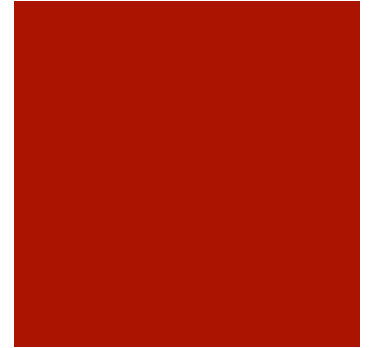# WeBike

T. Carpenter, M. Khaki, C. Ograda-Bratu, I. Rios, R.P. Singh, S. Keshav

December 9, 2014

Agenda

- introduction to the team

- update on status

- some results

- new, personalized website

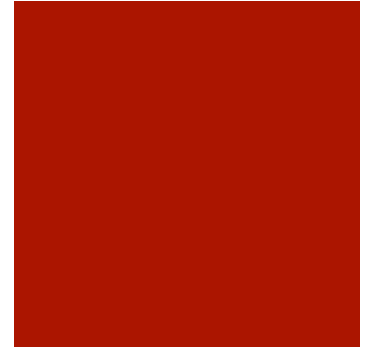- focus groups

- your chance to talk

What?

- A fleet of 31 instrumented eBikes on campus

Who uses them?

- UW faculty, staff, and students
  - Trustworthy
  - Are willing to have usage measured

- Selected using a comprehensive survey
  - based on brain/behaviour models
  - designed by Prof. Tobias Schroeder, U. Potsdam

Why?

- Scaled down, cheaper version of EVs

- With solar charging, is a cost-effective off-grid transportation solution

- Urban transport alternative

- Cool!
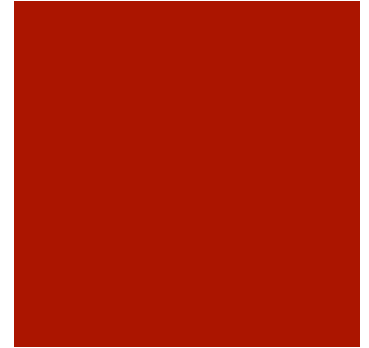
When?

- Started deployment in July 2014
  - fully deployed in August 2014
  - data collection issues sorted out in mid-October 2014
  - clean data from all 30 bikes since November 7, 2014

- 3-year duration
  - Bikes handed off to users at the end of study

Sensors

- Galaxy S III (Android)
  - Time
  - GPS location
  - Light (in lumens) for theft
  - Accelerometers

- Voltage
  - to infer battery state of charge

- Charging current

- Temperature sensors
  - inside sensor box
  - inside battery
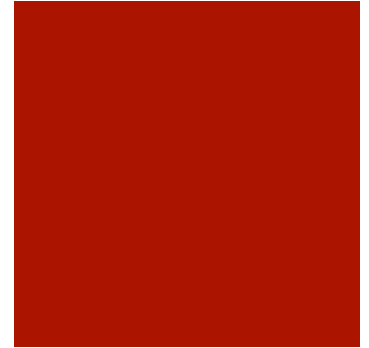
Sensors

