Mapping the health impacts of transport noise in the densely populated area of the Ile-de-France region

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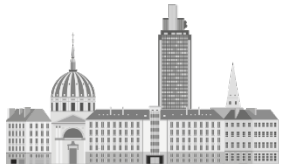

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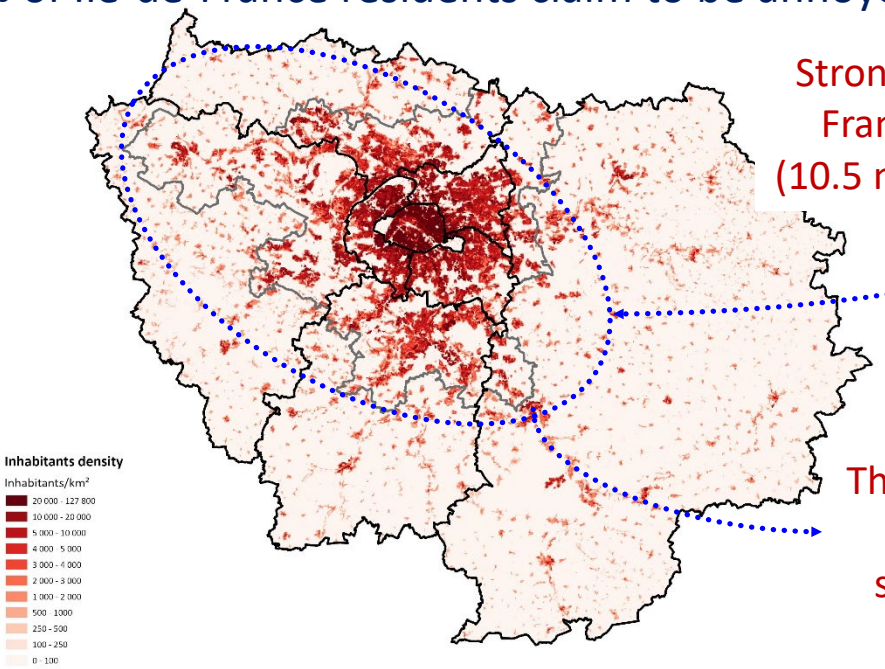
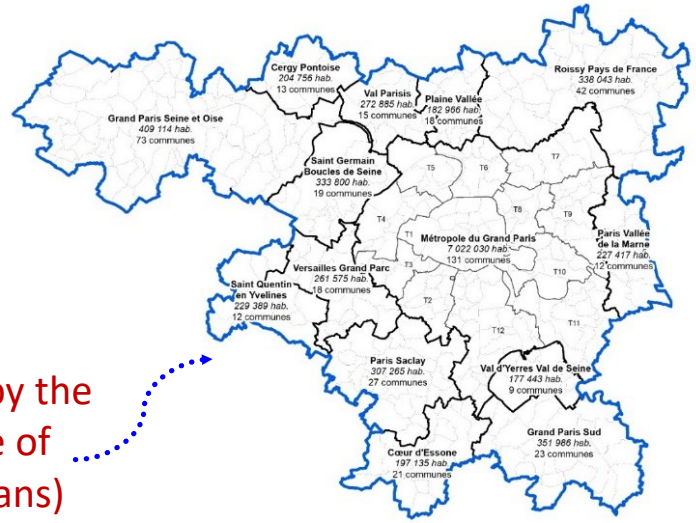
Key figures on noise issue in Ile-de-France region

The Ile-de-France region

- 12.2 millions of inhabitants = 18% of the French population
- 30% of the GNP
- 12,000 km^2
- Very highly and dense transport and infrastructures (40,000 km of roads, 1000 km of railways, 2 major international airports Paris-Charles de Gaulle (CDG), Paris-Orly, 1 business airport Paris-Le Bourget)
- Great concern related to noise:
  - → Noise is a major disadvantage of living in Île-de-France for 36% of inhabitants
  - → 56% of Ile-de-France residents claim to be annoyed by noise



Strong density disparity inside Ile-de-France region: 86 % of inhabitants (10.5 millions) live in 25 % of the region



The dense area directly concerned by the END (14 agglomerations in charge of strategic noise maps and action plans)

