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Effective usage of short-term parking zones by offering real-time information on the utilisation of parking lots

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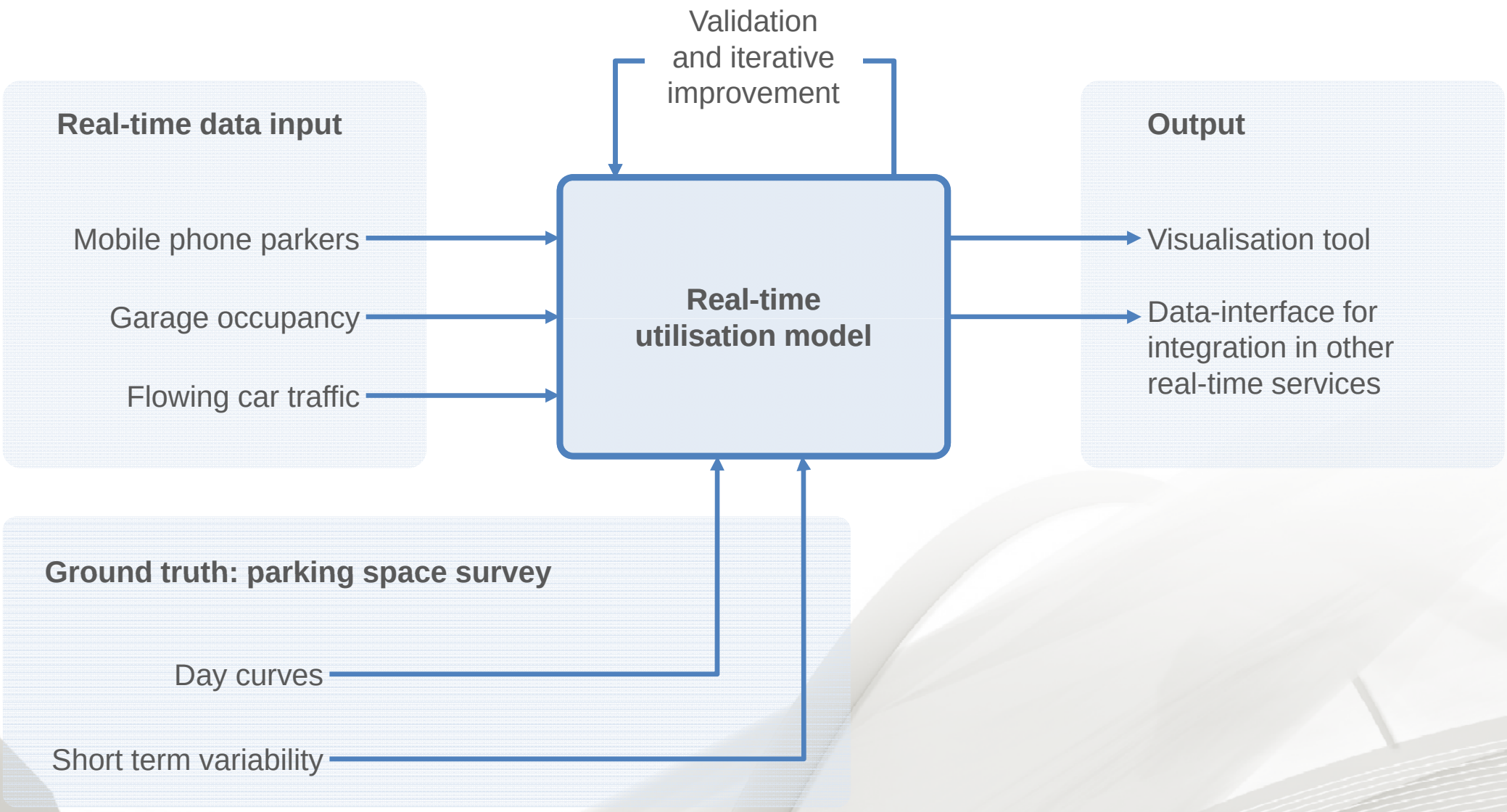
Introduction

- **Short-term parking zones** introduced in many European cities
- Still **parking search traffic** is a reason for high traffic volume
- Existing real time systems showing on-street occupancy of parking spaces are **expensive** and **controversial discussed**
- **Forecast** of the occupancy rates is preferred to reduce parking search traffic at the destination

