IRPET Istituto Regionale Programmazione Economica della Toscana

Transport and land use in a metropolitan context: the case of the florentine area

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Overview of the research

Objective:
Assess and evaluate the **socio-economic impacts of infrastructure investments and territorial planning** both at the urban and regional scale in an integrated framework.

Response variables include: location decisions of households and firms, territorial distribution of net economic benefits, housing prices, environmental cost/benefits.

Methodology:
Build a **Land Use/Transport Interaction** (LUTI) model using the Florence Metropolitan Area as a pilot project, integrating innovative data sources (Big Data) with more traditional datasets.

The socio-economic impact of transport

- IRPET has carried out many **evaluation of infrastructure investments** in transport networks and of mobility policies both at urban and regional scale (airport enhancement, LPT reforms, highways construction, mobility programmes, etc.)

- **Heterogenous tools of analysis** have been used in such research activities, based on the scope and the scale of the projects and on data availability (counterfactual methods, I/O models, transport simulation models, spatial econometrics, hedonic pricing, CBA, etc.)

- Recently, IRPET has taken an interest in integrating in a more structured model **transportation models and socio-economic models**. Thi has led to the idea of using the Florence metropolitan area as a test field for a LUTI model.

A unified and integrated framework

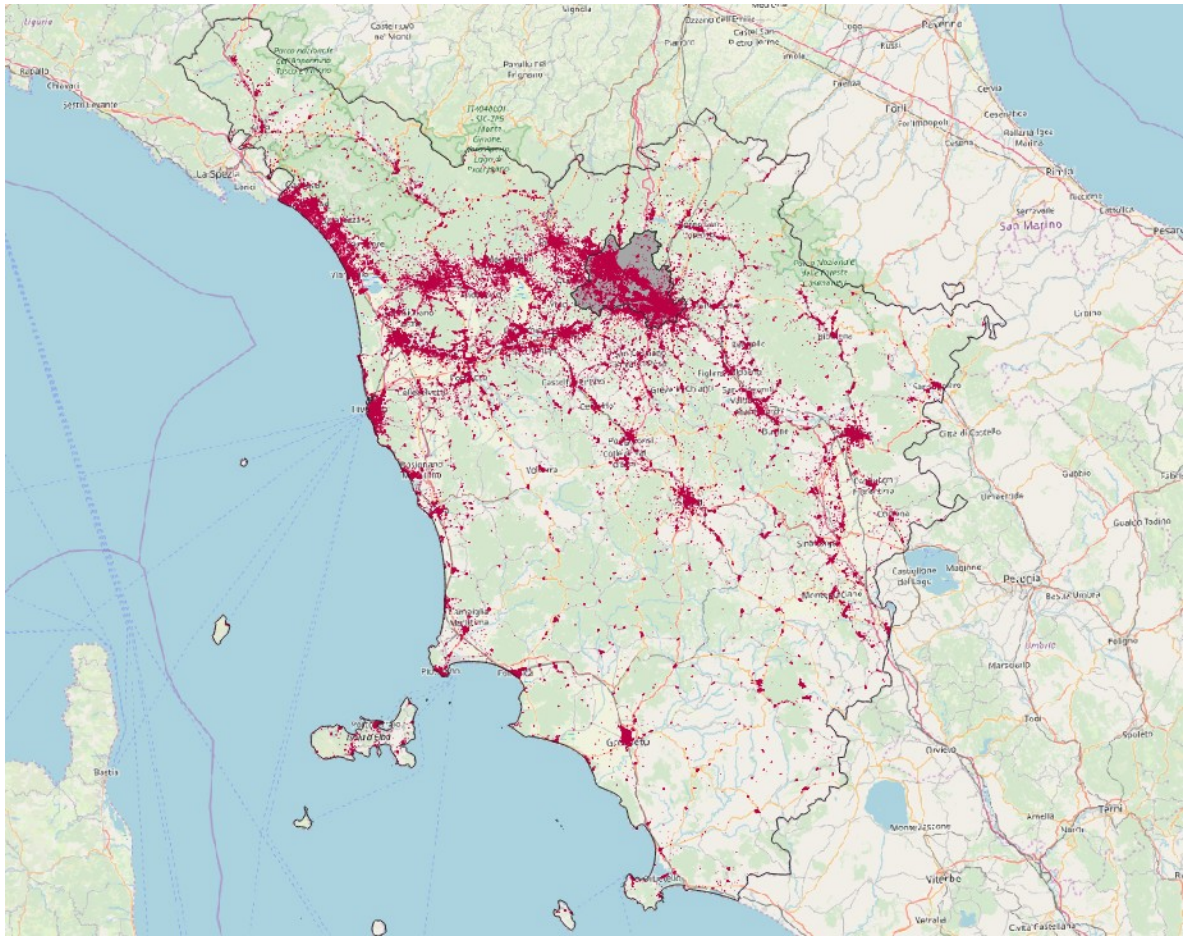
The research project is **currently WIP** and is comprised of three parts:

- Development of a **classical 4-steps transport model** for the Florence area and its surrounding, building upon pre-existing regional models and exploiting the informative potential provided by unstructured data sources (i.e. GPS data).

