

Synthetic Population & NoiseModelling

¿ who emits noise on whom ?

Valentin LE BESCOND, Université Gustave Eiffel, CEREMA,
UMRAE, F-44344, Bouguenais, France

Use a detailed representation of the population with NoiseModelling to estimate :

- The noise emitted by the population's mobility
- The noise received by the population

And answer the question “¿ who emits noise on whom ?”

Based on the work done with Johan Nygren, during his visit to UMRAE in Nantes for a few months in 2022

<https://doi.org/10.1016/j.scs.2024.105278>



Agent-specific, activity-based noise impact assessment using noise exposure cost

Johan Nygren^{a,b,*}, Valentin Le Bescond^{c,e}, Arnaud Can^{d,e}, Pierre Aumond^{d,e}, Pascal Gastineau^{c,e}, Susann Boij^{a,b}, Romain Rimpler^{a,b}, Ciarán J. O'Reilly^b

^a KTH Royal Institute of Technology, Department of Engineering Mechanics, The Marcus Wallenberg Laboratory for Sound and Vibration Research (MVL), SE-100 44, Stockholm, Sweden

^b KTH Royal Institute of Technology, The Centre for ECO² Vehicle Design, SE-100 44, Stockholm, Sweden

^c Université Gustave Eiffel, AME-SPLOTT, F-44344, Bouguenais, France

^d Université Gustave Eiffel, CEREMA, UMRAE, F-44344, Bouguenais, France

^e Institut de Recherche des Sciences et Techniques de la Ville (IRSTV), CNRS, 44321, Nantes Cedex 3, France

ARTICLE INFO

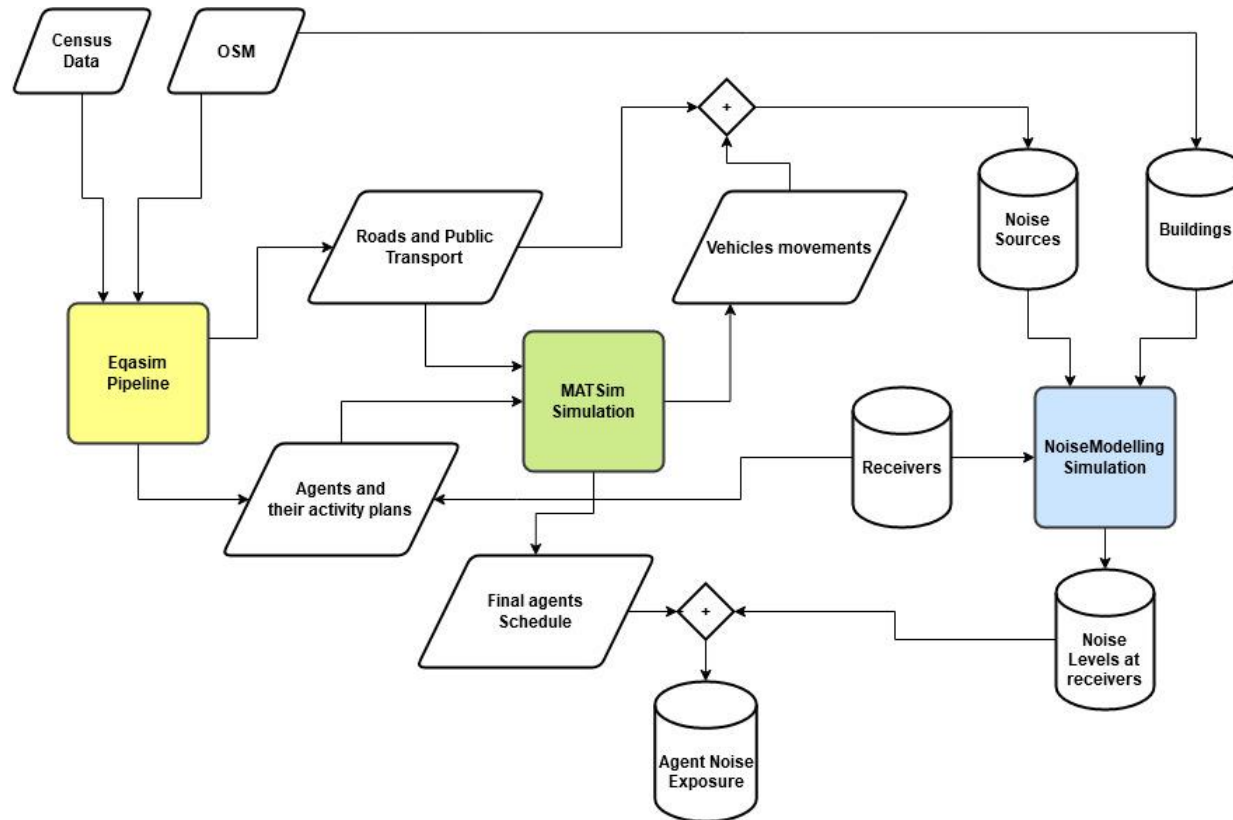
Keywords:

Road traffic noise
Noise impact assessment
Noise exposure cost
Agent mobility simulation

