Smart Cities or Human Cities

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The origines of the concept

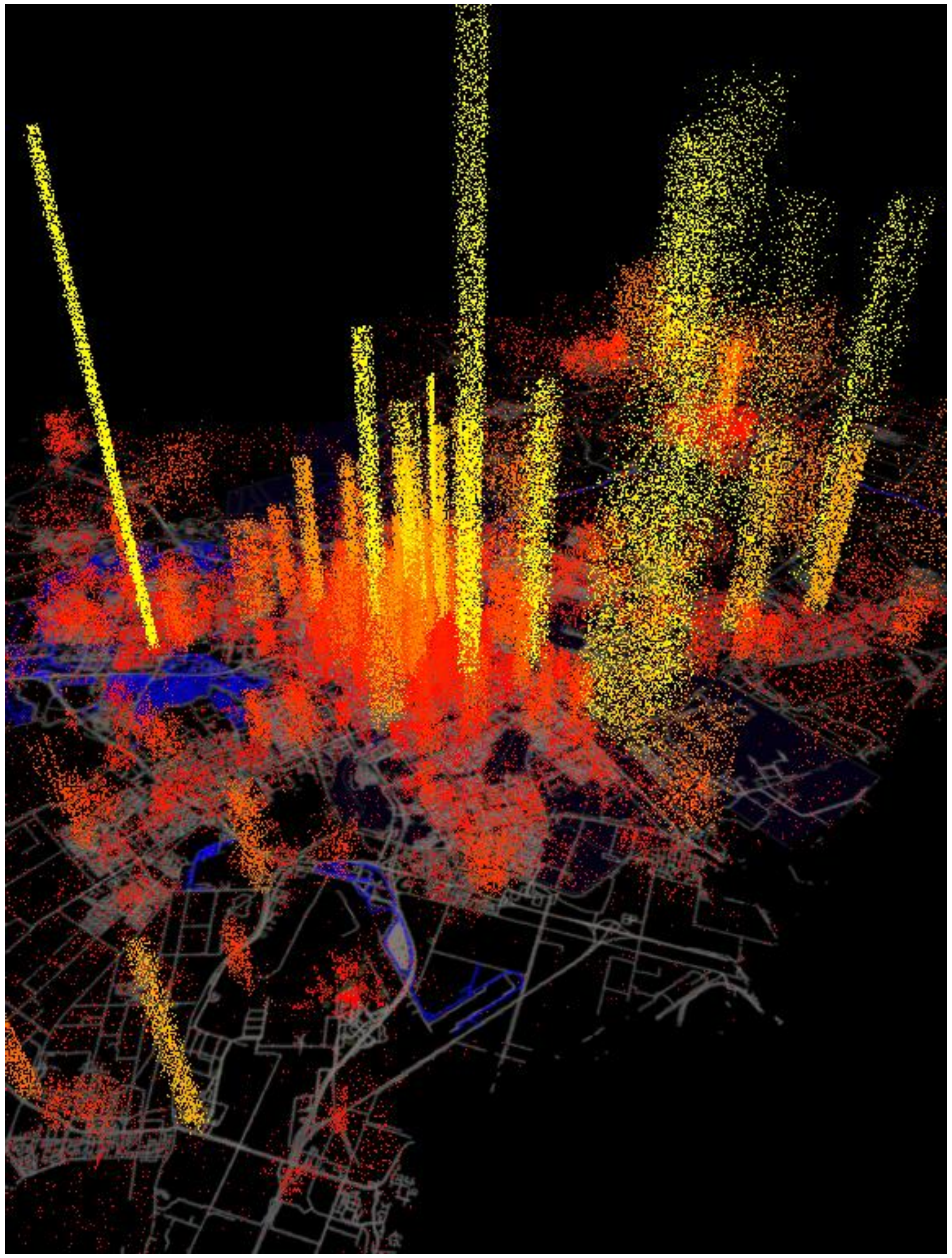
- J. Laterrasse, 1991
  - Les villes intelligentes : utopie ou réalité de demain ?
  - Main focus on the transportation network
- Bill Clinton, 2005
  - Challenge aimed at Cisco
  - « Connected Urban Development »
- IBM, 2008
  - Smarter Planet, Smarter Cities
  - Sensors, networks, data analytics

The first approach

- Cities = system of systems
  - Complexity to control
  - Metrics to optimize
  - Systems to manage
- Reminder : IBM leader of IT market
  - Mainframe OS
  - Optimization/Data analytics systems
  - => horizontal growth expected
- End siloed structures of cities
  - Department are not enough interacting
  - Data can fuel synergies
  - Analogy with data analytics

Why smart cities ?

- Cities = public marcket and political object
  - IBM vision did not generalize
  - Political, social, economical, industrial issues
  - Evolution of the notion
- Motivation ?
  - World urbanization
  - Over-densification of urban areas
  - Anthropocene challenges
- Societies needs progress
  - Public health and environnement
  - Transport public/private and mobility at large
  - Reactive public services
  - Security, democraty



Individualization of the experience of the city

Why smart cities ?

- Urban densification
  - Collage of urban functions
  - Public health
- Leaving is moving
  - Transports and spreading
  - Way of life correlated to social hierarchy
- Individual urban exprerience
  - Values et ways of leaving
  - Diverse urbanities
  - Digital revolution

HYGIENISM
TECHNOPHILY « URBAN ENGINEERING »

SATURATION & CLOGGING
OPTIMIZATION OF FLOWS

INDIVIDUALIZATION
INTERACTIONS
SERVICES

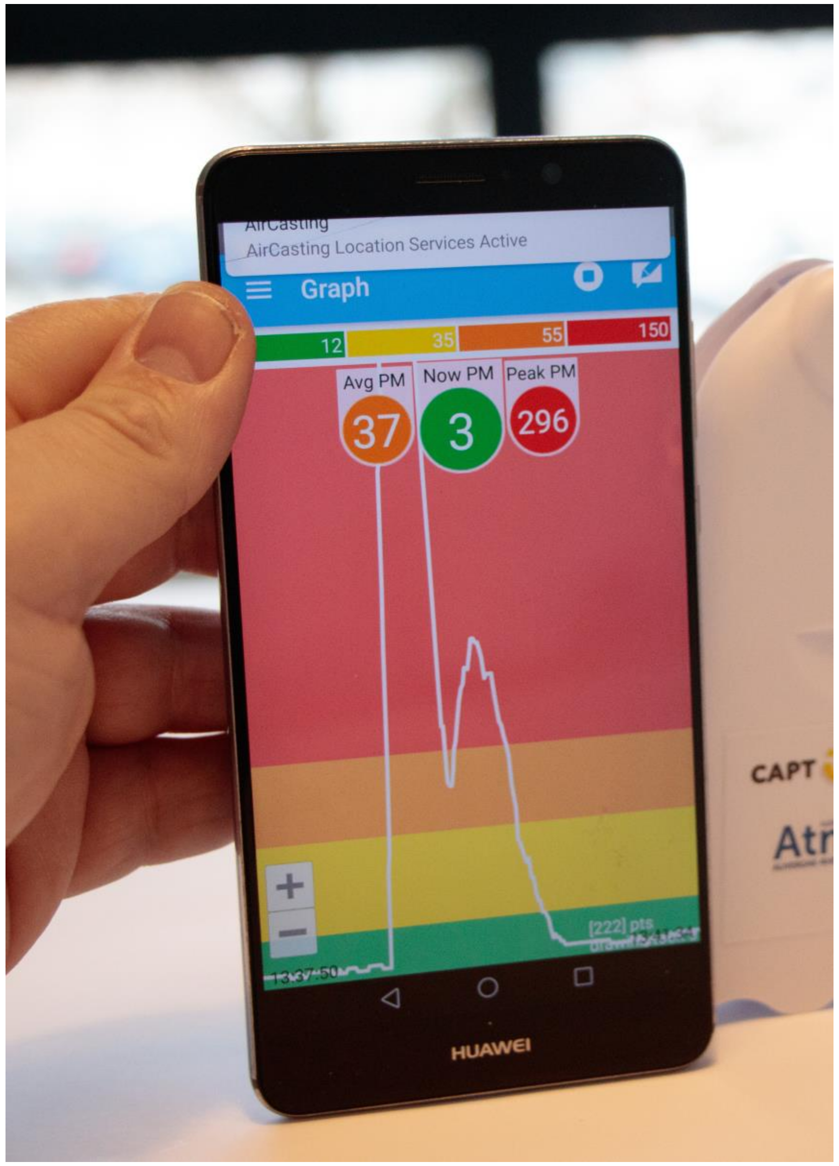
« Intelligence » ?