- Implementation of a **land use model** wich uses a bid function model to simulate supply and demand in the real estate market. The land use model is linked to the transport model via accessibility measures. Both models are developed with Citilabs' CUBE software.

- Defintion and operationalization of different long-term **territorial development scenarios**, based on a coherence matrix between the various projects which insist on the area. This will be the inputs to be fed to the LUTI model.

The study area



The area known as **"Piana Fiorentina"** accounts for less than 2% of the regional surface, but hosts:

~24% of firms
~20% of the population

And provides many services of **regional significance** (universities, research centers, administrative headquarters, transport nodes, etc).

The need for an integrated evaluation

The “Piana” is also an area where **many relevant infrastructure projects are currently being developed or planned**.The infrastructural previsions and their mutual coherence (or lack of) have spurred a high degree of social conflict in the area, resulting in numerous **grassroots movements** with specific **NIMBY** agendas.

Territorial development scenarios

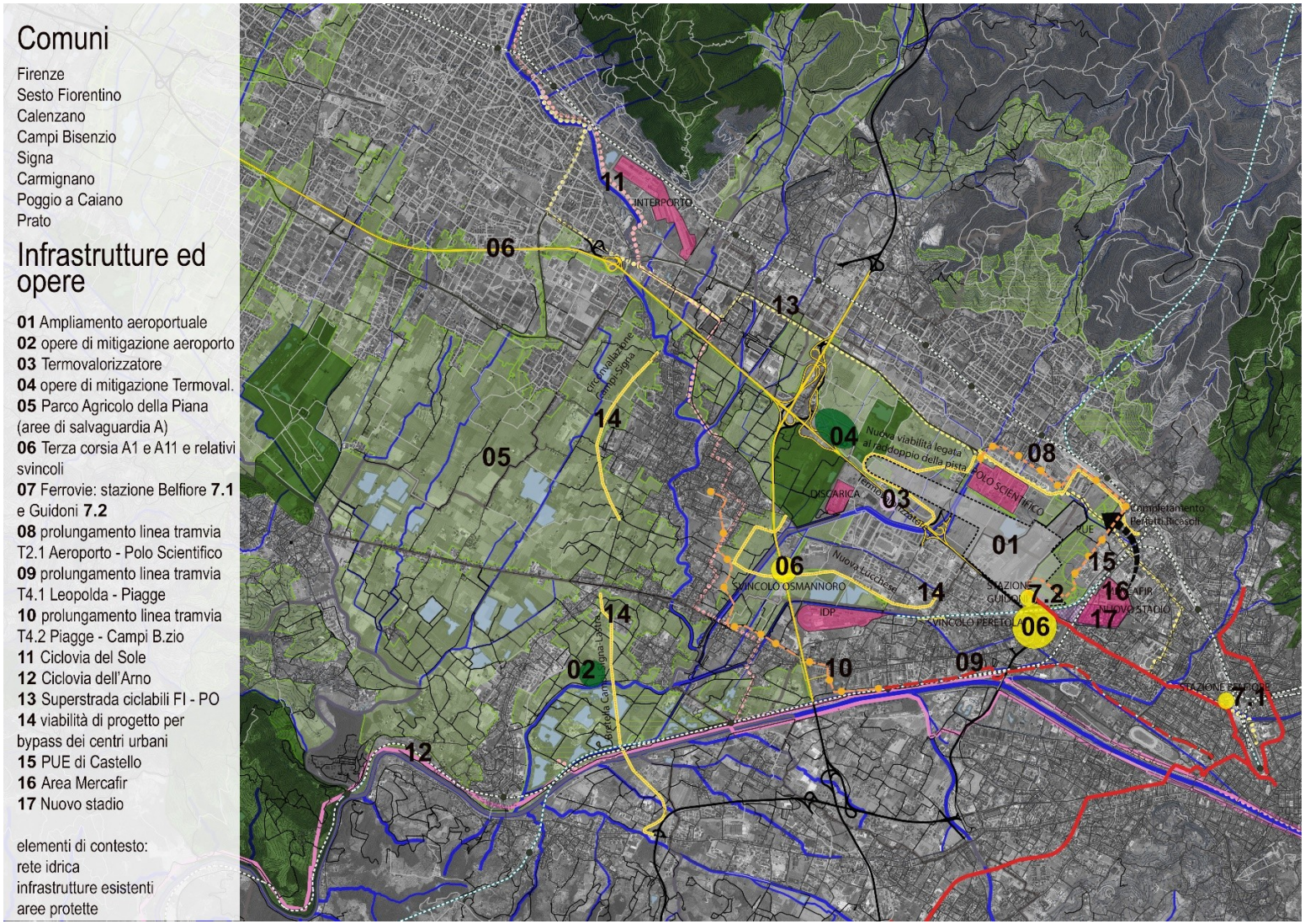
- We start by analyzing the **current state of land use planning** in the area at the different levels of government involved: single municipalities, the metropolitan administrative body, the provinces and the regional admnistration. Since many documents have been elaborated in different timeframes, we want to assess how many and which projects are **still operational**.

