Effects of the national radon action plan on radon risk mapping in Belgium

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Legal requirements after implementation of 2013/59/Euratom (BSS) in the Royal Decree on 29/08/2020

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- Article 54: radon in workplaces
  - member states shall require … radon measurements … in workplaces within the areas identified in accordance with Article 103(3)
  - In specific workplaces identified in the NRAP
- Article 103: national radon action plan
  - Develop an NRAP according to annex XVIII
  - Prevention in new buildings
  - Identify areas where the radon concentration in a *significant* number of buildings is expected to exceed the relevant national reference level
- Annex XVIII: content of the NRAP
  - surveys, mapping, identify workplaces, set reference levels, responsibilities of actors, reduce radon in dwellings, remediations, prevention,…
  - Schedules for reviews of the action plan
  - …


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Contents

II *Non-legislative acts*

DIRECTIVES

★ Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom 1

The Belgian NRAP

Belgian National Radon Action Plan 2020-2025

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- Covers a period of 6 years
- Covers all the topics listed in annex XVIII of the BSS
- Specifies the review of the NRAP after each 6-years period

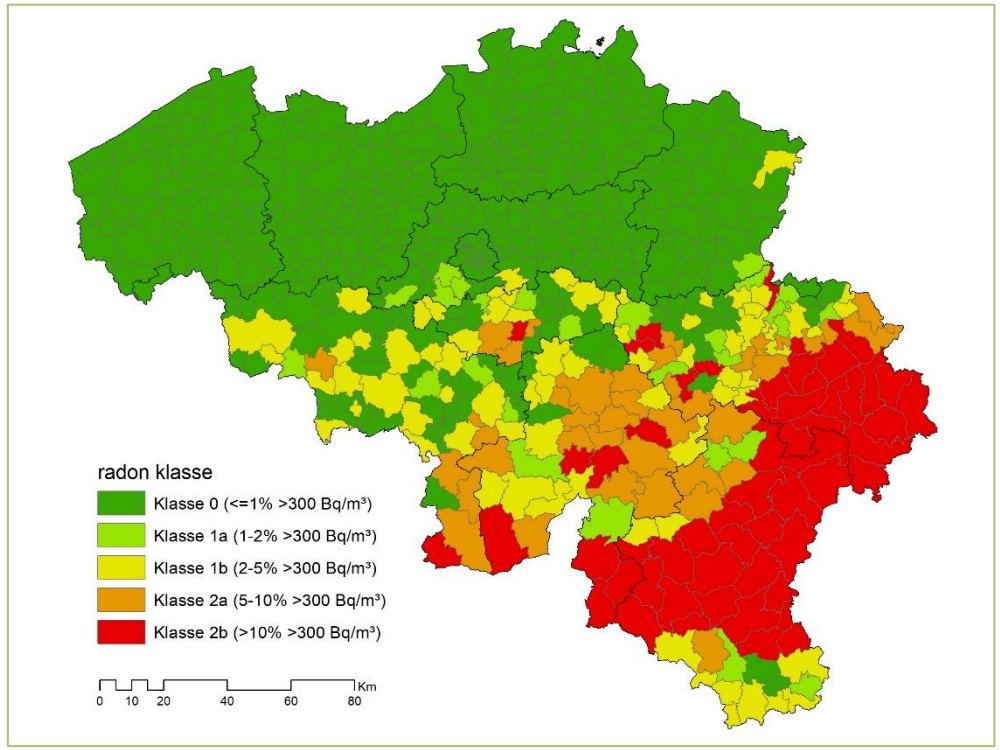
Important aspects for this presentation:

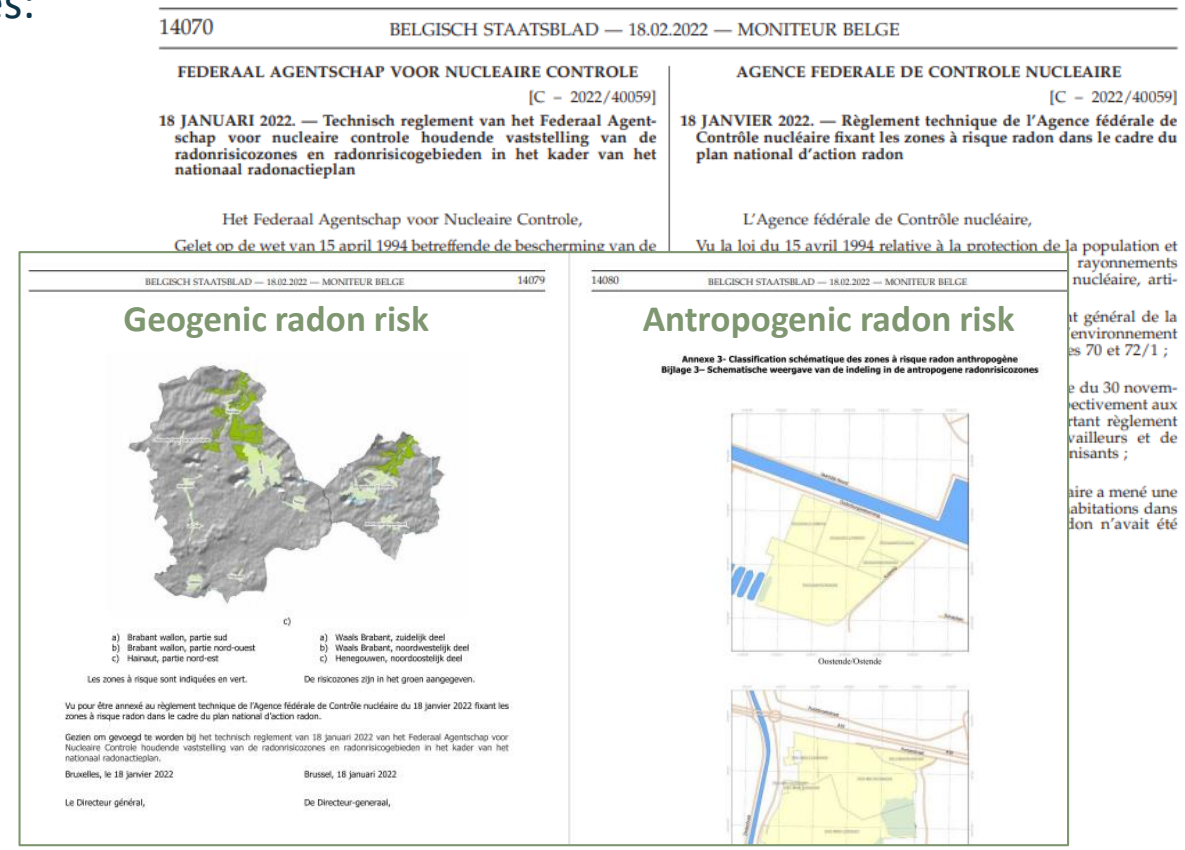
➔ Annual surveys (measurement campaigns)
➔ Mapping of radon risk

