

# ➤ Monitoring visitors in natural sites: insights from a case study in France the Chaîne des Puys – Limagne fault tectonic arena

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## ➤ Outline

- Introduction
  - Context / Study site
- Quantifying and qualifying visitors in 2019
  - Count data / Field survey / Global estimation
- Experiments of alternative methods
  - Flux vision / Online Survey
- Discussing monitoring system
  - Tested methods / Methodological framework
- Conclusion

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## > Introduction

- A **continuous growth** in tourism, especially in rural and mountain areas in recent years, notably linked to the presence of “must-see” protected natural sites, and increased by excursionists and locals since pandemic (lifestyle changes, teleworking)
- Consequently, monitoring visitors is even more a crucial element of management policies, to meet the **dual objective** of **preserving environments** (managing tourist pressure) and **developing the tourism economy**, as a lever for local development
- This involves the collection over **geographically extensive and complex areas**, of data about visitors and associated economic flows, that requires the implementation of a reliable, reproducible, but neither too cumbersome nor too costly system, that will enable replications over time for **inter-annual comparisons**
- The objective of this presentation is to provide **insights based on some experiments** to help developing a **methodological framework** for monitoring visitors in natural sites, based on the approach used to estimate visitor numbers **in a French natural site**.

## ➤ Contexte

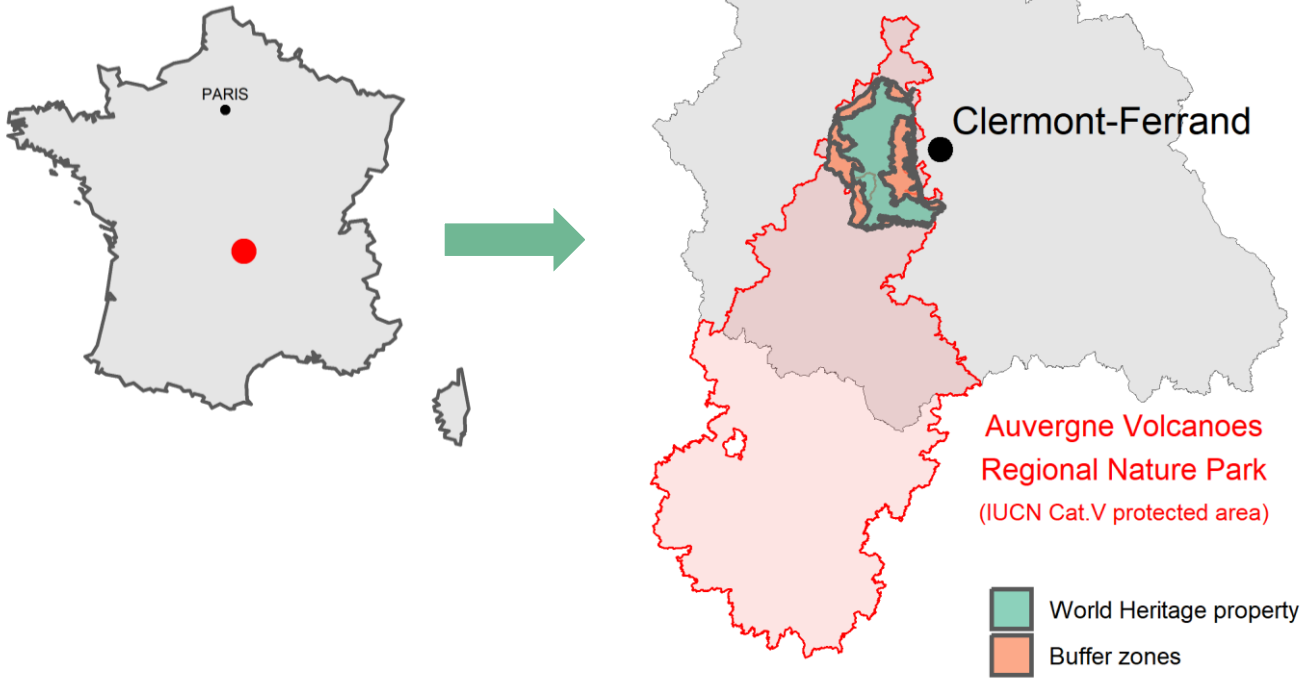
- Valo-Sites project (2019-2022)
  - Methods for evaluating the socio-economic effects of management and valorisation policies of natural sites
  - Main partners: Puy de Dôme departmental council, Auvergne Volcanoes Regional Nature Park
  - Associated sites: Causses and Cévennes, Cirque de Navacelle
- A task dedicated to study visitor flows (tourism and leisure activities)
  - Estimating the total number of visitors in 2019
  - Conducting a visitor survey to assess economic impacts
  - Testing methods for visitor monitoring systems

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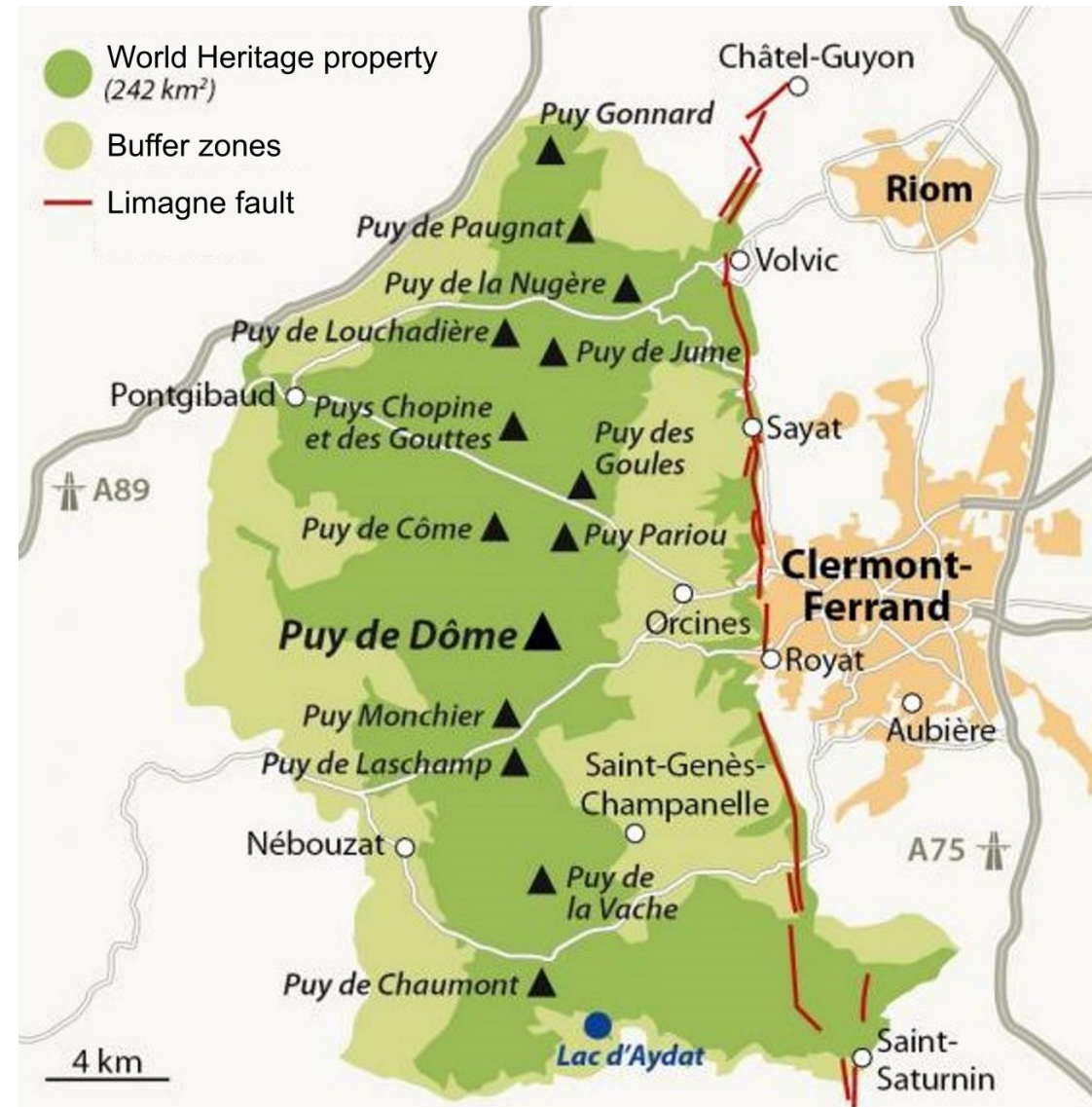
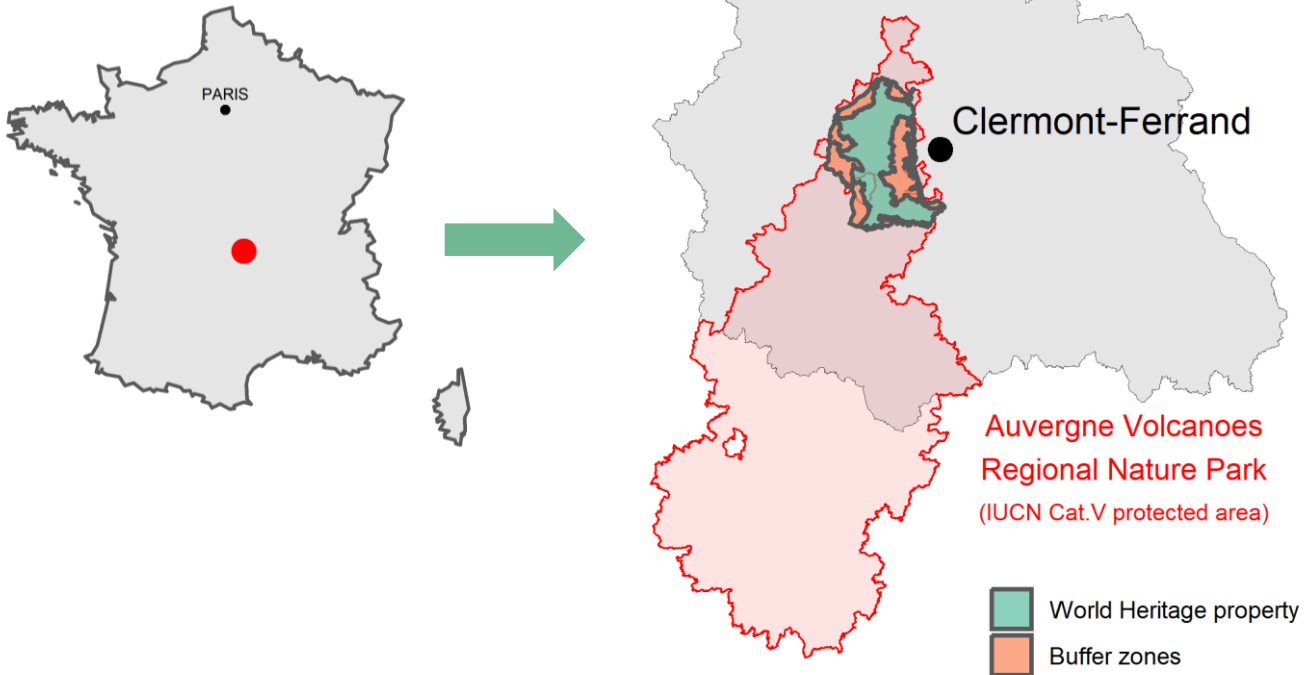
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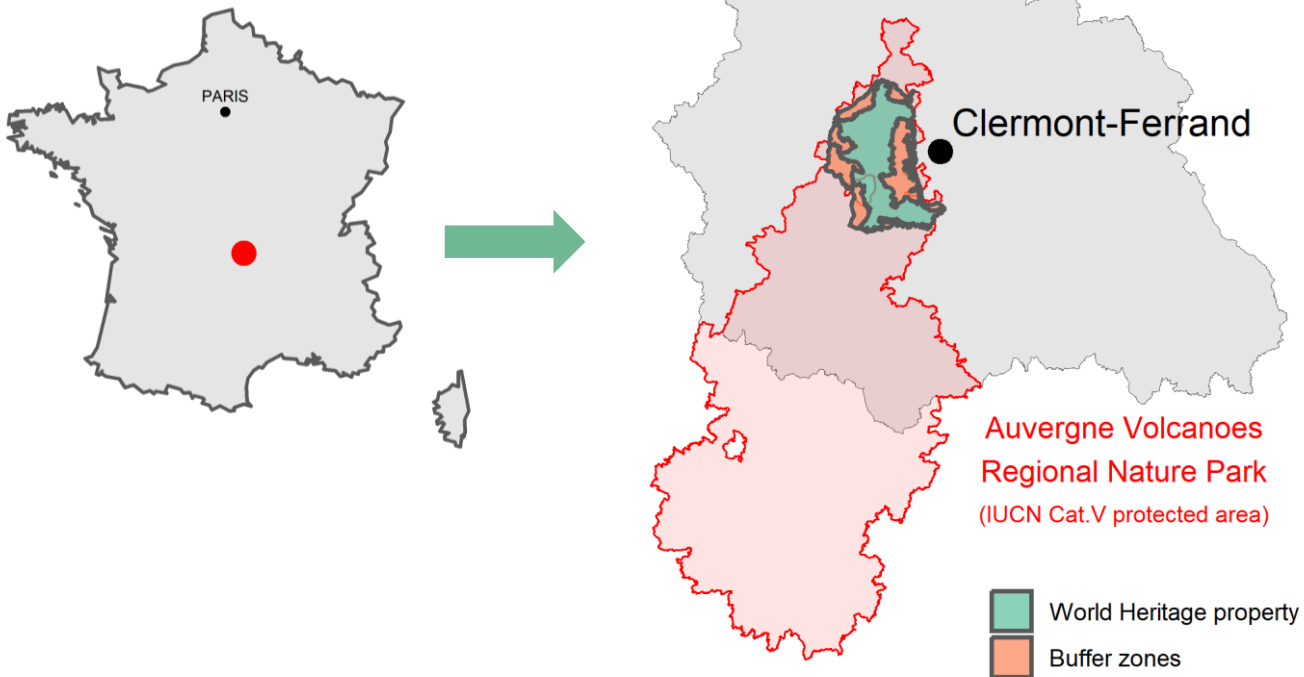
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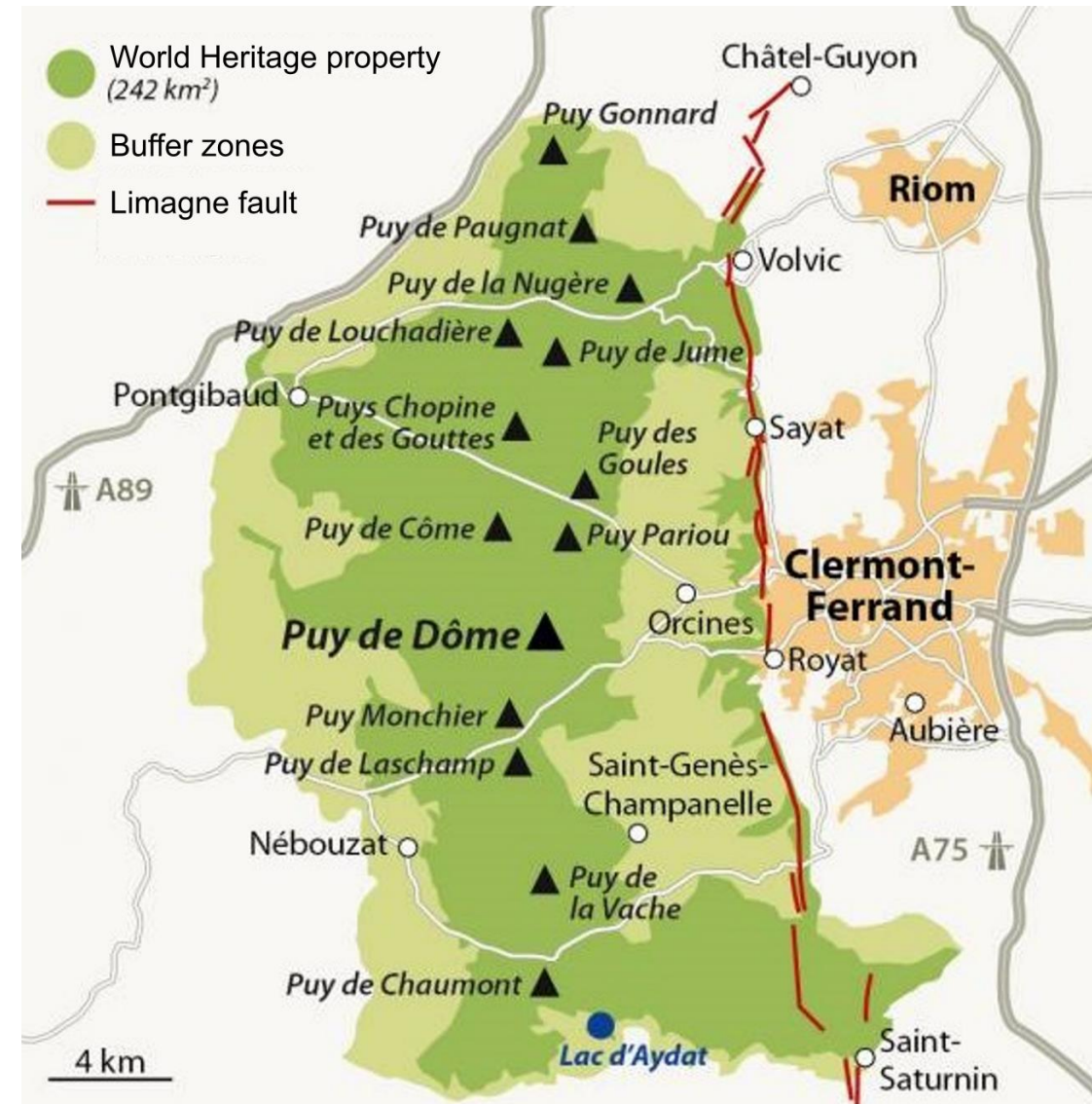


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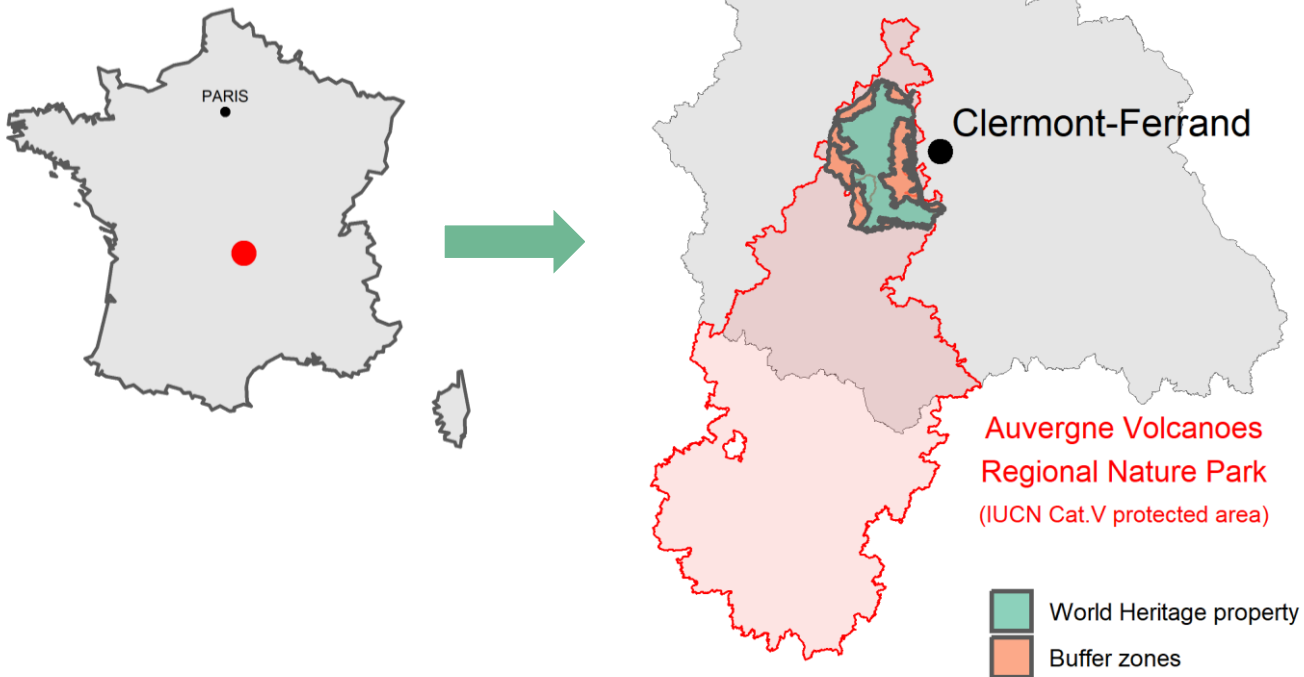


### Chaîne des Puys - Limagne Fault tectonic arena (CPLF)

- RNP Auvergne Volcanoes (since its creation in 1977)
- « Site classé » (law of 1930) since 2000
- Grand Site de France (since 2008)
- **UNESCO's World Heritage List in 2018** for its tectonic features (criterion viii)

