PRESENTATIONS SEP-OCT 2015

EXPERT GROUP ON DRIVING BEHAVIOUR UNDER THE RDE-LDV EXPERT GROUP

results reported in:

- **Chase car study: driving behaviour in the Netherlands, Belgium, France and Germany (TNO 2017 R11227)**

link: https://repository.tudelft.nl/view/tno/uuid%3A2bef9ce0-8de1-46e8-acea-467e83816d72

- **On-road determination of average Dutch driving behaviour for vehicle emissions (TNO 2016 R10188)**

link: https://repository.tudelft.nl/view/tno/uuid%3Acb430165-414f-4203-9cf5-2d352c3c571b

- **UDRIVE:** V.A.M. Heijne, N.E. Ligterink, U. Stelwagen. UDRIVE deliverable 45.1 Potential of eco-driving of the EU FP7

VAPOS DETERMINATION IN DUTCH TRAFFIC

driving behaviour boundary | Norbert Ligterink

TNO innovation for life

DRIVING BEHAVIOUR DETERMINATION
FOR DUTCH NATIONAL EMISSION FACTORS

- professional driver:
  - following cars and vans with constant headway
  - random selection of vehicles to follow based on licence plate numbers
- 50 km distance per trip:
  - 30 min - 1 hour of driving per trip
  - equal distance split urban/rural/motorway
- vehicle velocity based on wheel speed (GPS also available)
- So far:
  - 68 hours of data at 1 Hz
  - 120 trips collected (ongoing)
  - full coverage of Dutch roads

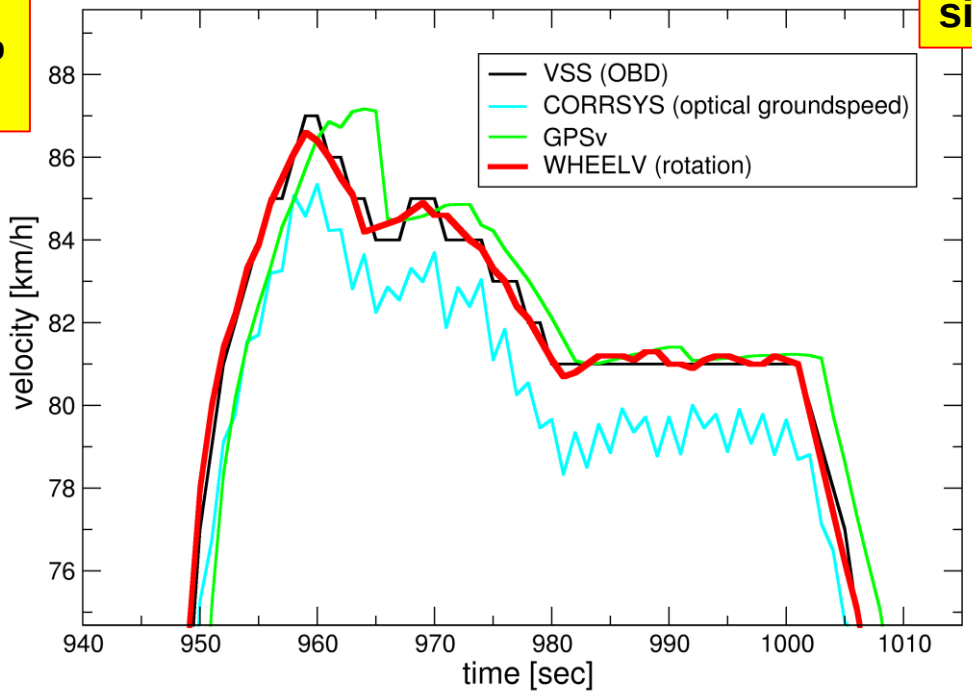
THE ROUTES TILL 14/9

VELOCITY SIGNALS

REQUIRED QUALITY FOR DETERMINING ACCELERATION

GPS signal is poor, deviating, and absent 5%-15% of the time

wheel speed gives accurate and robust signal (e.g. ABS)



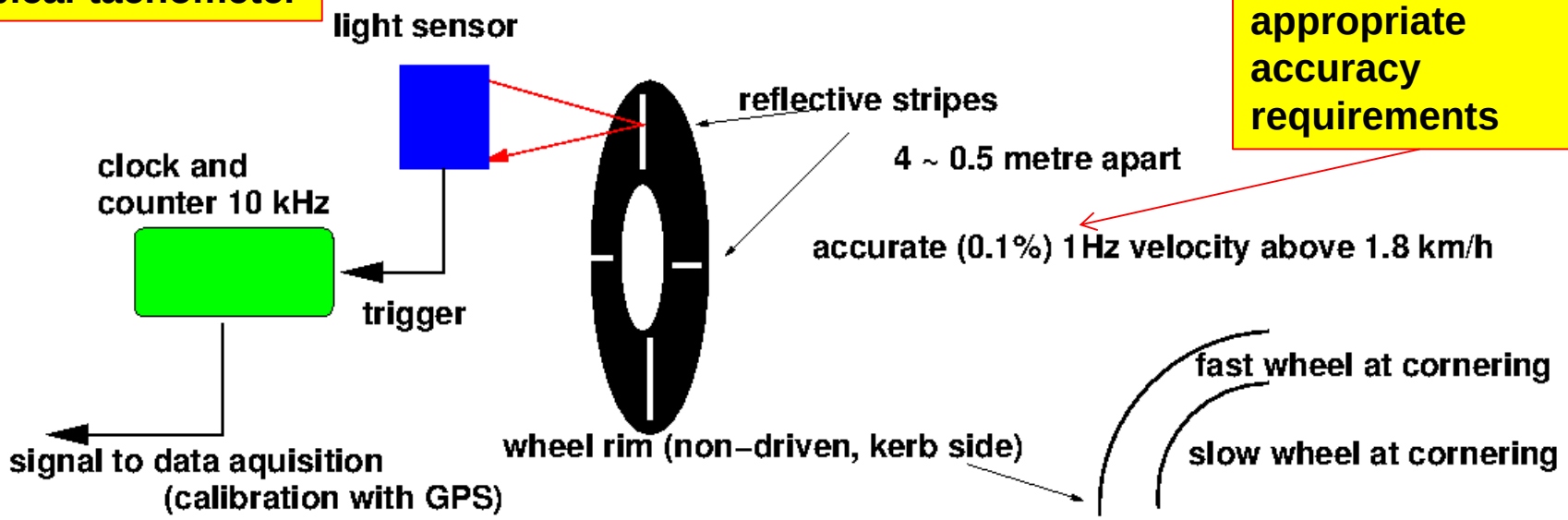
OBD signal often “stylized”

