Visual Analysis of Floating Taxi Data based on selection areas

Andreas Keler, Jukka M. Krisp

Applied Geoinformatics, Institute of Geography,
University of Augsburg

geoinformatics group Augsburg

Universität Augsburg University

The idea (1)

- Designing a geovisualization tool for interactive inspection of traffic (taxi FCD) and air quality (static sensors) in areas of interest over time

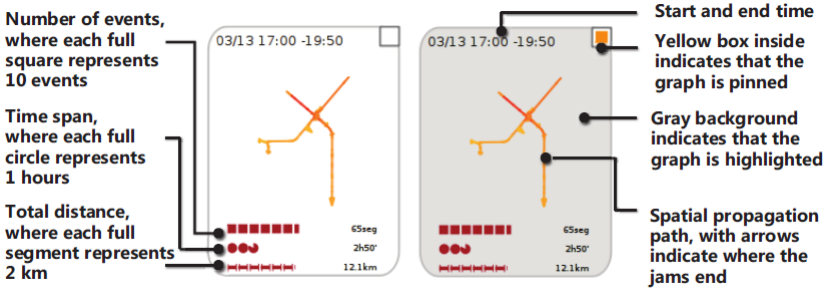
- Areas of interest may have varying size and shape, (and time component,) including POIs like “my house”, “the place I work” or “where I want to go”

- Multiple selected areas are represented in a “global view”, where each area is classified by selected average information (interactive map with multiple locations, optionally with slider tool for changing time windows)

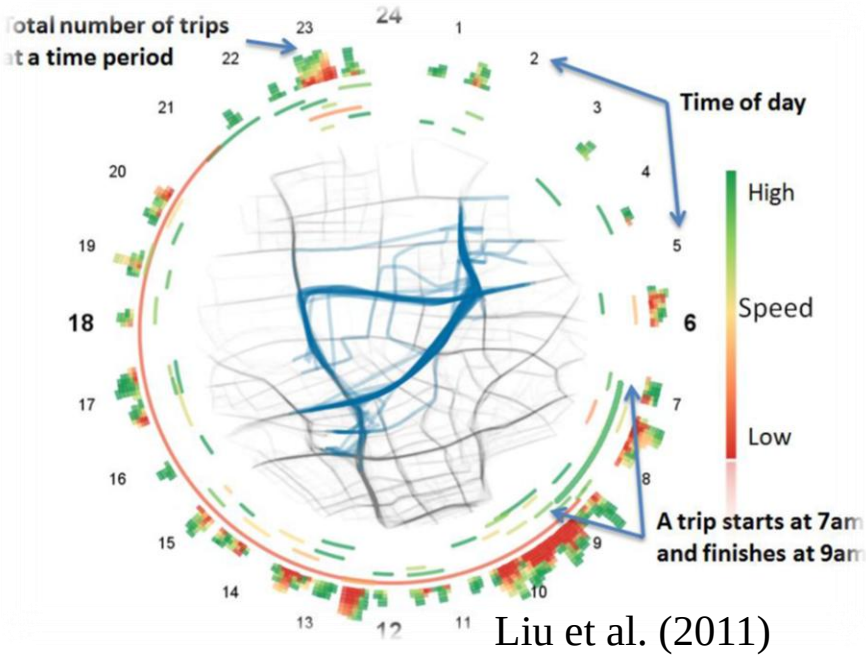
The idea (2)

- Possible aim: Exploratory data analysis based on areas of interest with recent and historical travel time information (statistical methods) and additional information
  - Multiple successive selections are connected by semantic relations (POIs), topological relations (same road network) and temporal relations (working hours)
  - Each selection area is product of personal interest (“personalized traffic information”)
  - Additional: Visual representation of relations between selected areas

