

# Statistical prevision and modeling of the alighting and boarding times using passenger flows

Rémi COULAUD<sup>1,2</sup>, Marc DERUELLE<sup>1</sup>, Christine KERIBIN<sup>2</sup>, Pierre MESSULAM<sup>1</sup>, Gilles STOLTZ<sup>2</sup>

<sup>1</sup>SNCF Transilien : Lab' Mass Transit ; <sup>2</sup>Laboratoire de Mathématiques d'Orsay, Université Paris-Sud, CNRS

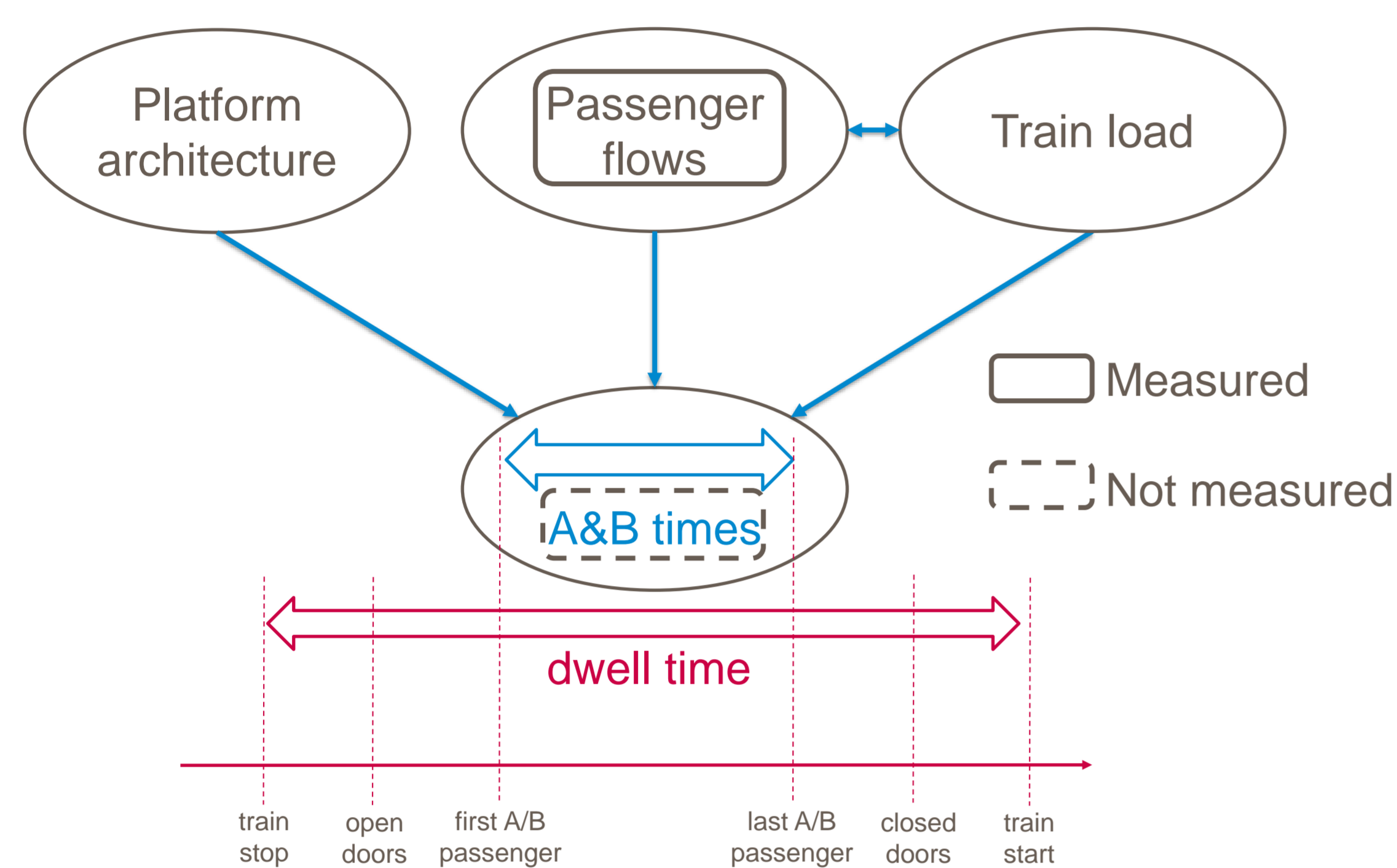
## ➤ Transport context

- ✓ Increasing demand on IDF network forces operators to deal with **mass transit** situations
- ✓ Management of **alighting & boarding** (A&B) times is a key element for exploiting a mass transit network through, for instance, technology as **NExTEO** [1]

## ➤ Statistical methodology

- ✓ Identify main patterns thanks to **exploratory analysis and machine learning**
- ✓ **Forecast** time series of passenger flows and A&B times at different scales
- ✓ Define a **probabilistic model** to represent the A&B times