optical signal can be improved

INDEPENDENT DETERMINATION OF VELOCITY

BASED ON WHEEL SPEED CALIBRATED WITH GPS

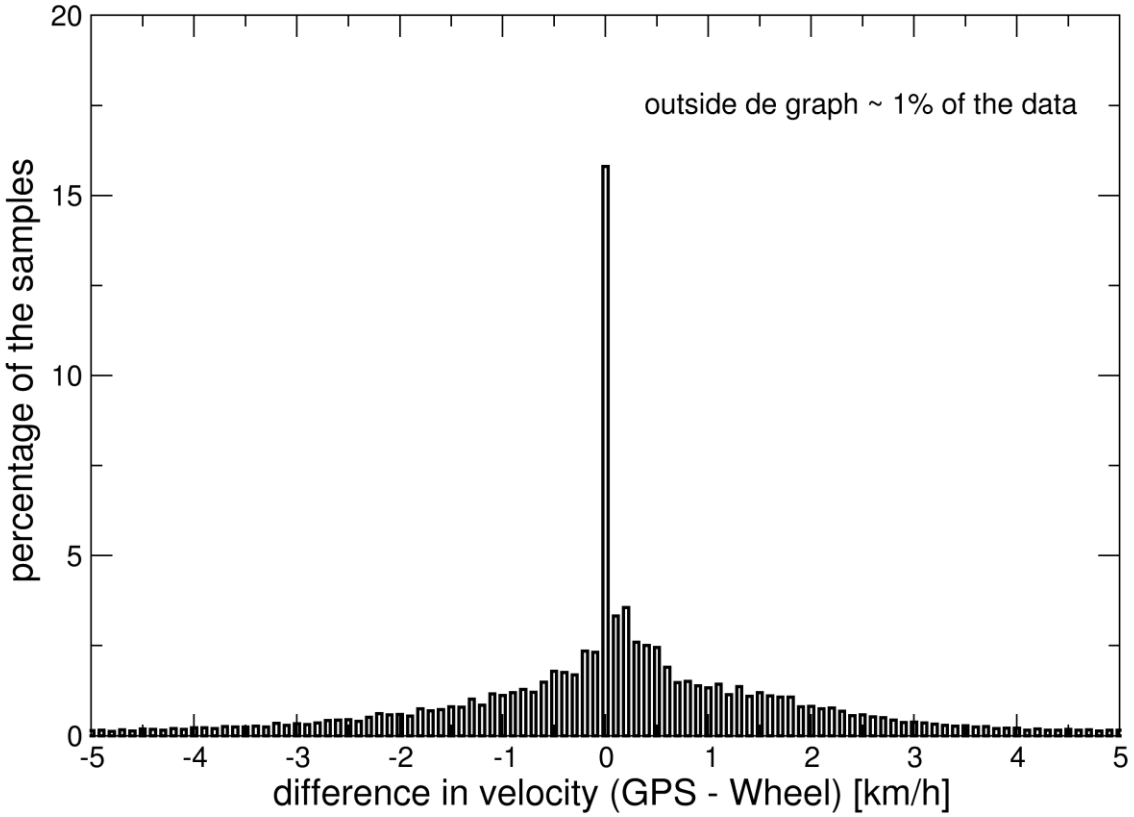
typical tachometer



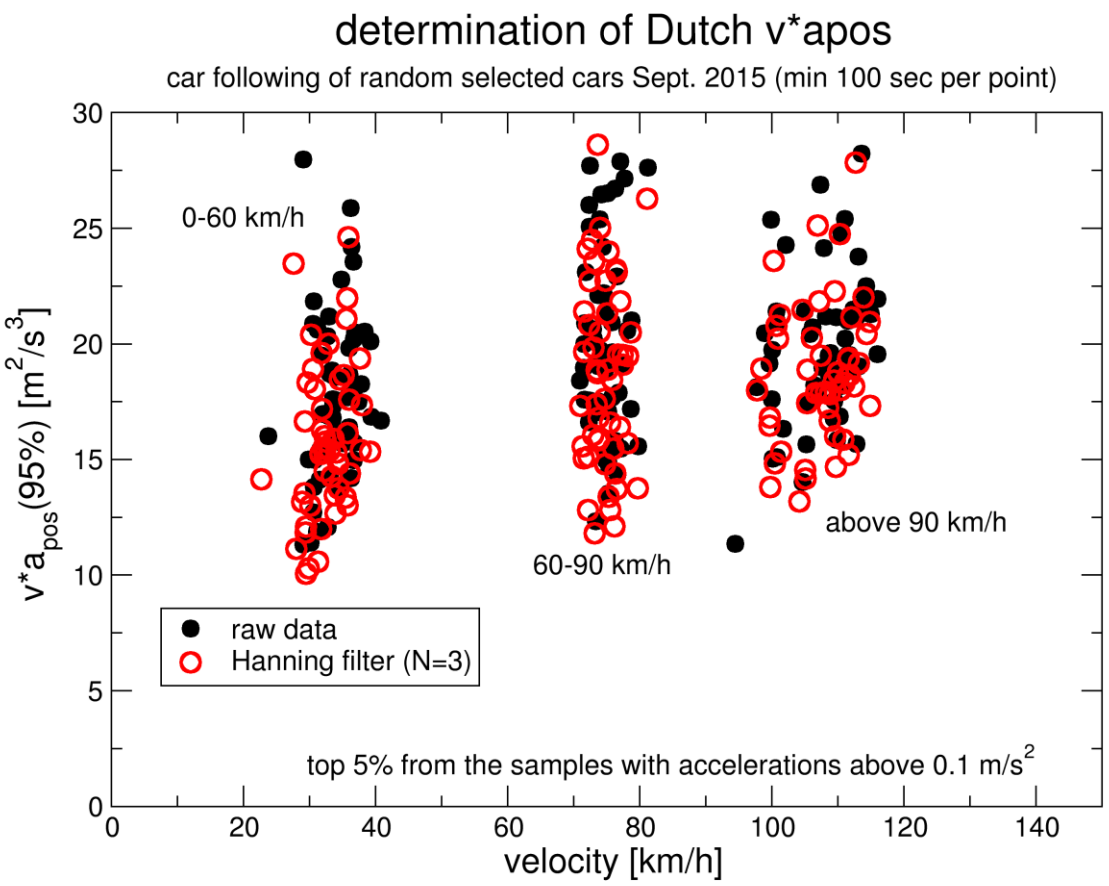
alternative setups possible with appropriate accuracy requirements