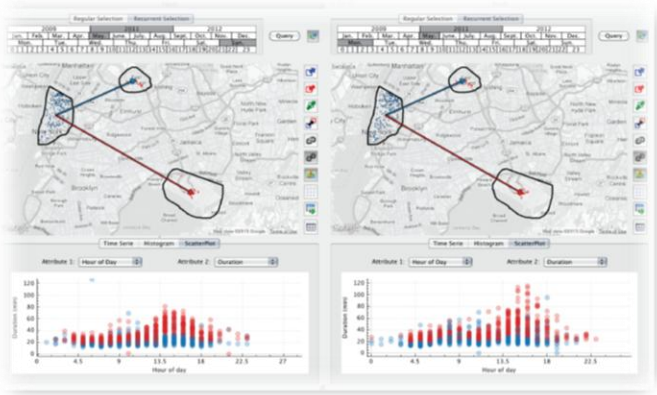
Similar approaches



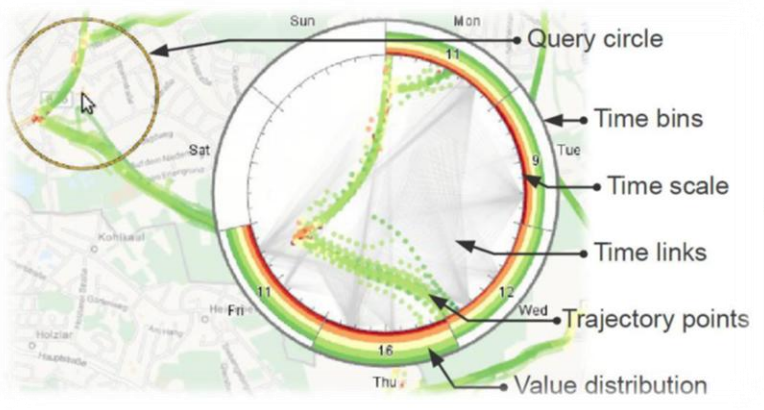
Wang et al. (2013)



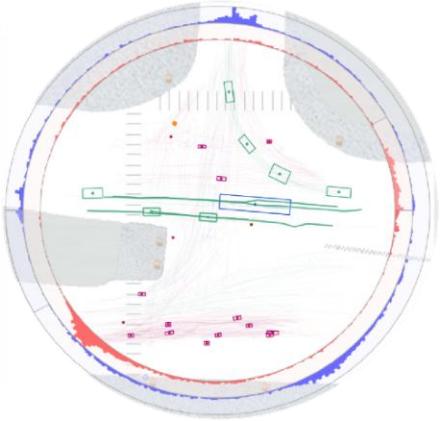
Liu et al. (2011)



Ferreira et al. (2013)



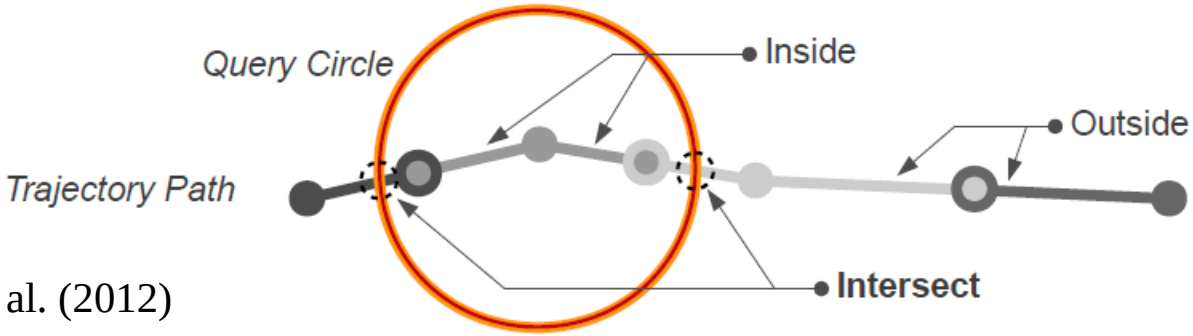
Tominski et al. (2012)



Guo et al. (2011)

Selecting segments

- Dynamic spatial query: cases of path-segment-circle intersections



Tominski et al. (2012)

- Selection areas as selection circle and road selector
  - Path segments included as partitions (node positions)
  - Movement trajectories as partitions by record (obj_id)

The data

- FCD (historical) from taxis and buses

obtained from Wireless and Sensor networks Lab (WnSN), Shanghai Jiao Tong University