- Intelligence in French
    - Anthropomorphic notion
    - Understanding and adaptation

- Smartness
    - Concept from cybernetics
    - Adaptat to modifications of the environnement
    - Notion of resiliency

- Bad french translation pour technical systems

- More relevant for pour the city as a collectivity
    - Including citizens
    - Not limited to techno-centric approaches
    - Grounded on digital cities



Physical – Digital continuum

- Digital revolution and electronics
  - Wealth of measurements and data
  - Fading boundaries … « phygital »
- Environnement and activity sensors
  - In the public urban space
  - In connected things, vehicles, …
- RFID tags for logistics and more
- Smartphones : passive tracking
- Social networks : active tracking

- Data redistribution: services, visualizations, open data, etc.

Manyfold and heterogeneous observations of urban phenomenons

An example : the energy grid

- Energy production : expensive infrastructure / slow evolution/ complex control
- Energy consumption : fast variations / individual behaviors

- Data analysis + statistical smoothing

=> Time dependent faring

- Low frequency measurement
    - Peak detection / individual control

⇒ Device per device switch on/off

In both case : adapt consumption to production

- High frequency measurements +
    - Environmental data
    - Socio-economics and urbanization

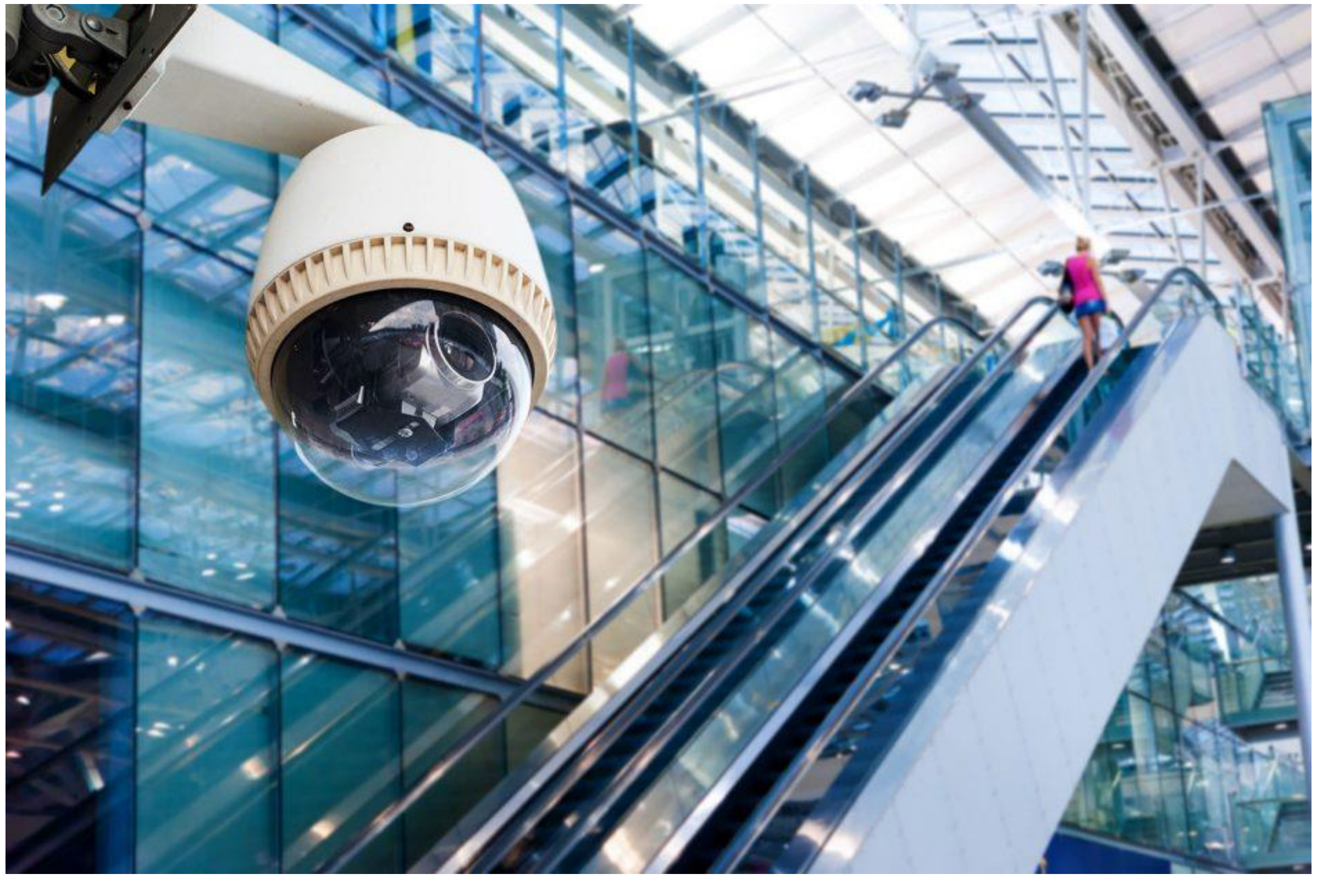
⇒ Precise consumption prediction (AI)

⇒ Enables smart-grid : adapt production to consumption

⇒ Need computer science and networking in the infrastructure

Many issues that are not purely technical

- Energy consumption = people and activities
  - Mobility / presence detection
  - Activity inference (even appliance wise)
- Privacy and security issues
- Technology in our intimacy
  - **Who access what and why ?**
  - Social acceptance
- But also
  - Easier decentralized production
  - Efficiency / resilience of the grid
  - Hybrid infrastructures
  - Necessary for renewable sources



Air Pollution Monitoring

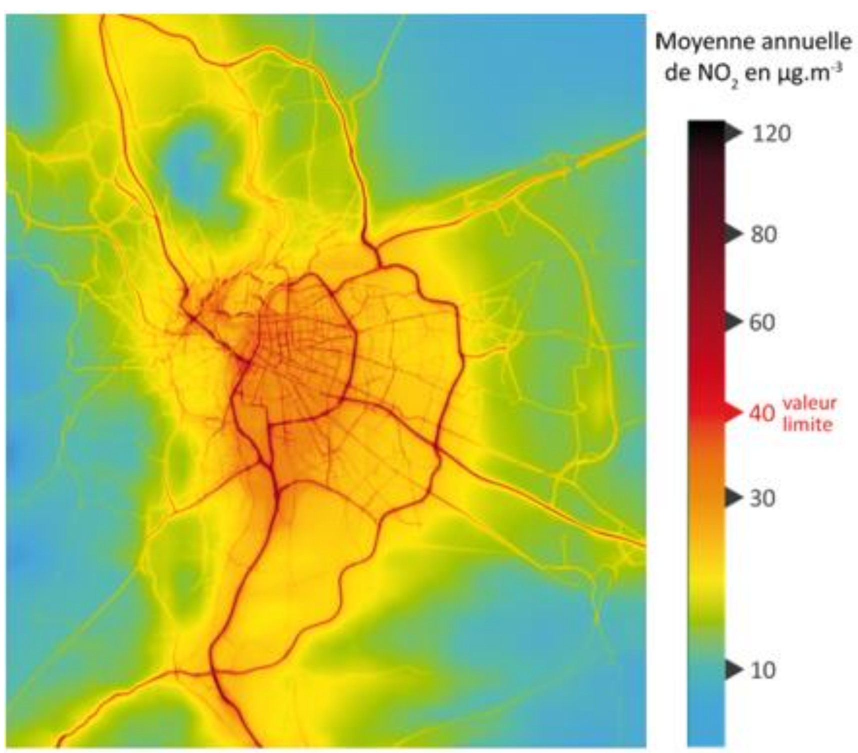
Mainly simulations + few measurements

Modeling : physicochemical dispersion models (SIRANE, ADMS, etc.)

