

ENV-167

Introduction to environmental engineering

Geographic Information Systems in environmental engineering

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Geospatial Molecular Epidemiology (GEOME) group at LGB


- Geographic Information Systems (GIS)
- Spatial analysis and spatial statistics
- Investigation of genetic and health data in the fields of population genomics and population health
- In population genomics, we participate in the development of the fields of landscape and seascape genomics
- In population health, we carry out research in spatial epidemiology and analyze the geographic dimension of health determinants – with a particular focus on health inequalities – to inform public health authorities

Program

1. Geographic Information Systems for conservation genetics
2. The role of geographic information in spatial epidemiology



Evolutionary biology



Human health, epidemiology

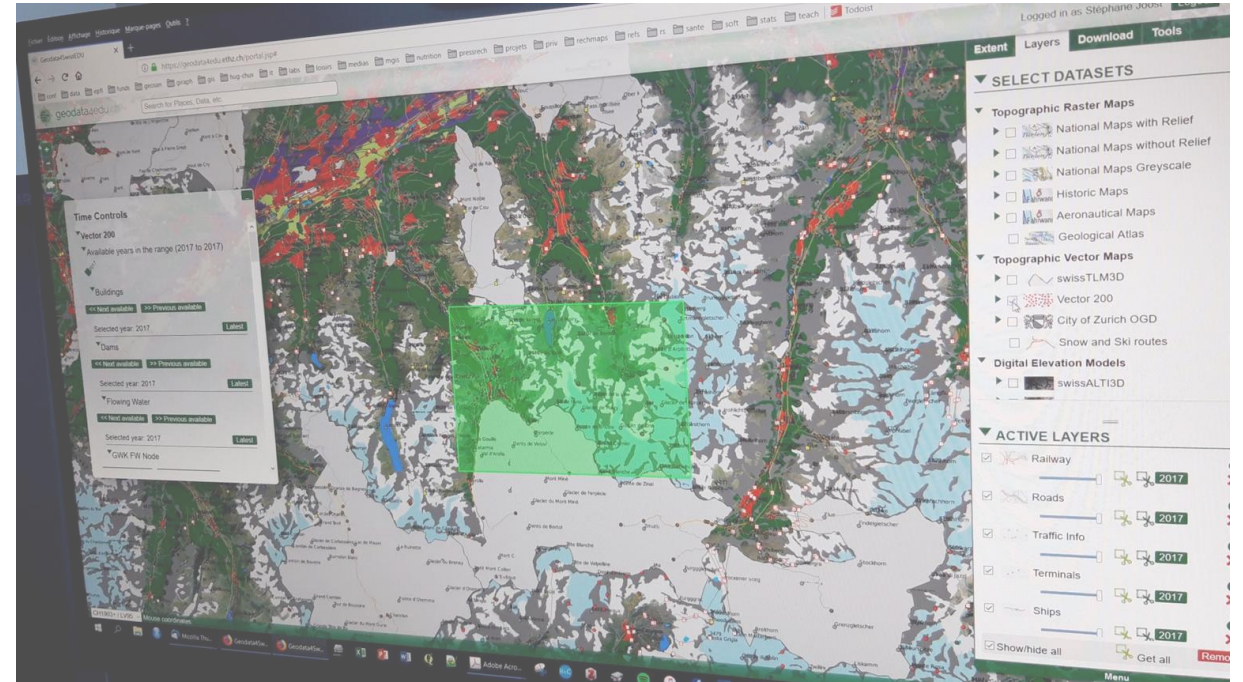
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Introduction to environmental engineering

Geographic Information Systems for conservation genetics

GIScience and Geographic Information Systems (GIS)

- Geographic Information Science (GIScience) is a scientific discipline at the crossroads of computational science, social science, and natural science
- It studies geographic information, how it represents phenomena in the real world (modeling), how it can be captured, organized, and analyzed in Geographic Information Systems (GIS)
- A GIS consists of integrated computer hardware and software that store, manage, analyze, edit, output, and visualize geographic data (lon x, lat y)
- GIS store geographic information in the two following forms
 1. Vector objects described by pairs of geographic coordinates (X,Y) and by a series of thematic attributes (vector mode)
 2. Images whose pixels have a given spatial resolution, a center described by a pair of geographic coordinates (X,Y), and a thematic attribute (raster mode)



- Geographic data are stored in a spatial database and can be visualized on a cartographic interface

GIS for biodiversity conservation

GIS are of interest to the domain of conservation biology because they can contribute to:

1. The elaboration of efficient decision-making support approaches to favor the conservation of plant/animal genetic diversity
2. The advancement of our understanding of the mechanisms controlling the evolution of species (adaptation to the local environment)

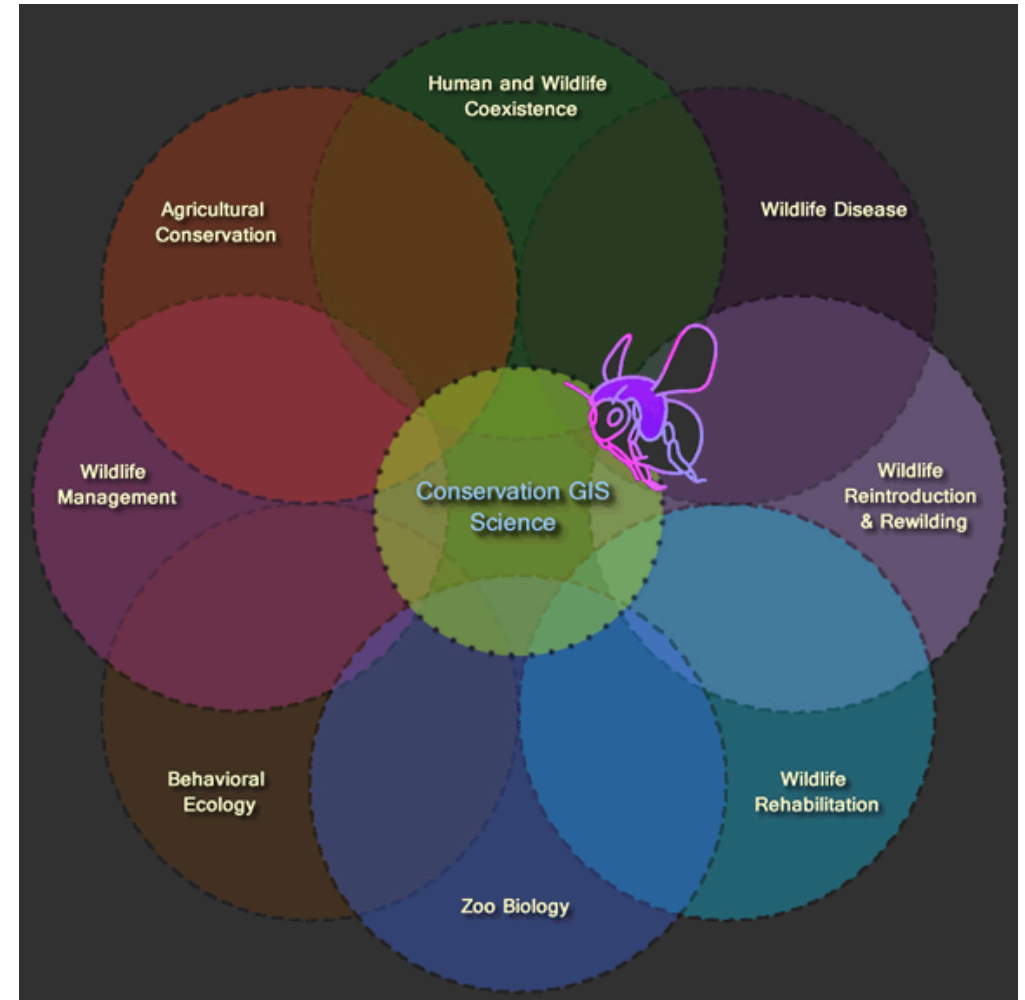
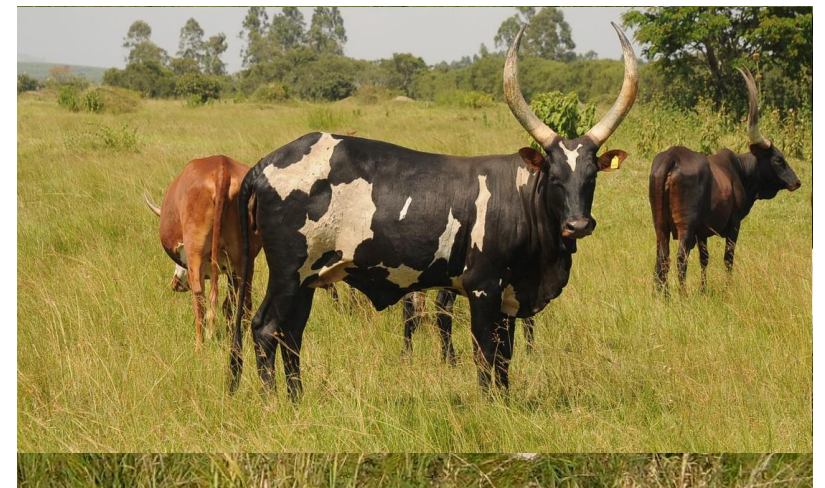


Figure: Sandoval-Green, C.M. J. «GIS as cross-pollinator»

Conservation of Farm Animal Genetic Resources (FAnGR)

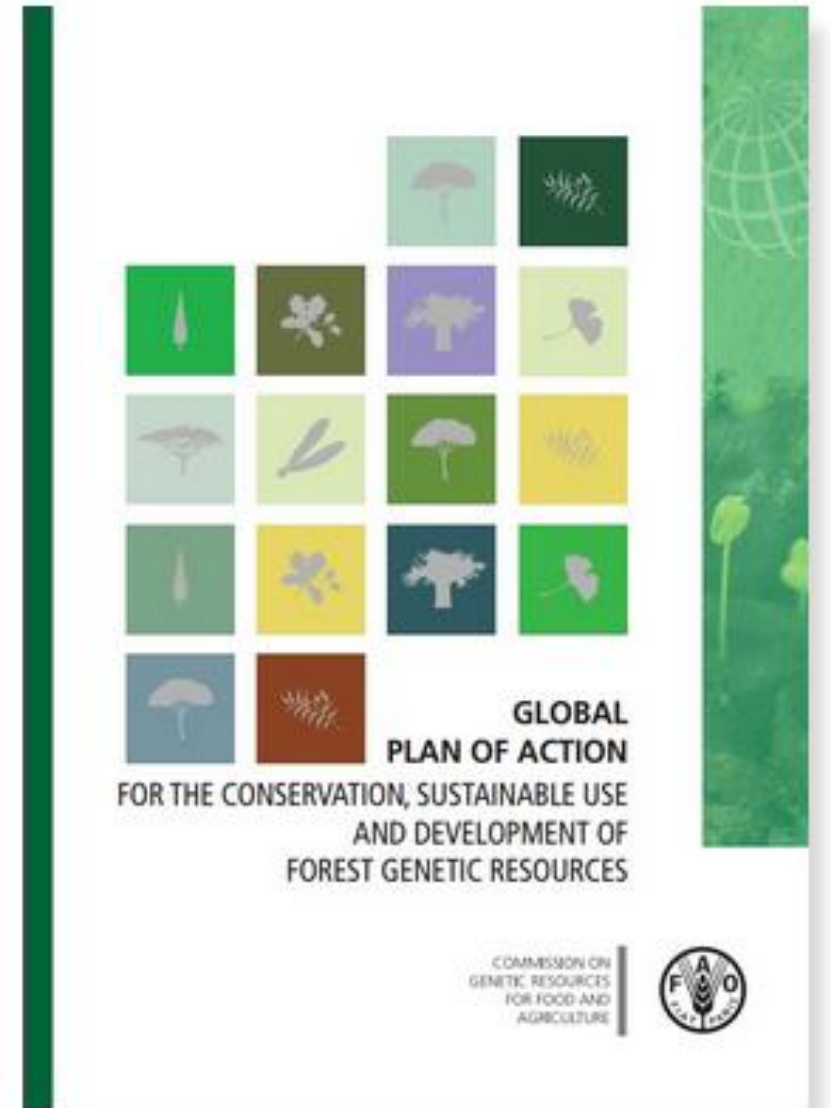
- Valuable livestock breeds possess valuable genetic resources
- Valuable breed = unique, robust, able to adapt to specific environmental conditions (hot, cold, humid, etc.)
- Valuable gene = unique gene conferring a selective advantage (e.g. disease resistance, adaptation to cold)
- For productivity purposes, breeders tend to choose highly productive breeds, that are not adapted to local conditions
- Crossbreeding of locally adapted animals with highly productive imported ones that cannot cope with local harsh environmental conditions and diseases
- The original breed is **endangered** – biodiversity loss
- Socio-economic issues for the breeders (lose their livelihood, join slums in urban areas)
- Food security, social and biodiversity conservation related issue



FAnGR monitoring

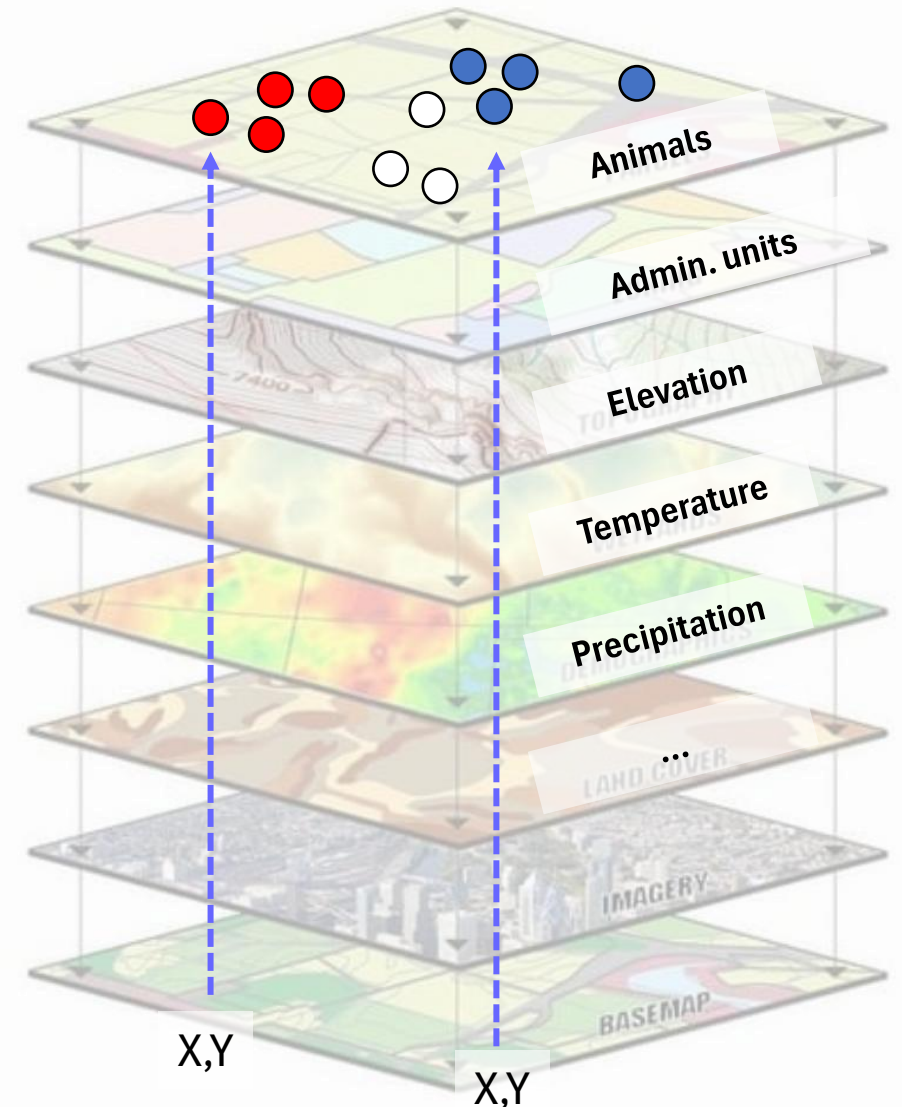
Food and Agriculture Organization (FAO), United Nations

- Since 2007 (Interlaken Conference), FAO's Global plan of action requires member countries to monitor their FAnGR
- In 2016, 17% (1,458) of the world's farm animal breeds were at risk of extinction
- The risk status of many others (58%) was simply unknown due to a lack of data
- 100 livestock breeds have gone extinct between 2000 and 2014
- **Management and conservation of livestock genetic resources** is key: it implies breed prioritization and decision making
- Decision making rests on the simultaneous analysis of several criteria to identify breeds to conserve and to favor sustainable breeding conditions
- Which breeds to prioritize ? How much funds allocated?
- Need for georeferenced data from different fields



Data categories

1. **Genetics** - Population and evolutionary genetics
2. **Animal husbandry** practices
3. **Socio-economics** and **socio-demographics** in the regions where animals are bred
4. **Natural environment**: climatic and geophysical characteristics of the places where animals are bred
5. **Political and administrative boundaries**: geographical units where policies must be applied

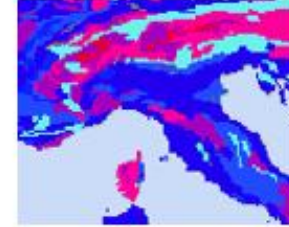


GIS and data integration



Administrative boundaries
Socio-Economic data
Socio-demographic data

Environmental data:
topography, climate,
soil, etc.