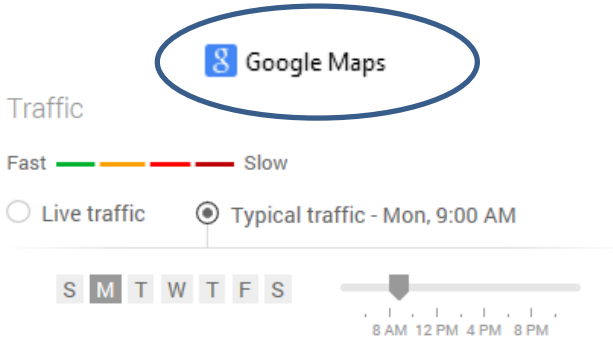
- Air quality data (static monitoring stations), (Zheng et al. 2014)

Microsoft Research (ongoing project)

Urban Air

- Street data from OpenStreetMap (OSM)

- Google traffic layer
  - Road-segment-wise traffic information (every 5 till 10 minutes)
  - Method from Tostes et al. (2013)



The method

1. User defines polygons based on one selected point (POI) or on one line (selected road segment)
2. Sequence of user is recorded (ID, pol_ID, time, type, name)
3. Defined Polygons are enriched with average information on traffic states, air quality and travel times (different modes)

AVG:
Three different approaches

Examples for selection areas in a global view with

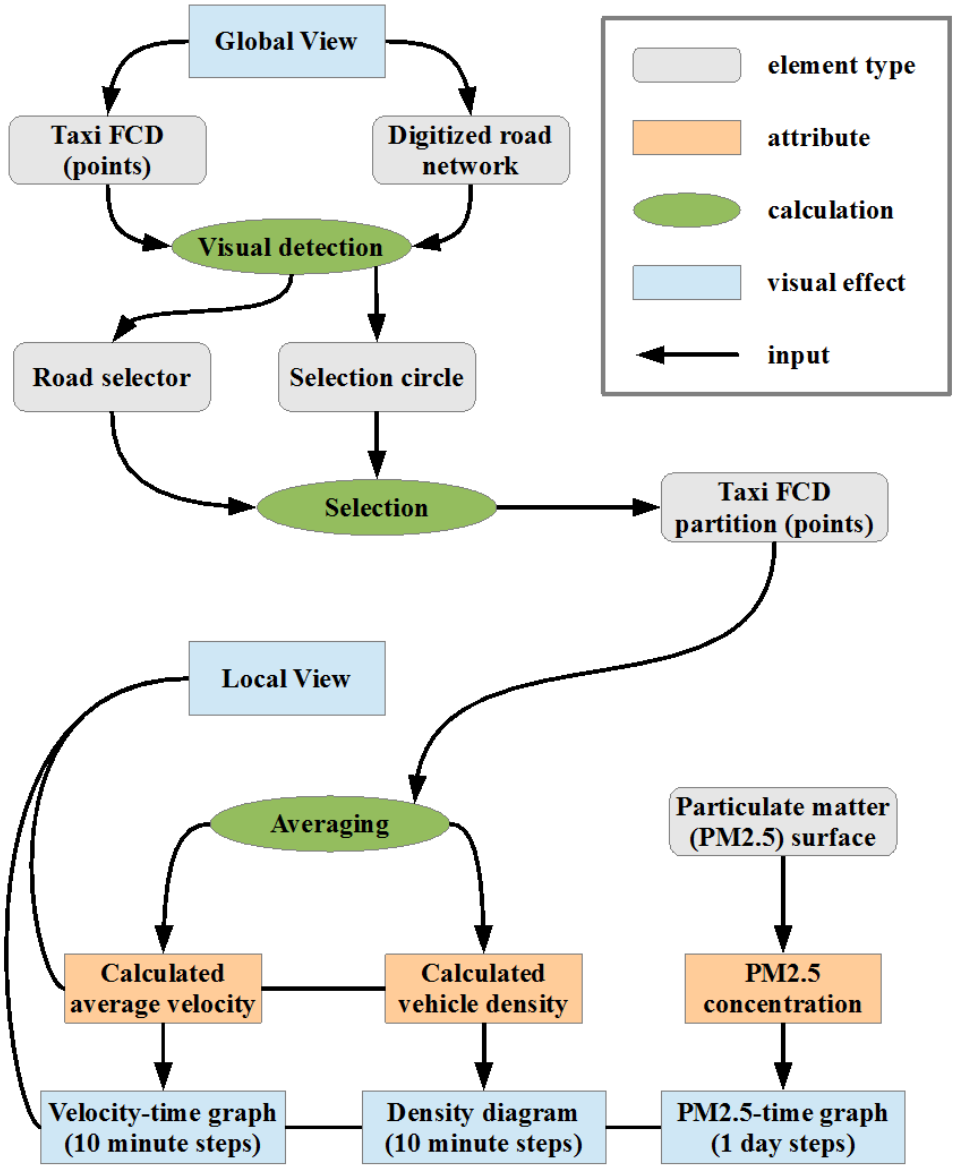
FCD records as points