Input: locations of pollution sources, emission rate, meteorological data …

Measurement: reference monitoring stations, accuracy, high cost, low density

Traditional Monitoring Solutions



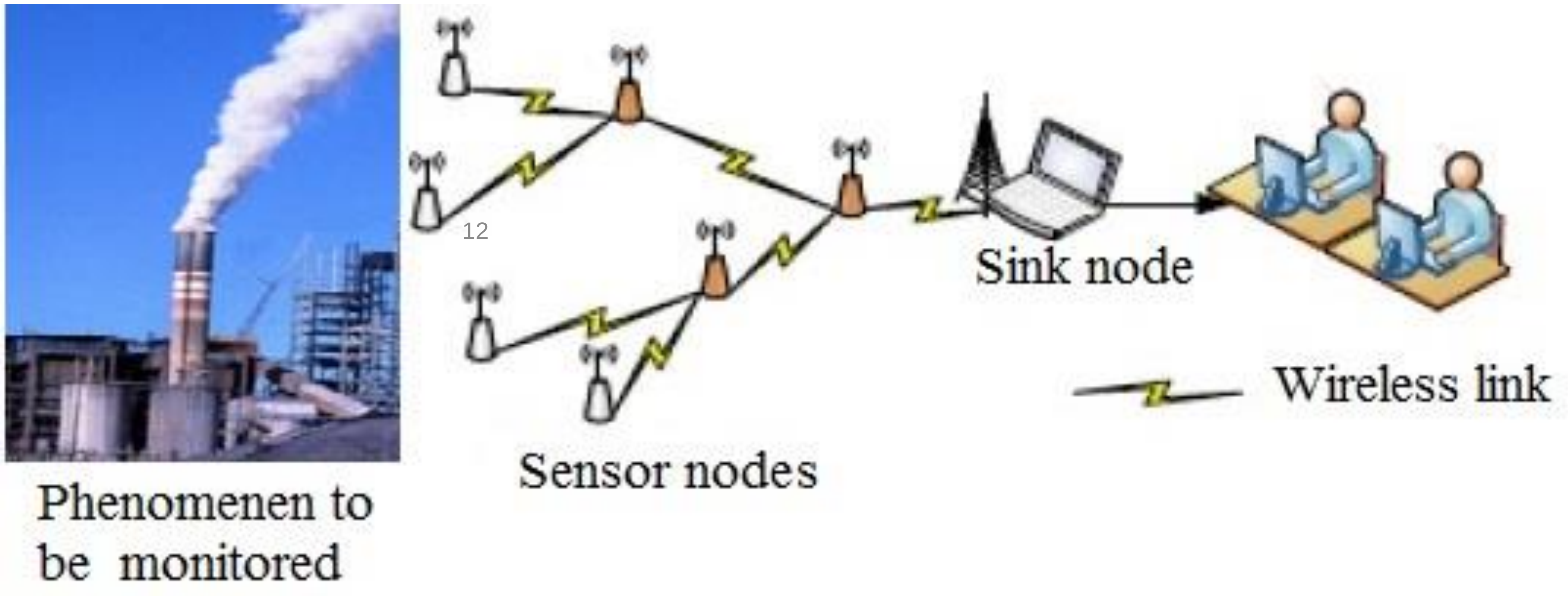
NO2 Concentrations in Lyon in 2012
(Air-Rhone-Alpes)

Traditional monitoring stations, Paris, France

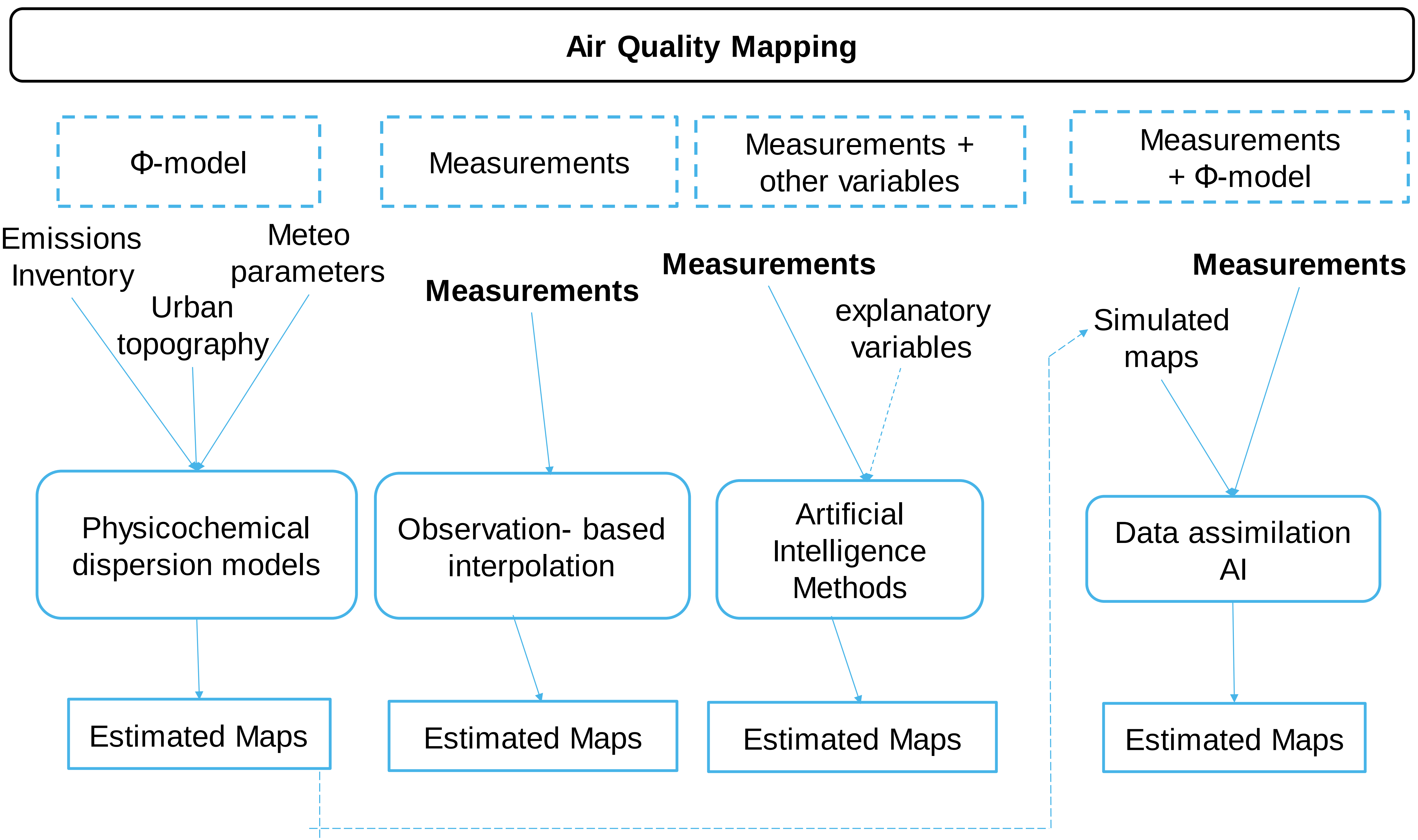
Context: low cost wireless sensor networks