accurate (0.1%) 1 Hz velocity above 1.8 km/h

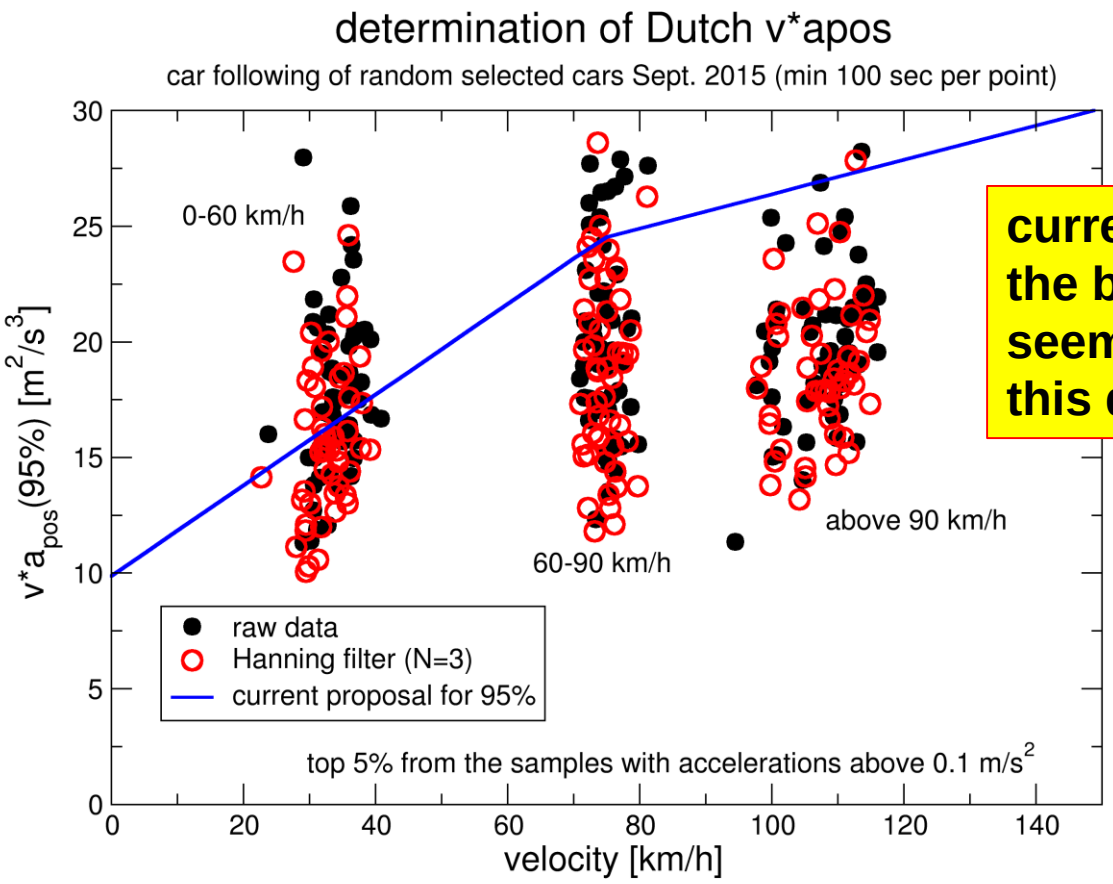
GPS DEVIATION



V*A_{POS} DETERMINATION



V*A_{POS} DETERMINATION



current proposal of the boundary in v*a_{pos} seems low, based on this data

THANK YOU FOR YOUR ATTENTION

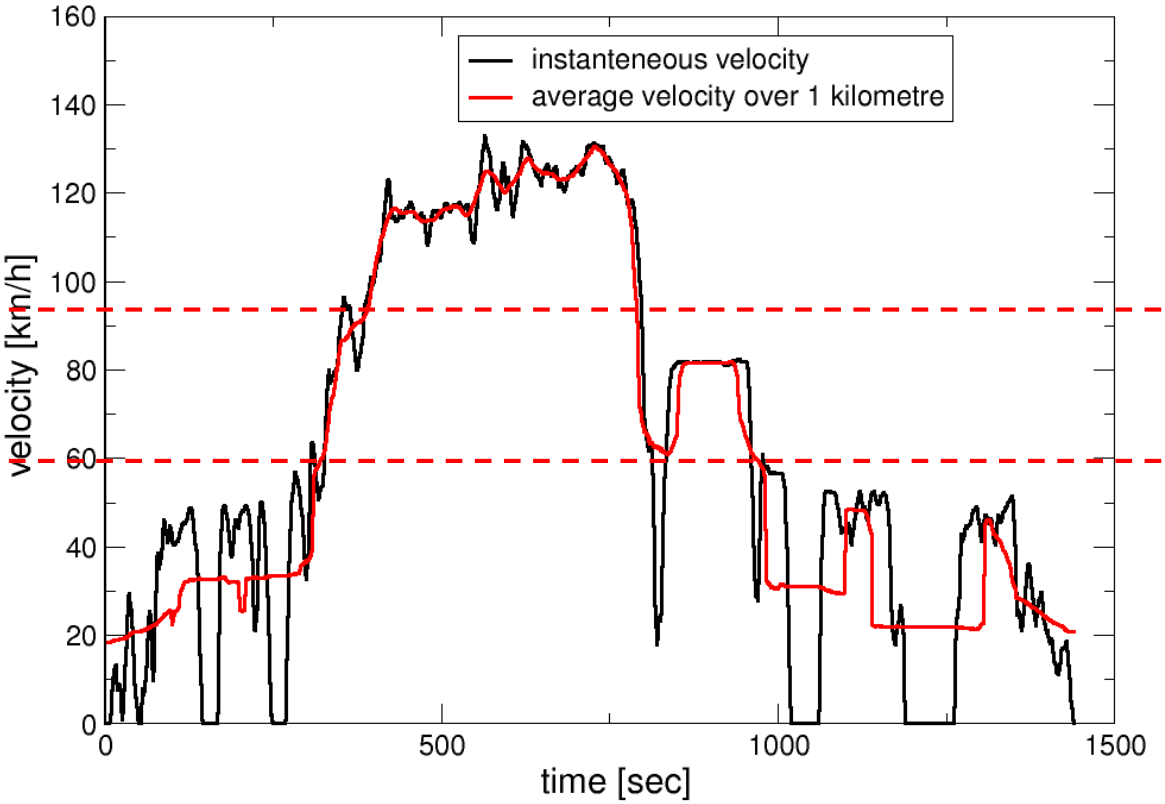
TNO innovation for life