2021-09-22-belgian-national-radon-action-plan-2020-2025-en-v2.pdf

Mapping radon

FANC Decree classification of the territory in radon classes:





14070 BELGISCH STAATSBLAD — 18.02.2022 — MONITEUR BELGE

FEDERAAL AGENTSCHAP VOOR NUCLEAIRE CONTROLE

[C − 2022/40059]

18 JANUARI 2022. — Technisch reglement van het Federaal Agentschap voor nucleaire controle houdende vaststelling van de radonrisicozones en radonrisicogebieden in het kader van het nationaal radonactieplan

Het Federaal Agentschap voor Nucleaire Controle,

Gelet op de wet van 15 april 1994 betreffende de bescherming van de

AGENCE FEDERALE DE CONTROLE NUCLEAIRE

[C − 2022/40059]

18 JANVIER 2022. — Règlement technique de l'Agence fédérale de Contrôle nucléaire fixant les zones à risque radon dans le cadre du plan national d'action radon

L'Agence fédérale de Contrôle nucléaire,

Vu la loi du 15 avril 1994 relative à la protection de la population et

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Geogenic radon risk

c)

a) Brabant wallon, partie sud
b) Brabant wallon, partie nord-ouest
c) Hainaut, partie nord-est

a) Waals Brabant, zuidelijk deel
b) Waals Brabant, noordwestelijk deel
c) Henegouwen, noordoostelijk deel

Les zones à risque sont indiquées en vert.

De risicozones zijn in het groen aangegeven.

Vu pour être annexé au règlement technique de l'Agence fédérale de Contrôle nucléaire du 18 janvier 2022 fixant les zones à risque radon dans le cadre du plan national d'action radon.

Gezien om gevoegd te worden bij het technisch reglement van 18 januari 2022 van het Federaal Agentschap voor Nucleaire Controle houdende vaststelling van de radonrisicozones en radonrisicogebieden in het kader van het nationaal radonactieplan.