Temperature sensor
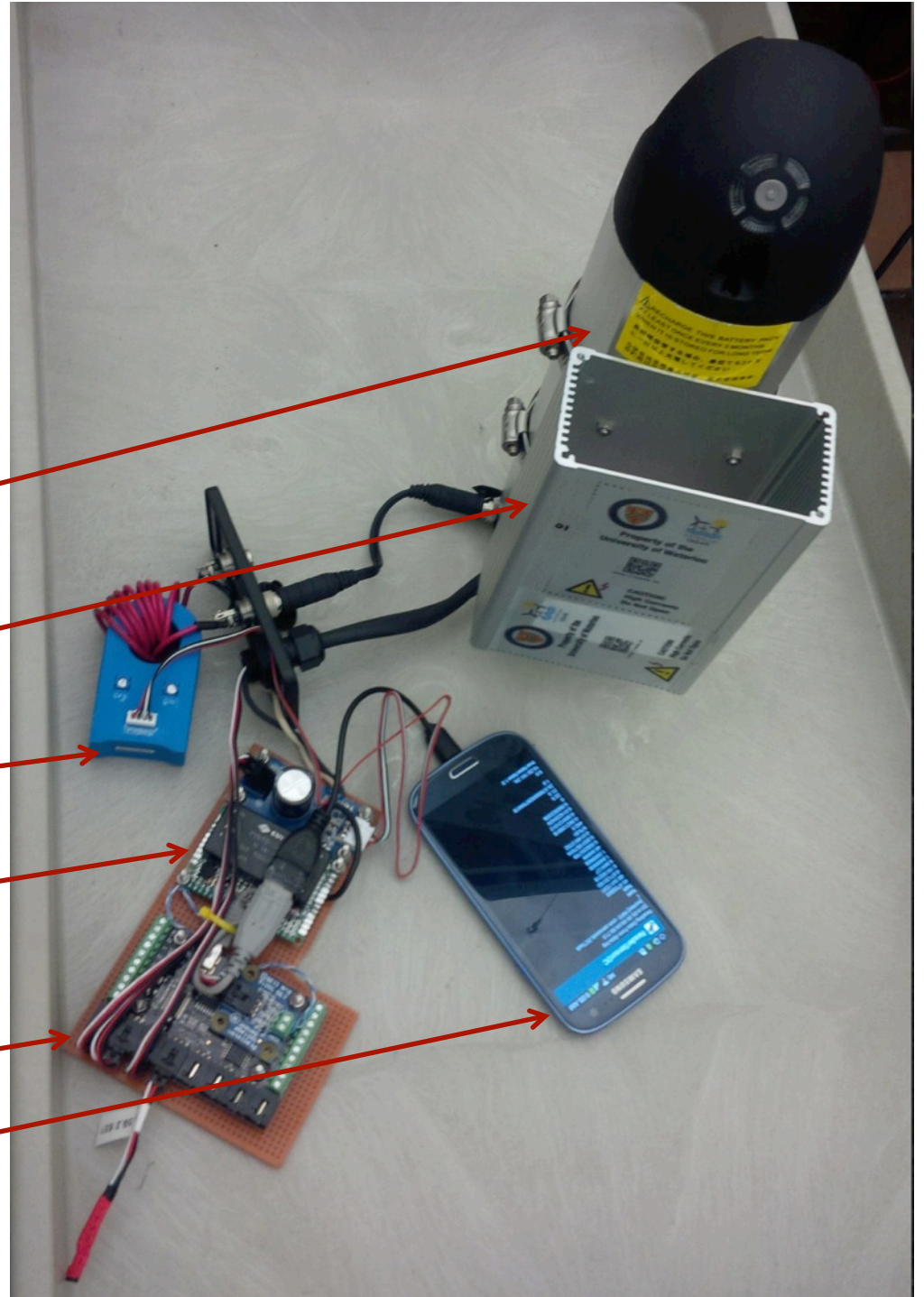inside battery casing

Sensor enclosure

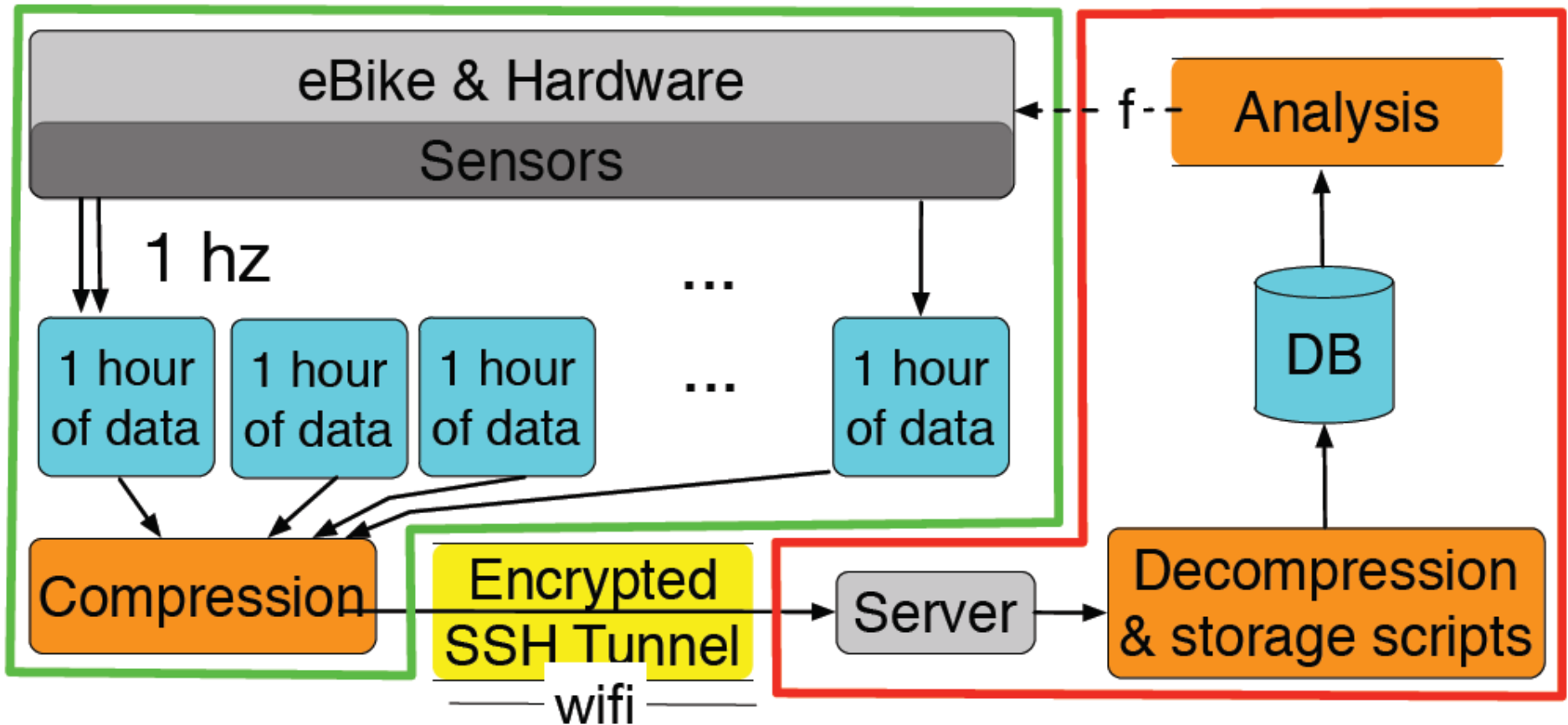Current sensor

Voltage sensor

Phidget I/O board

Samsung galaxy
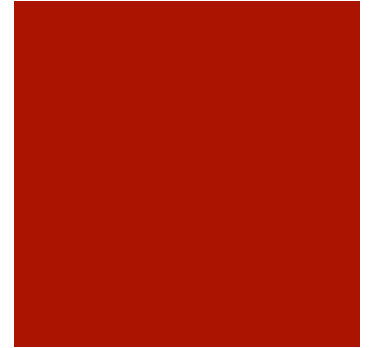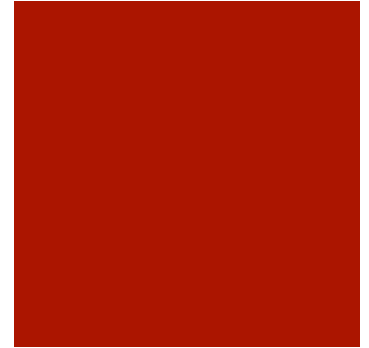
Software system

Components

- Hardware and software
  - design
  - implementation
    - on device
    - server-side
      - data storage
      - analysis
  - Process
    - testing
    - re-design and re-testing
    - deployment
    - debugging and re-testing
    - updating software over-the-air and recalls
    - server-side debugging is ongoing…

Others…

- Obtaining finance

- Locating and buying hardware

- Research ethics clearance

- Legal clearance

- Setting up partnerships with eProdigy and Cycle Electric
  - permission to modify battery
  - bike assembly and storage
  - rider training