ABSTRACT

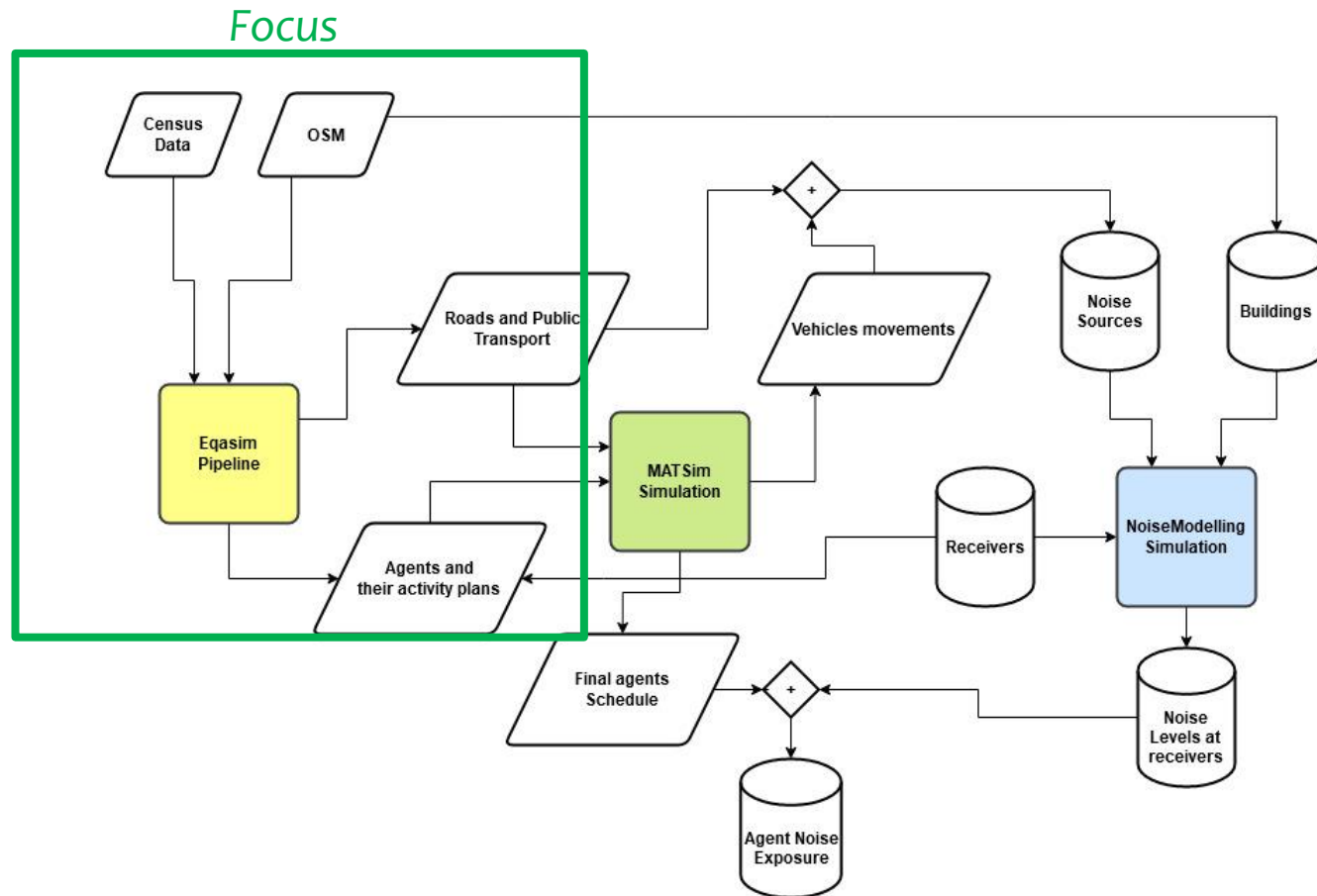
This study introduces an agent-specific assessment method of traffic noise exposure in agent mobility simulations. The assessment is achieved through a combination of an energy-based noise exposure impact assessment using noise exposure cost, and the state-of-the-art traffic noise prediction tool NoiseModelling coupled with the activity-based agent mobility simulation software MATSim. The agent-specific noise exposure cost is a measure to evaluate how the noise emissions from the transport of agents relate to the noise-related impact on other agents performing stationary activities. By introducing an agent-specific level, each agent's individual responsibility for the noise exposure may be estimated. The potential of the agent-specific noise exposure cost concept, combined with the MATSim-NoiseModelling framework, is illustrated through a case study, applying activity-based agent mobility simulations across Nantes, France. The results of the case study highlight, among other considerations, the insights that an agent-specific, activity-based noise exposure cost approach provides by visualizing the noise exposure "footprint" resulting from an agent's transportation activities.

Global Framework



Open-source modeling chain for the dynamic assessment of road traffic noise exposure, V. Le Bescond, A. Can, P. Aumond, P. Gastineau, TRD, <http://dx.doi.org/10.1016/j.trd.2021.102793>

Global Framework



Open-source modeling chain for the dynamic assessment of road traffic noise exposure, V. Le Bescond, A. Can, P. Aumond, P. Gastineau, TRD, <http://dx.doi.org/10.1016/j.trd.2021.102793>

Let's create a synthetic population with open source software !



<https://github.com/eqasim-org/>



0:00 - 8:00



08:30 - 17:00



17:30 - 0:00



0:00 - 9:00



10:00 - 17:30



17:45 - 21:00

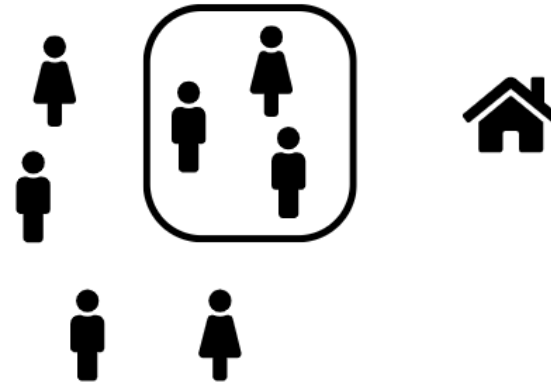


22:00 - 0:00

Credits to Sebastian Hörll, IRT System X, presentation : <https://slides.com/sebastianhorl/dpop2025>



Population census (RP)



> Truncate-Replicate-Sample (TRS)