Bruxelles, le 18 janvier 2022

Brussel, 18 januari 2022

Le Directeur général,

De Directeur-generaal,

14080 BELGISCH STAATSBLAD — 18.02.2022 — MONITEUR BELGE

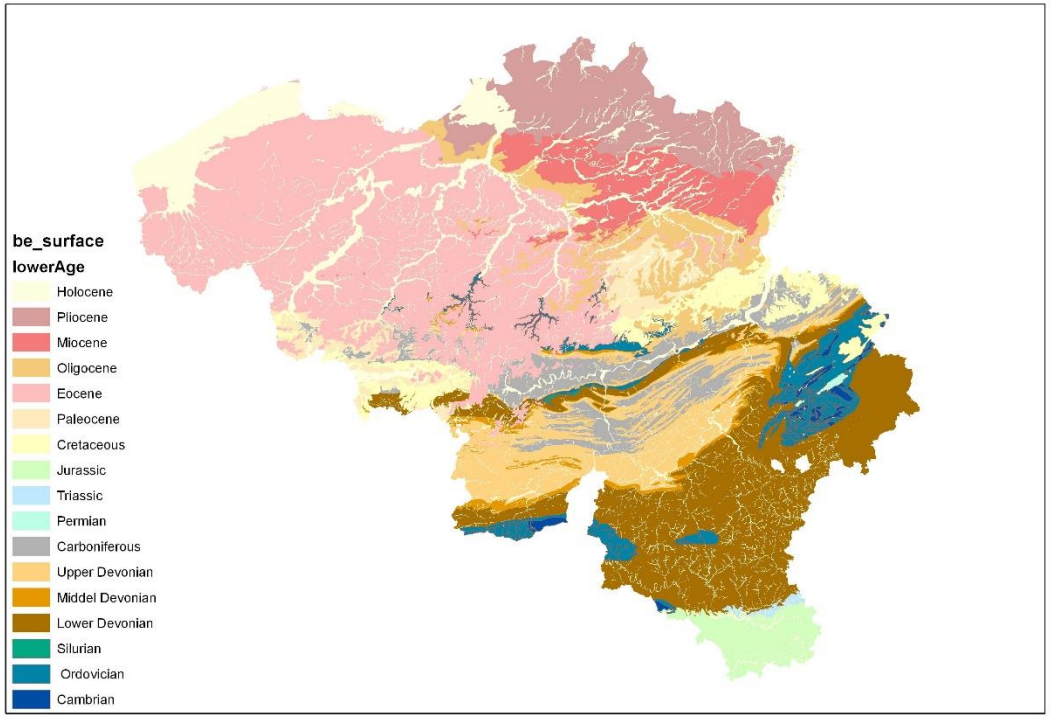
Antropogenic radon risk

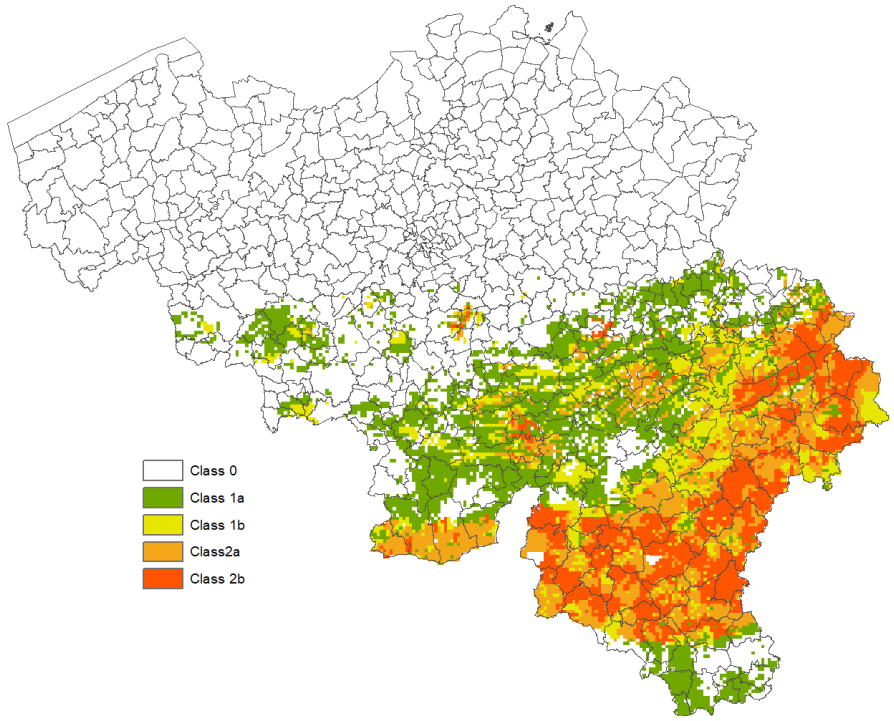
Annexe 3- Classification schématique des zones à risque radon anthropogène
Bijlage 3– Schematische weergave van de indeling in de antropogene radonrisicozones

Oostende/Ostende

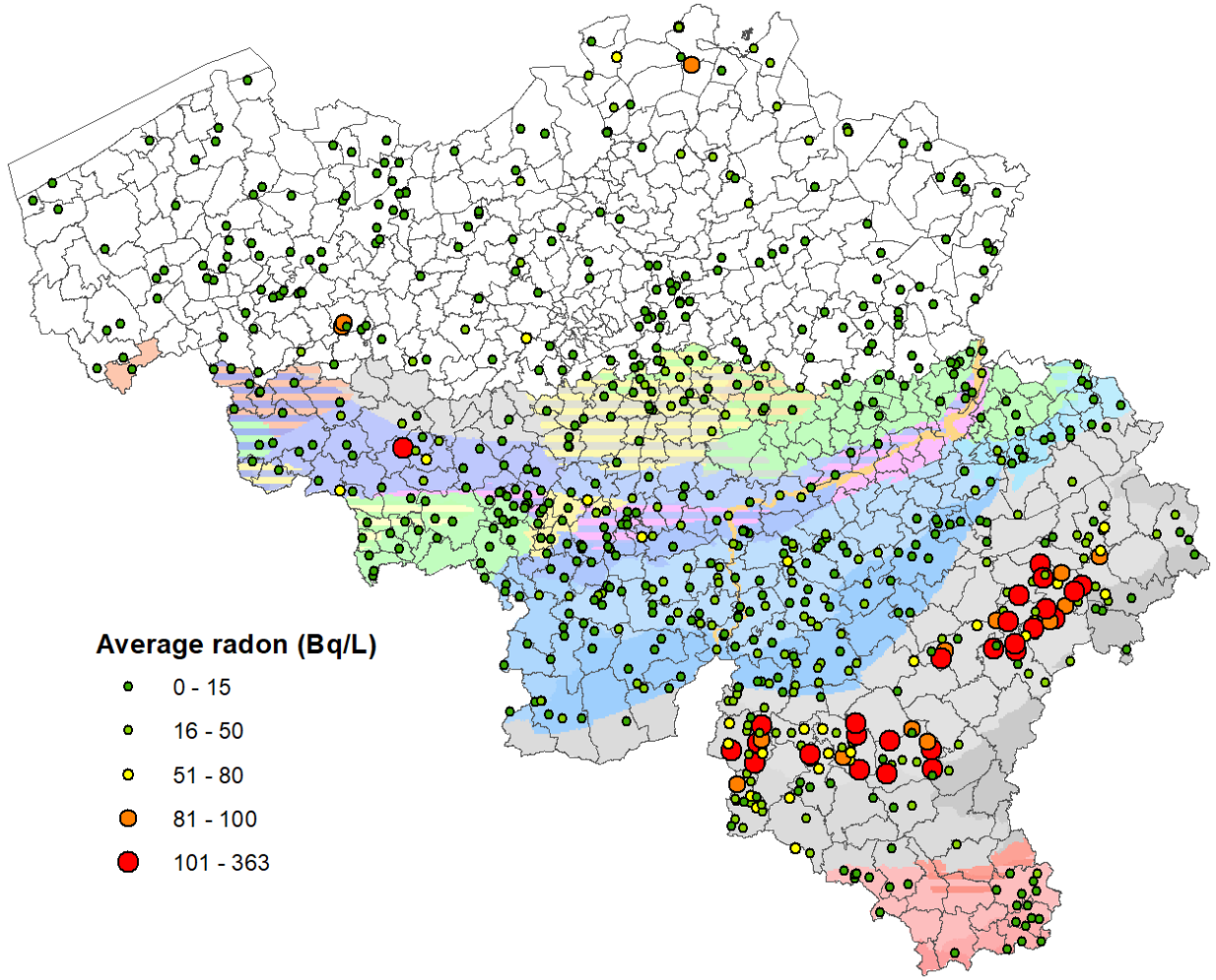
- Based on ~40000 indoor ground floor measurements of single-family houses (excluding flats) = conservative statistics
- Legislative purposes:
  - radon class 2 (>5% dwellings > AL (300 Bq/m³) radon measurements in workplaces mandatory
  - Graded approach of radon prevention