- Participant management
  - survey design and implementation
  - participant selection
  - dealing with bike problems, returns, theft
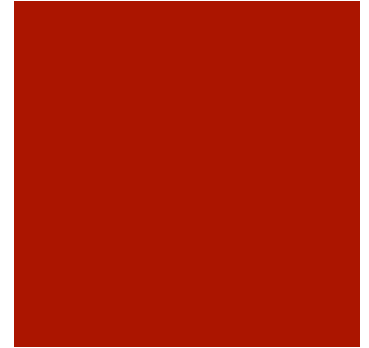 - termination and re-selection

Hardware Problems
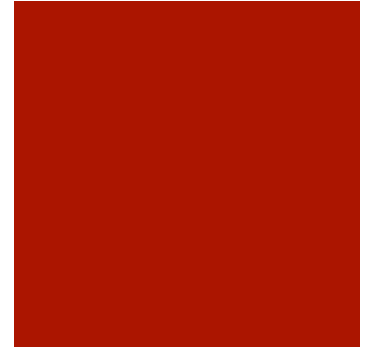
- Getting the right cell platform
  - On-the-go USB support
  - right version of Android

- Sensor range and sensitivity

- Getting rid of excess heat

- Waterproofing

- Wireless connectivity

- GPS accuracy
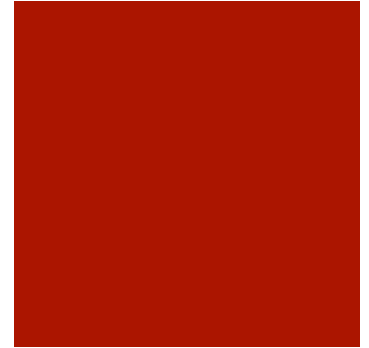
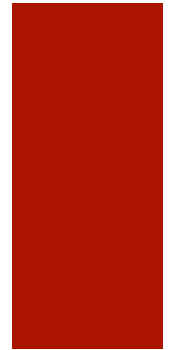- Physical layout – fitting it all in

Software problems on device

- Phidget library causes crashes
  - need to reboot phone hourly

- Android tries to kill off background processes

- Secure transfer of data to blizzard and typhoon
  - how often?

Server-side problems

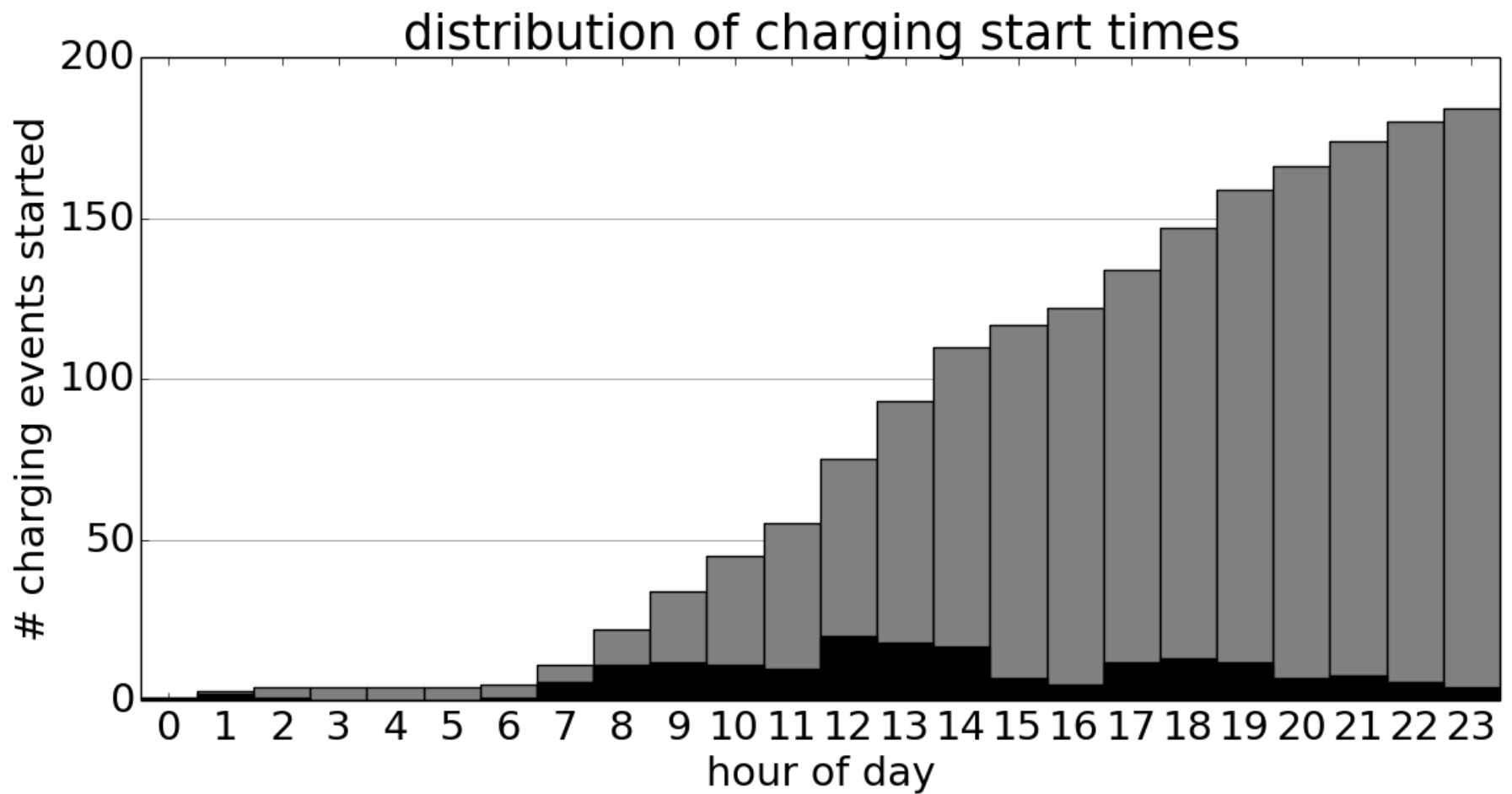- Big data – ~28 GB and growing about a GB every 3 days

