Transport simulation for air quality assessment Air Breizh

Equasim workshop 2025

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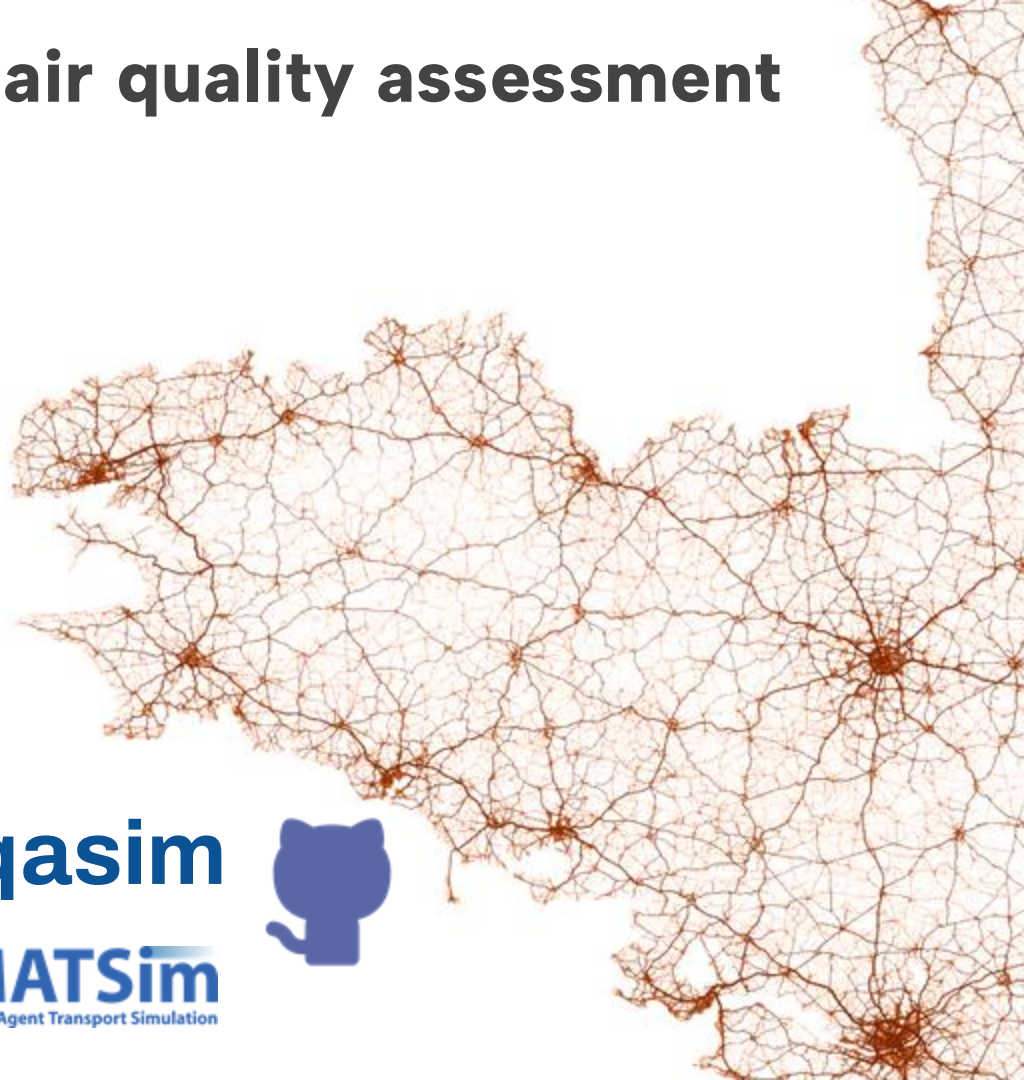


