TRACES - Agent-based model for prescriptive analysis of the link between land cover change and public transport development.

Team

TRACES project (2022-2025)

FNSNF Fonds national suisse de la recherche scientifique

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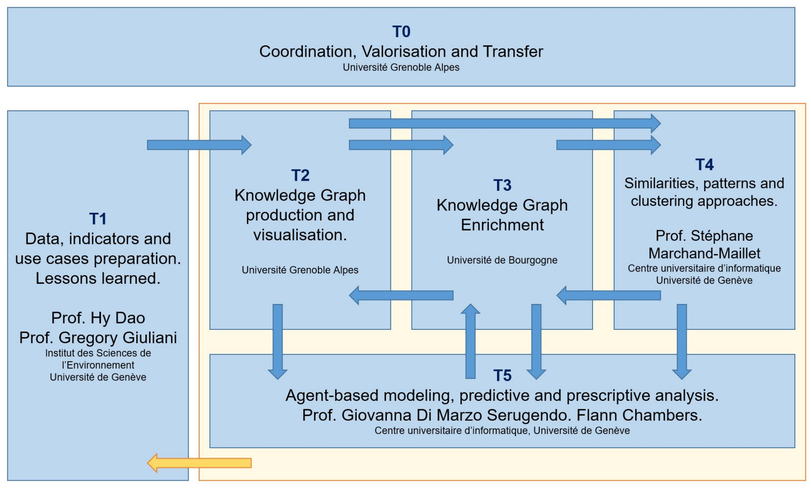


UNIGE Team:

Prof. **Giovanna Di Marzo Serugendo** is full professor at Geneva School of Social Sciences, and the Computer Science Center of the University of Geneva, Switzerland.

Flann Chambers is a PhD candidate and research assistant at UNIGE. He has a bi-disciplinary MSc in Physics and Biology (University of Geneva).
Research experience in AI (UNIGE) **:**

- Design of an ABM for canopy growth modeling.
- Design of an ABM for mobility and NEXUS resource accounting (geomatics certificate *mémoire*).
- Design of an ABM for land cover change modeling and public transport development modeling (the object of this poster).

Motivation

Problem
Drastic land cover changes in the canton of Geneva in the form of rapid urban densification is accompanied by the development of new axes of public transportation, mainly represented by the tram.

- How does the arrival of a new tram line influence the urban densification in the neighborhood ?
- Did the tram's arrival have the expected benefits in solving the overarching transportation conundrum and did it have any unexpected side-effects ?

Use case

- With the arrival of the tram 18 to Meyrin and CERN, the Les Vergers eco-district in Meyrin was built right next to a new tram stop for the line 18.
- The model will include the whole tram axis from Cornavin station to Meyrin, as well as the neighboring area.