- Missing data

- GPS jitter

- Upload problems

UI

Results

Charging times

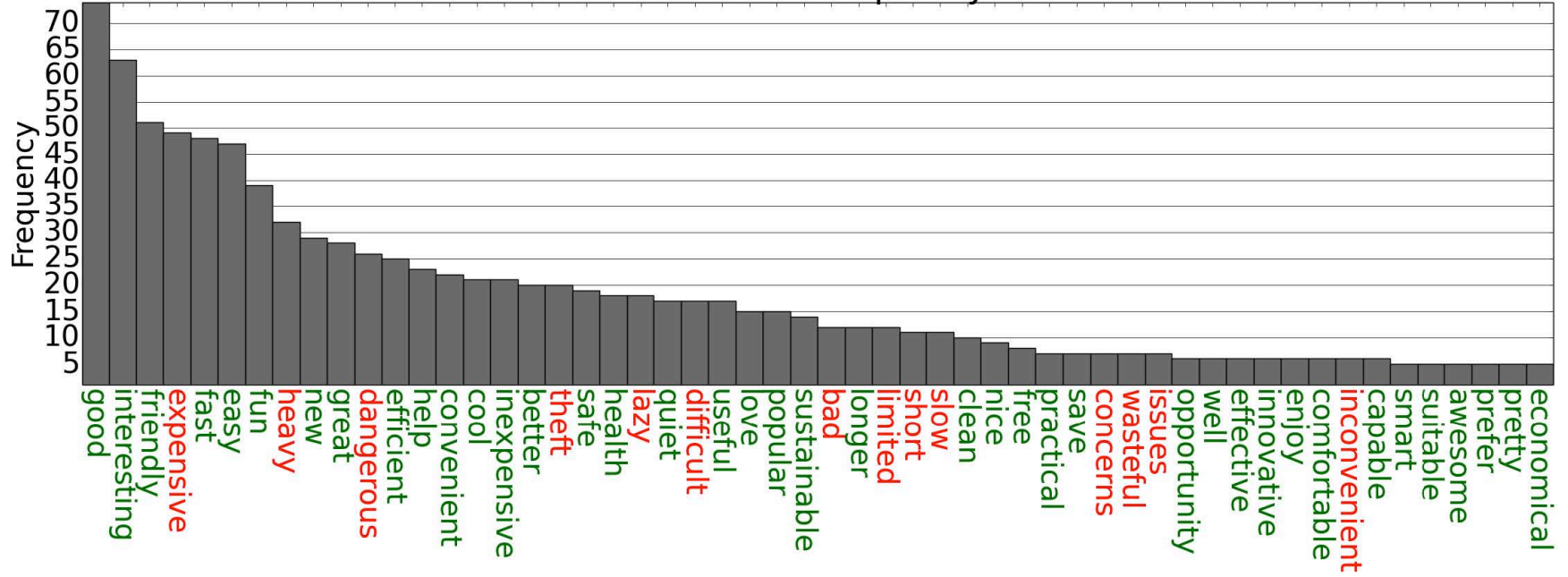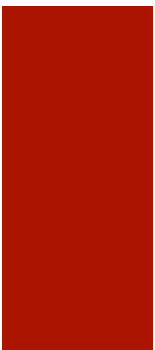distribution of charging start times
