An introduction to the GAMA platform

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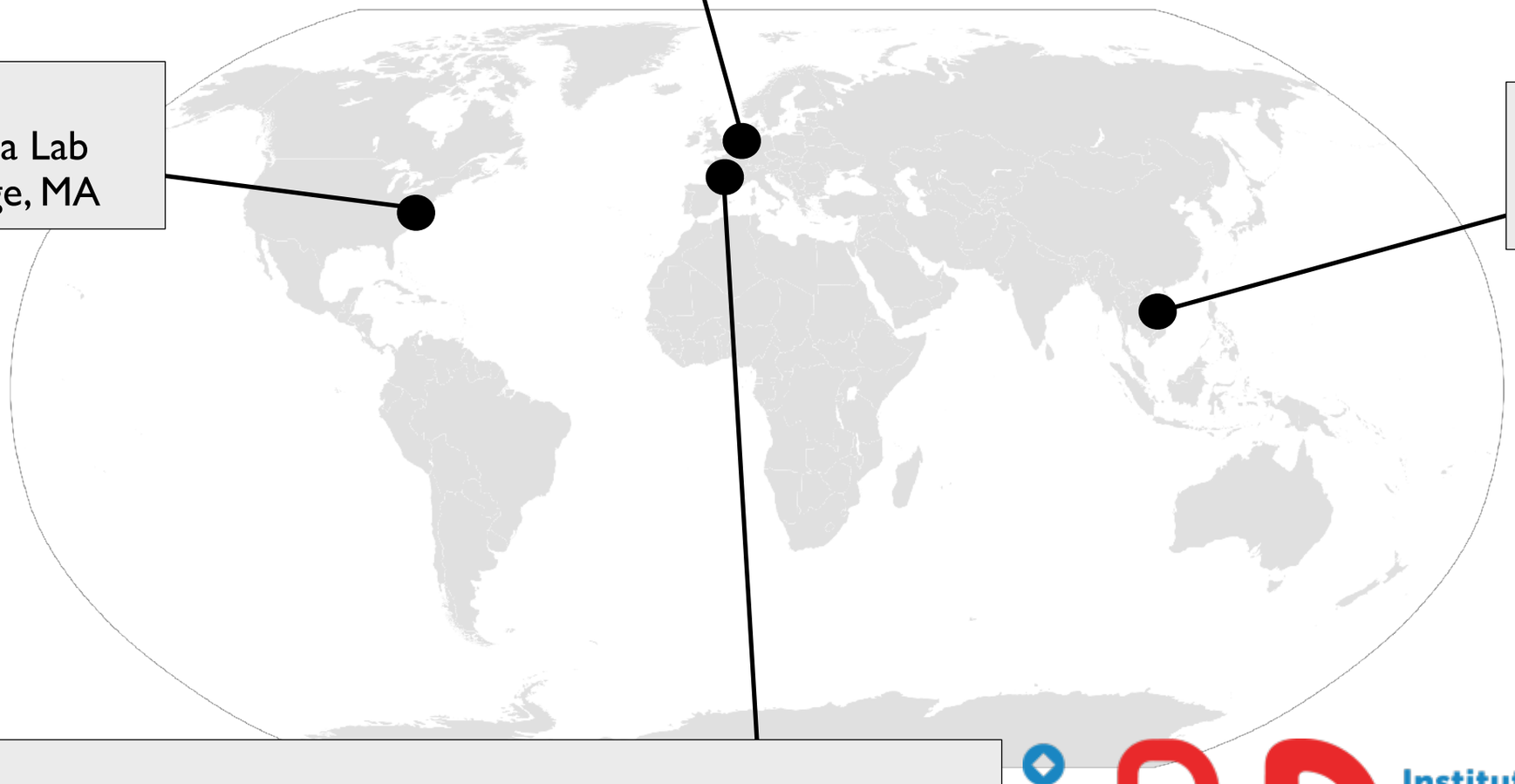
GAMA: a free software developed by an international consortium of research teams



Netherlands
Delft University of Technology

USA
MIT Media Lab
Cambridge, MA

Vietnam
USTH, University of Can Tho

France
IRD (PI), CNRS, INRA, University of Toulouse 1 Capitole, University Grenoble Alpes, University of Paris Sud, University of Rouen

GAMA, a platform dedicated to build spatially explicit agent-based models and run simulations.

- **Generic**: it can be used for a wide range of applications

- **Open-source:** it is developed under GPL/LGPL license (GNU v3)

- **Designed to modellers**: it allows modellers (even non computer-scientists) to build models **quickly and easily**:
  - Integrates a complete modelling language (**GAML**) and
  - an I**ntegrated Development Environment**

- **Easily extensible to take specific needs into account**: it is developed in **Java** using **Eclipse IDE,** with an open architecture thanks to Java and Eclipse features (Java annotations and OSGI plugin framework.

