

A novel data-driven algorithm for the automated detection of unexpectedly high traffic flow in uncongested traffic states

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De Verkeersonderneming



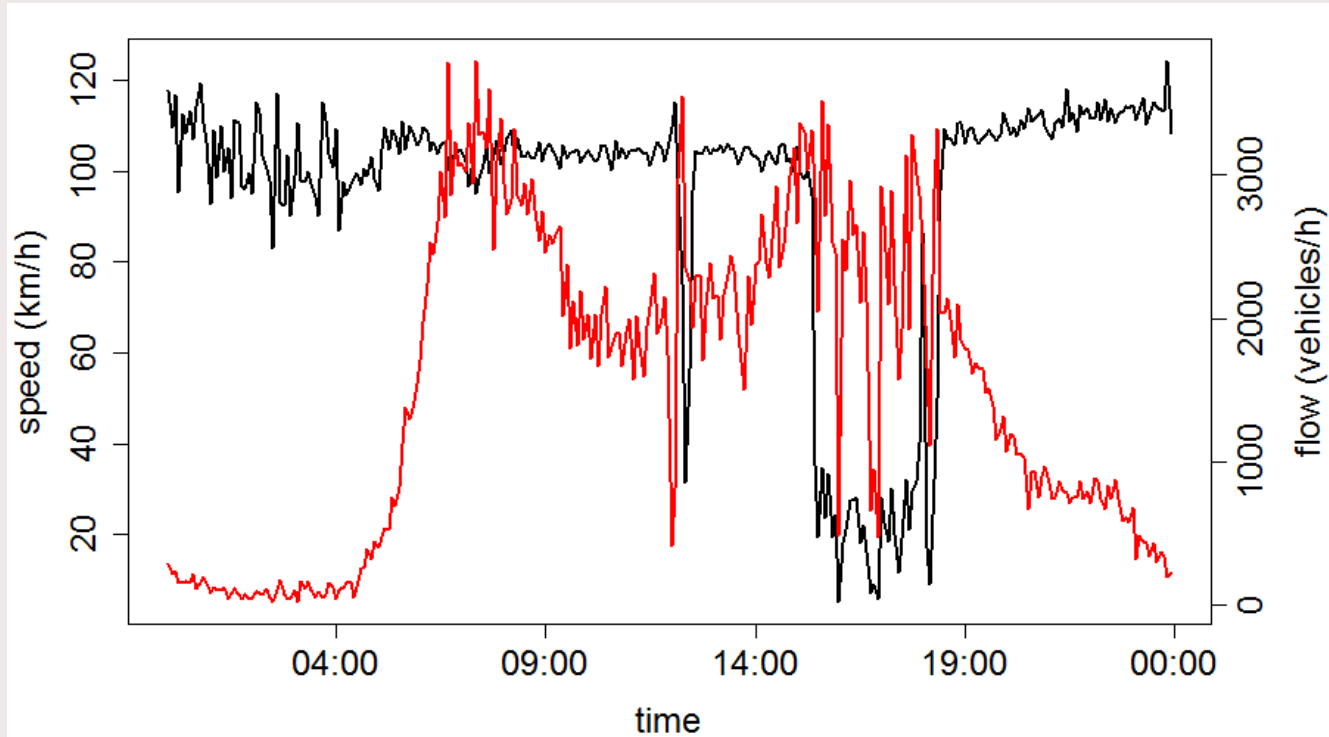
Outline

- Introduction