- We end up with a **list of projects to be included in the analysis**:

- Master Plan for the Florence Airport (with a new landing strip)
- Highway A1 – third lane
- Highway A11 – third lane
- New underground HSR station of Florence
- New metropolitan high frequence rail services
- New tramway sytem in Florence (3+ new lines)
- The metropolitan park known as “Parco della piana”

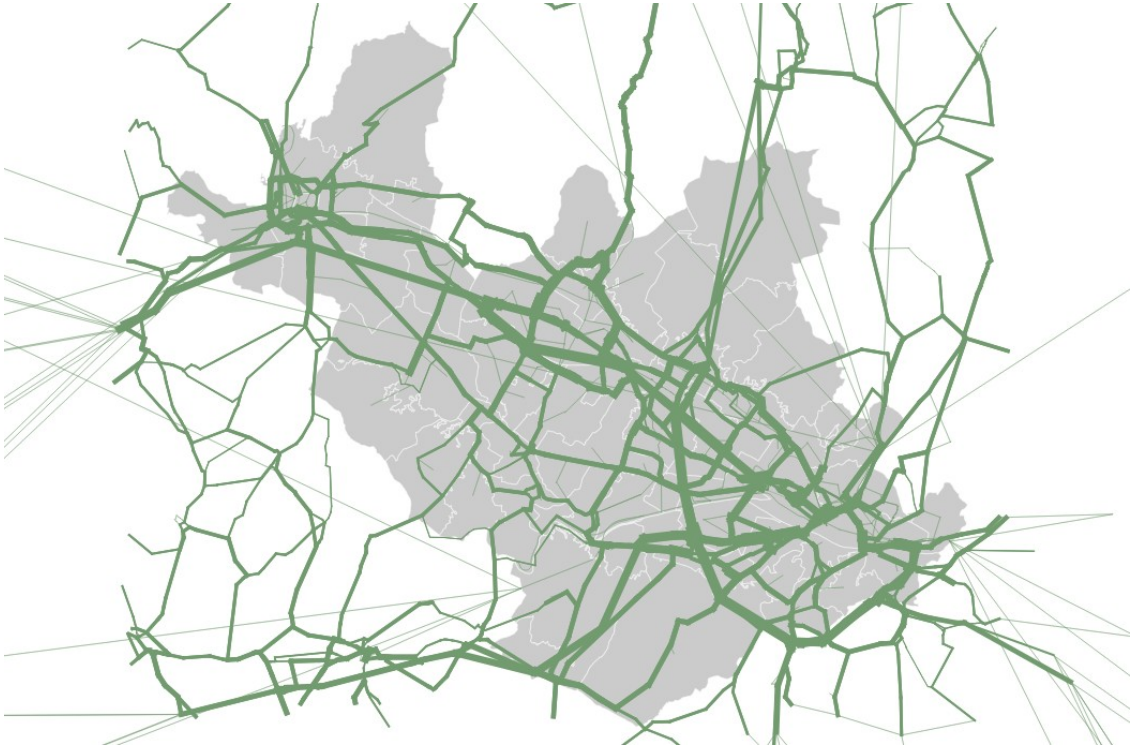
- We synthesize three alternative development scenarios: **Scenario 0** (B.a.U.), **Scenario 1** (environmental), **Scenario 2** (infrastructural)