USING DISTANCE-AVERAGE VELOCITY

90 and above

60-90

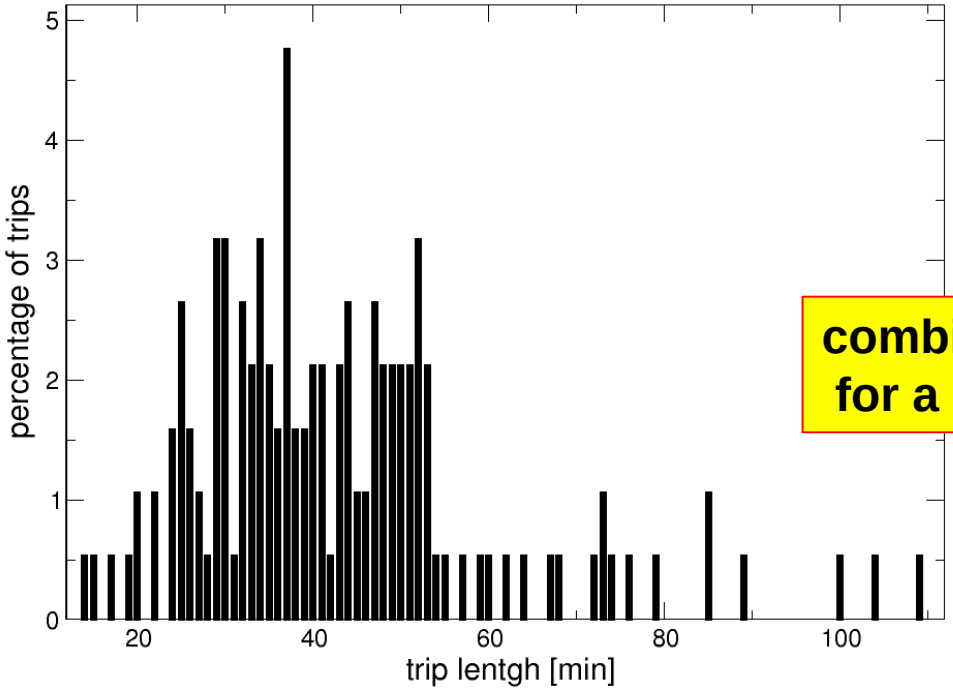
0-60



TRIP LENGTHS

TRIPS DESIGNED FOR EQUAL SHARES URBAN/RURAL/MWAY

"natural trip":
urban start → rural → motorway → rural → urban stop



combining two trips for a 50-120 minute trips

HANNING FILTER (N=3, SPSS)