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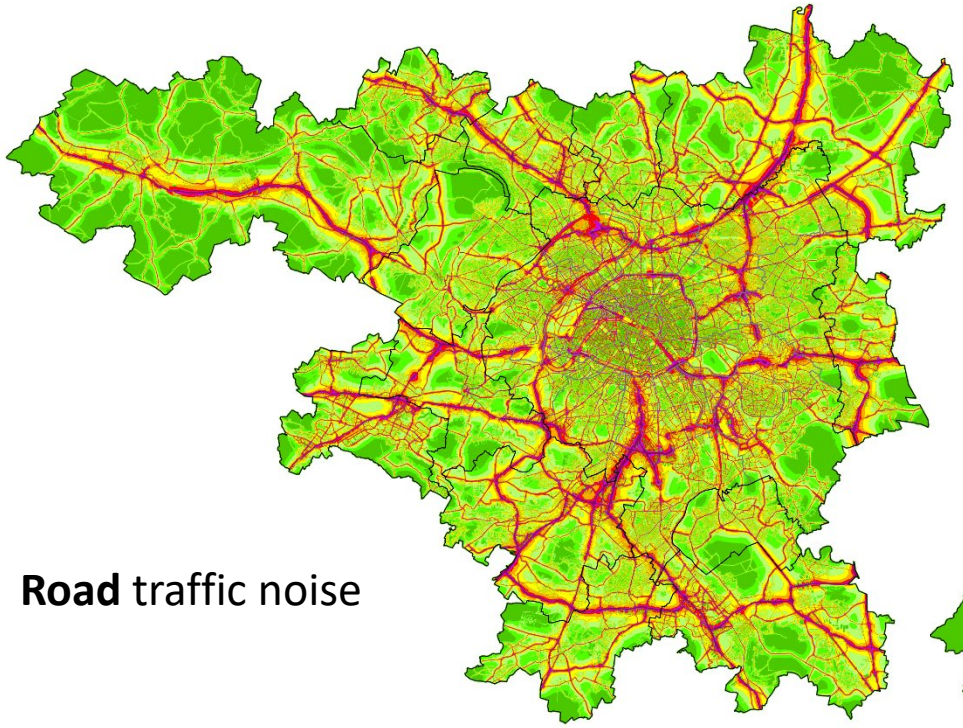
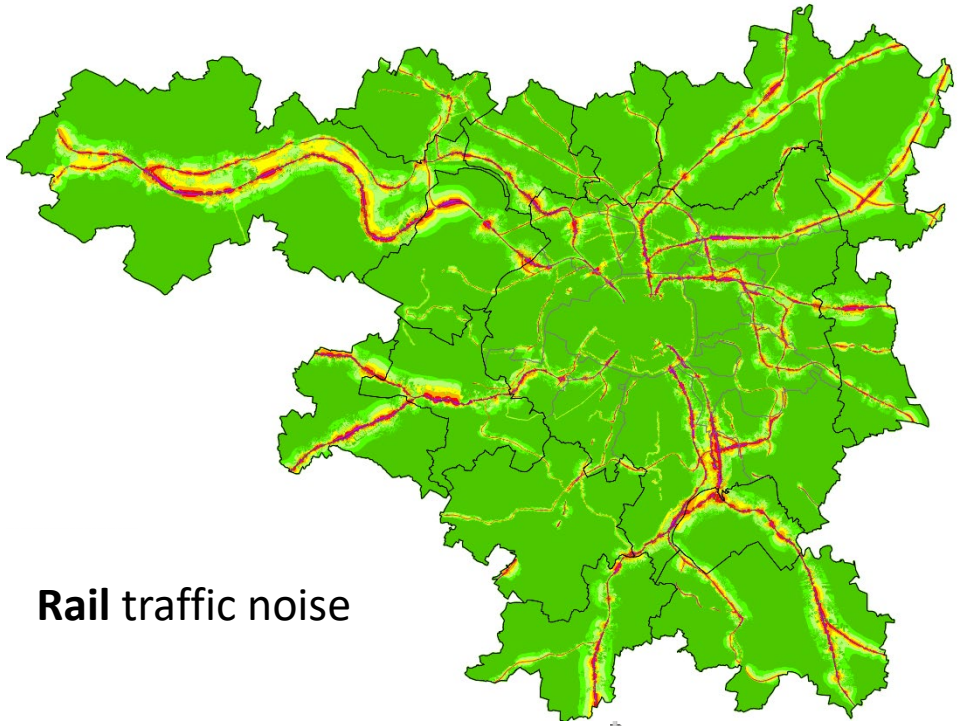
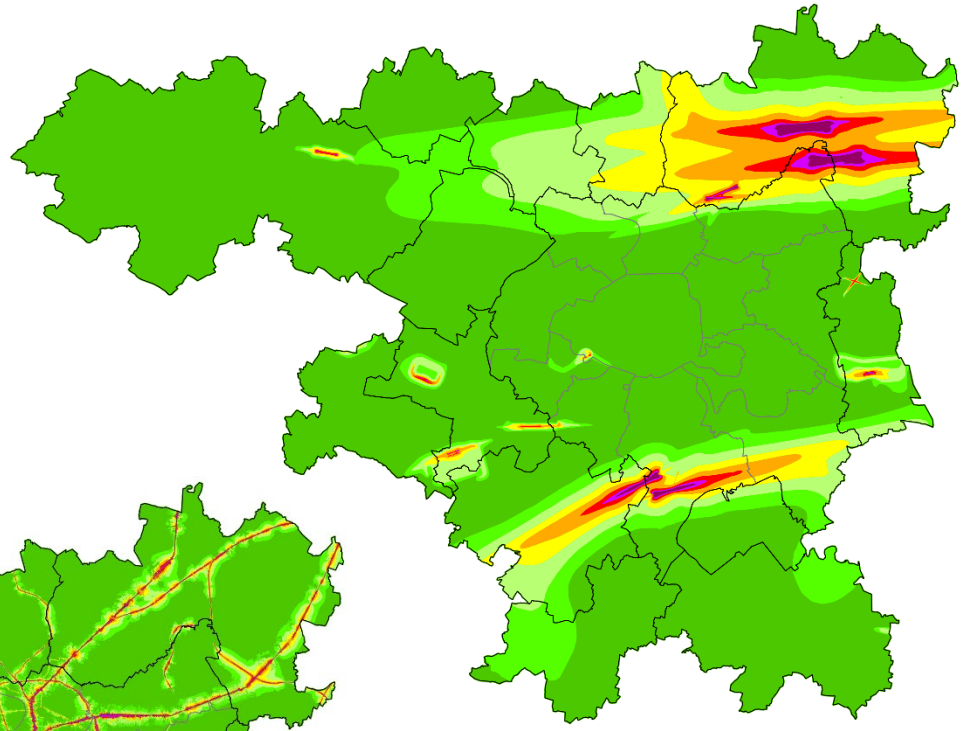
The strategic noise maps (4th round) of the dense area