classified road partitions

Case study: Different aspects of traffic and its correlation with air pollution

- Relation between global and local view of derived (averaged) traffic flow parameters and the comparison with additional interpolated data on fine particulate matter (PM2.5)

- Graphical data representations include 3D surface extrusions and other visualization techniques based on *density estimation*, *interpolation* and *weighting* of taxi FCD records and trajectory partitions within selected areas



Case study: Different aspects of traffic and its correlation with air pollution

- Possible displays of a local view on FCD with

(a) road selector on road network;

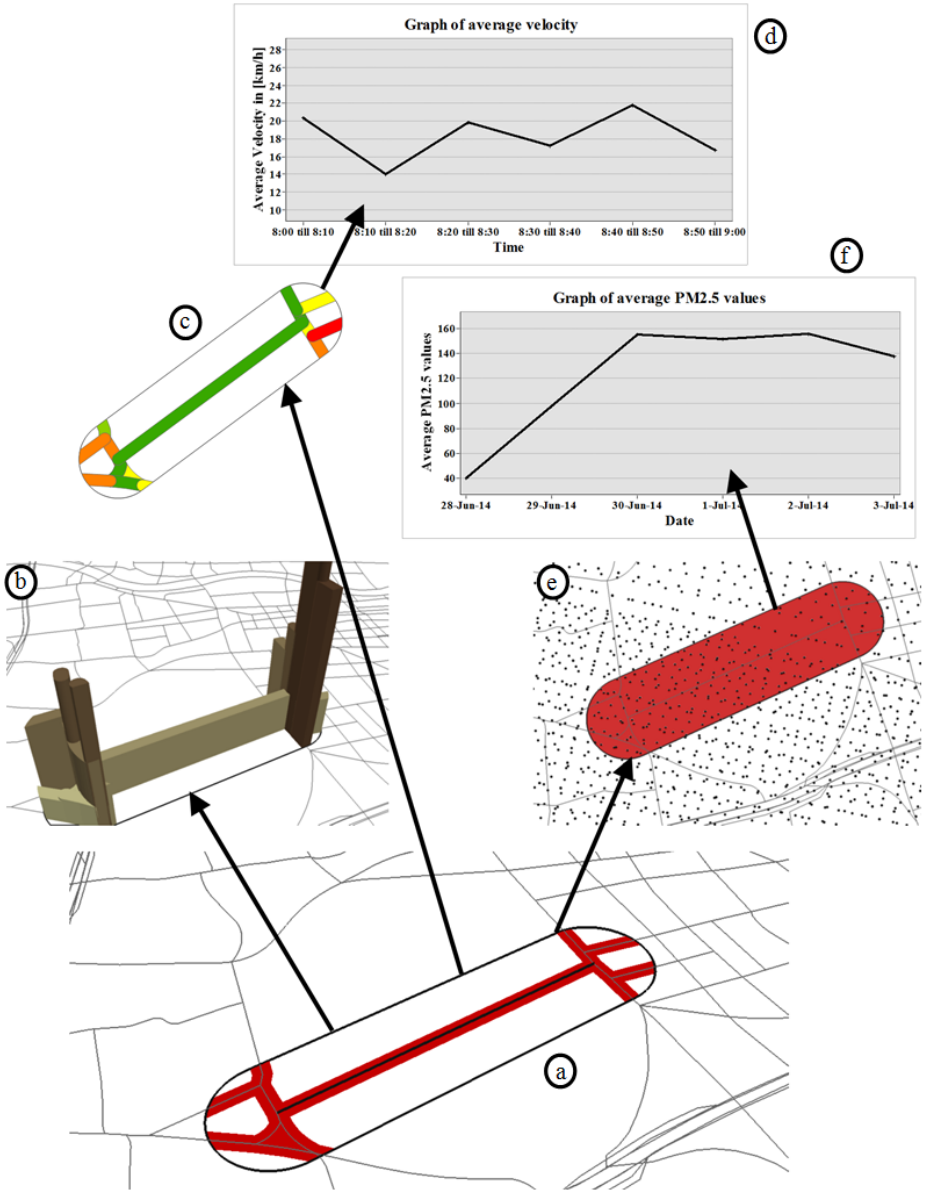
(b) extrusion of road segments based on taxi density;