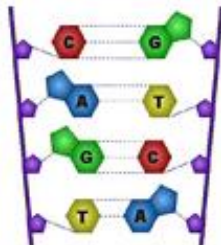
Geographic coordinates
X, Y



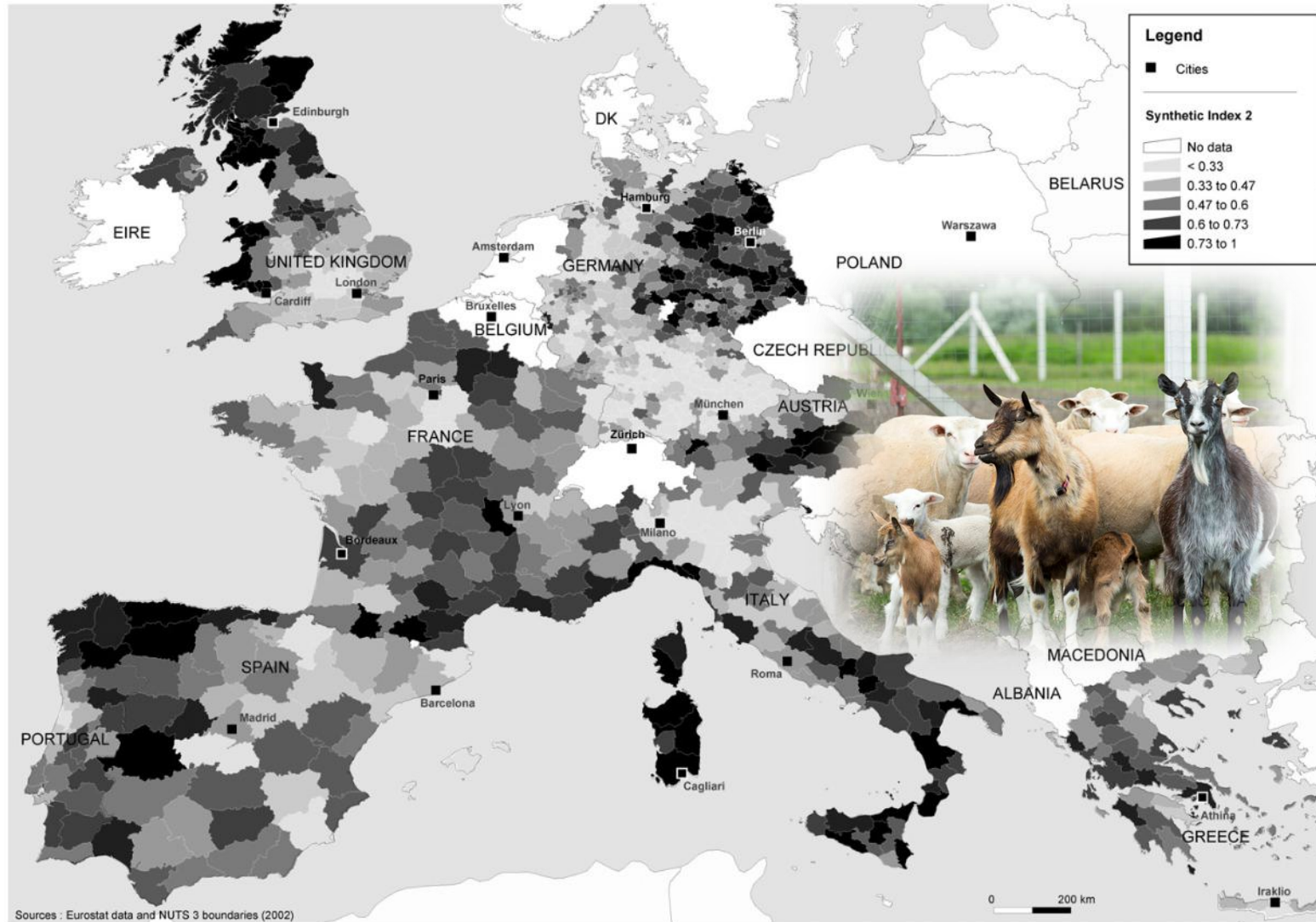
Sampling
Genetic data

GIS

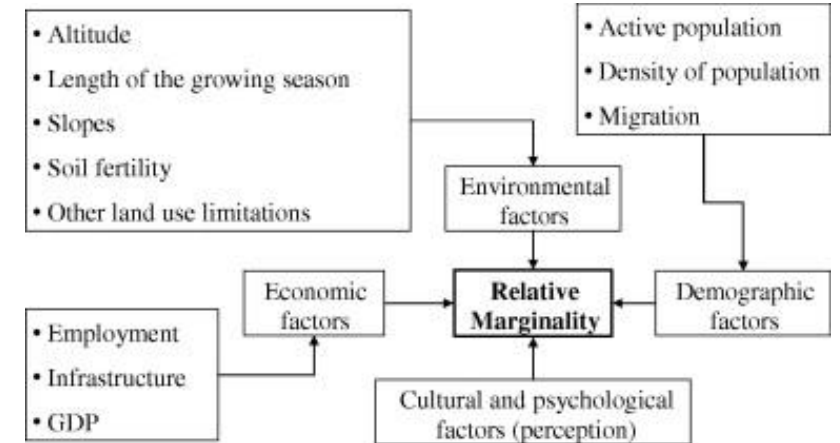
Questionnaires
Husbandry practices



Decision-making – Conservation of locally adapted small ruminants



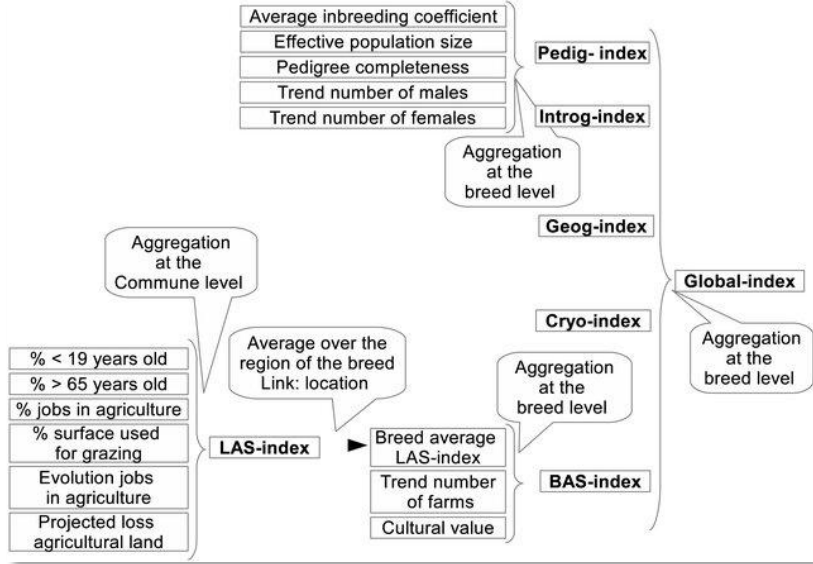
- European project on small ruminants
- Well adapted to marginal areas
- Economic importance
- Marginal area = where land uses are limited because of higher altitude, shorter growing season, steeper slopes, less fertile soils



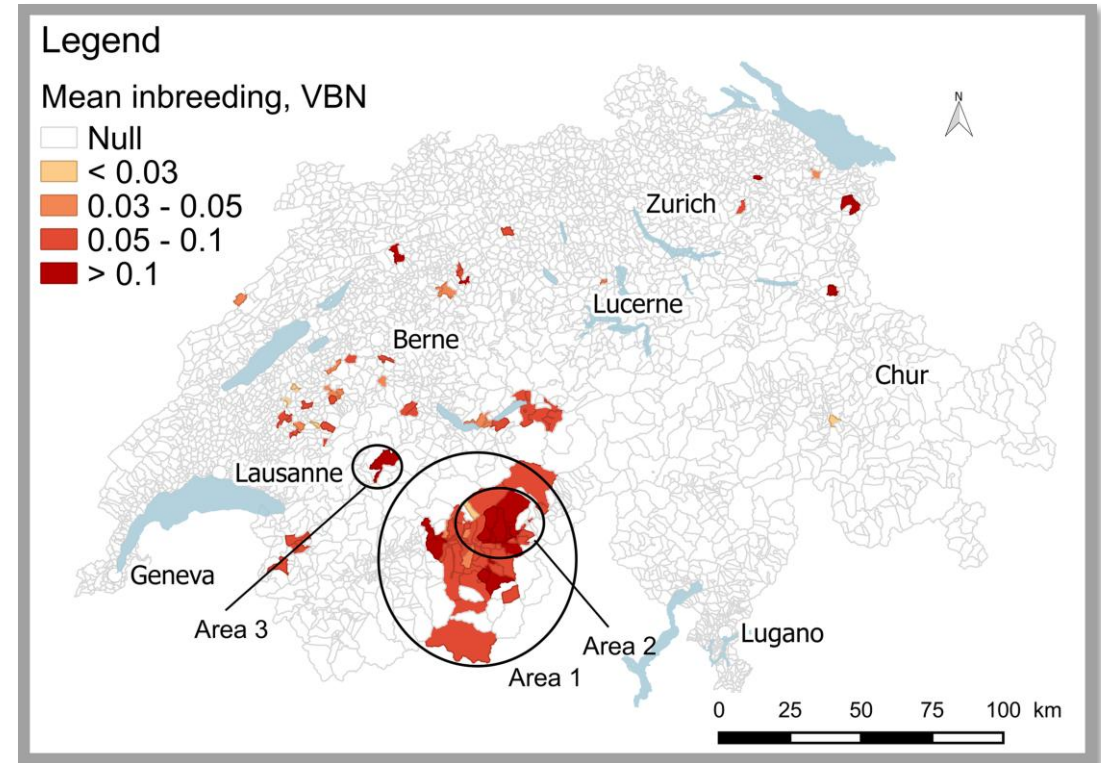
Monitoring of FAnGR

- The status of animal genetic resources is measured through a set of indicators relying on information collected through the **FAO Domestic Animal Diversity Information System (DAD-IS)**
- Information is compiled by FAO into status and trends of animal genetic resources reports (worldwide), which are produced every two years
- But countries have to develop their own system

Genmon – A WebGIS platform for the monitoring of FAnGR in CH

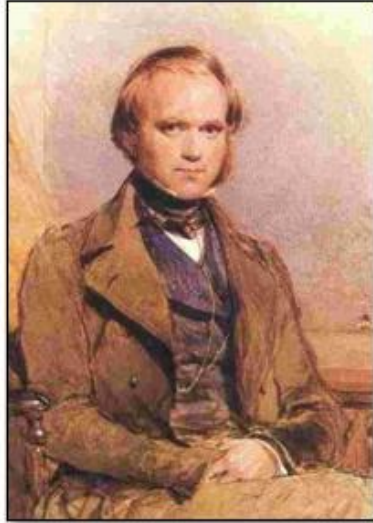


GIS-based Multi-Criteria Decision Analysis (MCDA) approach to support the aggregation of multi-thematic indices

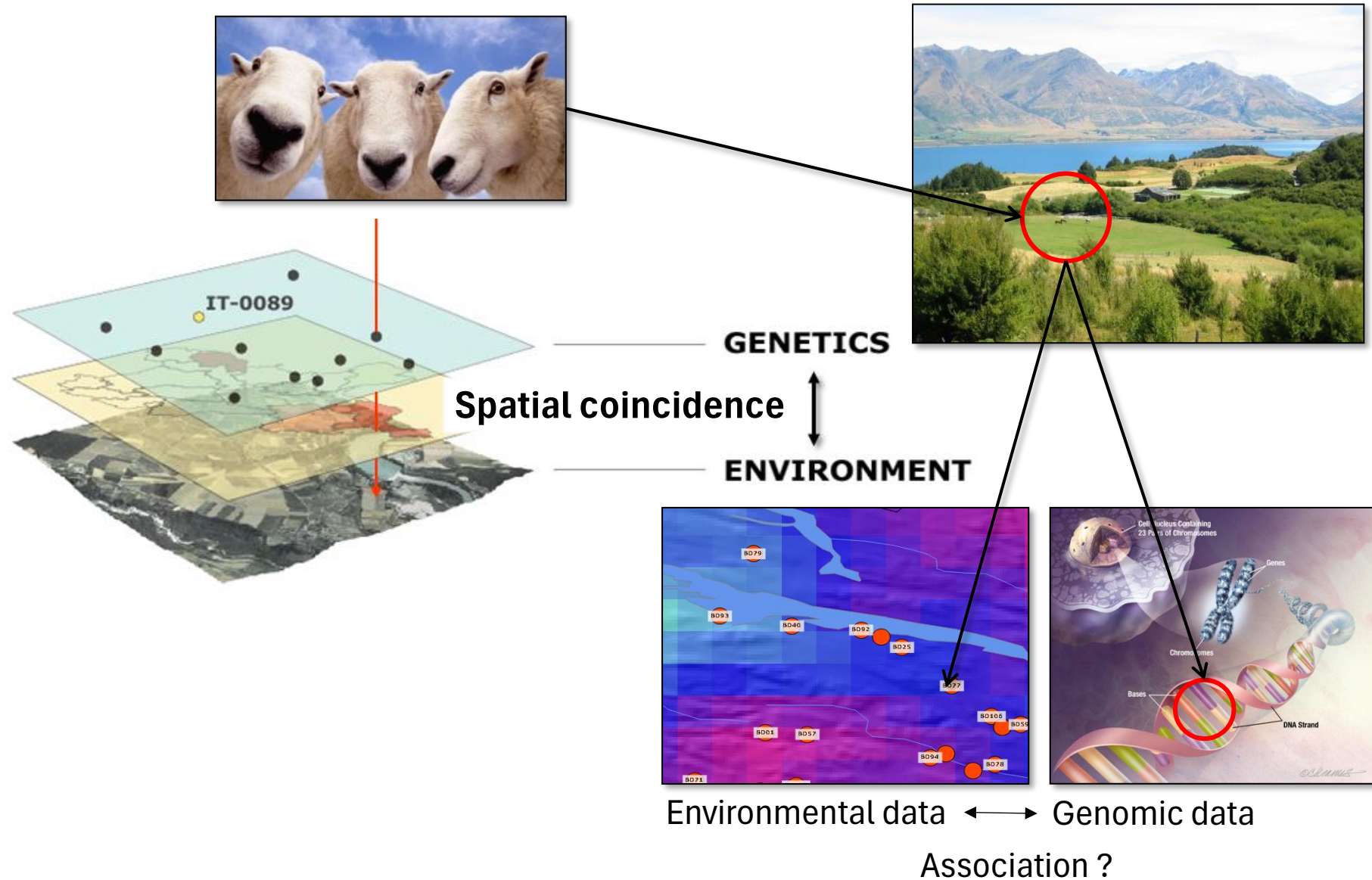


Breed Name	# Animals Last GI	Mean F Last GI	Ne Range	Pedigree complete ness	Trend males Last 5 yr	Trend females Last 5 yr	Pedig-Index	Intro-Index	Geog-Index	BAS-Index	Cryo-Index	Global index
VBN	34,291	0.101										0.43
FM	26,877	0.067	50-70	99.7	-2.4	-2.1	0.41	0.12	57.6	0.64	0.5	0.51
SIM	18,301	0.031	50-70	85.6	+54	+5	0.5	0.005	86.8	0.54	0.5	0.66
OBV	50,632	0.036	70-500	99.5	+2.5	+4.6	0.66	0	58.3	0.59	1	0.78

Understanding of mechanisms controlling the evolution of species

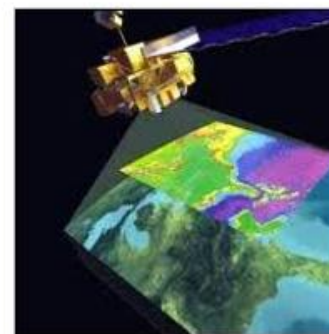
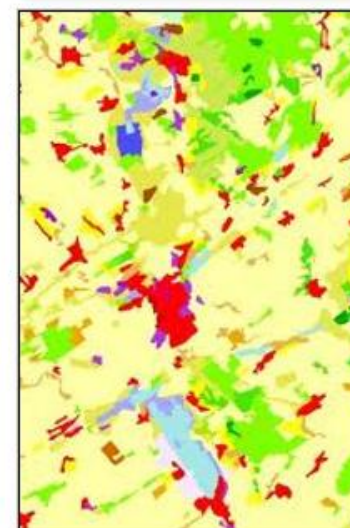
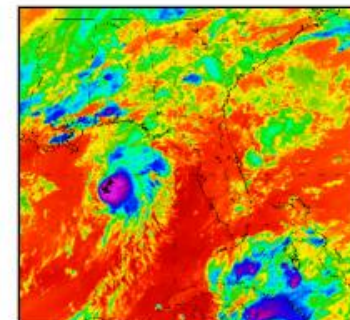


Landscape genomics



Environmental data

GEO			GENETICS													ENVIRONMENT							
1	farmid	animalid	OARJMP29_allele2_137	OARJMP29_allele2_139	OARJMP29_allele2_141	OARJMP29_allele2_143	OARJMP29_allele2_145	OARJMP29_allele2_147	OARJMP29_allele2_149	OARJMP29_allele2_151	OARJMP29_allele2_153	OARJMP29_allele2_155	OARJMP29_allele2_157	OARJMP29_allele2_159	OARJMP29_allele2_161	OARJMP29_allele2_163	OARJMP29_allele2_165	OARJMP29_allele2_167	wndjan	altitude	wndfeb	wndmar	wndapr
1044	PL-4005	OAPLPOM25	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.1	22	4.6	5	4.4
1045	PL-4005	OAPLPOM26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.1	22	4.6	5	4.4
1046	PL-4006	OAPLPOM01	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	5.3	153	4.8	4.9	4.3
1047	PL-4006	OAPLPOM15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.3	153	4.8	4.9	4.3
1048	PL-4006	OAPLPOM24	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	5.3	153	4.8	4.9	4.3
1049	PL-4007	OAPLPOM05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.3	250	4.8	5	4.5
1050	PL-4007	OAPLPOM16	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	5.3	250	4.8	5	4.5
1051	PL-4008	OAPLPOM09	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	5.2	166	4.8	5	4.4
1052	PL-4008	OAPLPOM19	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.2	166	4.8	5	4.4
1053	PL-4008	OAPLPOM20	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	5.2	166	4.8	5	4.4
1054	PL-4009	OAPLPOM10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.5	87	5	5.2	4.6
1055	PL-4009	OAPLPOM21	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.5	87	5	5.2	4.6
1056	PL-4010	OAPLPOM08	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	5.4	208	4.9	5.1	4.5