Including geological data

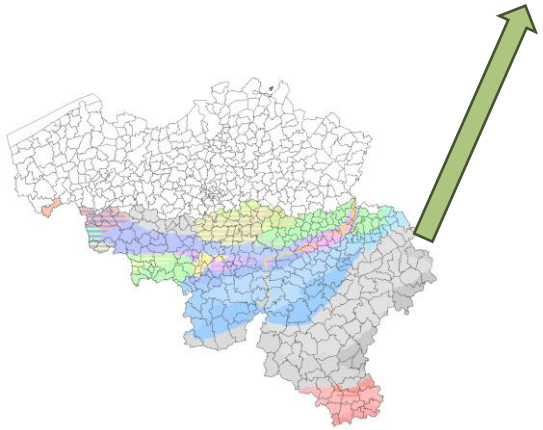


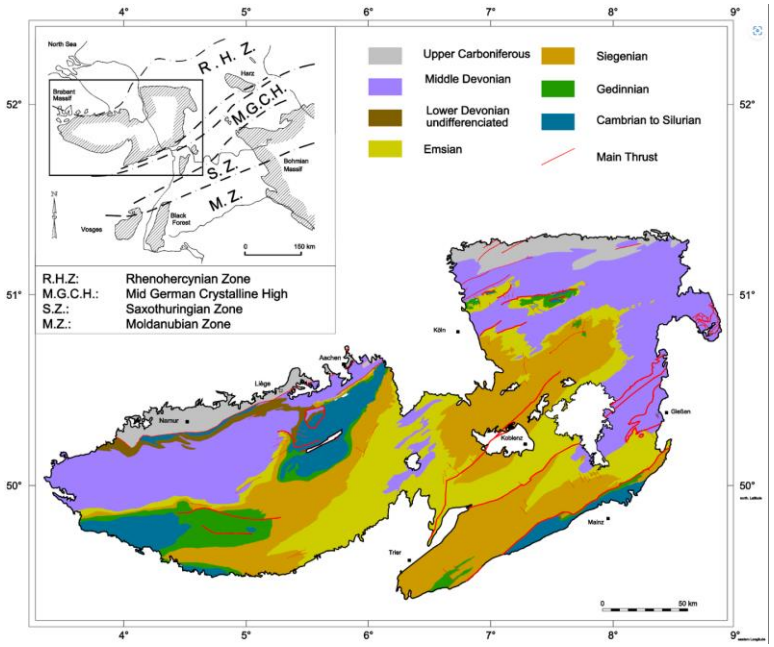


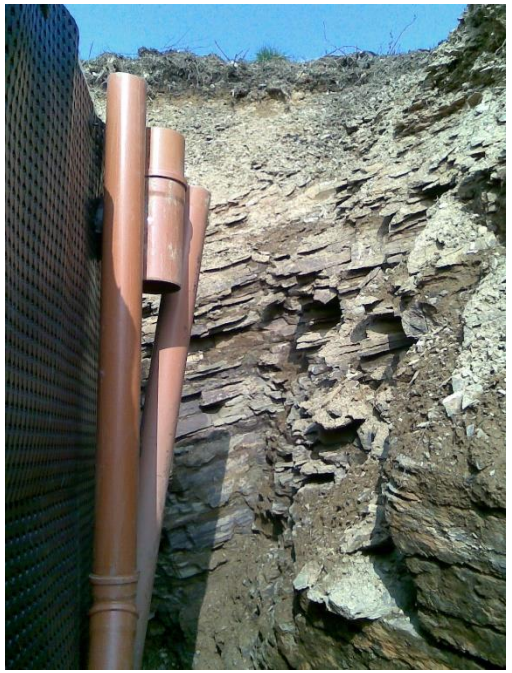
Radon in underground water



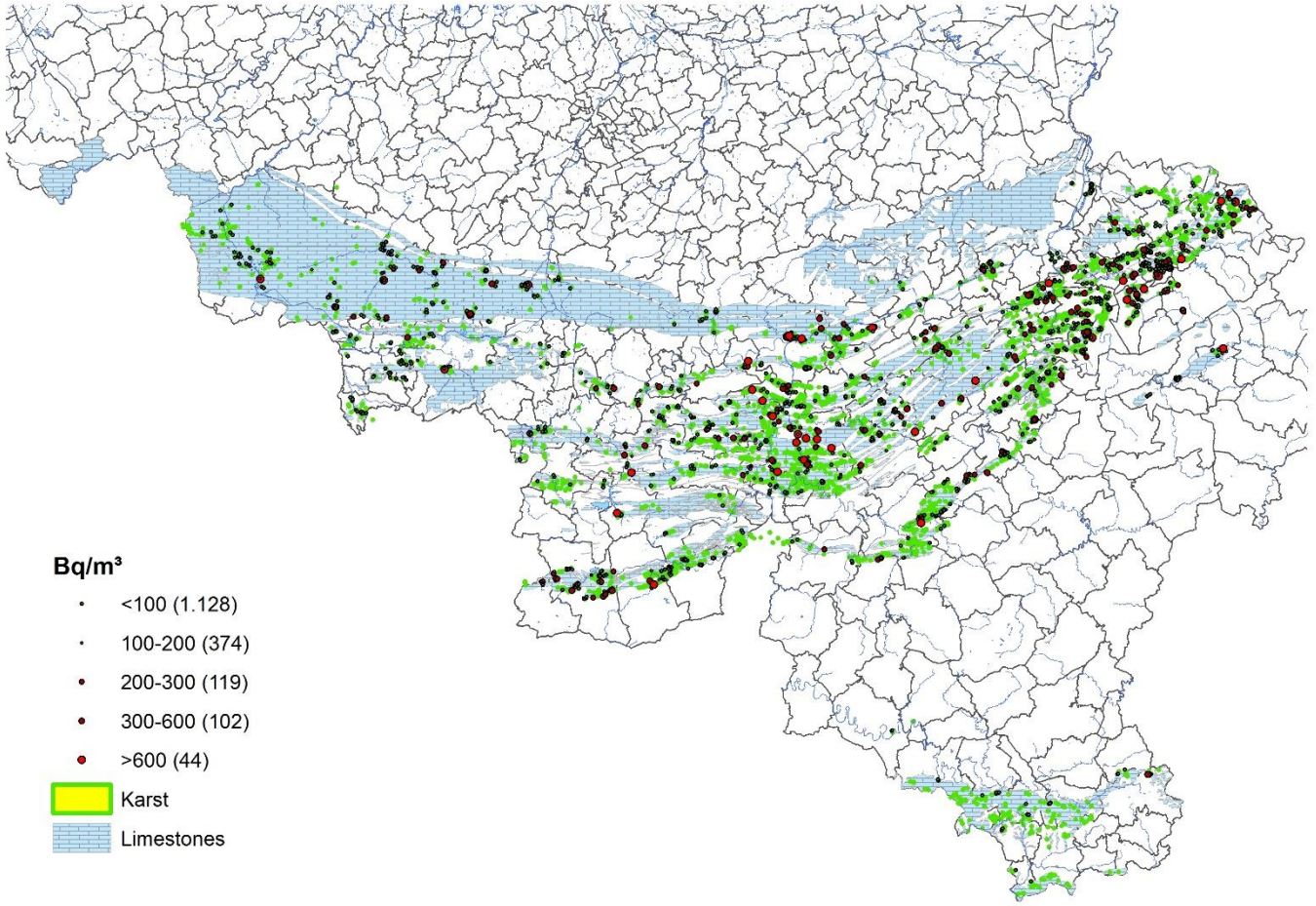
Shale and sandstone from the Ardenne (Rhenish) slate belt







Indoor radon and karst



The evaluation of the NRAP

➔ Published in august 2025

➔ To be used to ajust the next NRAP

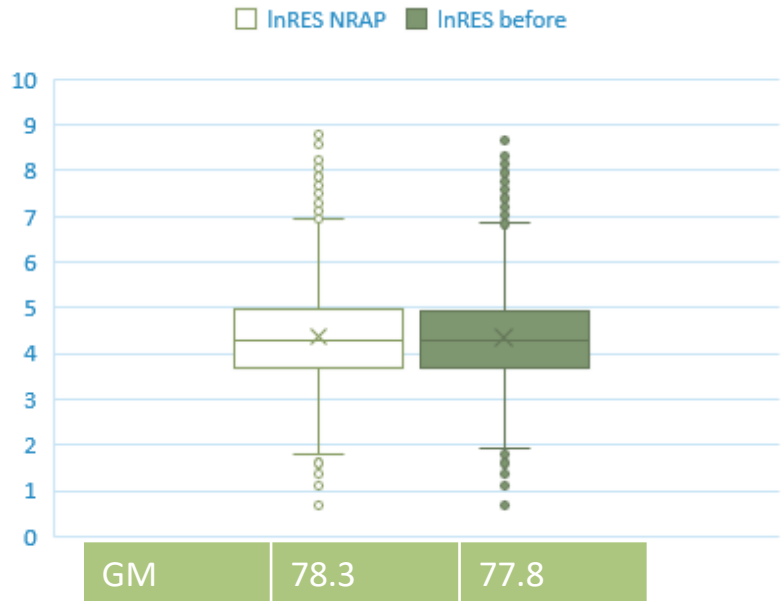
➔ Identification of 10 *indicators:*

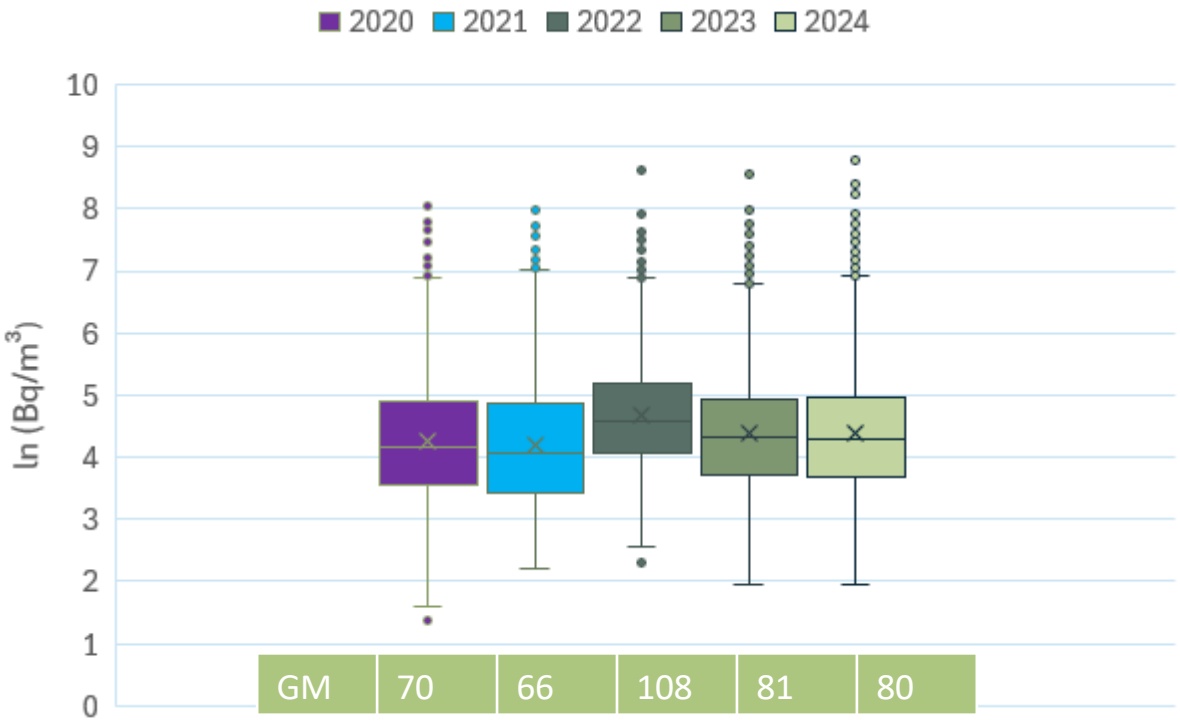
#	Indicator	Definition	Data Source	Target / Benchmark
1	Annual Radon Measurements	Number of radon tests conducted in homes and workplaces	Radonactie.be / Actionradon.be , Radonatwork.be	Approximately 3000 measurements per year with focus on Class 2 zones
2	Measurement Trend	Change in % of buildings exceeding 300 and 600 Bq/m³	FANC radon database	Downward trend in high-concentration buildings
3	Remediating Actions Reported	Number of corrective measures taken in response to high radon levels	FANC reports, self-reporting	Increase over the NRAP periods
4	Effectiveness of Remediation	% reduction in post-remediation radon levels	Follow-up measurements	≥80% achieve safe levels (< 300 Bq/m³)
5	Inspection Findings	% of inspected workplaces complying with standards	FANC workplace inspection reports	>90% compliance
6	Preventive Effectiveness in New Builds	% of new buildings with radon below 100 Bq/m³	Study by FANC	>90% compliance
7	Public Awareness Metrics	Website visits, detector requests, campaign participation	FANC web analytics, campaign data	Increasing public engagement
8	Training Outputs	Number of professionals trained (e.g., architects, officials)	FANC, Buildwise, CCW training logs	1 training session per year
9	Geographic Coverage	% of high-risk municipalities covered by campaigns	FANC campaign planning	100% coverage in Class 2 municipalities in the NRAP period
10	Radon Map Updates	Frequency and quality of updates to the national radon map	FANC geodatabase (ArcGIS)	Annual updates with new geological/radon data