GAMA overview: Strengths of GAMA

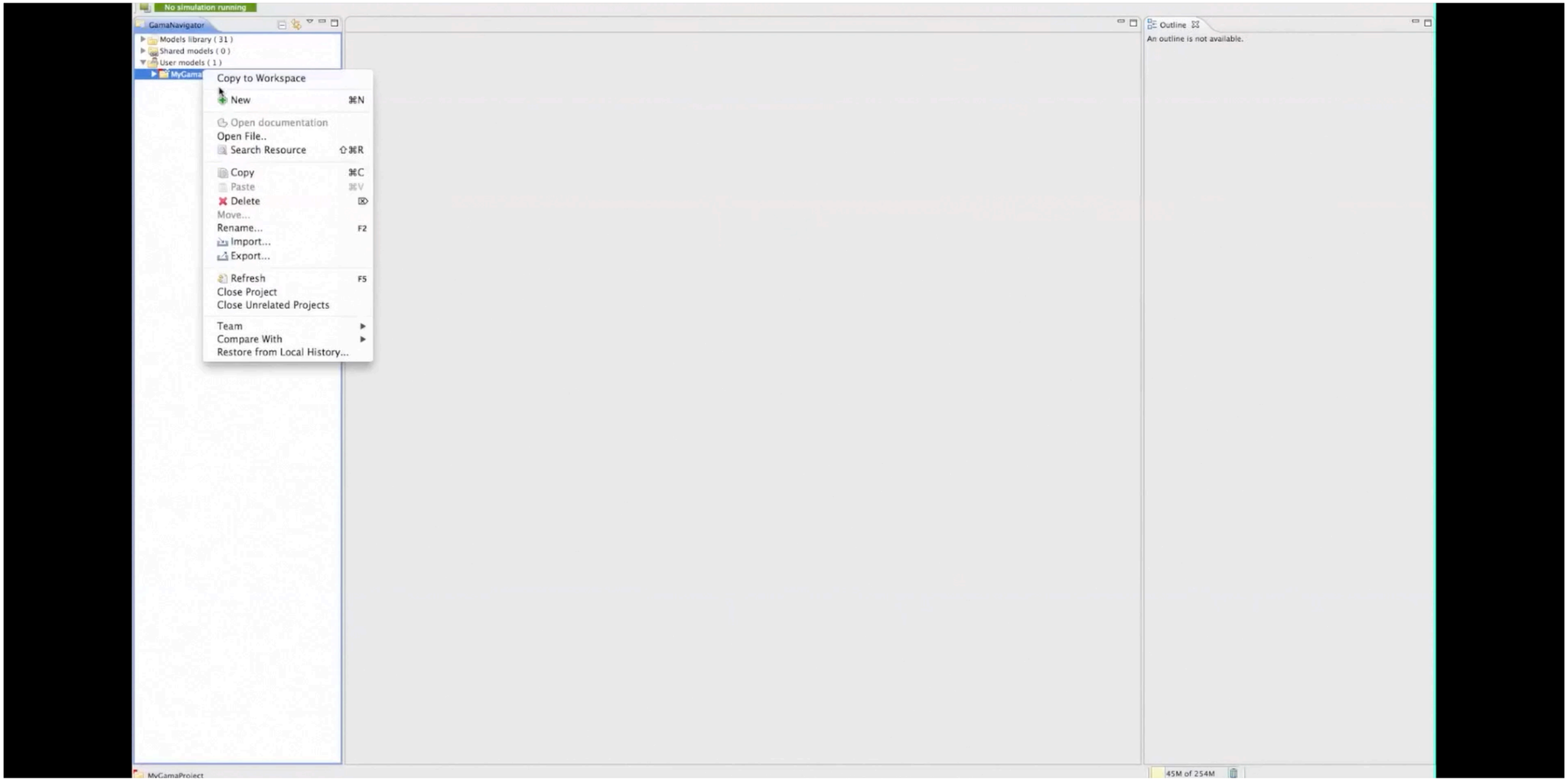
- Seamless integration of **geographic data and GIS** tools with agent-based models
- Supports the development of **quite complex models**
- Integrates a methodological approach to define **multi-level models**
- Integrates powerful **visualisation** tools
- Supports **multi-paradigm** models

- **Integrates tools to analyse models**: parameters space exploration and calibration.
- Now compatible with R and OpenMole for further exploration.

Last version: 1.8

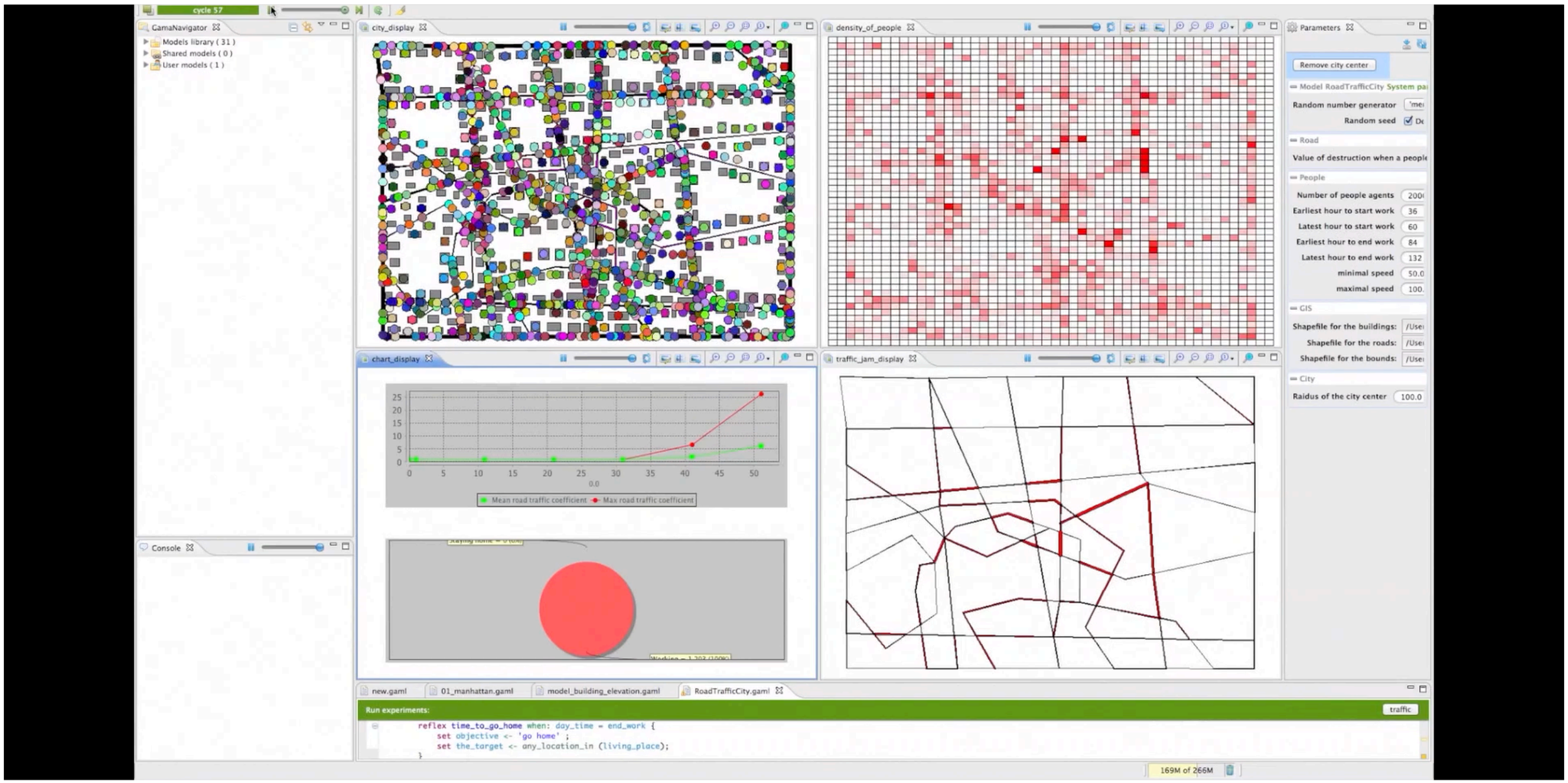
Main ***features*** of the Gama Platform

GAMA provides a complete Integrated Development environment (IDE) to build models



Dedicated modeling Language (GAML), easy to learn and to extend

Possibility to define as many environments as necessary (available: continuous, grid and graph)