- raw acceleration:

$$a_{i+1/2} = (v_{i+1}-v_i)/3.6$$

- Hanning filter (smoothing, as in SPSS, combined with Heinz definition of acceleration):

$$\underline{v}_i = 0.25*v_{i+1} + 0.5*v_i + 0.25*v_{i-1}$$

$$\rightarrow \underline{a}_i = (\underline{v}_{i+1}-\underline{v}_{i-1})/(2*3.6) = (0.125*v_{i+2} + 0.25*v_{i+1} - 0.25*v_{i-1} - 0.125*v_{i-2})/3.6$$

centrepoint definition from Heinz: additional smoothing

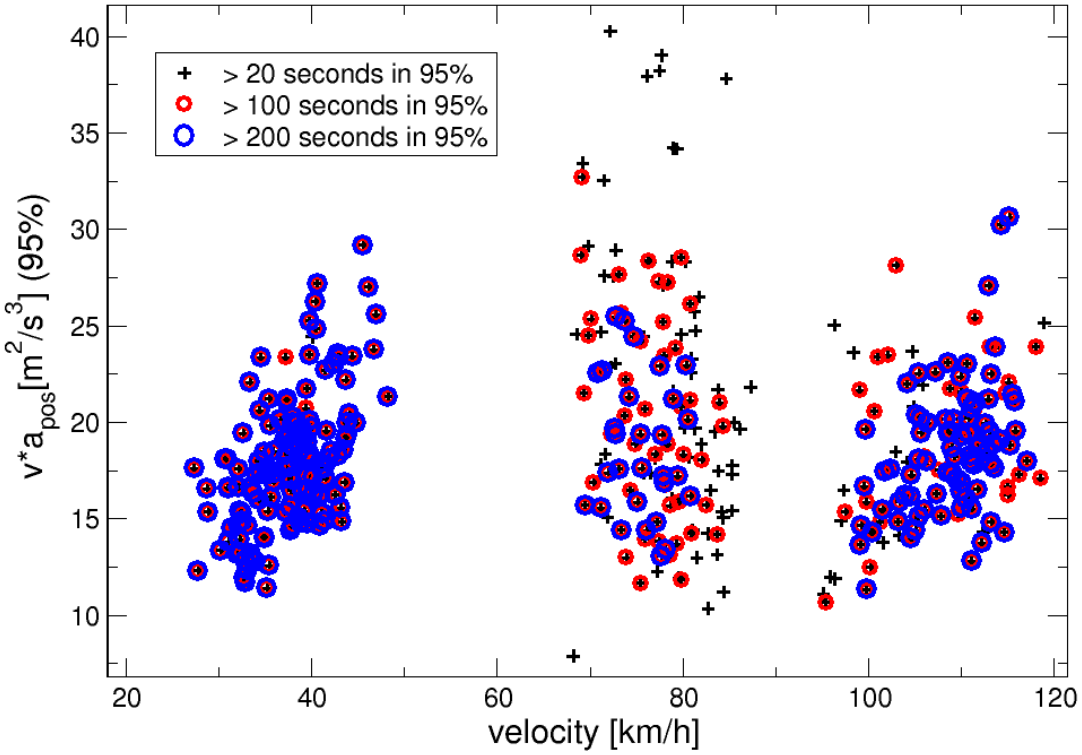
DRIVER EXPERIENCE

- urban driving:
  - more or less fixed vehicle followed (single lane traffic)
  - limited time free-flow (no car in front) (automatic gear AUDI)