Road traffic noise



Rail traffic noise



Air traffic noise

Lden (dBA)

- ≥75
- 70 - 75
- 65 - 70
- 60 - 65
- 55 - 60
- 50 - 55
- 45 - 50
- < 45

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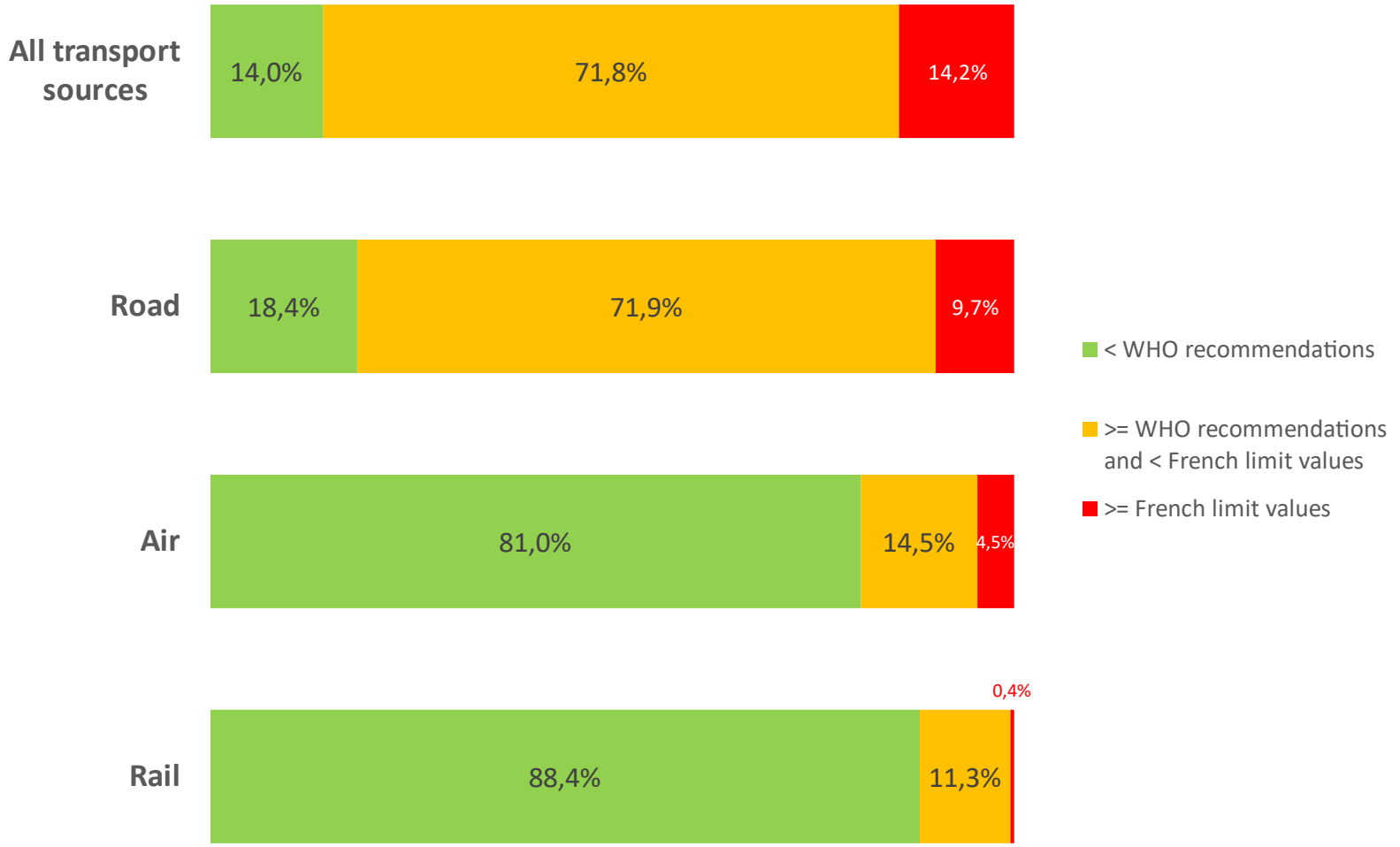
The strategic noise maps (4th round) of the dense area