- Location and data
- Methods
- Key Insights
- Conclusions

Introduction



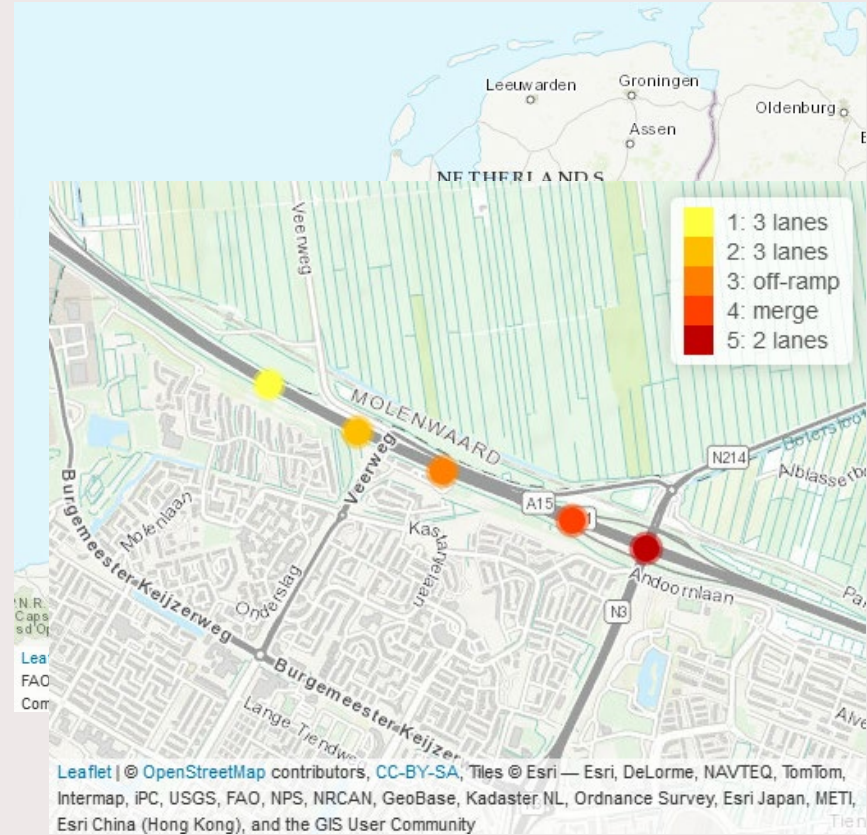
Introduction



Location of case study



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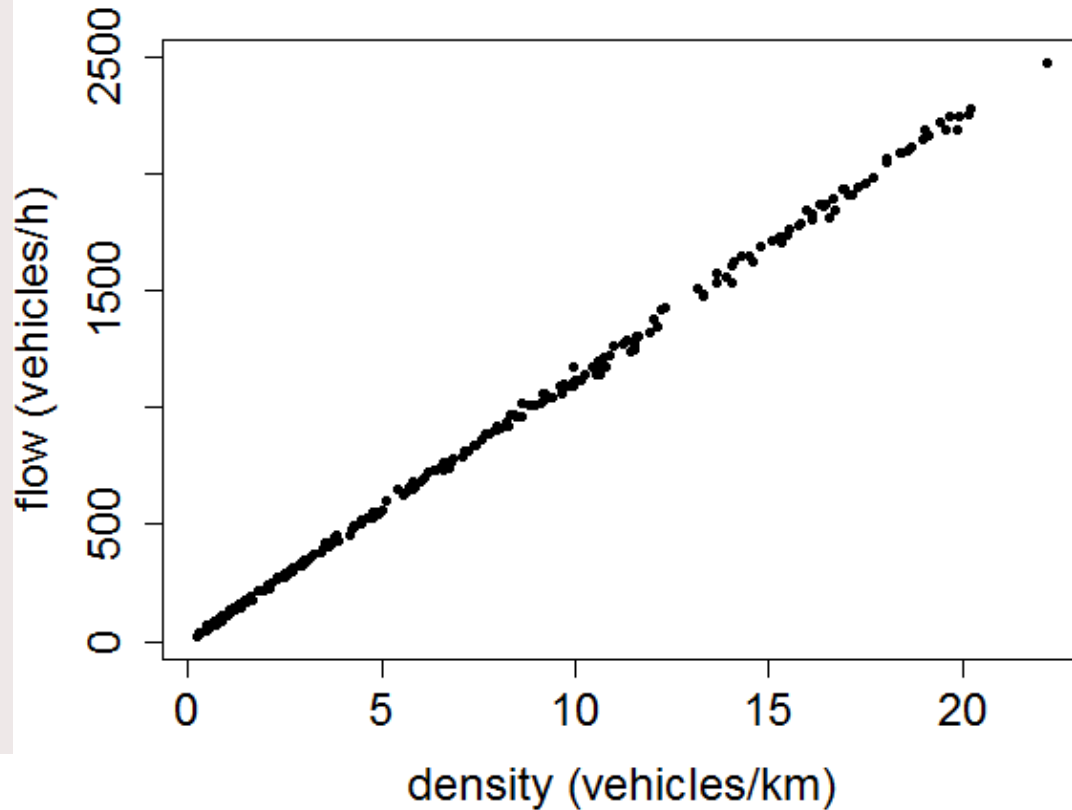