Credits to Sebastian Hörl, IRT System X, presentation : <https://slides.com/sebastianhorl/dpop2025>

 Population census (RP)

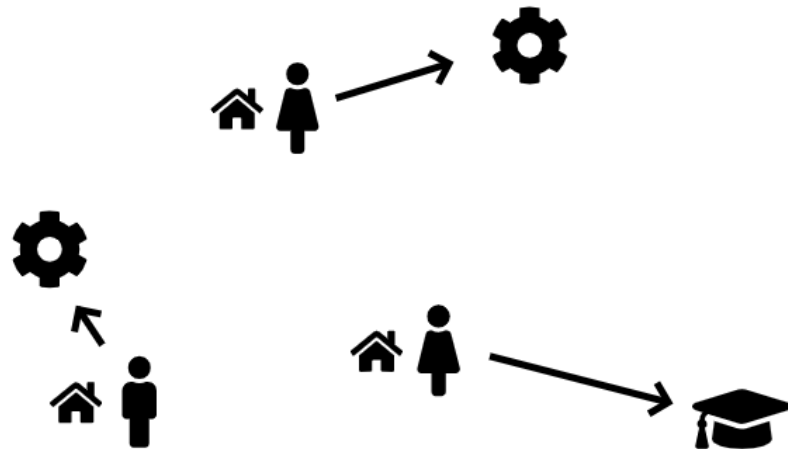
 Income data (FiLoSoFi)



> Imputation by quantile

Credits to Sebastian Hörl, IRT System X, presentation : <https://slides.com/sebastianhorl/dpop2025>

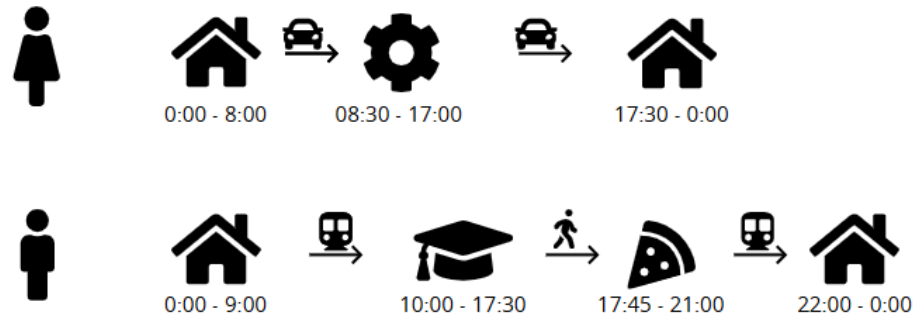
-  Population census (RP)
-  Income data (FiLoSoFi)
-  Commuting data (RP-MOB)



> Direct sampling from OD matrix

Credits to Sebastian Hörl, IRT System X, presentation : <https://slides.com/sebastianhorl/dpop2025>

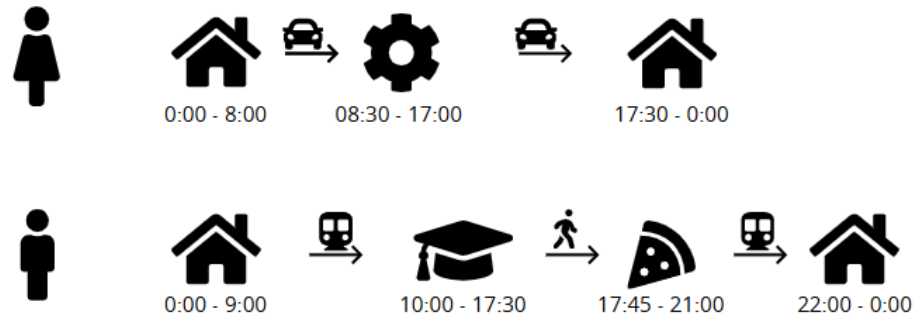
-  Population census (RP)
-  Income data (FiLoSoFi)
-  Commuting data (RP-MOB)
-  Household travel survey (EDGT)



> Assignment of activity chains
through **statistical matching**

Credits to Sebastian Hörl, IRT System X, presentation : <https://slides.com/sebastianhorl/dpop2025>

-  Population census (RP)
-  Income data (FiLoSoFi)
-  Commuting data (RP-MOB)
-  EDGT
-  National HTS (ENTD)



> Assignment of activity chains
through **statistical matching**

Credits to Sebastian Hörl, IRT System X, presentation : <https://slides.com/sebastianhorl/dpop2025>

-  Population census (RP)
-  Income data (FiLoSoFi)
-  Commuting data (RP-MOB)
-  EDGT  National HTS (ENTD)
-  Enterprise census (SIRENE)
-  Address database (BD-TOPO)