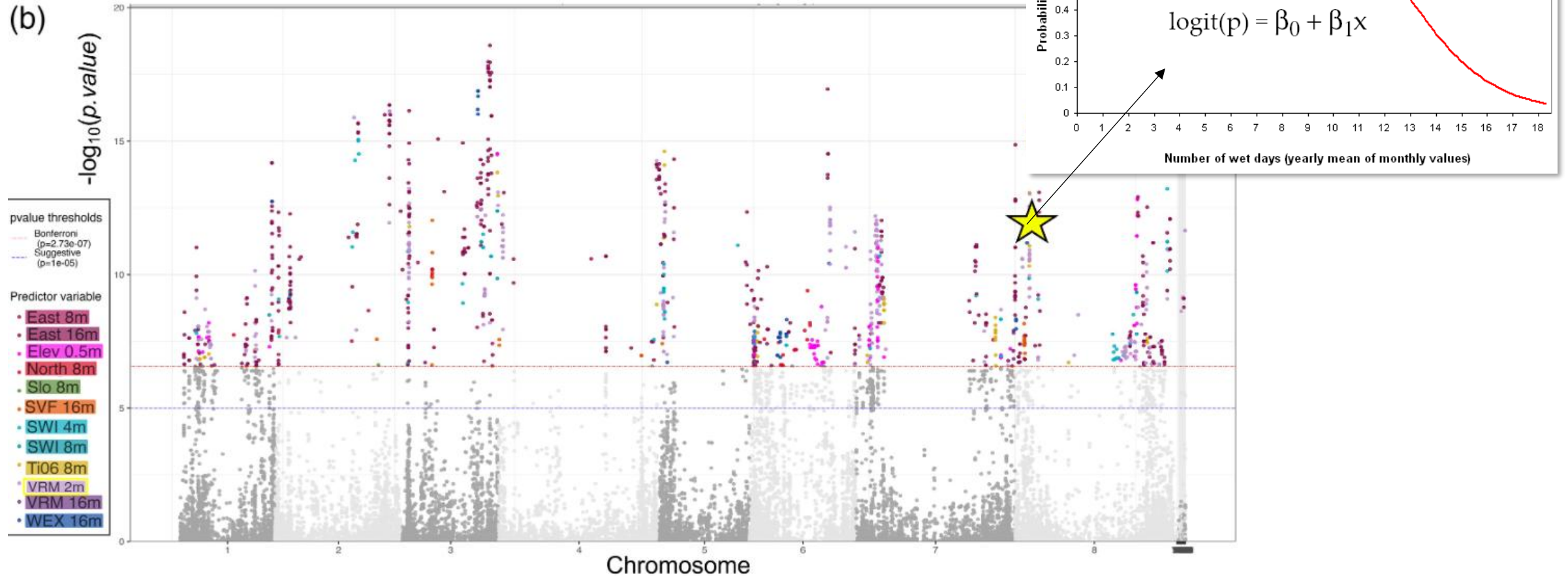


Association models – correlative approach

Individuals			Genetic data														Environmental variables						
1	farmid	animalid	OARJMP29_allele2_137	OARJMP29_allele2_139	OARJMP29_allele2_141	OARJMP29_allele2_14	OARJMP29_allele2_14	OARJMP29_allele2_14	OARJMP29_allele2_14	OARJMP29_allele2_15	OARJMP29_allele2_15	OARJMP29_allele2_15	OARJMP29_allele2_15	OARJMP29_allele2_15	OARJMP29_allele2_16	OARJMP29_allele2_16	OARJMP29_allele2_165	OARJMP29_allele2_16	wndjan	altitude	wndfeb	wndmar	wndapr
1044	PL-4005	OAPLPOM25	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.1	22	4.6	5	4.4
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1051	PL-4008	OAPLPOM09	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	5.2	166	4.8	5	4.4
1052	PL-4008	OAPLPOM19	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.2	166	4.8	5	4.4
1053	PL-4008	OAPLPOM20	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	5.2	166	4.8	5	4.4
1054	PL-4009	OAPLPOM10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.5	87	5	5.2	4.6
1055	PL-4009	OAPLPOM21	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.5	87	5	5.2	4.6
1056	PL-4010	OAPLPOM08	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	5.4	208	4.9	5.1	4.5

- Multiple parallel **logistic regressions** (Joost et al. 2007): MatSAM, Sambada, R. Sambada software developed in our lab (Joost et al. 2008; Stucki et al. 2017, Duruz et al. 2019)
- Billions of association models calculated (millions of genomic loci x hundreds of environmental variables)

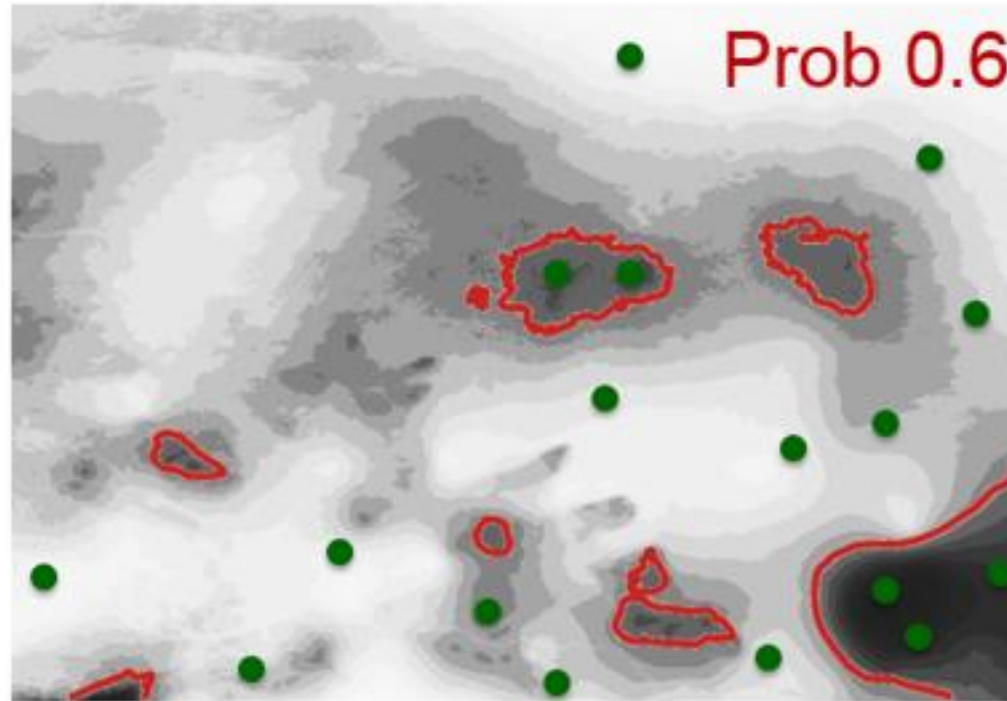
Genes under natural selection



Many different genomic regions (SNPs = Single Nucleotide Polymorphisms) associated with different environmental variables (colors). The red line shows the significance level.

Predict where favorable genetic variants are required

Probability of presence



Probability to find a favourable genetic variant in regions without sampling points

Contours of iso-probability

SPAG : Spatial Areas of Genotype Probability

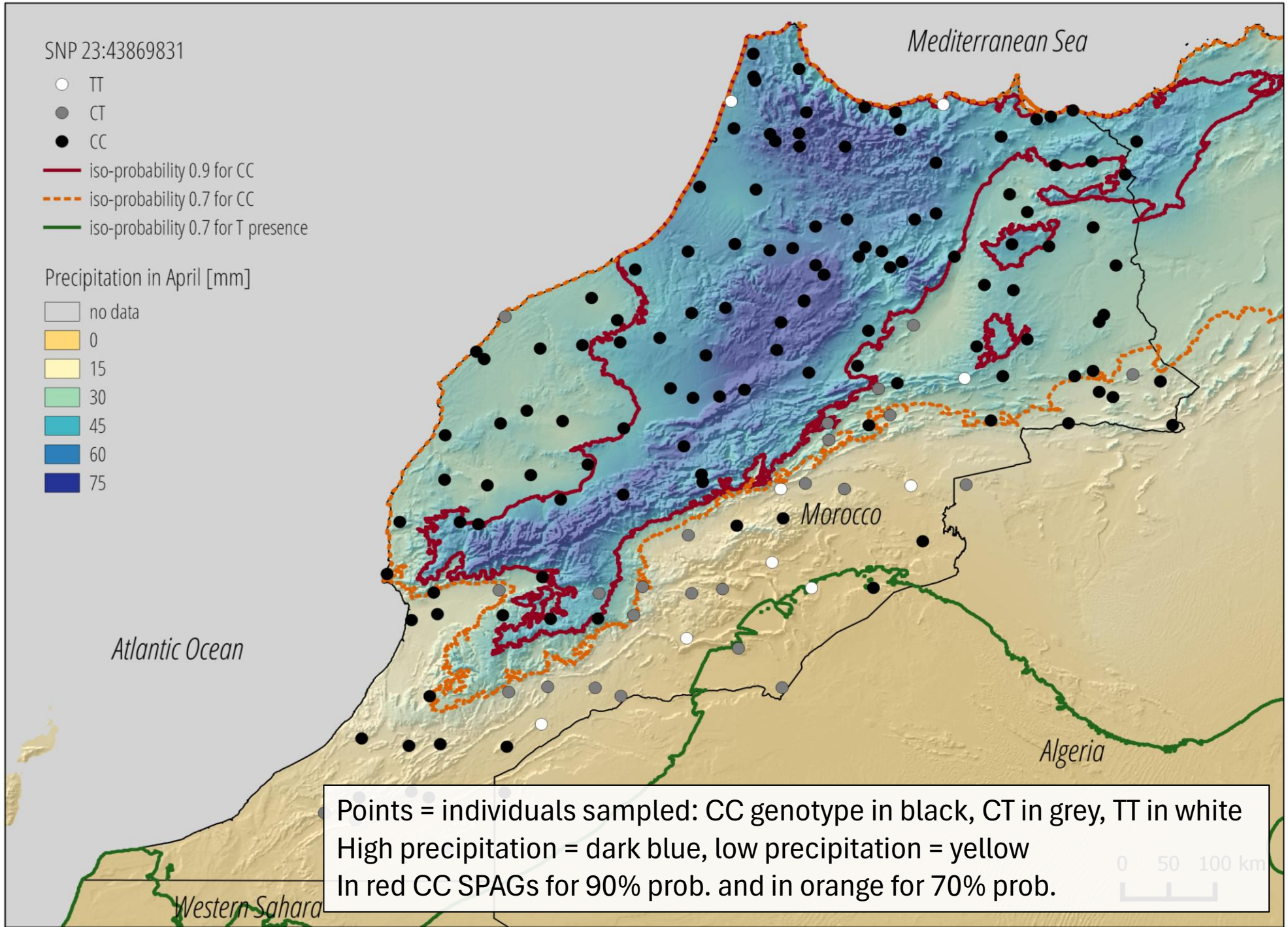
SPAGs for Moroccan sheep breeds

- Whole genome sequence (WGS) - 38.5 M SNPs (nextgen.epfl.ch)
- Detection of a specific SNP on **gene MC5R** significantly associated with precipitation
- SPAGs to delimit the geographic regions where this genotype is currently present
- Worldclim 2070 predictions for severe climate change (scenario GISS-E2-R, rcp 85), <http://www.worldclim.com/>)
- Map the predicted SPAG shift in the future

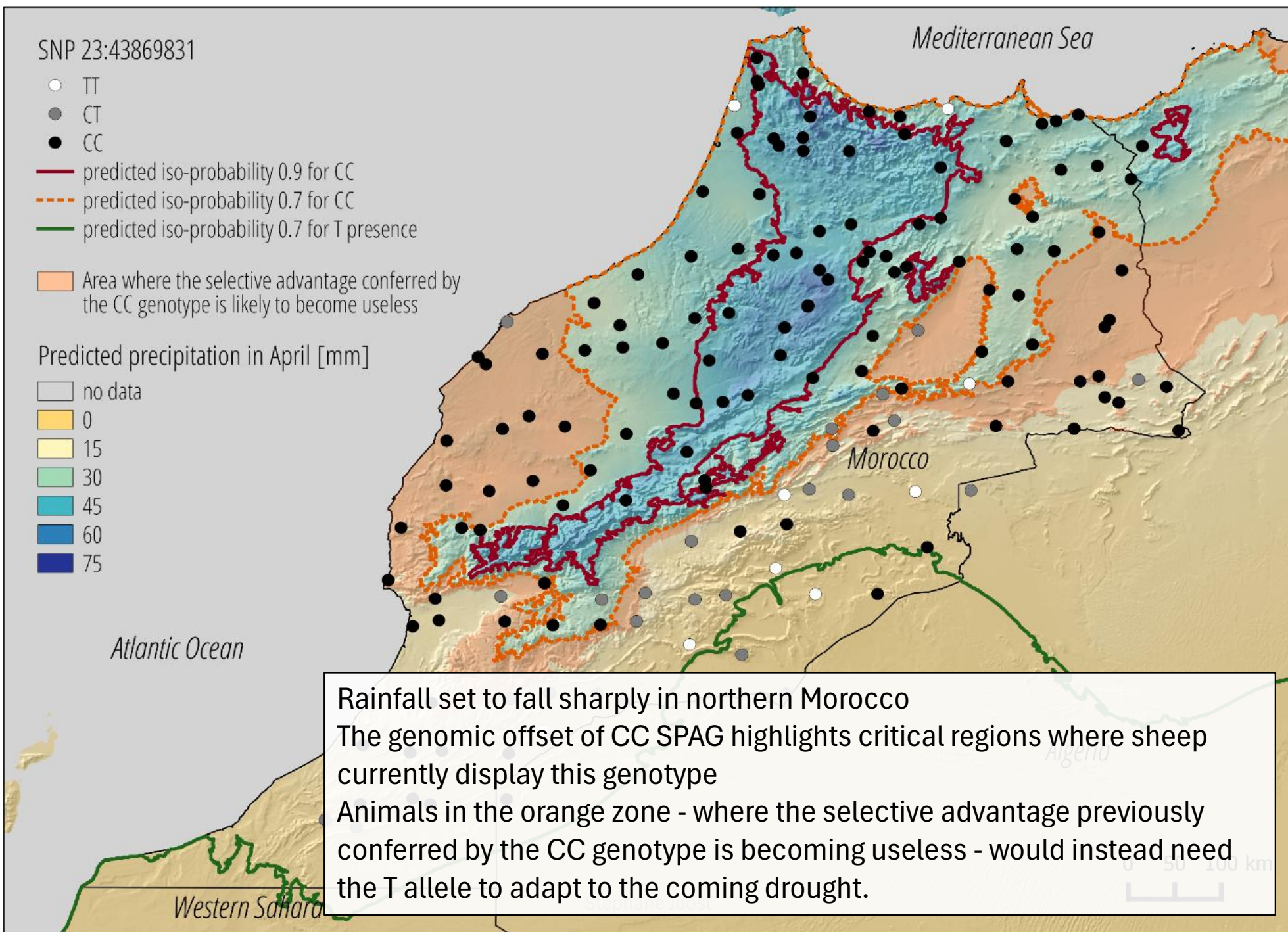
MC5R

- MC5R codes for a protein most likely involved in lanolin (wax) production (Chen et al. 1997)
- The **CC** genotype (without allele T) is positively correlated with precipitation
- Another genotype with allele **T** shows a negative association with precipitation
- **CC** could favor the production of lanolin and prevent the lumpy wool disease in sheep
- While allele **T** is likely to reduce this production and favor adaptation to drought

2020



2070

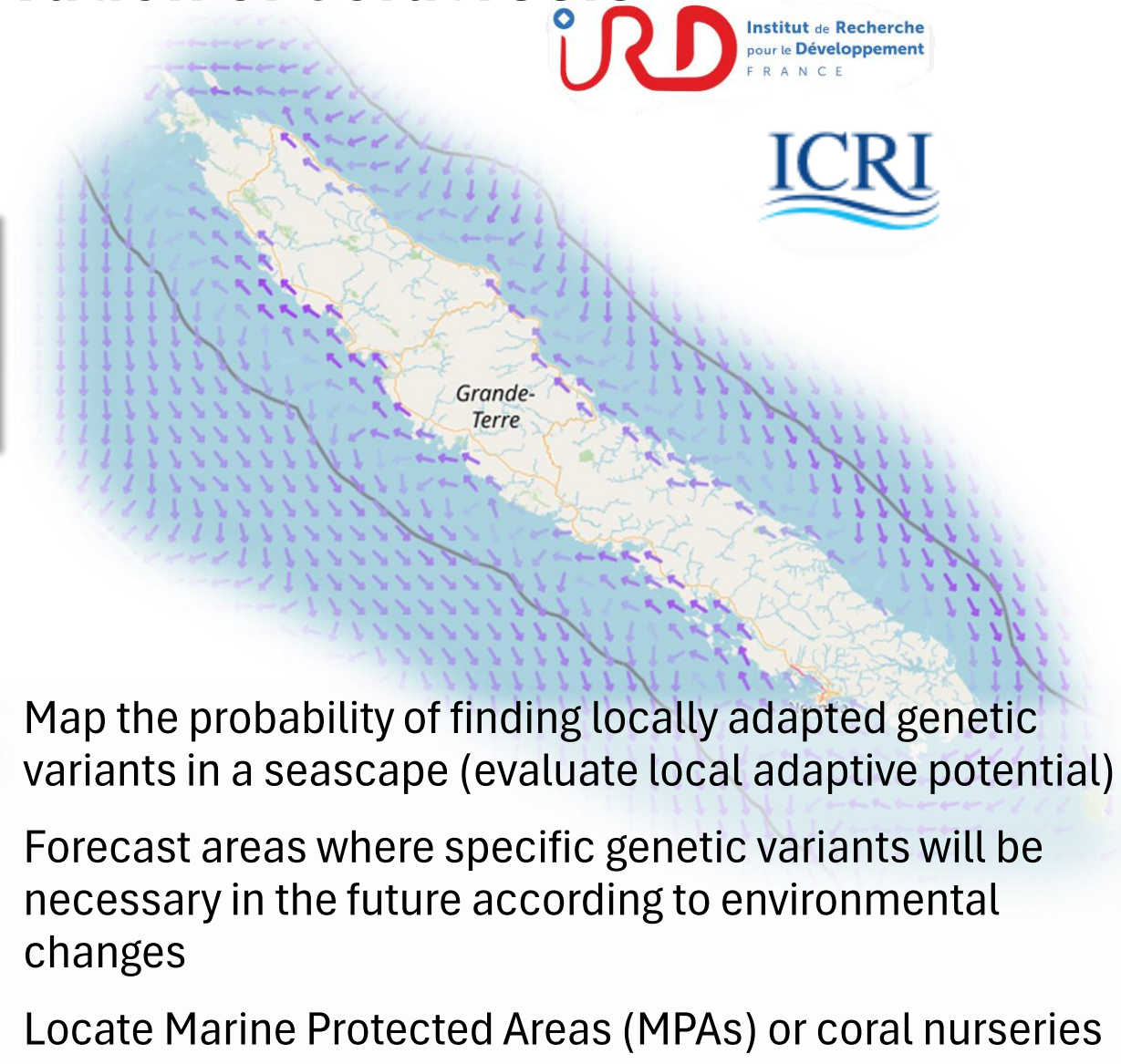
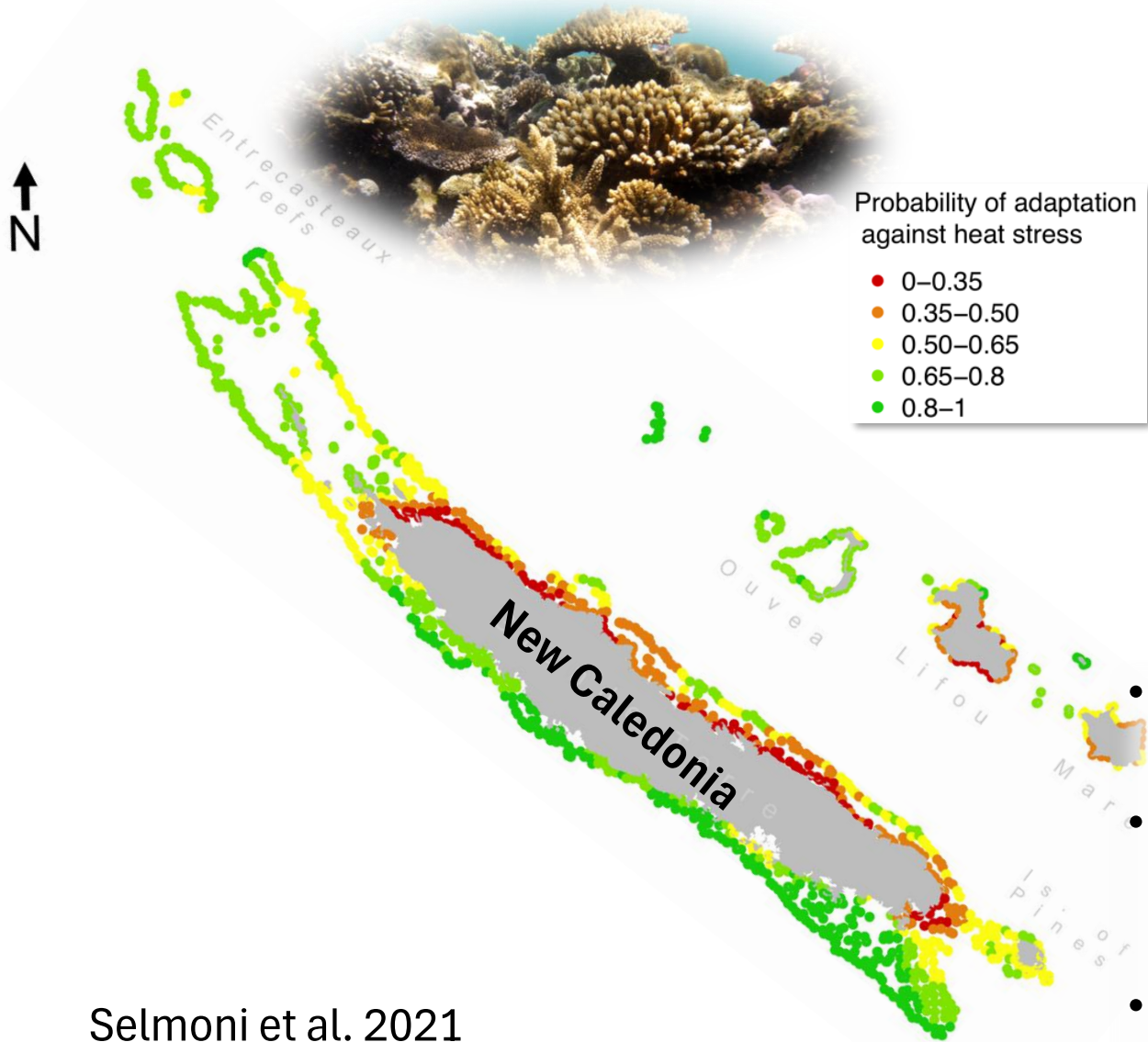