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Data

- Detector data
- Data from 1-1-2018 until 31-12-2018
- Number of vehicles per lane for each minute
- Average speed of vehicles per lane for each minute
- Aggregation of data to periods of 5 minutes
- Data freely obtained from NDW.nu

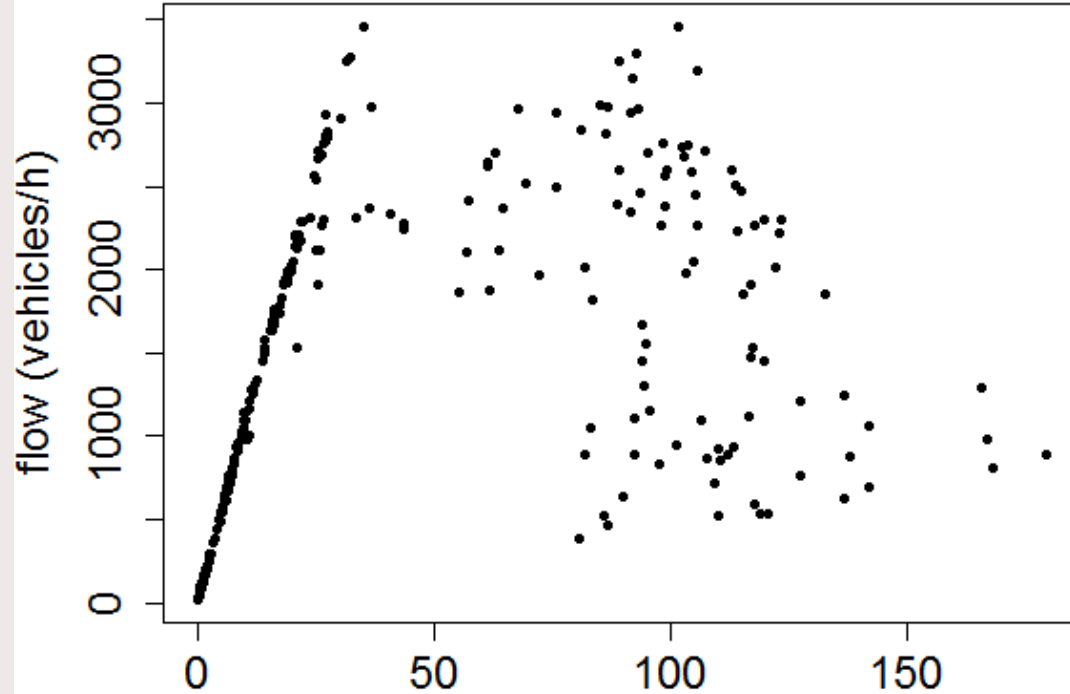
Method – fundamental diagram



Method – aim

- Our aim is to automatically identify days with high traffic flow **and** high speed (we call such days *high-performance days*)
- But what is high flow and high speed?
- We look at the *breakdown probability*, i.e. the probability that given the traffic flow, a transition from free flow to congestion occurs