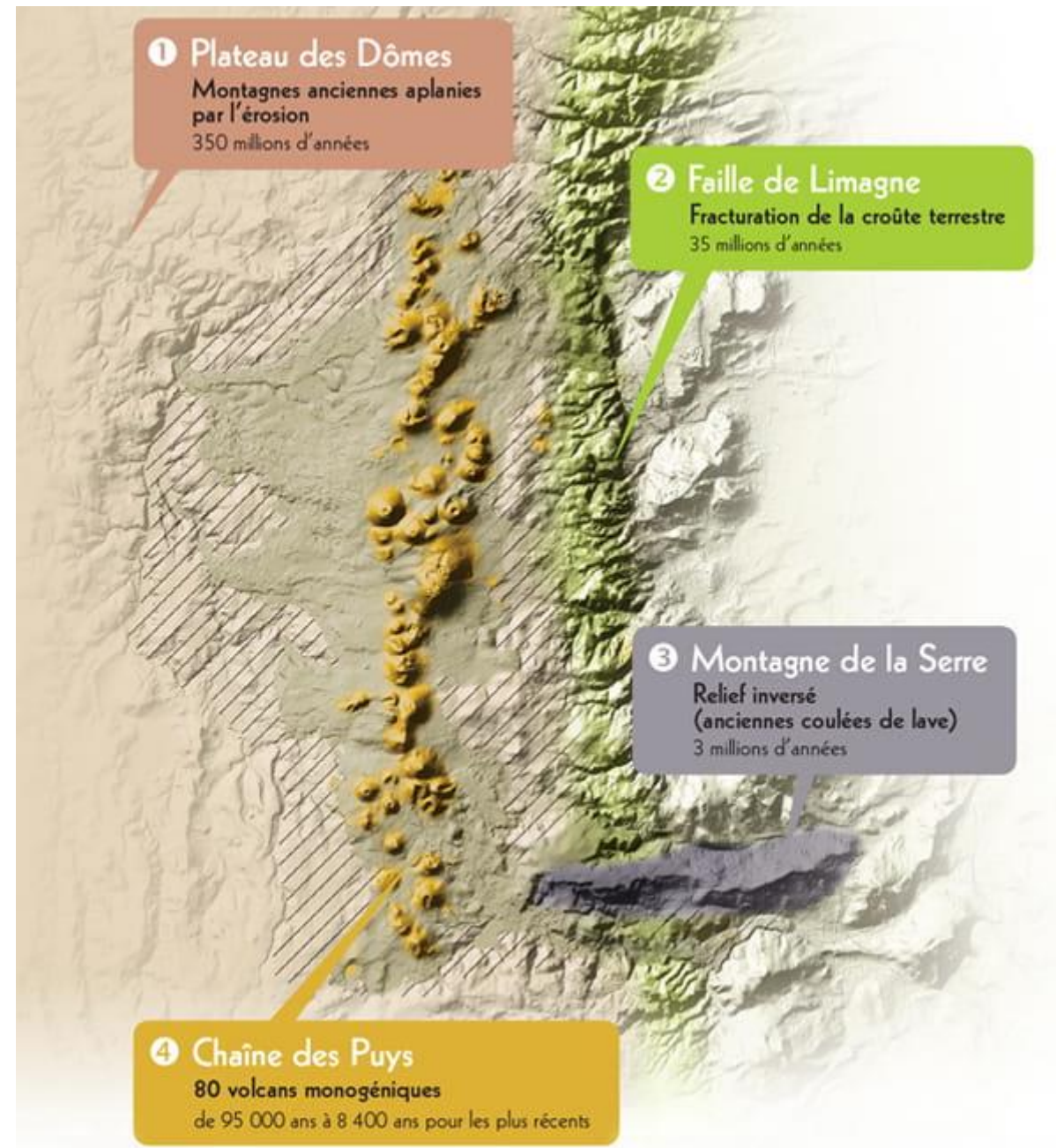


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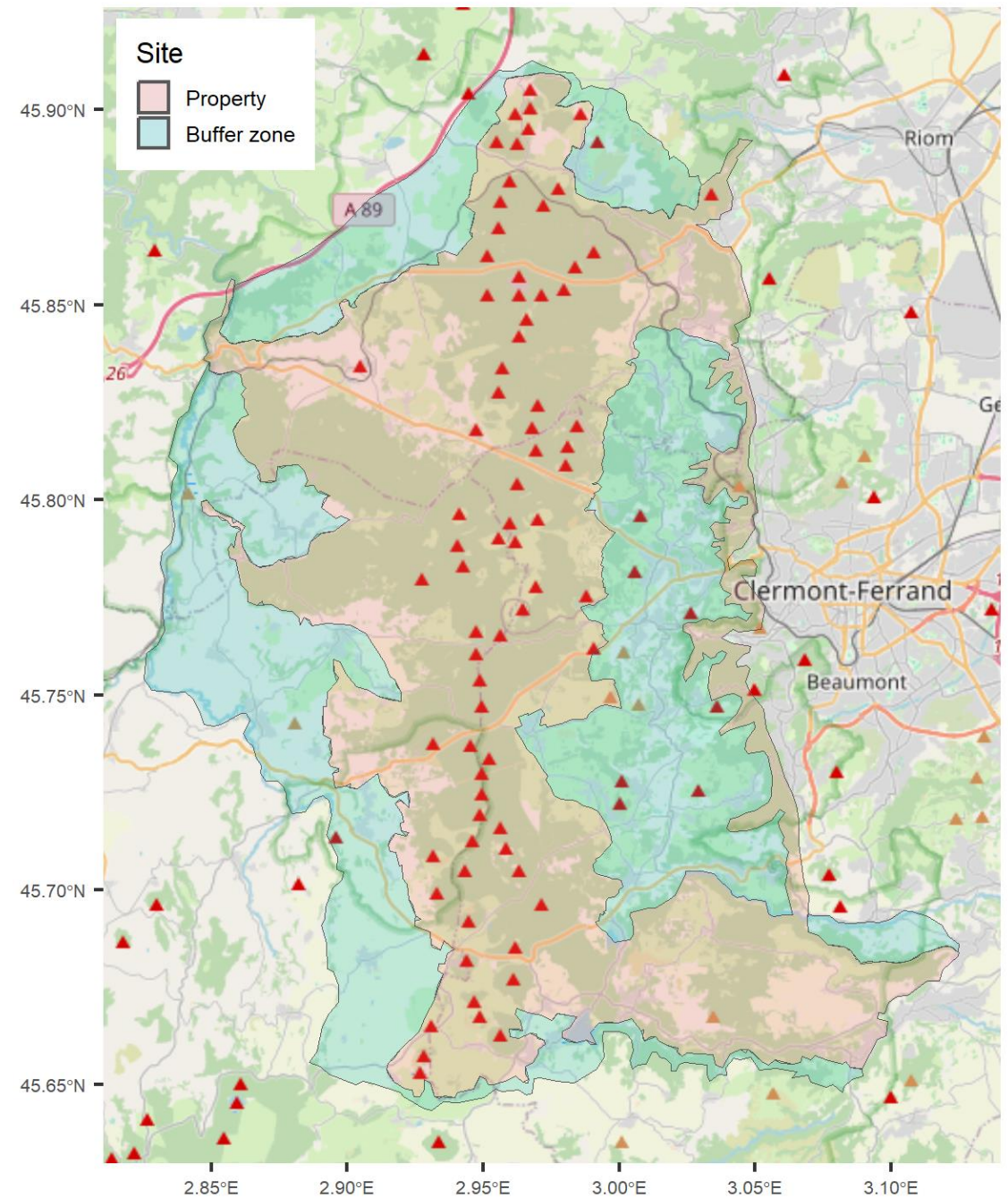
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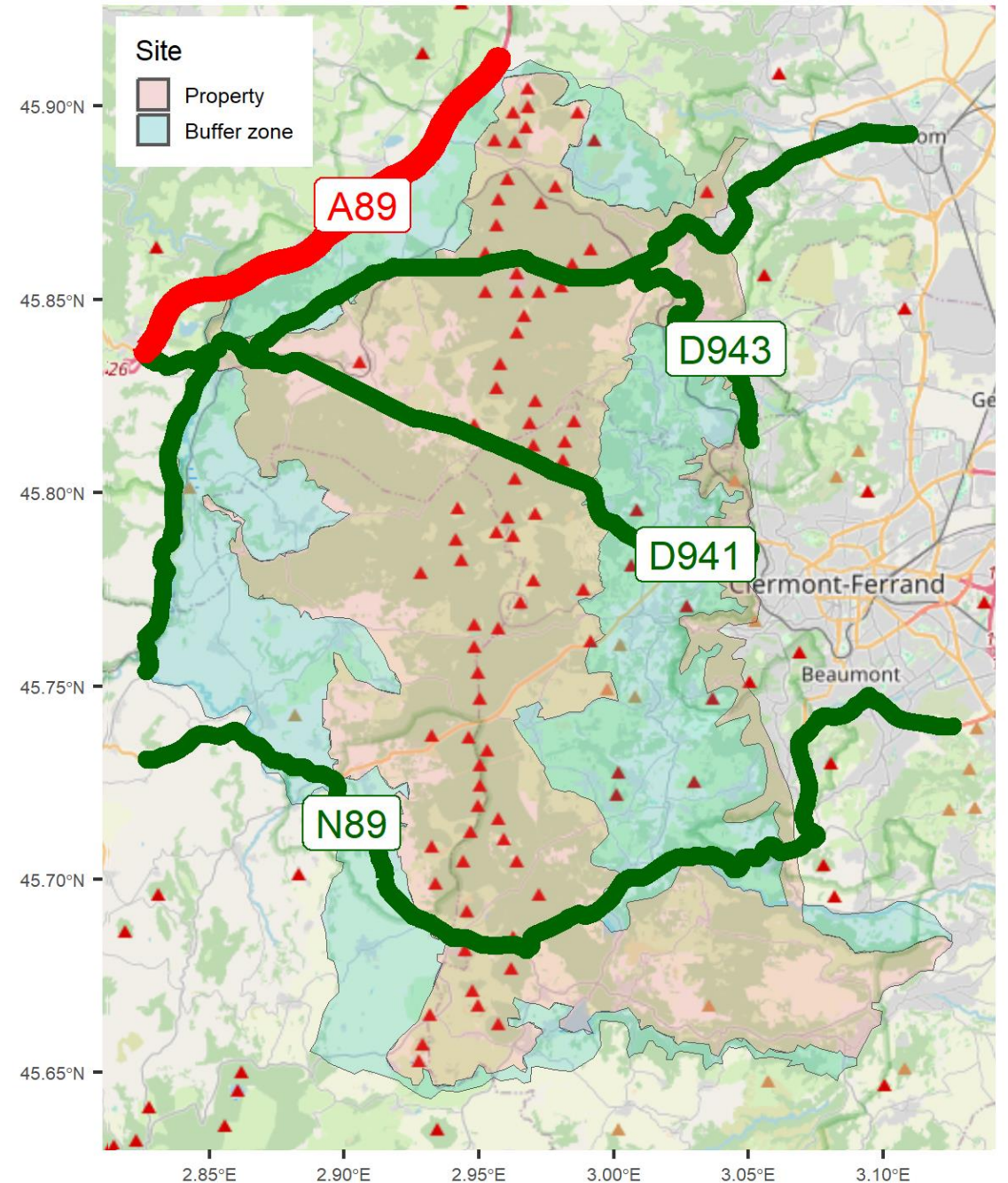
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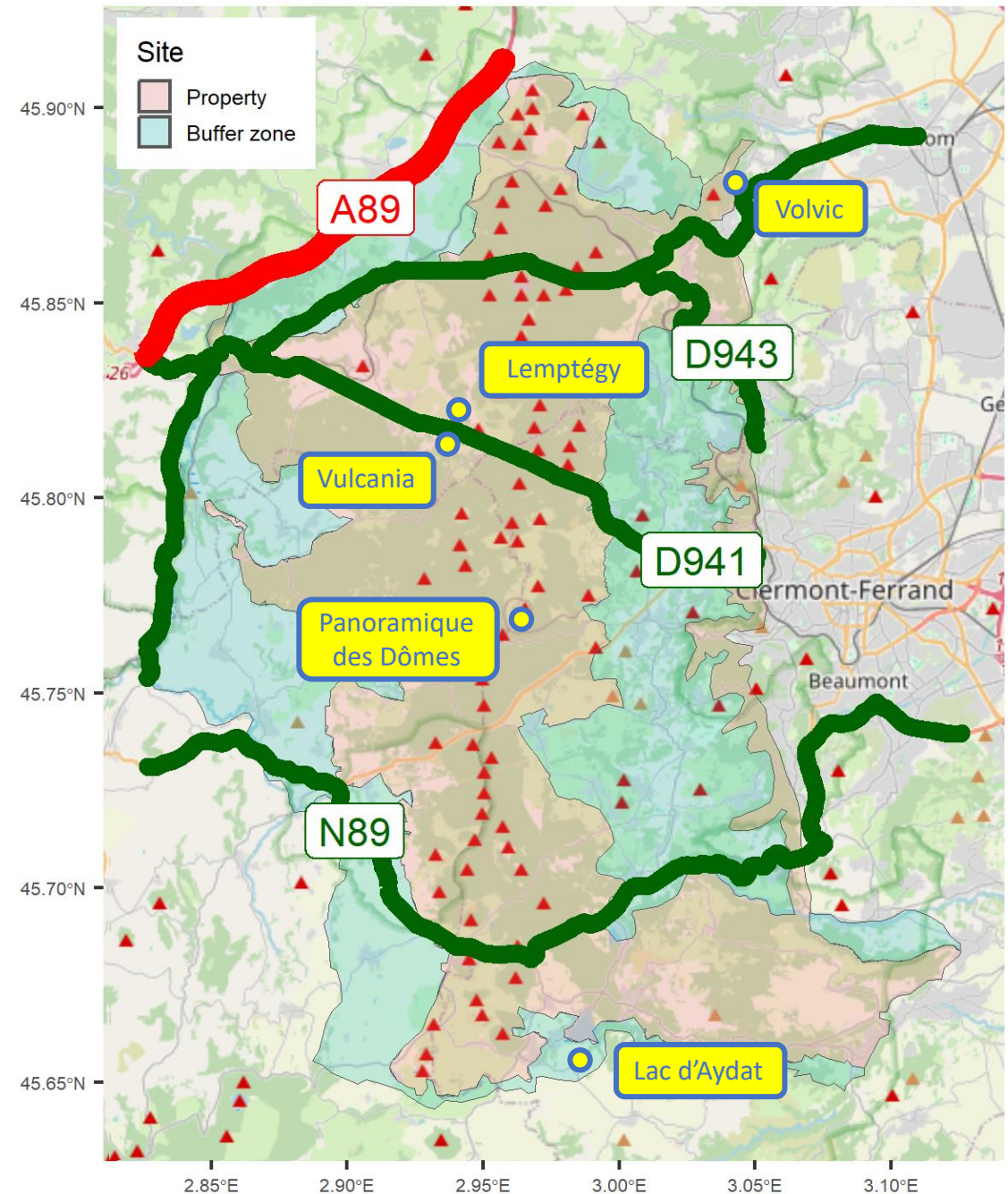
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  - transit with major roads crossing the area,
  - and many interconnected trails,



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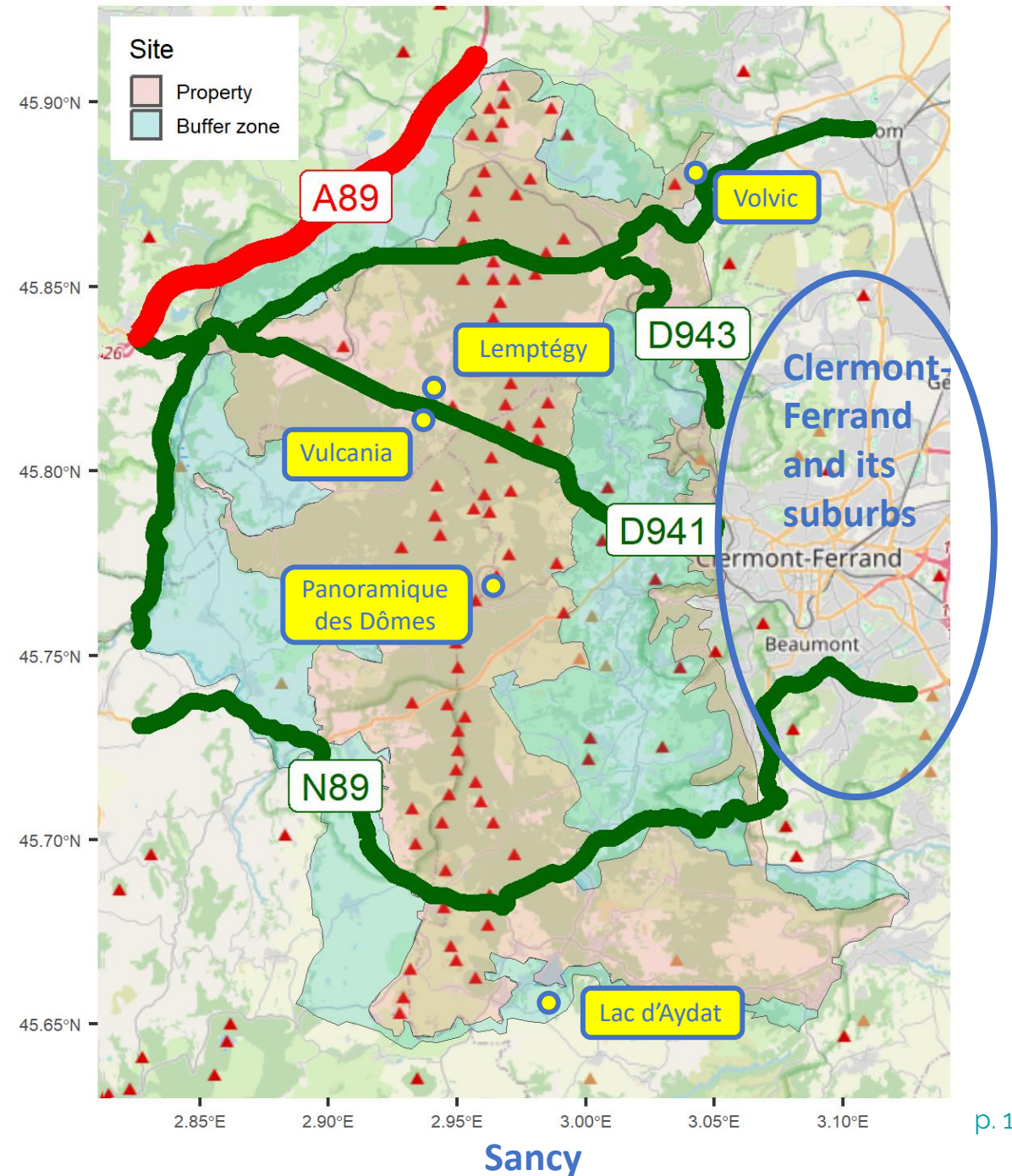
- its openness with:
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  - hiking, paragliding, water sports at Aydat...
  - Many attractions: Panoramique des Dômes, Vulcania, Lemptégy...



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- its openness with:
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- the diversity of recreational activities:
  - hiking, paragliding, water sports at Aydat...
  - Many attractions: Panoramique des Dômes, Vulcania, Lemptégy...
- Interactions with:
  - Clermont-Ferrand and its suburbs
  - The Sancy valley, another touristic spot just 15 km south of the site



## ➤ Landscapes

### Puy de Pariou



### Puy de Côme



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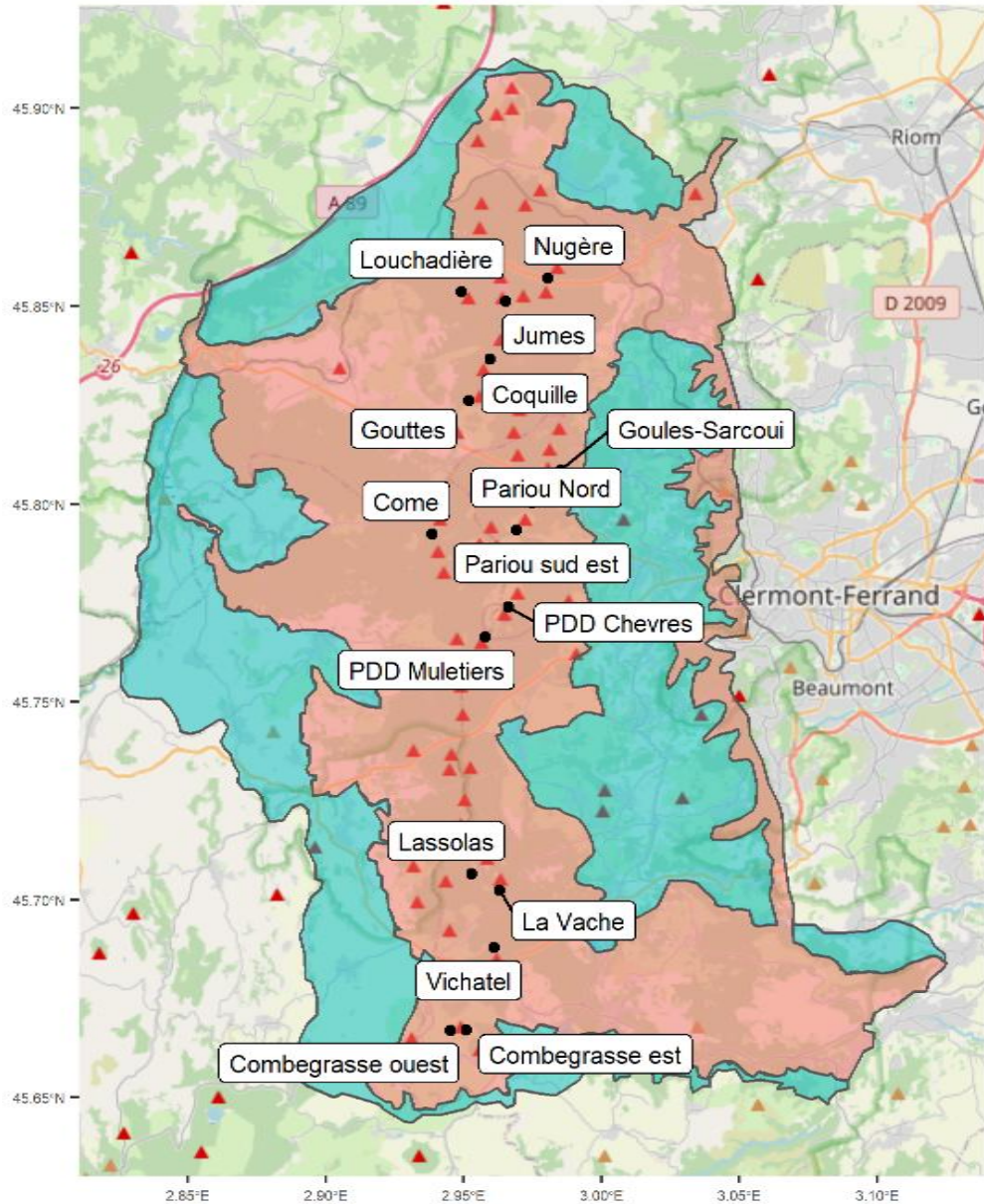
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## ➤ Available data

Source	Type	Resolution	Additional data
<b>Eco-counters (EC)</b>	16 EC in tracks to Puy 2 directions (IN / OUT)	hourly	Loss estimates (by park rangers)
<b>Panoramique des Dômes (PDD)</b>	Cogwheel train to Puy de Dôme	by trip	
<b>Lemptégy Volcano</b>	Ticket sales	monthly	Visitor numbers per day on August 2019
<b>Vulcania</b>	Ticket sales	yearly	Visitor numbers per day on August 2019
<b>Volvic</b>	Ticket sales (2 sites) - <i>Maison de la Pierre</i> - <i>Information Space</i>	yearly	
<b>Lac d'Aydat</b>			Tourist Office visits (per day) Summer peak estimate (people on the beach)

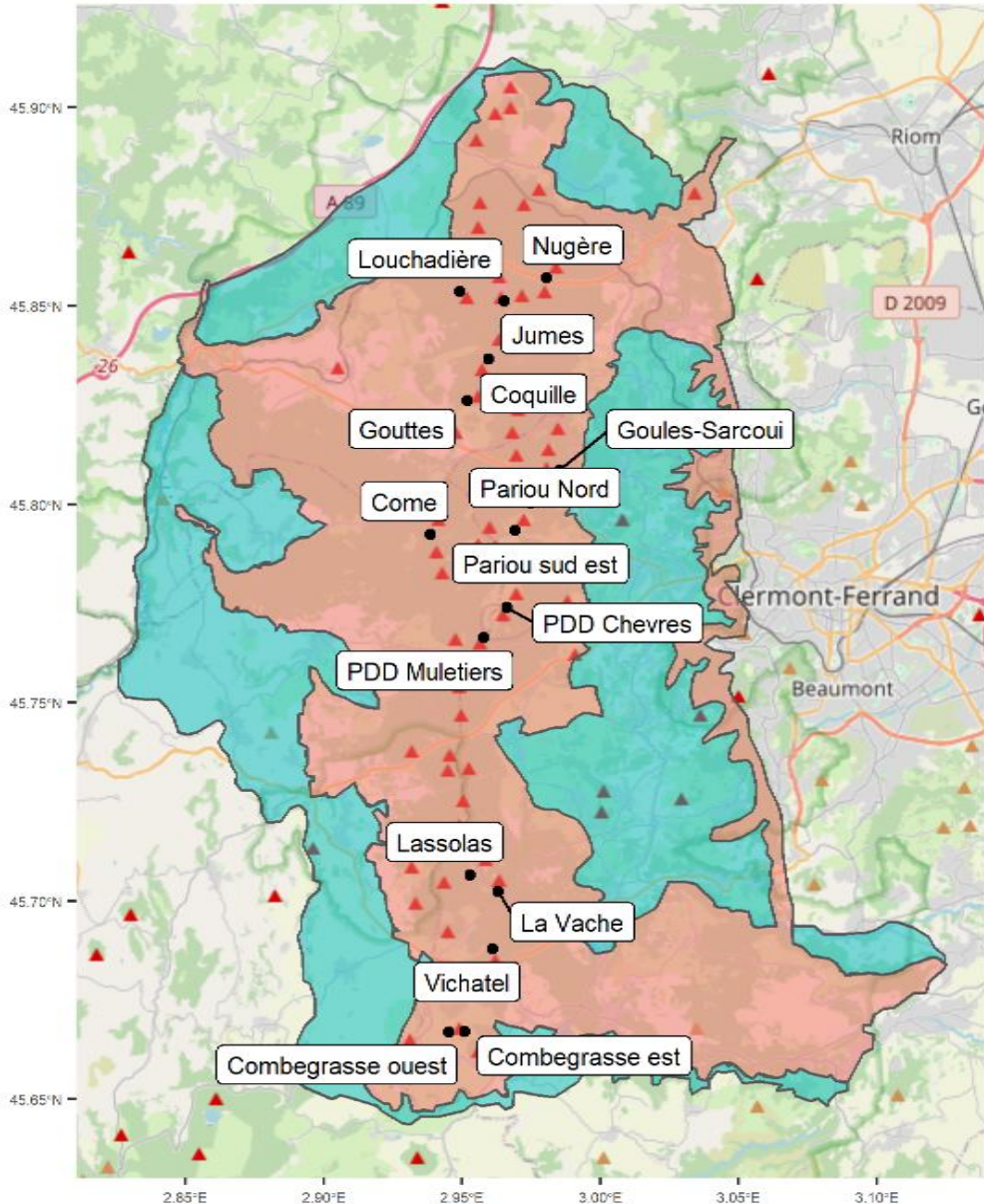
- Very heterogeneous data (resolution, quality)
- Eco-counters set up to monitor erosion... not visitors
- Sites et trails non-equipped (Aydat, Montagne de la Serre)

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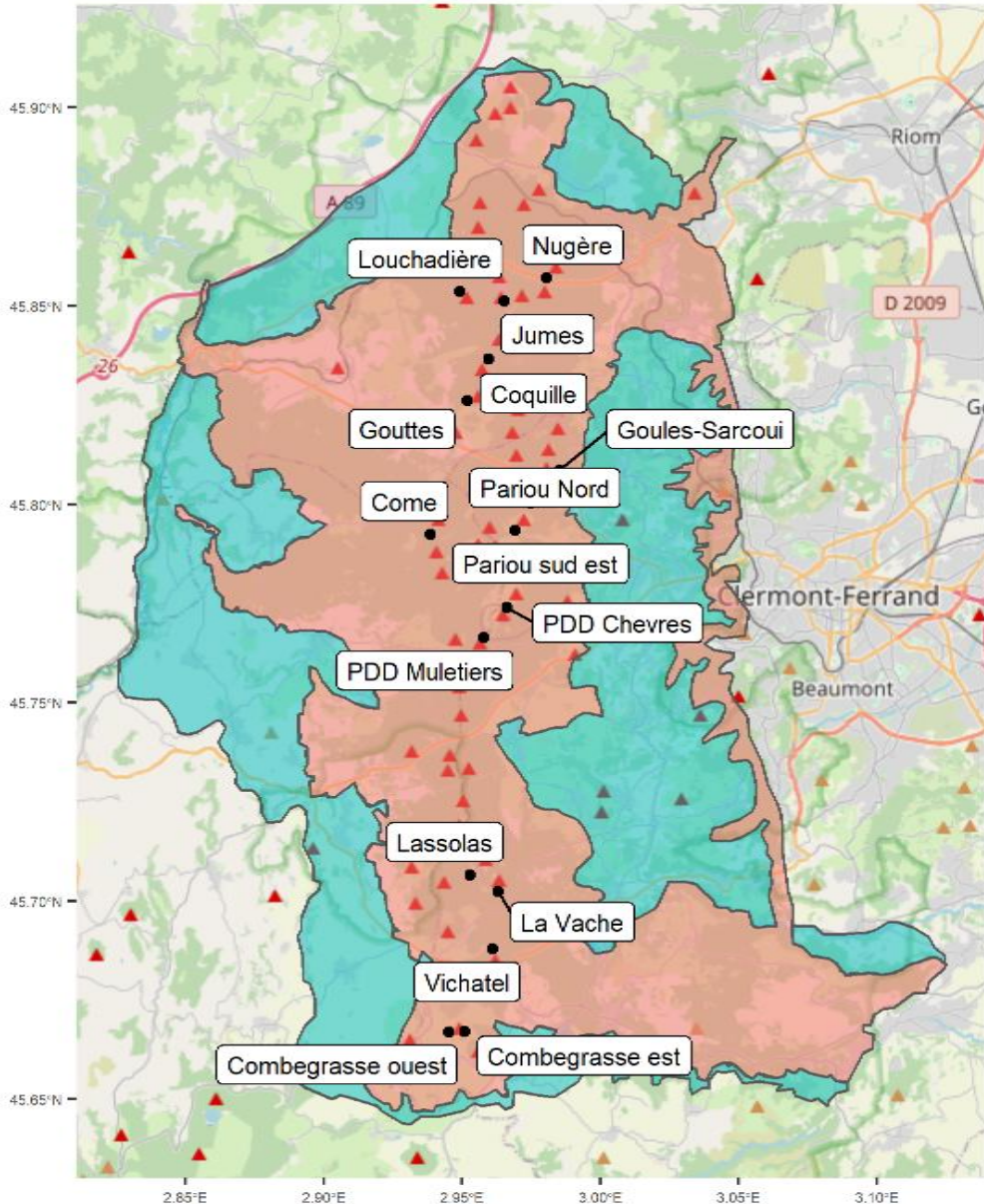
EC on paths that leads to the top of Puy...

