

UNECE Working Party on Transport Statistics

Estimating nationwide OD matrices based on Floating Car Data (FCD)

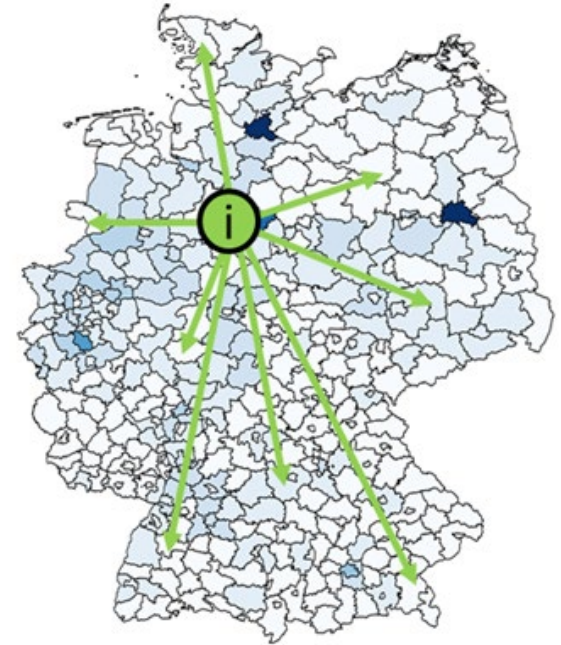
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Geneva/online, 11.06.2021

The aim

Using empirical big data from GPS navigation to estimate nationwide OD matrices

- of car and truck traffic
 - based on NUTS3 areas (Germany and neighbours)
 - for a complete year [trips/a] (2015/2017)
- ➔ Adding new empirically based methods and data to the model-based OD-matrix estimation for the German National Transport Plan (BVWP)



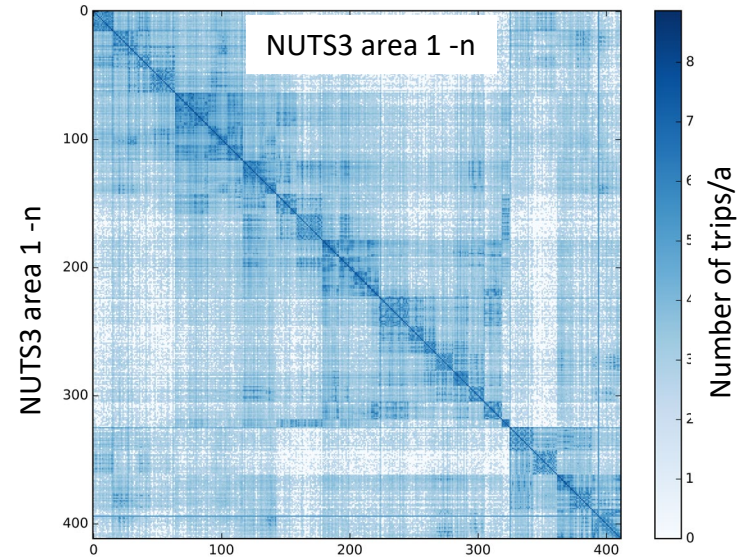
Data source

Floating Car Data (FCD) collected by German Automobile Club ADAC:

- covering Germany and neighboured countries
- primarily used to generate real time traffic flow information
- no data quality control regarding a representative sample (spatial, time-related, trip purpose-related) → „raw FCD“
- heterogeneous data structure due to several different FCD providers (only cars/trucks, mixed vehicles)
- Per provider: different data transmitting frequencies (important für data interpretation)
- Data privacy: anonymisation of vehicle-ID every 24 h

Challenges:

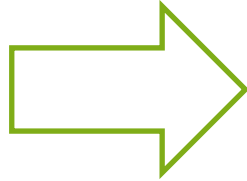
- ≈ 170.000 OD links in Germany (NUTS3 level)
- less than 10 trips/d on $> 85\%$ of all links
- no empirically proved „ground truth“ about spatial distribution of trips
- FCD sample covers 1-2% of daily trips
- FCD sample 2017 > 12 billion data sets (developing fast algorithms)



Visualisation of German-wide OD matrix (NUTS3-level):
Intensity of color represents amount of trips

FCD raw data:

- vehicle ID
- provider ID
- vehicle position
- time stamp
- instant speed
- vehicle type (to be checked)