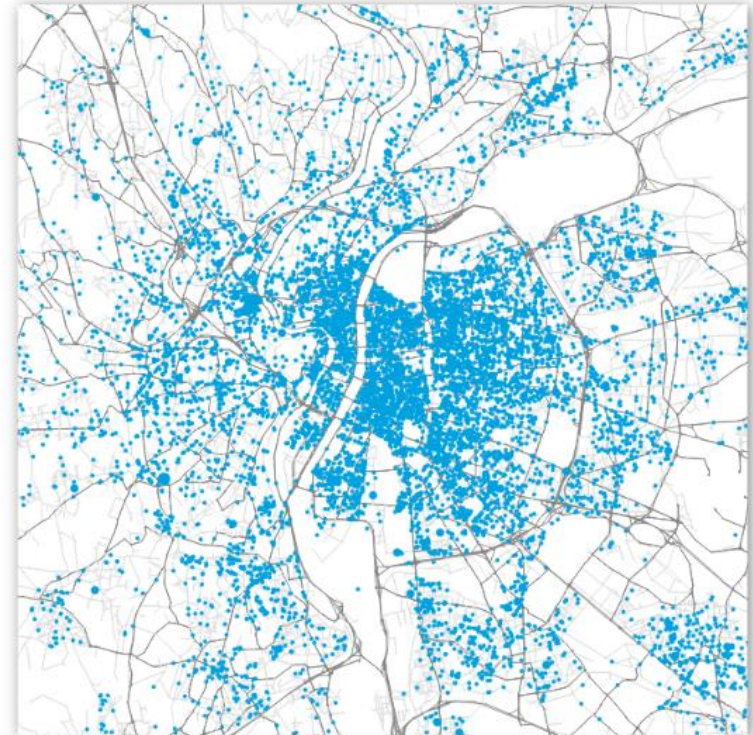


> Specifically designed approach to find secondary locations

Hörl, S., Axhausen, K.W., 2021. Relaxation–discretization algorithm for spatially constrained secondary location assignment. *Transportmetrica A: Transport Science* 1–20. <https://doi.org/10.1080/23249935.2021.1982068>

Credits to Sebastian Hörl, IRT System X, presentation : <https://slides.com/sebastianhorl/dpop2025>

-  Population census (RP)
-  Income data (FiLoSoFi)
-  Commuting data (RP-MOB)
-  EDGT  National HTS (ENTD)
-  Enterprise census (SIRENE)
-  Address database (BD-TOPO)

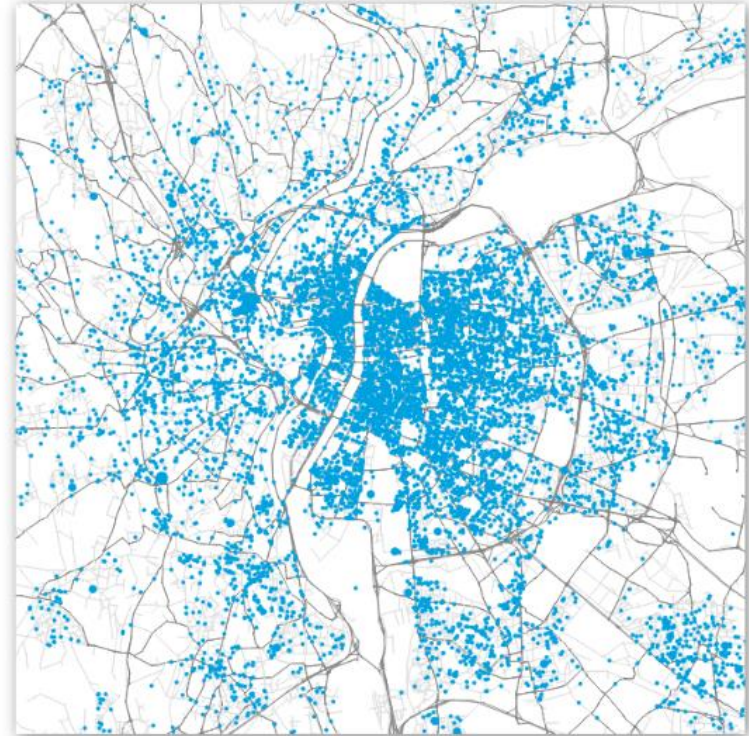


Person ID	Age	Gender	Home (X,Y)
1	43	male	(65345, ...)
2	24	female	(65345, ...)
3	9	female	(65345, ...)

Credits to Sebastian Hörl, IRT System X, presentation : <https://slides.com/sebastianhorl/dpop2025>

-  Population census (RP)
-  Income data (FiLoSoFi)
-  Commuting data (RP-MOB)
-  EDGT  National HTS (ENTD)
-  Enterprise census (SIRENE)
-  Address database (BD-TOPO)

Person ID	Activity	Start	End	Loc.
523	home		08:00	(x,y)
523	work	08:55	18:12	(x,y)
523	shop	19:10	19:25	(x,y)
523	home	19:40		(x,y)



Credits to Sebastian Hörl, IRT System X, presentation : <https://slides.com/sebastianhorl/dpop2025>

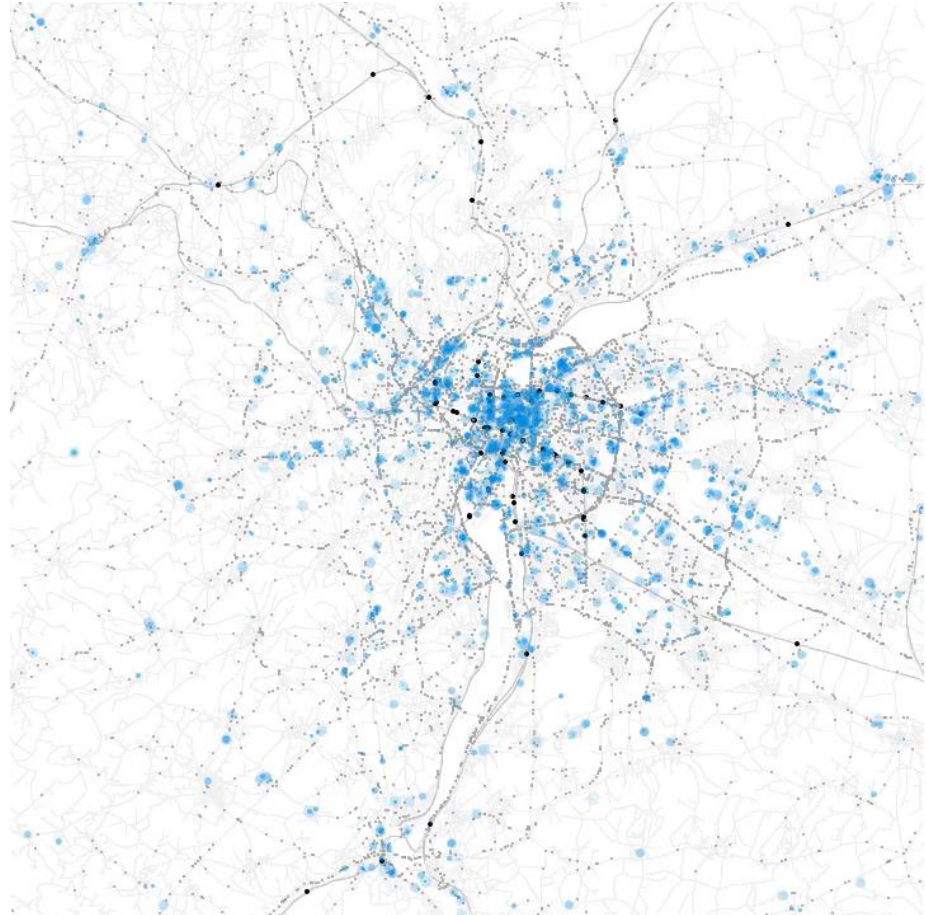
-  Population census (RP)
-  Income data (FiLoSoFi)
-  Commuting data (RP-MOB)
-  EDGT  National HTS (ENTD)
-  Enterprise census (SIRENE)
-  Address database (BD-TOPO)
-  OpenStreetMap
-  GTFS (SYTRAL / SNCF)