Rainfall set to fall sharply in northern Morocco
The genomic offset of CC SPAG highlights critical regions where sheep currently display this genotype
Animals in the orange zone - where the selective advantage previously conferred by the CC genotype is becoming useless - would instead need the T allele to adapt to the coming drought.

Use of adaptive potential in conservation

- Information on adaptive potential is key to predict the response of species to climate change
- Main application of adaptive potential is prioritization of areas based on the information characterizing evolutionary processes
- Use of SPAGs can help identify:
 - Well-adapted populations with adaptive genotypes expected to be optimal under future conditions
 - Threatened populations, with “missing” genetic variants, unable to adapt, like e.g. coral reef species under heat stress (bleaching)

Seascape genomics for the conservation of coral reefs



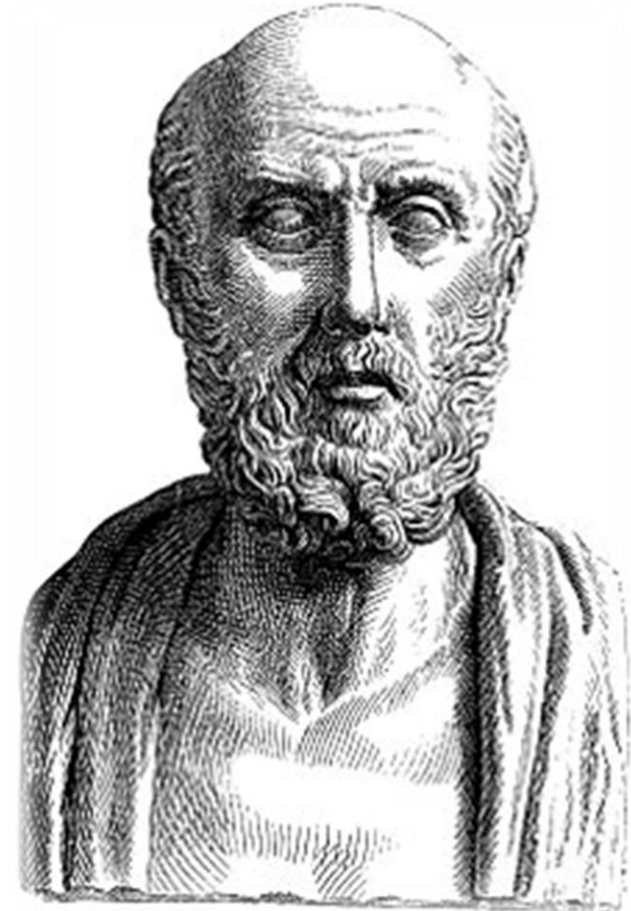
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Introduction to environmental engineering

The role of geographic information in spatial epidemiology

Health and place

- The study of the relationship between health and place: Hippocrates
- "Airs, waters, and places" influences a whole section of medicine (more than 2,000 years ago)
- Air and water quality must be considered, but also the socio-economic environment and behaviors
- Medical geography: largely based on associations between health and place



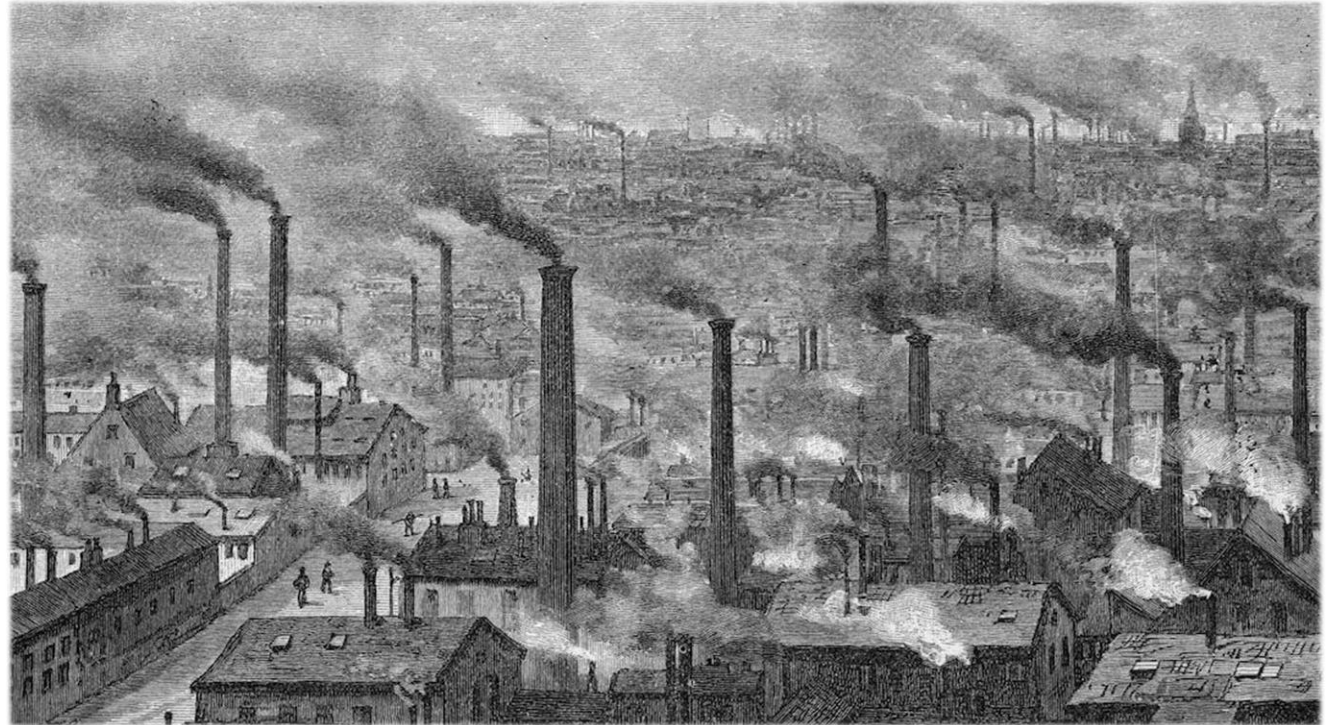
Disease and lockdown areas

- Plague
- 1690 – 1692 in the province of Bari (Filippo Arrieta)
- The map shows areas most affected by plague
- It highlights boundaries of a quarantine zone imposed to prevent its spread to neighboring towns and other provinces



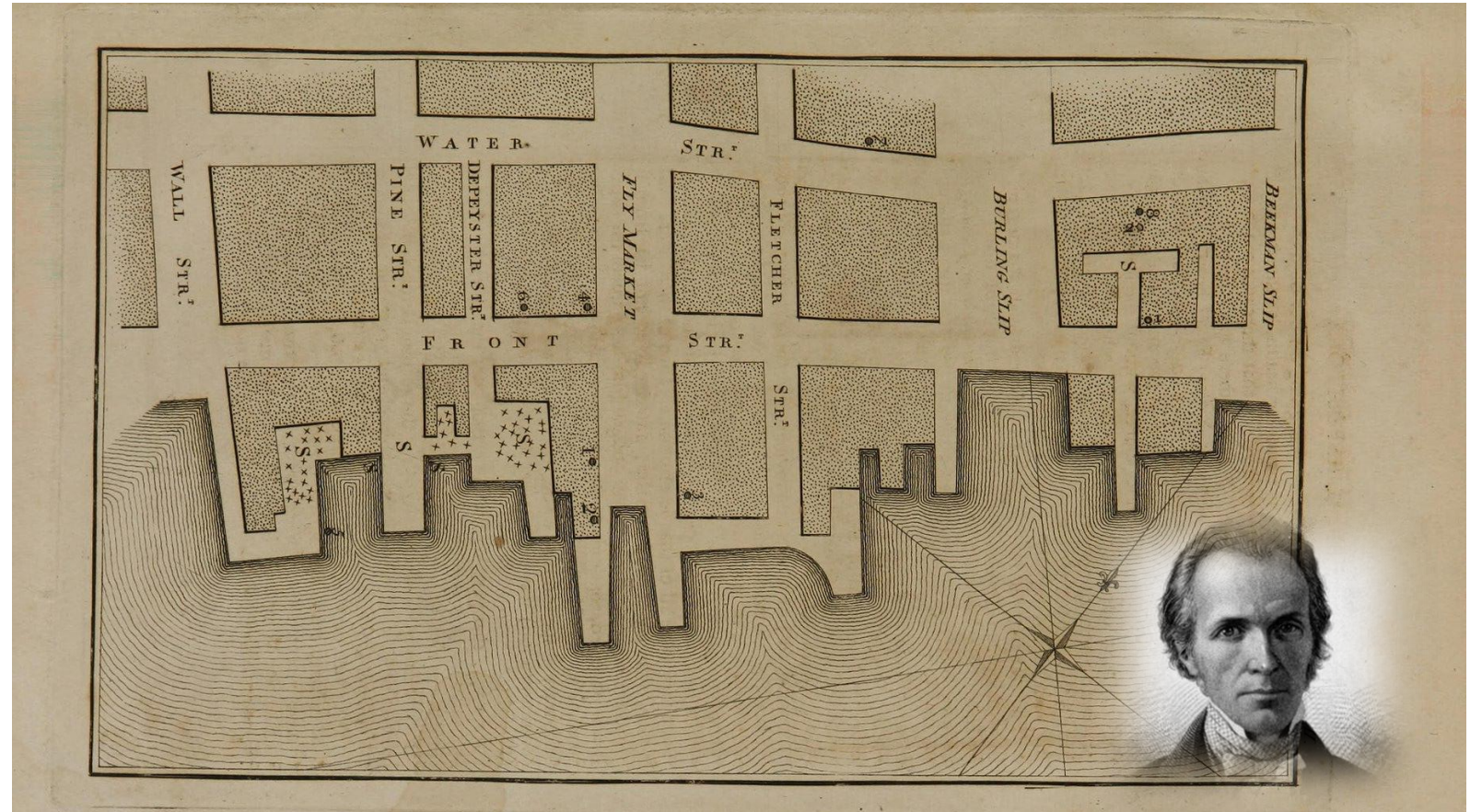
Industrial revolution

- Industrial revolution end of 18th Century: many public health issues
- Need to inform about risk areas where tuberculosis, cholera or yellow fever appear most frequently
- Emergence of medical cartography

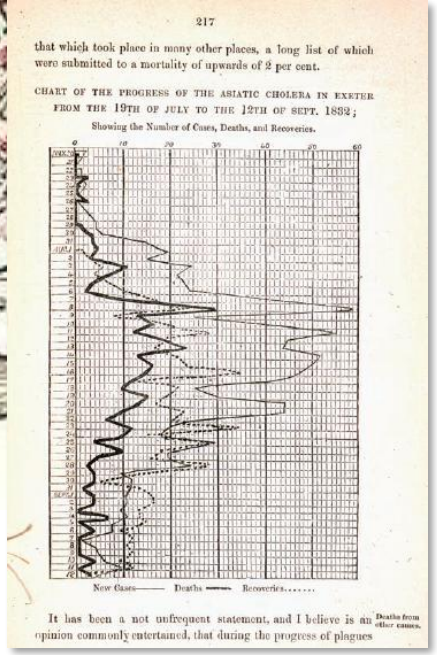
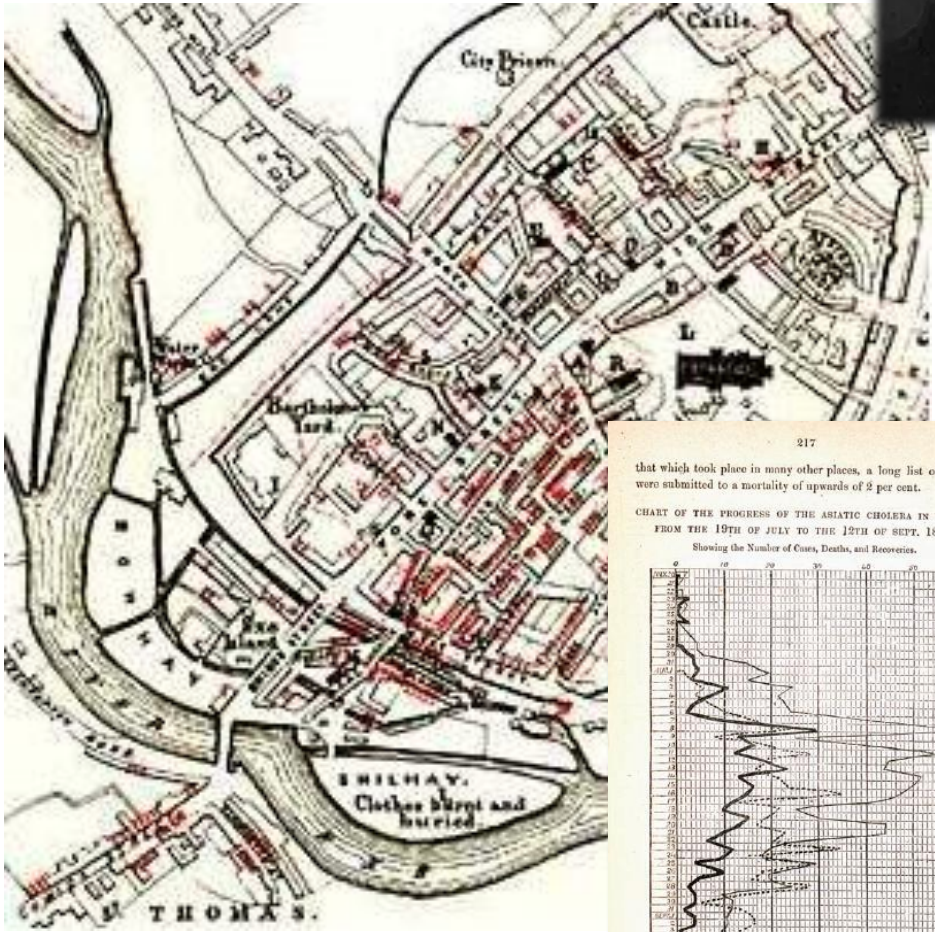


Yellow fever

- 1798 - Valentine Seaman, a surgeon at New York Hospital, investigated the yellow fever outbreak in his city
- Seaman argued the origin of the city's disease outbreak was the smell that arose from the garbage and sewage that accumulated in the harbor area
- “In the city there appears to be an intimate and inseparable connection between the prevalence of yellow fever and the existence of putrid effluvia”