Emergence of low-cost wireless sensors: flexible & cheaper solution

- ☺ Tiny and low cost
- ☺ Better spatial/temporal granularity
- ☺ Lower installation and operational cost
- ☺ Self organization and autonomy, more flexible
- ☹ Less accurate compared to dedicated instruments
- ☹ Lifetime, need to regularly calibrate electrochemical sensors



Methodology



Many research issues

- Low cost sensors for better physical phenomena characterization
  - Optimal deployment of sensor nodes
    - for phenomena mapping
    - for model corrections
    - for threshold detection
  - WSN platform
    - Node / network design
    - Deployment
    - Front end
  - Sociological study
    - Qualitative study
    - Quantitative study
  - Data analysis of crowdensed data
    - Node/ network Design
    - Regression Vs Assimilation
  - UAV fleet mobility for punctual rejection
    - Optimal mobility

Urban life is mobile

Mobile sensors :
- Smartphones, cars, public transport
- Understand mobilities, usages

Mobility part of the measurement :
- Crowdsourcing
- Sensing correlated to people density

The cellular network as a mobility sensor
- Macro/Mesoscopic analysis

Understanding of society
- Urban tissue
- Urban segregation
- Mobility and network usage

New urban mobilities

Adaptative guidance

- Crowdsourcing : Google waze / coyote …
- => Air quality aware path
- => Exposure to publicity