Credits to Sebastian Hörll, IRT System X, presentation : <https://slides.com/sebastianhorl/dpop2025>

-  Population census (RP)
-  Income data (FiLoSoFi)
-  Commuting data (RP-MOB)
-  EDGT  National HTS (ENTD)
-  Enterprise census (SIRENE)
-  Address database (BD-TOPO)
-  OpenStreetMap
-  GTFS (SYTRAL / SNCF)

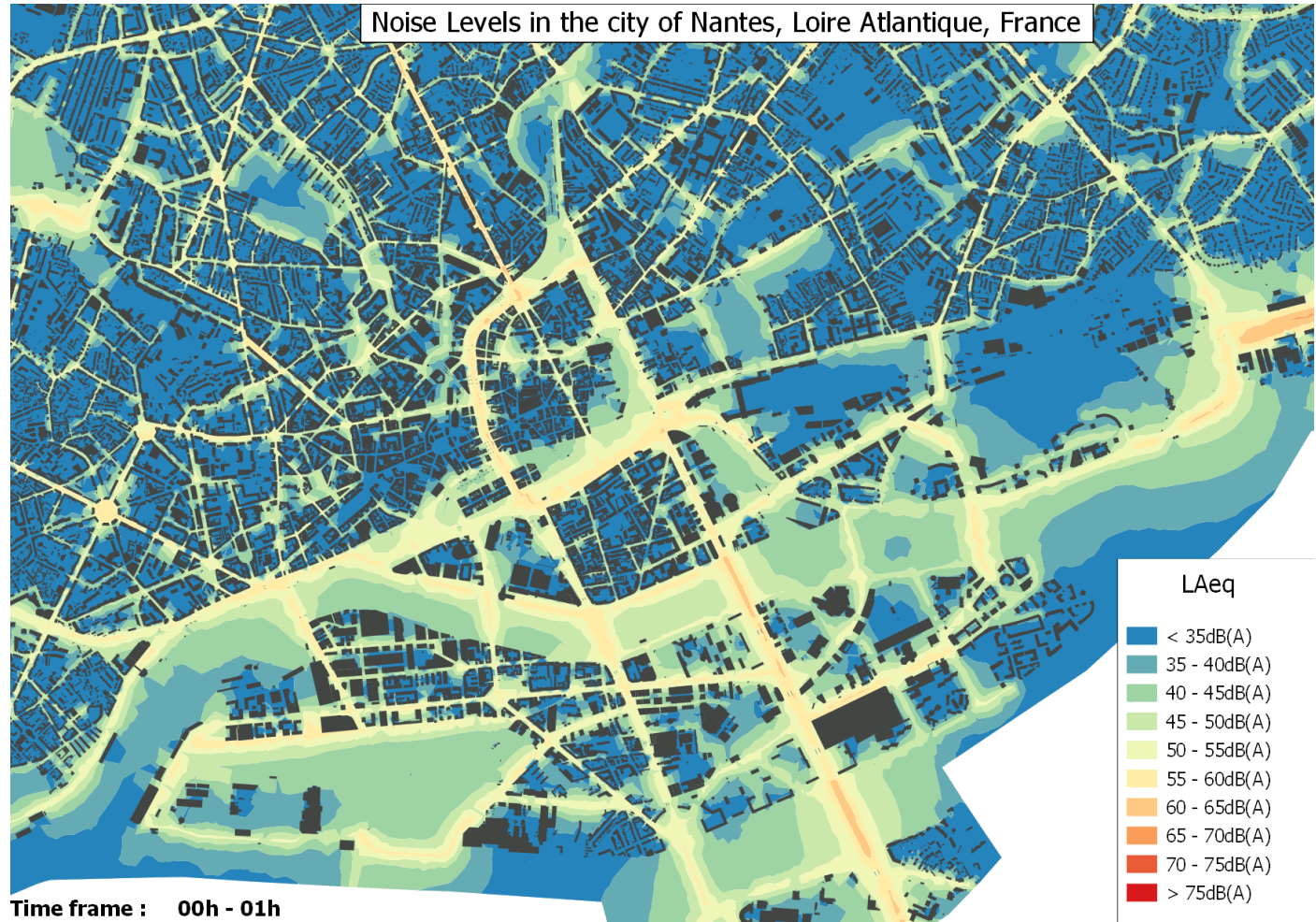
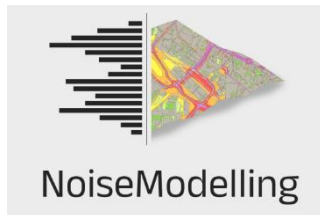
MATSim
Multi-Agent Transport Simulation