Cholera



Thomas Schapter
Exeter 1832

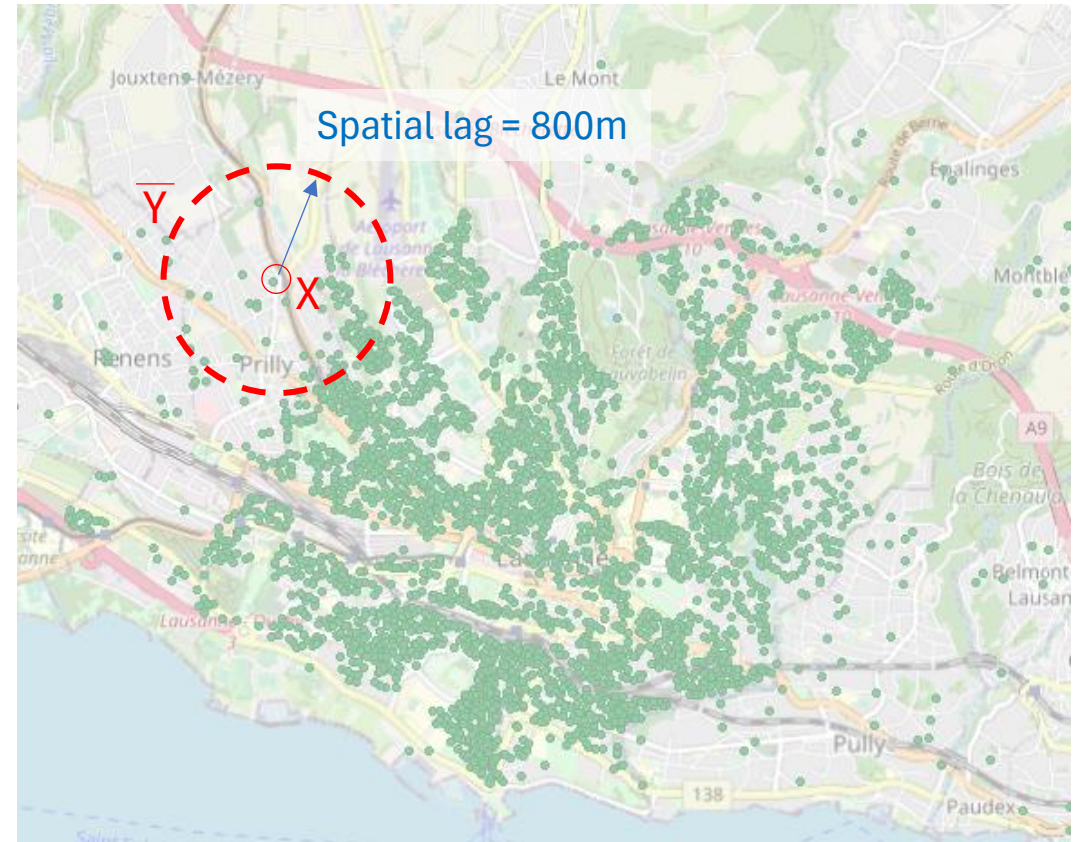


John Snow
London, 1854

Medical cohorts



- Participants in medical cohorts precisely located in space
- Method: georeferencing
- X,Y (geographic coordinates) of places of residence (Rue Neuve 14, 1009 Pully)
- **First law of geography** “Everything is related to everything else, but near things are more related than distant things” (Tobler, 1970)
- Measuring spatial dependence

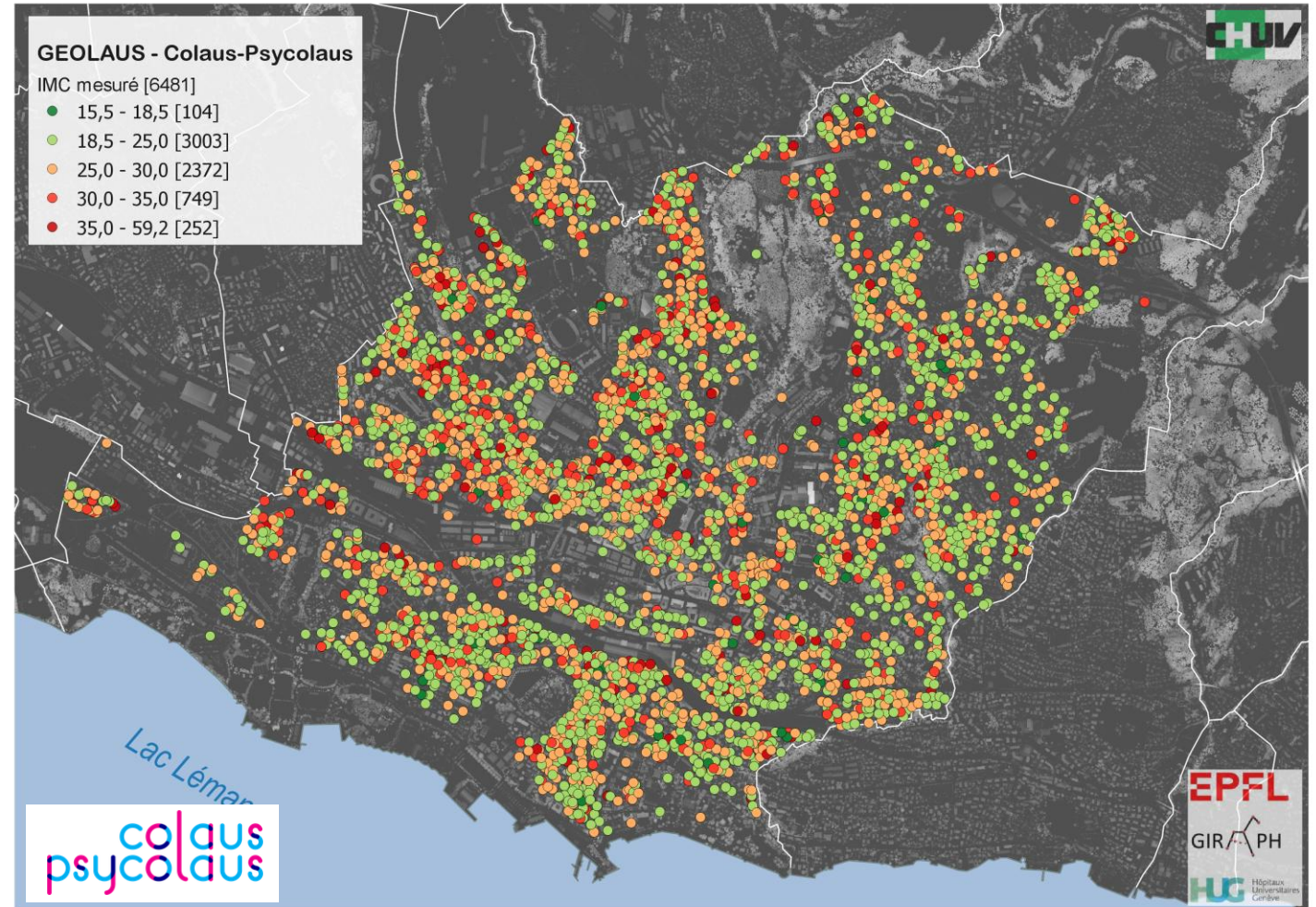


Does X look like \bar{Y} ?

Without Tobler's law

- No detectable signal through standard thematic mapping

Classification en fonction de l'indice de masse corporelle	
Insuffisance pondérale	< 18.5
Éventail normal	18.5 - 24.9
Surpoids	≥ 25.0
Préobésité	25.0 - 29.9
Obésité	≥ 30.0
Obésité, classe I	30.0 - 34.9
Obésité, classe II	35.0 - 39.9
Obésité, classe III	≥ 40.0



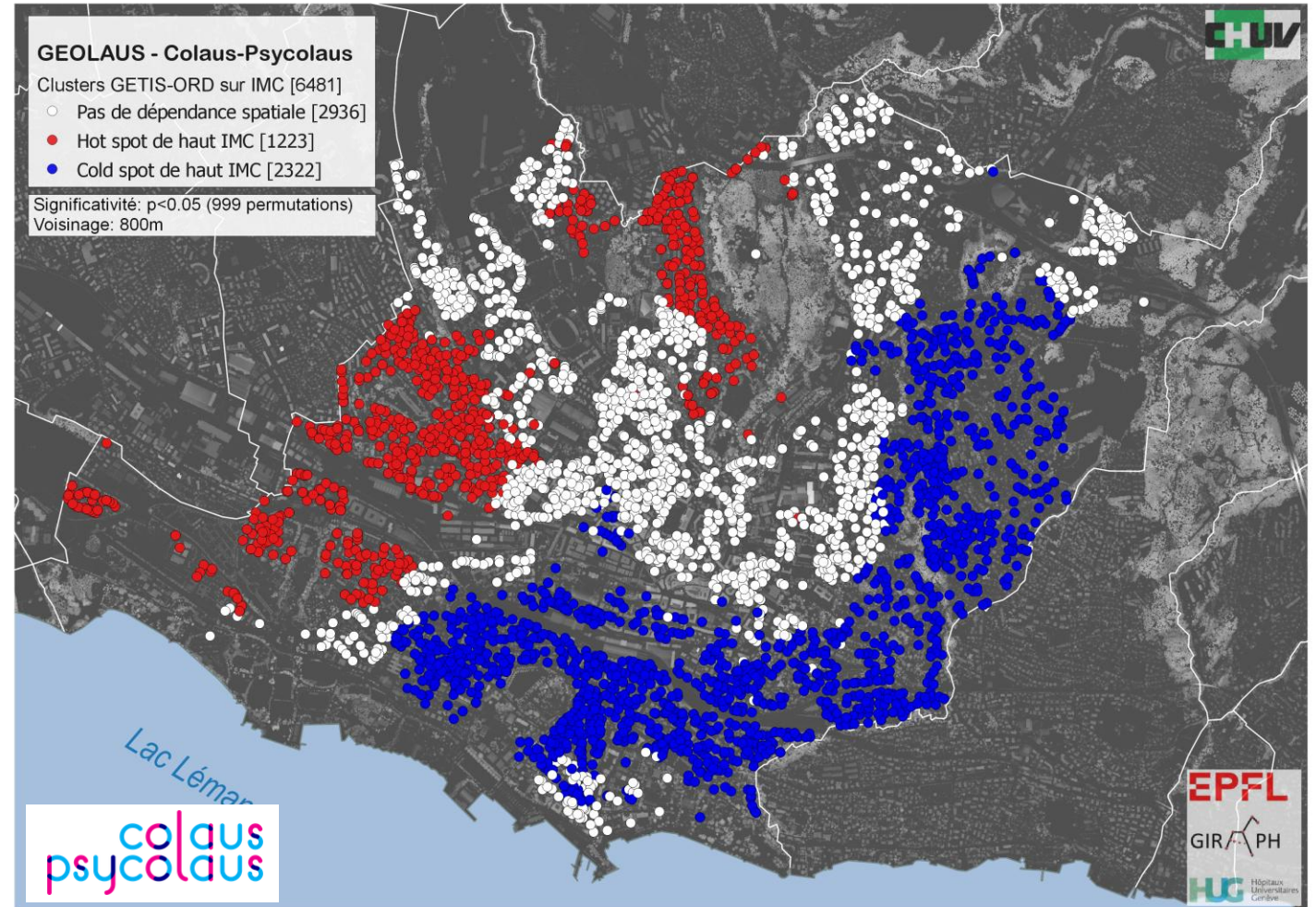
Body Mass Index, Colaus-PsyColaus cohort

Joost et al. 2016

With Tobler's law

- Specific statistical tools
- Key to make the invisible visible!
- Potential to develop **targeted prevention actions** where needed!

Spatial dependence, spatial statistics



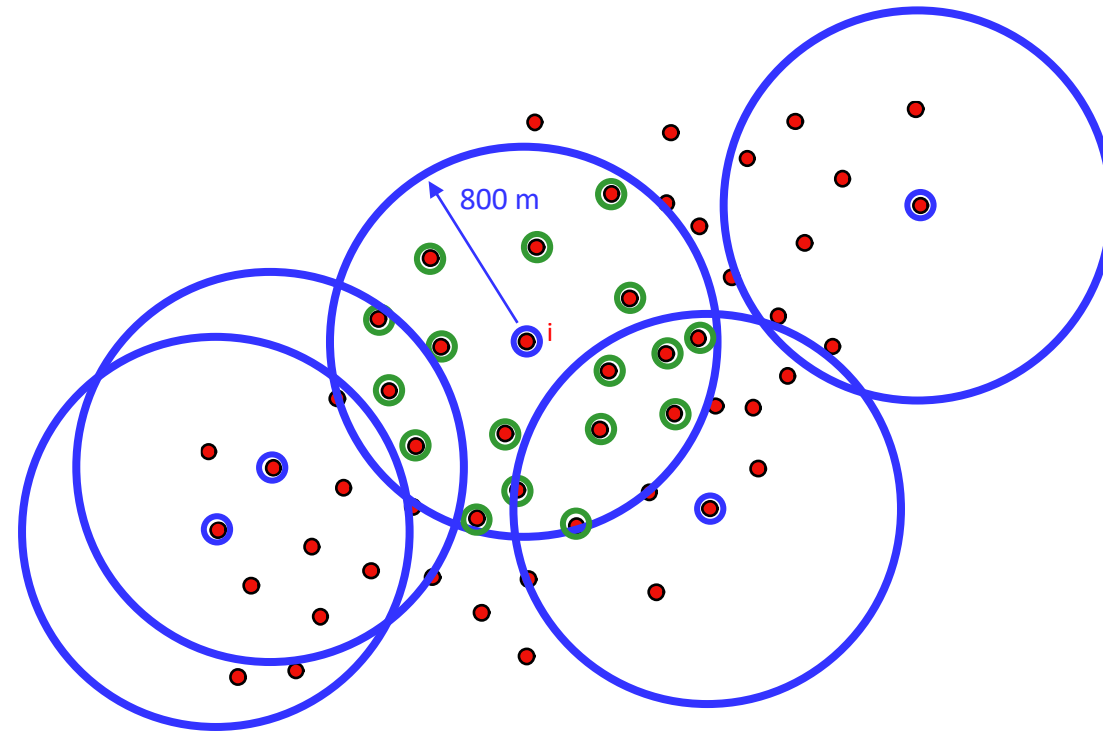
Body Mass Index, Colaus-PsyColaus cohort

Joost et al. 2016

How to measure spatial dependence ?

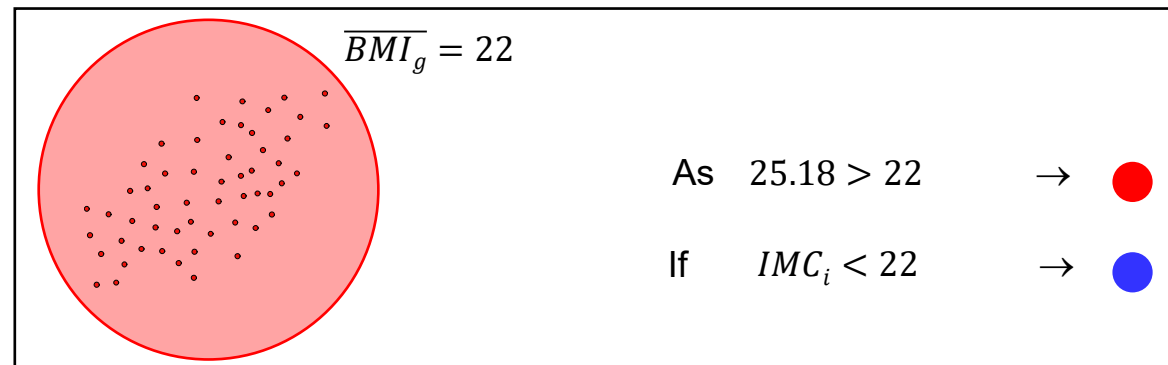
- Use neighborhood relationships
- "How much" an individual resembles his neighbors in a given neighborhood
- Example with body mass index (BMI) and Getis-Ord statistics

$$\text{BMI} = \frac{\text{Weight}}{(\text{Height})^2}$$



- BMI=23
- BMI=21
- BMI =27
- BMI =23
- BMI =29
- BMI =23
- BMI =33
- BMI =35
- BMI =18
- BMI =23
- BMI =22
- BMI =26
- BMI =27
- BMI =27
- BMI =25
- BMI =21

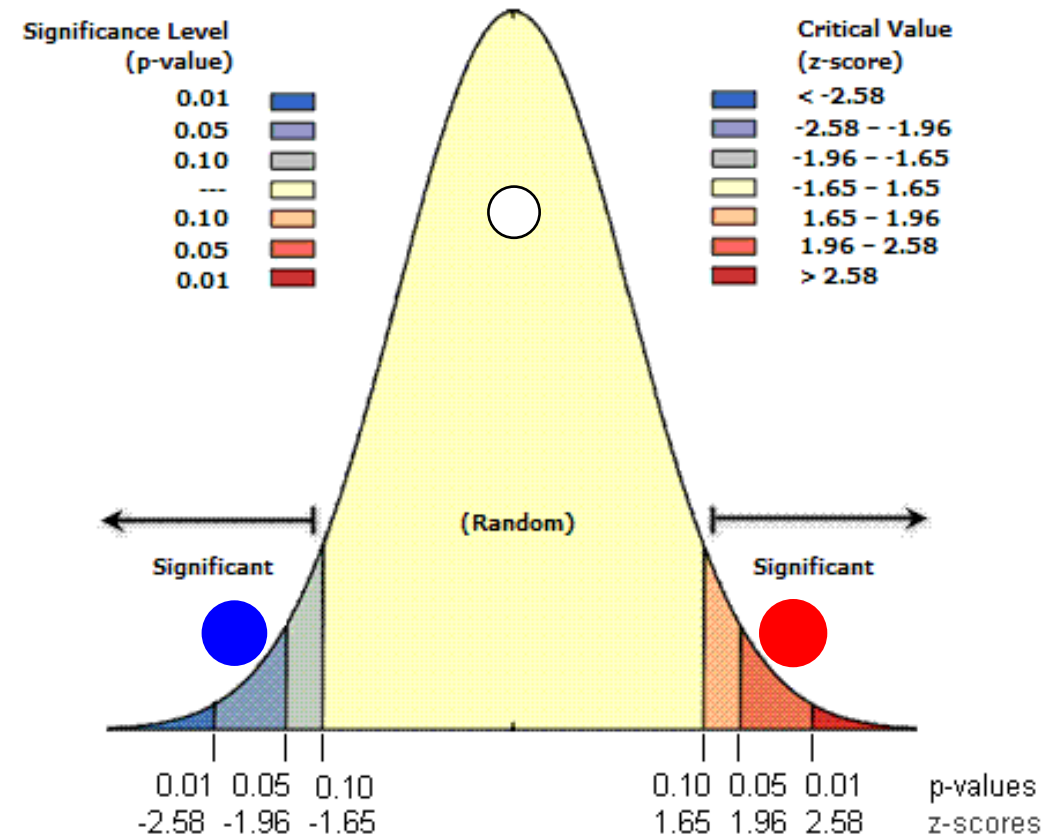
$$\overline{\text{BMI}}_i = 25.18$$



Spatial dependence or random distribution?

