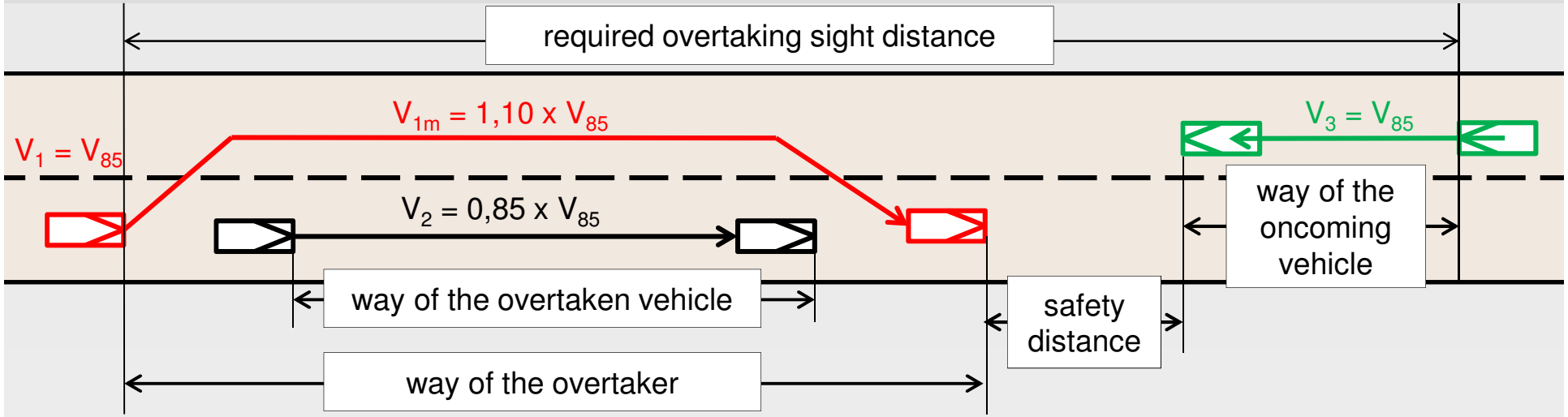
Verifying the Model for Overtaking on Single Two Lane Carriageways

(research project 02.336/2012/BGB)

5th meeting in the Rural Road Design Group
Copenhagen, April 3rd - 4th 2014

Univ.-Prof. Dr.-Ing. Christian Lippold
Dipl.-Ing. Anne Vetters

Reason for the Research Project

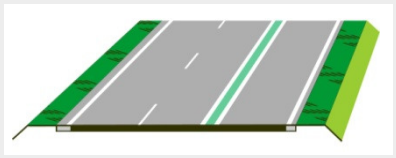


- model of overtaking RAS-L 1995
- accelerated overtaking
- sight distance more than 600 m

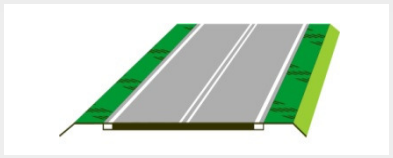
Reason for the Research Project

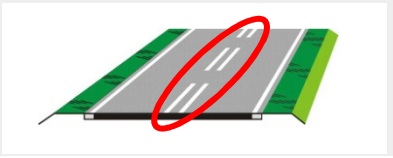
- new guidelines for rural roads (RAL)
  - **standardized** and **recognizable** roads
- aim: reduce the accidents on rural roads
- different design classes with different concepts of overtaking