Method – fundamental diagram



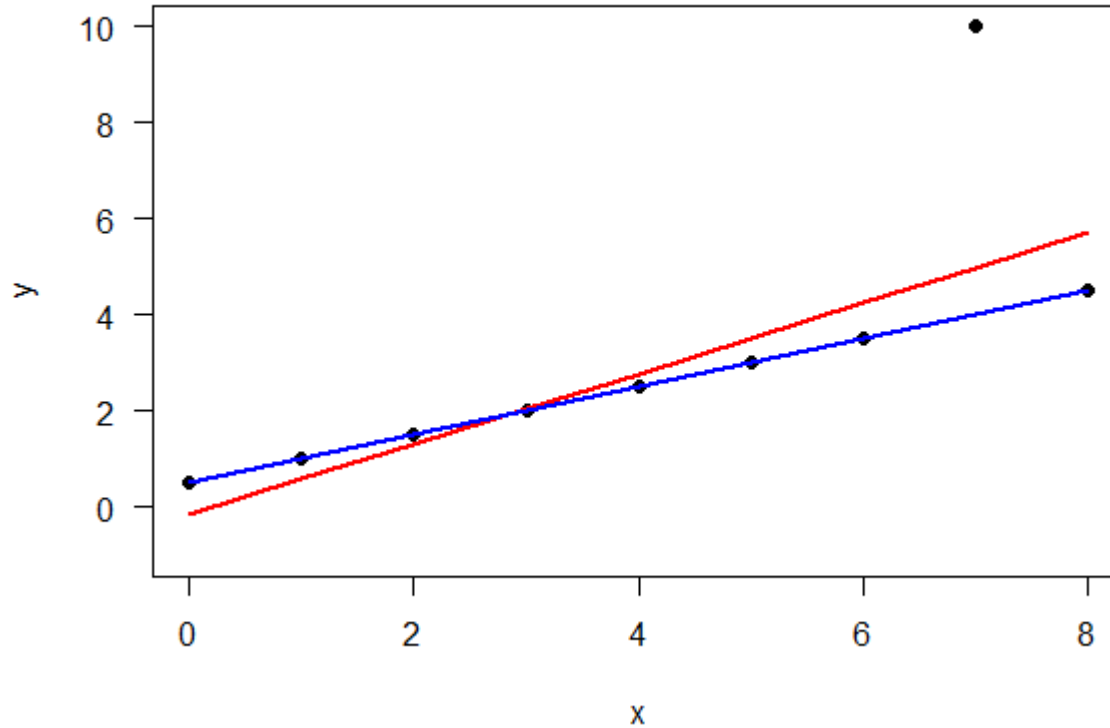
Method – aim

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- But what is high flow and high speed?
- We look at the *breakdown probability*, i.e. the probability that given the traffic flow, a transition from free flow to congestion occurs
- Then we can identify *unperturbed moments*, moments at which a breakdown is likely, but did not occur
- And many unperturbed moments imply a high-performance day

Method – labelling

- Free flow: approximately a straight line through the origin
- Congestion: clearly deviating from this straight line
- Fit a *robust regression* model on the data to estimate the straight line