- Null hypothesis: the observed local value is not different from the general mean
- Random permutations on standardized BMI
- T-test* to compare the means

- Significantly lower than the general average, the value depends on its geographical location
- Random value, does not depend on its geographical location
- Significantly higher than the general average, the value depends on its geographical location



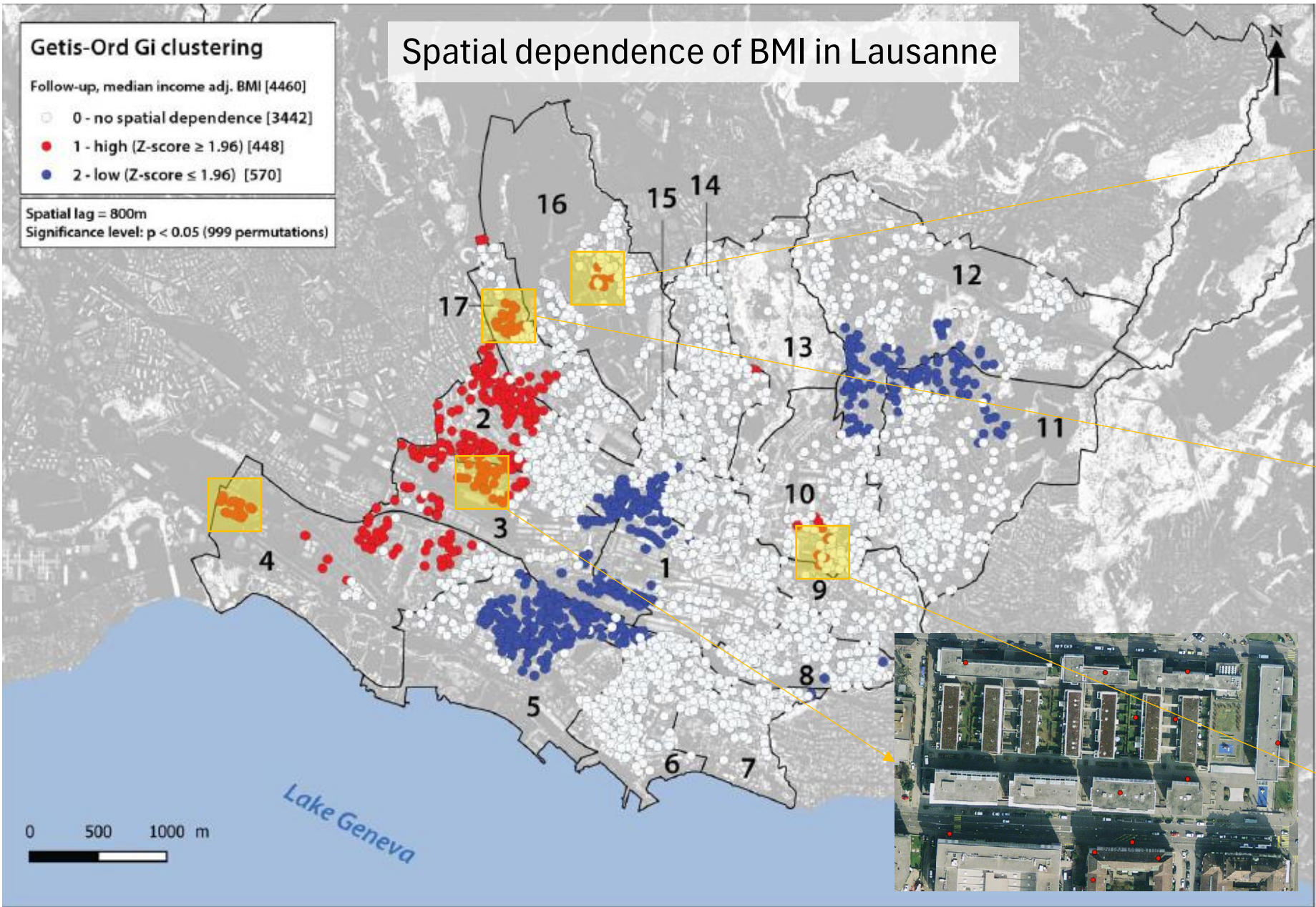
Spatial dependence of BMI in Lausanne

Getis-Ord Gi clustering

Follow-up, median income adj. BMI [4460]

- 0 - no spatial dependence [3442]
- 1 - high (Z-score ≥ 1.96) [448]
- 2 - low (Z-score ≤ -1.96) [570]



Spatial lag = 800m
Significance level: $p < 0.05$ (999 permutations)

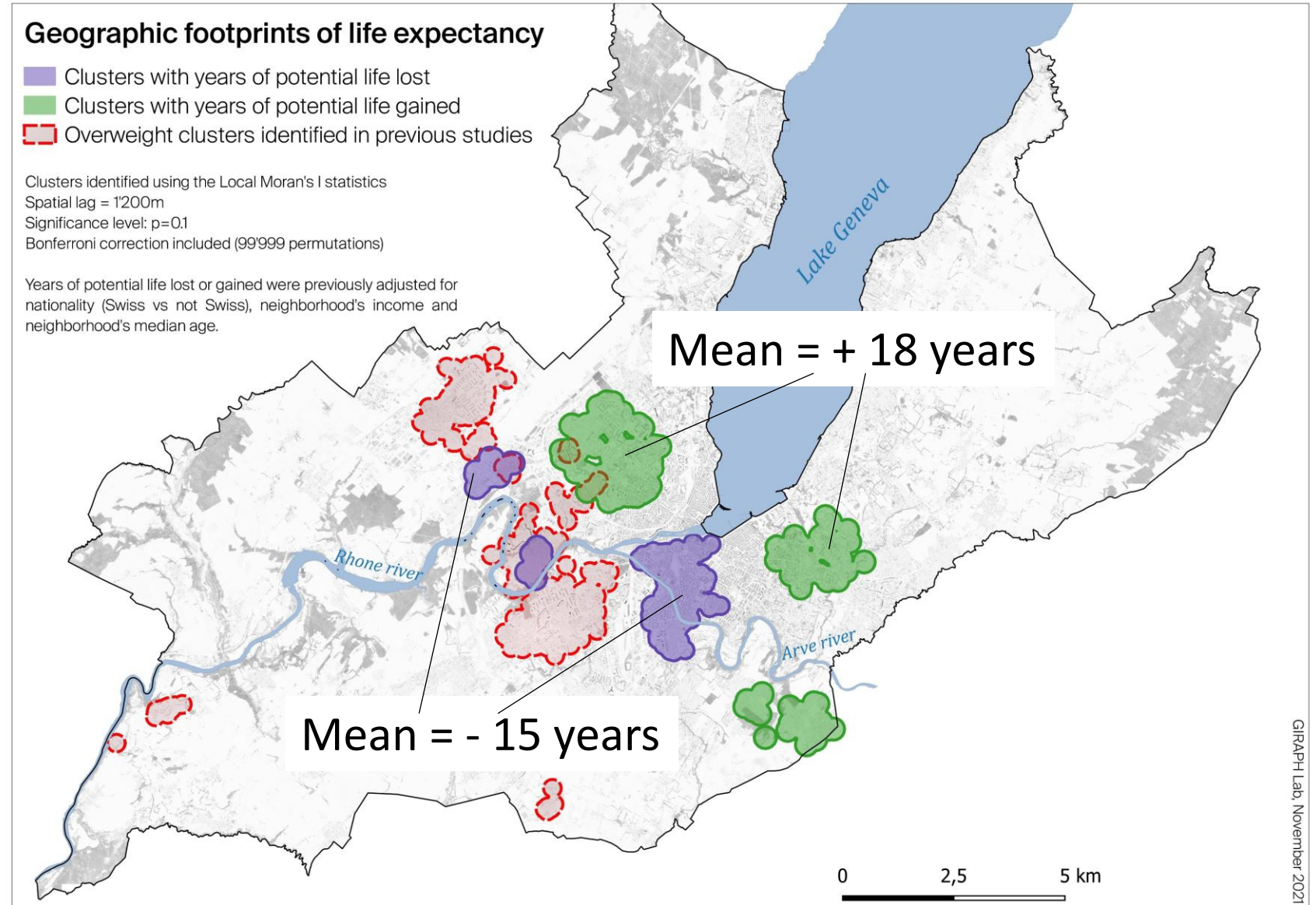


Geographical containment



Difference in life expectancy at birth

- Green zones gain an average of 18 years on life expectancy at birth 
- Purple areas lose an average of 15 years compared with life expectancy at birth 
- These are areas where unfavorable conditions such as soil and air pollution have accumulated over the years (Jonction and west of the Arve river)



Characterising clusters with environmental variables

- Natural and built environment (pollution, vegetation, etc.)
- Socio-economic environment
- Demographic environment
- Cultural environment (language, religion, etc.)

“The Swiss Confederation estimates the health costs of traffic noise at CHF 2.6 billion. It increases risks in several areas: cardiovascular, psychological, and sleep. In 2018, a study carried out in Lausanne demonstrated the link between noisy neighborhoods and heavy daytime sleepiness, and hence lack of sleep.”

— Grand Format —

*Le bruit: enjeu majeur de
santé publique*



Road traffic noise in Lausanne

24heures SIGNÉ LAUSANNE   

Vaud & Régions Suisse Monde Économie Sports Savoirs Culture High-Tech People Vivre Auto Plus

Lausanne & Région Riviera-Chablais Nord vaudois-Broye La Côte Faits divers Signé Lausanne

L'actu en dessins Images Clic-clac

Le PS lausannois lance l'idée d'un centre-ville à 30 km/h

Bruit La conseillère Anne-Françoise Decollogny suggère la mesure pour lutter contre le bruit routier excessif.



Anne-Françoise Decollogny se félicite des tests nocturnes menés à Vinet-Beaulieu et propose désormais d'aller plus loin.

Image: Florian Cella

Un logiciel pour prédire le bruit qu'il fera

Dans le cadre de la lutte contre le bruit à Lausanne, la Municipalité veut acheter un logiciel (CadnaA) spécialisé dans sa prédiction. En simple: un outil informatique pour prévoir le bruit qu'il va faire. Il est présenté par ses concepteurs comme la solution «la plus performante» pour le calcul, l'évaluation, la prévision et la représentation de l'impact du bruit dans l'environnement. Son coût, qui figure dans la première série de crédits supplémentaires pour le budget 2018 de la Ville de Lausanne: 12'000 francs.

Spatial clusters of daytime sleepiness in Lausanne

- ColaUS-PsyColaUS study, a longitudinal study in the population of Lausanne
- 6700 participants recruited between 2001 and 2003 (baseline)
- 2009-2012: follow-up study
- HypnolaUS substudy: 3700 subjects from the baseline sample, georeferenced at their place of residence
- Questionnaires on daytime sleepiness
- Sleepiness measured using the **Epworth Sleepiness Scale (ESS)**

Epworth Sleepiness Scale (ESS)

- The 3700 participants in the GeoHypnolaus study completed a short questionnaire to quantify daytime sleepiness
- The Epworth Sleepiness Scale estimates the probability of falling asleep in everyday situations
- The higher the score, the greater the daytime sleepiness, and the more likely it is that the person is experiencing night-time sleep problems, including sleep disturbed by environmental factors

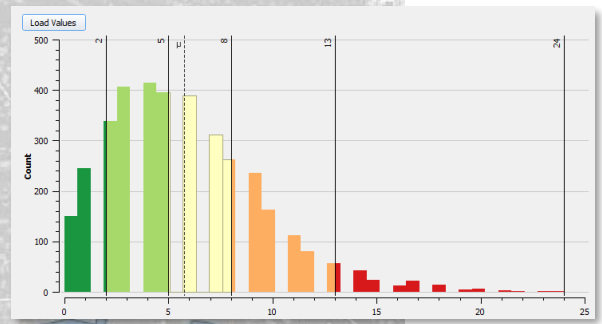
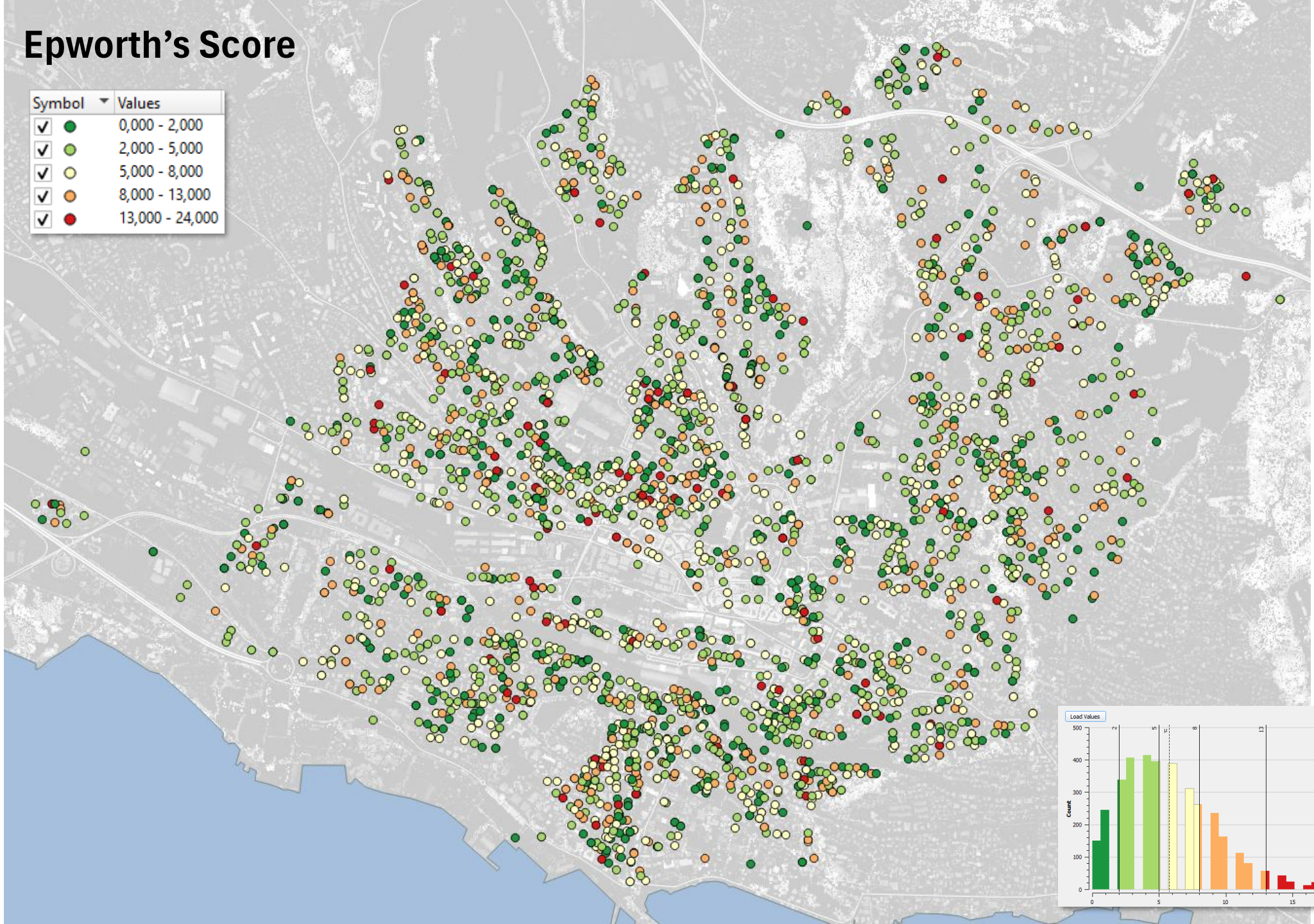
Test d'Epworth

Afin de pouvoir évaluer chez vous une éventuelle somnolence dans la journée, vous pouvez répondre aux questions de l'échelle de somnolence d'Epworth. Voici quelques situations relativement usuelles où nous vous demandons d'évaluer le risque de vous assoupir. Si vous n'avez pas été récemment dans l'une de ces situations, essayez d'imaginer comment cette situation pourrait vous affecter. Pour répondre, utilisez l'échelle suivante en choisissant le chiffre le plus approprié pour chaque situation : 0 = aucun risque de somnoler ou de m'endormir 1 = faible risque 2 = risque moyen 3 = fort risque

	0	1	2	3
Pendant que vous êtes occupé à lire un document	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Devant la télévision ou au cinéma	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Assis inactif dans un lieu public(salle d'attente, théâtre,...)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Passager, depuis au moins une heure sans interruptions, d'une voiture ou d'un transport en commun(train, bus, avion, ...)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Allongé pour une sieste, lorsque les circonstances le permettent	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
En position assise au cours d'une conversation (ou au téléphone) avec un proche	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tranquillement assis à table à la fin d'un repas sans alcool	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Au volant d'une voiture immobilisée depuis quelques minutes dans un embouteillage	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Epworth's Score

Symbol	Values
✓ ●	0,000 - 2,000
✓ ●	2,000 - 5,000
✓ ●	5,000 - 8,000
✓ ●	8,000 - 13,000
✓ ●	13,000 - 24,000



Getis-Ord G_i^*

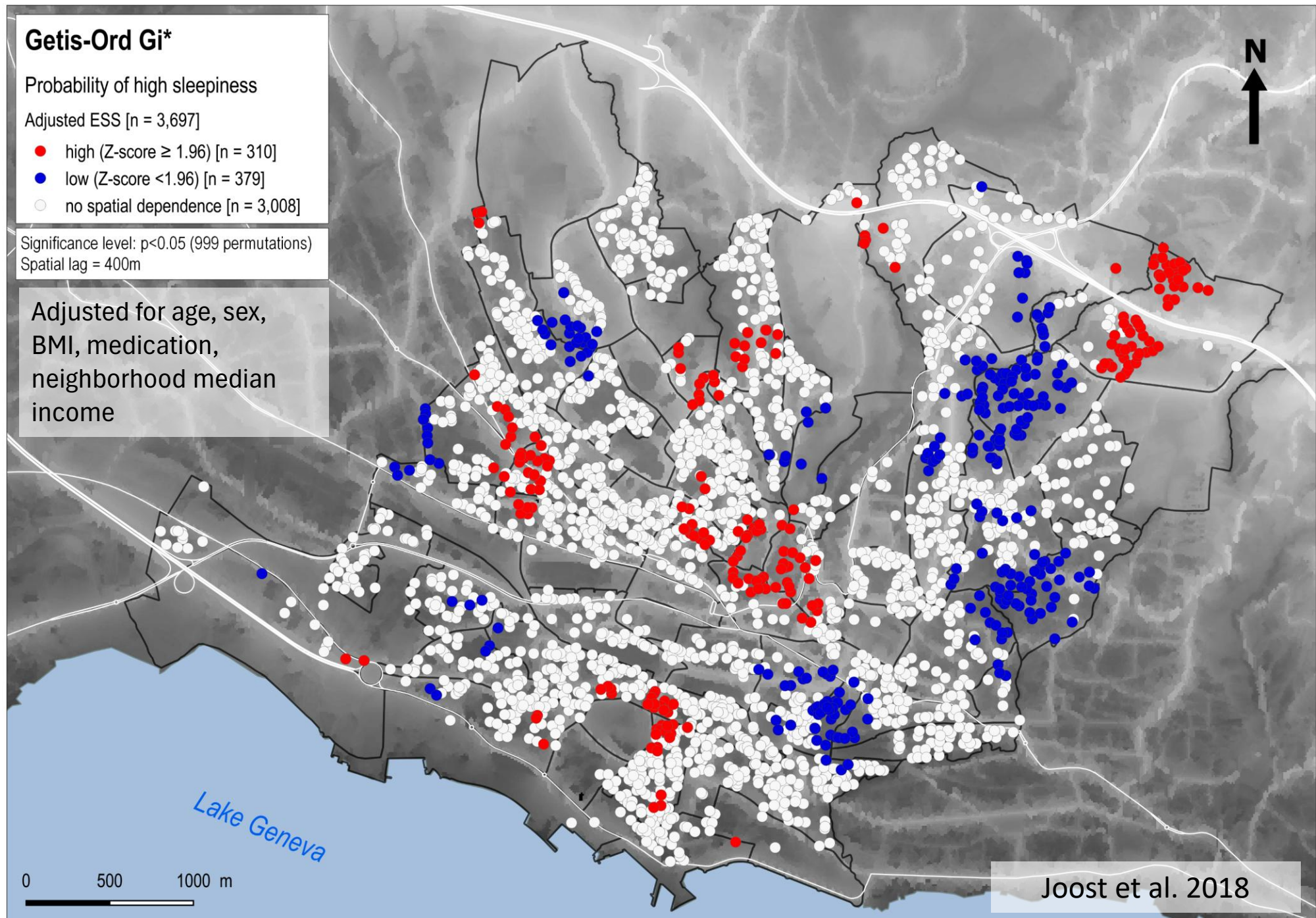
Probability of high sleepiness

Adjusted ESS [n = 3,697]