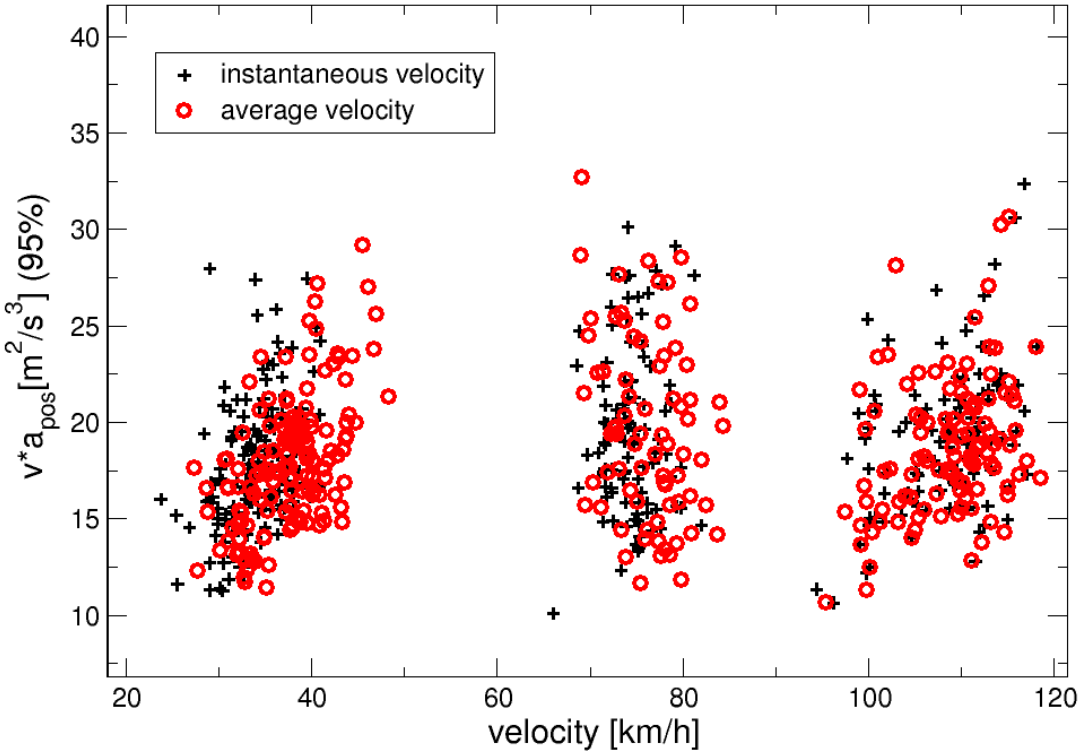
- rural and motorway driving:
  - following cars for at least 2-3 kilometres (limited vehicle variation)
  - large variation in driving styles observed
  - a number of times “let cars go” because of speed limit violations

EFFECT OF MINIMAL SAMPLE SIZE

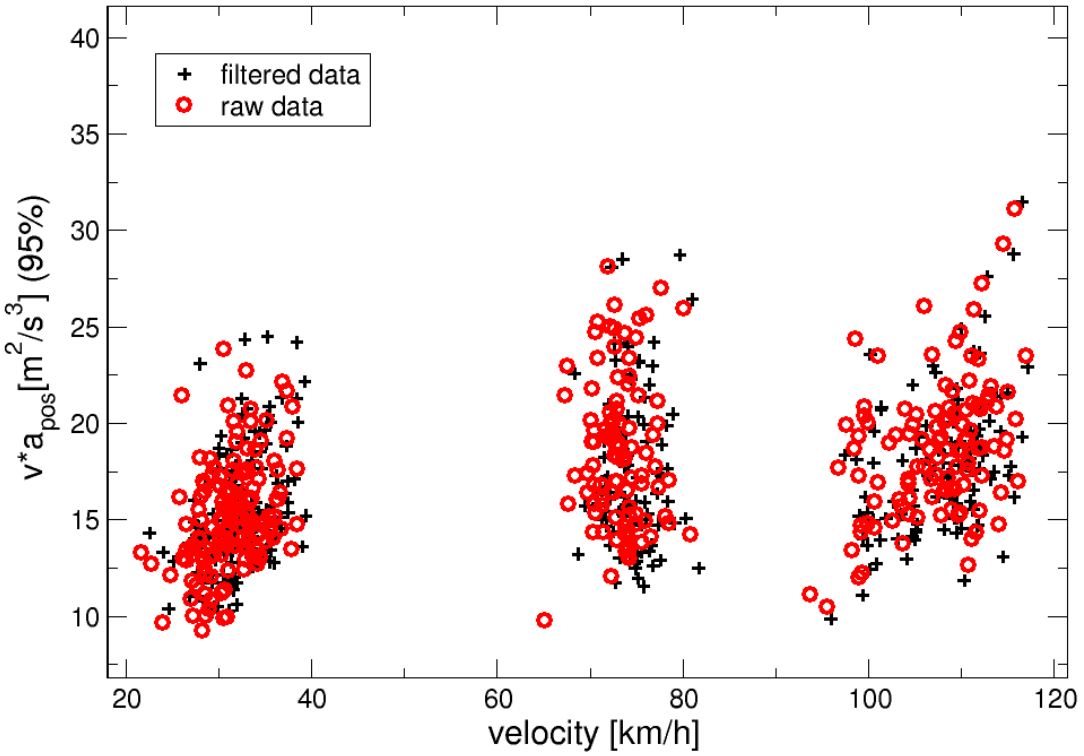
AFFECTING MAINLY RURAL DATA ON THIS DATA