Eqasim

MATSim
Multi-Agent Transport Simulation

Our missions : monitoring the air, climate and energy data in Britanny

1

Measure

With our regional network of air quality monitoring stations

3

Raise awareness

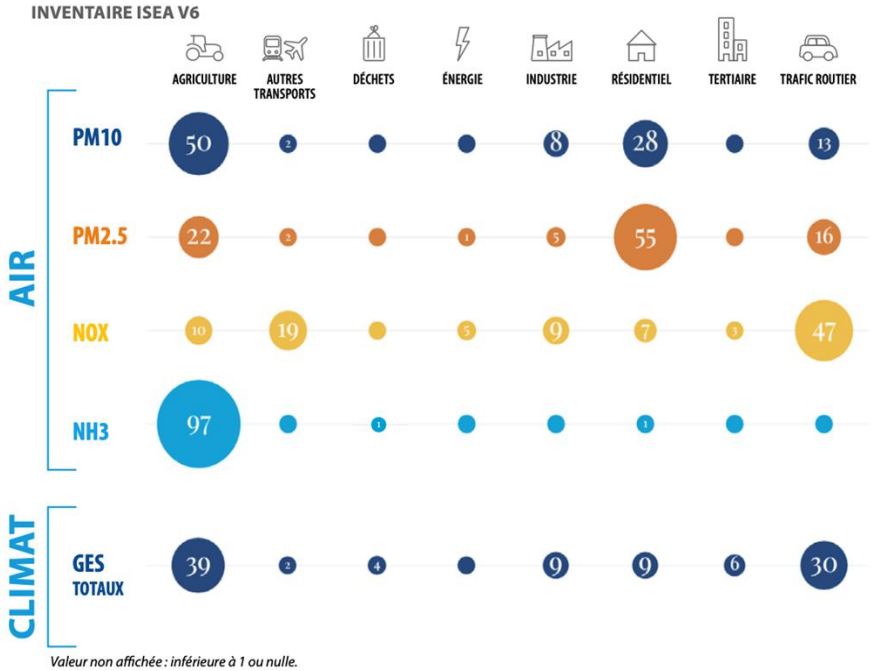
Inform the general public and differents stakeholders (the EU, the state, local governements) about air quality and climate issues

2

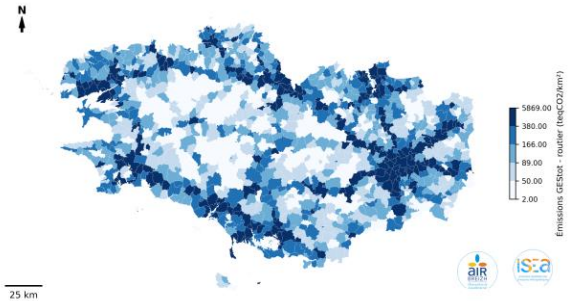
Monitor

Data analysis,
Emission production assessment,
Air quality modelling

Our challenge: ISEA, the inventory of emissions



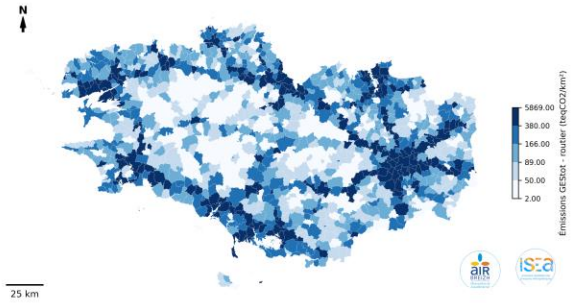
- Quantify pollutants of air (PM_{10}, NO_X, NH_3...) for thirty pollutants
- And climate, with greenhouse gas (CO_2, N_2O, CH_4...)
- For each sector, and specially road traffic
- Assist in the planning and monitoring of regulatory planning actions



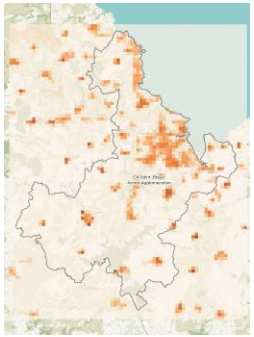
Our challenge: Modelling air quality using the ISEA database

To produce a good air quality assesement we need :

