52°North – Open Innovation Network

+ Open network with partners from industry, academia and public administration
+ Applied research in the field of Geoinformatics
+ 52°North is the network’s legal body and service center, non-profit
+ All results published as open source SW
Amount of vehicles in Germany 2015

Total: **53.7** million vehicles on road
Continuously growing: +8.9% since 2008
539 cars / 1000 inhabitants

A blue rectangle equals one %
Source: German Federal Motor Transport Authority
Annual fuel consumption of cars in Germany: 44bn liter (2013)

Federal Ministry of Transport and Digital Infrastructure
Kilometers driven and emissions from passenger cars in Germany: 1999-2013

Federal Statistical Office, Germany, „Verkehr auf einen Blick“, 2013
CO2 emission of passenger transportation in Germany 158m tons (2010)

Federal Statistical Office, Germany, „Verkehr auf einen Blick“, 2013
Mobility & Environment

Science

Citizens

Administration

Industry
Cars are turning into sensor platforms

- On average more than 150 sensors in today's cars
- Communication via Controller Area Network (CAN bus) message protocol
- Access to on-board diagnostics via OBD2 interface

Picture: Solids.wii, Kodiath
Data collected from driving cars

+ **Floating Car Data – FCD**
  > Timestamp, location, speed, direction
  > Mostly from cellular network data, positioning via triangulation, high number of samples
  > Mainly used to determine information related to traffic flow

+ **Extended Floating Car Data – XFCD**
  > FCD + RPM, throttle position, mass airflow, ambient temperature, fuel consumption, CO2 emission, and many more…
  > Both by car-born and additional sensing devices, positioning via GPS
  > Mainly used for fleet management, driver assistance, .. traffic management (e.g. evaluation of traffic light circuits)
Prerequisites for a broader use of XFCD in traffic management

+ Improved availability and accessibility
  > Existing sources (e.g. from fleet management applications) are typically not accessible for traffic management

+ Availability of validated data analysis methods
  > Statistical methods for analyzing trajectories, standards and best practices for XFCD based analysis of traffic quality

+ Availability of XFCD tools
  > XFCD data analysis is the business of experts today
The enviroCar platform for managing, analyzing and mapping crowd sourced XFCD
enviroCar App for Android - Accessing carSensor Data through OBD2

- OBD2 adapters
- accessible via bluetooth
Estimating fuel consumption and CO2 emissions from mass airflow sensor data (MAF)

\[
\frac{\text{fuel weight}}{s} \left( \frac{g}{s} \right) = \frac{\text{MAF} \left( \frac{g}{s} \right)}{\text{AFR}}
\]

\[
\text{fuel consumption} \left( \frac{l}{s} \right) = \frac{\text{fuel weight}}{s} \left( \frac{g}{s} \right) \cdot \frac{\text{fuel density}}{\text{g}} \left( \frac{g}{dm^3} \right)
\]

+ engine keeps the air fuel ratio close to 14.7 to produce a combustible mixture
+ enviroCar assumes a density of 745 g/l
+ CO2 emissions are in a linear relationship with the fuel mass that is combusted; in case of gasoline, combusting 1 liter results in 2.35 kg of CO2
Managing the XFCD data pool with the enviroCar Server

- Identity management
- Anonymization
- Upload

- Data management
- Based on MongoDB
- RESTful interface
- Open Database License

- selective access
- Mapping to output formats
  - CSV
  - RDF
  - Shape
  - JSON
Organizing functional data views and on demand processing services

- Geoevent Processor
- PostGreSQL
- ArcGIS Server
- 52N WPS
- R
  - ...
Sharing data and maps through ArcGIS Online

- use
- process
- recombine
- publish
- ..
enviroCar - Shared Maps
Further Information

- Website - [www.envirocar.org](http://www.envirocar.org)
- Mail - [enviroCar@52north.org](mailto:enviroCar@52north.org)
- ArcGIS Online - [http://52north.maps.arcgis.com](http://52north.maps.arcgis.com)
- Youtube – [www.youtube.com/watch?v=LTsuUEOfWa0](http://www.youtube.com/watch?v=LTsuUEOfWa0)

Thanks for your attention..