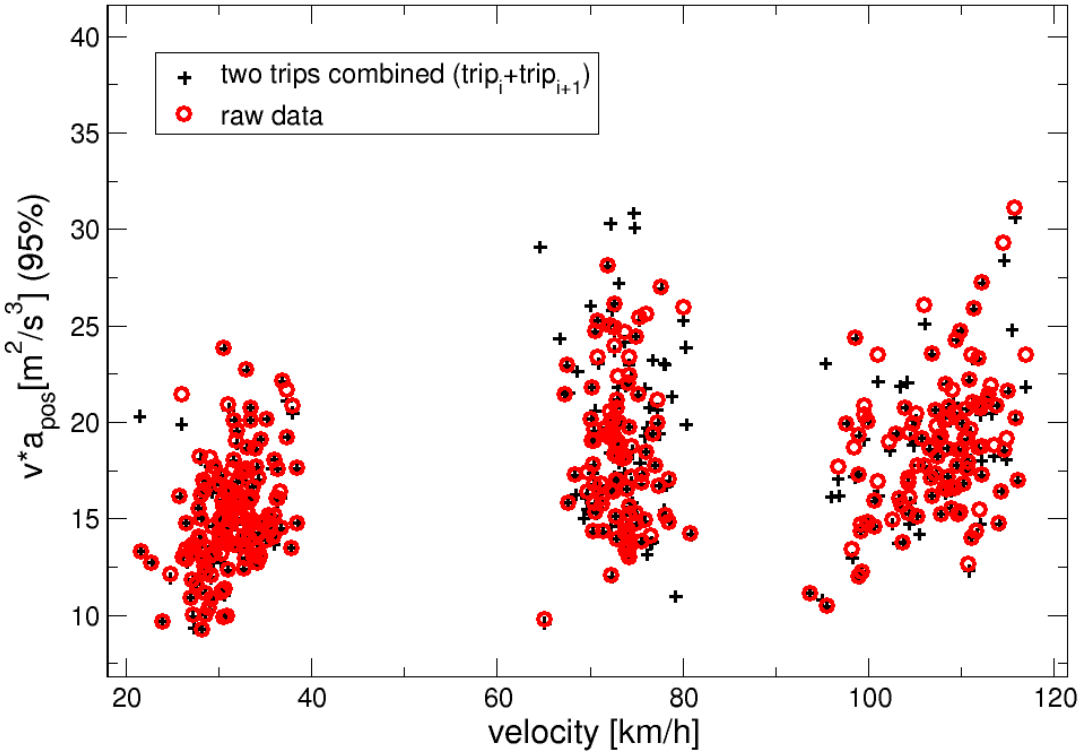
EFFECT OF THE VELOCITY DEFINITION



EFFECT OF FILTERING/SMOOTHING

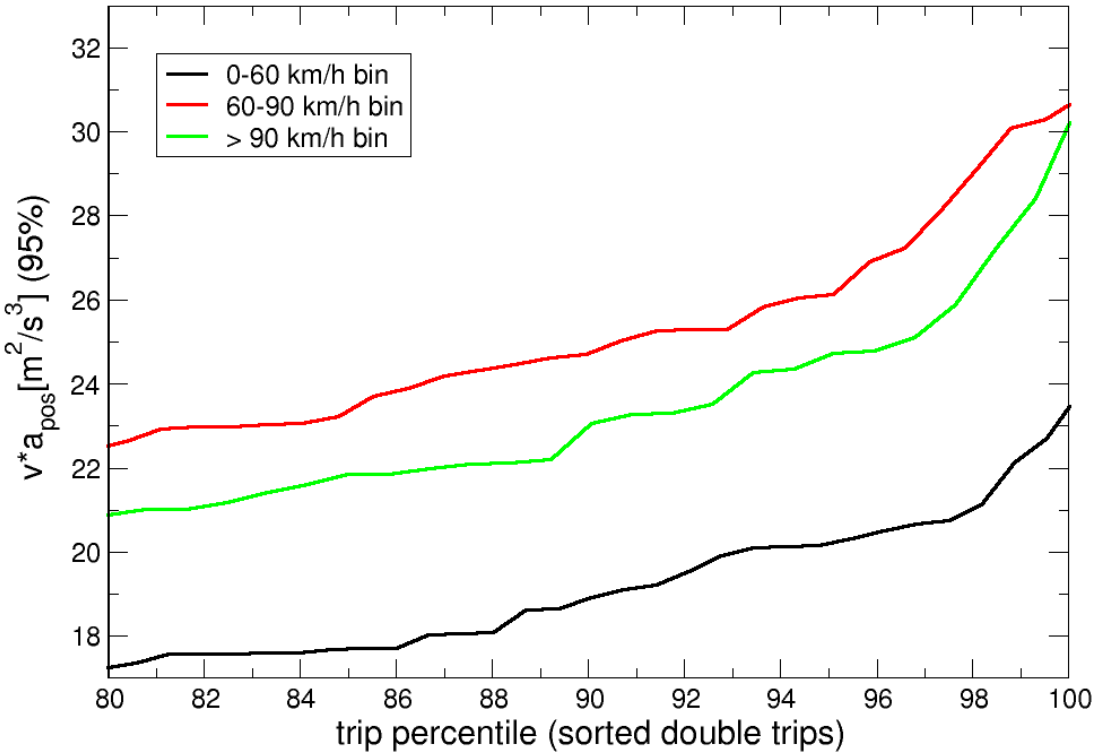


EFFECT OF THE 90-MINUTE TRIP LENGTH (TWO-TRIP COMBINATIONS)