(c) coloration based on average velocity ranges;

(d) graph of average velocity;

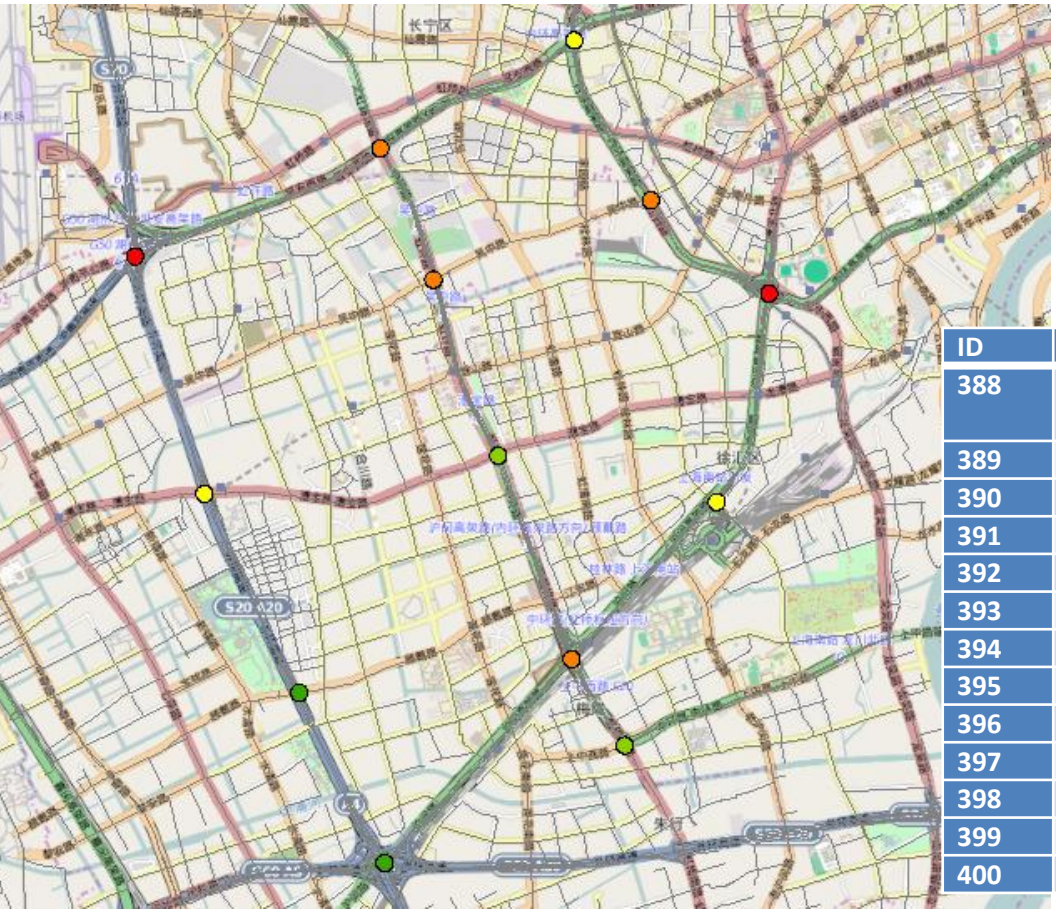
(e) proportion of interpolated PM2.5 values and

(f) associated graph.