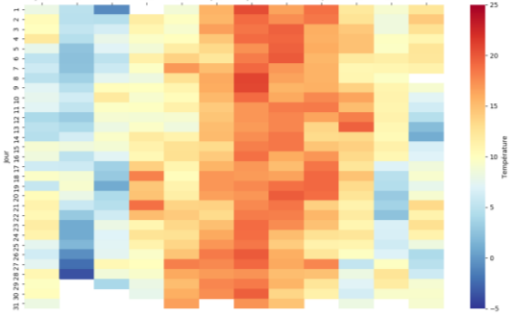
Accurate emissions quantification



Precise emissions spatialisation



Reliable weather data

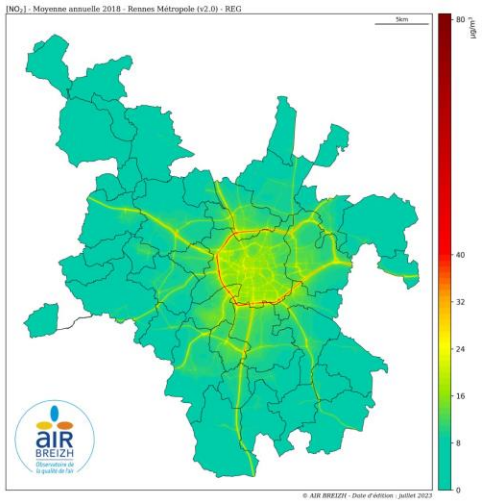


SIRANE
Urban Air Quality Model

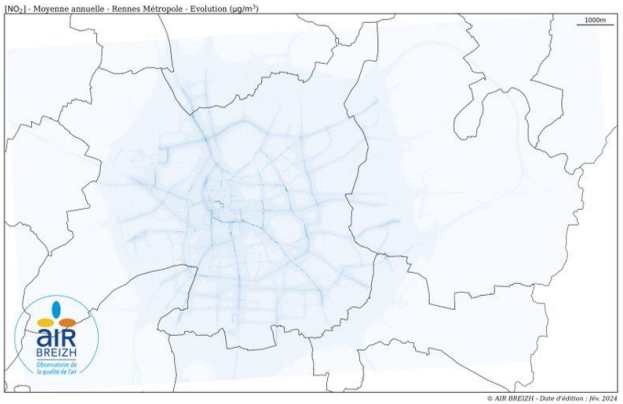
Our challenge: Modelling air quality using the ISEA database

After the validation with in situ measurements, the resulting air concentration maps are used :

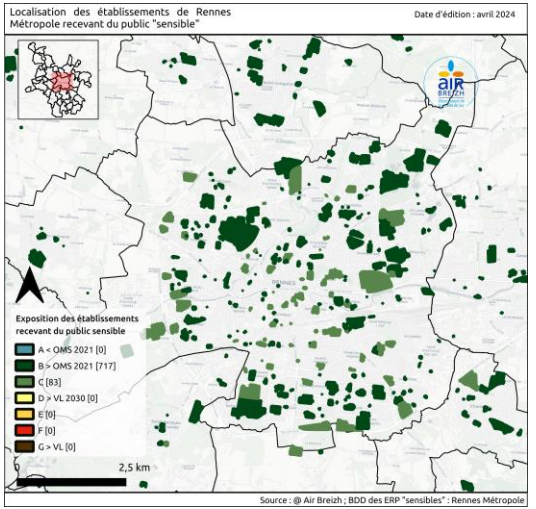
For air quality assessment



For public policy scenarios such as LEZ (Low Emissions Zones) or urban planning projects



To estimate the exposure of the population to poor air quality

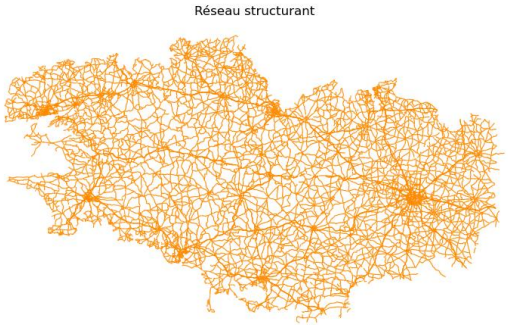


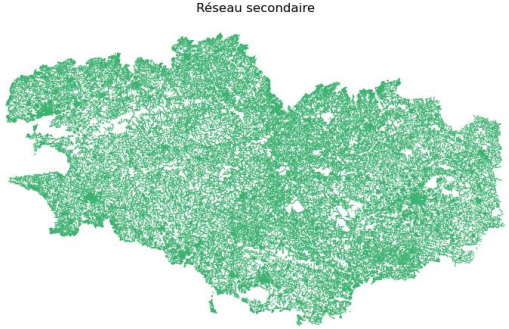
Our challenge: quantify pollutant emissions and produce high-resolution modelling of air **quality**

- Road traffic is one of the main contributors to pollutant emissions

… which can be imprecise

- **Primary road network**
- **Secondary road network**





BD Topo with manual extension of the traffic counts

But :

- ***Time-consuming***
- ***Not very detailed***

a problem for modelling (SIRANE)

Since 2022, Air Breizh has been moving into modelling !