Main statistics



Transport noise recommendations by WHO (2018)

	Lden dBA	Ln dBA
Road	53	45
Rail	54	44
Air	45	40

French regulatory limit values for transport noise

	Lden dBA	Ln dBA
Road	68	62
Rail (conventional)	73	65
Air	55	50

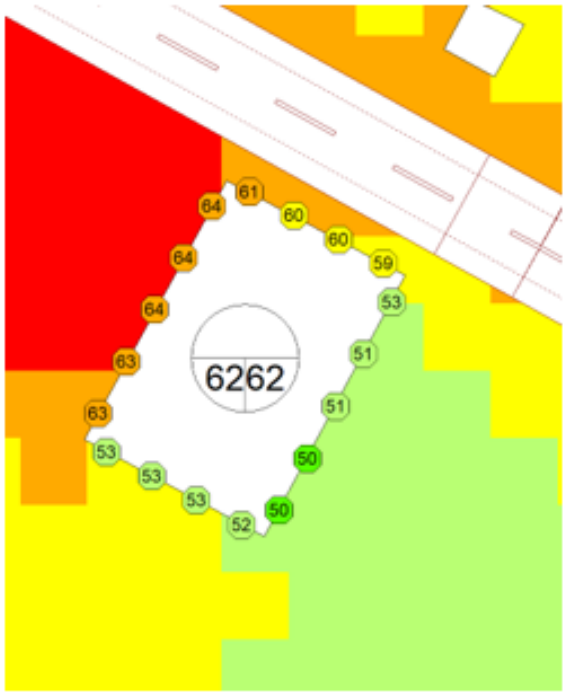
Methodology for mapping health impact of noise

1st step: Assessment of the exposure of people living in dwellings to noise

Based on strategic noise maps (4th stage) results for Lden and Ln

Use of the CNOSSOS-EU method

Storage of results for each receiver



RECEIVER	NOISE LEVEL LDEN	NUMBER OF PEOPLE
1	49.1	0
2	49.4	0
3	50.7	0
4	51	0
5	51.7	0
6	52.4	0
7	52.5	0
8	52.6	0
9	53	0
10	58.7	6.89
11	59.2	6.89
12	59.9	6.89
13	60.8	6.89
14	62.2	6.89
15	63	6.89
16	63.6	6.89
17	63.9	6.89
18	64.1	6.89

Example of assessment of the exposure of people living in dwellings (here 62 inhabitants) to noise for road traffic noise, with the median method.

Methodology for mapping health impact of noise

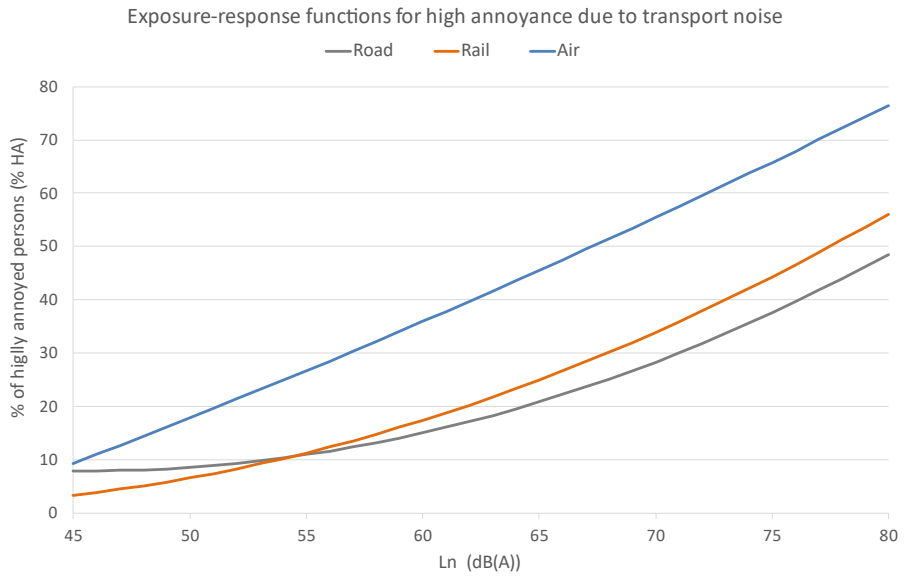
2nd step: Calculation of health impact indicators