Credits to Sebastian Hörl, IRT System X, presentation : <https://slides.com/sebastianhorl/dpop2025>

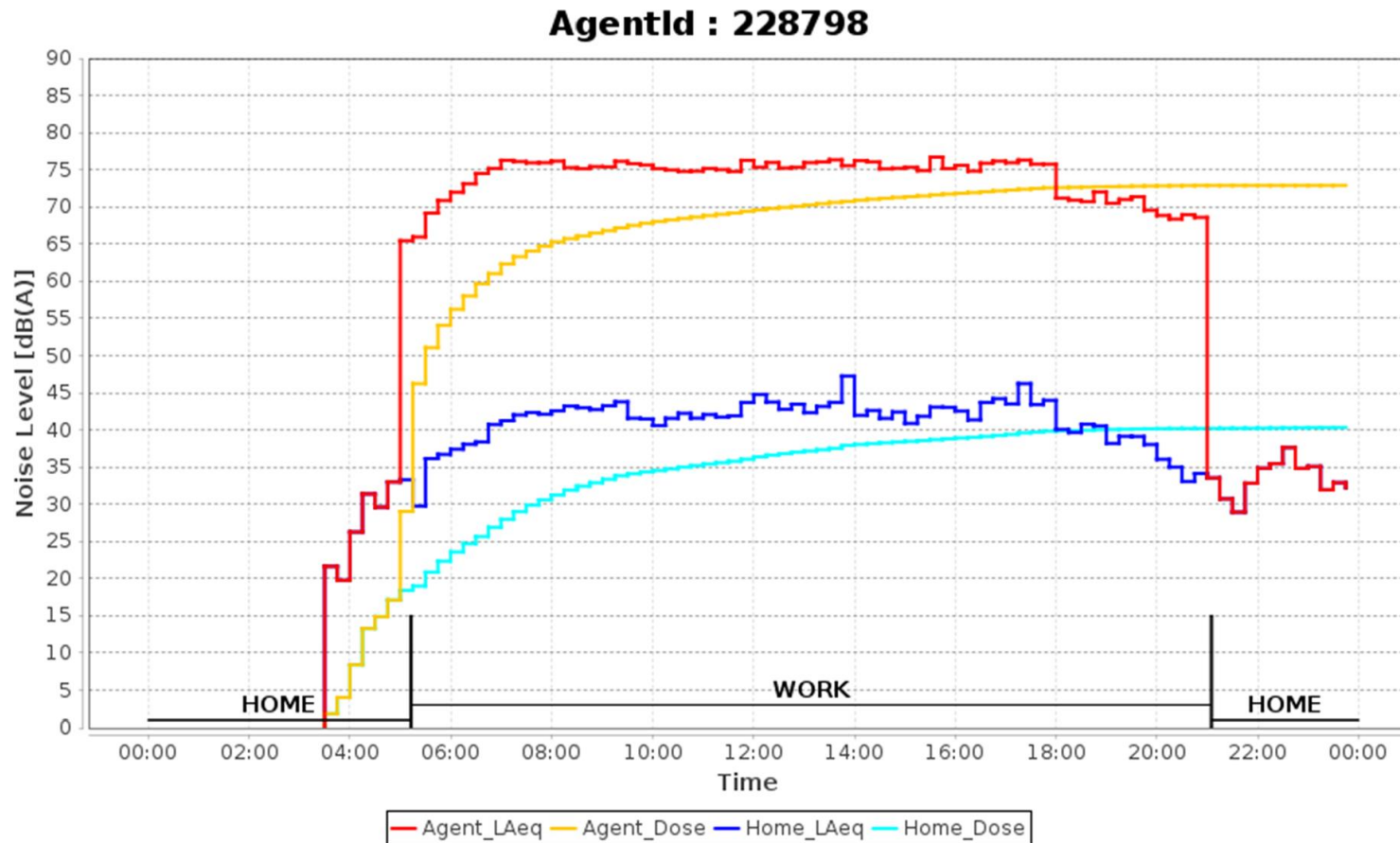
NoiseModelling

From the agents mobility, we can build a dynamic noise map !