- Many interconnected paths around Puy, which do not lead to summit, used by many locals
- Losses due to off-trail walks and alternative paths
- Unequipped trails
- Possibility of different combinations of the same Puy

Most series are also affected by:

- Malfunctions and losses due to vandalism, rodents...
- Peaks due to races, school outings... and sheep flocks
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→ Need solutions to:

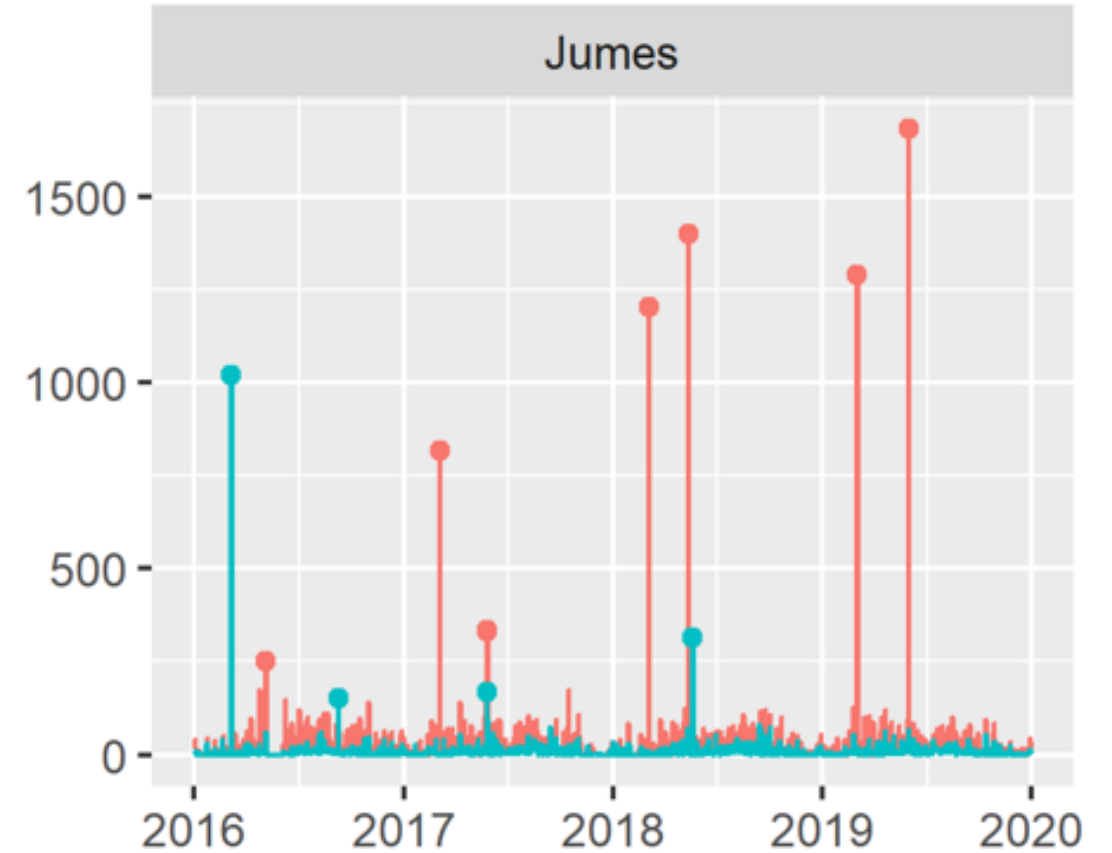
- detect abnormal patterns and provide corrections
- extrapolate the number of visitors on unequipped paths
- properly combine data

## ➤ Processing of Eco-Counter data

- Detection of abnormal patterns

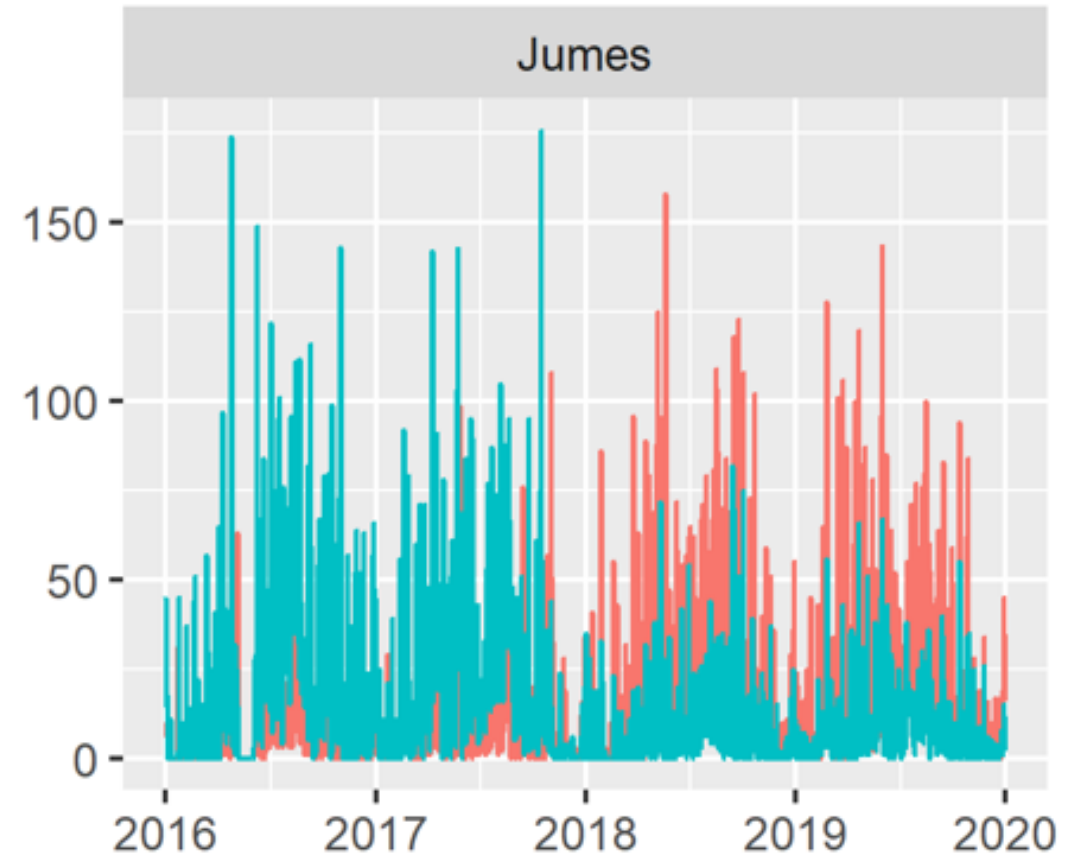
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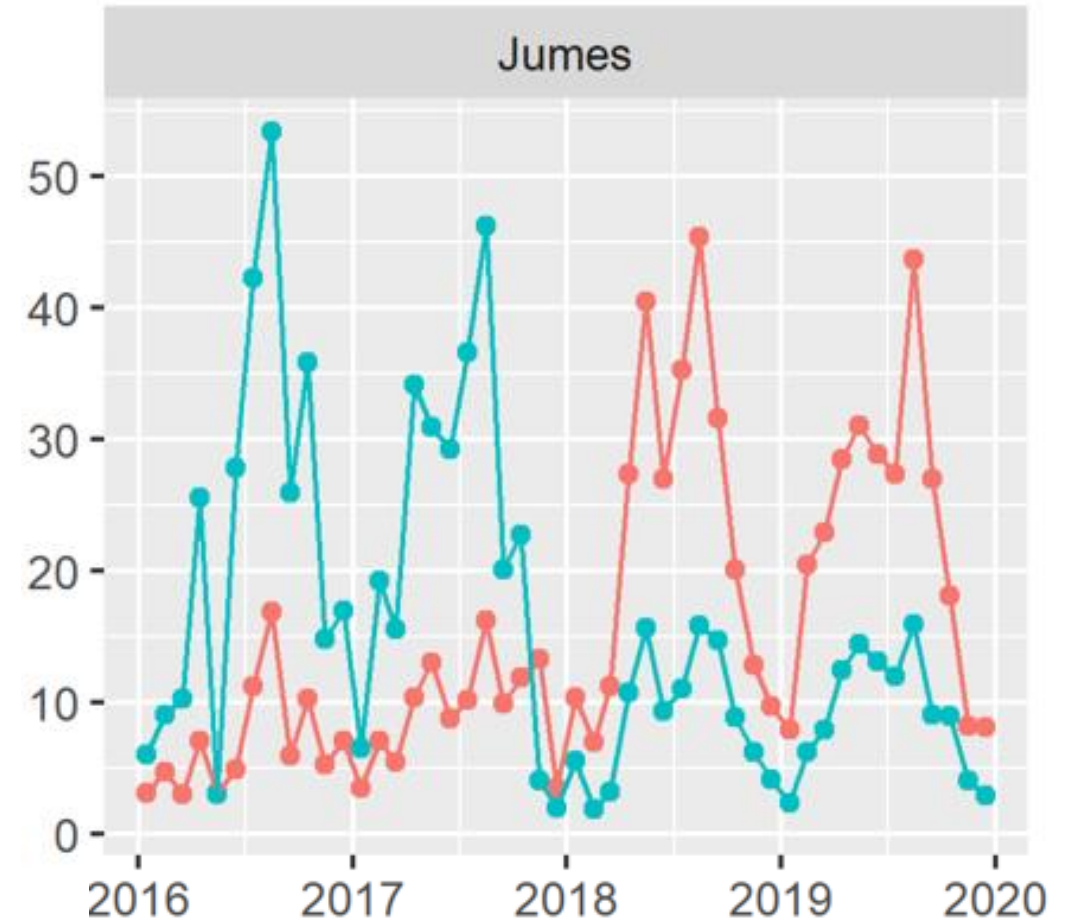
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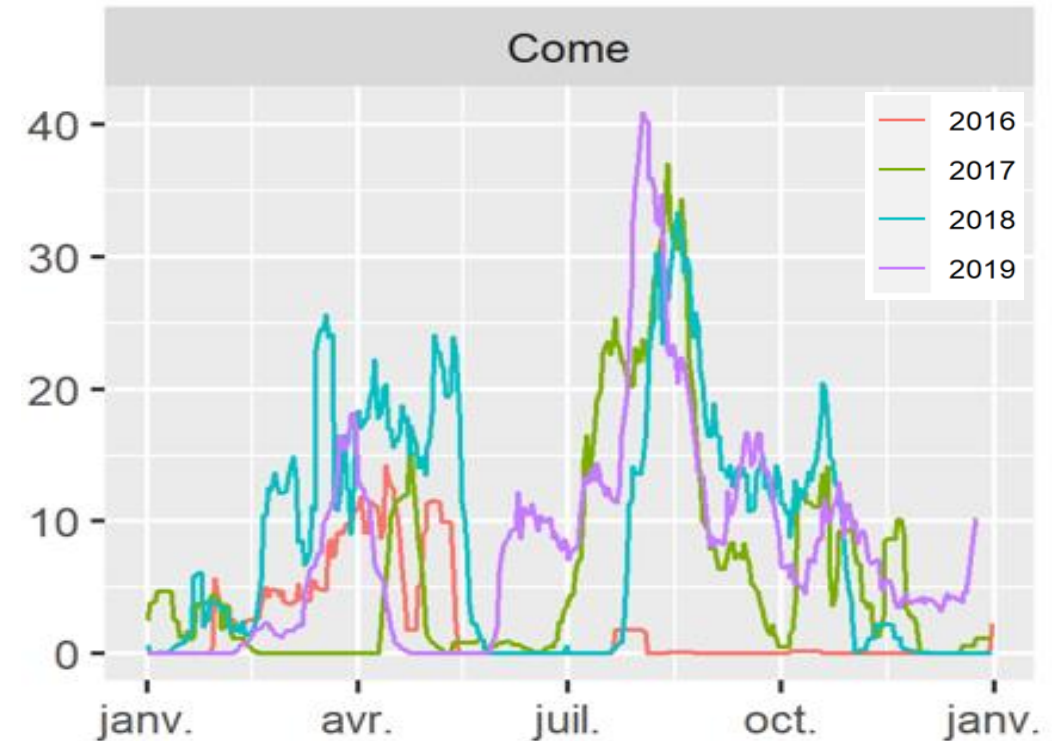
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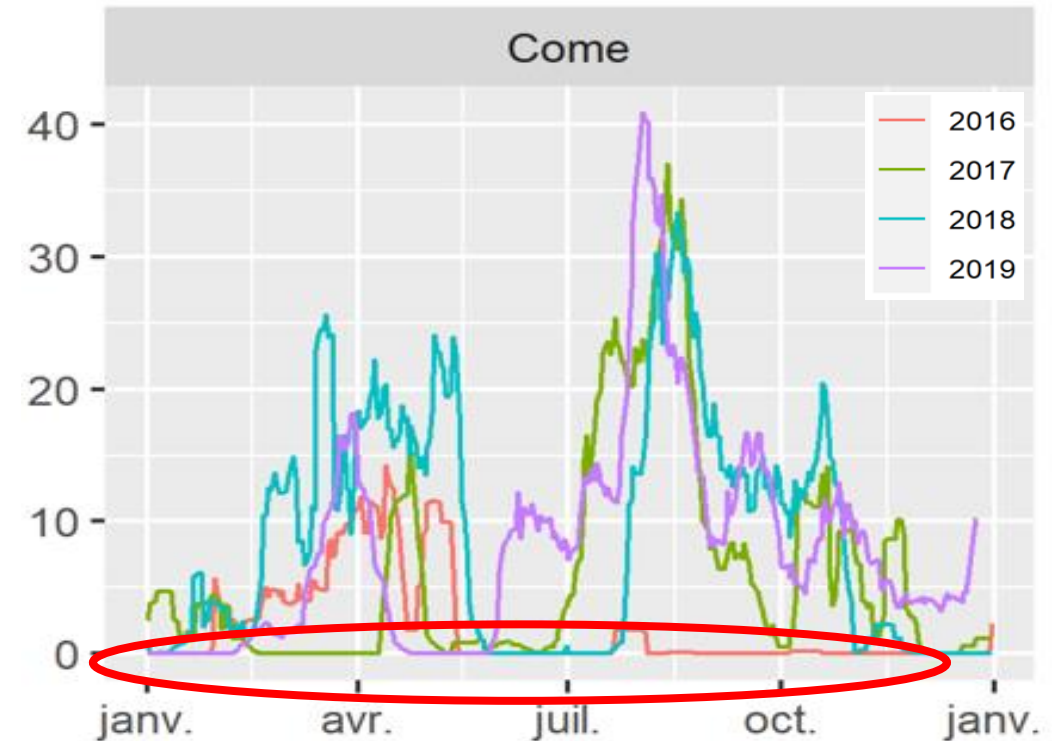
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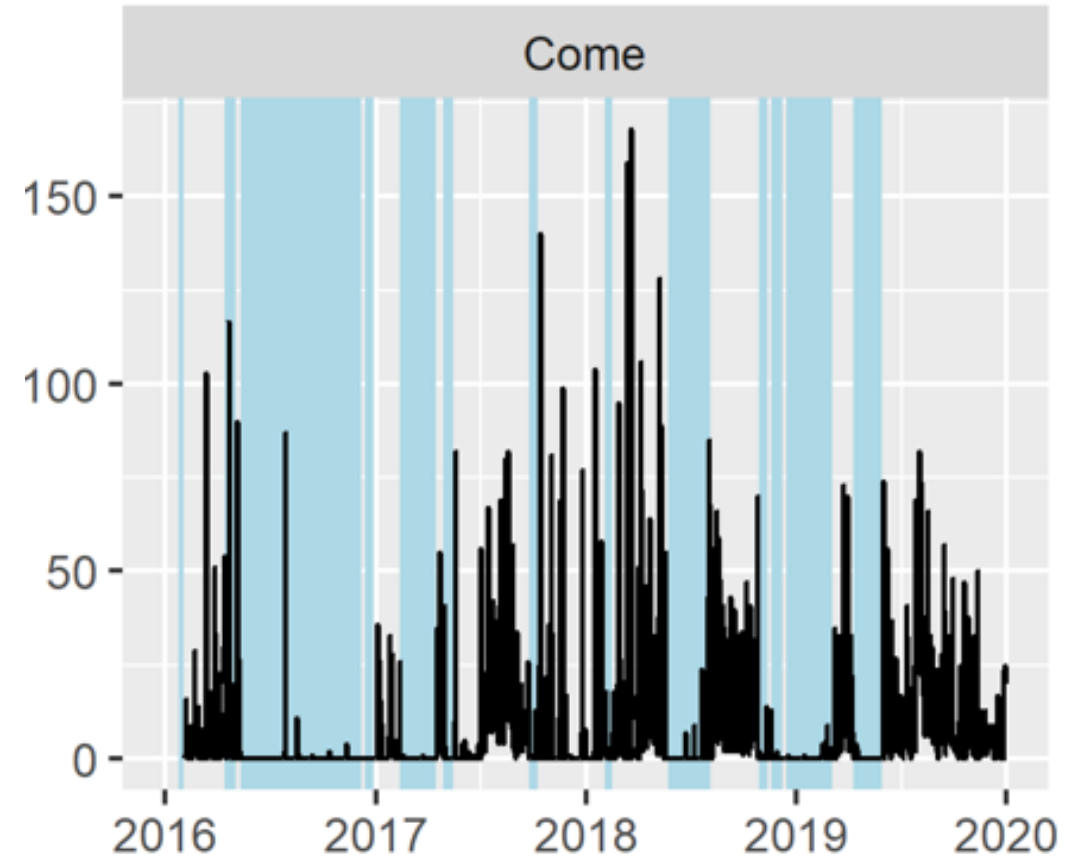
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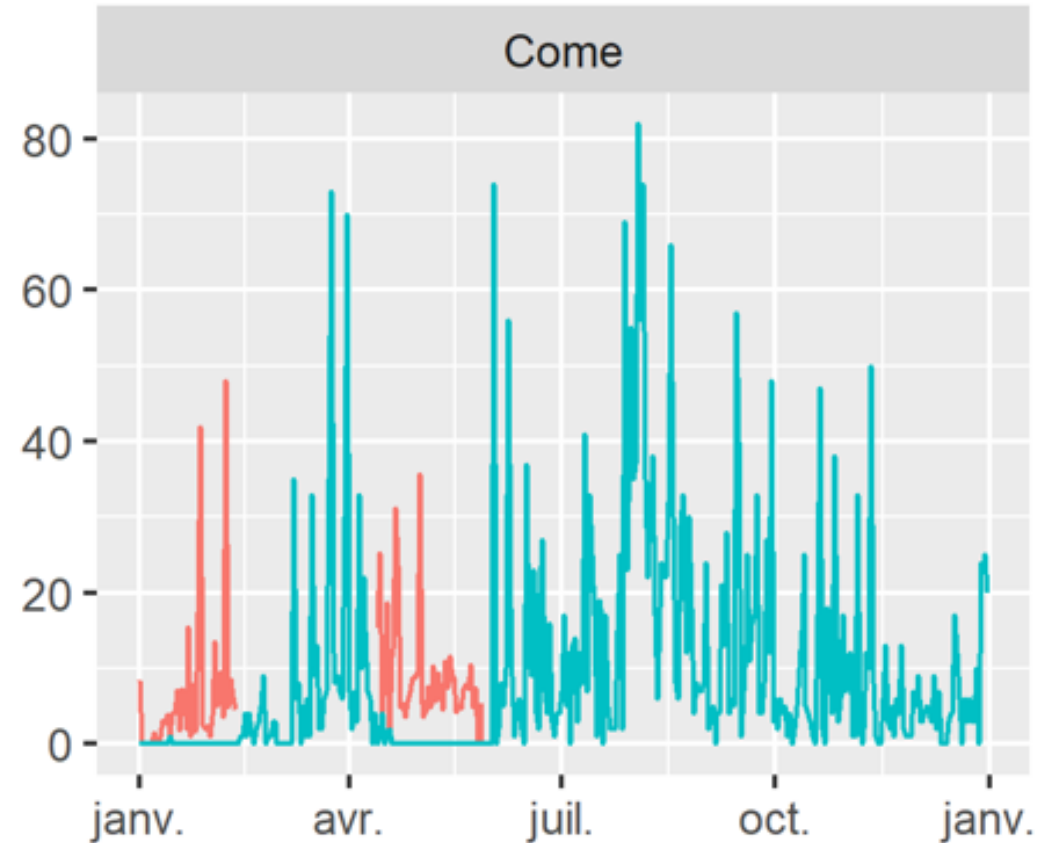
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- Processing
  - Design of filters for **automatic detection**



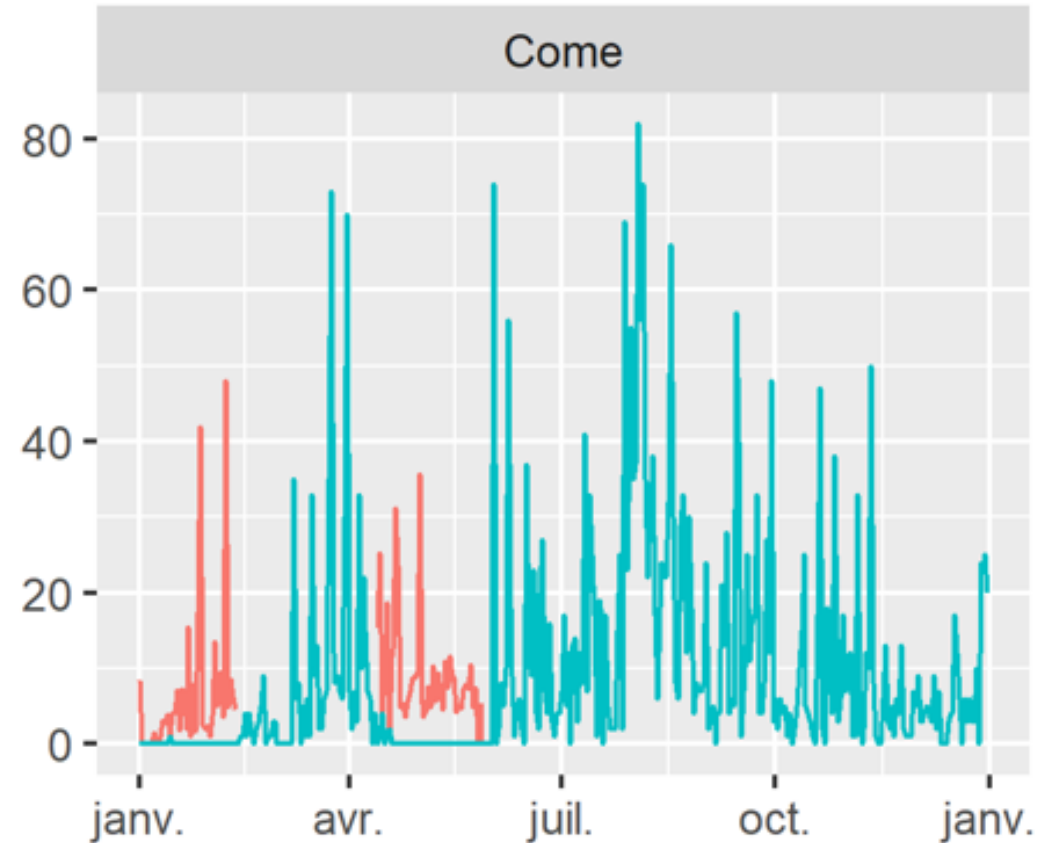
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  - Design of filters for **automatic detection**
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- Extrapolation
  - Extrapolation to account for losses and unequipped trails using modulation **coefficients** by sub-areas established **by expertise** (park officers and rangers)