Objectives

- Development of a **real-time information service for the utilisation of short-term parking zones**
- Usage of three existing **real-time data sources:**
  - ⇒ counts and location of electronically purchased parking tickets
  - ⇒ counts of short term parkers in car parks
  - ⇒ counts of flowing car traffic
- No indication of occupancy of single parking lots

Data flow in the real-time information system



Real time data sources

- Cooperation with mobile network operator to get information on the cell-IDs, from which electronic parking tickets are booked
- Due to data protection concerns data is not available in real-time, but for the model calibration
- Data from 3 parking garage operators available
- Traffic flow data available for the whole city

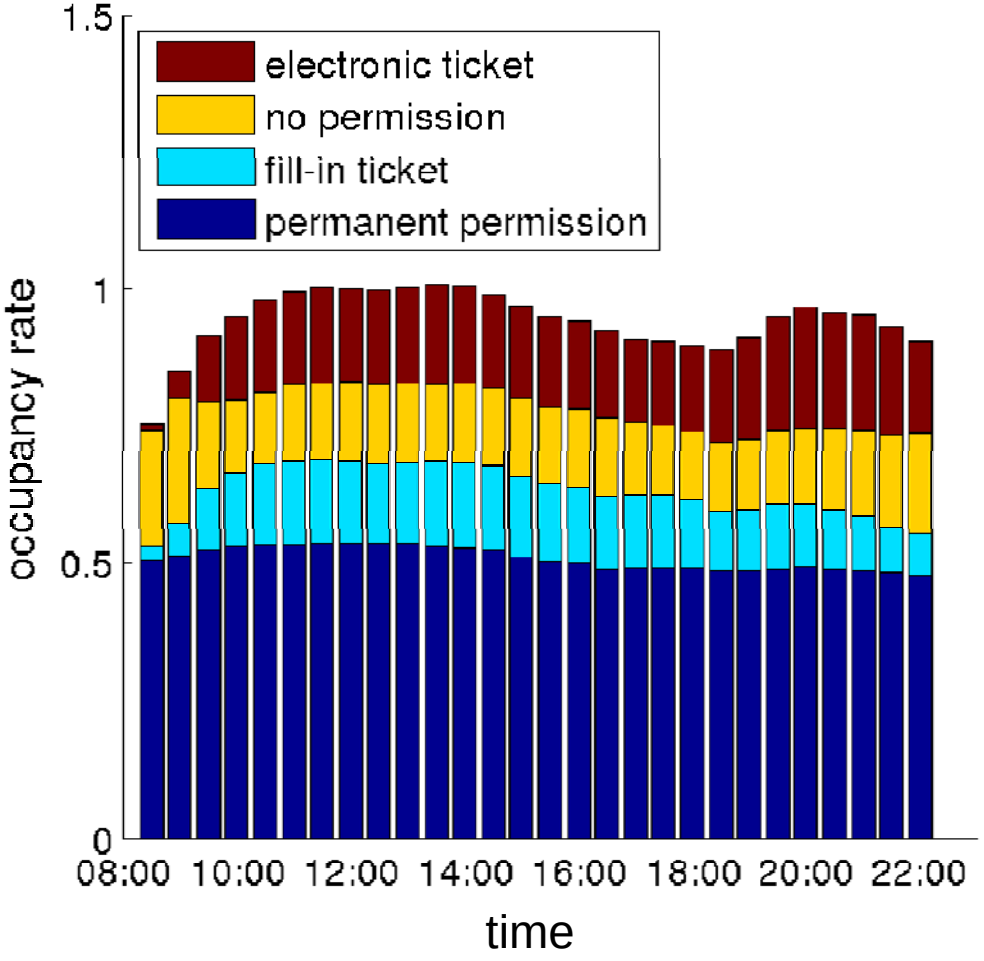
Parking space survey

- Aim of the survey: ground truth for calibrating and validating the occupancy model
- Two test areas with 3.000 on-street parking spaces and 2.400 parking spaces in garages
- Three observation periods between February and April 2012 each including 3 days from 8.00 am to 10.00 pm.