Test results

- Selected crossings classified by quality of traffic congestion (5 classes)
- Important: connectivity (OSM) for estimating travel times



Distance [km]

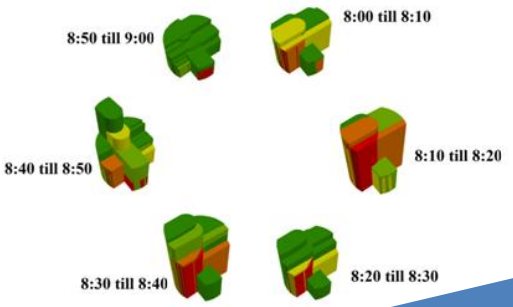
By vehicle	Public transport
Pol_ID	301
301	0
302	3.1
303	7.1
304	10.8
305	11.9
306	13.9
307	4.6
308	7.6

Time [hh:mm]

By vehicle	Public transport
Pol_ID	301
301	0
302	00:04
303	00:16
304	00:15
305	00:15
306	00:16
307	00:08
308	00:12

ID	Sel_area	Sel_lon	Sel_lat	Sel_ID
388	Wai Huan Hu Qing Ping Li Jiao Qiao	121.358094	31.183053	301
389	849 Hong Xu Lu	121.388660	31.193598	302
390	827 Zhong Shan Xi Lu	121.412212	31.205220	303
391	1885 Cao Bao Lu	121.367646	31.158105	304
392	1619 Gu Dai Lu	121.379107	31.136764	305
393	Xin Zhuang Li Jiao	121.389511	31.118375	306
394	708 Wu Zhong Lu	121.394401	31.180858	307
395	2 Wu Zhong Lu	121.421279	31.189230	308
396	71 Cao Xi Lu	121.436061	31.179283	309
397	688 Cao Bao Lu	121.403223	31.162119	310
398	Hu Min Lu Fu Lu	121.419189	31.148112	311
399	76 Liu Zhou Lu	121.429660	31.156339	312
400	710 Shang Zhong Xi Lu	121.418159	31.131703	313

Outlook (1)



extrusion: *vehicle density*
color: *avg velocity*

- How to represent different traffic situations on one and the same crossing visually?

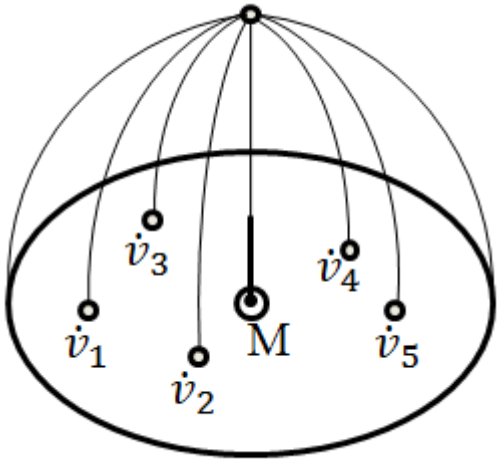
  Example: different times of the day

- Defined preference of selection areas useful?

Frequency of inspection needed, not only order (temporal) and definition (local knowledge) of selection areas

- In case of multiple POIs in the same selection area or overlapping selection areas:

Weighting of different POIs within selected area based on distance?



Outlook (2)

- Questions that result from first test:
  - Is extension of traffic map possible with more interactivity?
  - Helpful tool for commuters?
  - Extension for visual analysis process?

- Evaluation of the test implementation:
  - “ease of use” for a potential user – evaluation with individual selection areas
  - Results: Initial point for conception of GUI for visual analysis of FCD?

Thank you for your attention!

References (1)

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