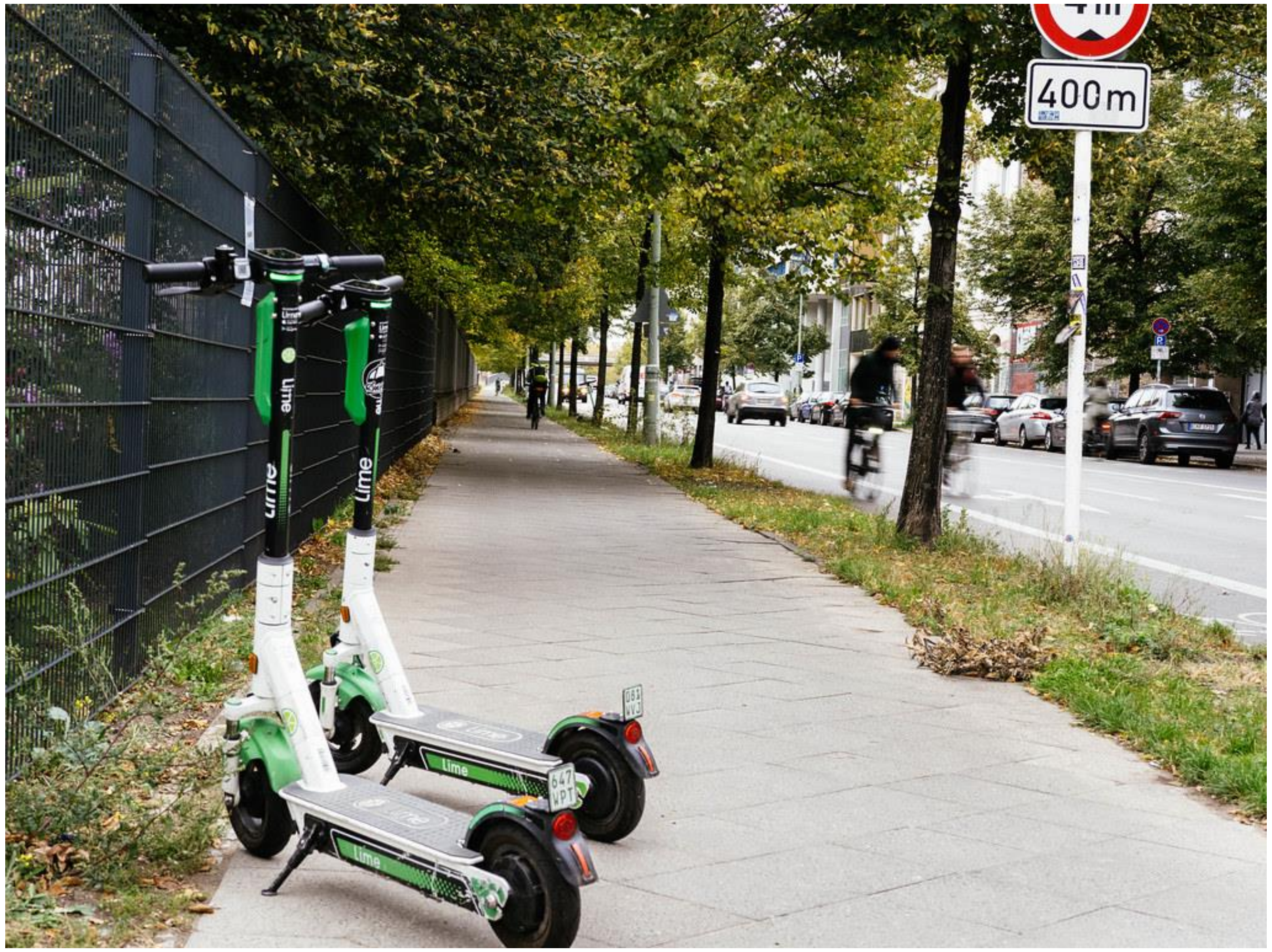
New micro-mobilities

- New usage of the public space
- Regulation and infrastructure issues

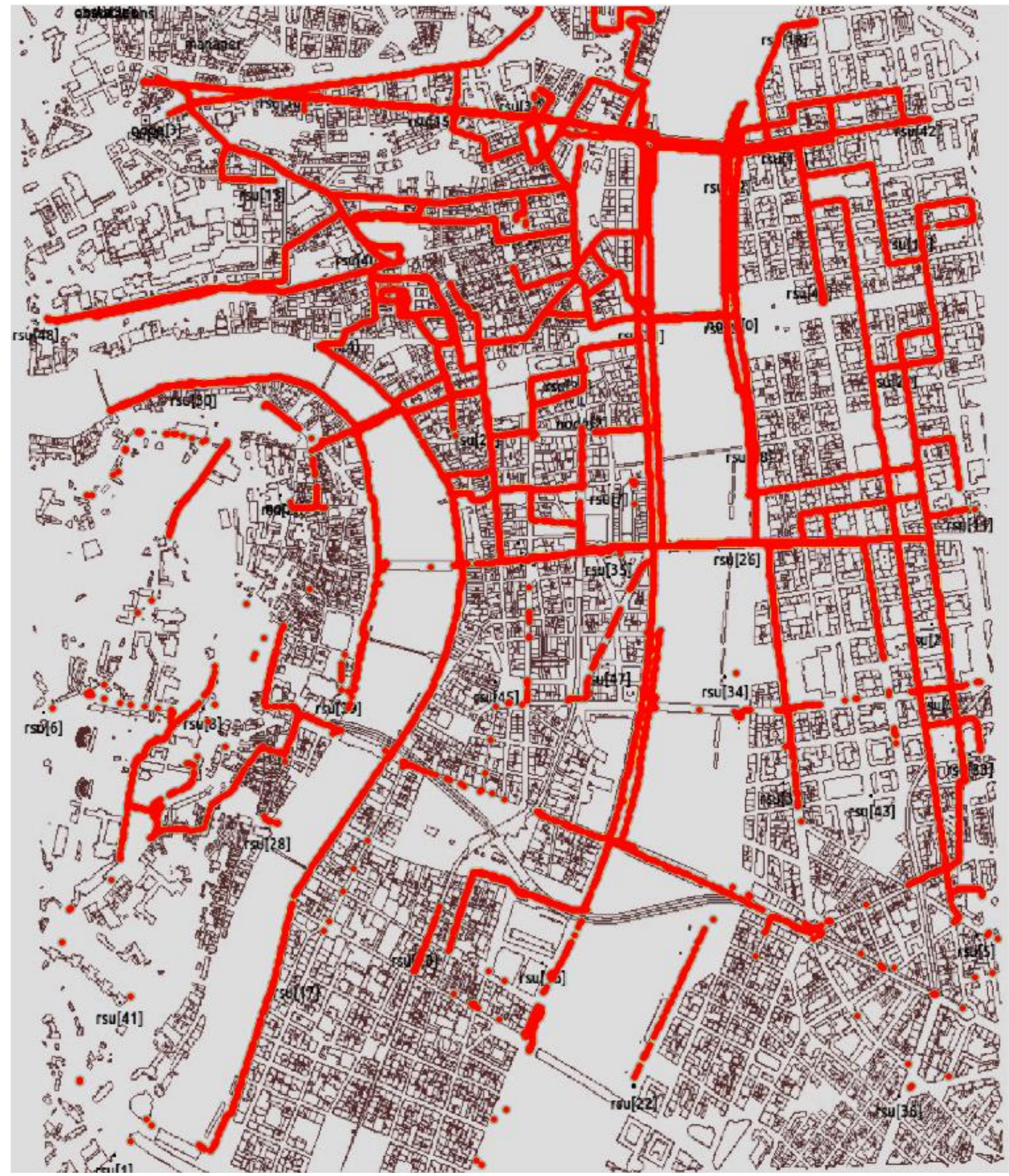
Mobility regulation equilibrium

- Urban mobility planning
- Commercial interests
- LOM law

How to arbitrate ?