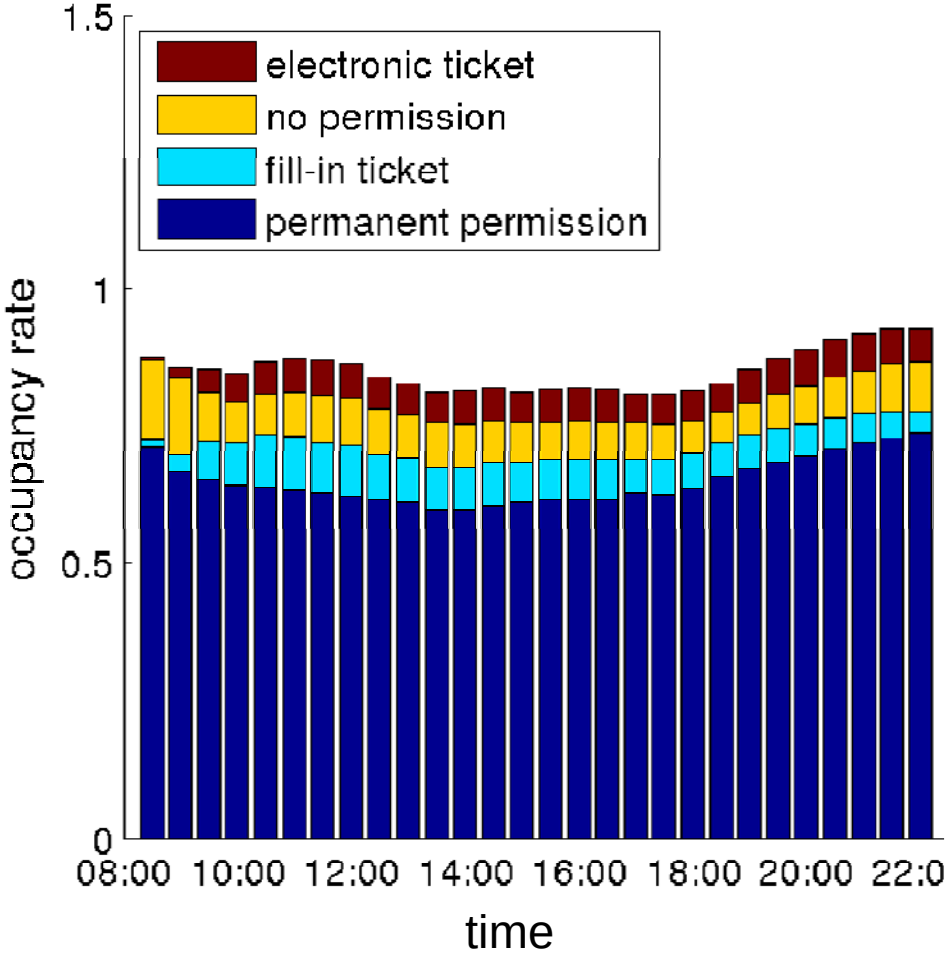
Parking space survey

Parking space survey

1. disctrict



6. district



Correlation between occupancy rate and real time data

- No systematic relationship between car park inflow and parking space occupancy
- No significant correlation between traffic flow data and utilisation of on-street parking spaces
- These two real-time data sources were not integrated in the model

Correlation between occupancy rate and real time data

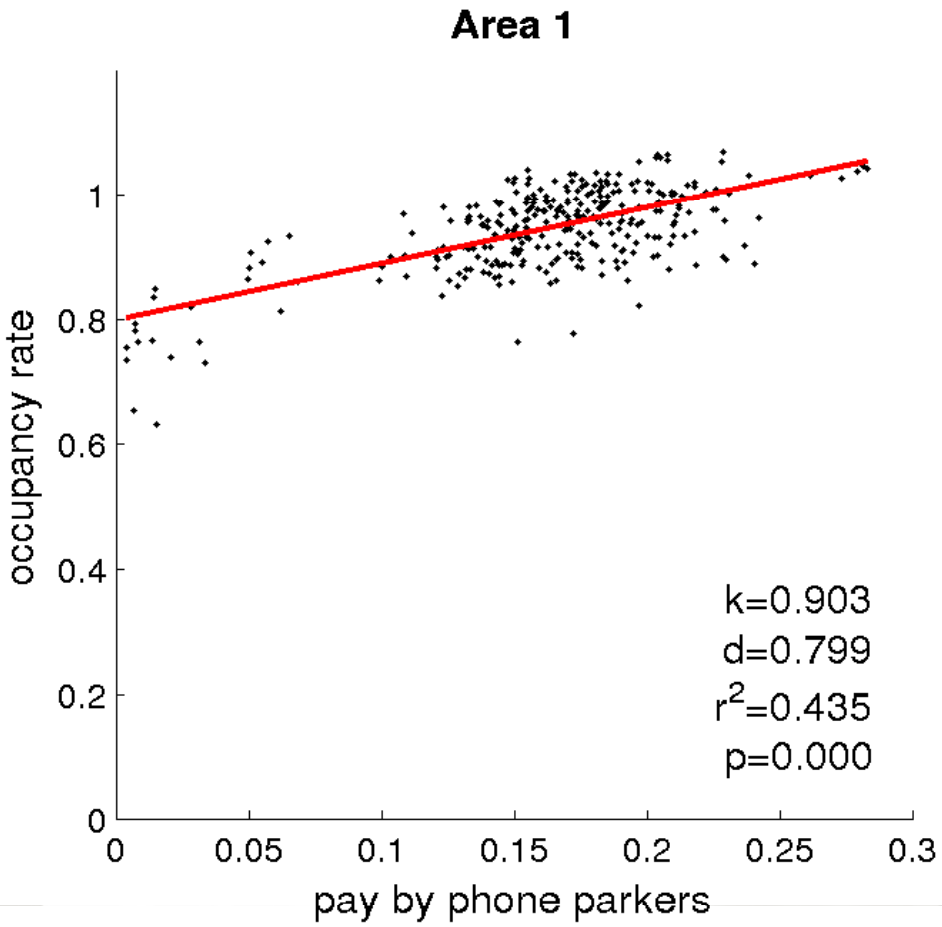
- Correlation between mobile phone parking data and occupancy rates