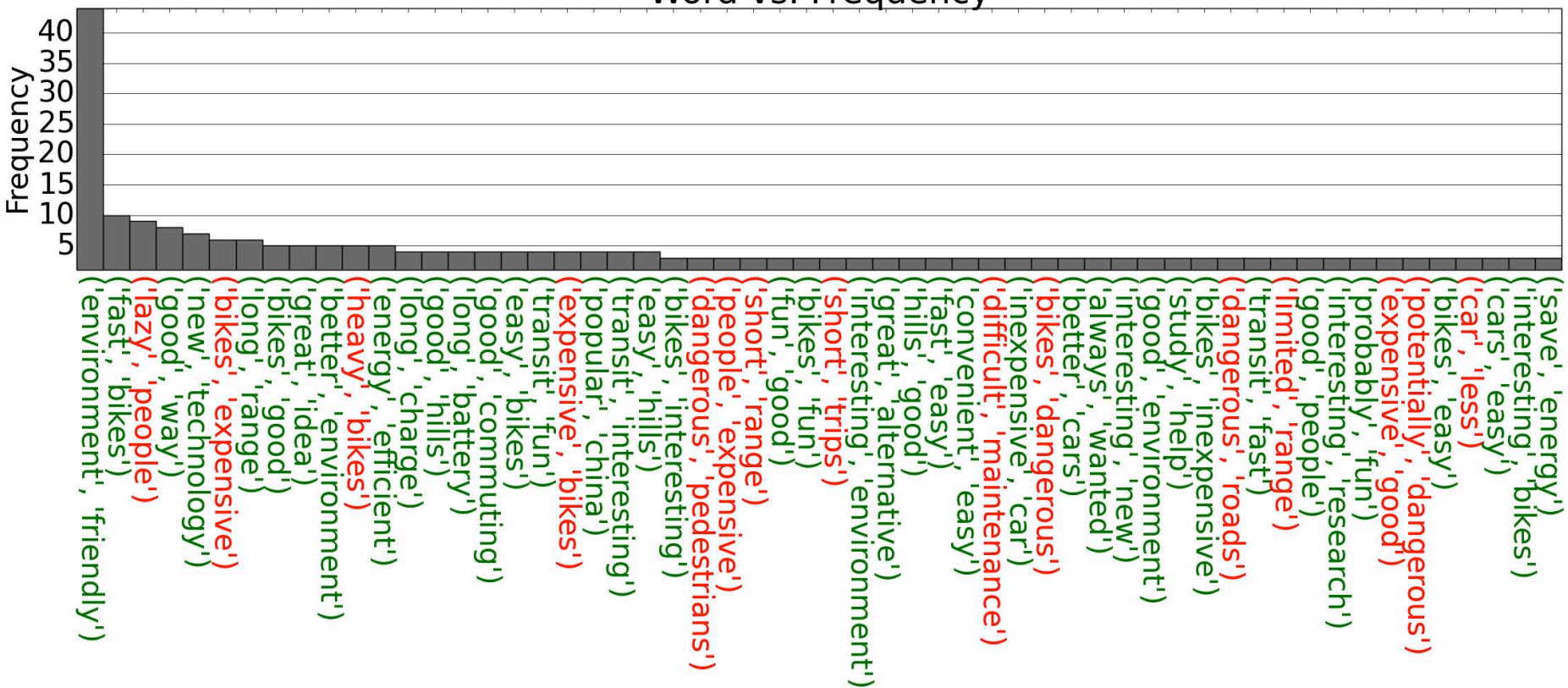
hour of day
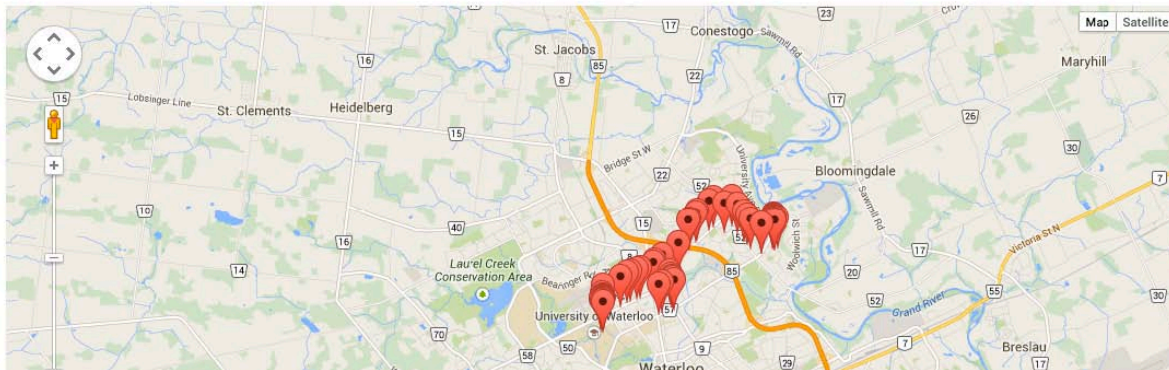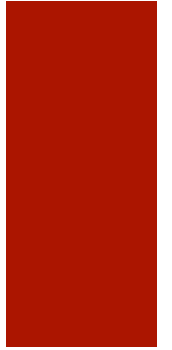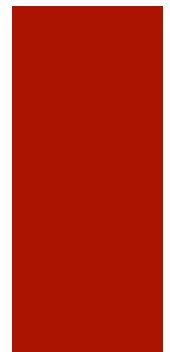