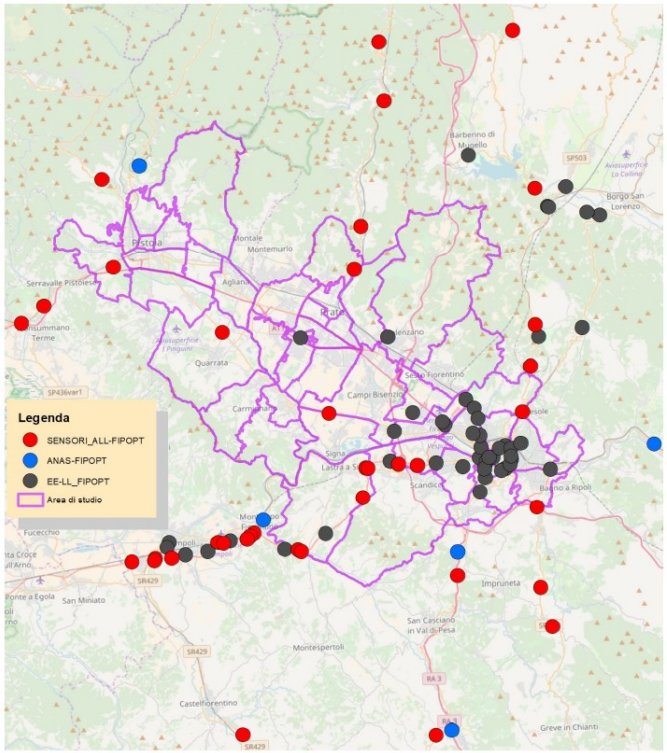
The projects under assessment



Transport model

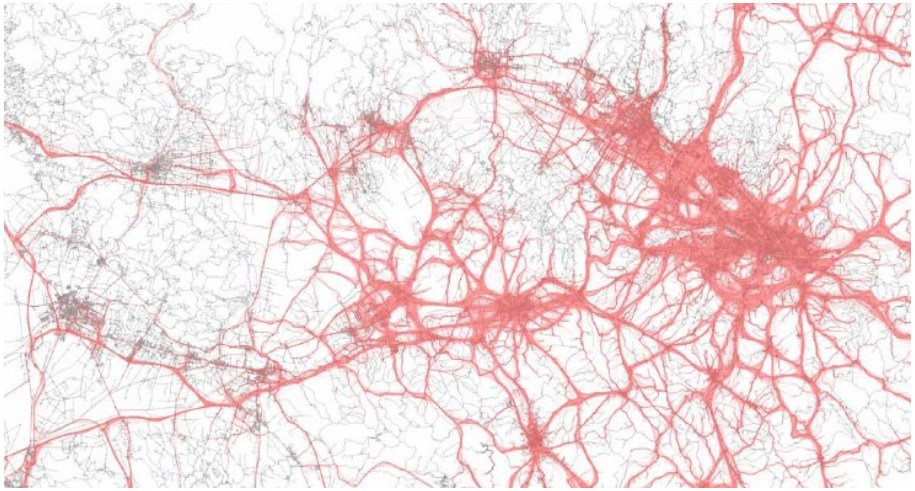
The transport model is a **classical 4-step model** which uses a simplified network of public and private transport. It uses a discrete choice model (derived from a pre-exixting municipal model for Florence) for the public/private split. It is calibrated on **sensor data** from various sources and on GPS data.