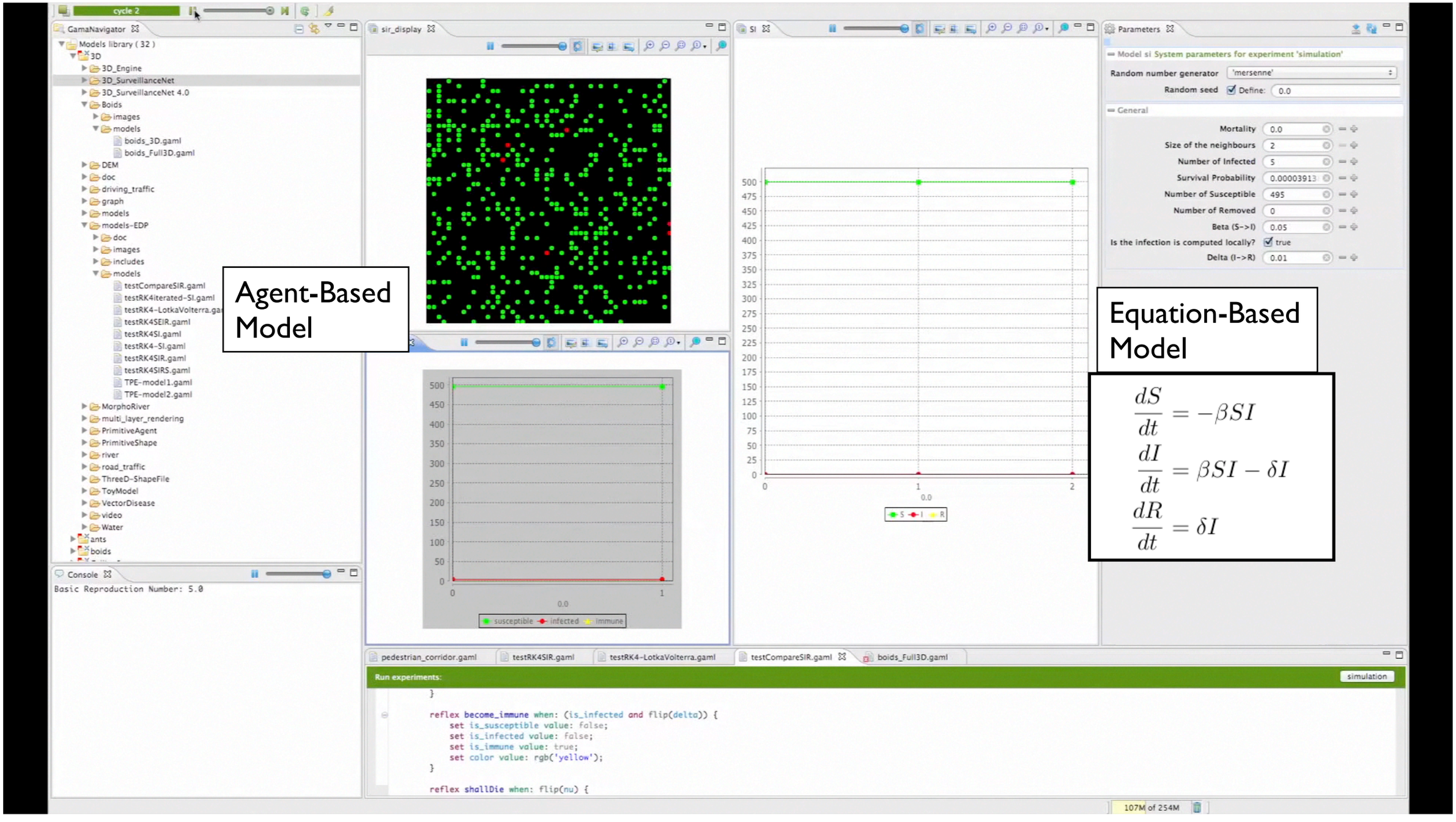
2D Grid (rectangle, hexagon)
Continuous environment, torus environment, graphs

Native integration of spatial data

Many features to make agents move

Powerful tools of visualisation (2D-3D)

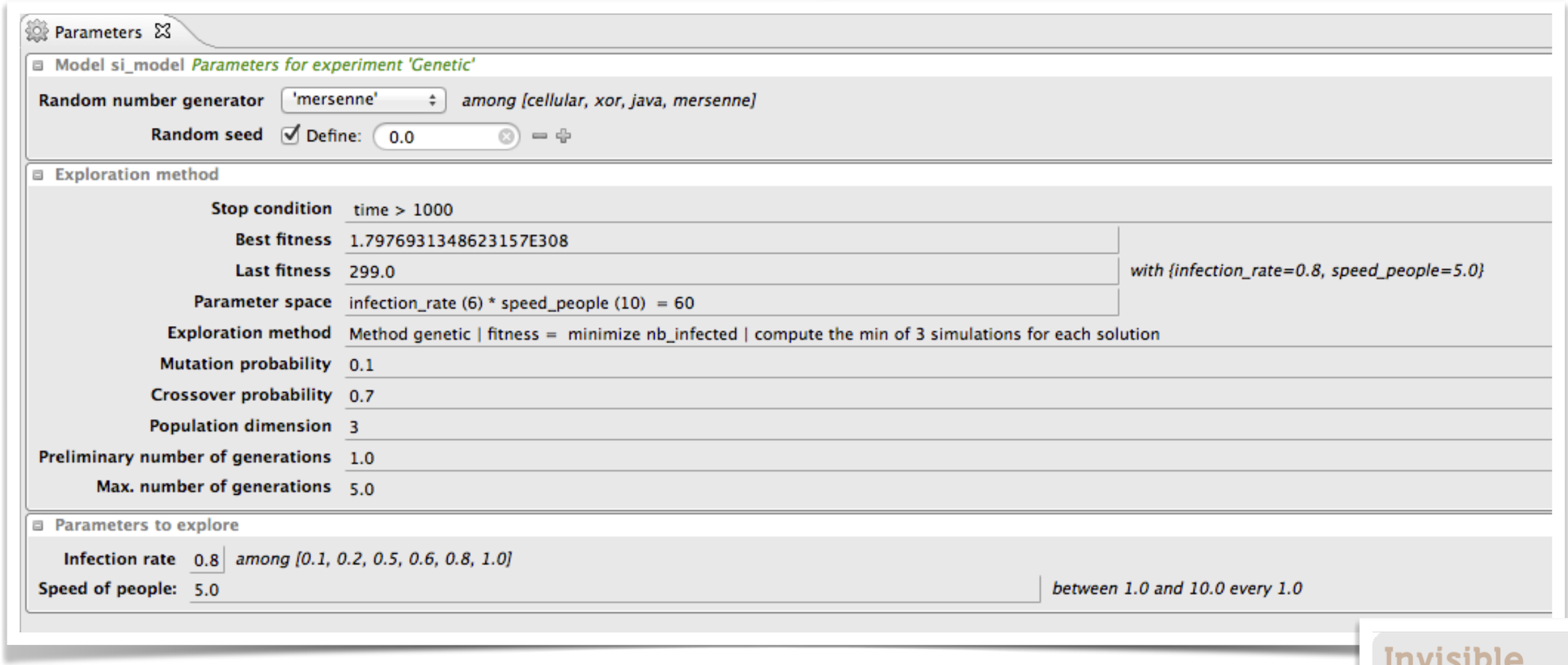
Allows to use different formalisms to define agent behaviours



Differential equations, Finite state machine, Reflexes, ...