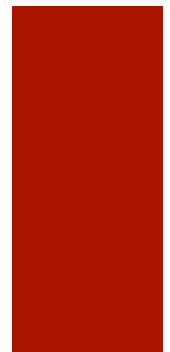# Sentiment analysis
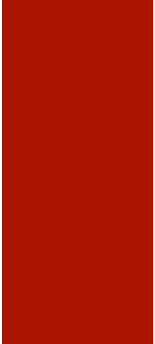
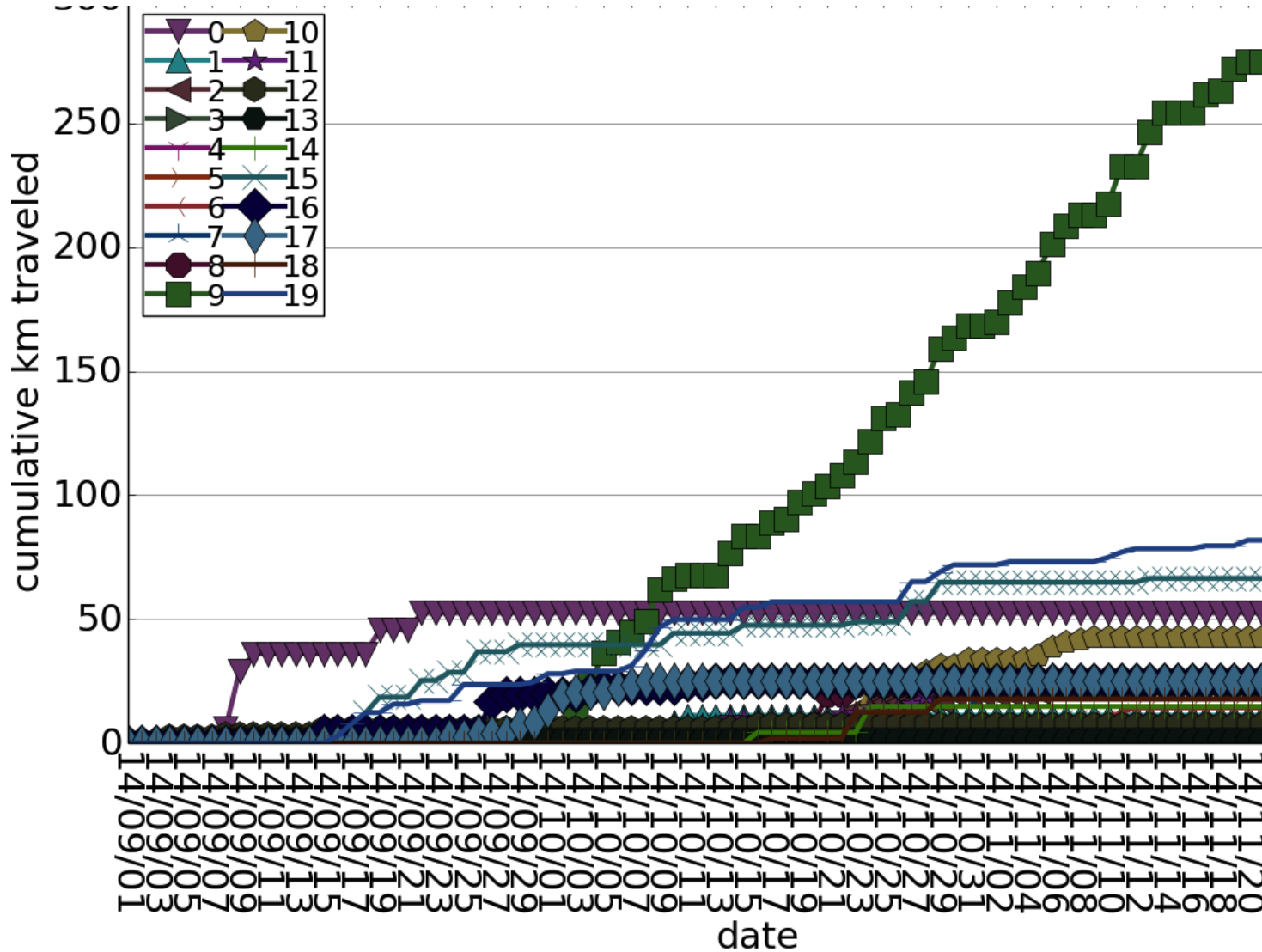Word vs. Frequency
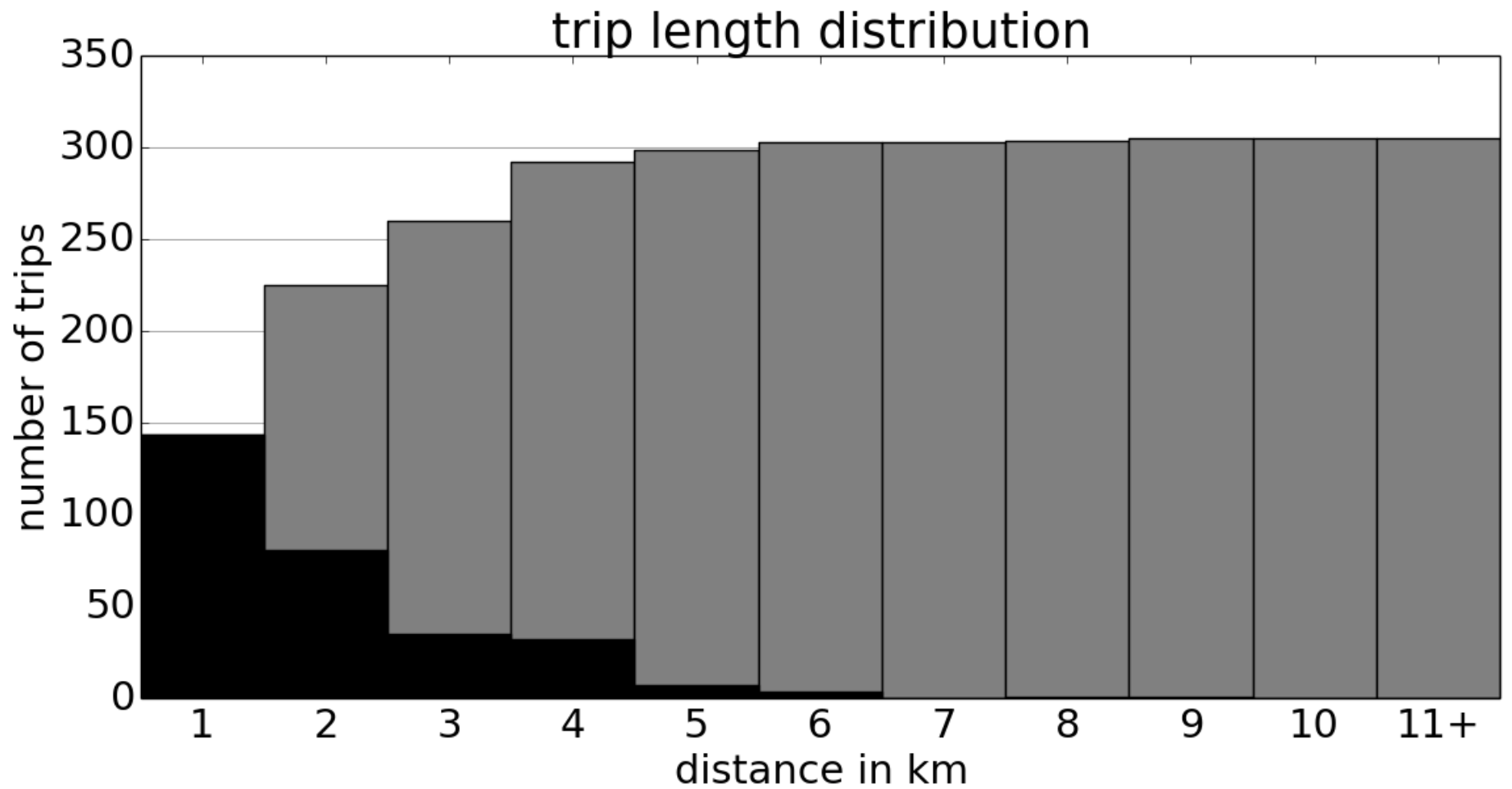
Sentiment analysis

