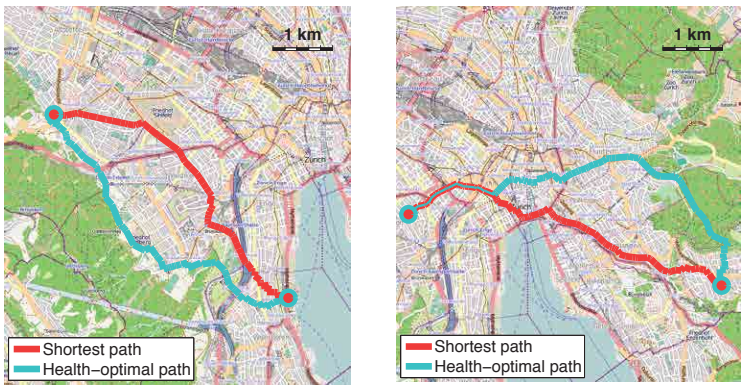
Map of Zurich (OpenStreetMap) — Road network graph

Road network is an undirected graph G = (V, E, W_d, W_p)

- Each node $v_i \in V$ represents a crossroad or dead-end street
- An edge $e_j \in E$ connects two nodes if they are directly connected by a road segment
- Each edge is associated with two weights:
  - $w_{d,j} \in W_d$ denotes the length of the road segment
  - $w_{p,j} \in W_p$ denotes the expected pollution exposure
- Size of Zurich's road network graph:
  - |V| = 27,000
  - |E| = 74,000

Comparing Shortest and Health-Optimal Paths

Analyzing length and pollution exposure differences of the two paths



Routing from Albisrieden to Wollishofen | *Routing from Wiedikon to Witikon*

Differences are most significant during fall months (based on 1000 random source-destination pairs):

- Average exposure reduction of 7.1%
- Average path length increase of 6.4% (548 m)

OpenSense Zurich Website: www.opensense.ethz.ch