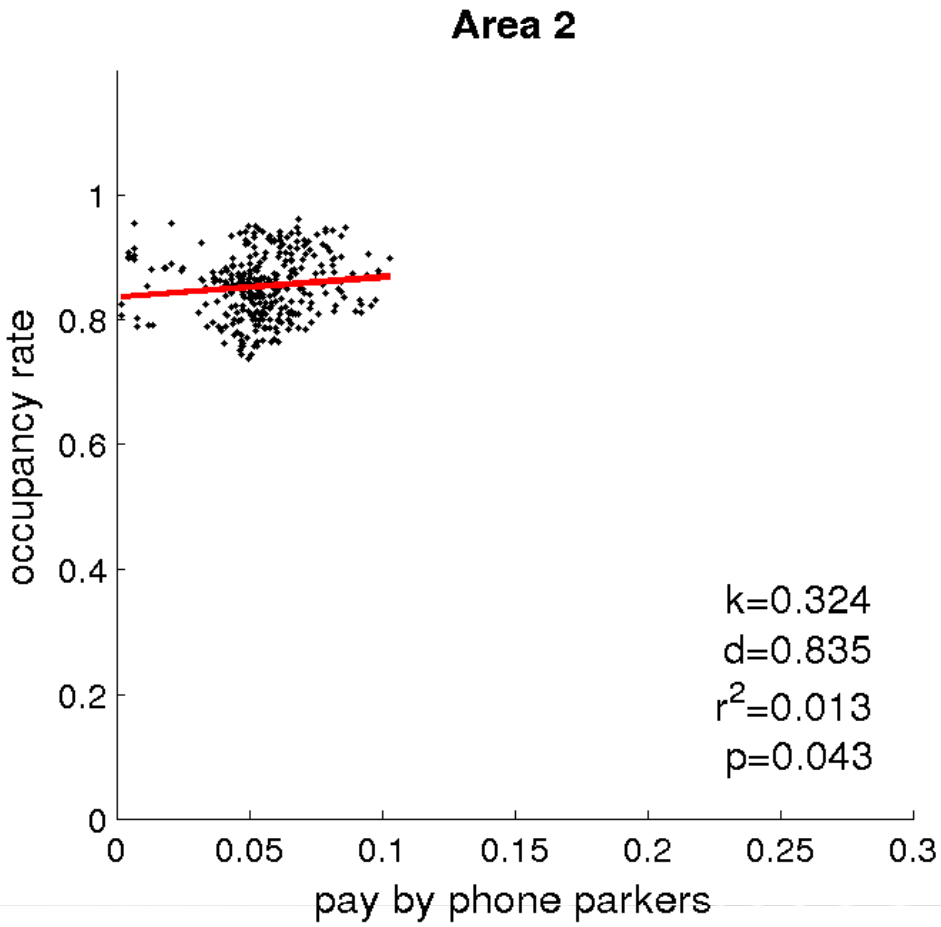
Kind of permission	Area 1		Area 2	
	r	*p*	*r*	*p*
fill-in tickets	0.515	0.000	0.503	0.000
permanent permissions	-0.259	0.000	-0.269	0.000
cars without permission	-0.372	0.000	-0.418	0.000
all other permissions	-0.067	0.241	-0.238	0.000
total occupancy rate	0.659	0.000	0.115	0.043