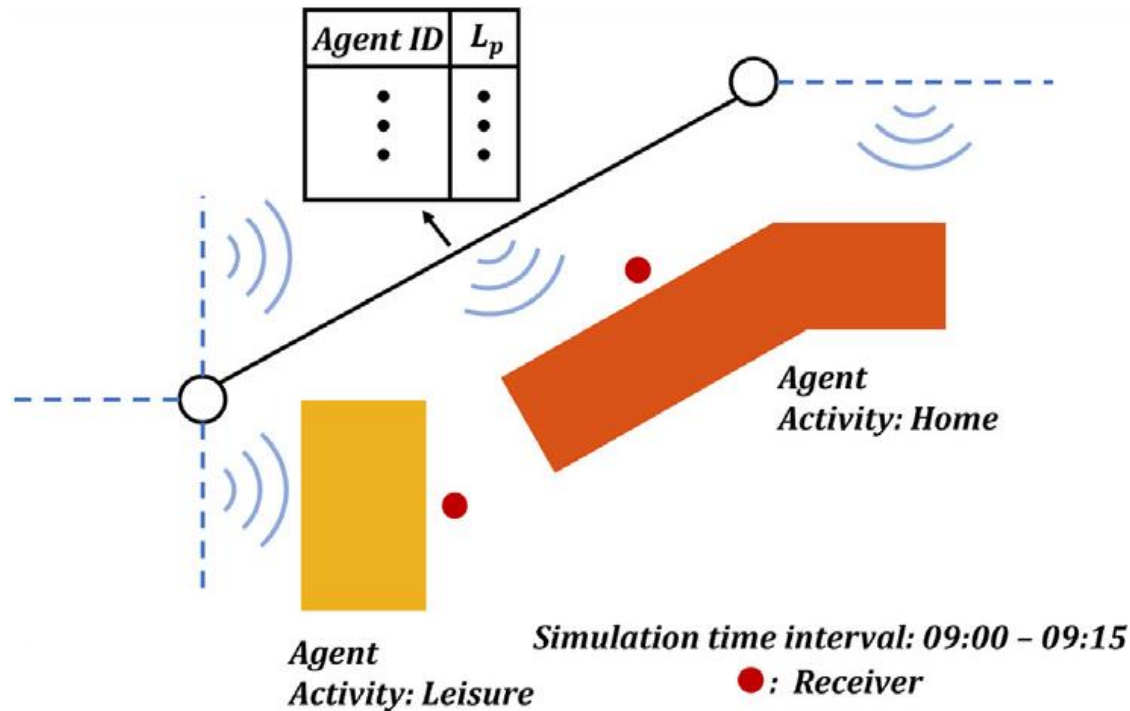
NoiseModelling

And follow agents noise environments through the day



Agent Noise Contributions

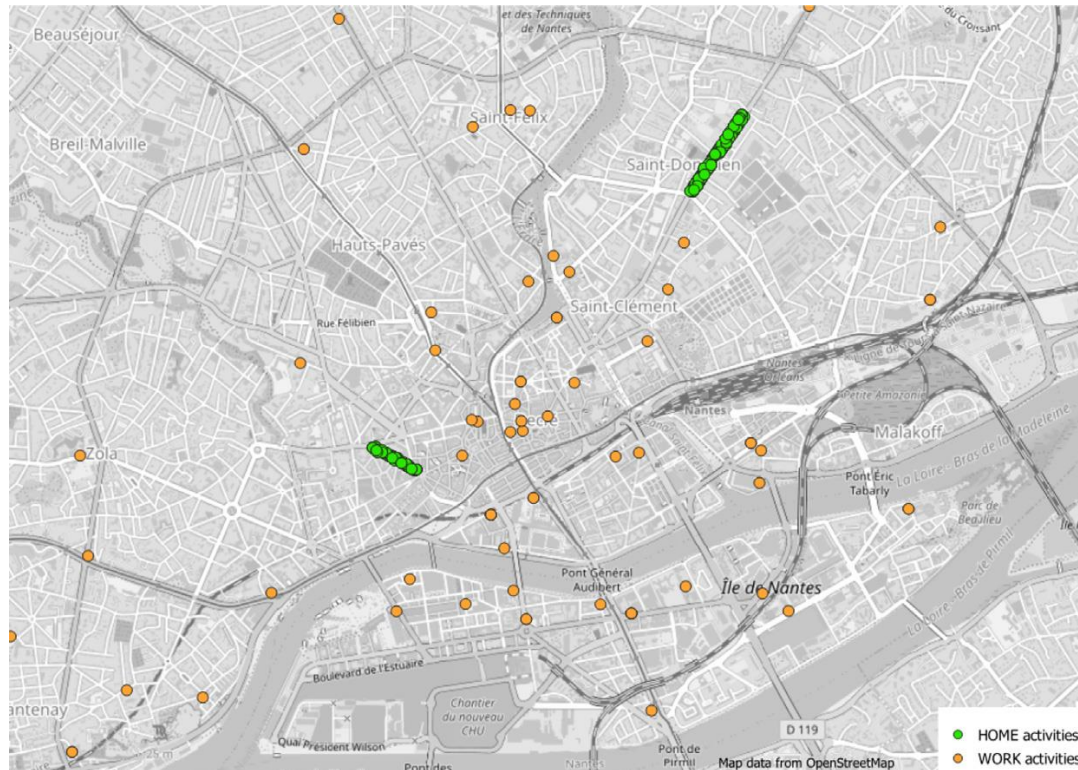
We can actually keep track of who emits noise on whom.



J. Nygren et al., Agent-specific, activity-based noise impact assessment using noise exposure Cost, Sustainable Cities and Society, DOI: 10.1016/j.scs.2024.105278