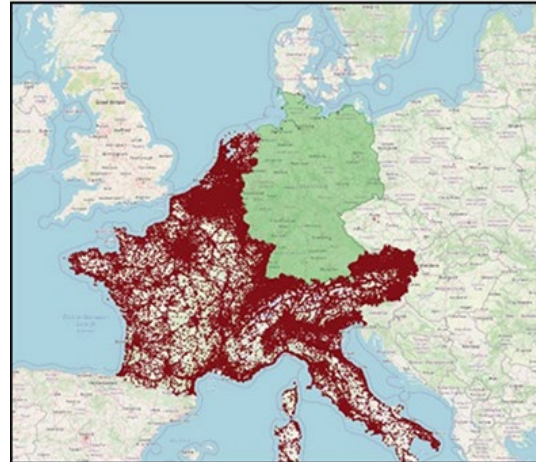


- (1) Quality checks
- (2) Representativeness/Skewness
- (3) Trip segmentation
- (4) Trip purpose estimation
- (5) Weighted expansion (due to lacks in representativeness)

(2) Representativeness/Skewness

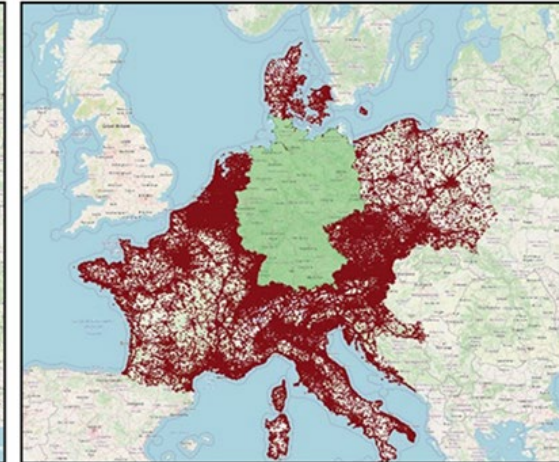
- Satisfying temporal distribution (light peaks in summer: holiday trips)
- Satisfying spatial distribution inside Germany
- Disappointing coverage of cross-border trips, high regional skewness* and significant influence of roaming fees (ending Juni 2017)

FCD density until May 2017



● Vehicle IDs

FCD density from June 2017



● Germany

Hintergrundkarte: © OpenStreetMap contributors

* ADAC provides traffic flow information for winter tourism to Austria and Switzerland

(3) trip segmentation (example: 1 vehicle)

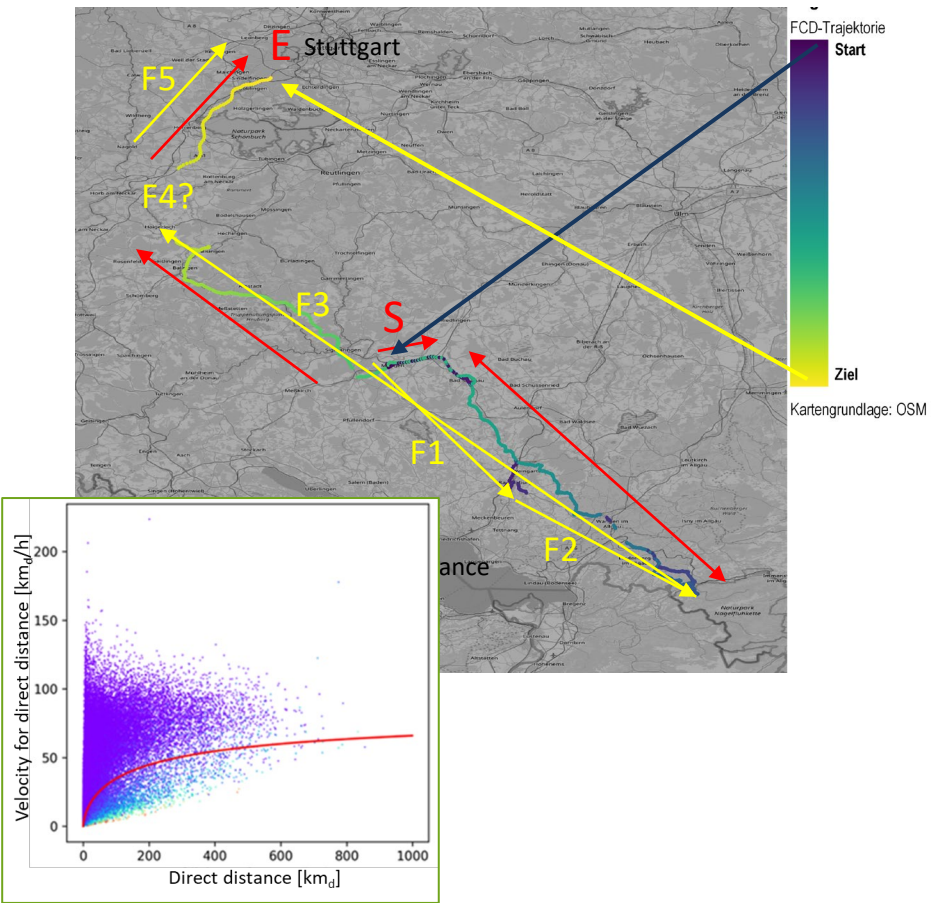
Vehicle positions with $v=0$ km/h not reported