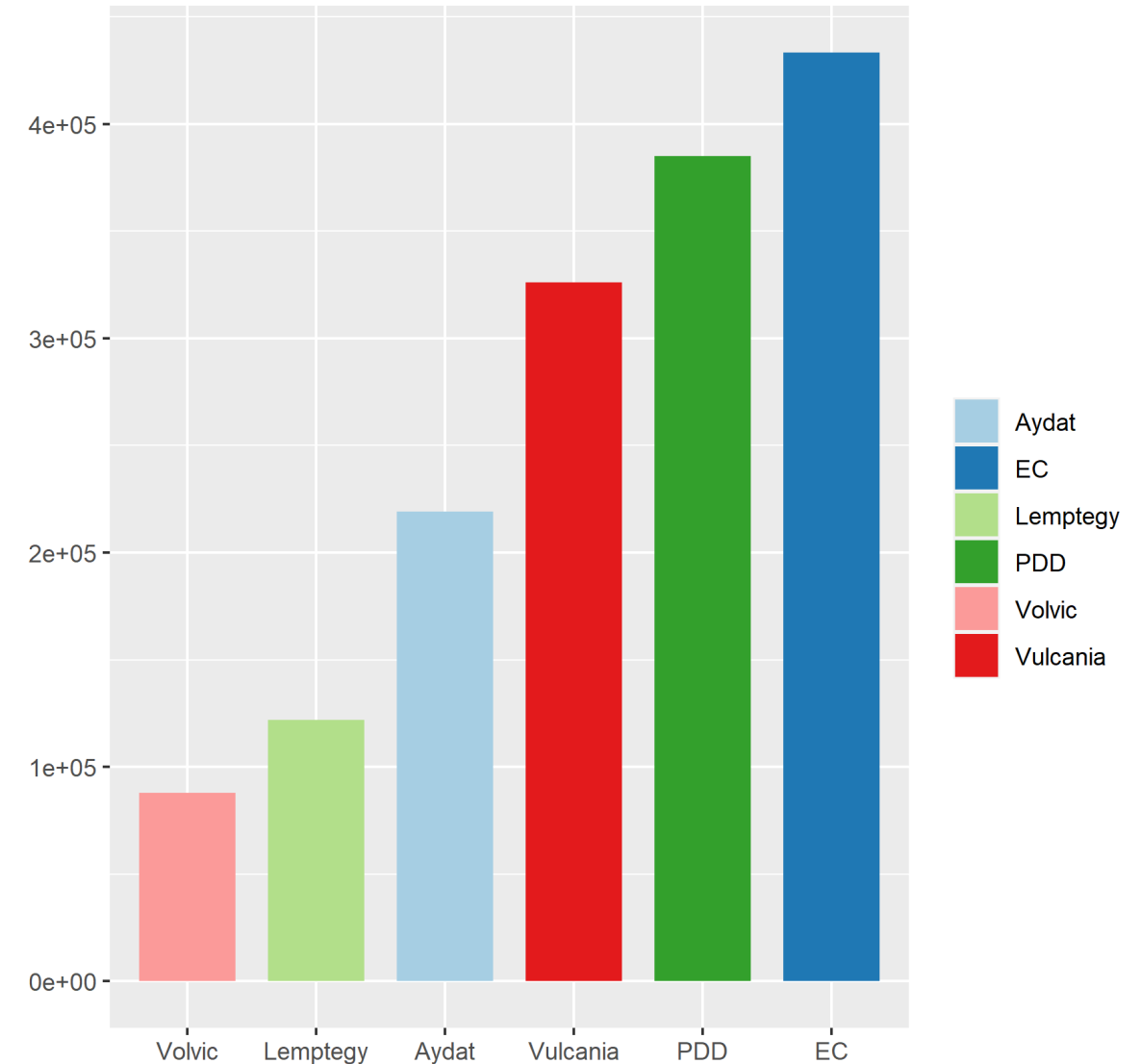
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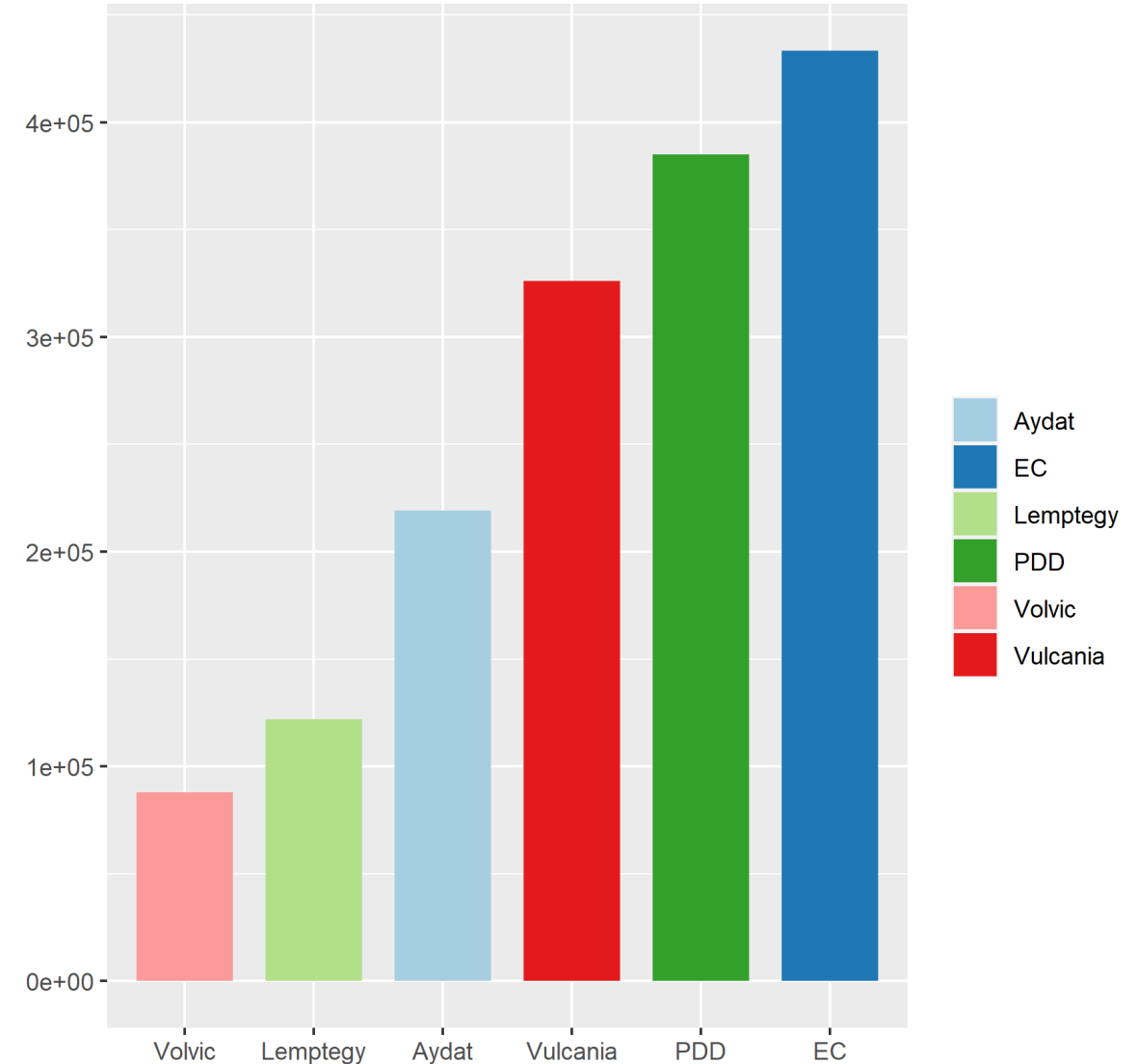
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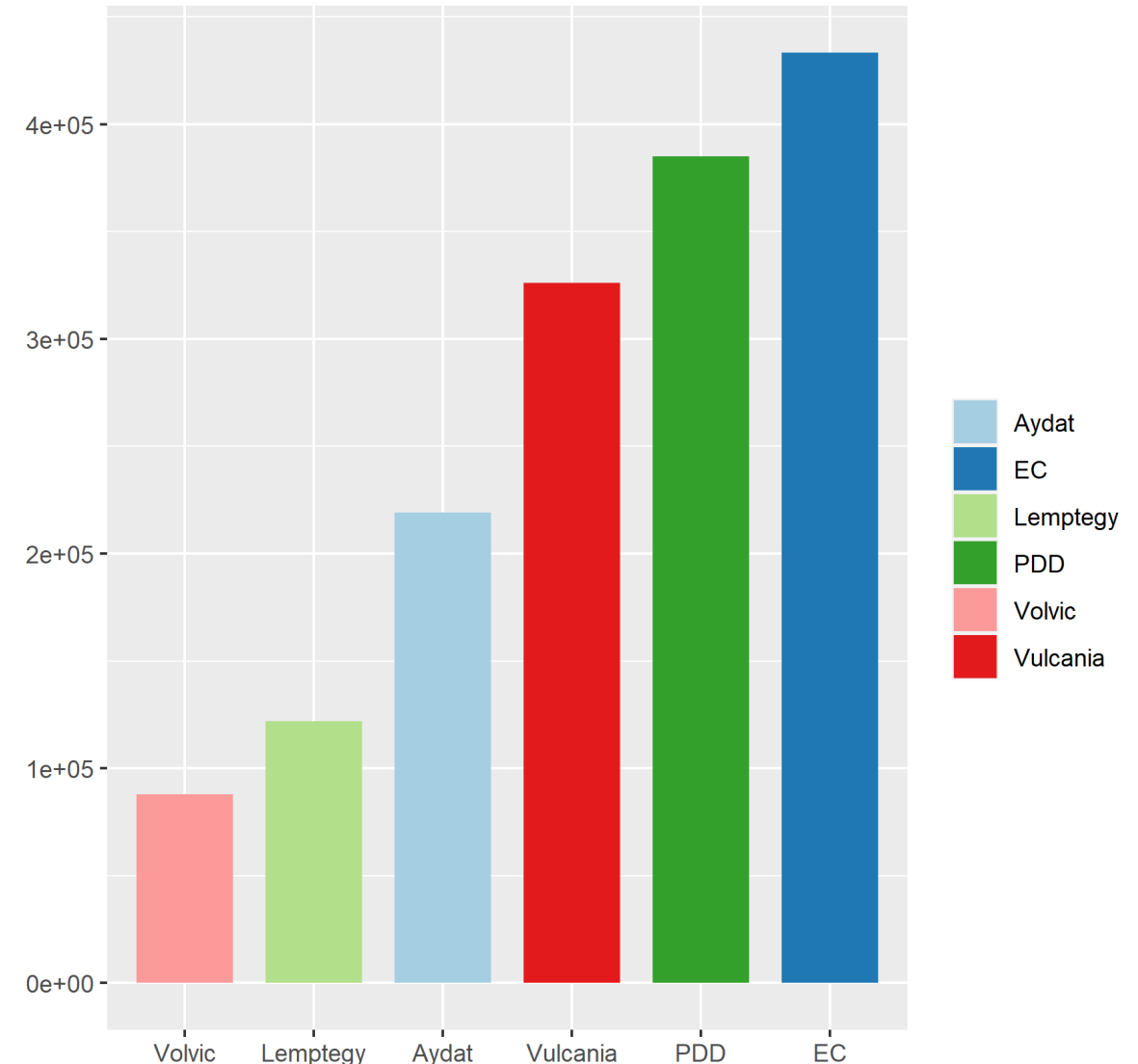
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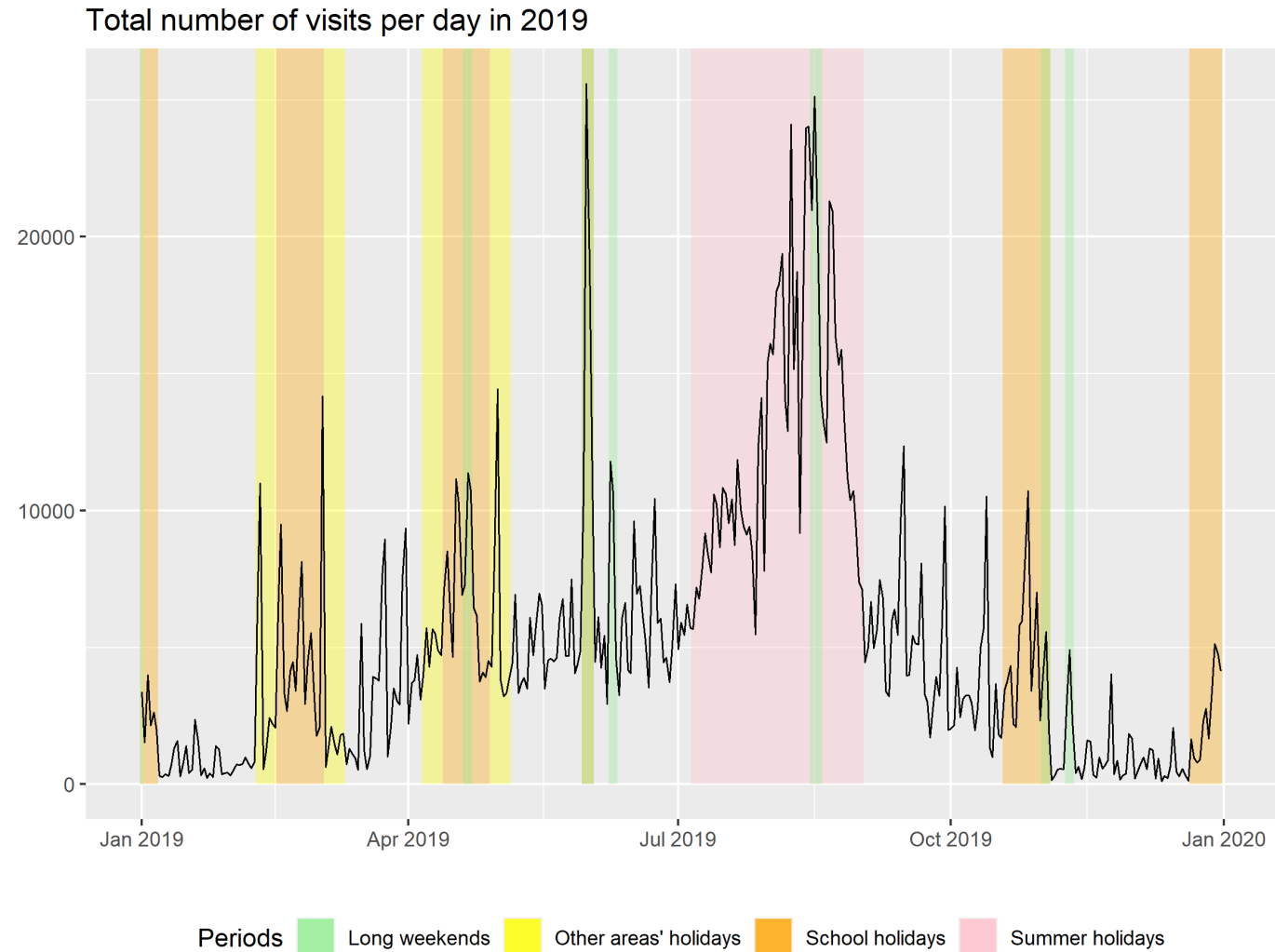
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- **Aggregation of data from all countable sites** including ticket sales for Vulcania, Lemptégy...
- Reconstruction of series of **daily numbers of visits** using opening schedule, Lemptégy and PDD data



## ➤ A large visitor survey (2019-2020)

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**Purpose :** to study visitors' motivations and spending to estimate economic impacts

**Questionnaire on:**

- Nature of stay and destination choice
- Visits and activities distinguishing intra- and extra-CPFL
- Accommodation (type, location)
- Expenditures by categories (food, transportation, activities...)
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### **Method:**

- Quota sampling (by location and period), face-to-face, 15 to 30 minutes
- 15 survey locations (Panoramique des Dômes, Vulcania, Lemptégy, various Puys, Aydat lake...)
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### **Results:**

1011 interviews representing 2894 visitors

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Some parameters are necessary to **convert visits into numbers of visitors** and to **distinguish between tourists and excursionists** :

- The average number of visiting days during tourists' stay
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Based on parameters estimated from the 2019-2020 survey data, we found:

- A total of **1.65 million visiting days**
- by **560,014 tourists** and **222,466 excursionists**

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## ➤ Experiments on other counting methods

### • Test of Road Counting:

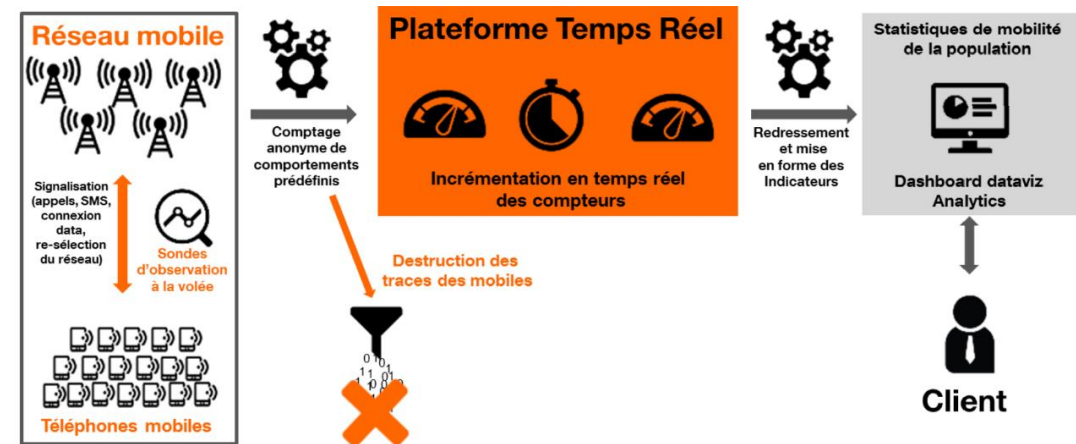
- Measurement of flows around the site parking lots
- 10 mobile counters deployed during the summer of 2019
- Video counting at the entrance of Lemptégy parking



Comptage par tube pneumatique  
Comptage par capteur magnétique  
Comptage par caméra

### • Test of the Flux Vision solution (by Orange):

- Based on SIM card detection
- 2 Flux Vision products: Tourism and Geomarketing
- 4 zones over 3 months (from August to October 2019)



## ➤ Flux Vision (Orange)

### On paper...

- Already **used by many local authorities**
- Improved for over 5 years (in 2019)
- **Presumably reproducible** (stable algorithm)
- **Rich content** (socio-demographic data, origins, places of overnight stays...)
- **No double counting problem** (over 24h)
- Daily and even hourly (2h) resolution
- **Segmentation** designed by professionals
- Ability to track inter-zone mobility
- **Moderate cost** (decreasing, low compared to surveys)

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### In practice

**Problematic** in sites like CPFL due to:

- Rugged terrain,
- Poor coverage (3G/4G)
- Proximity to urban areas, transit

Resulting in:

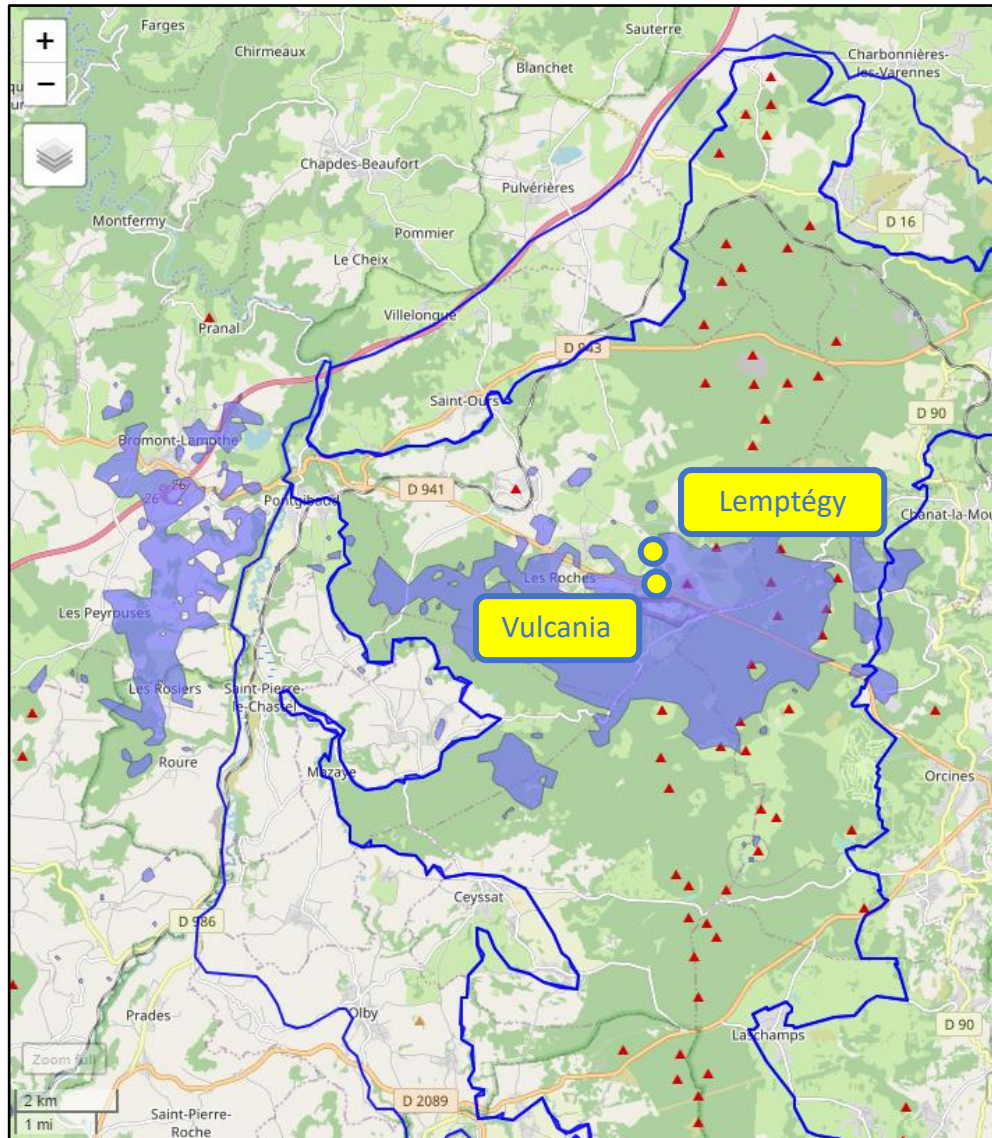
- Sometimes unusable study areas
- Significant overflows difficult to handle

And, additionally:

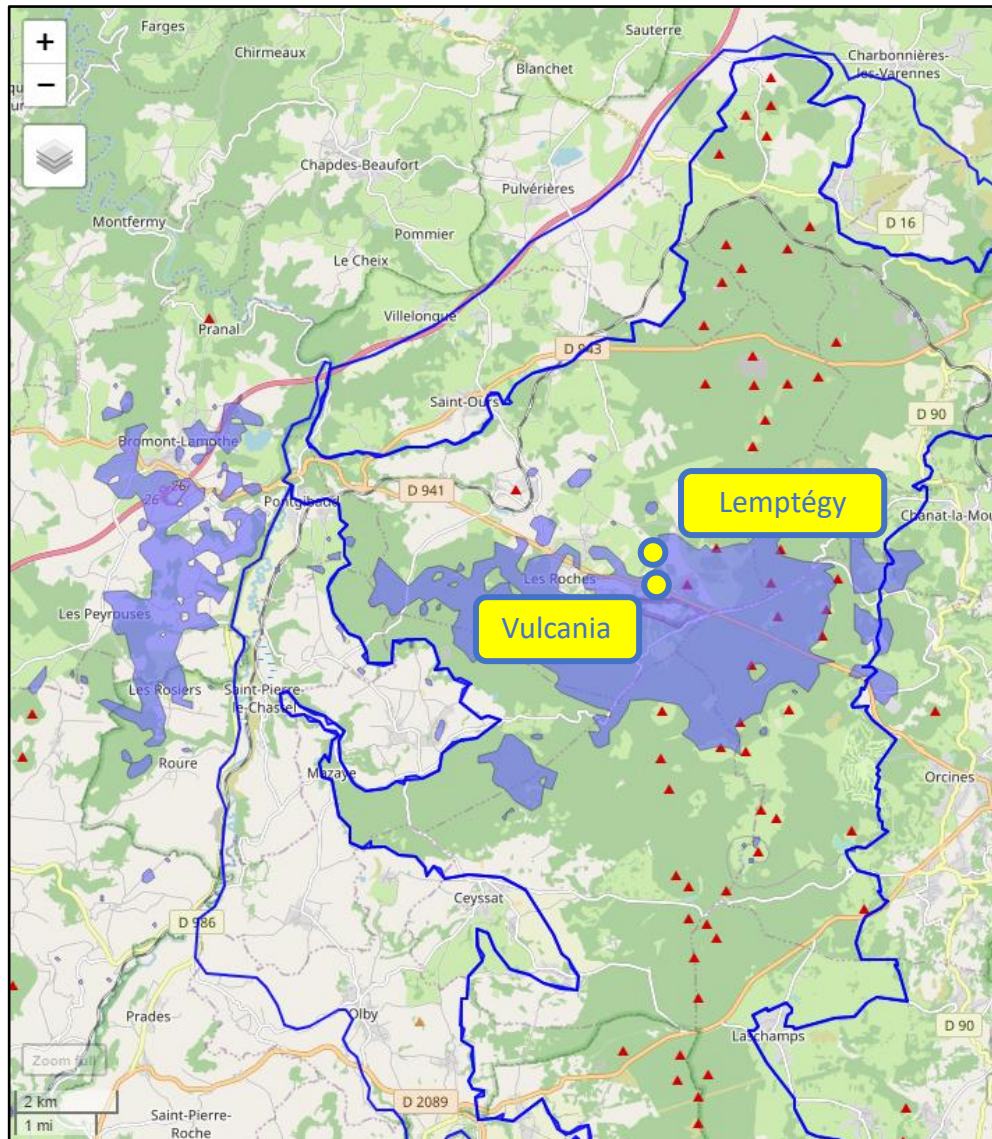
- Difficult delimitation of study areas
- Inadequate segmentation for small areas
- Lack of transparency

## ➤ The Vulcania test zone

Zone to test the reliability of Flux Vision, covering mainly Vulcania and Lemptégy (ticket offices)



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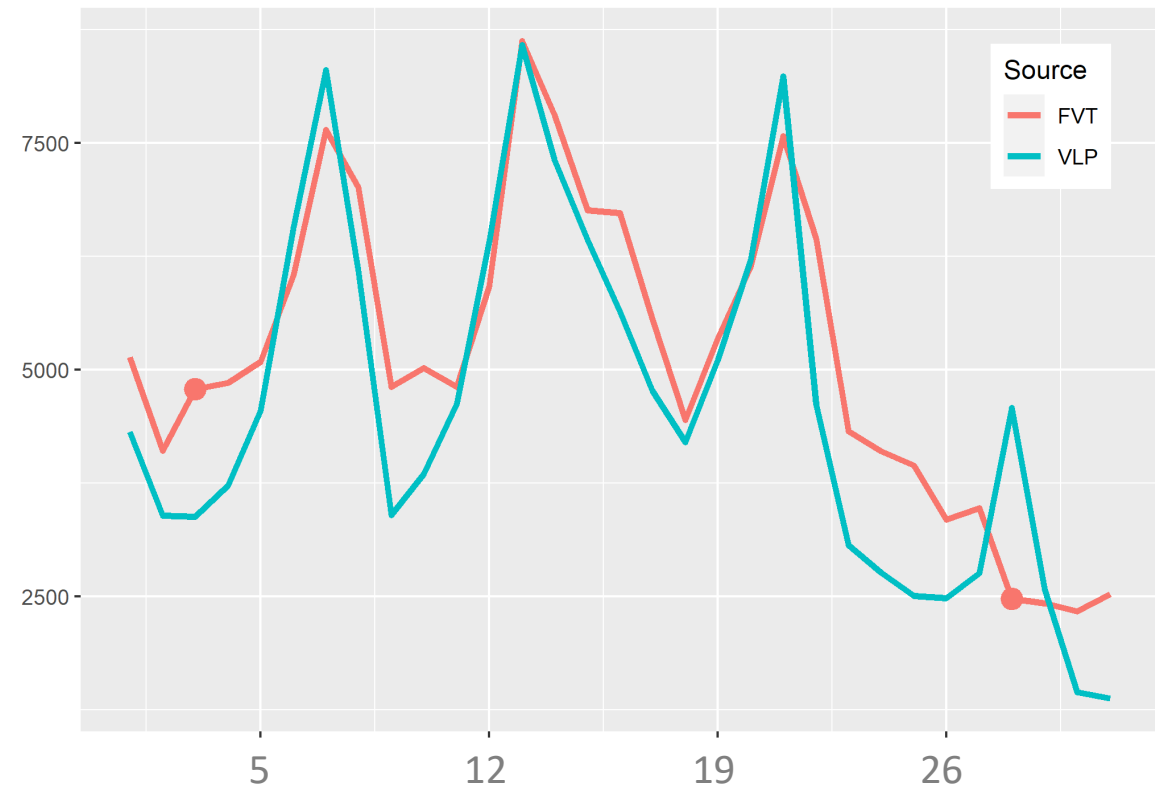


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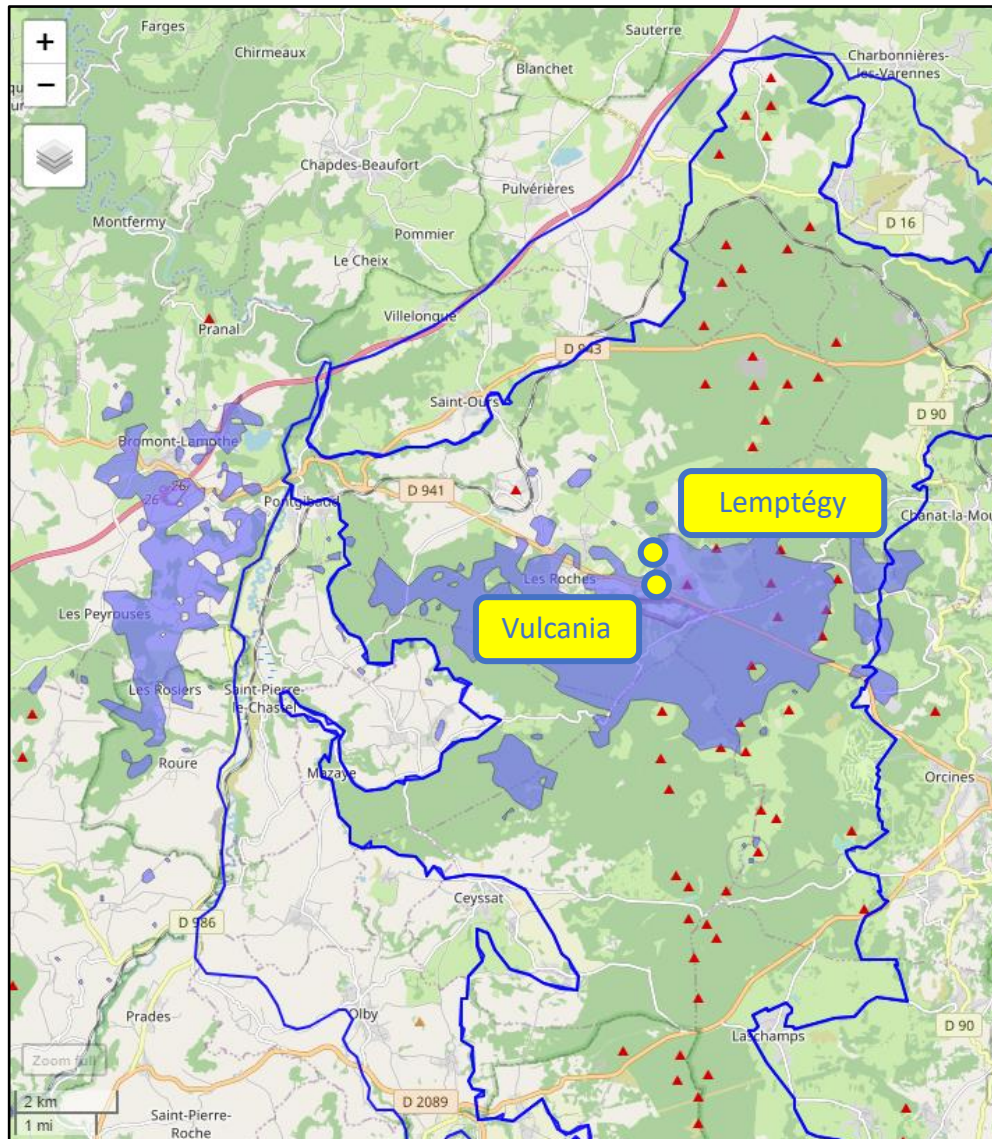
**FVT = Flux Vision Tourism**