Agent Noise Contributions

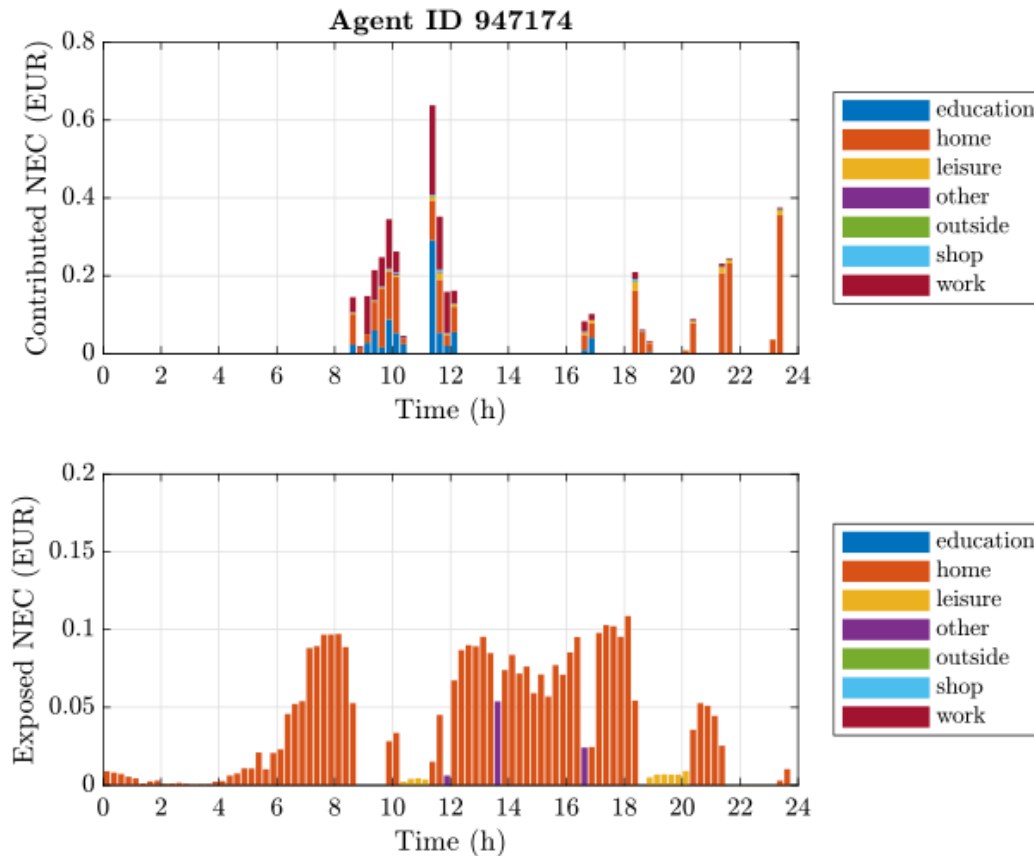
Let's pick a few agents



J. Nygren et al., Agent-specific, activity-based noise impact assessment using noise exposure Cost, Sustainable Cities and Society, DOI: 10.1016/j.scs.2024.105278

Agent Noise Contributions

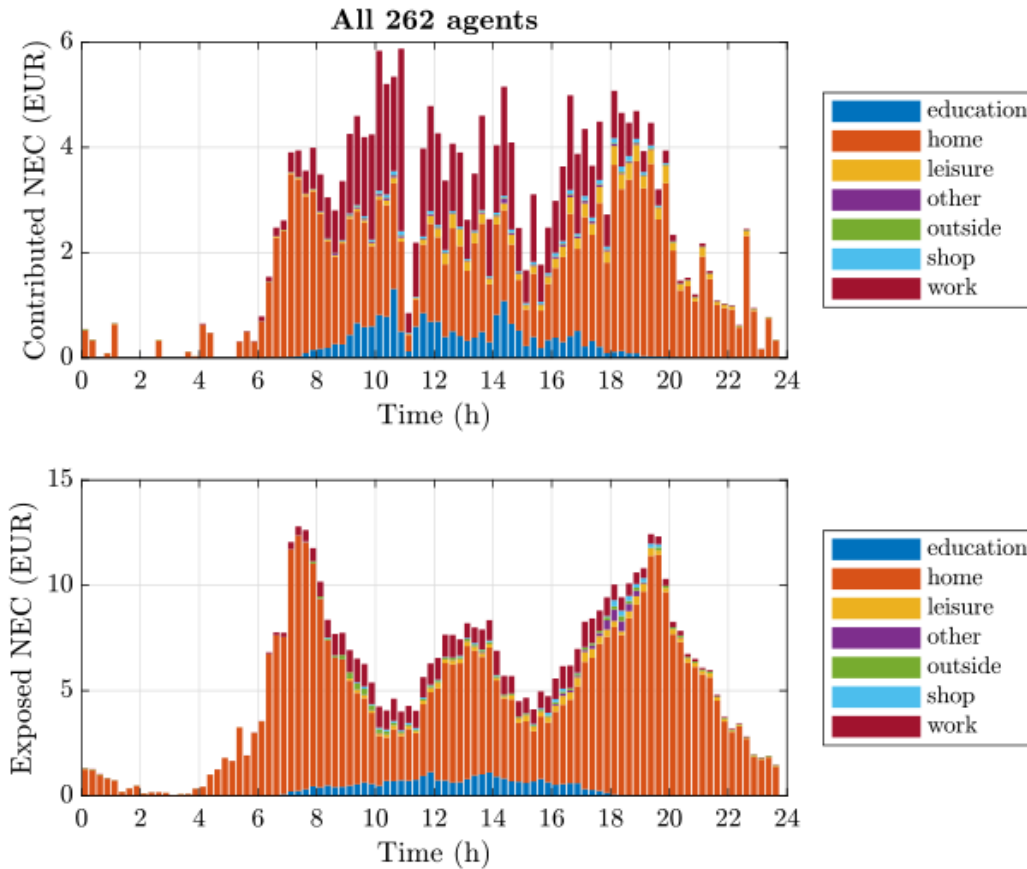
After applying a disaggregated noise cost model :



J. Nygren et al., Agent-specific, activity-based noise impact assessment using noise exposure Cost, Sustainable Cities and Society, DOI: 10.1016/j.scs.2024.105278

Agent Noise Contributions

After applying a disaggregated noise cost model :



J. Nygren et al., Agent-specific, activity-based noise impact assessment using noise exposure Cost, Sustainable Cities and Society, DOI: 10.1016/j.scs.2024.105278

Using available open-data available open-source software, we can do some crazy science !

We want to :

- Explore inequities in the population by looking at SPC groups
- Use Sumo
- Add motorcycles
- Add aircraft noise
- Improve noise assessment during bike rides or walks
- Improve noise assessment for specific activities
- ...

Your welcome to join us.

- Contact :

- valentin.lebescond@univ-eiffel.fr

- Links :

- <http://www.umrae.fr/>
- <https://eqasim-org.github.io/ile-de-france/>
- <https://www.matsim.org/>
- <https://noisemodelling.readthedocs.io/>