Advanced features: multi-simulation, multi-level, co-modeling

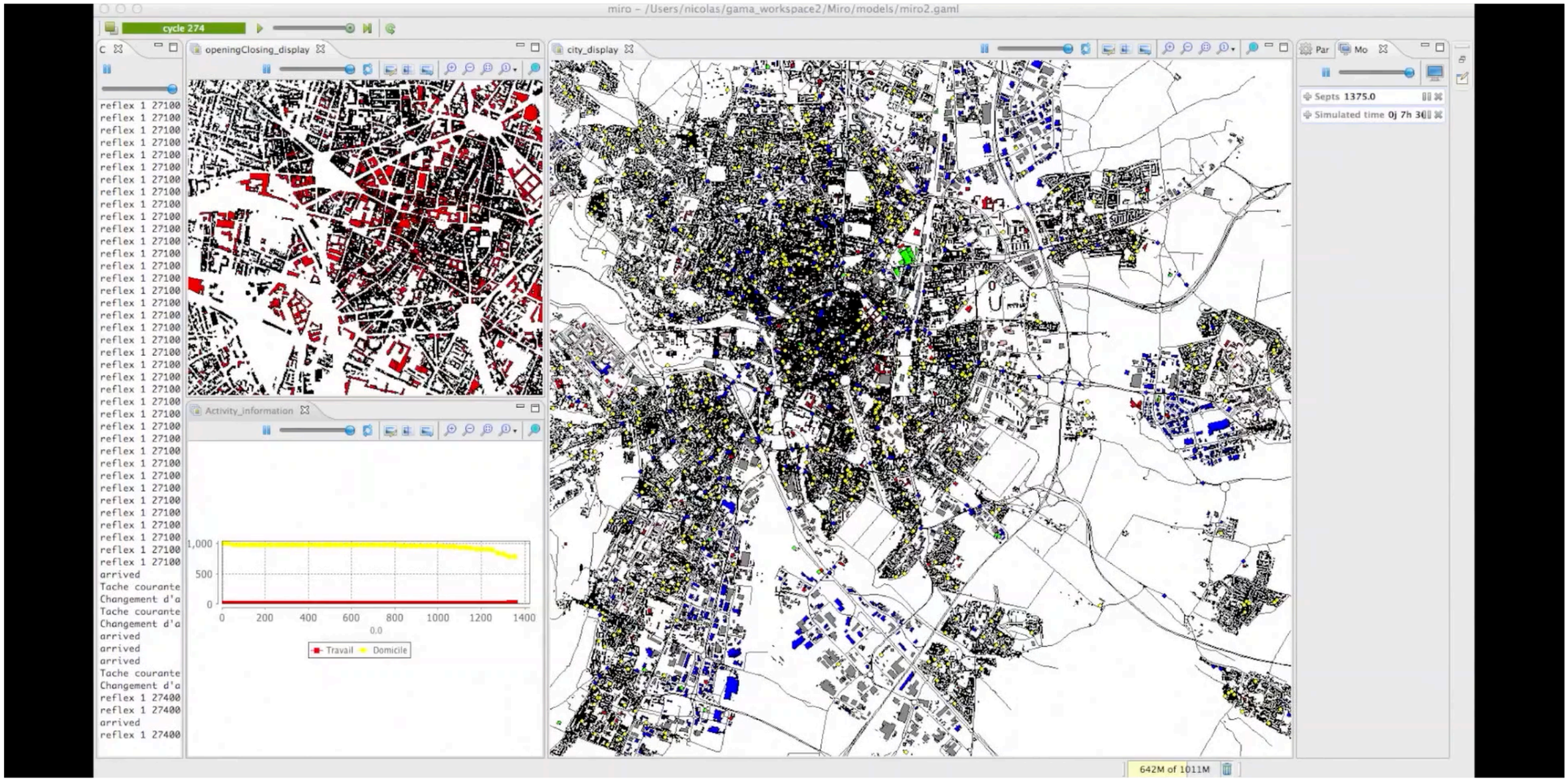
Simulation exploration: Batch mode, headless mode, OpenMole and R



Parameter space exploration (exhaustive, tabu search, genetic algorithm,..), Compatible with OpenMole and R

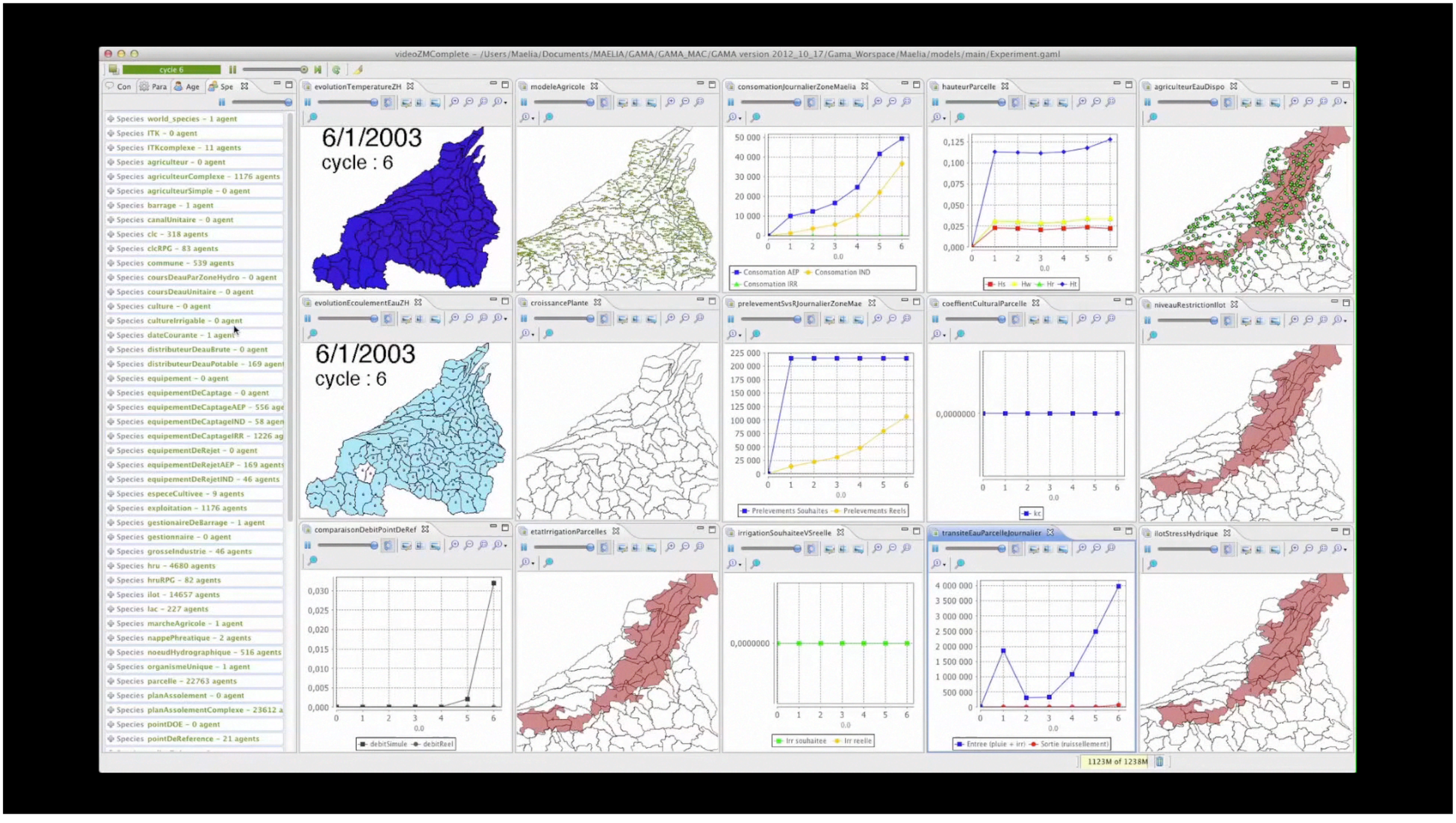
Examples of ***applications*** of the GAMA Platform