Eqasim


Sebastian Hörl


Milos Balac

- An open source project with documentation
- … using french open data

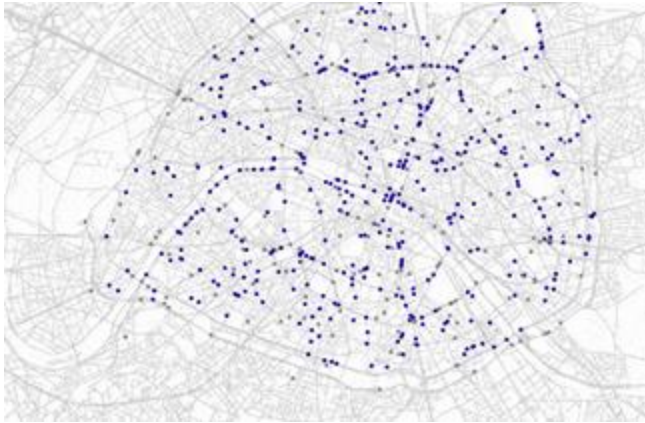
IGN
Insee
SDES

Generation of a synthetic population

OSM
GTFS

MATSim

Iterative simulation of agent trips



Exemple d'une visualisation dynamique du déplacements des agents d'Eqasim, Eqasim.org

- ✓ adaptation to Brittany
- ✓ a correction method based on traffic count data
- ✗ limited perspective on the technology, its inputs, and the available documentation ?
- ✗ an automated process ?

2025 : an internship to incorporate these modelling results into the emissions inventory

- Reinstall the **modelling environment** on a more powerful machine

  Reduced computation times and the capacity to model a larger domain

  Updated calculation methods and the inclusion of new data

- **Fully automated processing chain adapted to Air Breizh technologies**

  Package python and notebooks
  Gitlab
  documentation, ...

- **Building a methodological foundation and documentation**

  Sensitivity testing of the model (parameters, etc.)

L'Open Data pour modéliser le trafic routier

Une simulation de bretons fictifs (plutôt) intelligents

Trafic Moyen Journalier Annuel (TMJA)

Tout type de véhicules motorisés confondus

[50 - 200 [

[200 - 1000 [

[1000 - 41175]

TMJA >= 50
Discrétisation : quartiles

Variation de taille :
Méthode exponnentielle

MATSim Un modèle trafic routier ...
Multi-Agent Transport Simulation

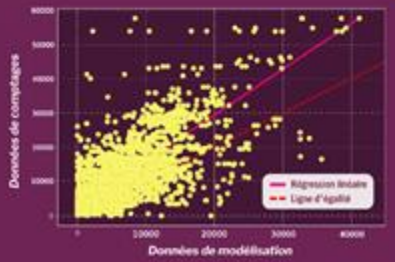
On le dit **multi-agents** car il calcule le trafic en générant des "**agents**", à savoir des personnes fictives, par le biais de multiples données et simule leurs déplacements.

Eqasim ... simplifié et adapté au territoire français

Il s'agit d'un environnement permettant, entre autres, une **prise en main facilitée** de MATSim. Cela passe notamment par la considération des **données françaises**.

N

Comparaison aux données de comptages : des sorties de modèle sous-estimant le trafic routier



$R^2 = 0.63$
$r = 0.80$

Les données des points de comptage de 2023 et 2024 permettent d'avoir une idée de la pertinence du modèle.

Sur les 8255 tronçons OSM couverts par des données de comptages, le modèle sous-estime le trafic mais semble tenir la route. Pour qu'il soit utilisé par les ingénieurs d'Air Breizh, une correction spécifique par ces données de comptage sera de mise.

Realisation : Charly Ciantar, 2025

0 20 km

Sources des données de modélisation
IGN, INSEE, Ministère de l'Environnement (SDES), OSM, Région Bretagne

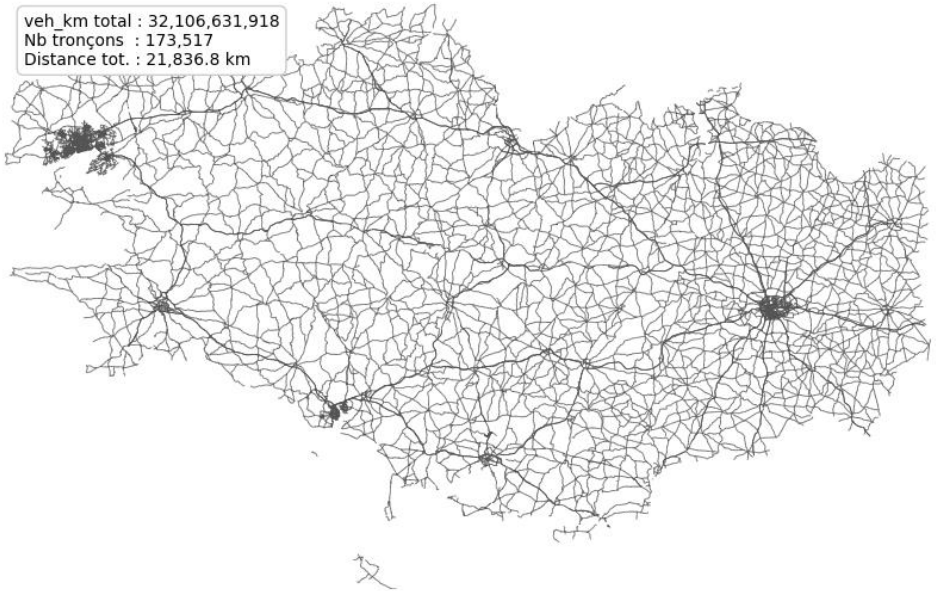
Sources des données de comptages
Départements (35, 56, 22, 29), DIR Ouest, Brest Métropole, Rennes Métropole, Ville de Quimper