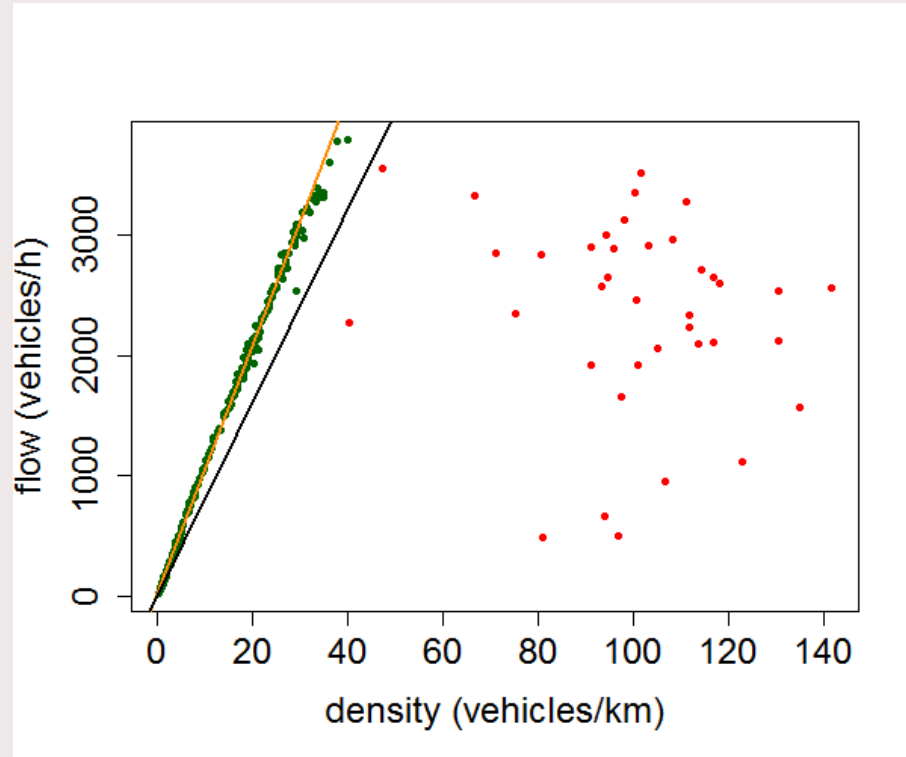
Method – robust regression



Method – labelling

- Free flow: approximately a straight line through the origin
- Congestion: clearly deviating from this straight line
- Fit a *robust regression* model on the data to estimate the straight line
- If a point is below the free flow speed and has a low weight we label the point as congestion

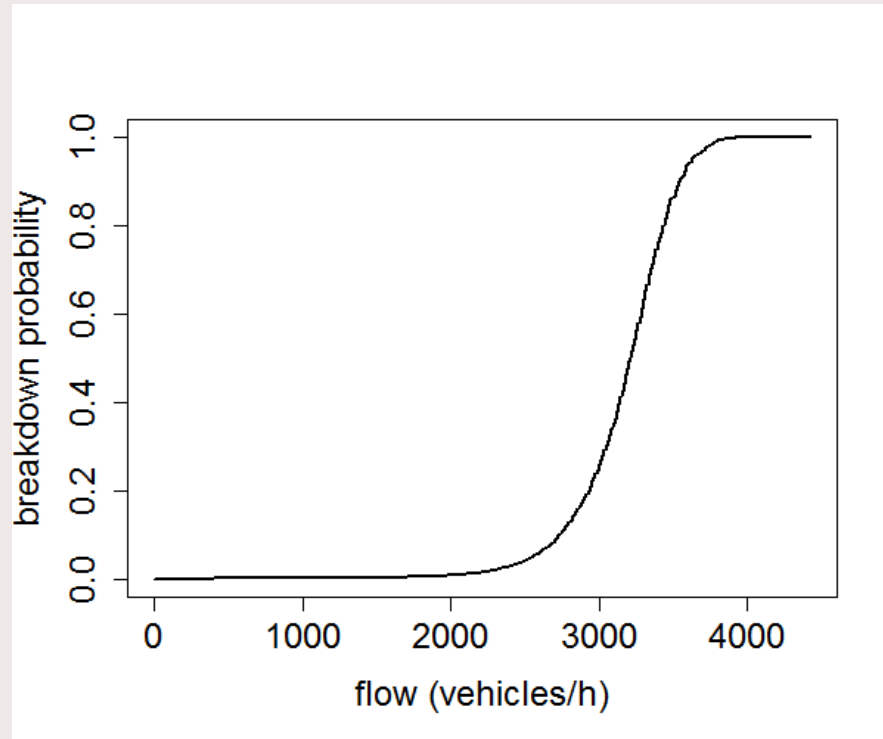
Method – labelling & critical speed



Method – breakdown distribution

- $R(q)$ is the number of times a breakdown did occur at a flow q or lower
- $S(q)$ is the number of times a breakdown did not occur at flow q or higher
- Then the breakdown distribution is
- $P(q) = \frac{R(q)}{S(q)+R(q)}$ (Arnesen and Hjelkrem, 2017)