Decarbonized mobilities



Static spacial division per mobility

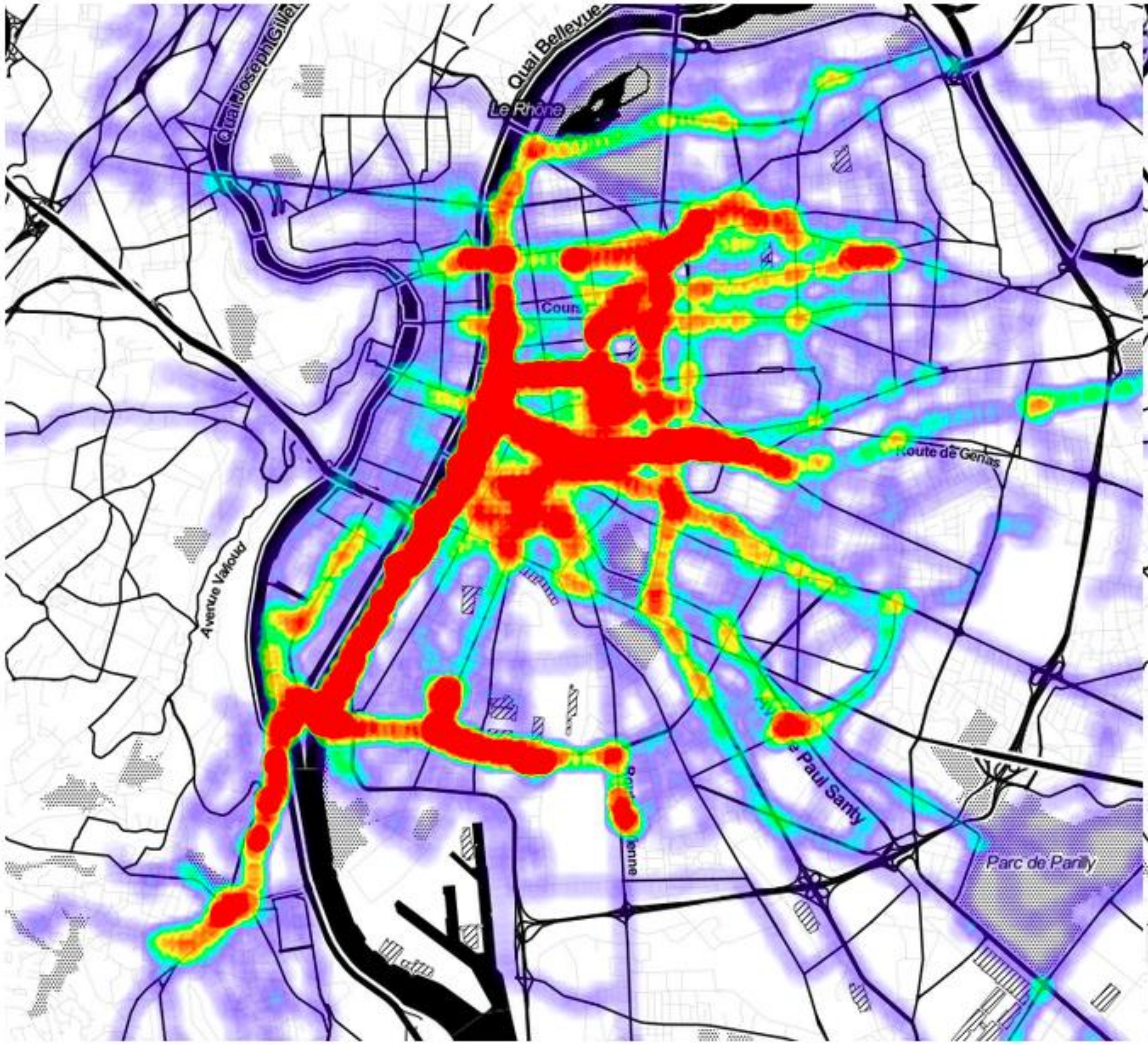
Power relationships between modes

Deviations for confort and security

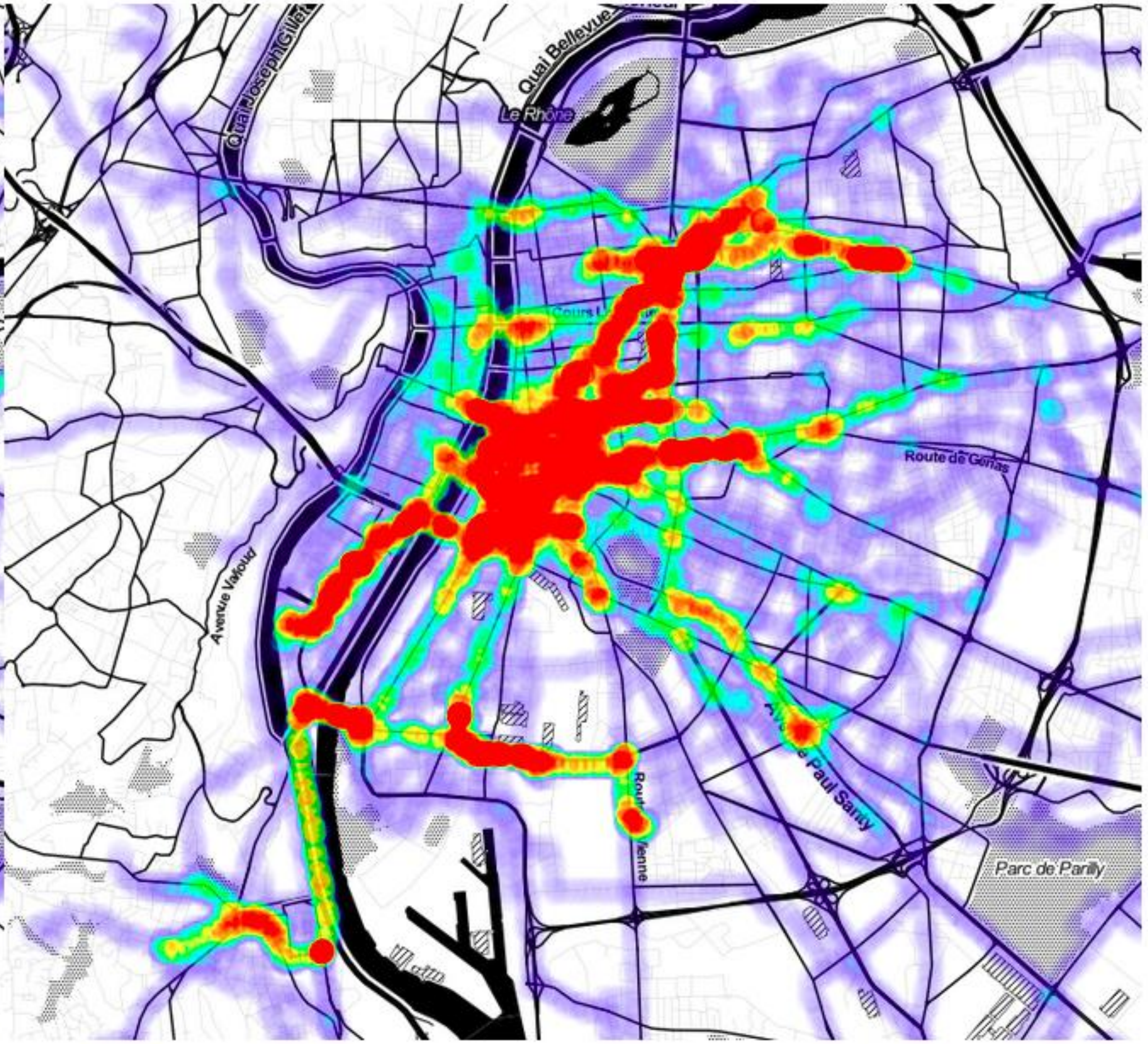
How to adapt to new usage ?

Data driven route choice understanding

How bike path are chosen ? What are the criteria ?