Technologies de modélisation utilisées
Matsim, Eqasim

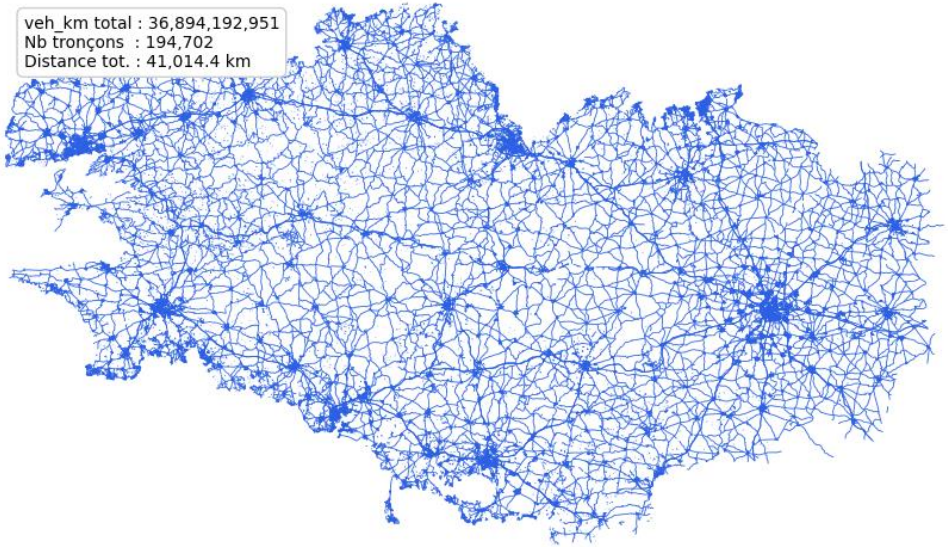
ISEA v6 2022 vs Matsim 2024

Bilan ISEA V6 et MATSim corrigé (version sans unclassified)

ISEA V6 — Réseau



MATSim corrigé (version originale) — Réseau



- The corrected MATSim network is much more detailed than the ISEA V6 network, with more road segments and improved spatial accuracy.
- As a result, the total vehicle-kilometres are higher, reflecting a more complete representation of real traffic flows.

Results

ISEA v6 2022

from an older version of Prism

Substance	Total
bc	262 218
ch4	152 957
co2.ind	919 771
co2.nbio	**6 414 659 463**
no2	4 981 855
nox	**15 516 568**
pm10	2 498 280
pm2.5	1 527 923
tsp	4 176 538

🚗 Vehicle kilometer indicator

32 017 899 370 *Linéaire*

\+ 839 488 891 *Surfacique*

32 857 388 261

Matsim 2022 model release

from an older version of Prism

Substance	Total
bc	147 376
ch4	268 519
no2	4 088 512
nox	**14 659 138**
pm10	2 529 092
pm2.5	1 533 772

🚗 Vehicle kilometer indicator

28 876 786 310

Matsim 2024 model release

from the latest version of Prism

Substance	Total
bc	*coming soon*
ch4	*coming soon*
no2	*coming soon*
nox	**15 302 655**
pm10	*coming soon*
pm2.5	*coming soon*

🚗 Vehicle kilometer indicator

33 362 408 869

The potential causes

A change in methodology since 2022

- After running MATSim, real traffic counts are applied where available
- Three redistribution methods were tested and evaluated: nearest neighbour, KNN, and an fclass-based approach.
- Real integration of TMJA data:

- The selected method is a KNN model applied within each fclass, providing consistent and reliable results for emissions calculs.

The OSM road network has become denser

Highway	2022	2024 v2
Residential	80 554	104 997
...	77 602	85 190
Total	157 556	190 167

Thanks for your attention !

Do you have some questions ?