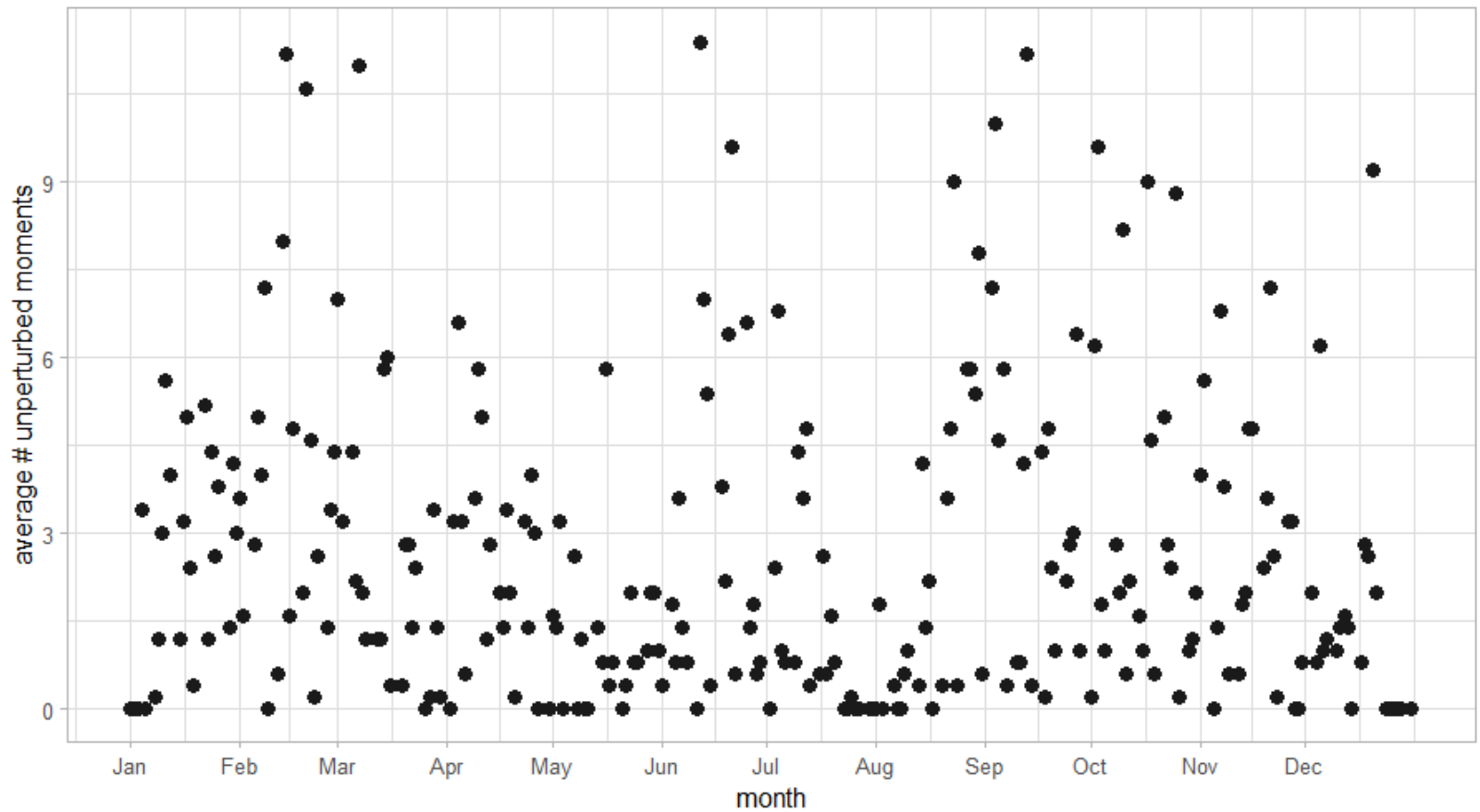
Method – breakdown distribution



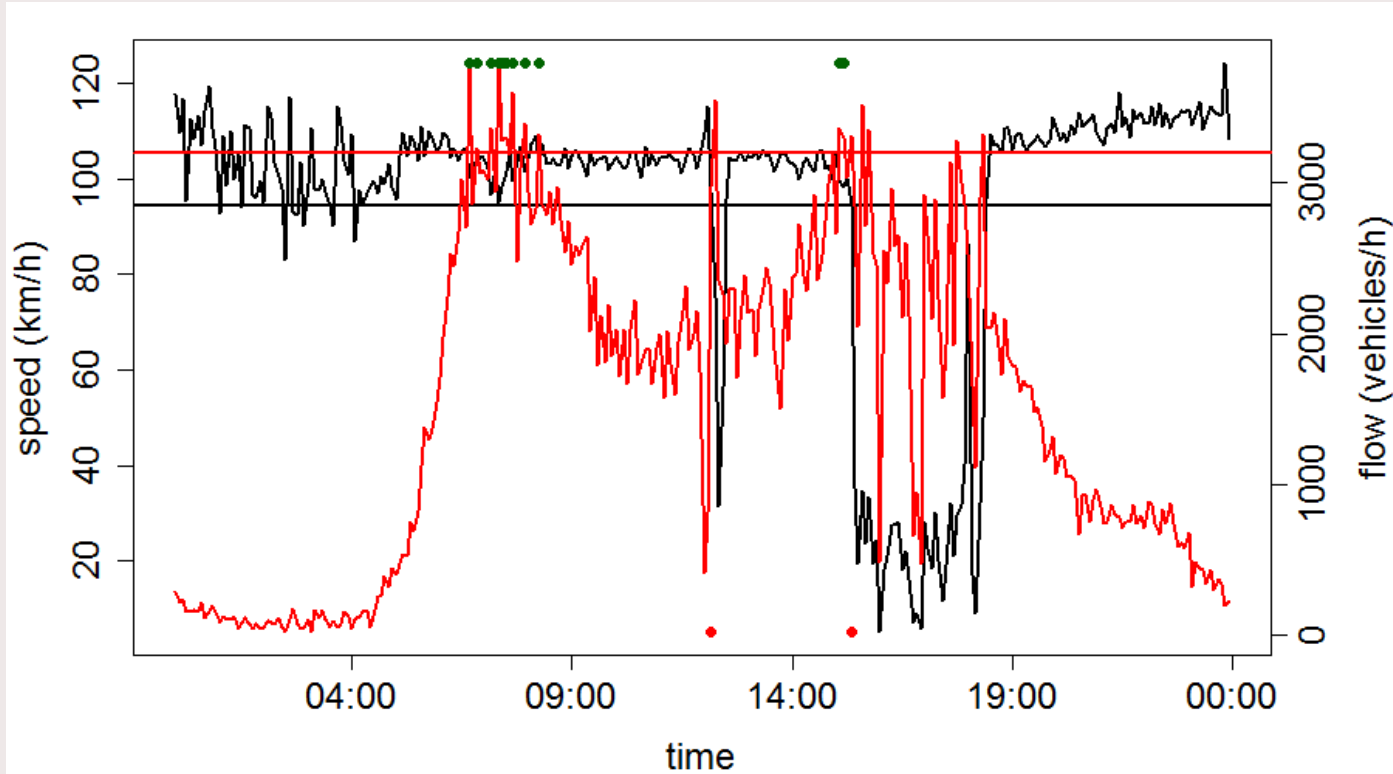
Method – summary

- Estimate the critical speed
- Label each data point as free-flow or congested
- Find the breakdown distribution
- Identify the unperturbed moments
- Identify the high-performance days