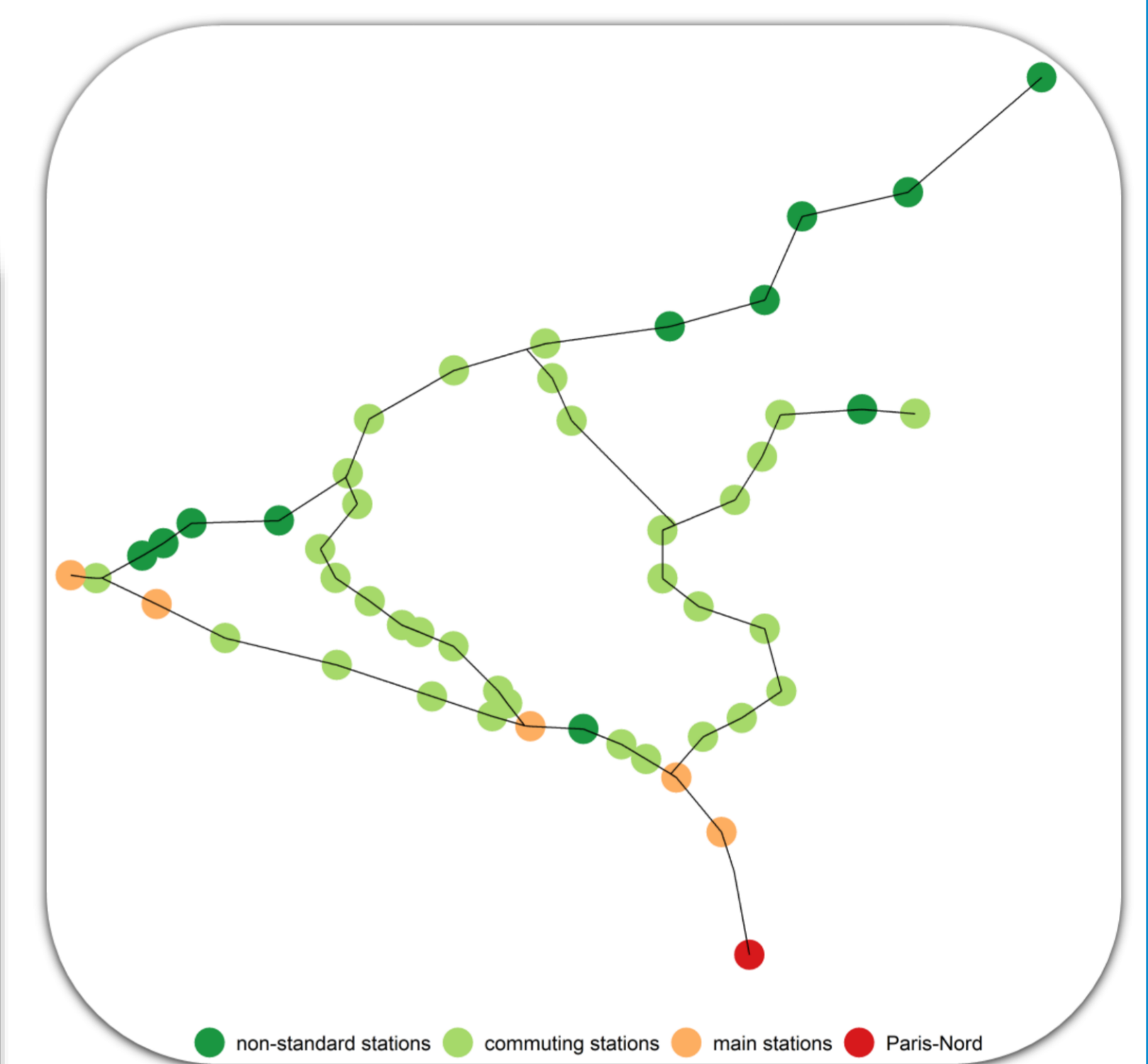
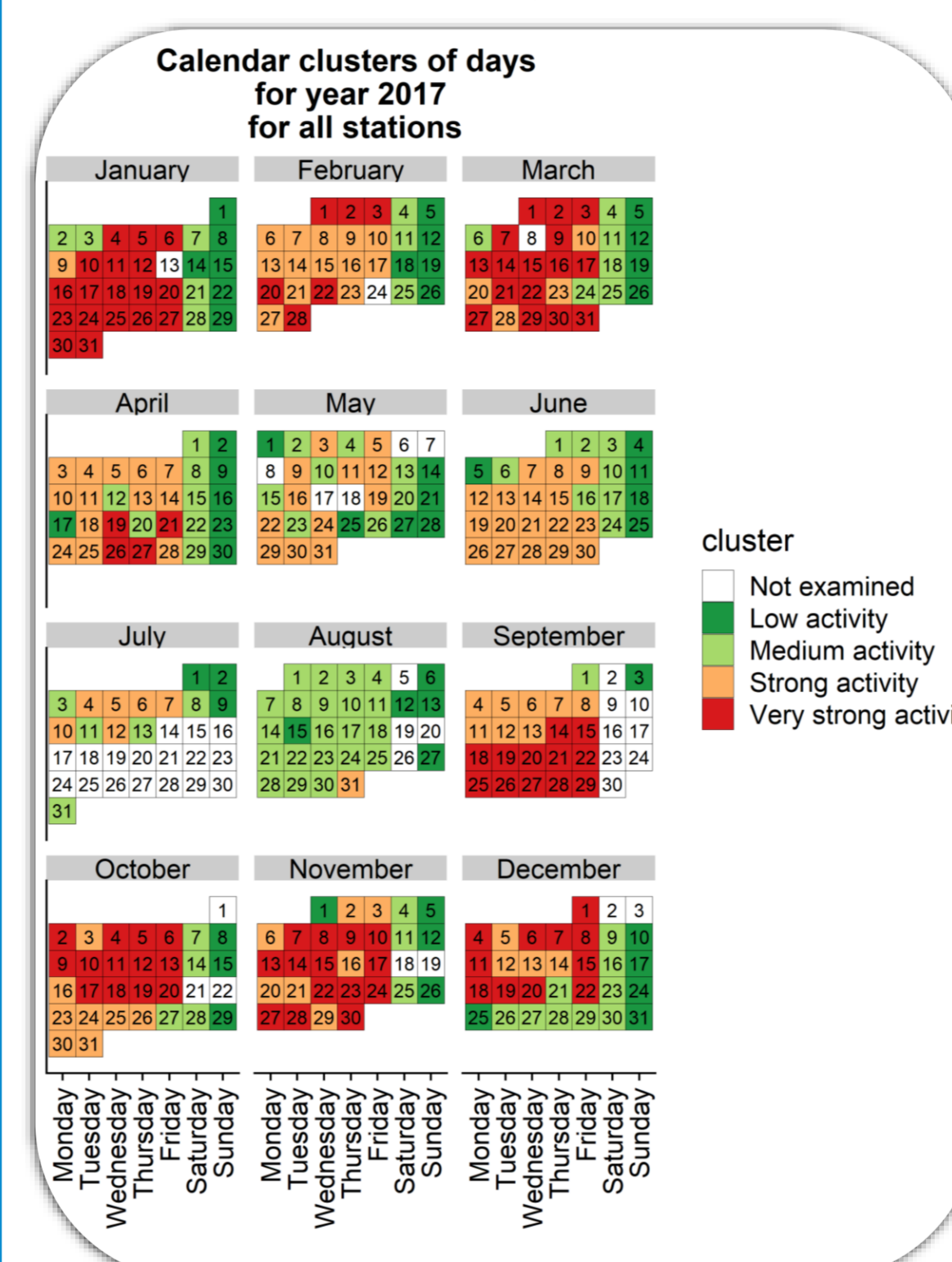
## ➤ Train Platform interface