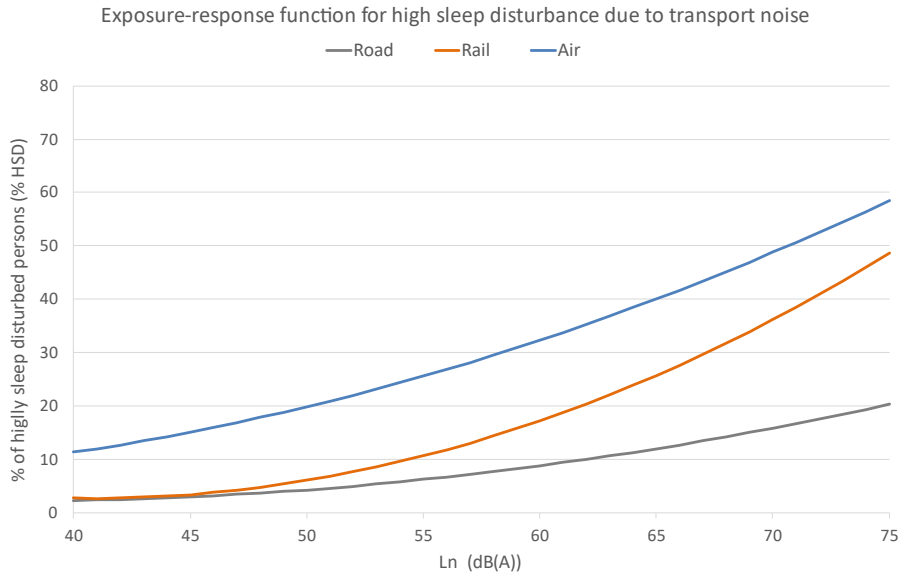
Selection of health impact indicators

- High annoyance (HA)
- High sleep disturbance (HSD)
- ~~Cardiovascular risks~~
- ~~Learning difficulties~~

Not selected because ERFs are available only for one transport source (road for cardiovascular, air for learning difficulties)

Use of exposure-response functions (ERF) (WHO, 2018)





→ **HA and HSD for each type of transport at each receiver**

Methodology for mapping health impact of noise

3rd step: Calculation of Disability-Adjusted Life Years (DALY)

Conversion of HA and HSD in DALY by using Disability Weights (DW) (WHO, 2011)

- DALY_HA = **0.02** * HA
- DALY_HSD = **0.07** * HSD

For each type of transport (road, rail, air) and in total at each receiver

Aggregation of results at two resolution scales:

- A 200 metre grid
- At the level of each municipality

Mapping of two types of health impact indicators:

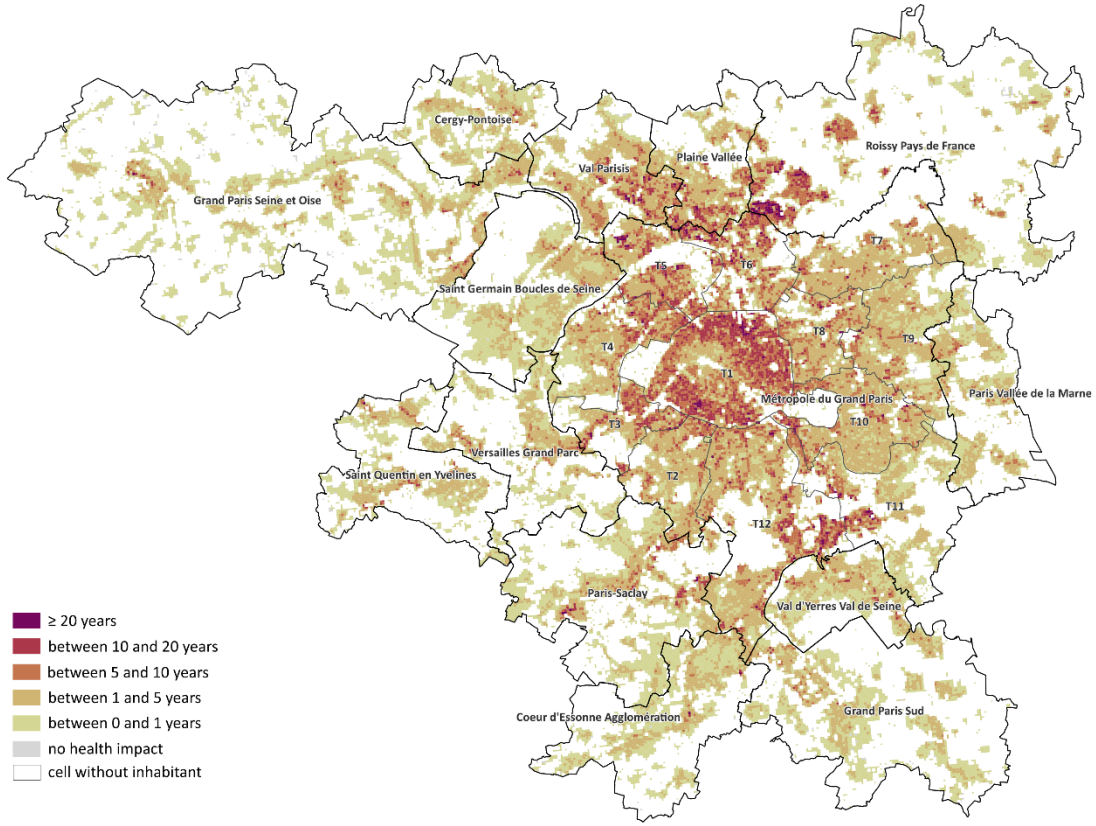
- The total number of DALY for each territorial unit (DALY) → **collective impact**
- The average **individual risk** for each territorial unit: healthy life-months lost per individual over a lifetime (i_DALY)
- Maps available for each health indicator (DALY_HA, DALY_HSD, DALY_tot) and for each type of transport (road, rail air, all transports) but we present here only the results in DALY_tot for the three sources of transport noise cumulatively