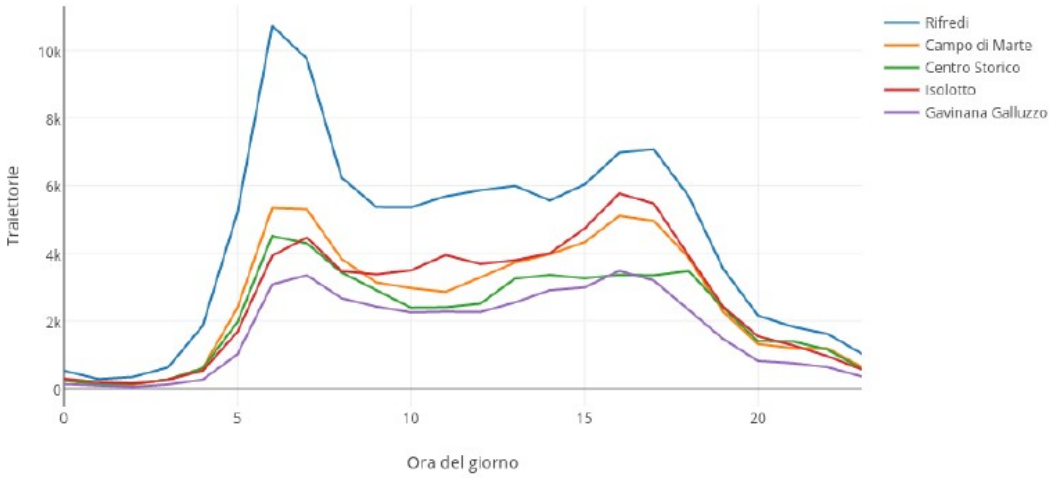




Additional analytical capacity with Big Data

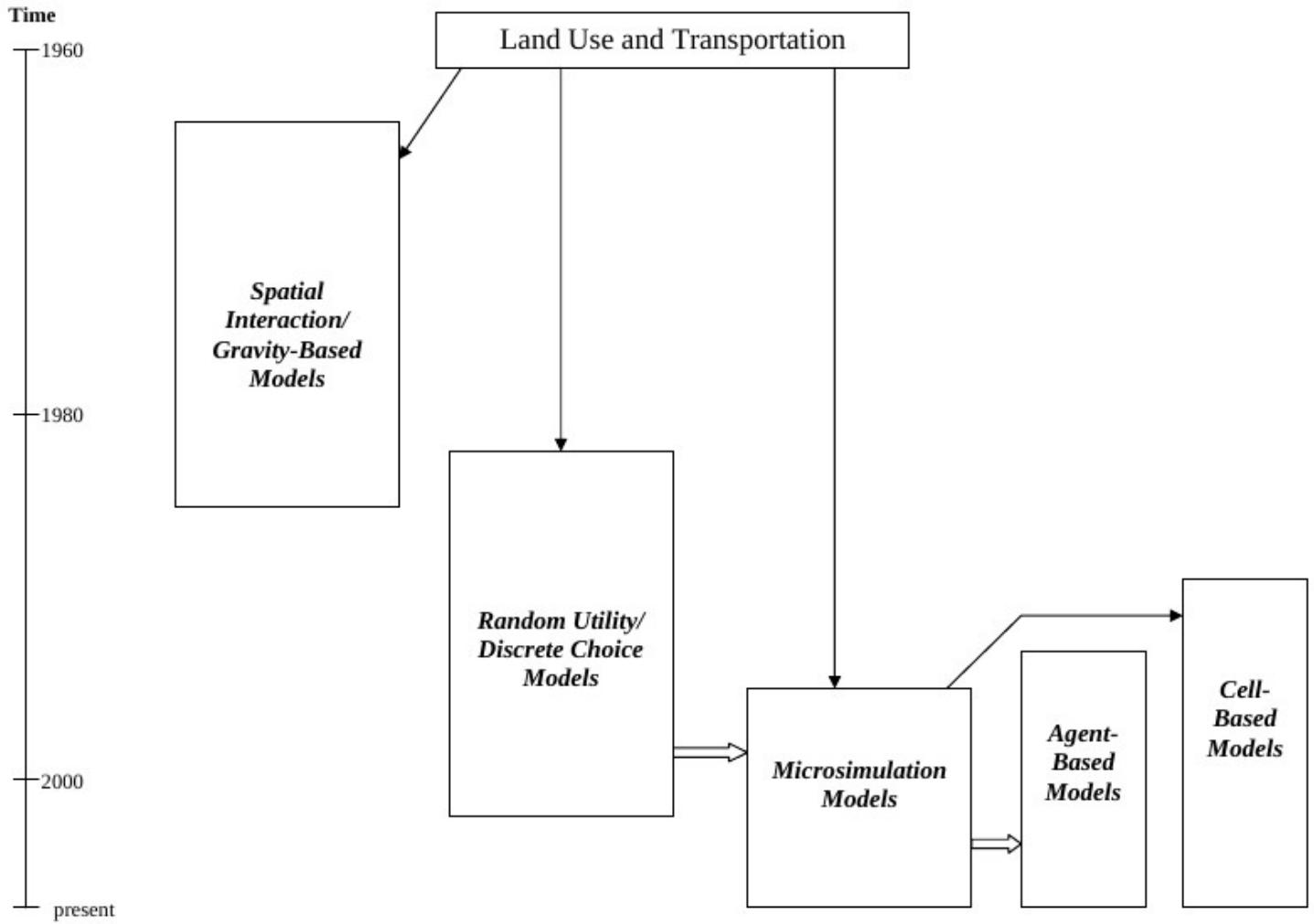
Data availability is a longstanding problem in transportation analysis. The digital age provides a partial solution to this problem, and although it also poses **new challenges** (reliability, privacy, ownership), it also sheds new lights on the phenomenon (e.g. **sistematic VS. non-sistematic mobility**).





The GPS device captures the position ~ every 30 second with a 10 meter precision. Sample coverage is nearly 10% of actual Tuscan vehicle population. Since the data is very micro by nature, **spatial and temporal disaggregation of mobility patterns** and accessibility indexes is feasible.

LUTI models: hetrogeneity of approaches



Source: Iacono, M., Levinson, D., & El-Geneidy, A. (2008).
Models of transportation and land use change: A guide to the territory.