The evaluation of the NRAP

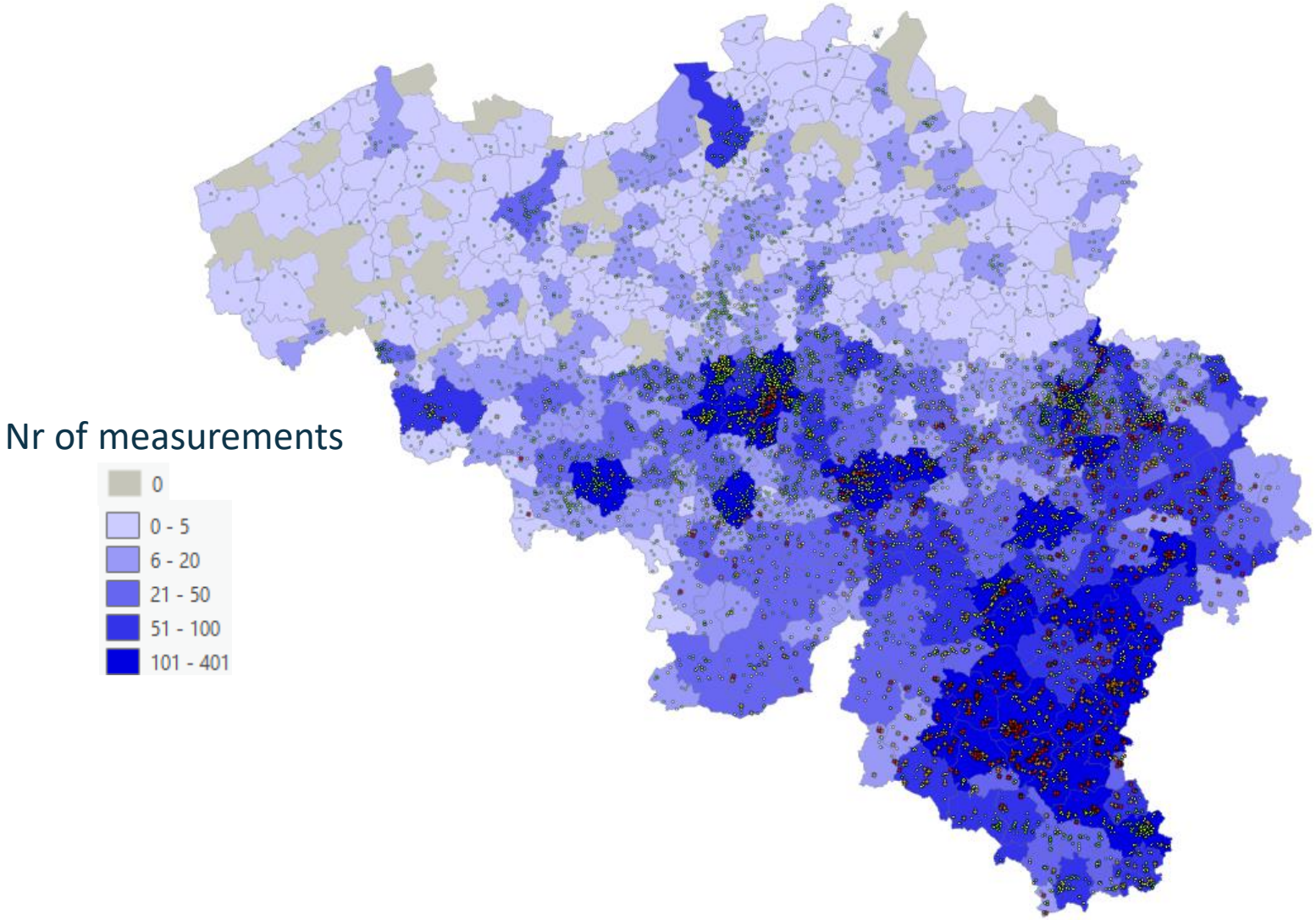
Year	# measurements	% > 300 Bq/m³	% >600 Bq/m³
AR2020	2897	9.6	3.1
AR2021	2277	10.5	3.5
AR2022	2723	10.8	3.9
AR2023	3207	9.2	2.9
AR2024	3616	9.8	2.7
TOTAL	14720	9.2	3.0