Main results

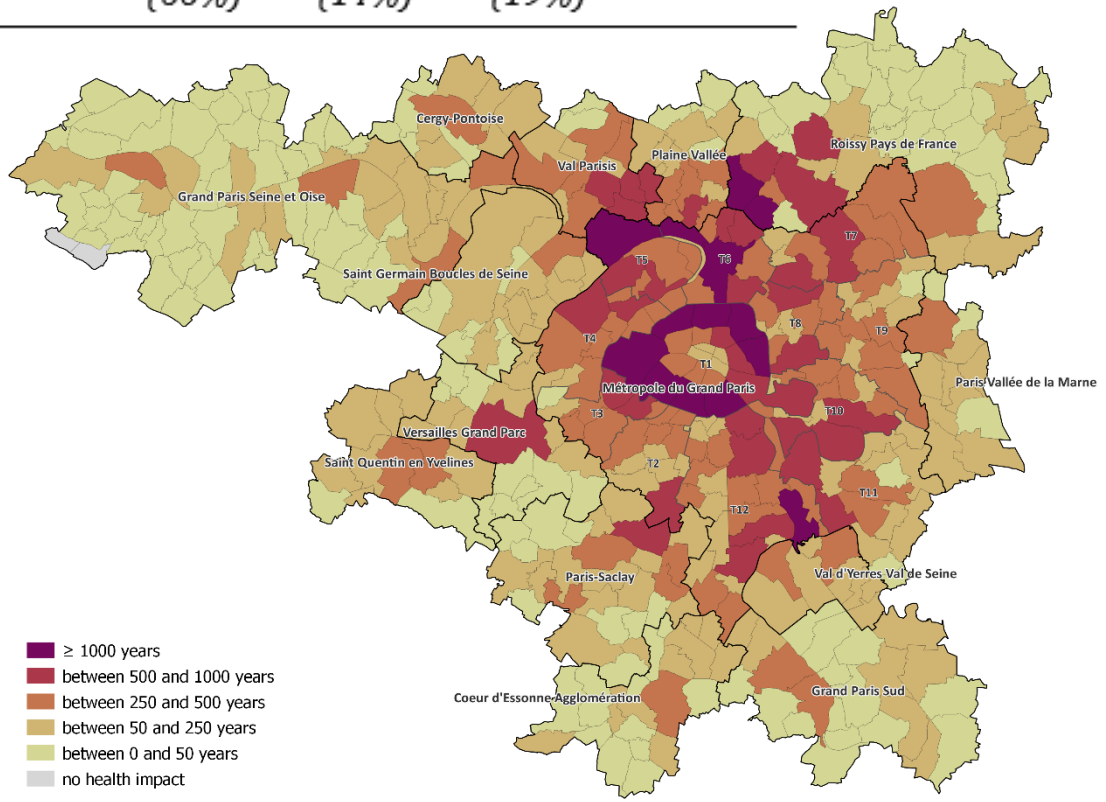
Collective impact: 99,200 DALY/year

- HSD: 53% and HA: 47% of the DALY_tot
- Road noise represents 66% of the health impact, then aircraft noise (19%) and at las railway noise (14%)

DALY	Road	Rail	Air	Total
HSD	33,589	8,176	11,169	52,934 *(53%)*
HA	32,341	5,970	7,955	46,266 *(47%)*
Total	65,930 *(66%)*	14,146 *(14%)*	19,124 *(19%)*	99,200



DALY at the 200 meters grid resolution
for the three sources of transport noise cumulatively