Dijon city, France: how to improve the individual accessibility to the city in order to better manage urban mobility ?



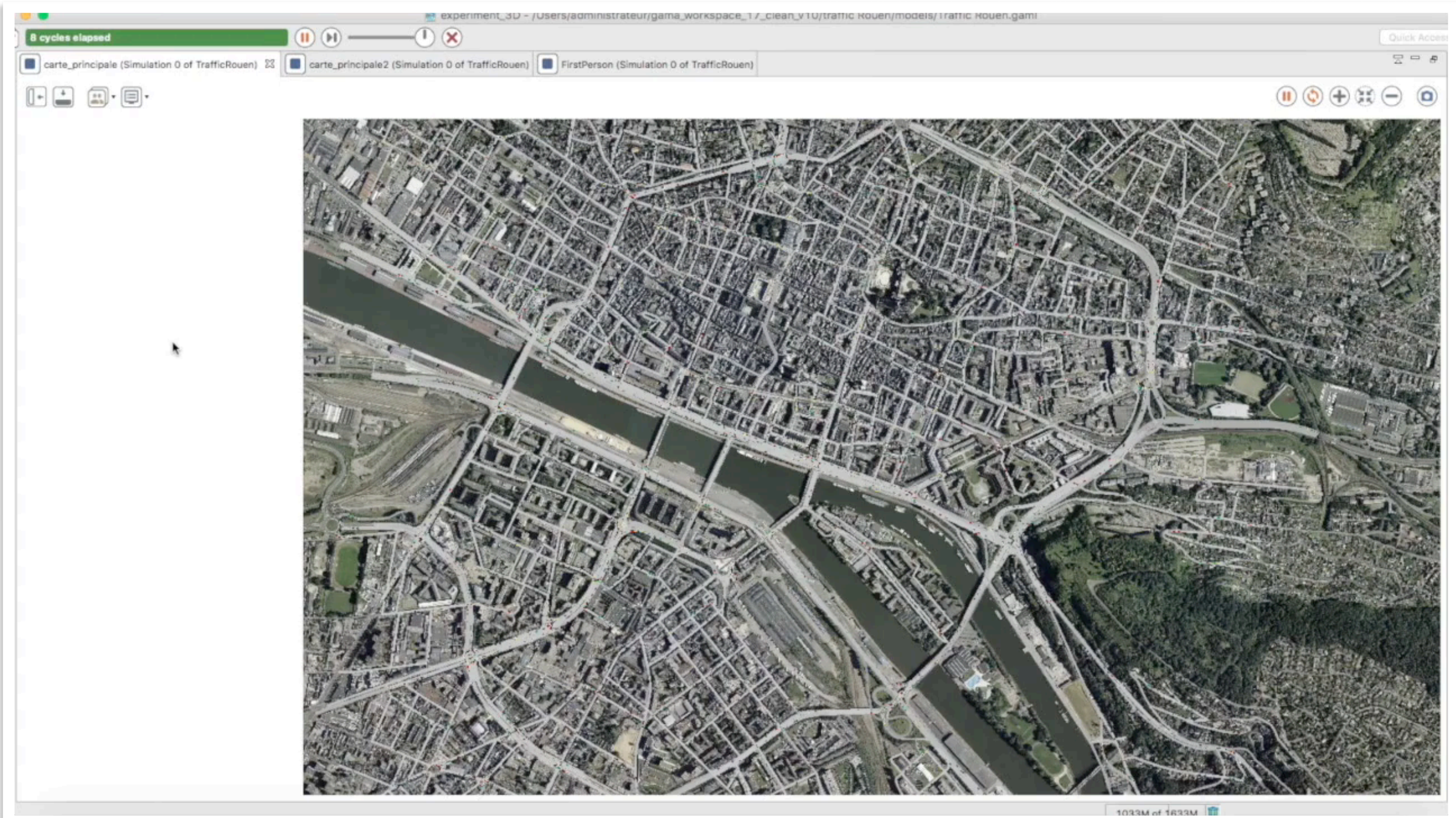
A. Banos, N. Marilleau, and MIRO Team, "Improving individual accessibility to the city: an Agent Based Modelling approach," ECCS 2012 - European Conference of Complex Systems, Bruxelles 2012

Adour-Garonne basin, France: what is the socio-environmental impact of water management norms on water resources?