**VLP = Vulcania + Lemptégy (tickets) + near trails (eco-counters)**

Flux Vision vs. Vulcania + Lemptégy – August 2019



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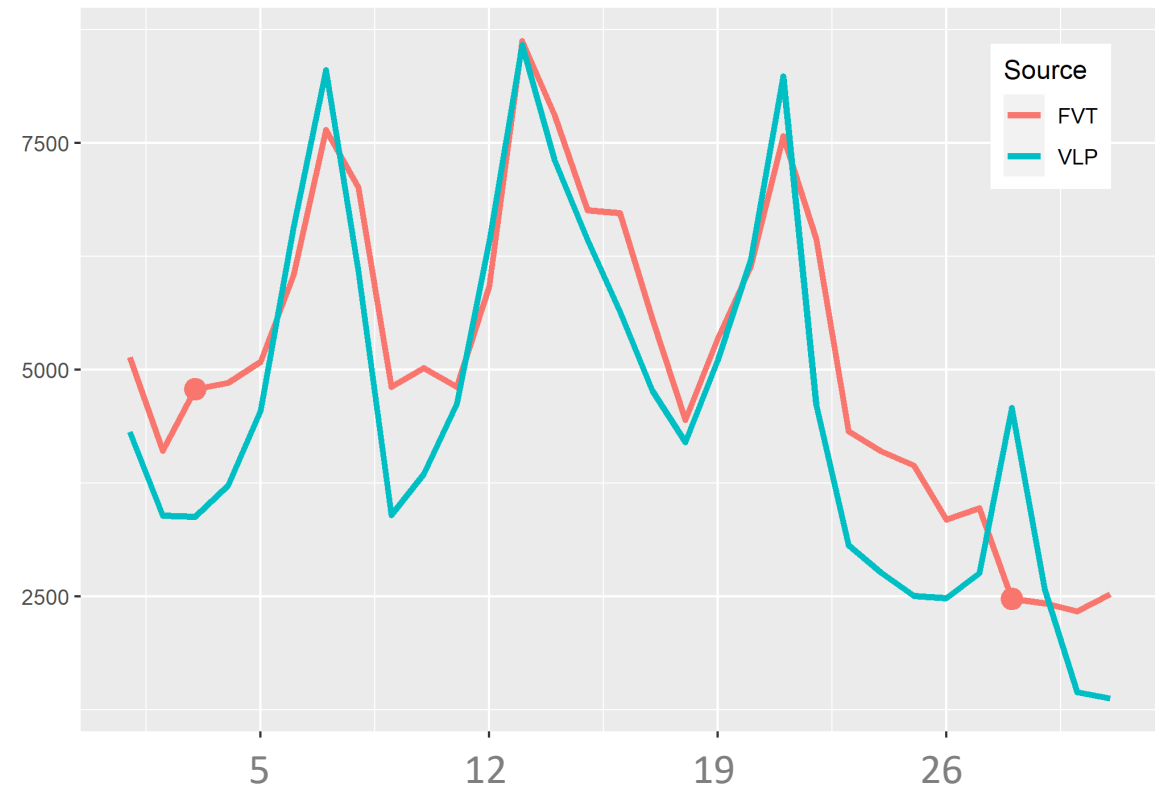


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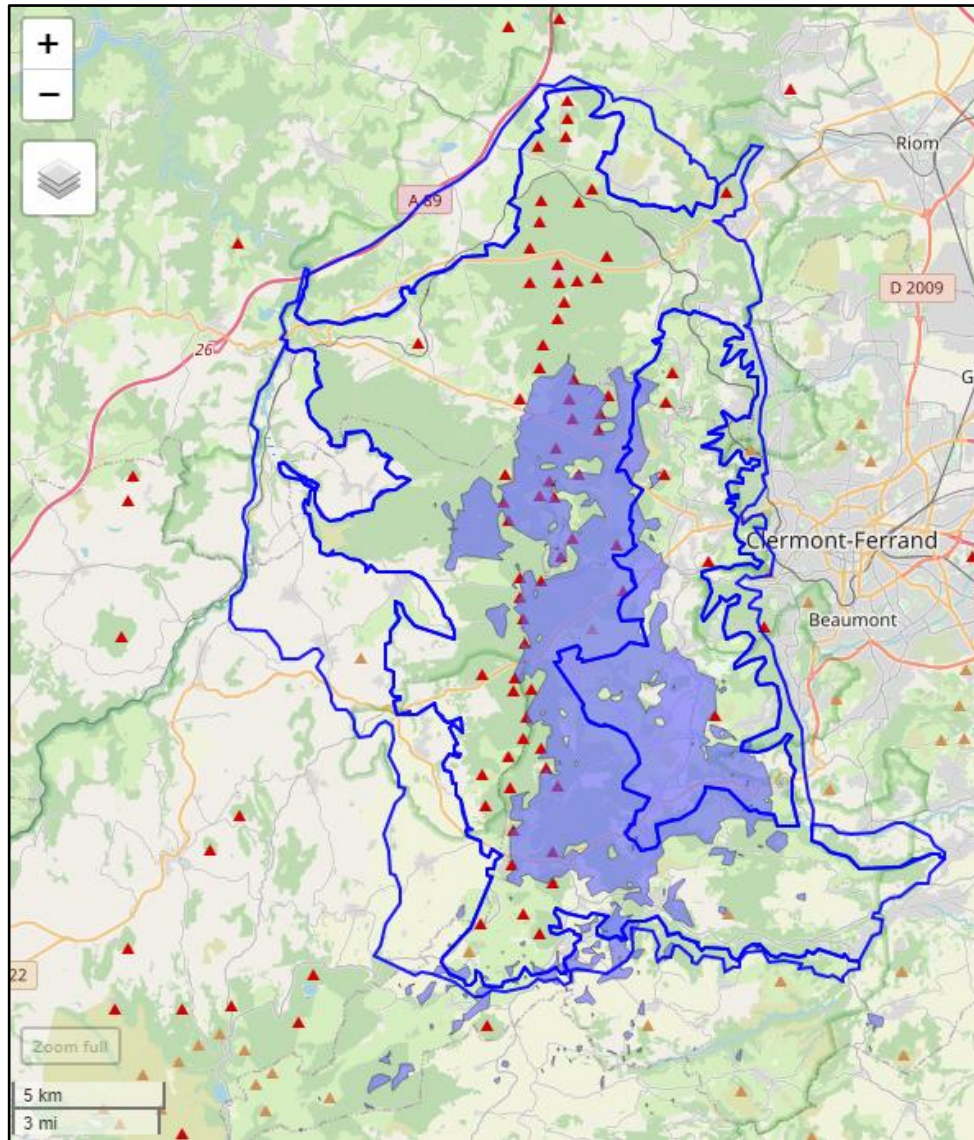
Flux Vision vs. Vulcania + Lemptégy – August 2019



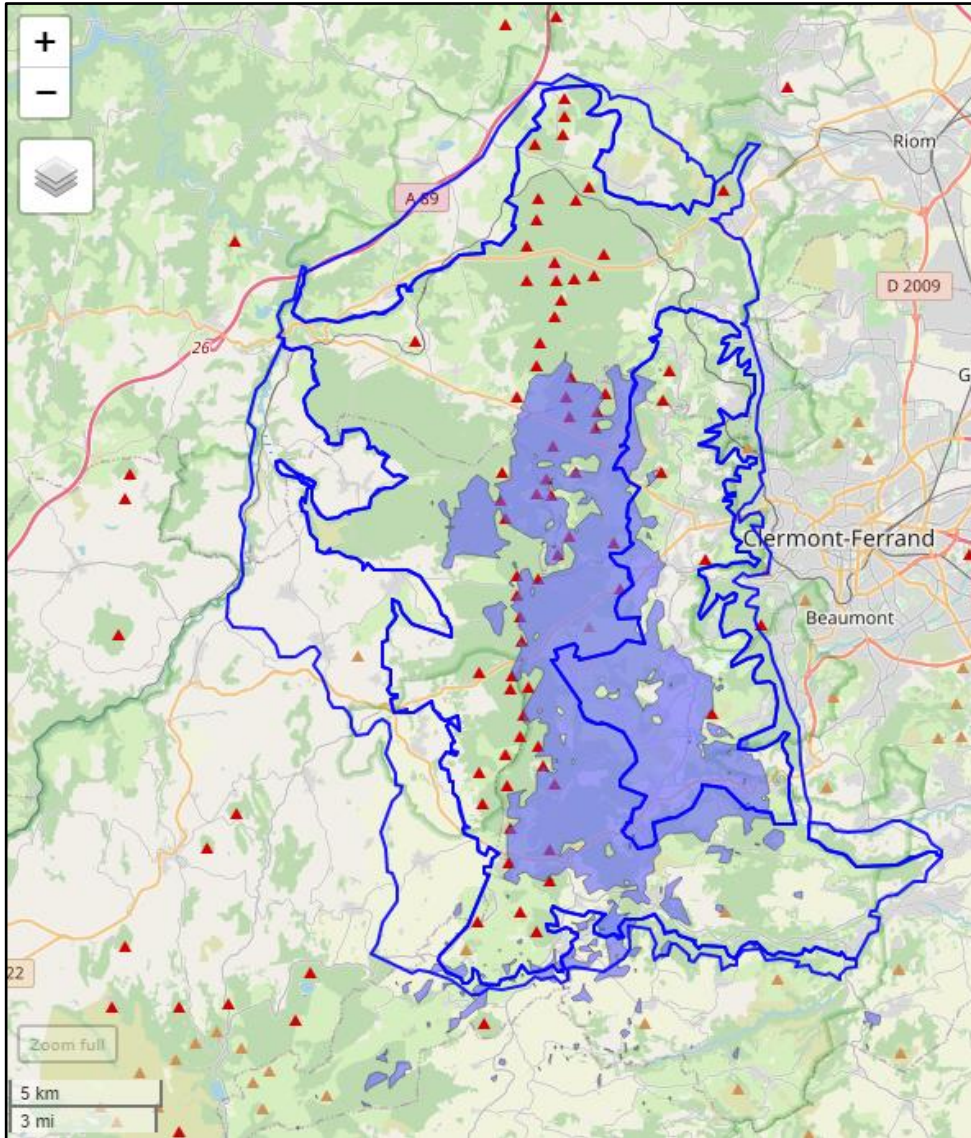
→ Good overall correlation

→ But notable discrepancies on some dates

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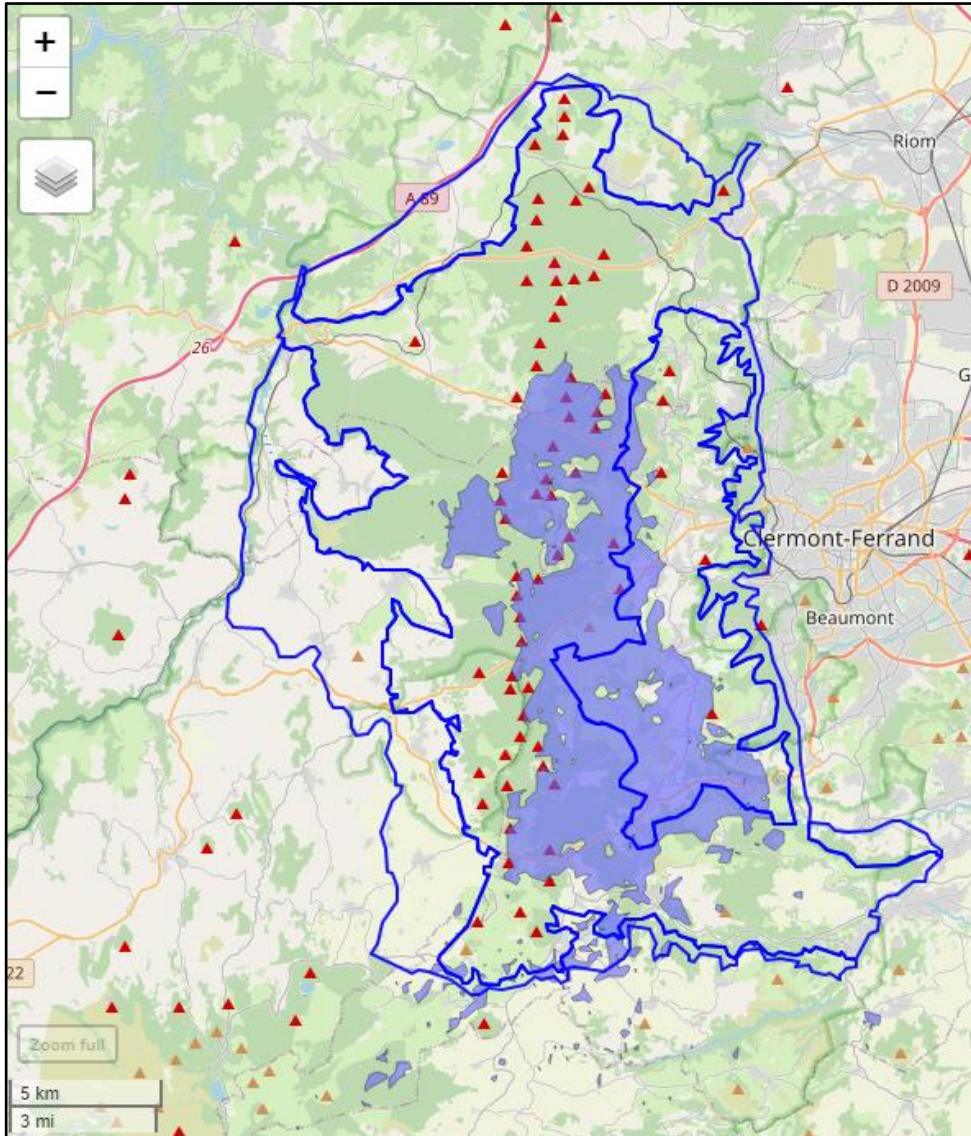


Corrections based on overnight stays :

- Identification of abnormal values using a ratio of overnight stays by population
- Correction of abnormal values using a model for overnight stays on accommodation capacity, population and distance to CPLF



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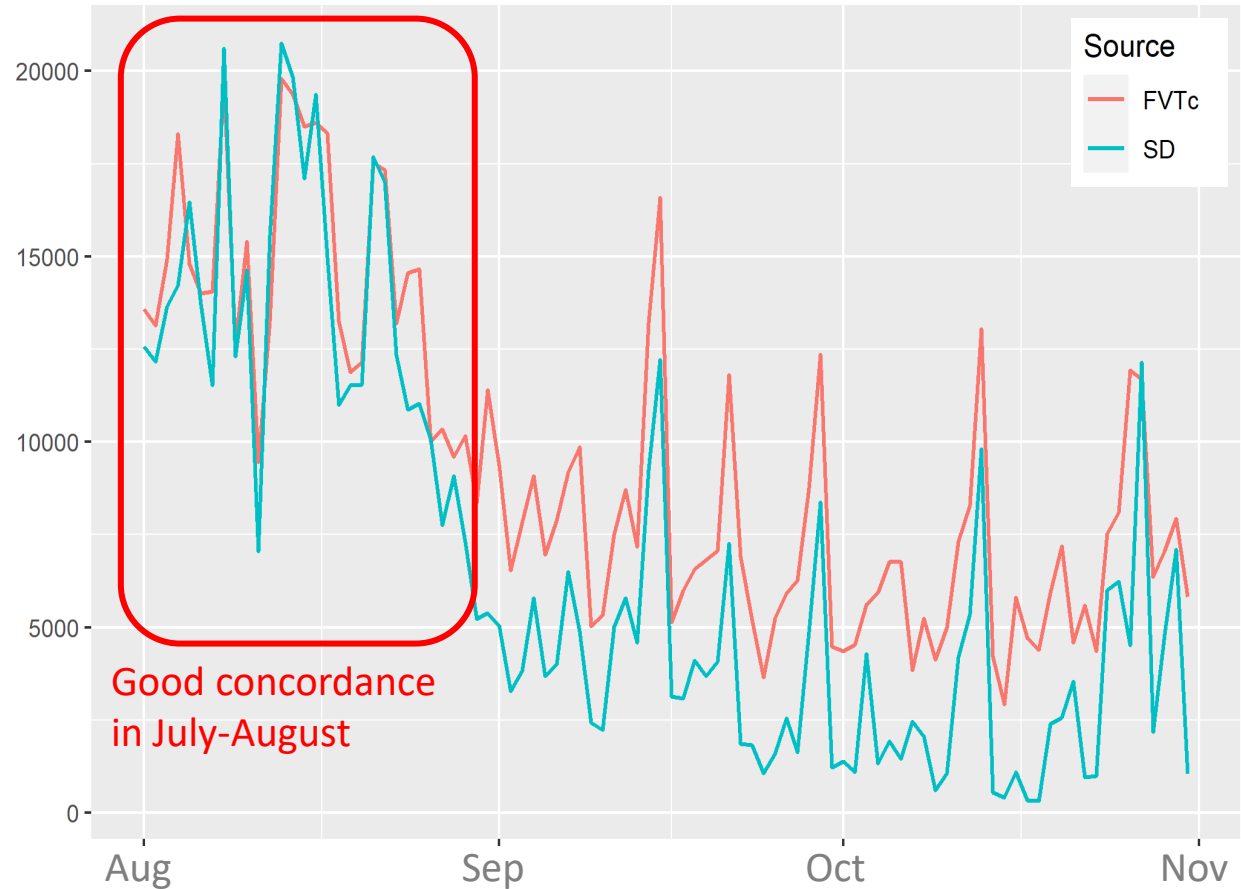
Corrections based on overnight stays :

- Identification of abnormal values using a ratio of overnight stays by population
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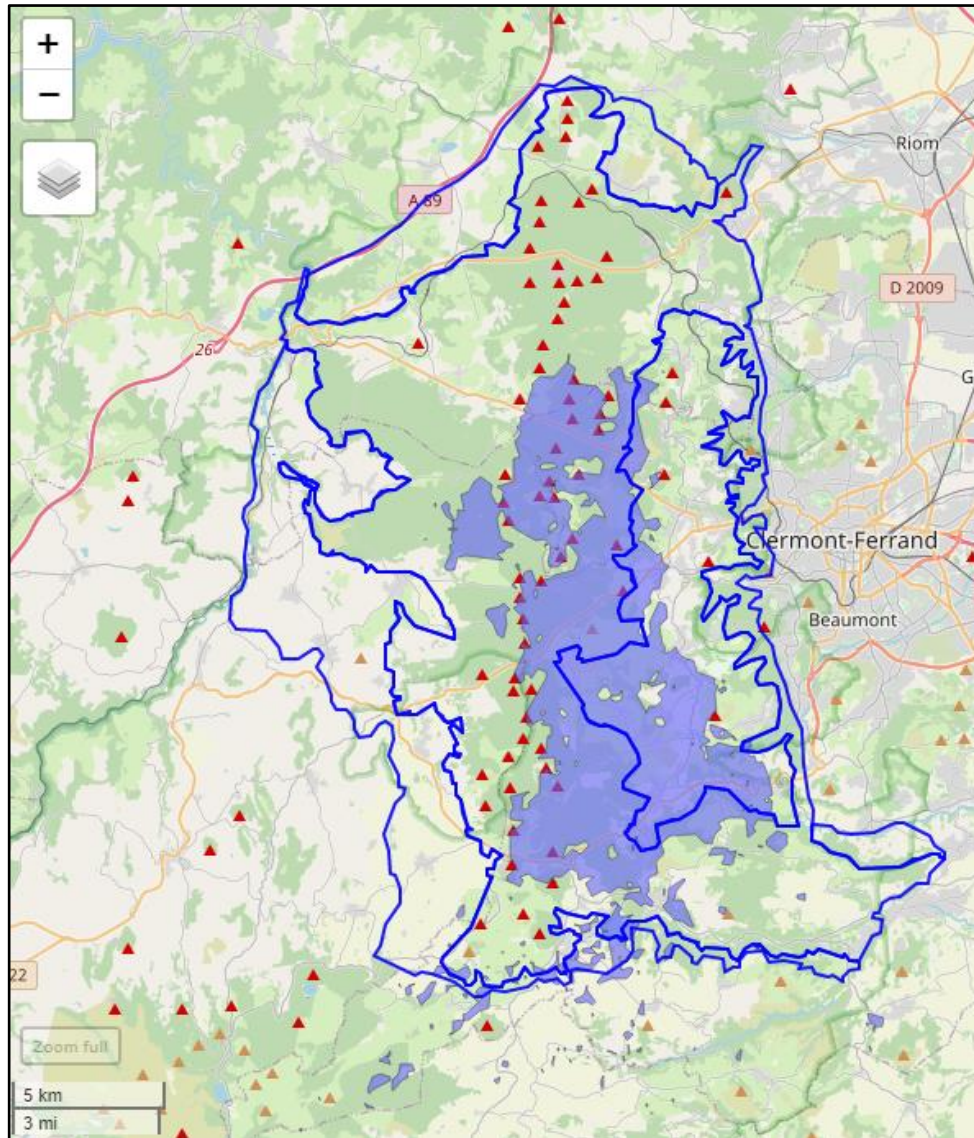
**FVTc = Flux Vision Tourism data (after corrections)**

**SD = Aggregate of countable sites (paid sites and trails with eco-counters)**

Flux Vision vs. Countable sites – August to October 2019



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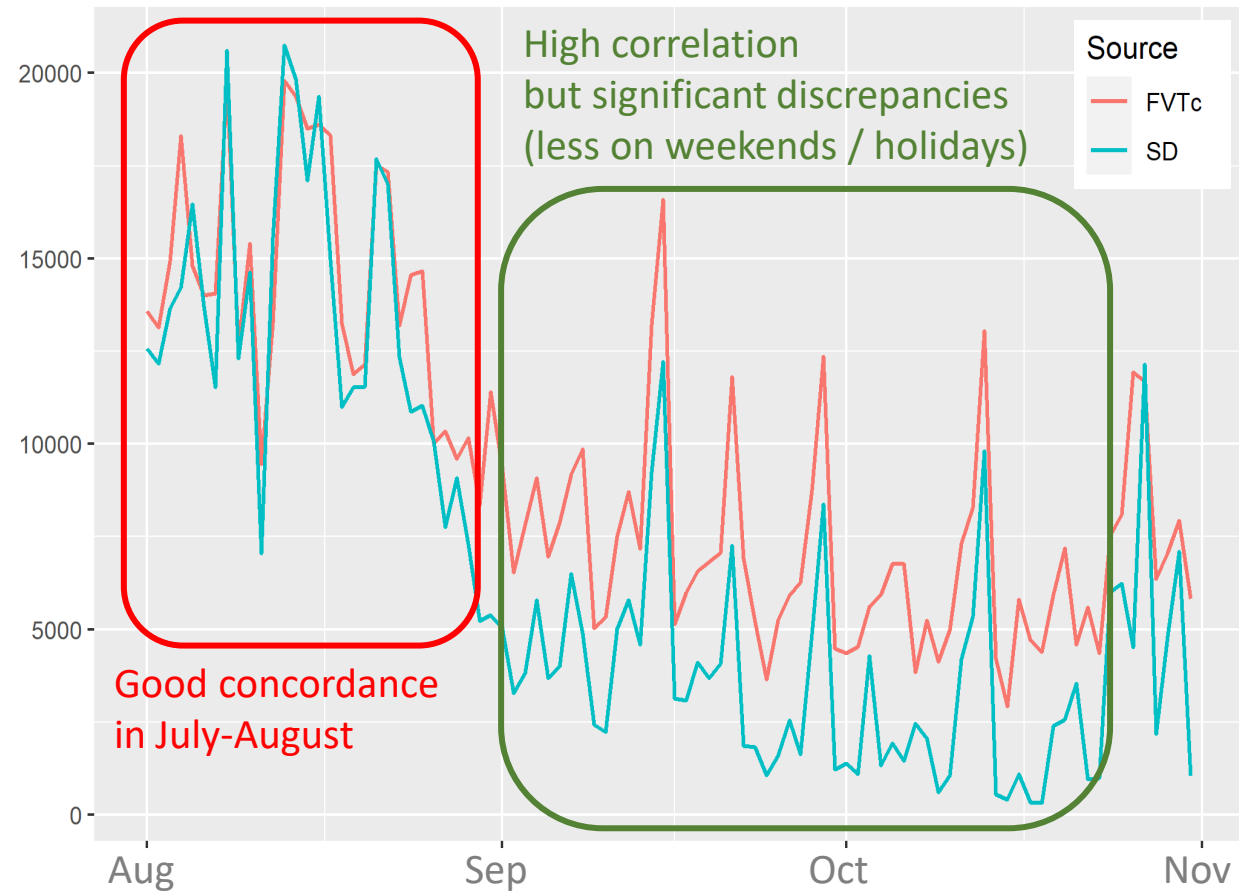
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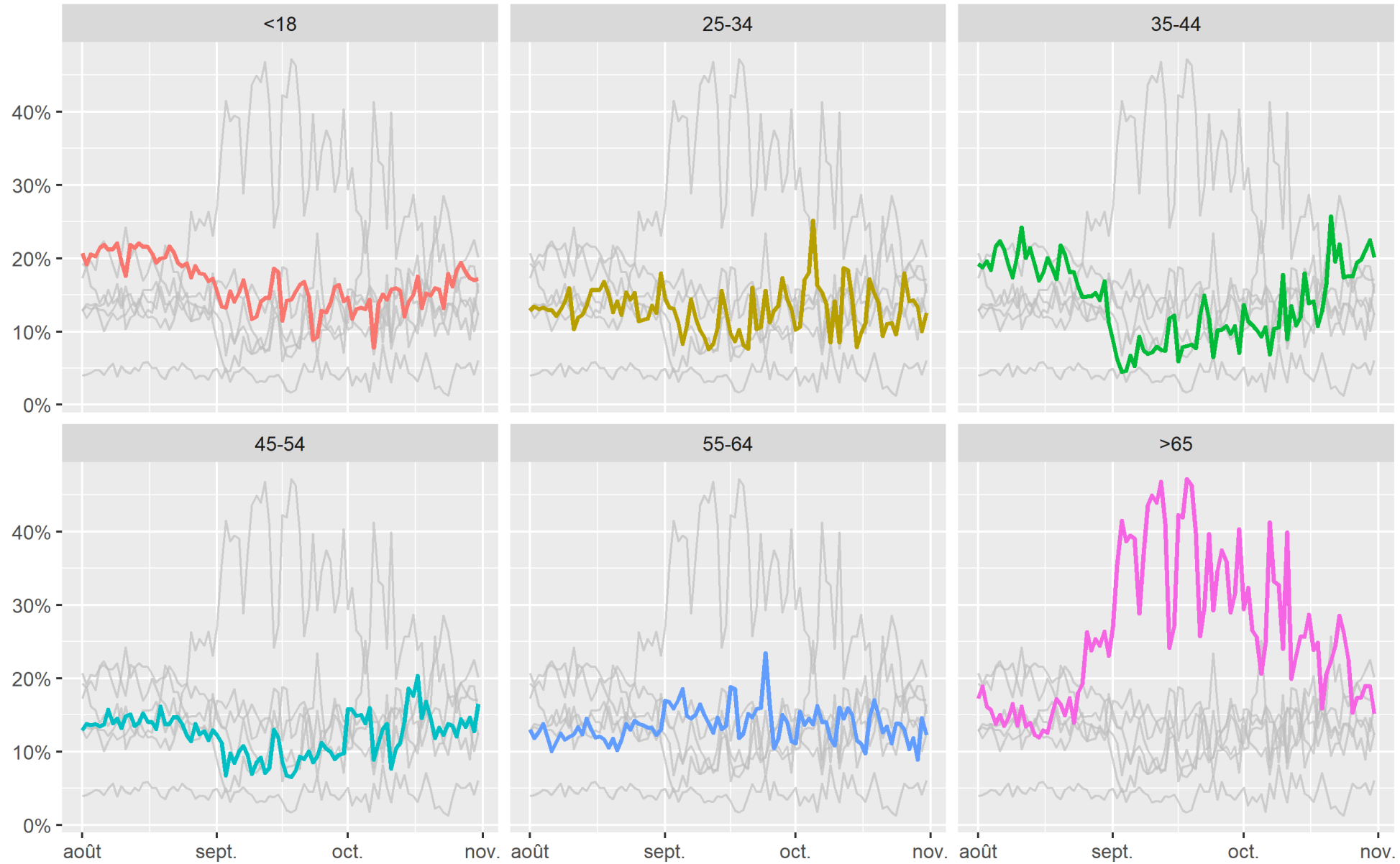
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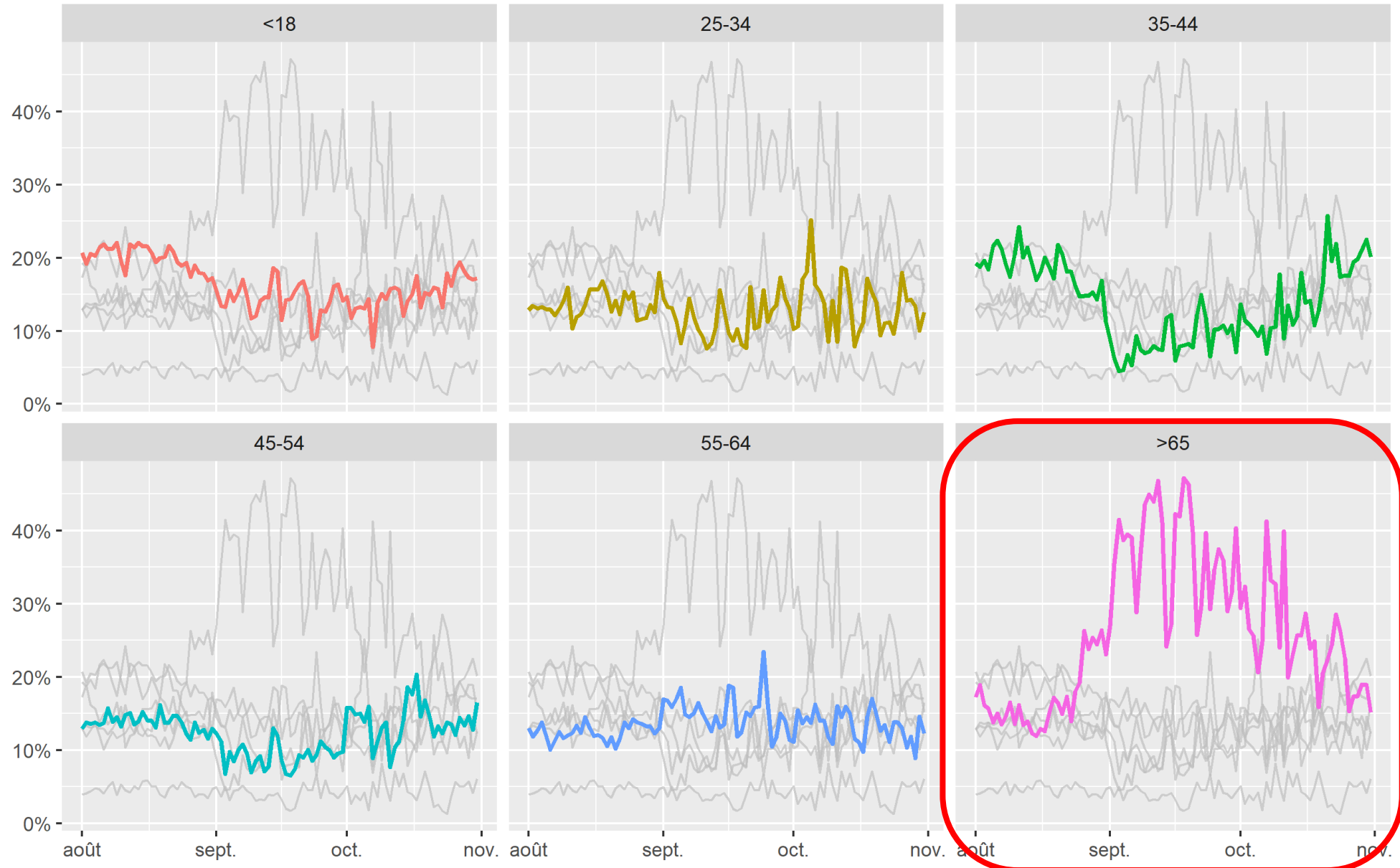
Flux Vision vs. Countable sites – August to October 2019