- ➔ Spatial gap between trip end position and next start
- ➔ Defining the „stopp velocity“:

Maximum spatial gap / minimum time gap

- ➔ Estimating limit for maximum spatial gap
- ➔ minimum time gap for activities (> 10 min)
- ➔ resulting stopp velocity indicates trips

Validation: Trips per vehicle (MiD, MOP, KBA), comparison with LOS-concept for links



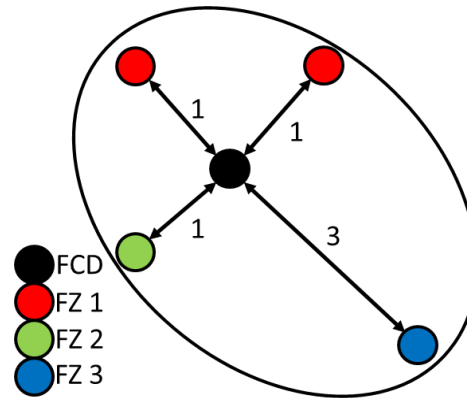
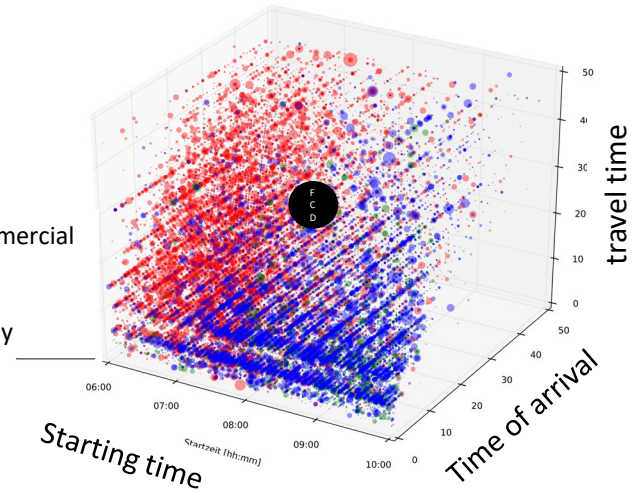
(4) Trip purpose estimation

- 3 groups of trip purposes:
- work/education/commercial
- shopping
- private/leisure/holiday

... characterized by typical patterns of

- starting time
- Time of arrival
- travel time

- work/education/commercial
- shopping
- private/leisure/holiday



➔ Probability to belong to a trip purpose

(5) Weighted expansion

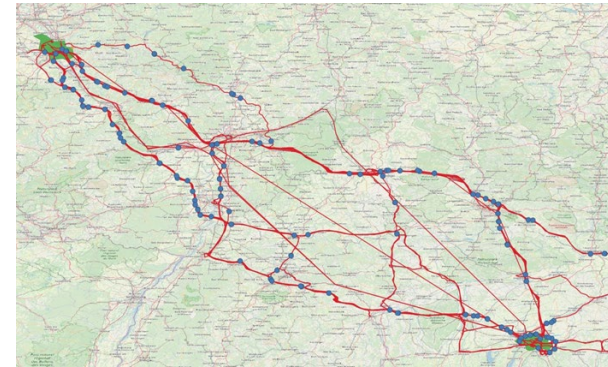
Correcting the skewness resulting from selective usage of navigation tools and provider sample: trip purpose, -length, destinations

Weighted expansion is based on population at origin and destination of trips (marginal totals of trips in the matrix):

- 3 trip purposes
- 7 sets of mobility patterns (spatial differentiation: *RegioStar*-types, MID)
- 9 distance classes

➔ 189 parameter combinations for weighted expansion (car matrix)

Truck matrix: expansion based on trips passing permanent counting stations



Conclusions and recommendations

- „Raw FCD“ contain worthwhile information about trips and routes – there is no comparable empirical data base available.
- FCD can't replace existing empirical surveys (validation, weighted expansion of FCD trip samples).
- Potential users have to face undeclared skewnesses. Nonetheless they should head for integration of FCD based information into official transport statistics.
- FCD provided by navigation system operators need quality control and obligatory meta data sets describing representativeness, covered area, ...
- Alternative to commercial FCD: data from electronic road pricing ERP (data owned by state authorities, covering the complete population of trips in priced networks).
- Commercial FCD can complete information from ERP-FCD (for unpriced road segments).
- Scientist should receive an unhindered access to quality reviewed „raw FCD“ samples – official statistics can't answer all questions.

Thank You!



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