Taillandier, P., Therond, O., Gaudou, B, "A new BDI agent architecture based on the belief theory. Application to the modelling of cropping plan decision-making", Environmental Modelling and Software Society (iEMSs), Leipzig, Germany. 2012

MOSAIC (Rouen, France): Simulation of the traffic

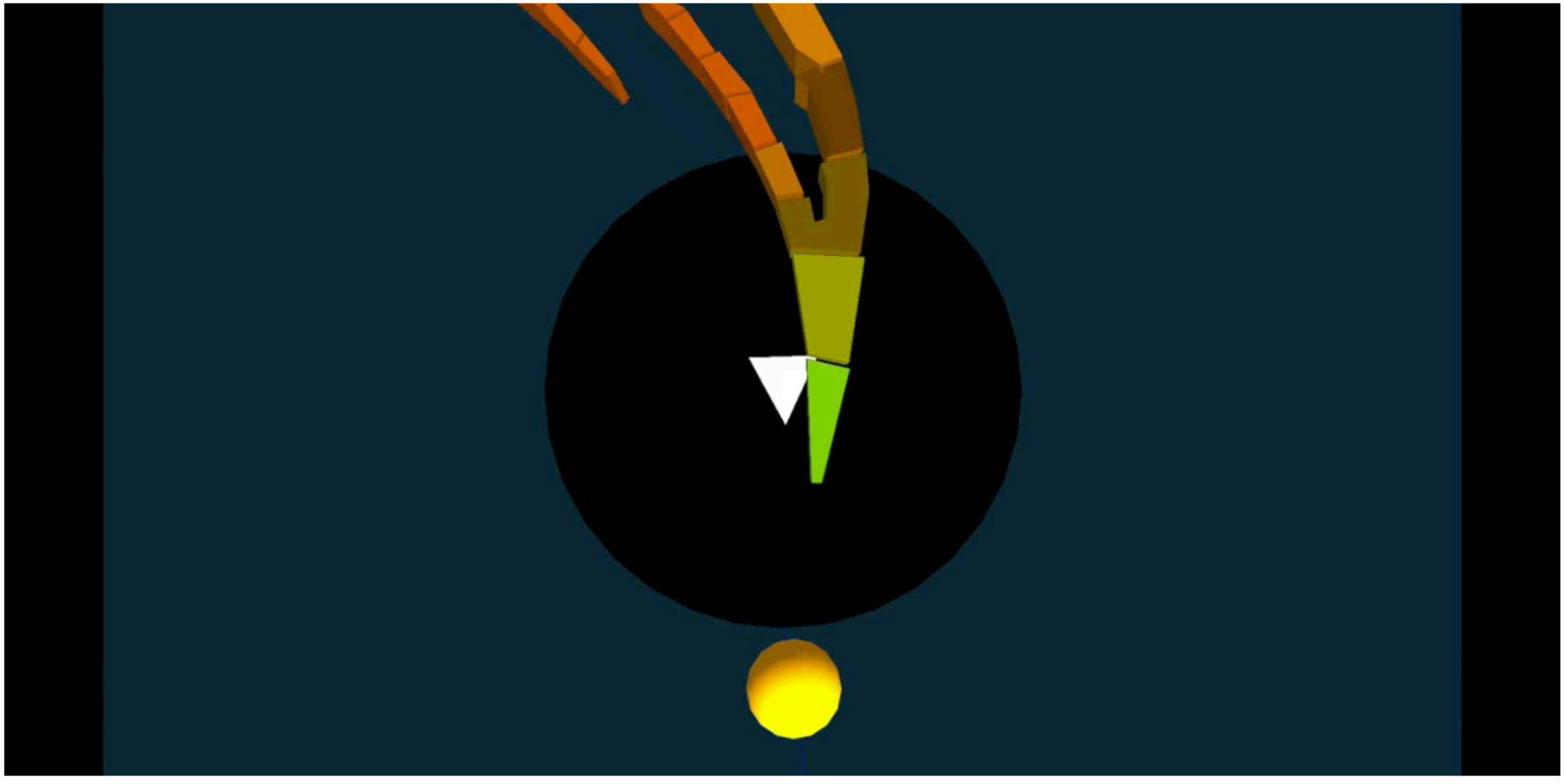


Impact of the building design (BIM file) and inhabitant behaviors (cognitive agents) on energy and pollution

GAMA, modeling made easy

GAMA PLATFORM

Rhone river: sediment flow



Oléron Island: Participative simulations about floods

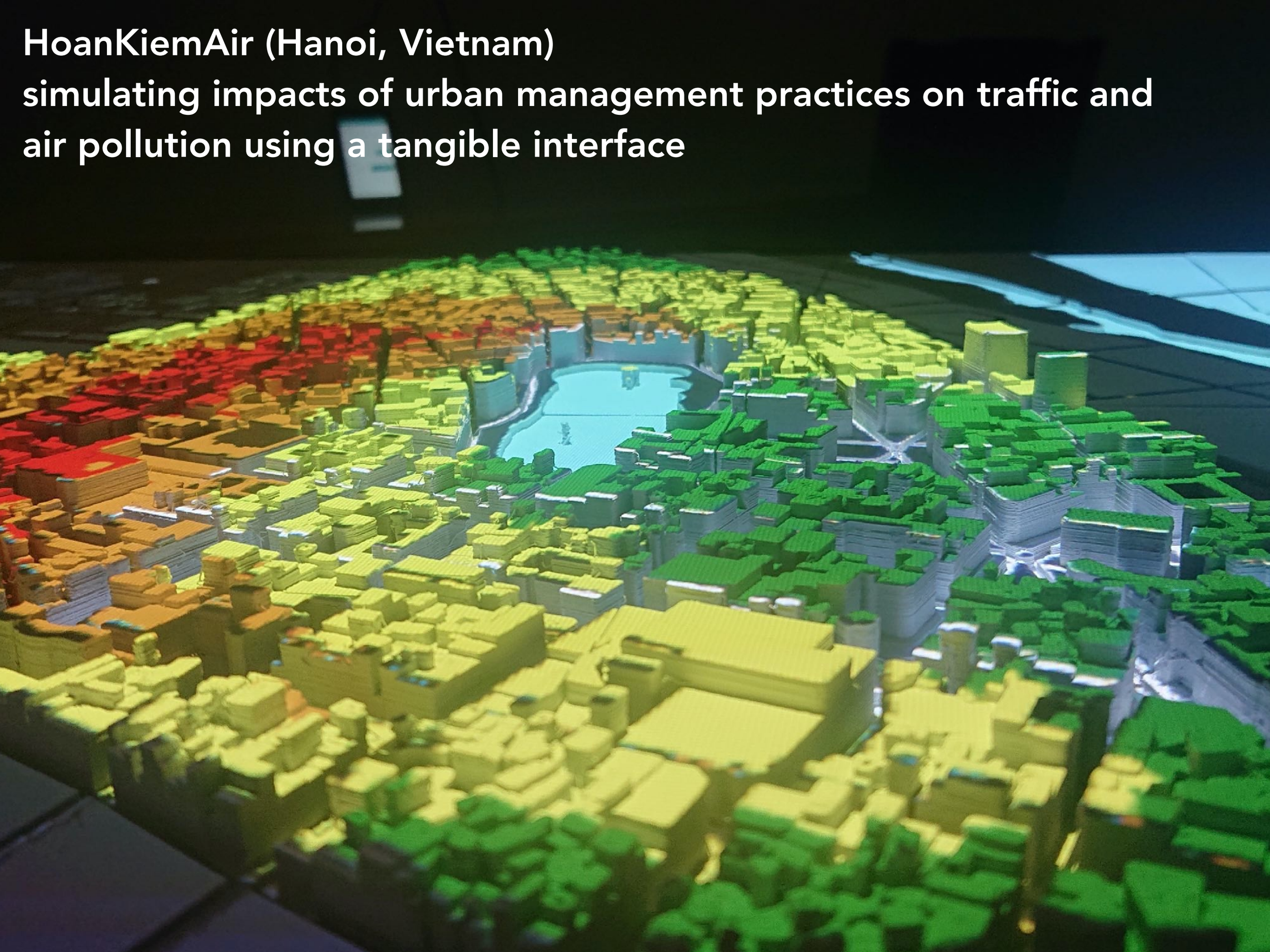
(a) Planning time: municipality players seat at separate desk