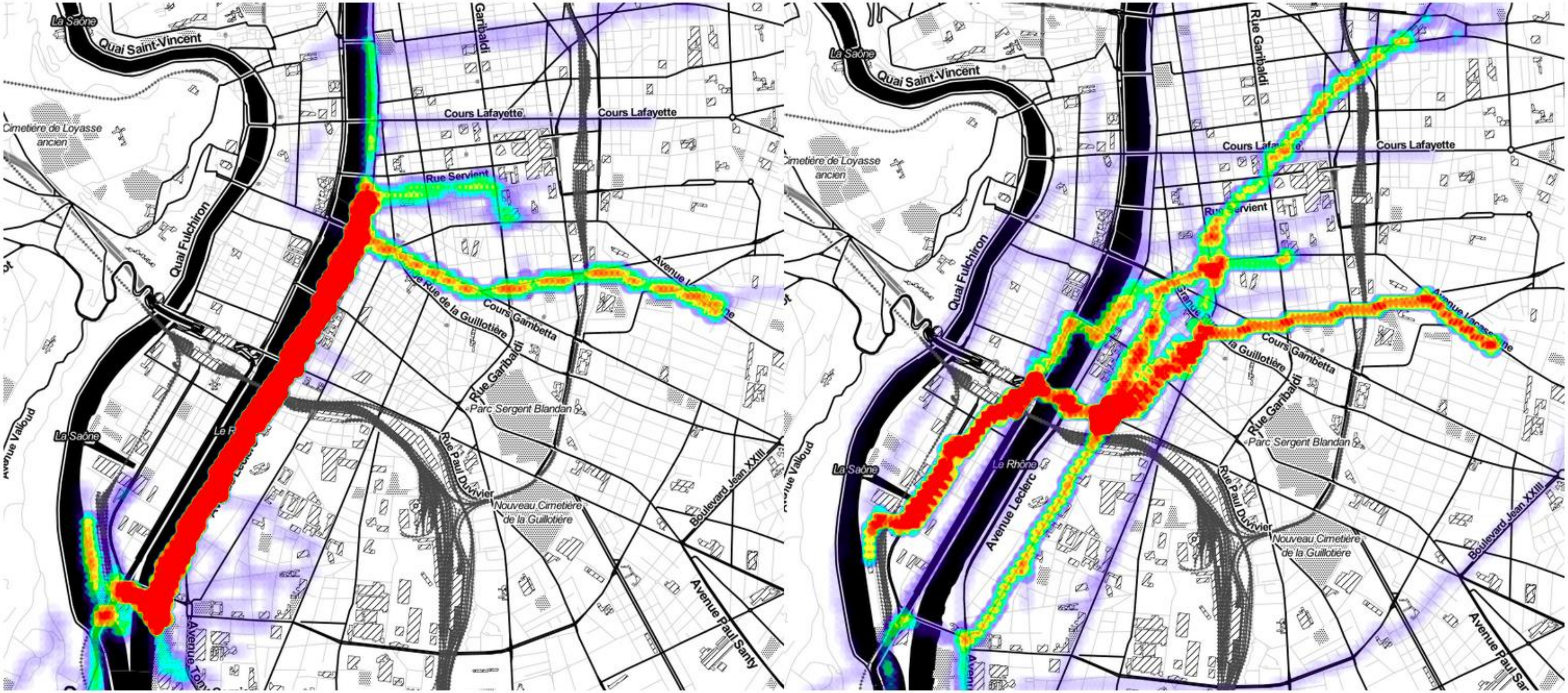
Real traces



Shortest paths

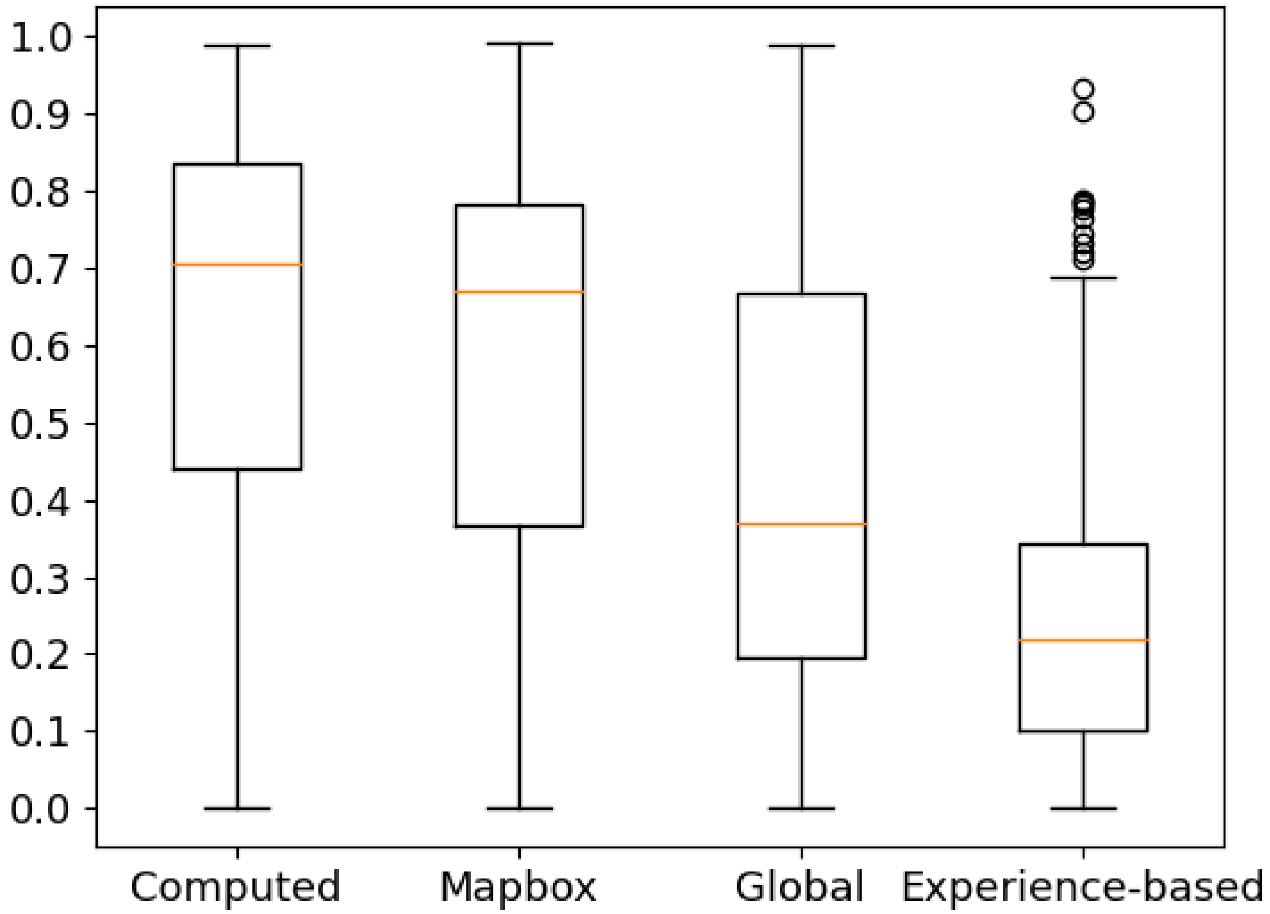
Clustering of GPS traces

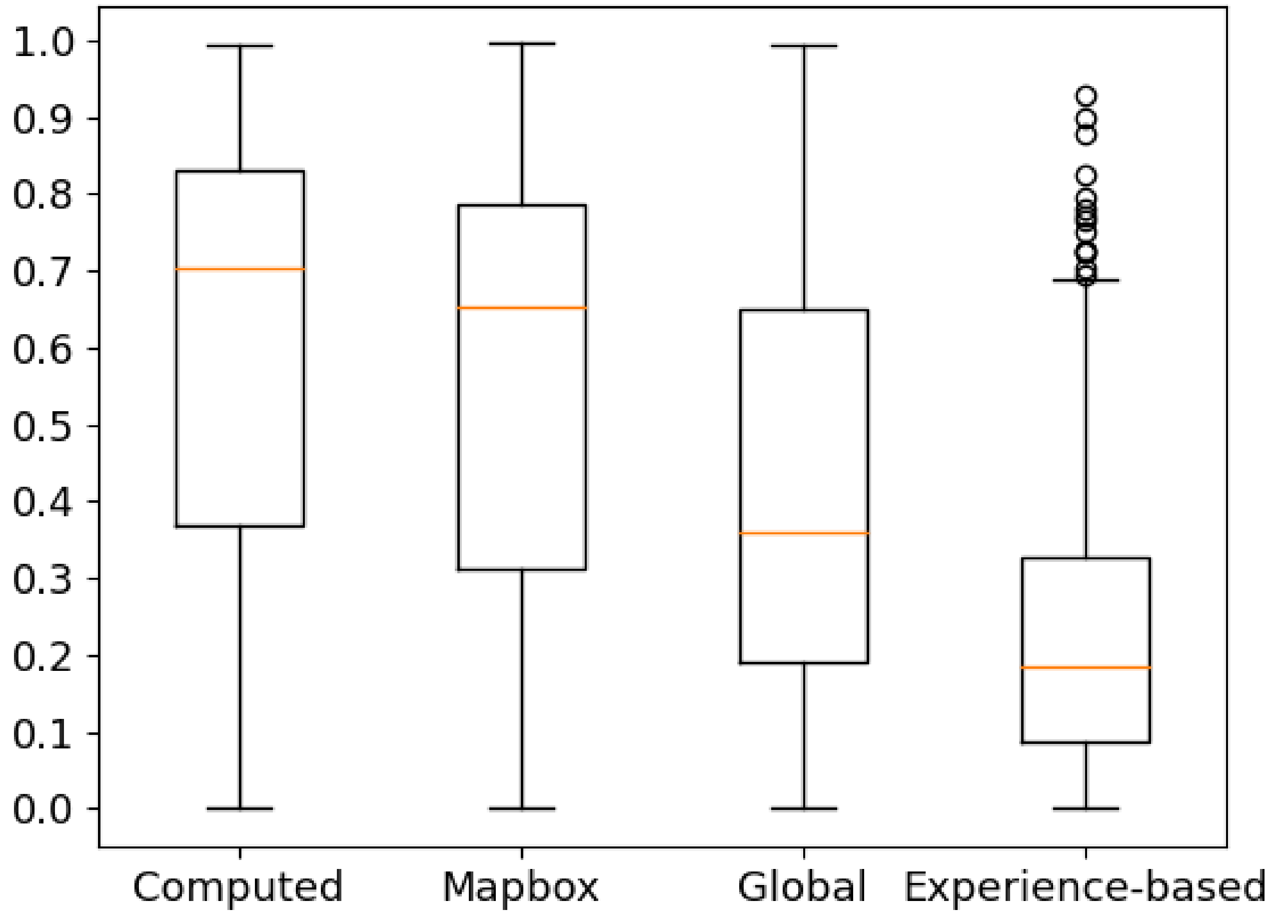
Spatial logics are identified - : diverse behaviors but rational choices (commuting)