## ➤ Flux vision – Visitor numbers by Age Group



## ➤ Flux vision – Visitor numbers by Age Group



# ➤ Experiments on lighter survey designs (2021)

## Self-administered online surveys



## Self-administered paper questionnaires



Enquête auprès des visiteurs du site  
Chaîne des Pays - Faïtelle de Limagne

L'INRAE (ex-INRA) a financé la recherche et agencé le questionnaire. L'entretien à la disposition de visiteurs et de visiteurs sur le site Chaîne des Pays - Faïtelle de Limagne. Ce questionnaire a été réalisé dans l'objectif d'analyser les choix de destinations, les parcours touristiques et leur contribution au développement local. Nous vous remercions de votre participation à cette enquête. Nous garantissons que les informations seront traitées de manière confidentielle.

**Nous étudions la fréquentation de la Chaîne des Pays - Faïtelle de Limagne, c'est-à-dire le site qui a été déclaré en 2002 sur le territoire national, à ne pas confondre avec le territoire de Sancy ou d'autres réserves d'intégrité.**

Q1. Êtes-vous un visiteur / une visiteuse ?  
 Oui  Non - Pour quelle raison, précisez-le s'il vous plaît ?

Q2. Êtes-vous un visiteur régulier ?  
 Oui  Non

Q3. Quelle est la durée de votre séjour ?

En	Nombre de jours	Nombre de nuits
Arrivée		
Fin de séjour		

Q4. Si vous êtes un visiteur régulier (circulaire), à quelle fréquence revenez-vous sur le site de la Chaîne des Pays - Faïtelle de Limagne ou sur le site de l'unité culturelle - par semaine ?  
 1 fois par semaine  2 à 3 fois par semaine  4 à 5 fois par semaine  Plus de 5 fois par semaine

En moyenne, à l'automne, combien de personnes, en moyenne, se rendent-elles sur le site ?

Q5. Depuis combien de jours revenez-vous au site ?  
 1 jour  2 à 3 jours  4 à 5 jours  Plus de 5 jours

Q6. Combien de jours avez-vous passés (individuellement ou conjointement) sur le site de la Chaîne des Pays - Faïtelle de Limagne ?  
 1 jour  2 à 3 jours  4 à 5 jours  Plus de 5 jours

Q7. Combien de fois revenez-vous et allez-vous venir sur le site au cours de l'année ?  
 1 fois  2 à 3 fois  4 à 5 fois  Plus de 5 fois

Q8. Dites nous que vous êtes venu / venue ?  
 Uniquement pour la Chaîne des Pays  Principalement pour la Chaîne des Pays  Principalement pour la Chaîne des Pays  Principalement pour la Chaîne des Pays  Principalement pour la Chaîne des Pays

Q9. Savez-vous que le site de la Chaîne des Pays - Faïtelle de Limagne est inscrit à l'UNESCO ?  
 Oui, avant de venir  Non, au moment de venir  Non, après de venir  Non

Le site est inscrit à l'UNESCO ?

## Simplified face-to-face surveys



## ➤ Experiments on lighter survey designs (2021)

### Self-administered online surveys



## ➤ Experiments on lighter survey designs (2021)

### Self-administered online surveys



**Purpose:** Test some lighter survey devices that could enable repeated surveys for visitor monitoring

**Method:**

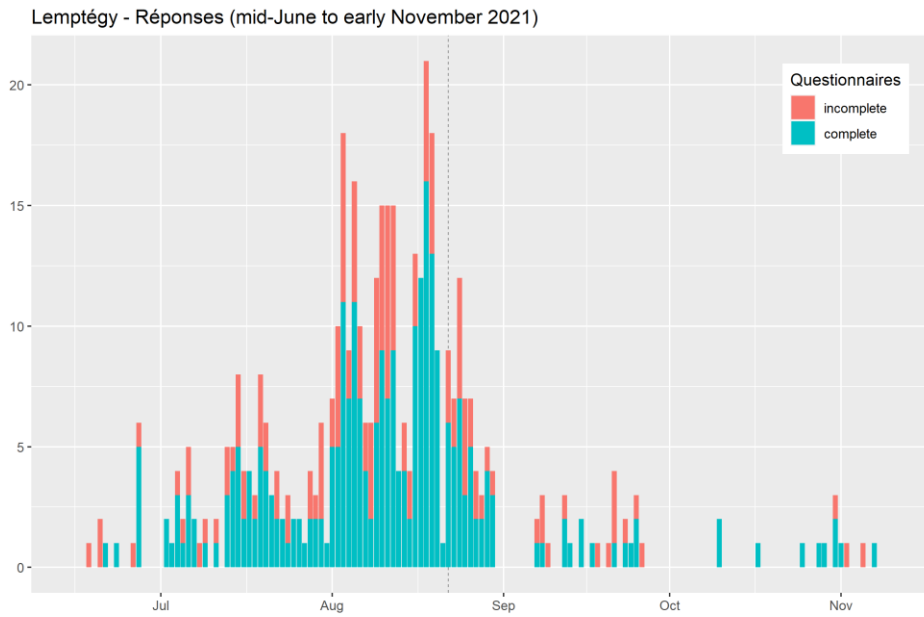
- Small posters with a QR-code and a few explanations displayed in main areas : recreational (Lemptégy), picnic tables at Aydat, tourist offices, parking lots and trailheads...
- A lime survey questionnaire with a gallery of photos as an incentive to get more answers

**Response rate:**

- High response rate at Lemptégy (avg: 5/day / max=21/day) (posters in waiting and dining areas)
- Low in outdoor areas (trailheads, Aydat)
- Disappointing at the panoramic train station (stress/departure) but improvable (eg. dining areas at the summit or station)
- Other option: in accommodation locations

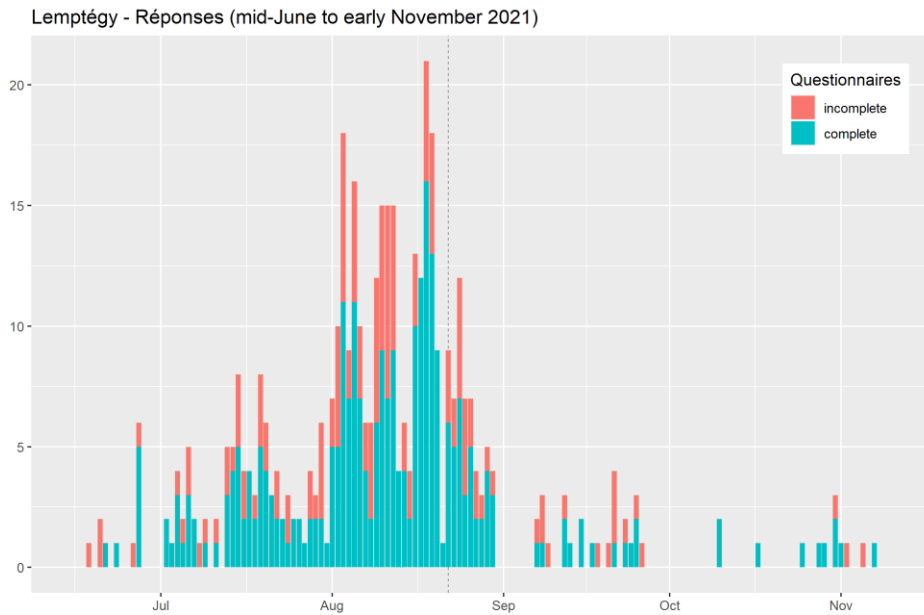
## ➤ Online survey – Results in Lemptégy

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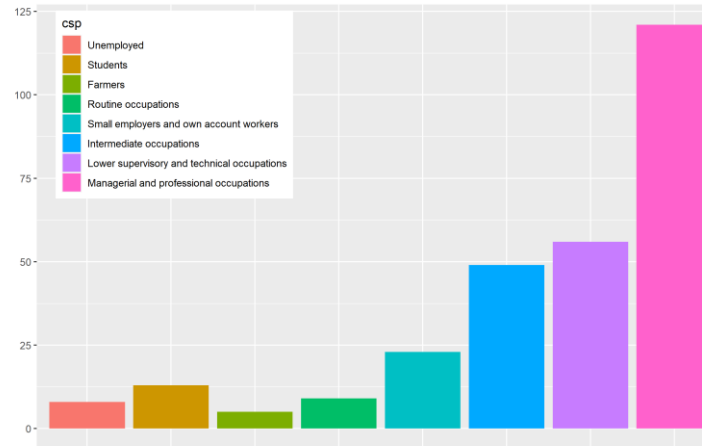


- High response rate in waiting areas (queues, dining...)

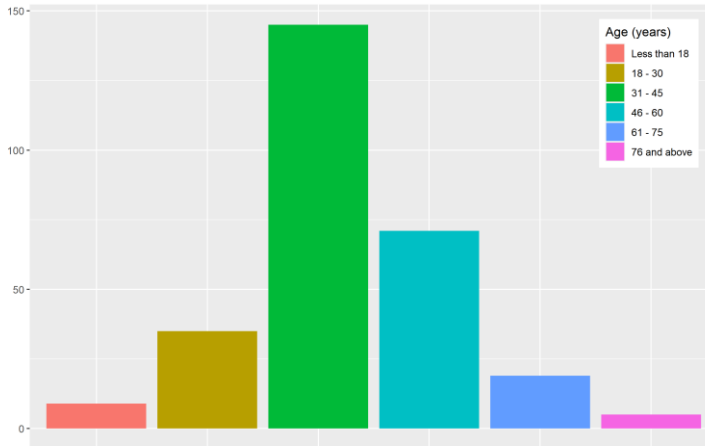
## ➤ Online survey – Results in Lemptégy



Lemptégy - Responses according to CSP (French occupations and socio-professional categories)

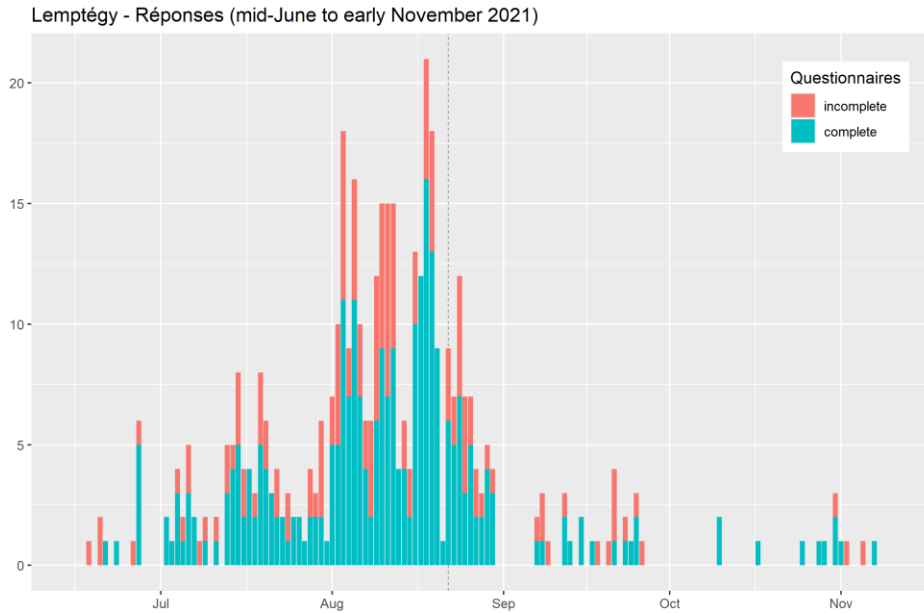


Lemptégy - Responses according to Age Group

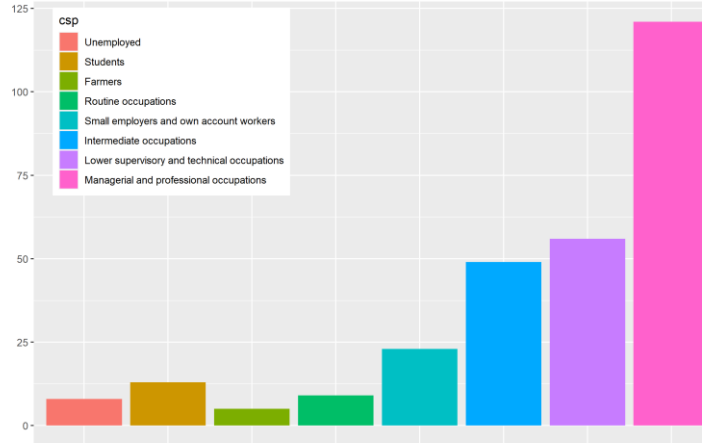


- High response rate in waiting areas (queues, dining...)
- All population strata well sampled (age groups, socio-professional categories)  
→ but adjustment might be necessary

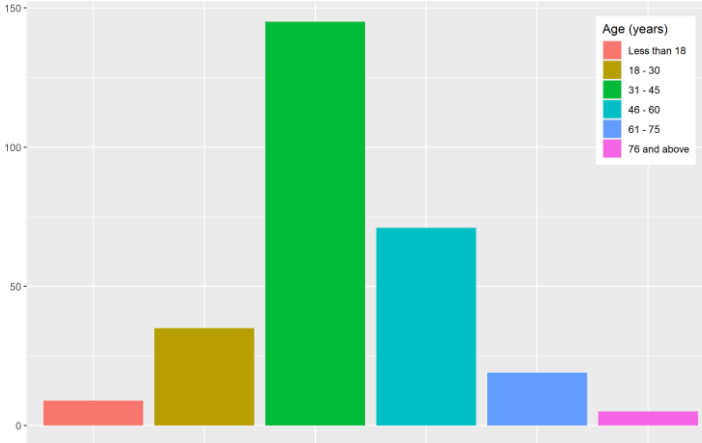
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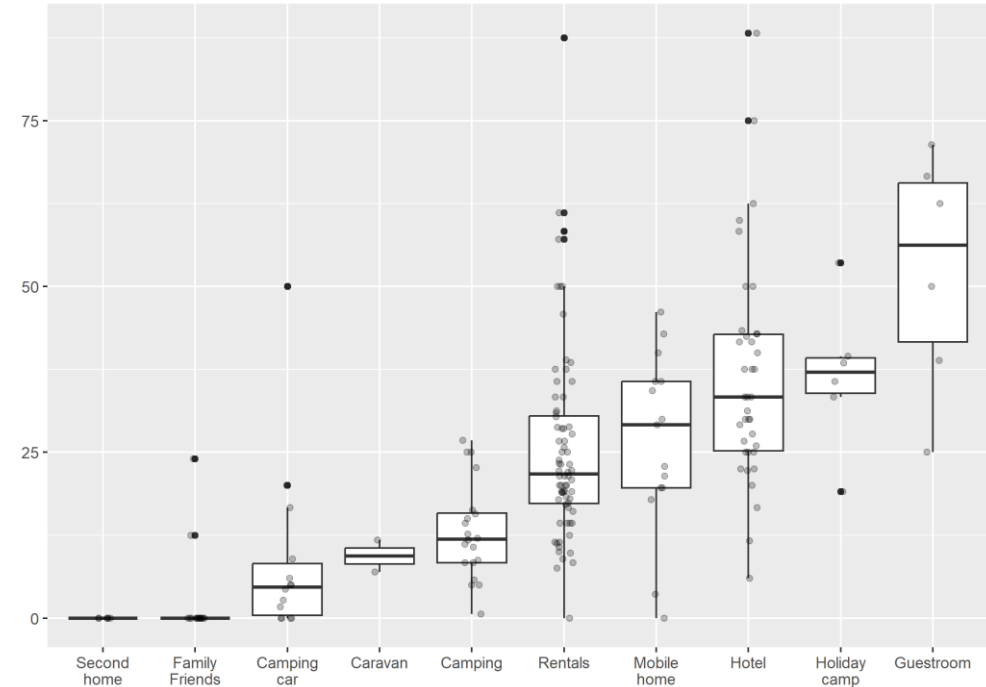
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Lemptégy - Responses according to Age Group



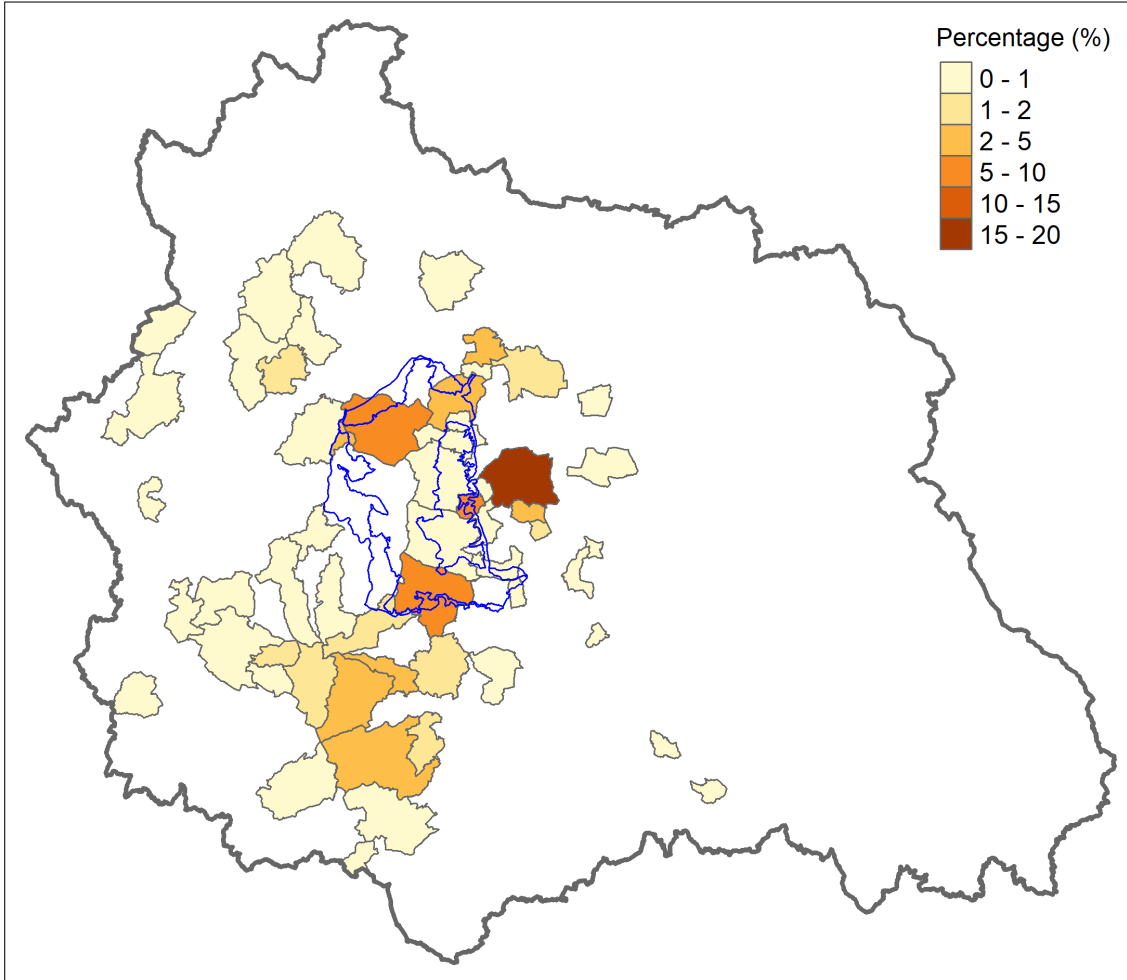
Budget per person and per day vs. Accommodation type



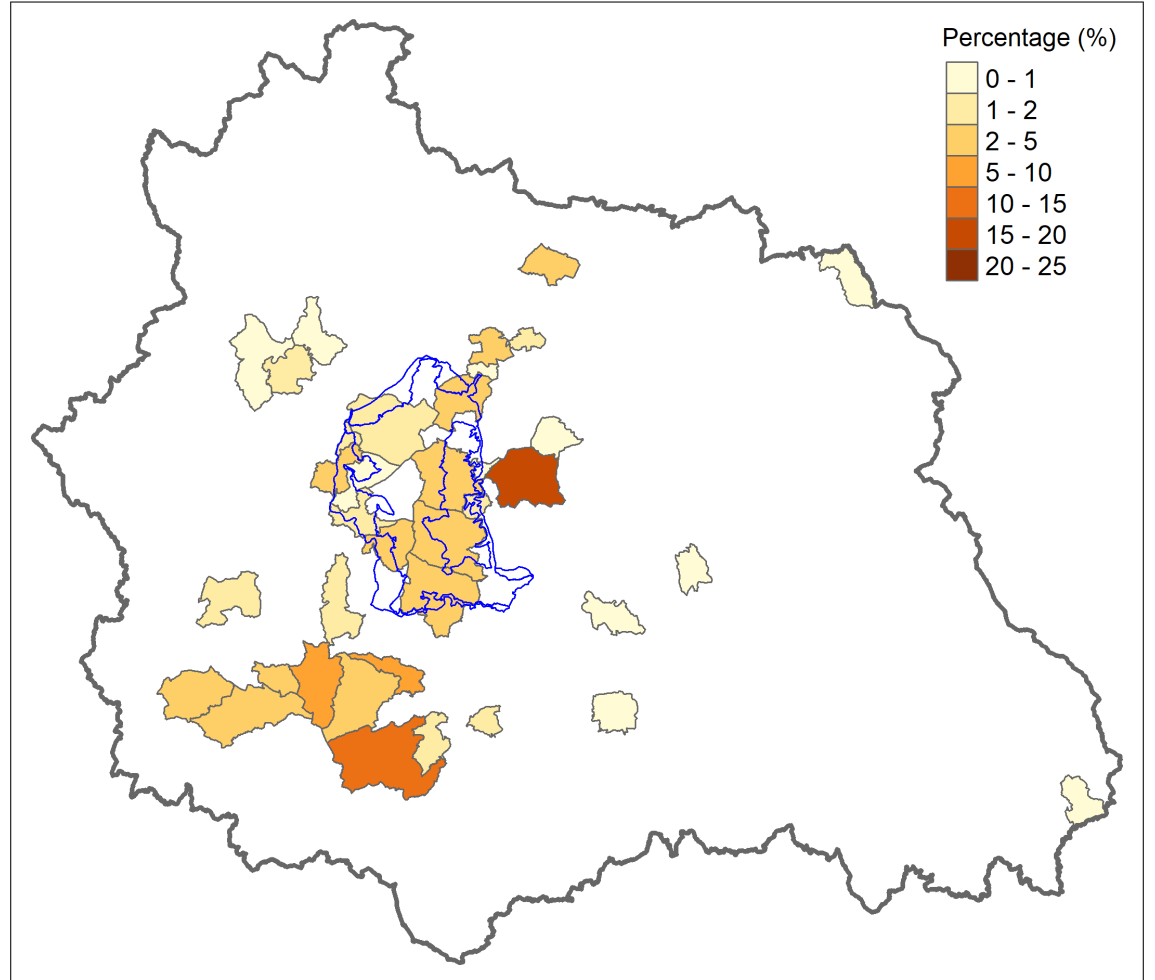
- High response rate in waiting areas (queues, dining...)
- All population strata well sampled (age groups, socio-professional categories)
  - but adjustment might be necessary
- Good consistency in responses (expenditures)
  - but some responses to be eliminated