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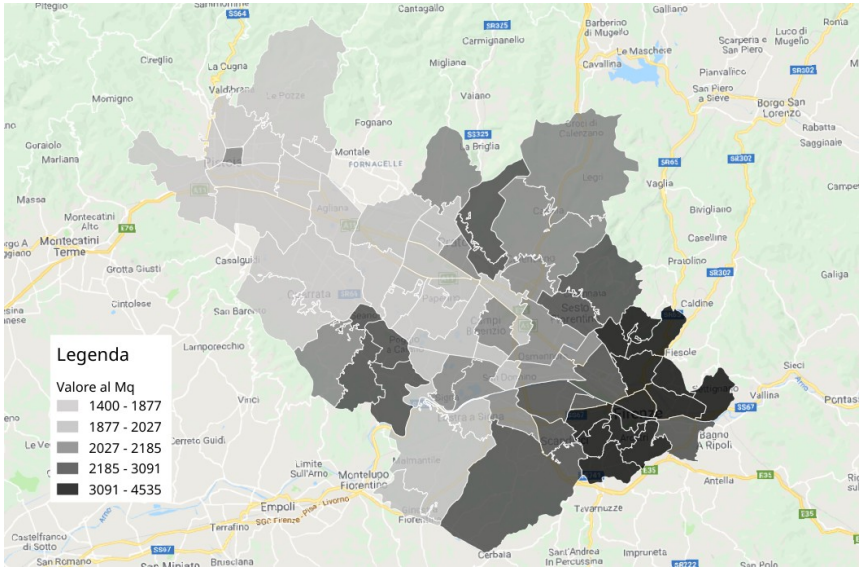
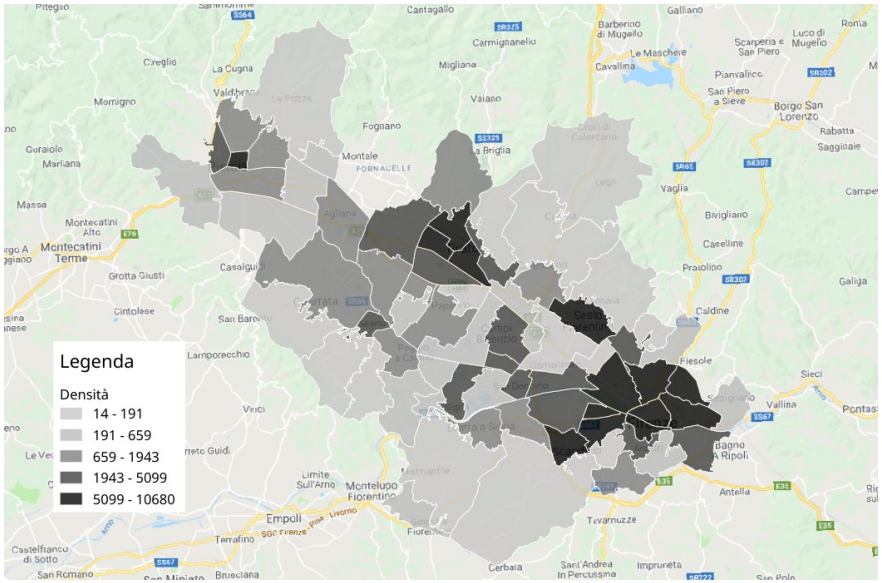
Zoning and data

Tipologies of agents:

5 **demographic** types:
students/unemployed;
housewives/retired;
employed by 3 income levels.

4 **economic** sectors: manufacture;
local retail; large scale retail; services.





Territorial endowments:

Schools
Universities
Hospitals
Turistic pressure
Amenities
Transport infrastructures

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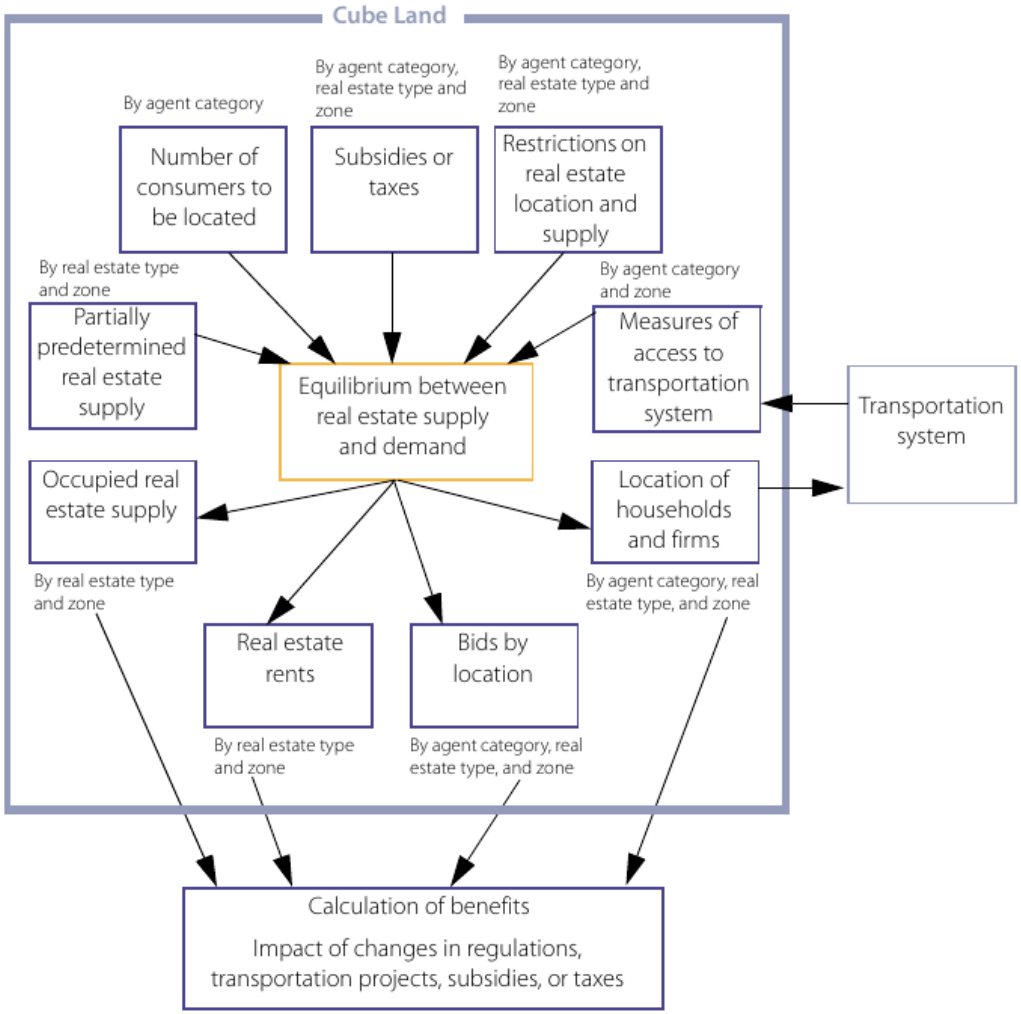
The bid-choice model