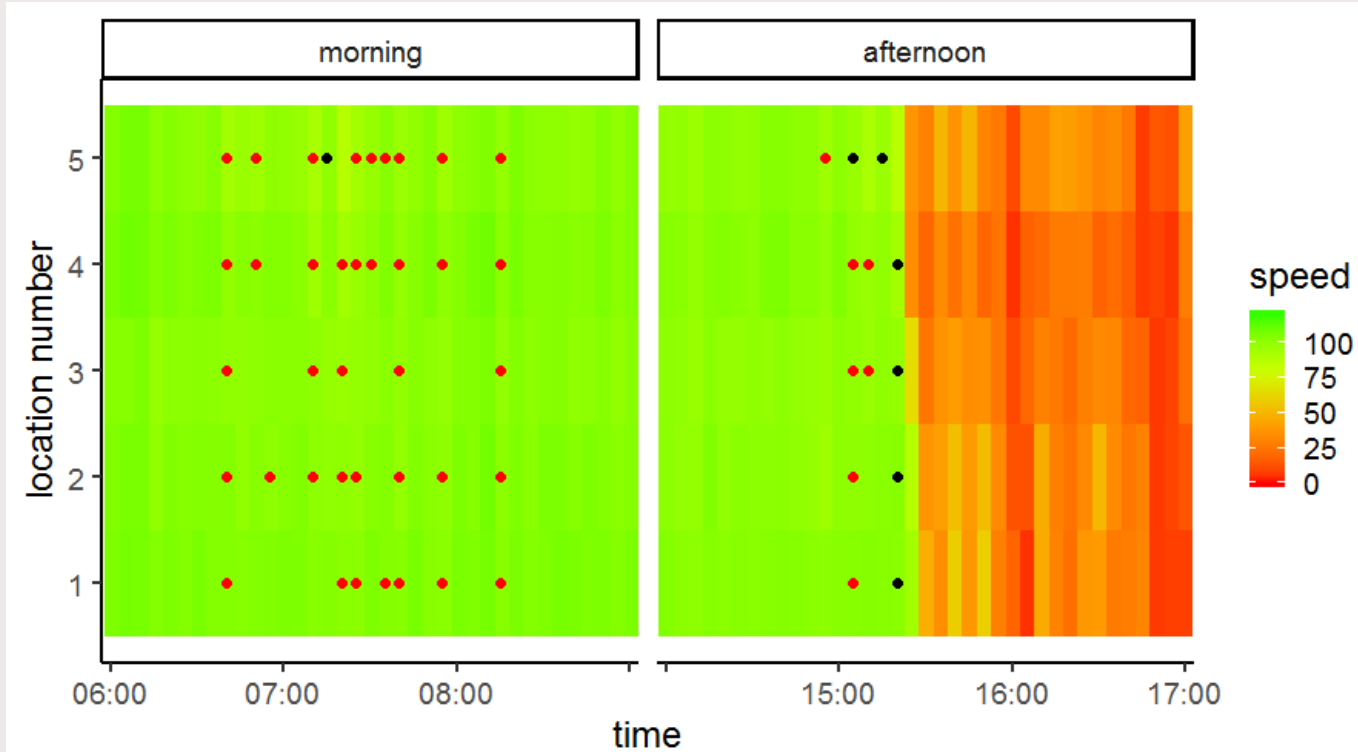
Key insights



Key insights



Key insights



Conclusions and discussion

- We are able to identify high-performance days
- Method is easy to use and does not need sophisticated data
- General method that can be applied elsewhere (under certain conditions)
- First step to identify characteristics of high-performance days

- Paper is available on arXiv: <https://arxiv.org/abs/1909.12782>

Thank you for your attention!