Word vs. Frequency

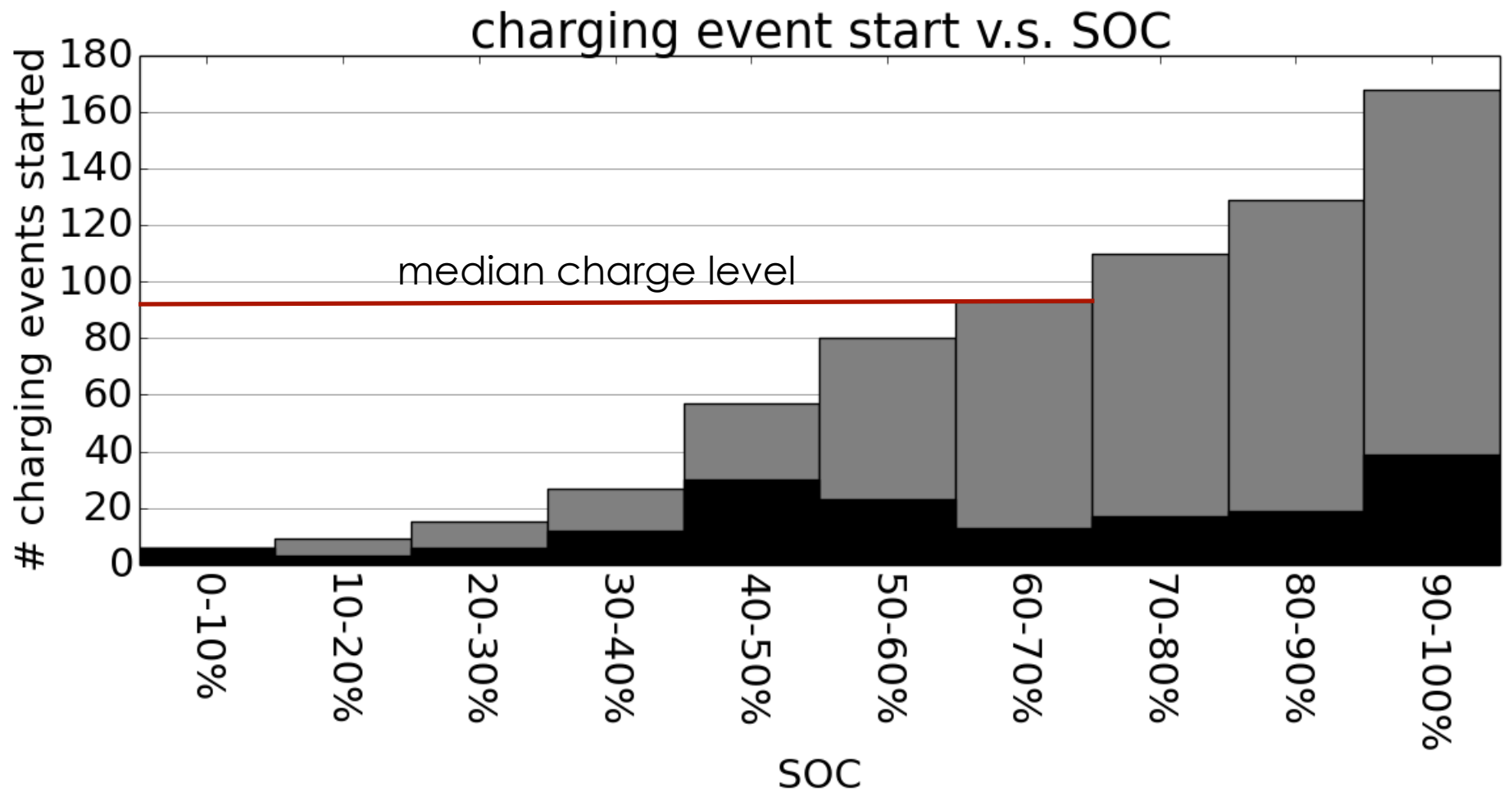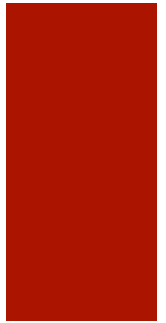# Data availability