The land use module is connected with the transport module via an **accessibility measure** that influences (among other factors) the **location decisions** of households and economic agents.

Currently the **land use supply is fixed** and exogenous, but the system allows for an explicit modelling of the real estate supply dynamics.

Market clearing in land use is obtained with a hybrid of **bid-rent** and **random utility theory** (Martínez,F.J., 1996)

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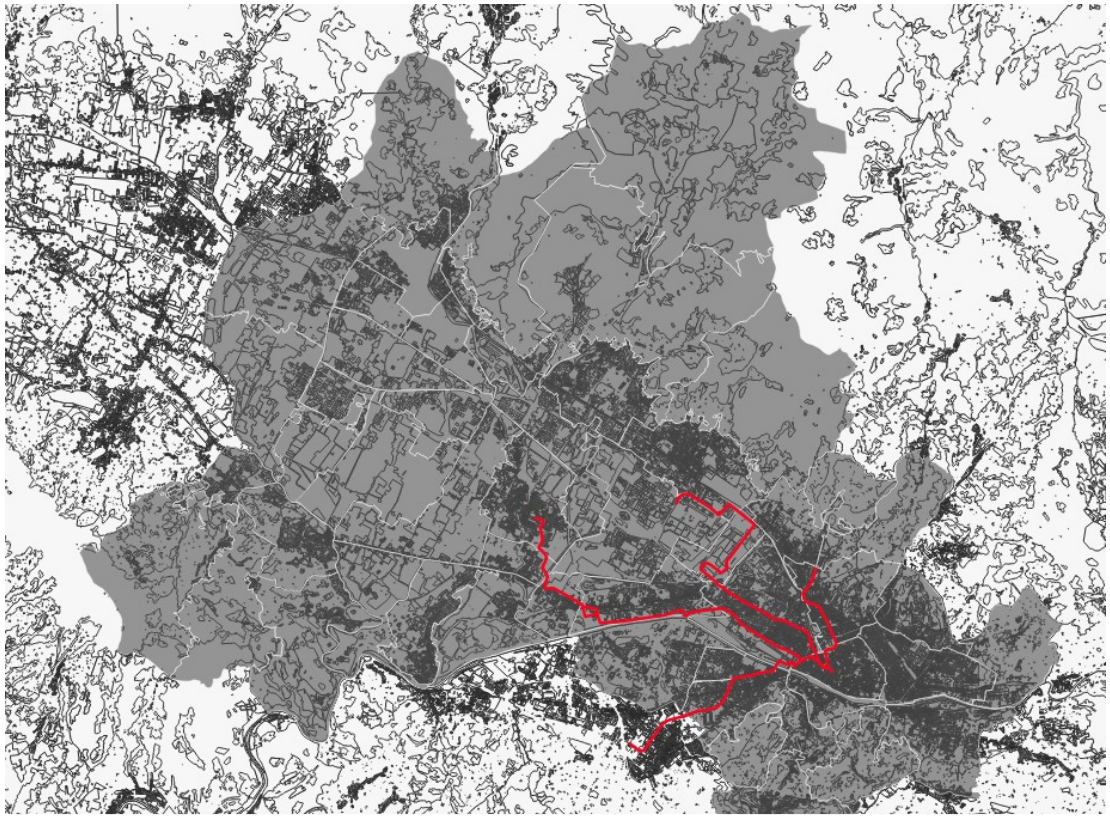
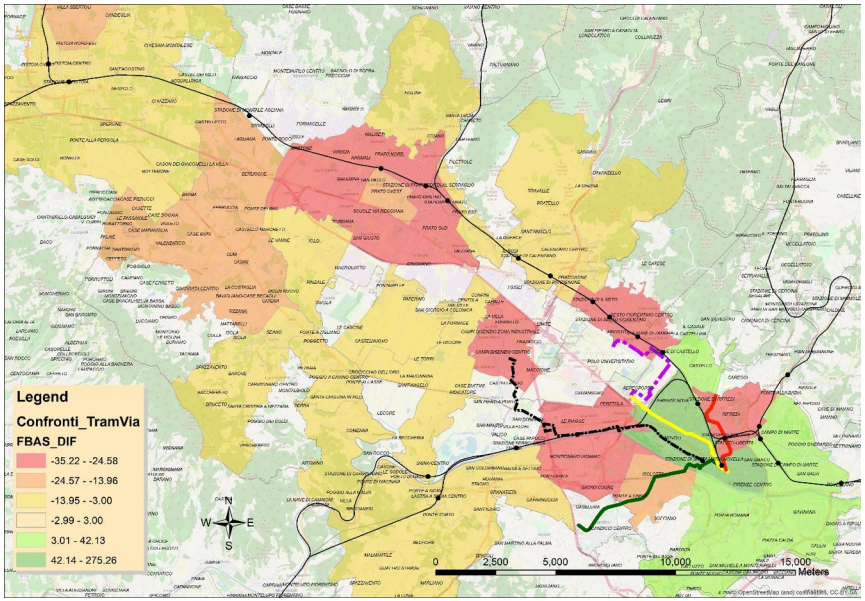
Preliminary results (I)