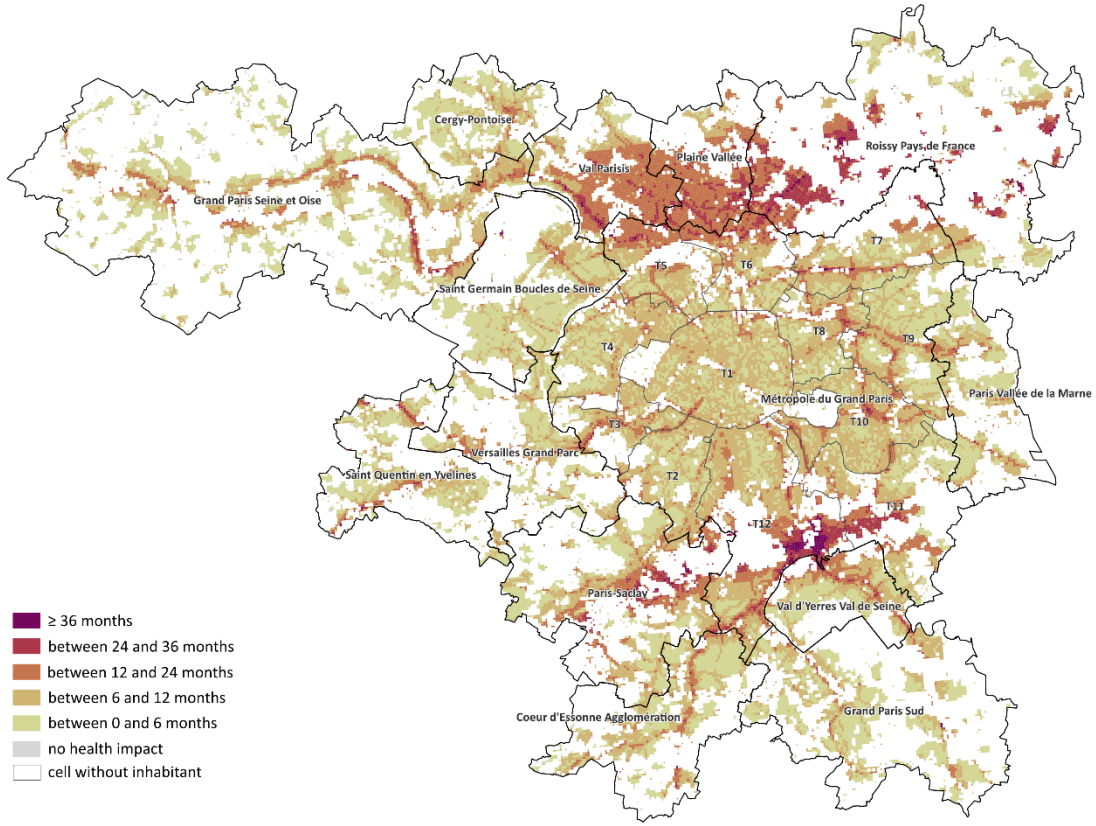
DALY at the municipality scale
for the three sources of transport noise cumulatively

Main results

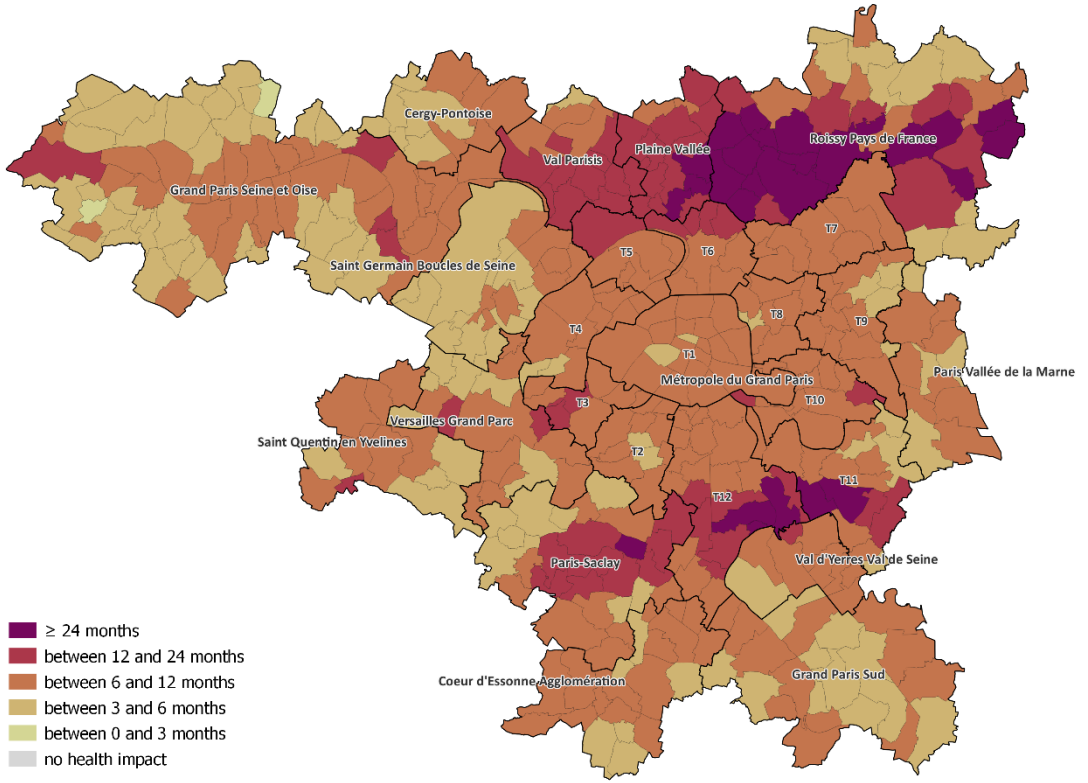
Individual risk: 9.4 months lost/individual