(b) Planning time: players use a computer tablet

(c) Submersion time: players gather around the submersion display

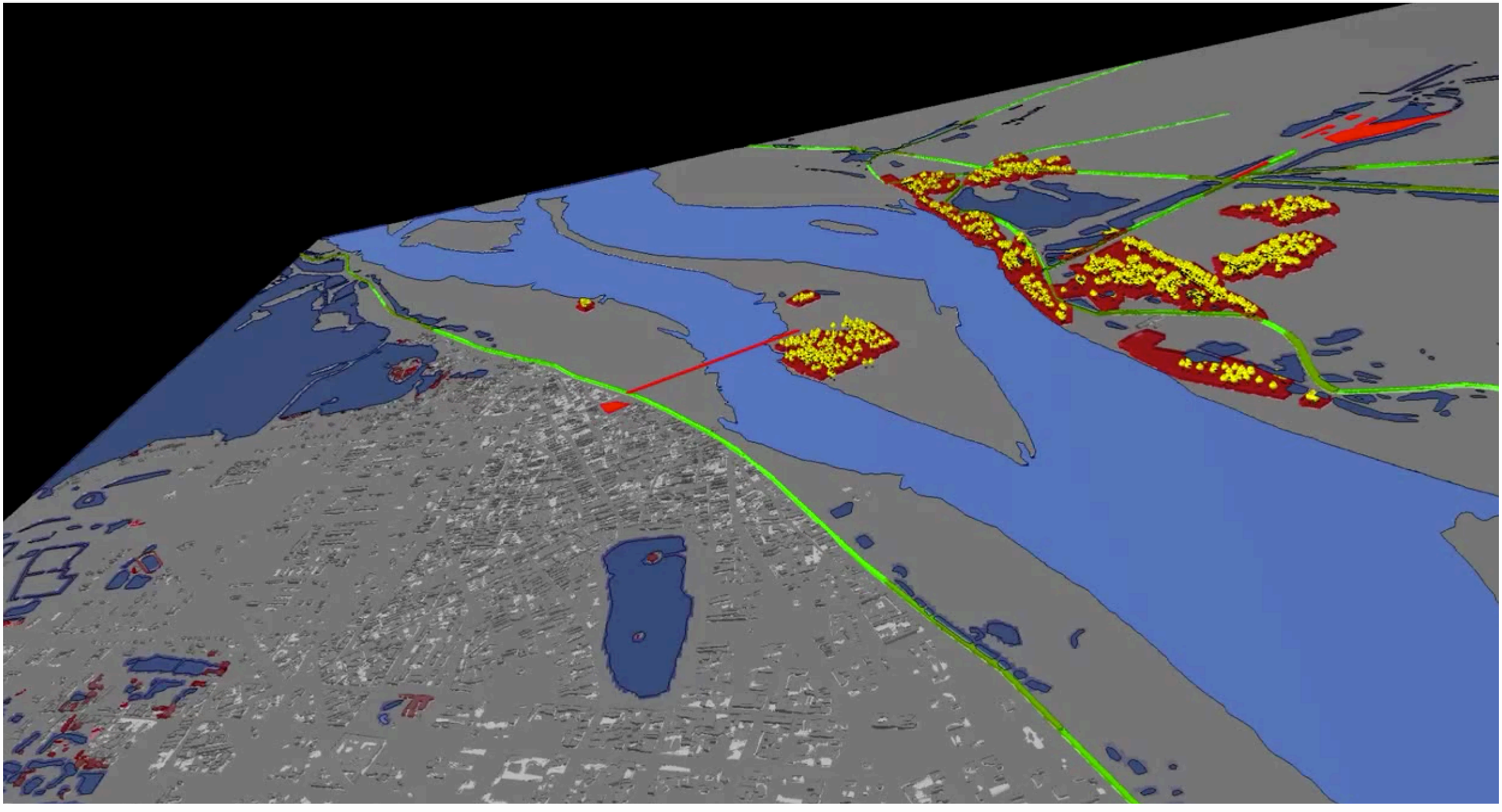
Nicolas Bécu, Marion Amalric, Brice Anselme, Elise Beck, Xavier Bertin, Etienne Delay, Nathalie Long, Corinne Manson, Nicolas Marilleau, Cécilia Pignon-Mussaud and Frédéric Rousseaux
"Participatory simulation of coastal flooding: building social learning on prevention measures with decision-makers"
(http://www.iemss.org/sites/iemss2016/img/pdf/vol4.pdf)

HoanKiemAir (Hanoi, Vietnam)
simulating impacts of urban management practices on traffic and air pollution using a tangible interface



ARCHIVES (Hanoi, Vietnam)