- high (Z-score ≥ 1.96) [n = 310]
- low (Z-score < 1.96) [n = 379]
- no spatial dependence [n = 3,008]

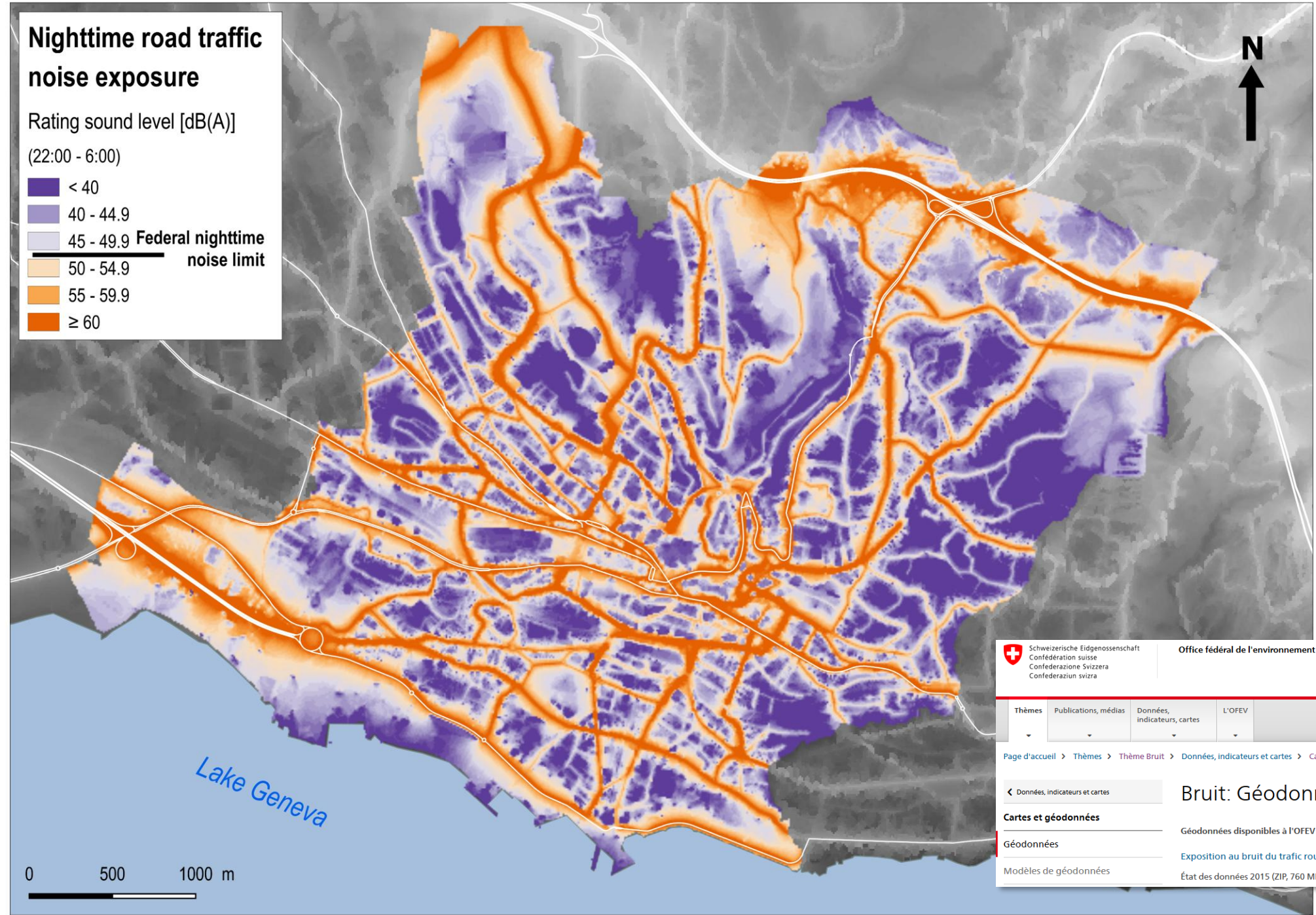
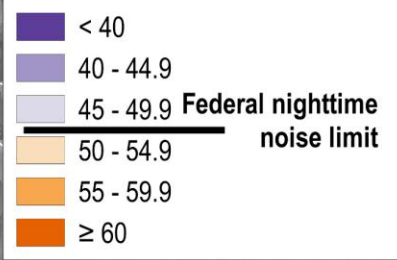
Significance level: $p < 0.05$ (999 permutations)
Spatial lag = 400m

Adjusted for age, sex,
BMI, medication,
neighborhood median
income



Nighttime road traffic noise exposure

Rating sound level [dB(A)]
(22:00 - 6:00)



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Office fédéral de l'environnement OFEV

Thèmes Publications, médias Données, indicateurs, cartes L'OFEV

Page d'accueil > Thèmes > Thème Bruit > Données, indicateurs et cartes > Cartes et géodonnées > Géodonnées

Données, indicateurs et cartes

Bruit: Géodonnées

Cartes et géodonnées

Géodonnées disponibles à l'OFEV sur le thème du bruit

Géodonnées

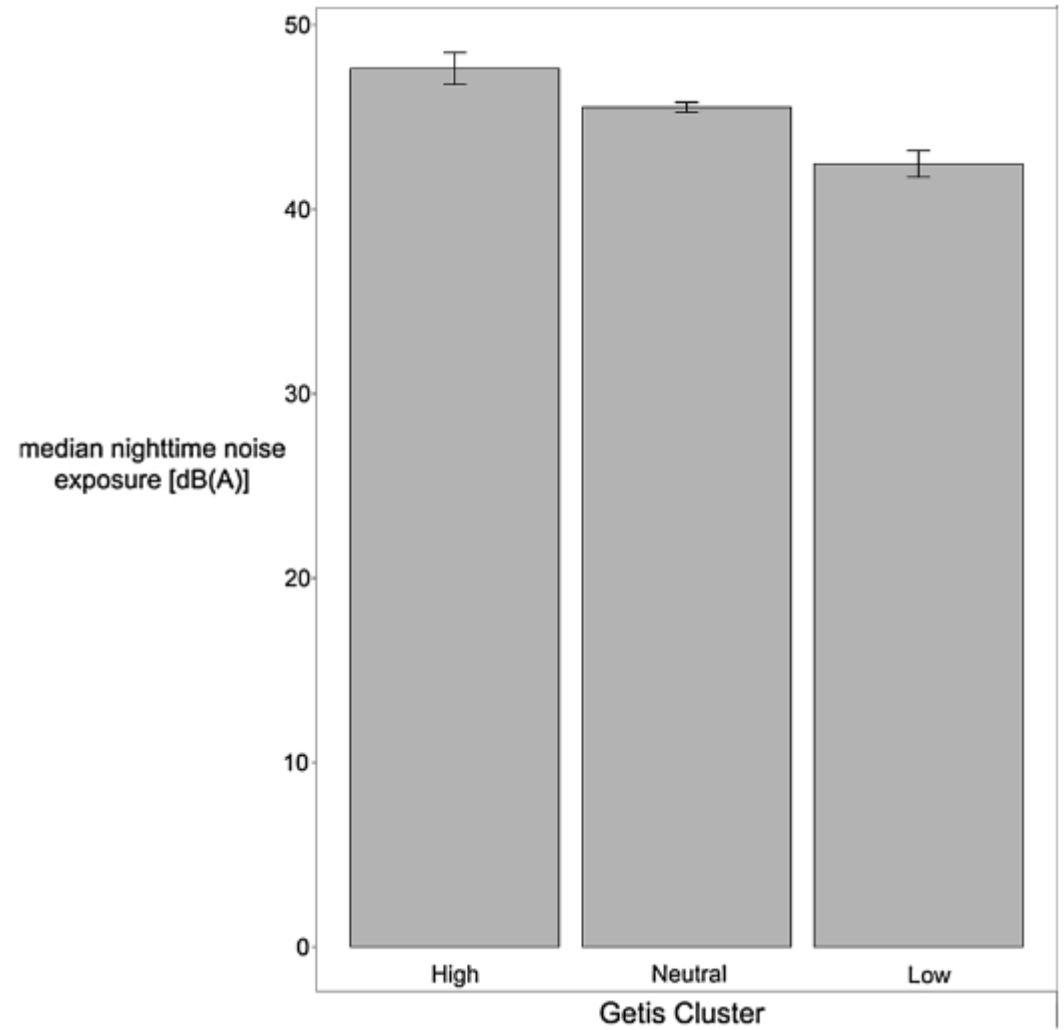
[Exposition au bruit du trafic routier \(Lr_jour\)](#)

Modèles de géodonnées

État des données 2015 (ZIP, 760 MB, 16.10.2018)

Results

- Variance analysis on cluster classes (Tukey's HSD)
- We observe a dose-response effect
- Getis-Ord: median nighttime noise in the high clusters was 2.10 dB(A) higher than in the neutral class ($p < 0.001$) and **5.16 dB(A) higher than in low clusters** ($p < 0.001$)
- Local Moran's I classes show a dose-response effect too
- The difference between the nighttime noise levels in the high-high and low-low clusters was **4.49 dB(A)** ($p < 0.001$)



Use of results by the city of lausanne

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journal homepage: www.elsevier.com/locate/ijheh

Spatial clusters of daytime sleepiness and association with nighttime noise levels in a Swiss general population (GeoHypnoLaus)

Stéphane Joos^{a,b,c,1}, José Haba-Rubio^{d,1}, Rebecca Hims^{a,b,c}, Peter Vollenweider^e, Martin Preisig^g, Gérard Waeber^e, Pedro Marques-Vidal^{c,e}, Raphaël Heinzer^{d,2}, Idris Guessous^{b,c,f,2,*}

^a Laboratory of Geographic Information Systems (LASIG), School of Architecture, Civil and Environmental Engineering (ENAC), Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland
^b Unit of Population Epidemiology, Division of Primary Care Medicine, Department of Community Medicine, Primary Care and Emergency Medicine, Geneva University Hospitals, Geneva, Switzerland
^c GIRAPH Lab (Geographic information for research and analyses in public health), Switzerland
^d Center for Investigation and Research in Sleep, Lausanne University Hospital (CHUV) and Lausanne University, Lausanne, Switzerland
^e Department of Medicine, Internal Medicine, Lausanne University Hospital (CHUV) and Lausanne University, Lausanne, Switzerland
^f Department for Ambulatory Care and Community Medicine, University of Lausanne, Lausanne, Switzerland
^g Department of Psychiatry, Lausanne University Hospital and Lausanne University, Lausanne, Switzerland



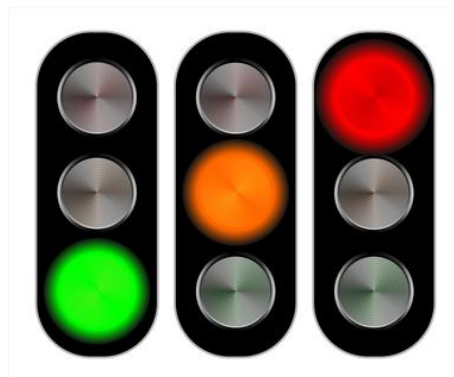
Ville de Lausanne

Agenda & actualités | Lausanne en bref | **Lausanne officielle** | Thématiques | Démarches

Vous êtes ici: Lausanne officielle > Administration > Finances et mobilité > Routes et mobilité



Service des routes et de la mobilité



Ici on teste
30km/h
de nuit

Sur les avenues de
Beaulieu et Vinet

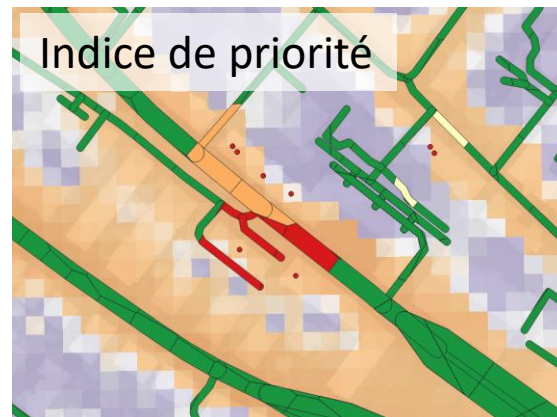
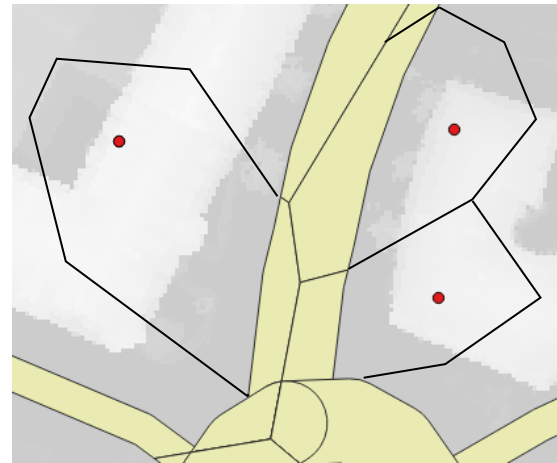
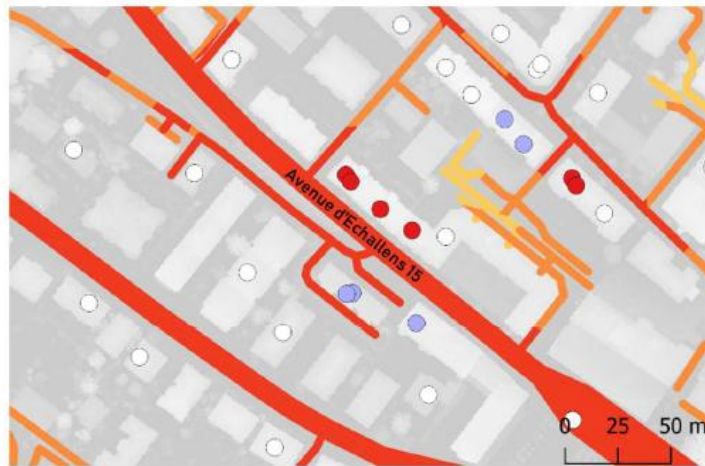
22h - 06h



Setting priorities between neighborhoods

Where are the more exposed neighborhoods: hotspots with the highest dB(a) mean values

Avenue d'Echallens



Catégorie LISA

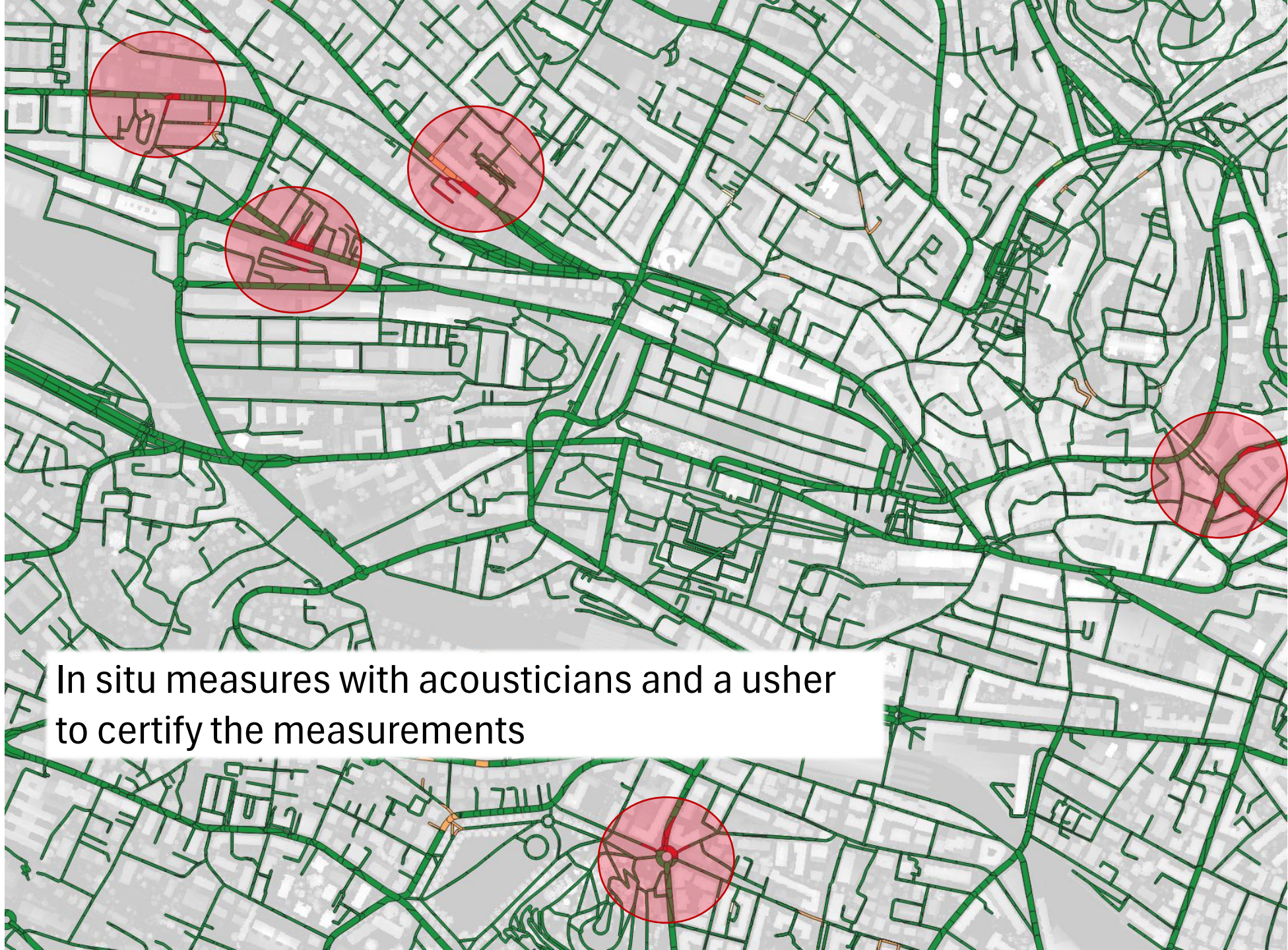
- Not significant
- High-High
- Low-Low
- Low-High
- High-Low

Bruit Nocturne [dB]

- 9.6621 - 23.3974
- 23.3974 - 37.1326
- 37.1326 - 50.8679
- 50.8679 - 64.6032
- 64.6032 - 78.3385

rues_prioritaires_Isne :: Features Total: 40091, Filtered: 40091, Selected: 0

ID_adr	type	axSpe	STRNAME	DEINR	PLZ4	priority	H16PTOT	night_mean	night_max
1	9439	pe...	Rue Jenny-Enning	1	1003	0,997...	111	62,81865934892...	65,00013732910...
2	9439	pe...	Rue Jenny-Enning	1	1003	0,997...	111	62,81865934892...	65,00013732910...
3	9439	sec...	Rue Jenny-Enning	1	1003	0,997...	111	62,81865934892...	65,00013732910...
4	9439	sec...	Rue Jenny-Enning	1	1003	0,997...	111	62,81865934892...	65,00013732910...
5	9439	sec...	Rue Jenny-Enning	1	1003	0,997...	111	62,81865934892...	65,00013732910...
6	4416	sec...	Rue Caroline	8	1003	0,989...	92	62,66678206125...	64,00010681152...
7	6722	un...	Route de Chavannes	5	1007	0,983...	16	62,53676716874...	73,00000762939...
8	6722	pe...	Route de Chavannes	5	1007	0,983...	16	62,53676716874...	73,00000762939...
9	6722	pe...	Route de Chavannes	5	1007	0,983...	3	62,53676716874...	73,00000762939...
10	6722	ser...	Route de Chavannes	5	1007	0,983...	3	62,53676716874...	73,00000762939...
11	6722	ser...	Route de Chavannes	5	1007	0,983...	3	62,53676716874...	73,00000762939...
12	6722	ser...	Route de Chavannes	5	1007	0,983...	3	62,53676716874...	73,00000762939...
13	6722	ser...	Route de Chavannes	5	1007	0,983...	3	62,53676716874...	73,00000762939...
14	6722	pri...	Route de Chavannes	5	1007	0,983...	3	62,53676716874...	73,00000762939...
15	6722	pri...	Route de Chavannes	5	1007	0,983...	3	62,53676716874...	73,00000762939...
16	6722	pri...	Route de Chavannes	5	1007	0,983...	3	62,53676716874...	73,00000762939...