## ➤ Overnight stay locations – Online survey vs. Large survey

Online Survey - Overnight stay (Tourists present in Lemptégý - A

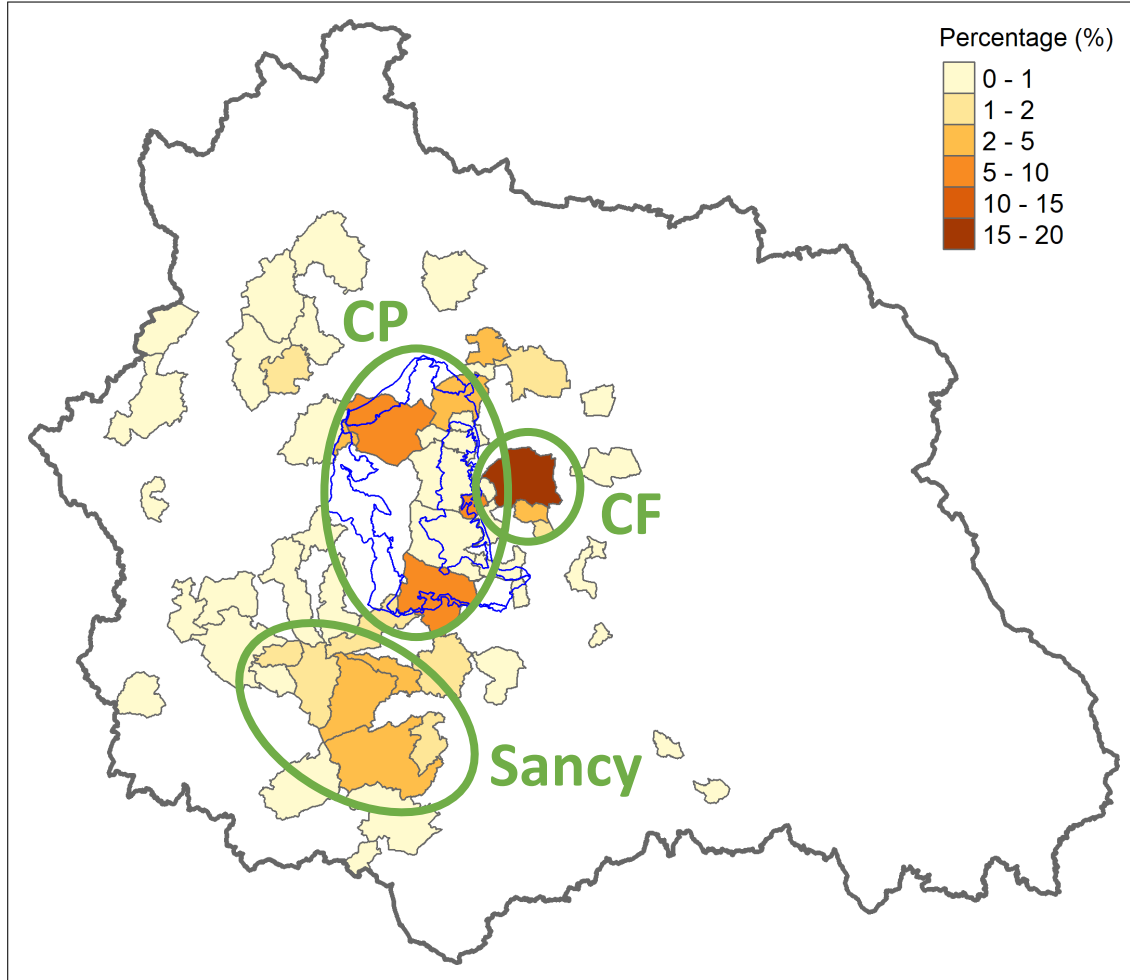


Large Survey - Overnight stay (Tourists present in Lemptégý - A

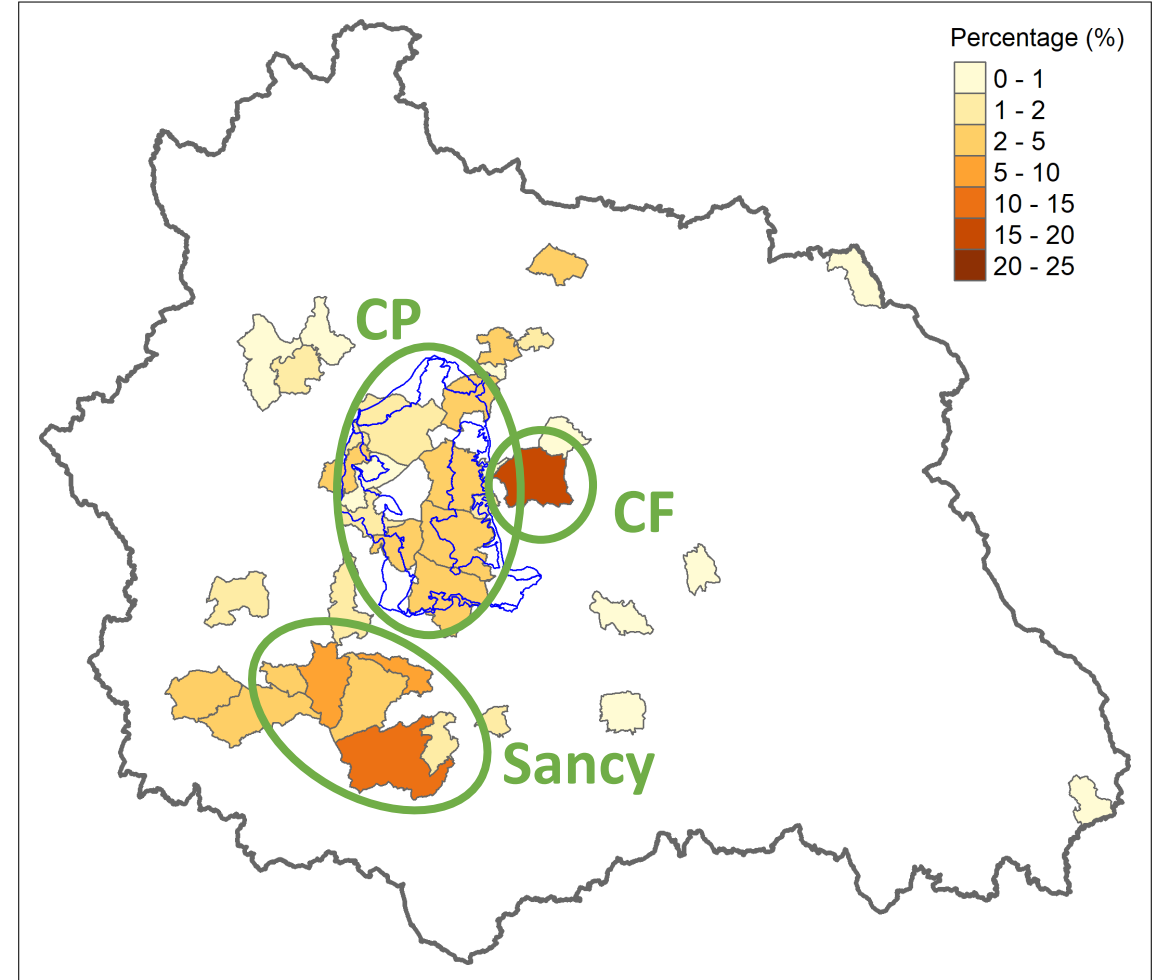


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## ➤ Outline

- Introduction
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- Quantifying and qualifying visitors in 2019
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  - Tested methods / Methodological framework
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Methods	Advantages	Disadvantages
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<b>Flux Vision</b>	<ul style="list-style-type: none"><li>- Presumably reproducible</li><li>- Rich information</li><li>- Diffuse frequentation</li><li>- No double counting</li><li>- Visitor segmentation</li></ul>	<ul style="list-style-type: none"><li>- Black box</li><li>- Reliability? In rugged sites, with low 3G/4G coverage</li><li>- Expensive (but decreasing, and low compared to surveys)</li></ul>

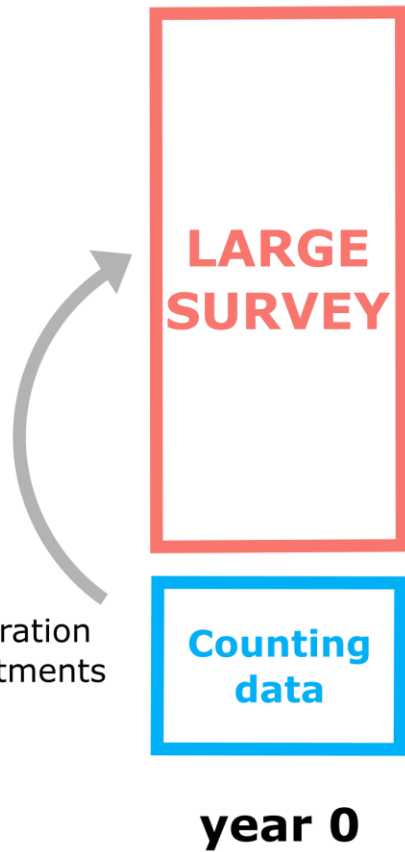
## ➤ Comparison of survey methods

Methods	Advantages	Disadvantages
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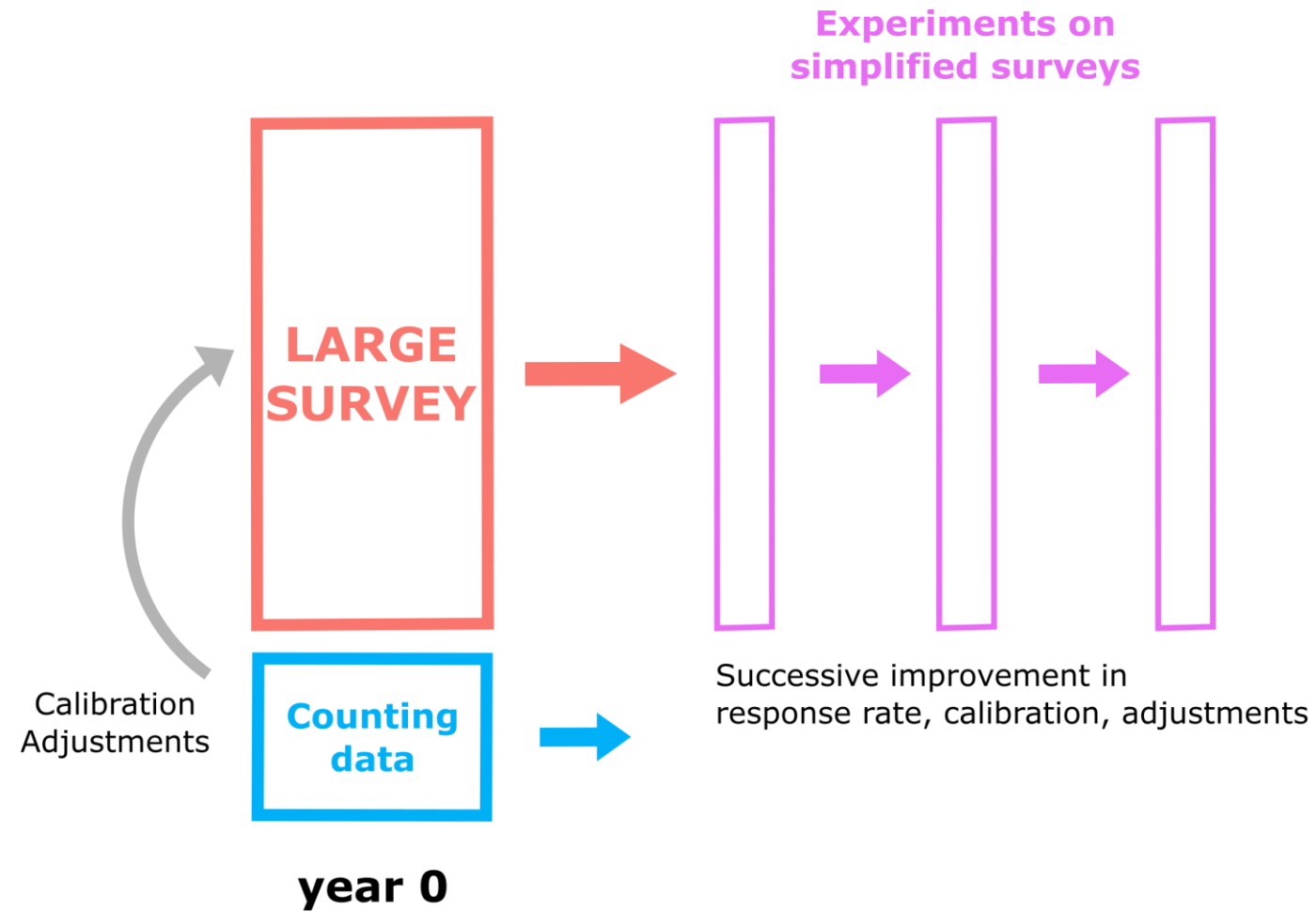
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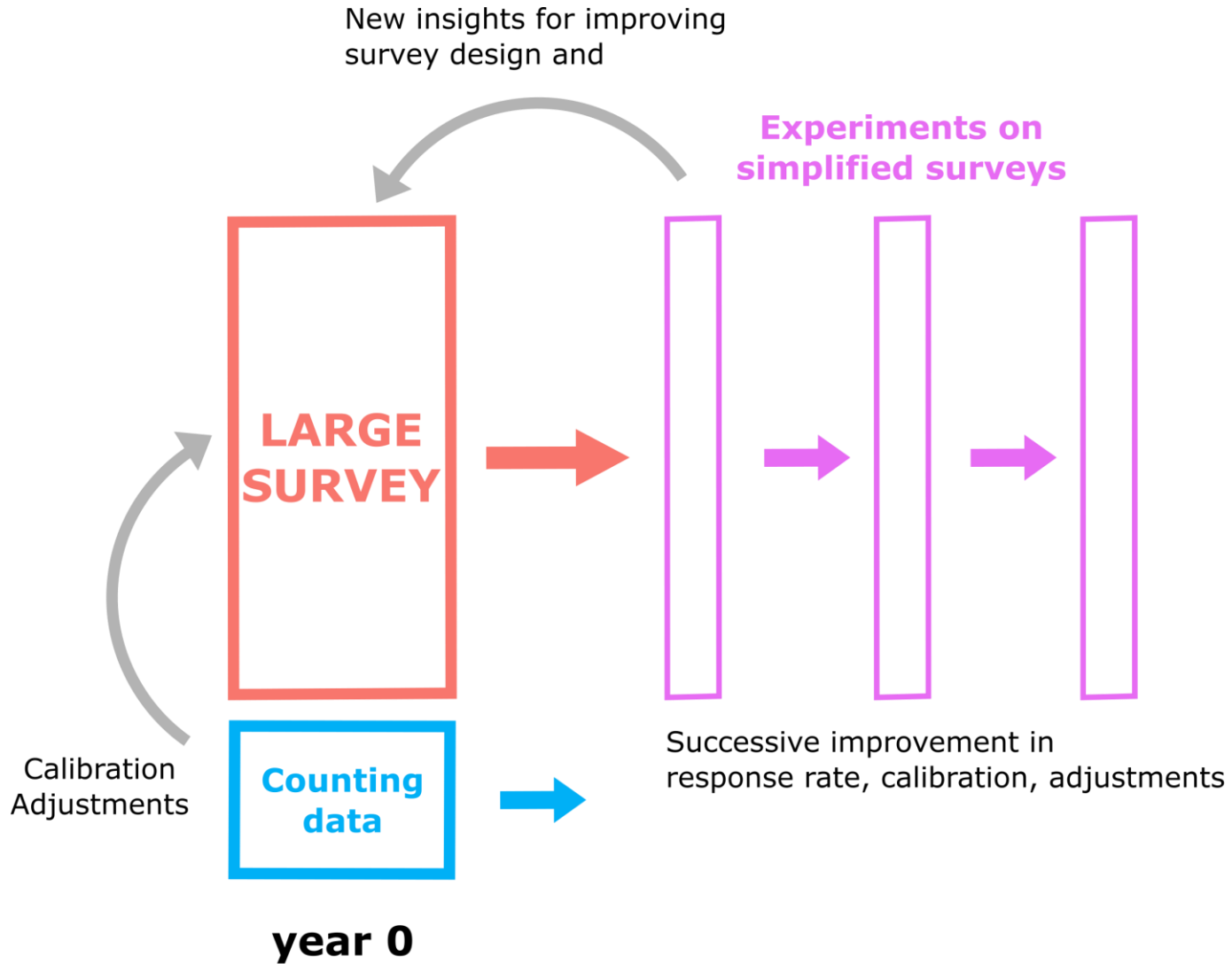
## ➤ A methodological framework for monitoring visitors



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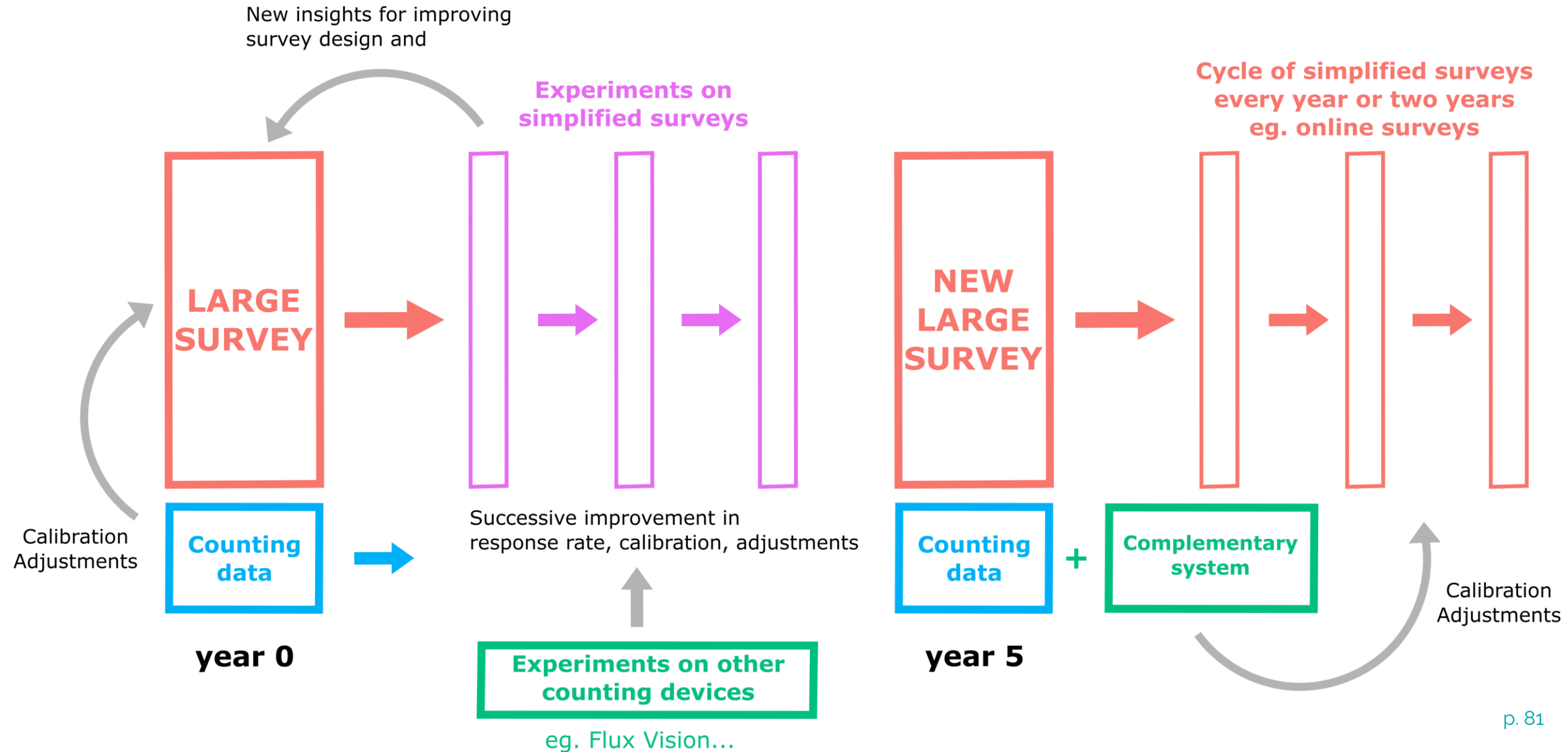


# ➤ A methodological framework for monitoring visitors





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- **Count data** from tickets and eco-counters enable a **low estimate of the number of visits** which can be converted into a number of visitors using **survey data**
- For unequipped sites ad hoc protocols look necessary
- Daily data from ticket offices would help further analyzing and modeling frequentation

## > Conclusion

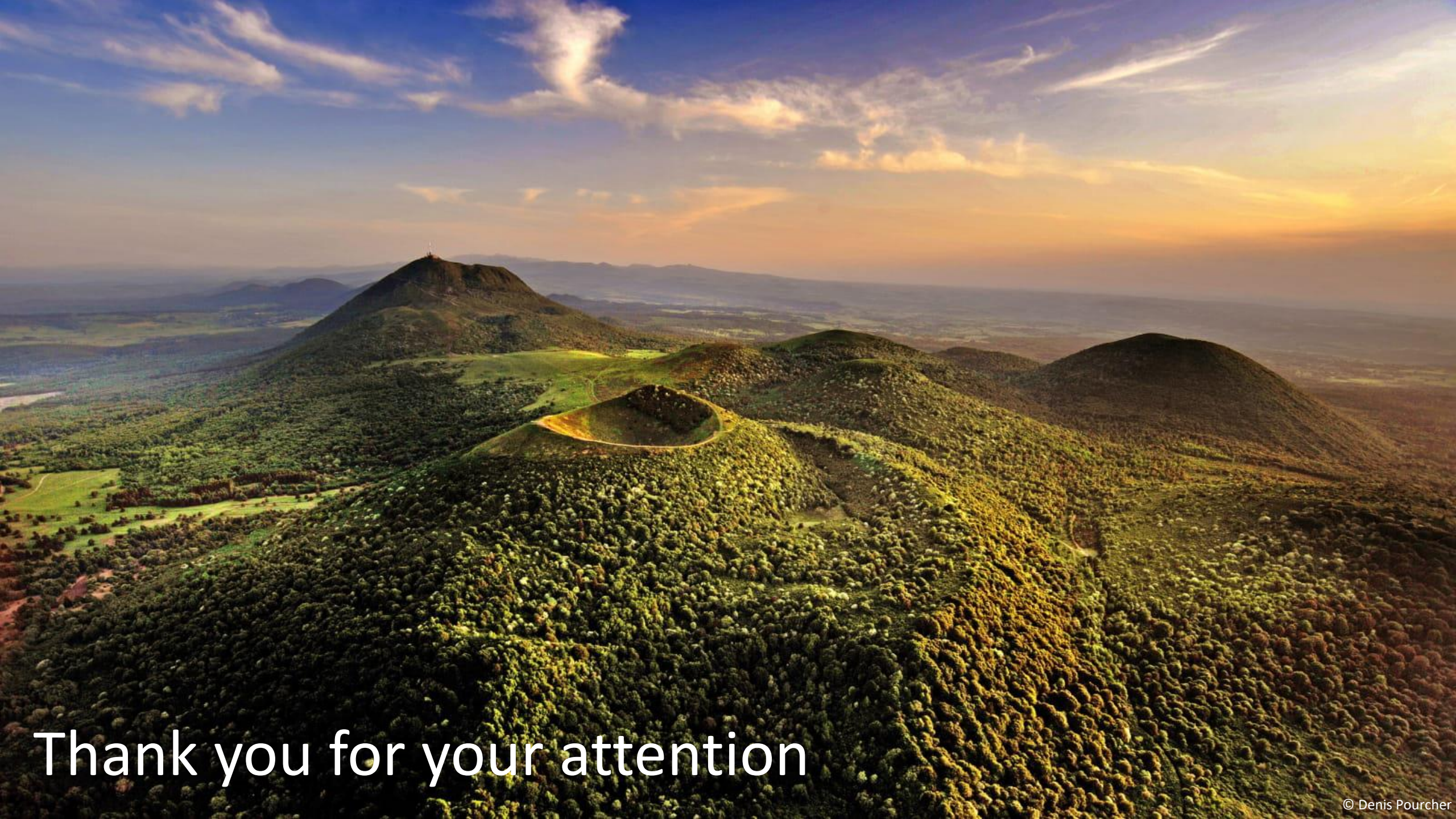
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→ but it should be assessed first, since these data appear questionable in natural sites especially in rugged terrain, with limited digital coverage

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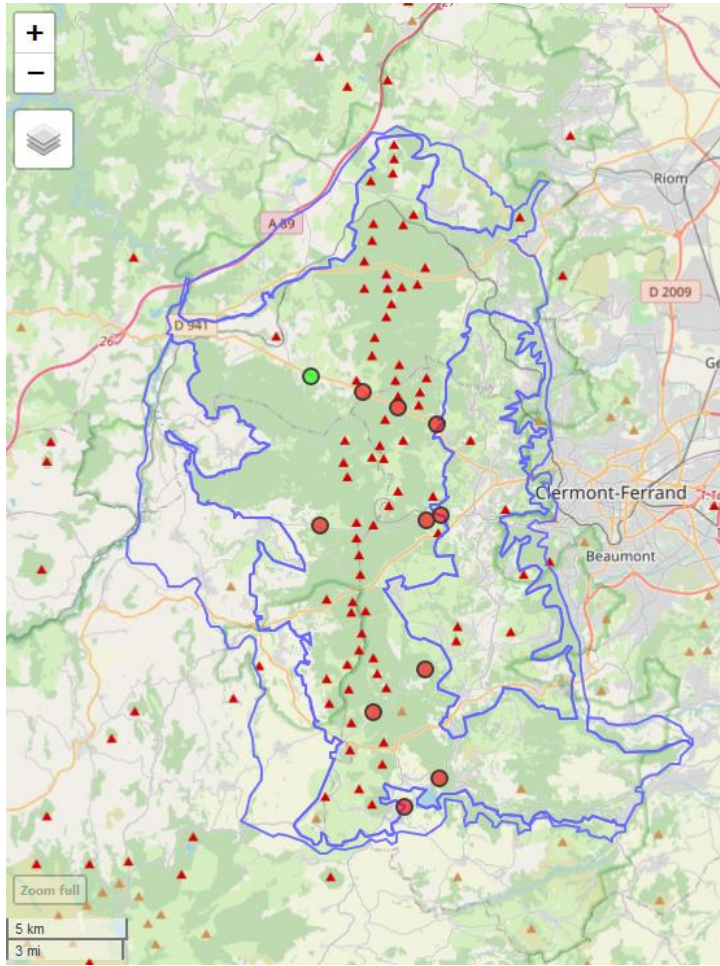
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- The combination of these counting and survey methods could be considered to design a visitor monitoring system, notably in view to creating an observatory