Reproduction of past crisis events: the flood of 1926 in Hanoi



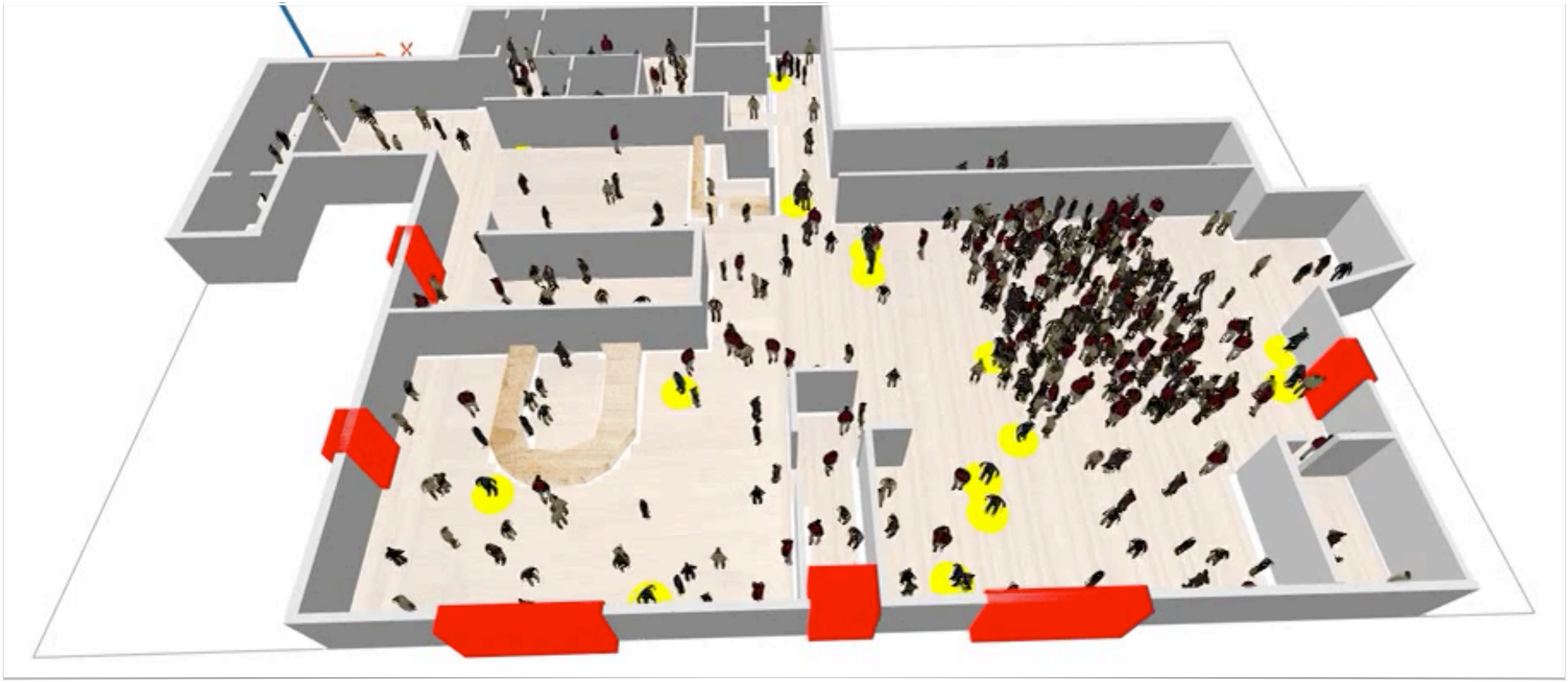
N. Gasmi, A. Grignard, A. Drogoul, B. Gaudou, P. Taillandier, O. Tessier, and D. A. Vo. Reproducing and exploring past events using agent-based geo-historical models. In E. Norling and F. Grimaldo, editors, International Workshop on Multi- Agent-Based Simulation (MABS), Paris, France, Volume 9002 of the series LNCS, pp 151–163. Springer-Verlag, 2015.

ESCAPE project (Hanoi, Vietnam)
Massive and multi-modal evacuation in case of dam break

- **Dijon city, France**: how to improve the individual accessibility to the city in order to better manage urban mobility ?

Chapuis, K., Taillandier, P., Gaudou, B., Drogoul, A., & Daudé, É. (2018, October). A Multi-modal Urban Traffic Agent-Based Framework to Study Individual Response to Catastrophic Events. In International Conference on Principles and Practice of Multi-Agent Systems (pp. 440-448). Springer, Cham.

Station Night club, Rhode Island (U.S.A)
Night club evacuation with cognitive and social agents



Valette, M., Gaudou, B., Longin, D., & Taillandier, P. (2018). Modeling a Real-Case Situation of Egress Using BDI Agents with Emotions and Social Skills. In International Conference on Principles and Practice of Multi-Agent Systems (pp. 3-18). Springer, Cham.

Conclusion

To conclude:

- Developed under GPL license : **open-source**
- 6 French people with **permanent positions** (in 4 institutions) are (actively) involved in implementing GAMA + several former Vietnamese PhD students with a lecturer position in their institutions + non-permanent
- It is used in **several lectures and training sessions** (mainly in France, South East Asia, Africa, Brazil …).

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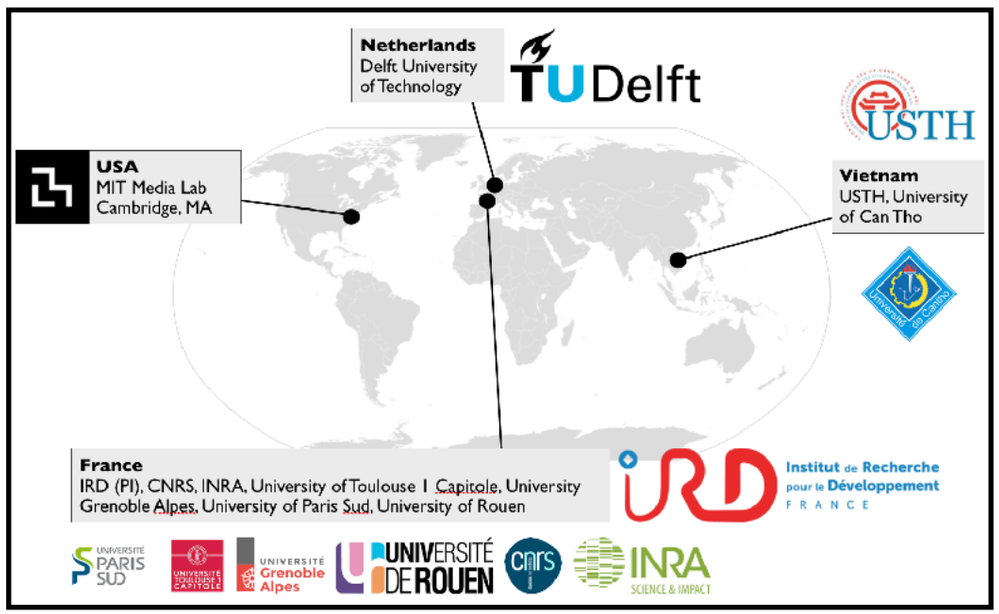
- It is the support of several French and international projects.
- Valorisation process in progress to build a consortium around GAMA.
- **Very active mailing lists!!**
  - answer questions, help, model corrections
  - easy to request enhancements for the platform to fit with user needs



More information

- **Official web site:** http://gama-platform.org
- **Social Network:** https://www.facebook.com/GamaPlatform
- **Nice videos:** Youtube Channel: gama Modeling
  http://youtube.gama-platform.org
- **GitHub repository:** https://github.com/gama-platform/gama
- **Mailing-lists**
- General mailing-list
  https://groups.google.com/forum/?fromgroups#!forum/gama-platform
- Developers mailing-list
  https://groups.google.com/forum/?fromgroups#!forum/gama-dev

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