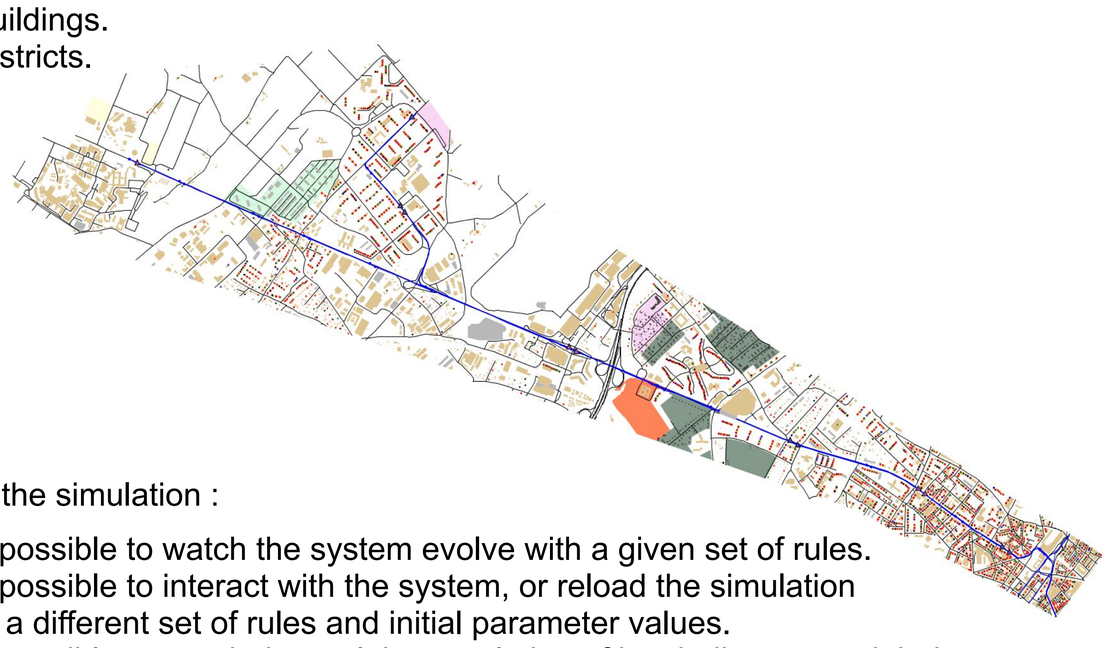
Ambition of the project

- Provide a decision-making tool for urban planning and management.
- Provide monitoring of key indicators and a deeper understanding of urban consolidation and its underlying mechanisms.
- Provide three types of analysis :
  - descriptive, through model creation and evolution rules establishment.
  - predictive, through simulation for future time periods.
  - prescriptive, through scenario exploration and experimentation.

Method

Design an agent-based model with the GAMA platform for commuting behavior and land cover change modeling.

- Agents are at the core of an agent-based model. They are individual entities with their own behavior, perception, knowledge and memory. Each of these traits may affect each other.
- Agents may or may not be mobile, and may interact with other agents and their environment.
- Agents are grouped into species, which represent a group of agents that share some attributes. In our model, the following entities are modeled into species of agents :
  - People, modeled as commuters.
  - Tram vehicles and stops.
  - Roads and railroads.
  - Buildings.
  - Districts.



During the simulation :

- It is possible to watch the system evolve with a given set of rules.
- It is possible to interact with the system, or reload the simulation with a different set of rules and initial parameter values.
- It is possible to watch the real time evolution of key indicators and their graphs.
- It is possible to stop the simulation and save a variety of key indicators for future statistical analysis. Such indicators are :
  - Building type.
  - Building density, and its link to land cover change.
  - Time spent commuting for each commuter.
  - Population changes.
- Possible uses of this data include :
  - Statistical analysis of key indicators.
  - Color-coded maps for the spatial distribution of key indicators.
  - Model validation and calibration.

Roadmap

The current model bases itself on existing data sourced from the SITG (Système d'information du Territoire Genevois) to function. However, calibration and validation steps are still crucial to maximize the accuracy of the model's predictive analysis.

- For calibration, a reliable dataset that encompasses at least two different periods of time is needed.
- Ideally, the model is then tested against a different dataset for validation purposes.
- Such datasets need to be identified and their quality assessed in order to complete calibration and validation steps.
- Identify key indicators and rules to compare for calibration and validation purposes.
- Include more indicators such as job creation, rent dynamics, evolution of retail/shops and services offer and demand…

The model can also be seen as a more experimental tool. Different scenarios with a variety of assumptions may be played out inside the simulation, while keeping in mind that the outcome is heavily reliant on those assumptions or initial conditions.

- Identify useful scenarios to explore, implement them in the model and watch how they play out using the interactive view, graphs, maps, etc.

In the scope of the TRACES project, valuable information is gained from the knowledge graphs built by workpackage T2.

- Find a way to include this knowledge directly inside the model.
- Find a way to fully automate this process.

In the scope of the TRACES project, two other use cases may be considered, each with their lot of technical difficulties (such as access to data) and problematics.

- Adapt the model to the use case of Evian-Les-Bains, France.
- Adapt the model to the use case of Bulle, canton de Fribourg.