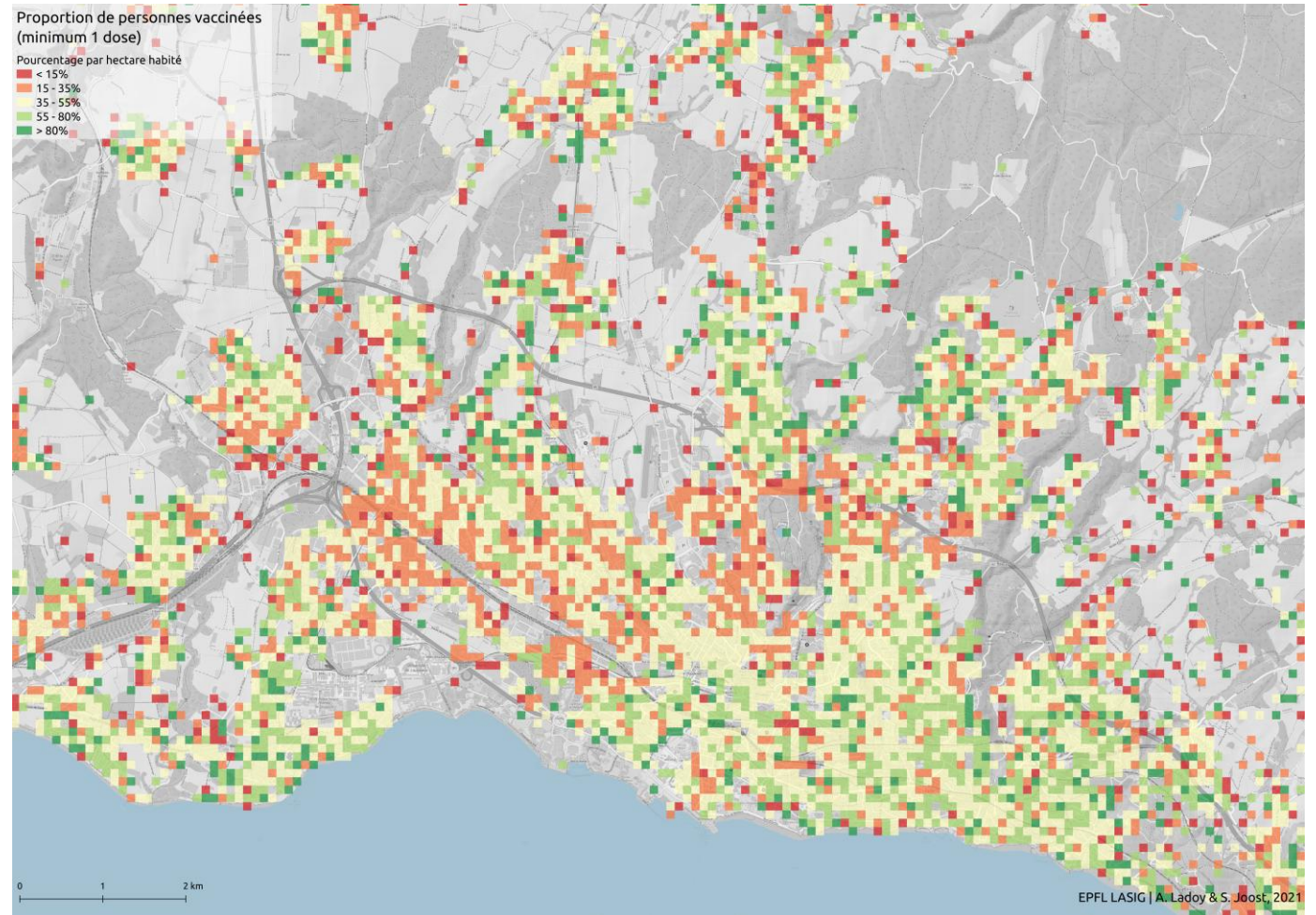
In situ measures with acousticians and a usher
to certify the measurements



La Source
Clinique

SARS-COV-2 Mobile Vaccination phase Hectare

- Target vulnerable populations in hectares where a low rate of "eligible" pop is vaccinated (1 dose)
- Ref: cantonal average = 40% of the population vaccinated in June 2021



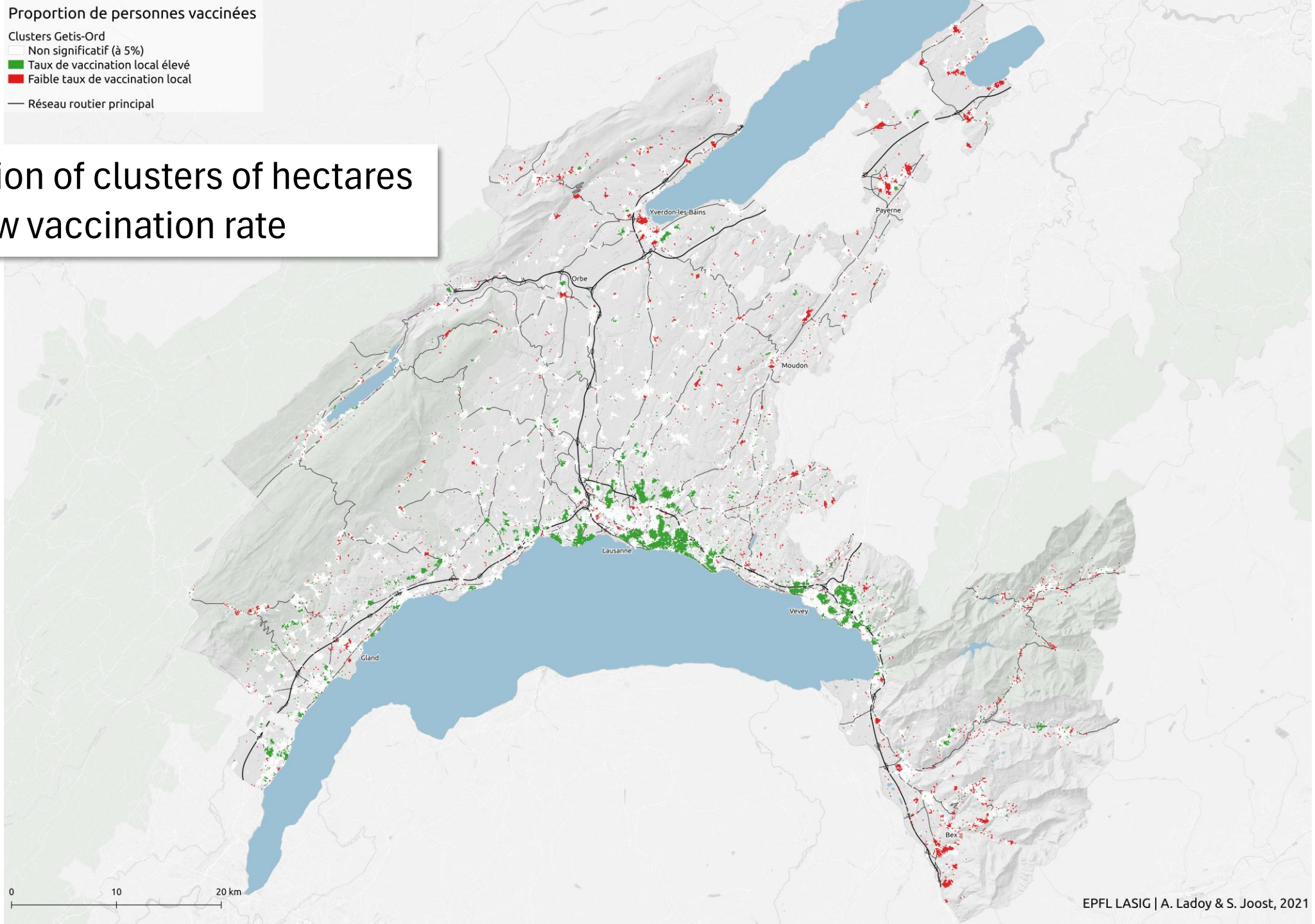
Proportion de personnes vaccinées

Clusters Getis-Ord

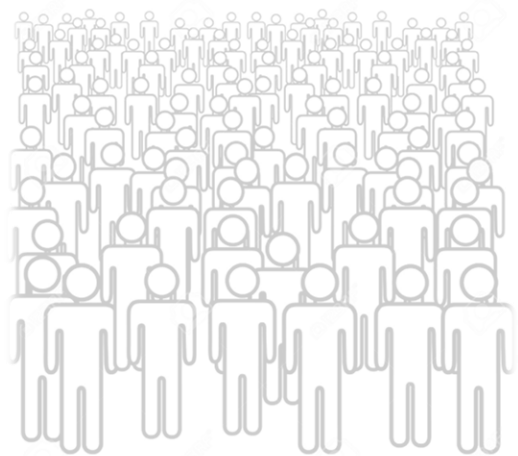
- Non significatif (à 5%)
- Taux de vaccination local élevé
- Faible taux de vaccination local

— Réseau routier principal

Detection of clusters of hectares with low vaccination rate



URBASAN – Sleep trouble early detection



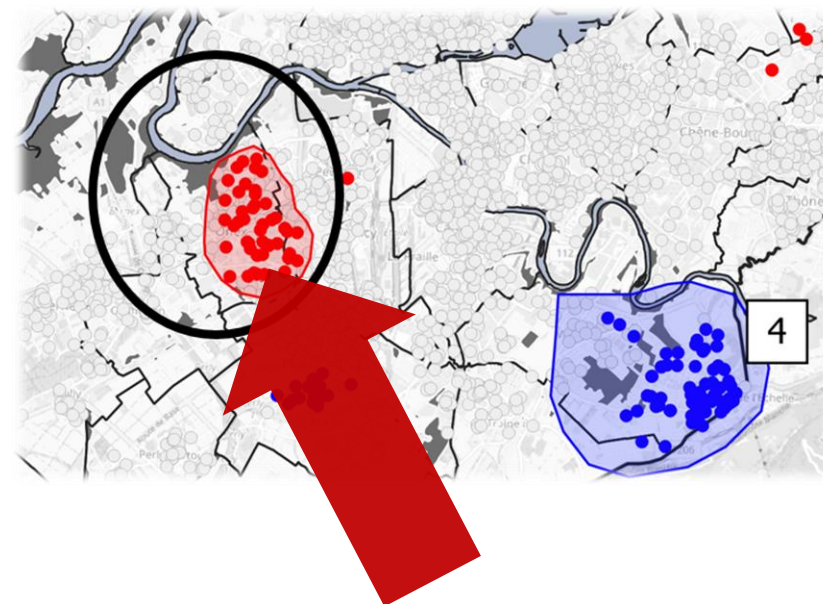
1. Actions de recrutement dans la population générale

2. Les participants volontaires remplissent des questionnaires en ligne sur la qualité du sommeil



3. Ces participants sont géoréférencés grâce à leur adresse postale (X, Y)

4. Leurs réponses permettent de détecter sur le territoire des regroupements significatifs de personnes avec troubles du sommeil (**clusters**)



5. Les professionnels de la santé et du sommeil proposent des ateliers de sensibilisation et de prévention directement dans les quartiers touchés

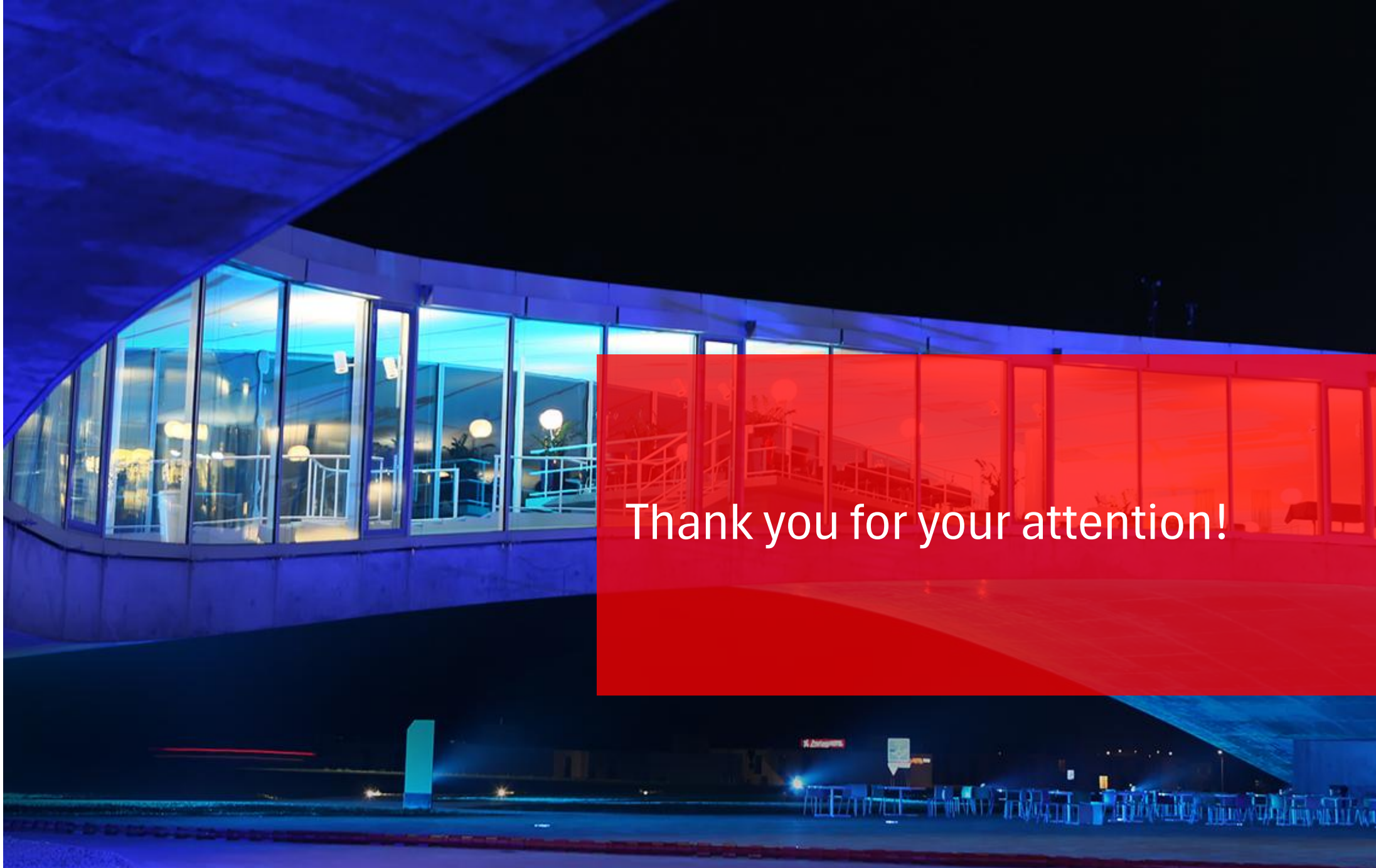
6. La même séquence d'actions est répétée chaque année et l'évolution des clusters est surveillée (mesure de l'effet des ateliers, répétition ou déplacement de ces derniers)

Conclusion

- With our research and training work in SIE/EPFL we can have a concrete impact on the society (e.g. GENMON for genetic resources; noise and speed reduction, COVID vaccination and Sleep trouble detection for public health)
- Many studies in VD and GE: on BMI (Guessous et al. 2014; Joost et al. 2016), nutrition (Joost et al. 2019; de Ridder et al. 2021), sleep disorders (Joost et al. 2018), physical activity (Vallarta-Robledo et al. 2022), infectious diseases (Ladoy et al. 2021), etc.
- Report on the public health policy of the canton of Vaud 2018-2022, Measure No. 4 “The use of geographic information in the development of public health and prevention policy programs must be intensified” (introduction of new practices based on SIE/EPFL research)
- URBASAN: from academic work to the implementation of public health prevention actions
- Dr Anaïs Ladoy, former SIE Ms and PhD student was hired by the state (now in charge of GIS and spatial epidemiology at the DGS Vaud)

Rapport
sur la politique
de santé publique
du canton de Vaud
2018-2022





Thank you for your attention!