Year	# measurements	% > 300 Bq/m³	% >600 Bq/m³
NRAP	14720	9.2	3.0
BEFORE	34470	9.6	3.5

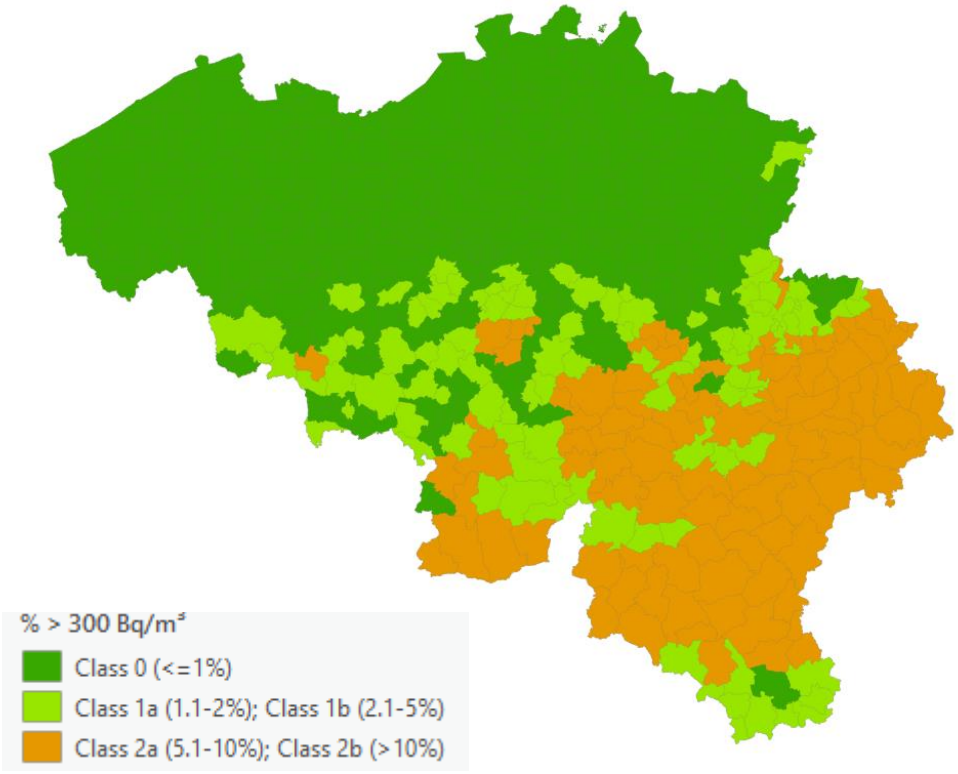


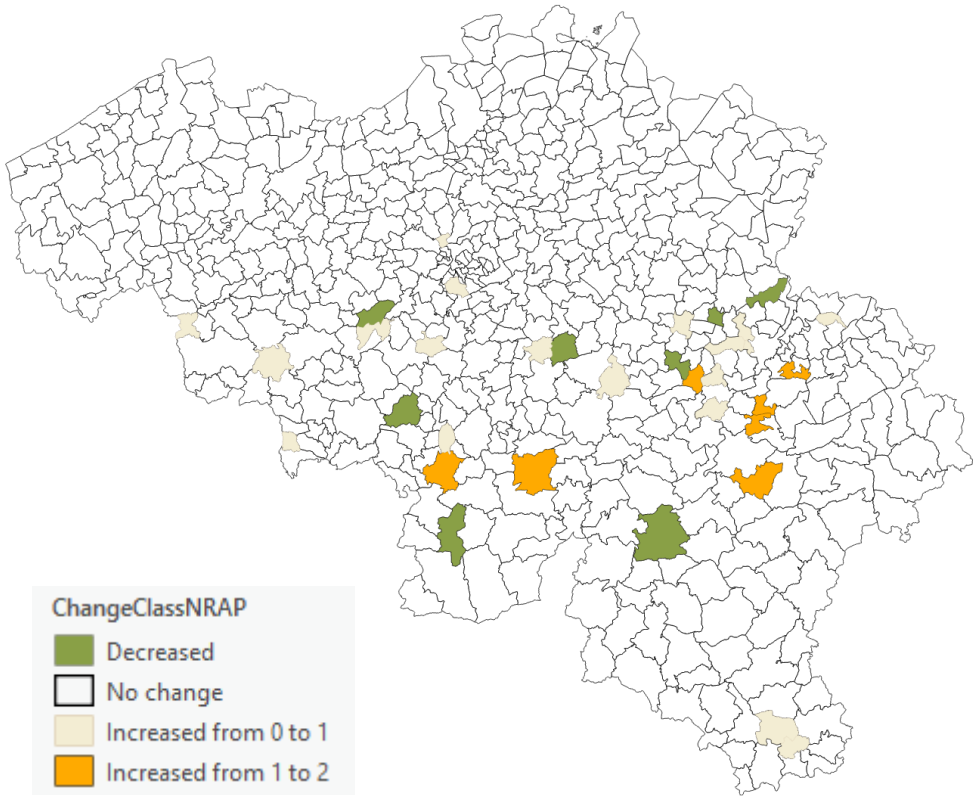


The evaluation of the NRAP

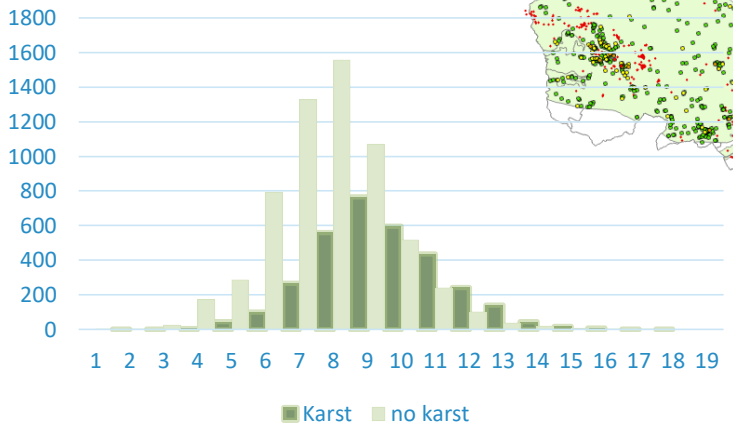


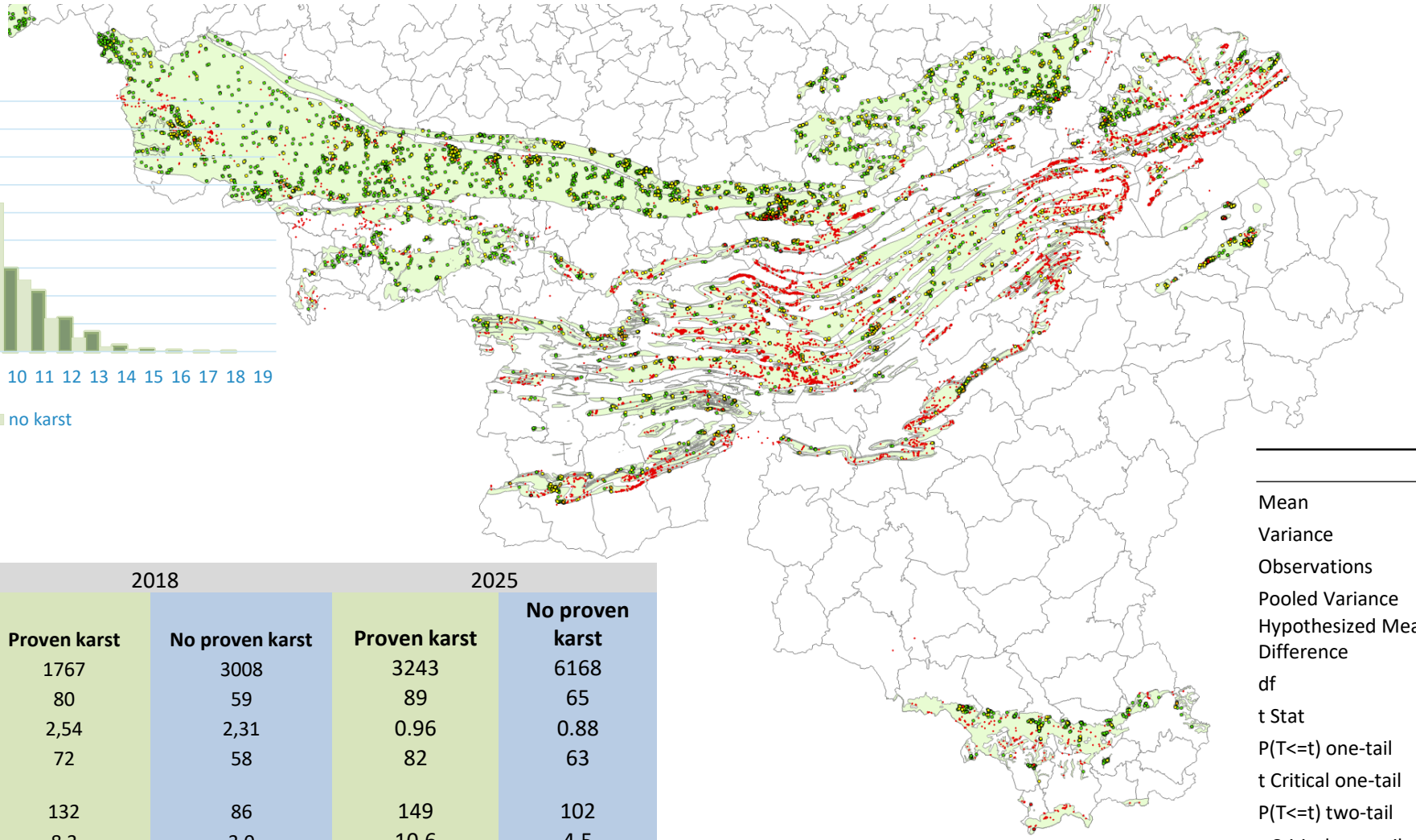
How did the new data change the existing map?





Radon and KARST





	2018		2025	
	Proven karst	**No proven karst**	**Proven karst**	**No proven karst**
count	1767	3008	3243	6168
GM (Bq/m³)	80	59	89	65
GSD	2,54	2,31	0.96	0.88
Median (Bq/m³)	72	58	82	63
Arithmetic mean (Bq/m³)	132	86	149	102
% > 300 (Bq/m³)	8,3	3,0	10.6	4.5
% > 600 (Bq/m³)	2,5	0,8	3.0	1.3

	karst	*No Karst*
Mean	4.49	4.17
Variance	0.91	0.77
Observations	3243	6168
Pooled Variance	0.82	
Hypothesized Mean Difference	0.00	
df	9409	
t Stat	16.04	
P(T<=t) one-tail	1.78E-57	
t Critical one-tail	1.65	
P(T<=t) two-tail	3.6E-57	
t Critical two-tail	1.96	

Conclusions

- The Belgian NRAP 2020-2025 has been evaluated following the EU BSS requirements
- Annual surveys are organised, leading to 14750 new measurements over the last few years
- Radon mapping is based on statistical analysis of the indoor radon measurements and geology
- The new measurements are used to improve the statistical robustness of the exiting radon maps
- Especially in areas with few measurements the new measurements improve the quality of the radon maps

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Thank you!