THE PERCENTILES OF VALID TRIPS

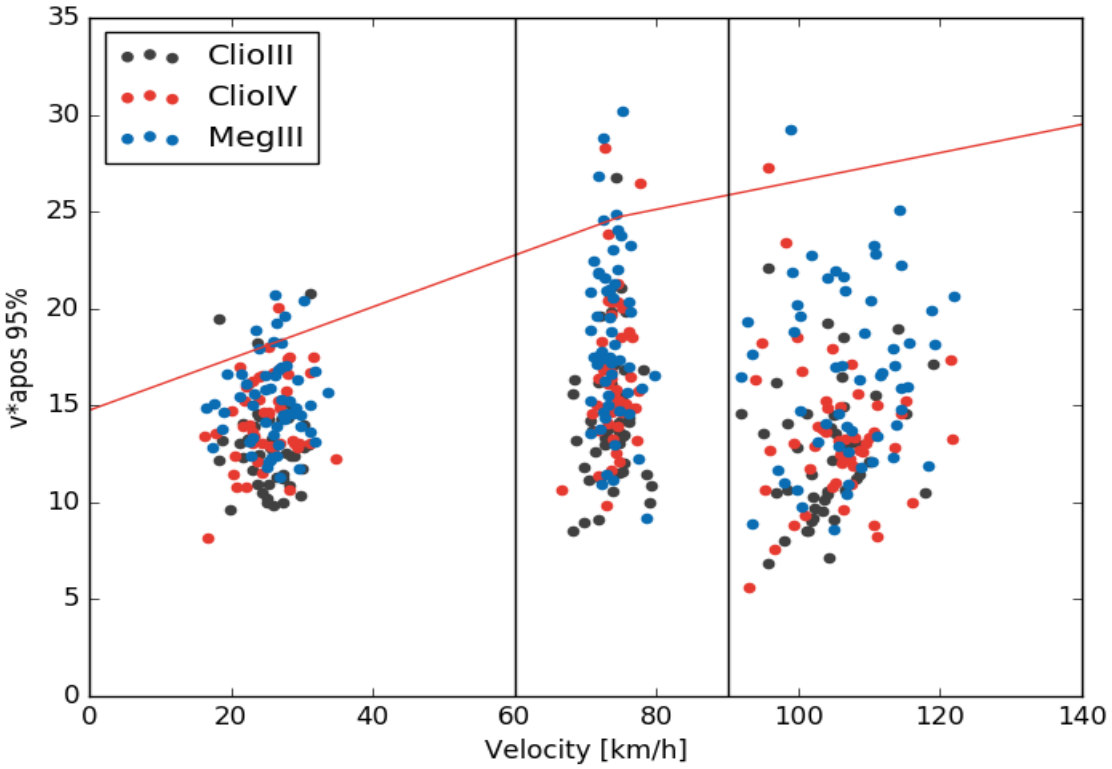
DISCARDING 5% OF THE TRIPS AS DRIVING BOUNDARY

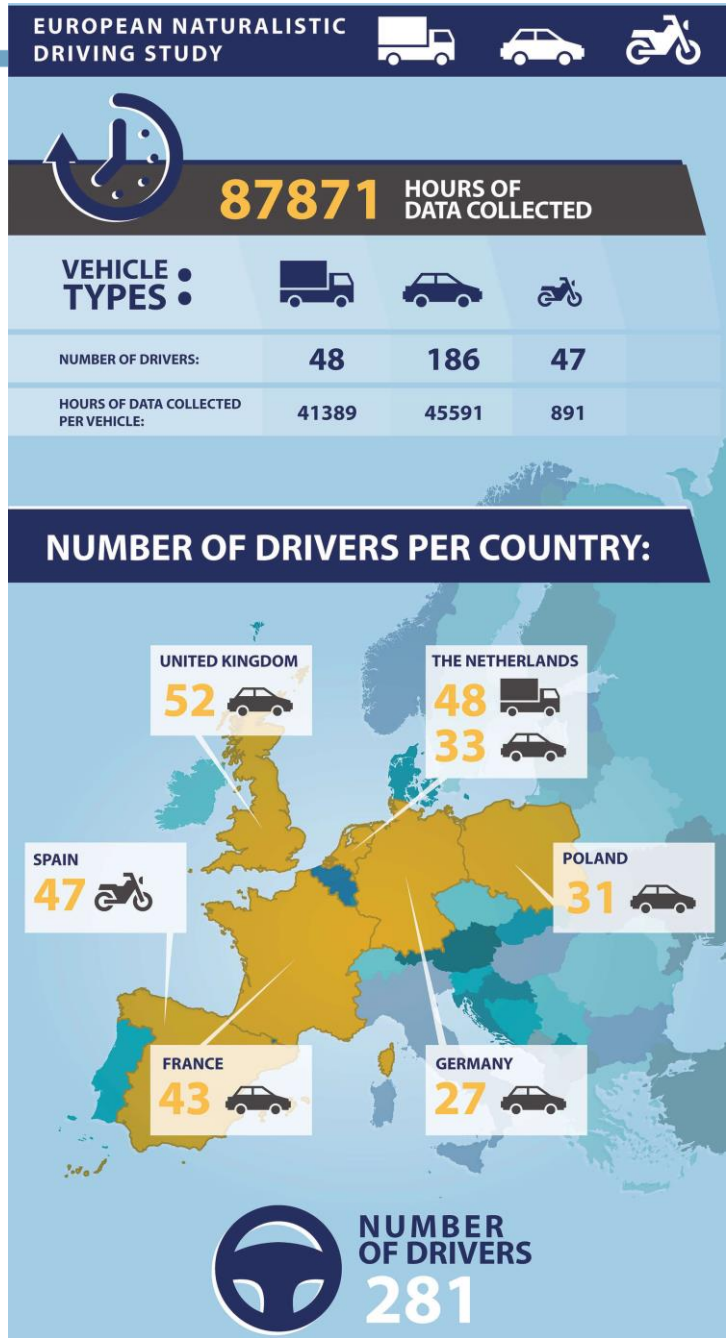


UDRIVE: HTTP://WWW.UDRIVE.EU/

UDRIVE PROJECT RESULTS

~145 DRIVERS





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