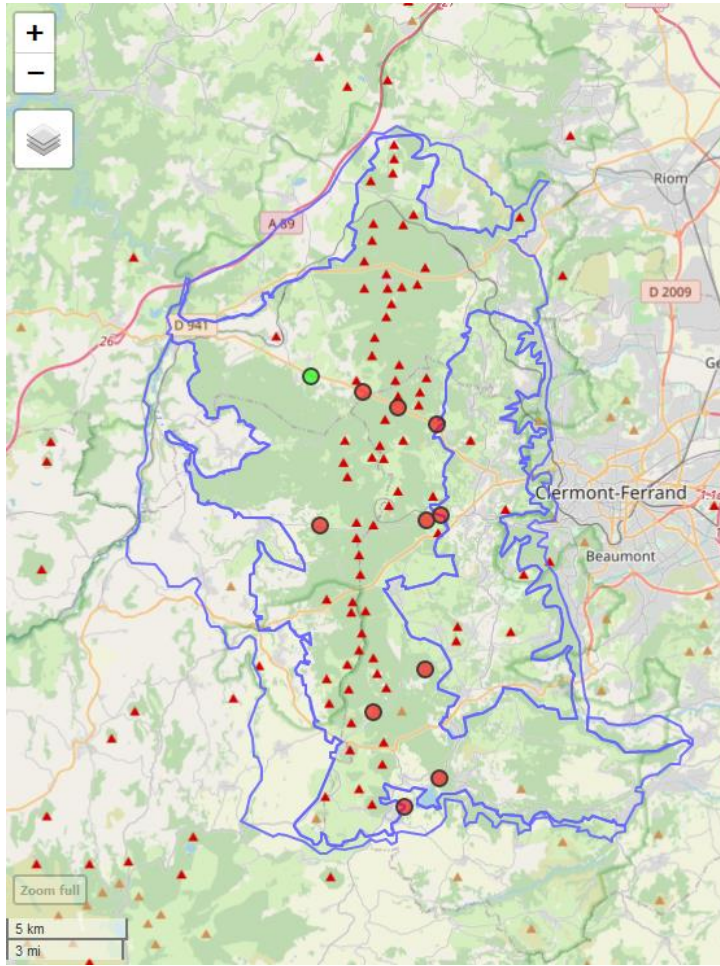
Thank you for your attention

## ➤ Road traffic counts

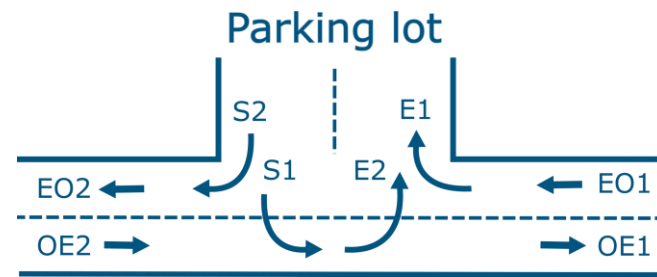
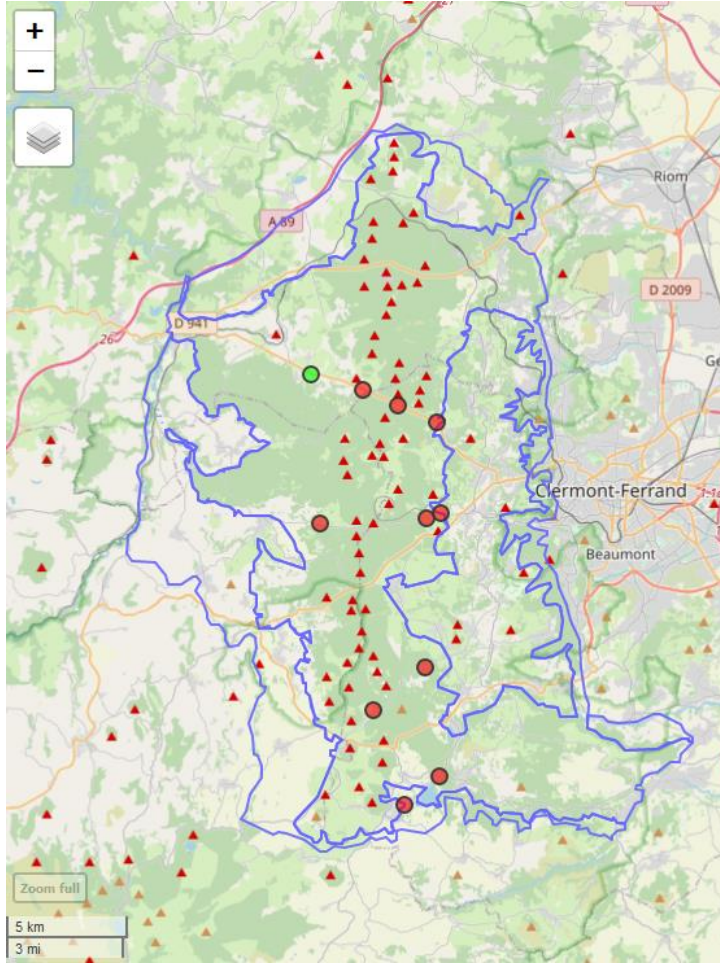
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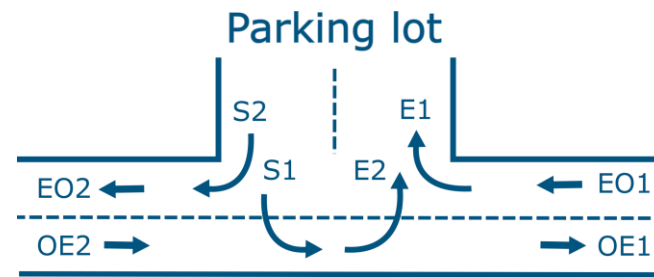
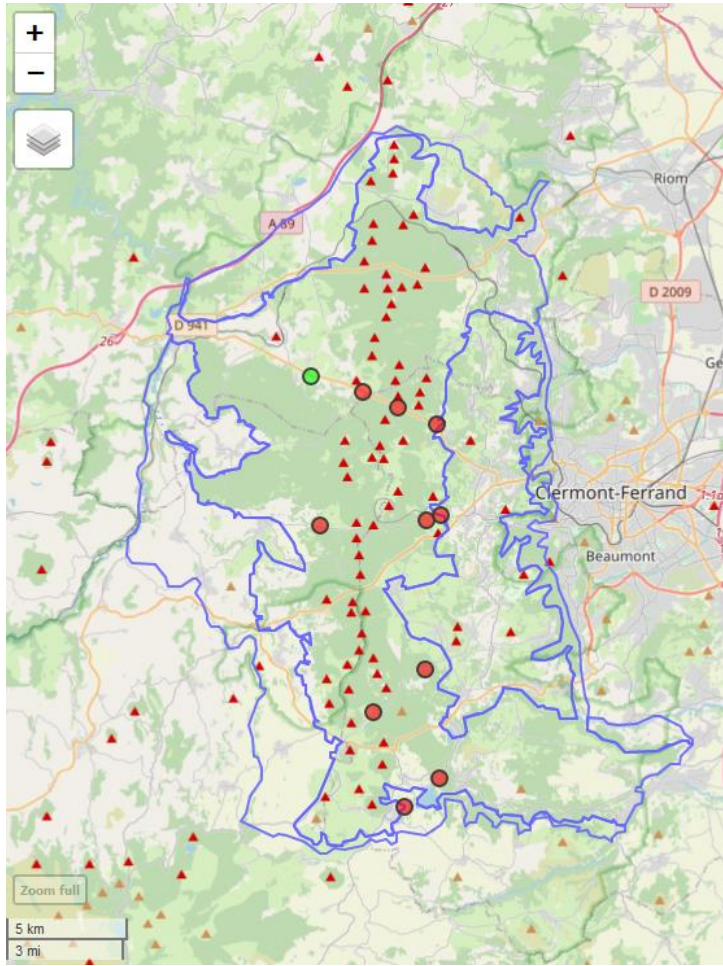
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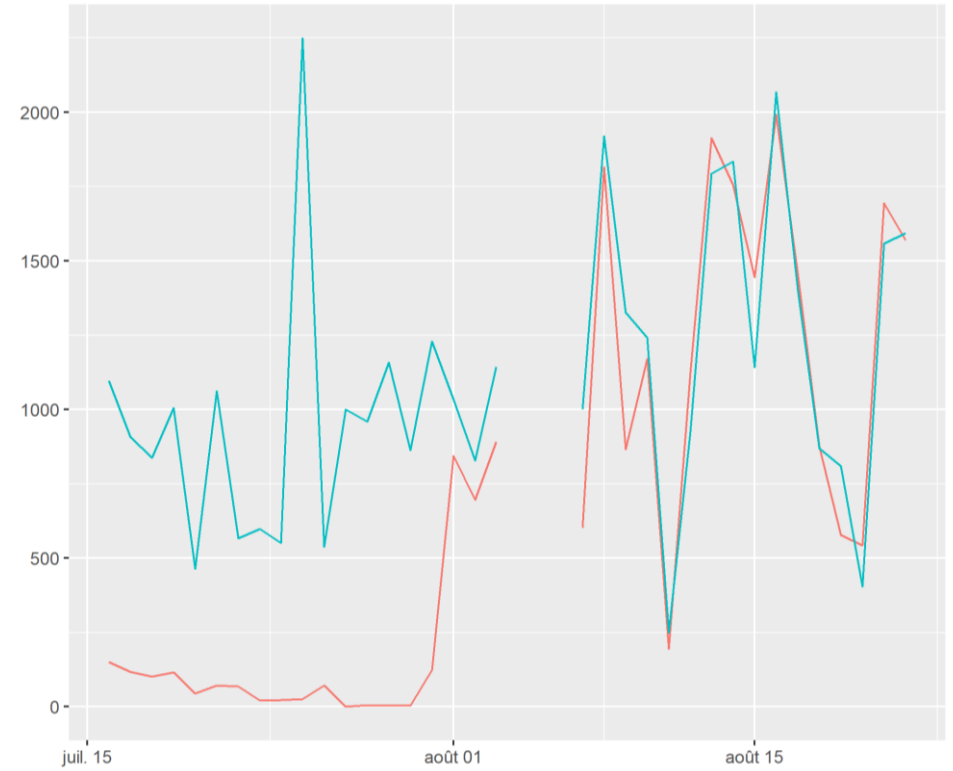
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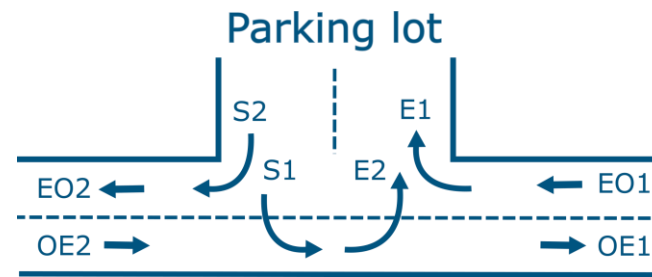
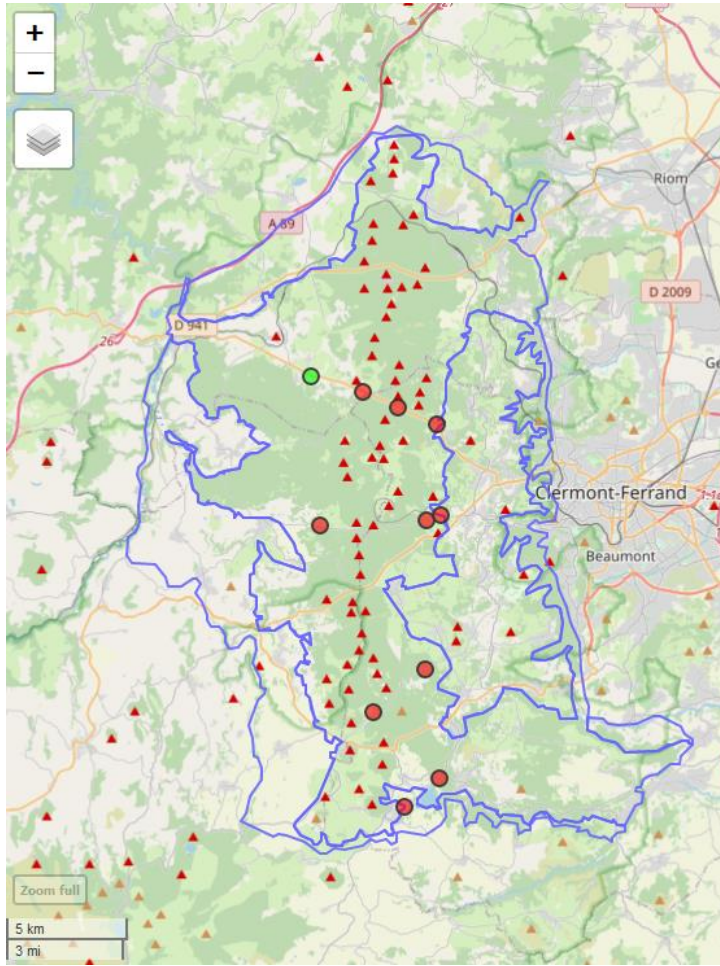
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Ceysnat pass parking lot vs. Muletiers trail to the Puy de Dôme

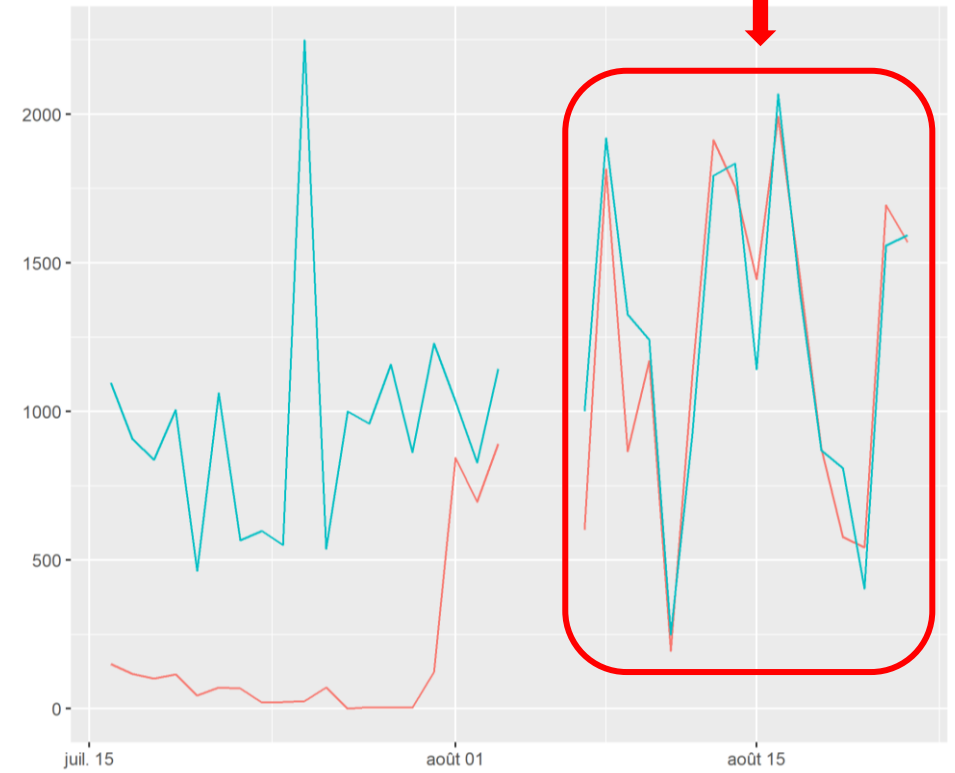


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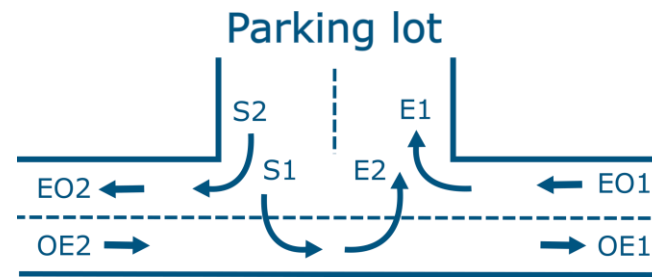
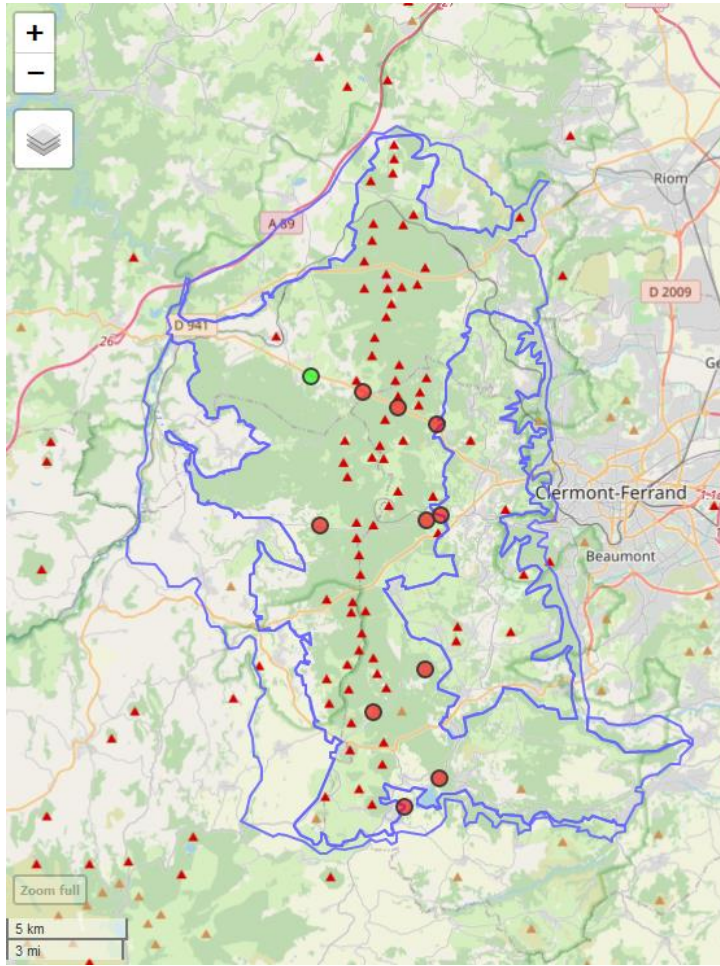


Very good correlation between eco-counter data (in red) and estimated parking counts (in blue) (with a multiplicative factor)

Ceysnat pass parking lot vs. Muletiers trail to the Puy de Dôme

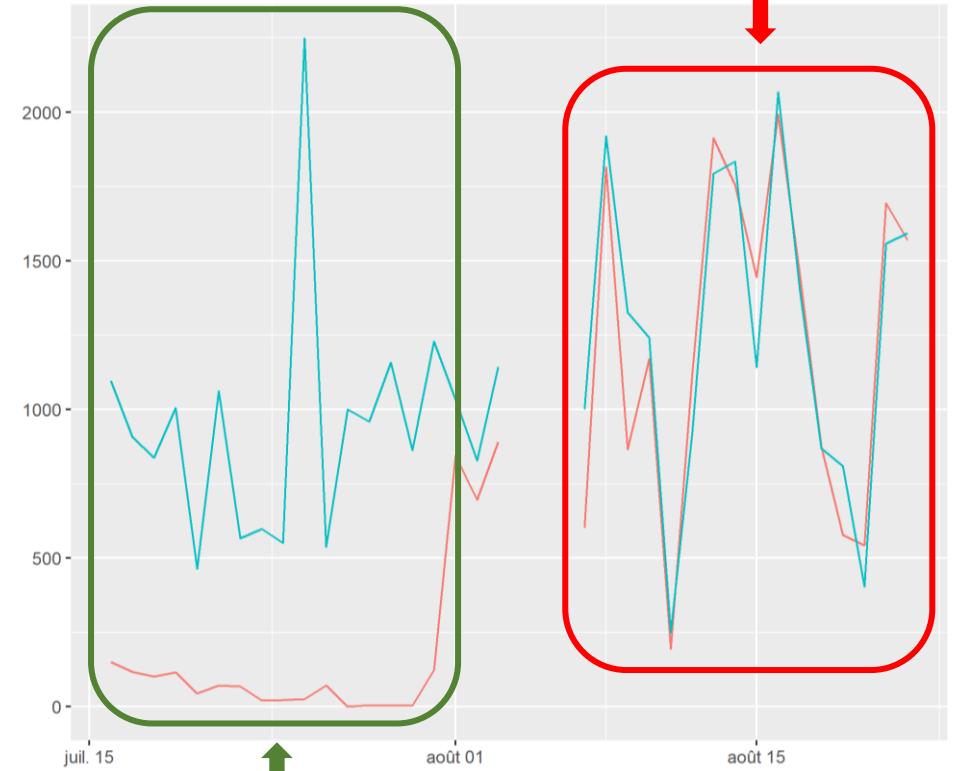


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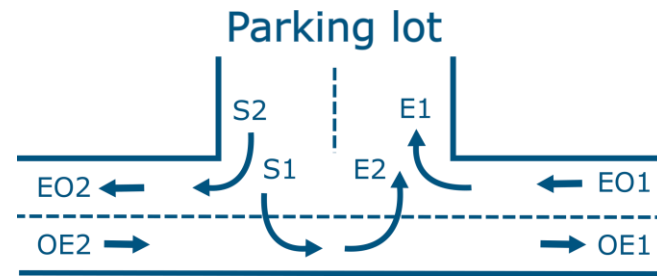
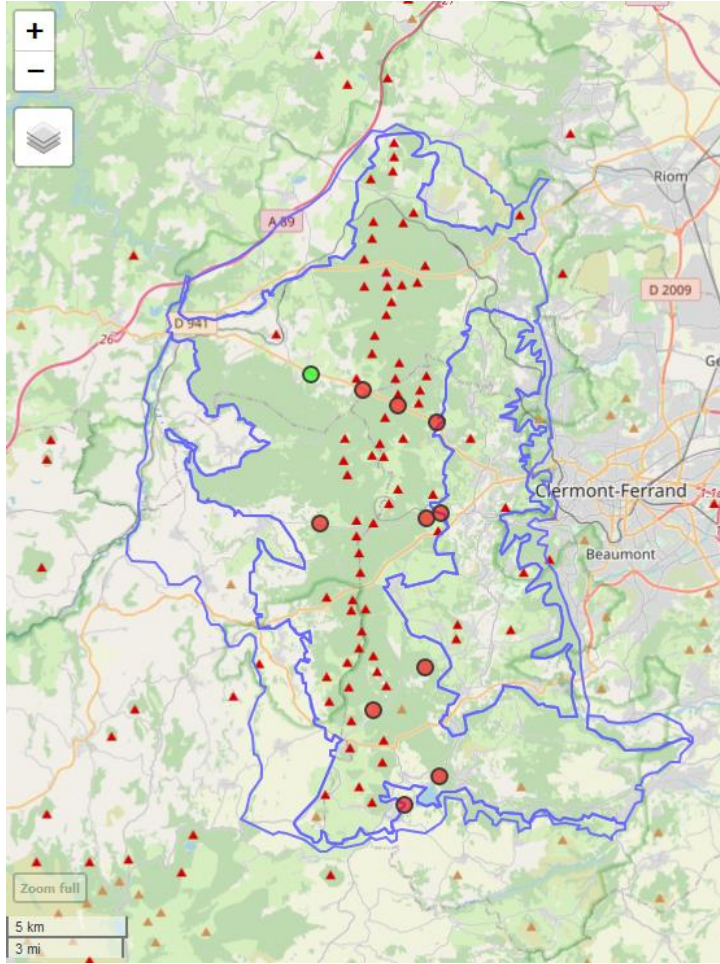
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Possibility of estimating traffic by the Muletiers trail from road counts when the eco-counter malfunctions

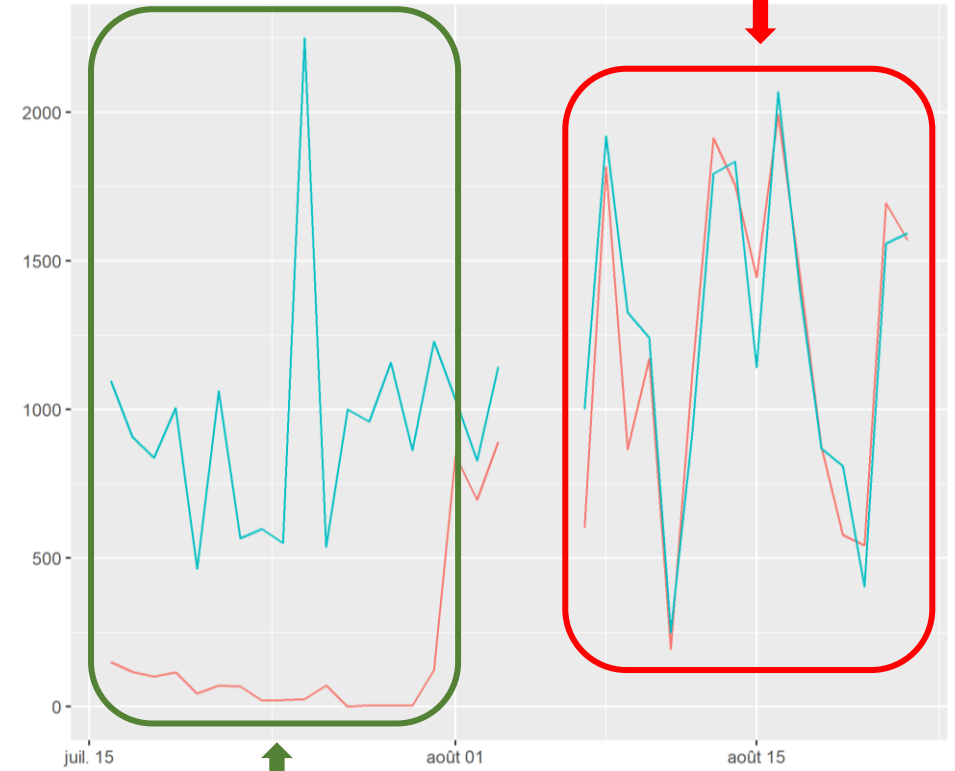
## ➤ Road traffic counts



- Problems encountered :
- Numerous malfunctions
  - Limited reliability, decreasing over time

Very good correlation between eco-counter data (in red) and estimated parking counts (in blue) (with a multiplicative factor)

Ceysnat pass parking lot vs. Muletiers trail to the Puy de Dôme



Possibility of estimating traffic by the Muletiers trail from road counts when the eco-counter malfunctions

## ➤ Summary

Methods	Advantages	Disadvantages
<b>Aggregation of countable sites</b> (eco-counters + ticket sales)	<ul style="list-style-type: none"> <li>- Data by site</li> <li>- Specific (tourism/leisure)</li> <li>- Rather reproducible</li> <li>- Limited cost</li> </ul>	<ul style="list-style-type: none"> <li>- Double counting problem</li> <li>- Partial (unequipped sites/trails, diffuse attendance)</li> <li>- Reliability (EC)?</li> <li>- Data loss (EC)</li> <li>- No information on visitors</li> </ul>
<b>Road traffic counting</b>	<ul style="list-style-type: none"> <li>- Complementary?</li> <li>- Information on vehicles</li> </ul>	<ul style="list-style-type: none"> <li>- Difficult extrapolation (number of people per vehicle)</li> <li>- Not very reliable (if mobile)</li> <li>- Cost (especially if fixed)</li> <li>- No information on visitors</li> </ul>
<b>Flux Vision</b>	<ul style="list-style-type: none"> <li>- Presumably reproducible</li> <li>- Rich information</li> <li>- Diffuse attendance</li> <li>- No double counting (over 24h)</li> <li>- Visitor segmentation</li> </ul>	<ul style="list-style-type: none"> <li>- Black box</li> <li>- Reliability? more/less credible (tourists + / excursionists -)</li> <li>- Cost (but low compared to surveys)</li> </ul>

## ➤ Summary

Methods	Advantages	Disadvantages
<b>Simplified face-to-face survey</b>	<ul style="list-style-type: none"> <li>- Accompaniment facilitates understanding, fewer non-responses...</li> <li>- Control of the sample</li> </ul>	<ul style="list-style-type: none"> <li>- High cost (fixed costs + 15'/survey = 20/day max)</li> <li>- Discontinuous</li> <li>- Administration bias</li> </ul>
<b>Self-administered paper survey</b>	<ul style="list-style-type: none"> <li>- Complementary?</li> <li>- Different respondents?</li> </ul>	<ul style="list-style-type: none"> <li>- No control/accompaniment</li> <li>- Data entry and retrieval costs</li> <li>- No follow-up possible + Losses</li> <li>- Less effective (without animation)</li> <li>- Impossible outdoors</li> <li>- Seen more as a complaint mode</li> </ul>
<b>Self-administered online survey</b>	<ul style="list-style-type: none"> <li>- Very low costs</li> <li>- Continuous responses</li> <li>- Real-time monitoring</li> </ul>	<ul style="list-style-type: none"> <li>- No sample control</li> <li>- No accompaniment</li> <li>- Low effectiveness on some sites</li> <li>- Response reliability</li> </ul>