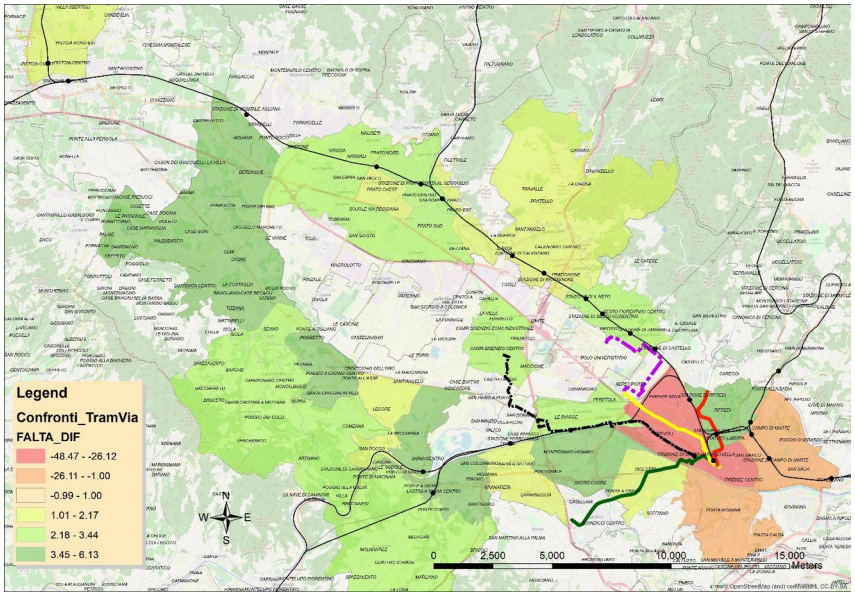


To calibrate and validate the model, we start with a simple scenario with just one project: the **new tramway network of Florence**. The project has significant impacts in terms of the relative accessibility of the metropolitan area, connects relevant functional nodes of the city and is expected to affect the location decisions of households and firms.

Preliminary results (II)

The land use model takes the **changes in accessibility and attractiveness** computed by the transport model (public and private transport, with a discrete choice model) and estimates the changes in **real estate prices**, **households location** (5 tipologies based on income levels) and **firms location** (manufacture, services and retail).





Preliminary analysis (still to be validated) points towards a **gentrification effect**, with the low income households being pushed farther away from the city center by the raise in real estate prices.

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Future lines of research

- **Generalization** of the model to the entire region (Tuscany).
- **Simplification** of some features so that the model may be able to adapt to heterogeneous territories.
- **Bottom-up structure** (municipalities – Labour Market Areas – region).
- Coherence and interaction with **regional macroeconomic models** developed at IRPET (i.e. Input-Output model).
- Less focus on fine-tuned transport simulation and more emphasis on **accessibility to human capital and firms** concentration to explain location decisitions.
- Introduction of a **time** dynamic and temporary **disequilibriums**.
- Inclusion of **environmental dimensions** in the analysis.

THANK YOU FOR YOUR ATTENTION!

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