Clustering of GPS traces

Shortest path on cluster-wise deformed distances => close to real traces

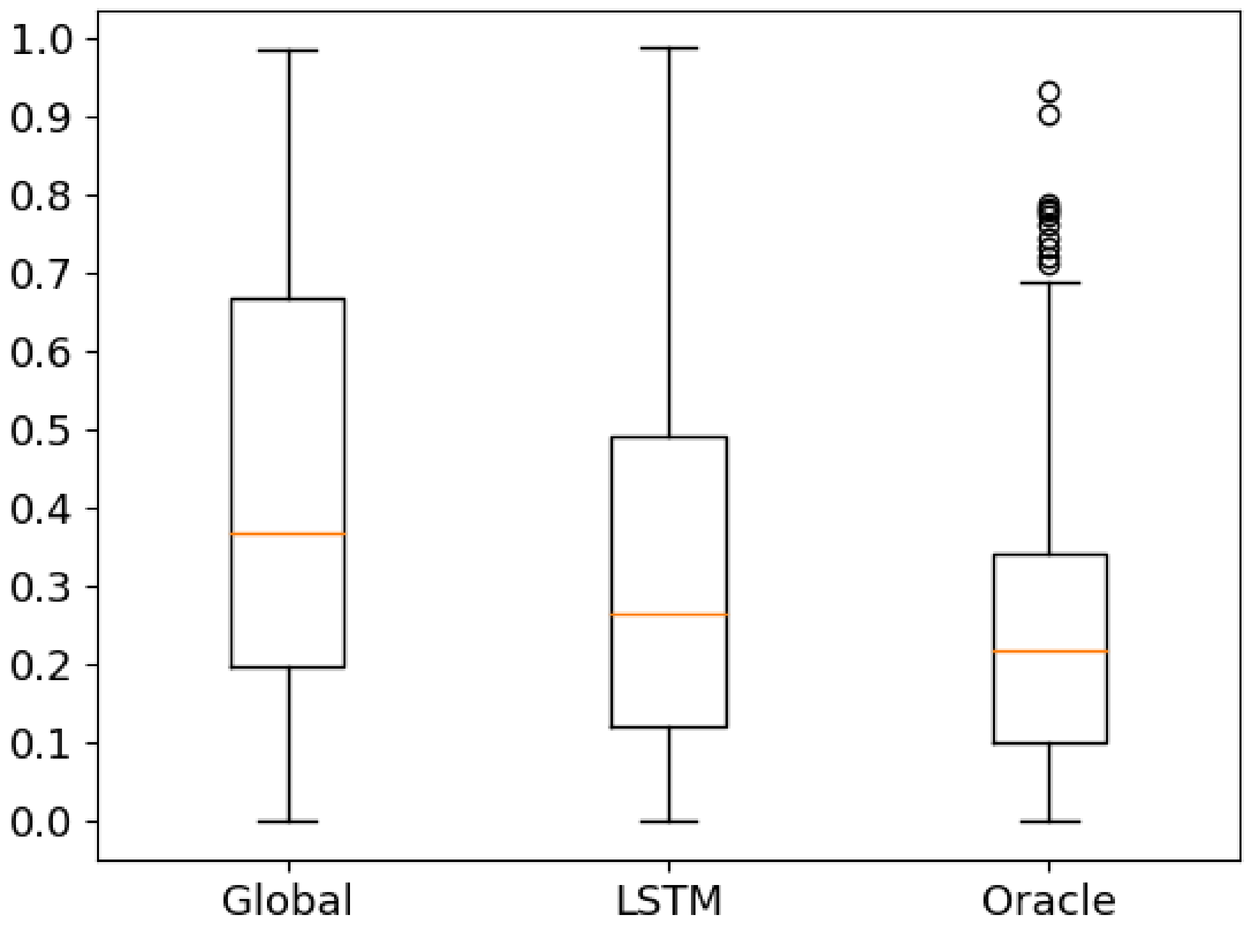


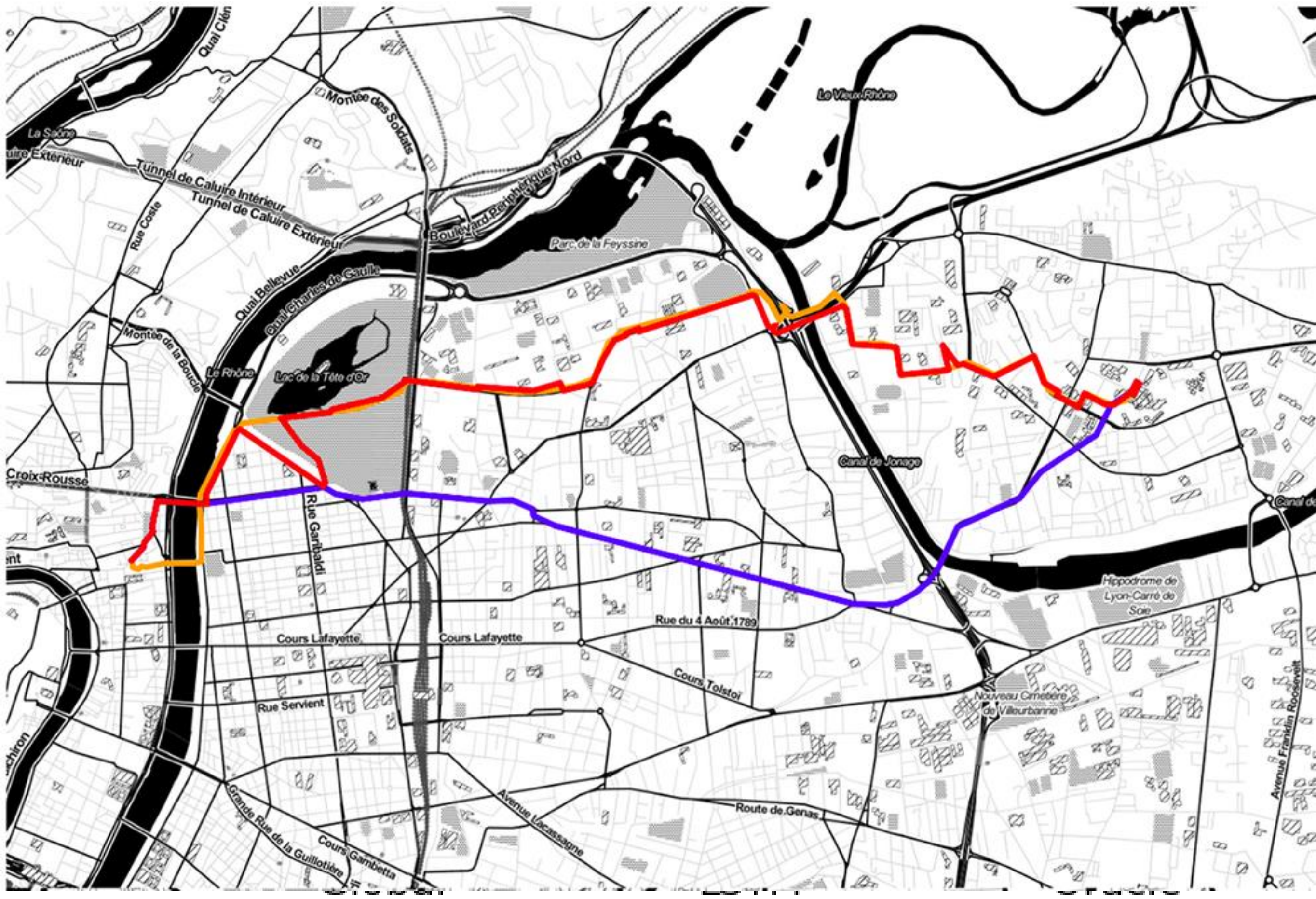


Clustering of GPS traces + Deep Learning

Associate a cluster to an origin, destination pair

O/D -> LSTM Neural Network -> cluster prediction -> shortest path





Next step : dynamic sharing of public space

Agile city adapting to its citizens

- Increase decarbonized mobility
- Provide secure path with limited deviation

Adapt virtualization to urban infrastructures

- Reserve space when needed
- Faster/cheaper than hard infrastructure

Data/IA/Networking needed

- Prediction of usage at micro-scale
- Social acceptance of deviation/waiting

Evolution of domination hierarchy on the road

- Priority to decarbonized mobility
- Political choice in a wider efficiency/sobriety/reliency equilibrium

Learning city

« Invisible » informations are highlighted

- Adaptation of infrastructure to citizens
- Monitor the evolution of social phenomenon

Spatio-temporal datas

- Renewed vision of the territory, of history
- Powerful tools for crossing informations
- Widen the field of possibilities (desirable or not)

Evolution of the relationship to urban space

- Diversity of urbanities
- Urban functions > mobility flows > information flows
- Rebuild political relationships from these flows

Cities learn from/about their citizens
Citizens need to build new skill sets

Major issues for society

Wealth of measurements but

- e-panoptical risk « supervise and punish »
- Monitoring/predicting is NOT understanding : human dimension necessary

Citizens understanding of process

- Invididual freedom issue
- « Digital devide » : culturall cognitive, education related

Ability to participate to public debates

- Privacy
- Ethiqual limits of AI

Democraty needs equality

- Urban segregation
- Evolution of jobs, citizenship, etc.
- Issue for initial and continuing education

Agora

et donc, voilà

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