## ➤ First results

### SPATIO-TEMPORAL TYPOLOGY OF PASSENGER FLOWS

Clustering of the days based on passenger flows



Clustering of the stations based on different variables of passenger flows hourly, during rush hours, daily

## ➤ Measures on line

- ✓ **Infra-red counting system** (available at J + 2 on SNCF app : **Châtelet**, real time soon...)



Infra-red counting system on Z50000

- ✓ IDFM confirms counting quality

- ✓ **Clustering** of days on line H is more **adaptive** than usual JOB/we/holidays segmentation
- ✓ Passenger flows depend on day times and spatial characteristics
- ✓ **Seasonality** of the time series and **topology** of the graphs are crucial to forecast passenger flows [2]

## ➤ To come : expert analysis

### SHORT TERM

- ✓ Asses the **quality of A&B times** measures

### MEDIUM TERM

- ✓ Understand **passenger distribution** on platform and in the train

## ➤ To come : statistical learning

### SHORT TERM

- ✓ **Co-cluster** train stations and hours/days passenger flows

### MEDIUM TERM

- ✓ Define **local short and long time forecasting models** for passenger flows

## ➤ References

1. S. Cornet, C. Buisson, F. Ramond, P. Bouvarel and J. Rodriguez, Methods for quantitative assessment of passenger flow influence on train dwell time in dense traffic areas. 2019, preprint.
2. A. Briand, E. Côme, M. K. E. Mahrsi and L. Oukhellou, A mixture model clustering approach for temporal passenger pattern characterization in public transport, *2015 IEEE International Conference on Data Science and Advanced Analytics (DSAA)*, Paris, 2015, pp. 1-10.