Data Available - At least one trip a day

End cap changed
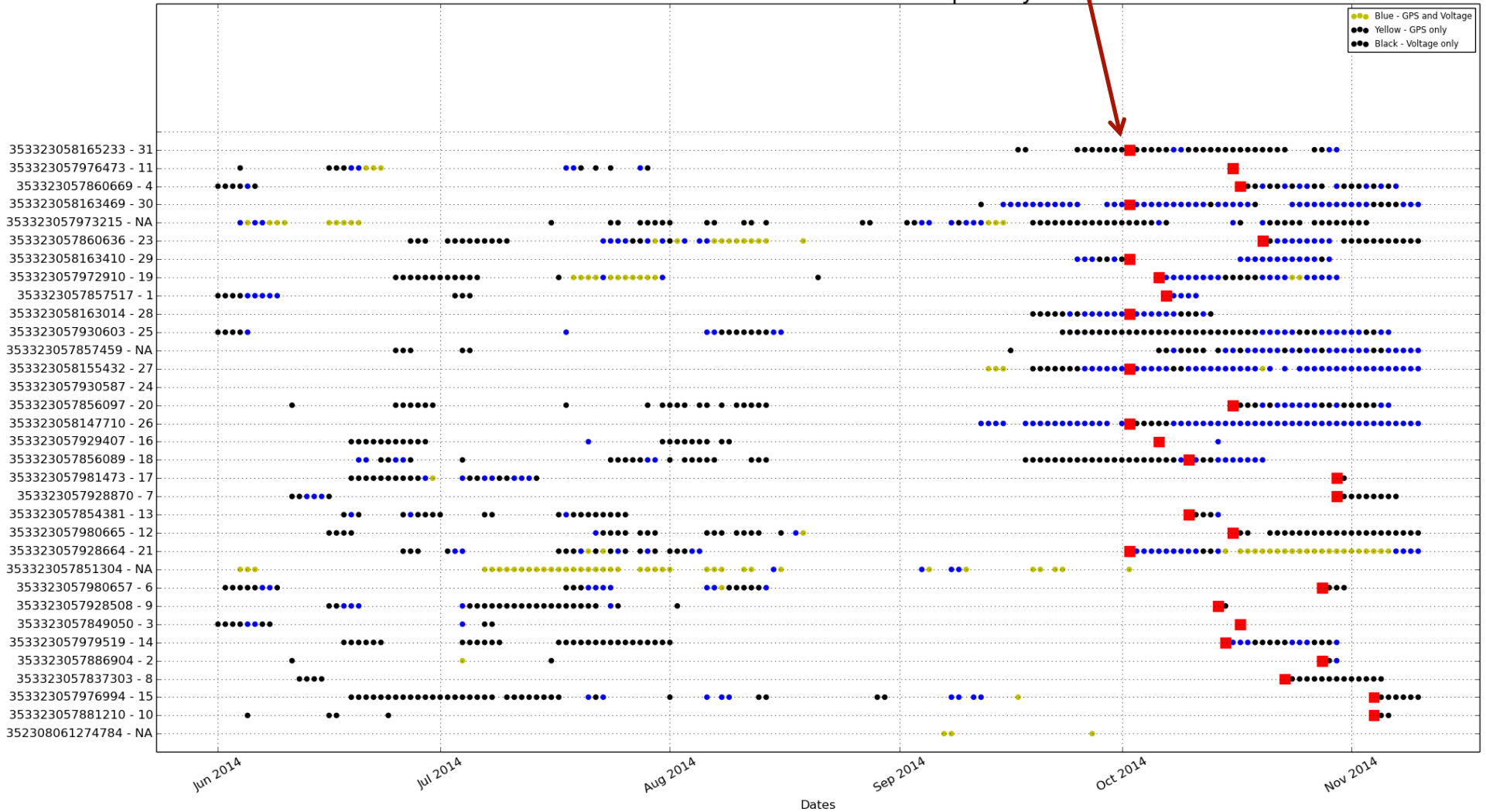
Cumulative riding

Trip lengths

trip length distribution
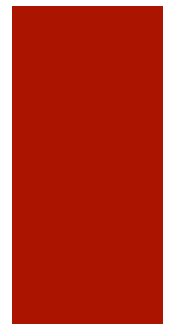
Range anxiety?
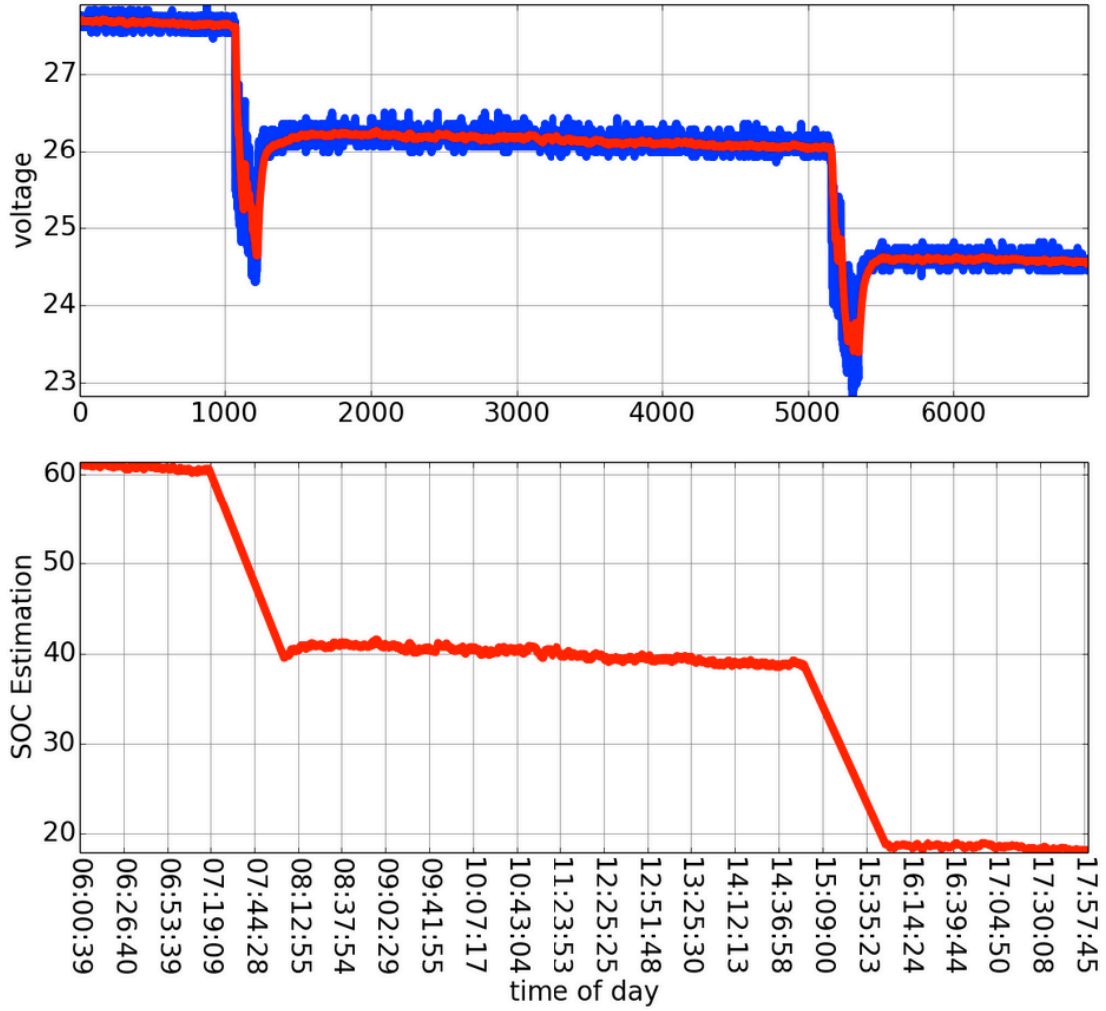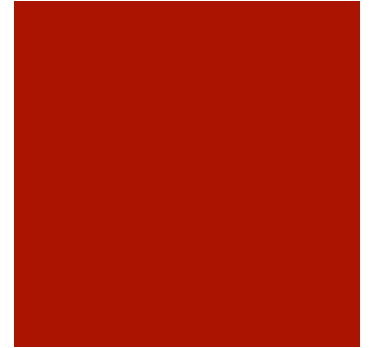
SOC

Future projects

- Estimation of remaining travel time
  - depends on the driver aggressiveness, state of charge, terrain, and/or temperature.

- Determining typical driving behaviour
  - as a function of age, gender, and/or social background of the driver

- Impact of bikes on sustainability

Future projects

LiON battery properties

- Estimate charging losses

- Estimate battery life/range depend on temperature

- Charging EVs using stand-alone PV

- Estimate battery capacity degradation over time
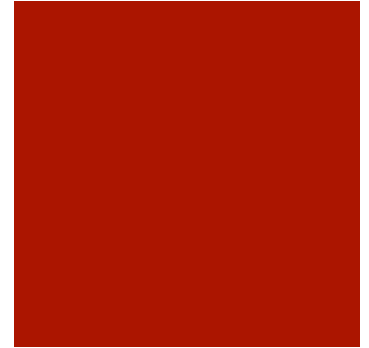
Future projects

- Hardware integration

- Determine the information to be displayed (either visually or audibly) for the participants.
  - health focused (e.g., calories burned),
  - environment focused (e.g., CO2 offset v.s. a car),
  - logistically focused (e.g., traffic conditions or route planning).

- Determine the effect of displaying information on user's behaviour.