- Significant variations: i-DALY values range from 3 to 35 months depending on the municipality
- Highlight the impact of aircraft noise

I_DALY	Road	Rail	Air	Total
HSD	3.2	0.8	1.1	5 *(53%)*
HA	3.1	0.6	0.8	4.4 *(47%)*
Total	6.3 *(66%)*	1.3 *(14%)*	1.9 *(19%)*	9.4



i_DALY at the 200 meters grid resolution
for the three sources of transport noise cumulatively



i_DALY at the municipality scale
for the three sources of transport noise cumulatively

Comparison with previous evaluation

DALY in the dense area of the Ile-de-France region for the 2019 (3rd round of END) and the 2024 (4th round of END evaluation)

- A sharp fall in exposure to railway noise (-40%), mainly due to the changes in railway noise modelling results and positive evolution
- No major changes for road and air

→ A slight decrease (-8%) of DALY

DALY	Road	Rail	Air	Total
2019	65,607	23,440	18,718	107,766
2024	65,930 *(+0.5%)*	14,146 *(-40%)*	19,124 *(+2%)*	99,200 *(-8%)*

Sensitivity tests (1/2)

Sensitivity to the thresholds to start considering noise exposure

- A major factor in the sensitivity of the results
- Especially for air traffic noise and rail traffic noise

→Using EU directive thresholds leads to a very significant underestimation of the health impacts of air traffic noise (-59%) and rail traffic noise (-32%) and a more moderate underestimate for road noise (-12%). Overall, the underestimation is of the order of -24%

→There is less difference between the two other methods

Thresholds	DALY			
	Road	Rail	Air	Total
45 dBA Lden and 40 dBA Ln (method used in the study)	65,930	14,146	19,124	99,200
WHO recommendation values	61,556 *(-7%)*	11,106 *(-21%)*	19,124 -	91,787 *(-7%)*
EU directive thresholds (55 dBA Lden and 50 dBA Ln)	58,159 *(-12%)*	9,557 *(-32%)*	7,817 *(-59%)*	75,533 *(-24%)*

Sensitivity tests (2/2)

Sensitivity to the level of precision considering noise exposure

We compared two methods and made the calculations for two types of thresholds:

- The precise method used by Bruitparif which assigns each inhabitant to a noise level with dBA precision before applying the ERF
- The approximate method which is proposed in France for calculating health impacts as requested by the Commission directive 2020/367 of 4 March 2020 amending Annex III to END: affects populations in 5 dBA wide noise bands before applying the ERF using the center of each noise band for calculation (example: 62.5 dBA for the 60-65 dBA noise band)

Thresholds	Level of precision	DALY			
		Road	Rail	Air	Total
45 dBA Lden and 40 dBA Ln	Precise method	65,930	14,146	19,124	99,200
	Approximate method	66,325 *(+0.6%)*	14,308 *(+1%)*	20,586 *(7%)*	101,220 *(+2%)*

If we consider exposures from 45 dBA Lden and 40dBA Ln, the level of precision of exposure data has relatively little influence (+2%) on the DALY results.

Thresholds	Level of precision	DALY			
		Road	Rail	Air	Total
EU directive thresholds 55 dBA Lden and 45 dBA Ln	Precise method	58,159	9,557	7,817	75,533
	Approximate method	52,041 *(-11%)*	8,590 *(-10%)*	6,336 *(-19%)*	66,967 *(-11%)*

If we consider exposure data only from the END thresholds, the level of precision has a significant influence. The approximate method leads to a underestimation of the health impact for the three types of transport in a range from -10% to -19%.

Conclusion

- With nearly **100,000 DALY/year** and **9.4 months lost over a lifetime in average**, **noise is the second-highest cause of morbidity** among environmental risk factors in the dense area of the Ile-de-France region, behind atmospheric pollution.
- **Strong variations within the territory are observed** with the individual health risk reaching three healthy life-years lost in areas suffering from cumulative exposure to air traffic noise and other sources of transport (road or rail).
- The sensitivity tests call for **starting considering noise exposure far below the END thresholds**, especially for air and rail traffic noise and for **aiming the best possible precision in noise exposure assessments**.
- A useful study for **prioritising noise abatement issues**, in the context of drawing up 4th round END action plans.

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Thanks a lot!

Any questions?

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