Correlation coefficients (r) and significance (p)

Correlation between occupancy rate and real time data

- A linear regression model given the number of electronic tickets explains $r^2 = 43.5\%$ of the occupancy rate variance in area 1 and only $r^2 = 1.3\%$ of the variance in area 2

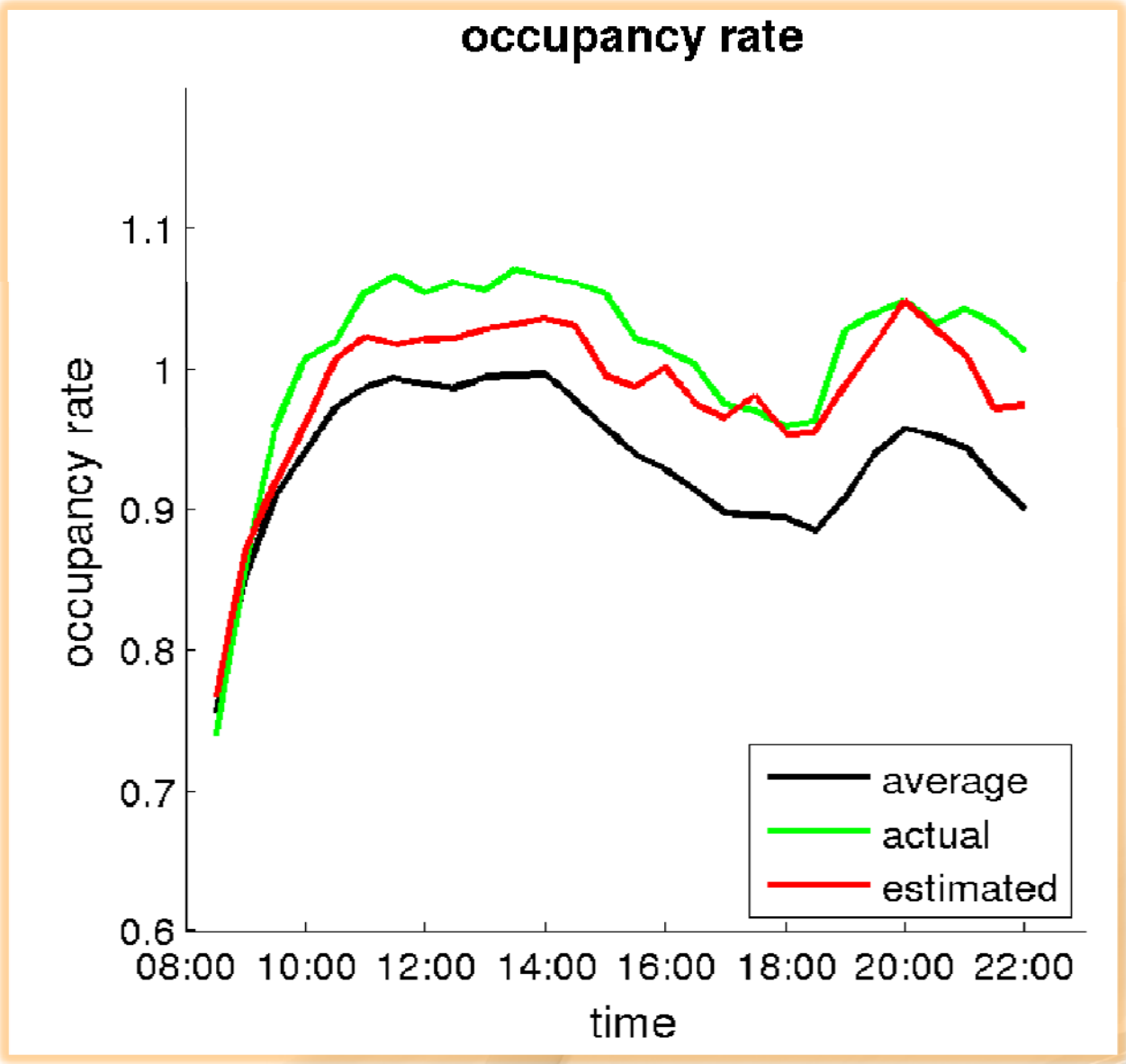




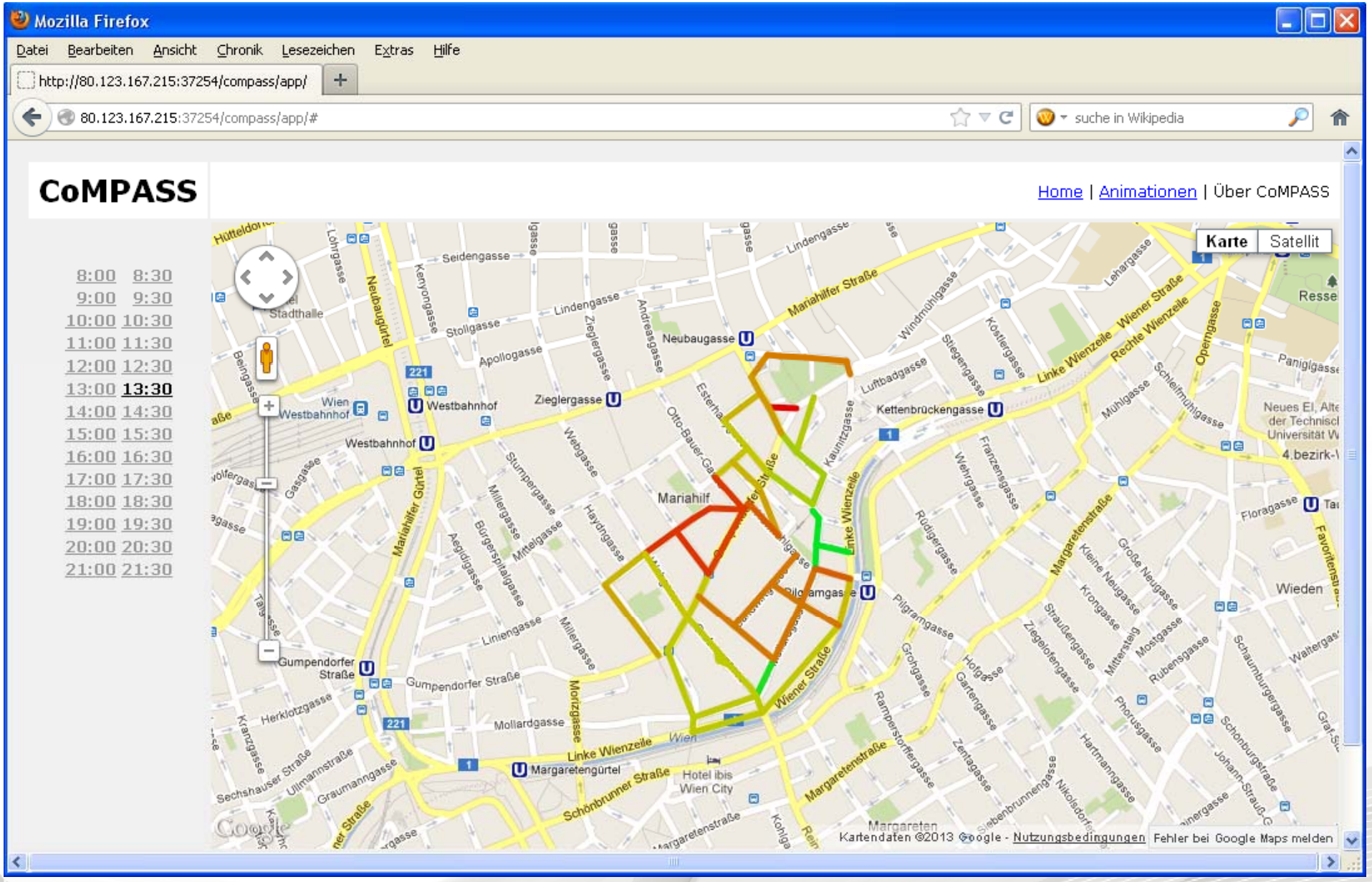
Real-time model

- An average day curve model was defined to measure the improvement in prediction accuracy gained from the real-time information
- Usage of real-time mobile phone parking data in the model can:
  - ⇒ slightly increase the fraction of explained variance in the **current time interval**
  - ⇒ not reduce the prediction error for **future time intervals**
  - ⇒ increase the accuracy of the model in **exceptional situations**

Real-time model



Visualisation



Conclusion and outlook

- Mobile phone parking data can help to indicate and predict the occupancy rate in short term parking zones
- The day curve model predicts the occupancy very well and can hardly be outperformed by a real-time model
- Unusual deviations from the day curve due to exceptional events can only be predicted by the real-time model
- To further develop the model data protection concerns have to be tackled

Thank you for your attention!

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