design class 1

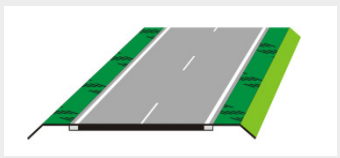


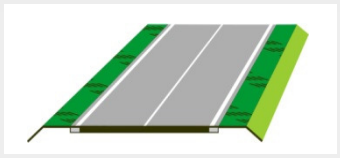
design class 2



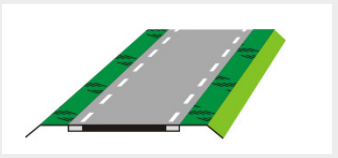


design class 3





design class 4



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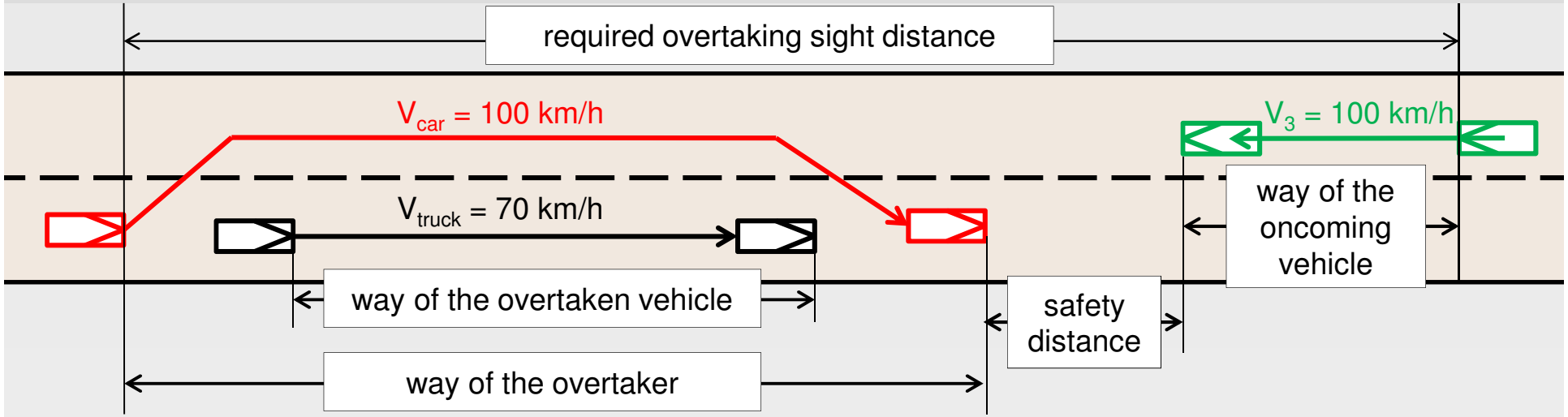
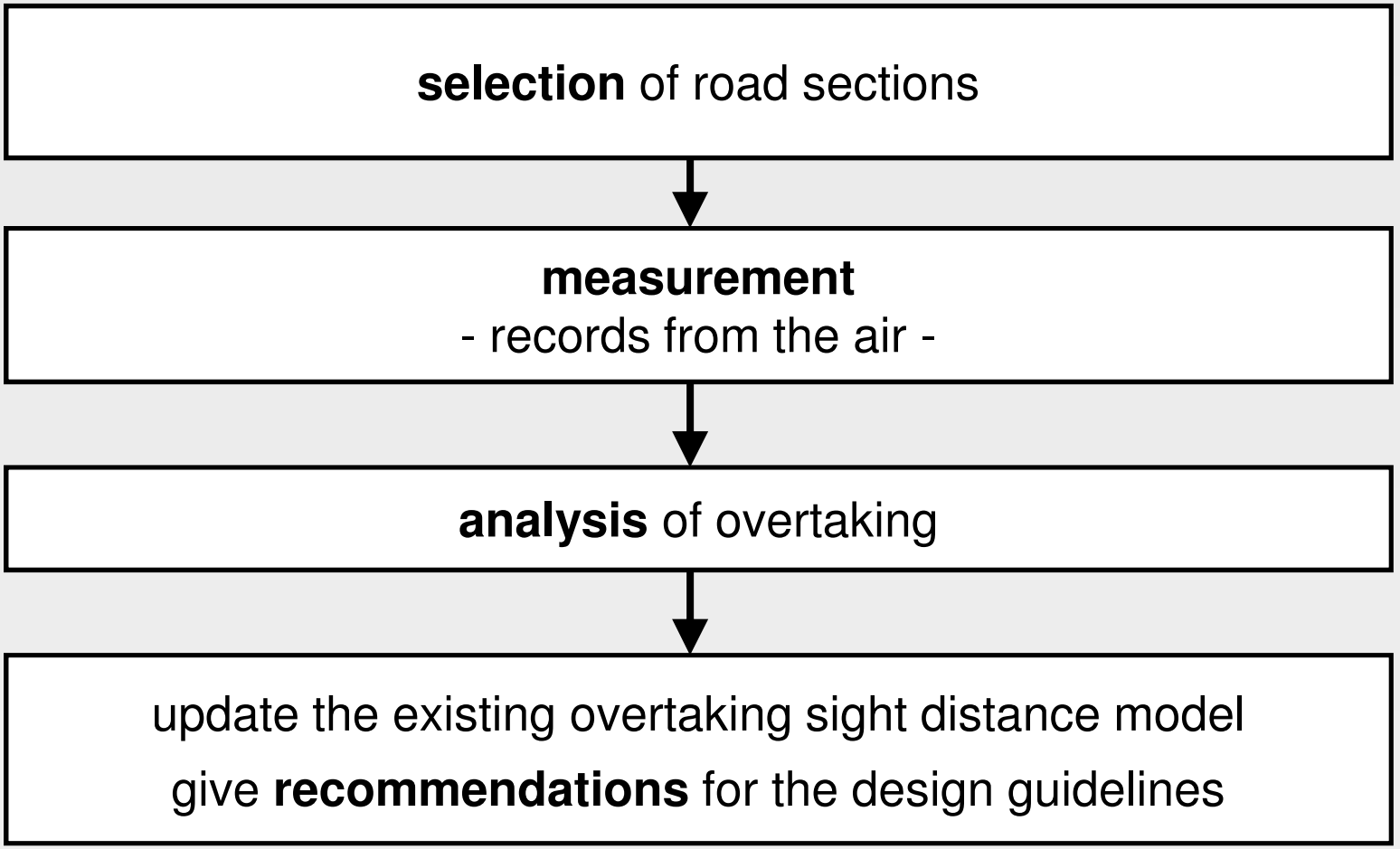


- valid model of overtaking RAL 2012
- flying overtaking
- sight distance more than 600 m

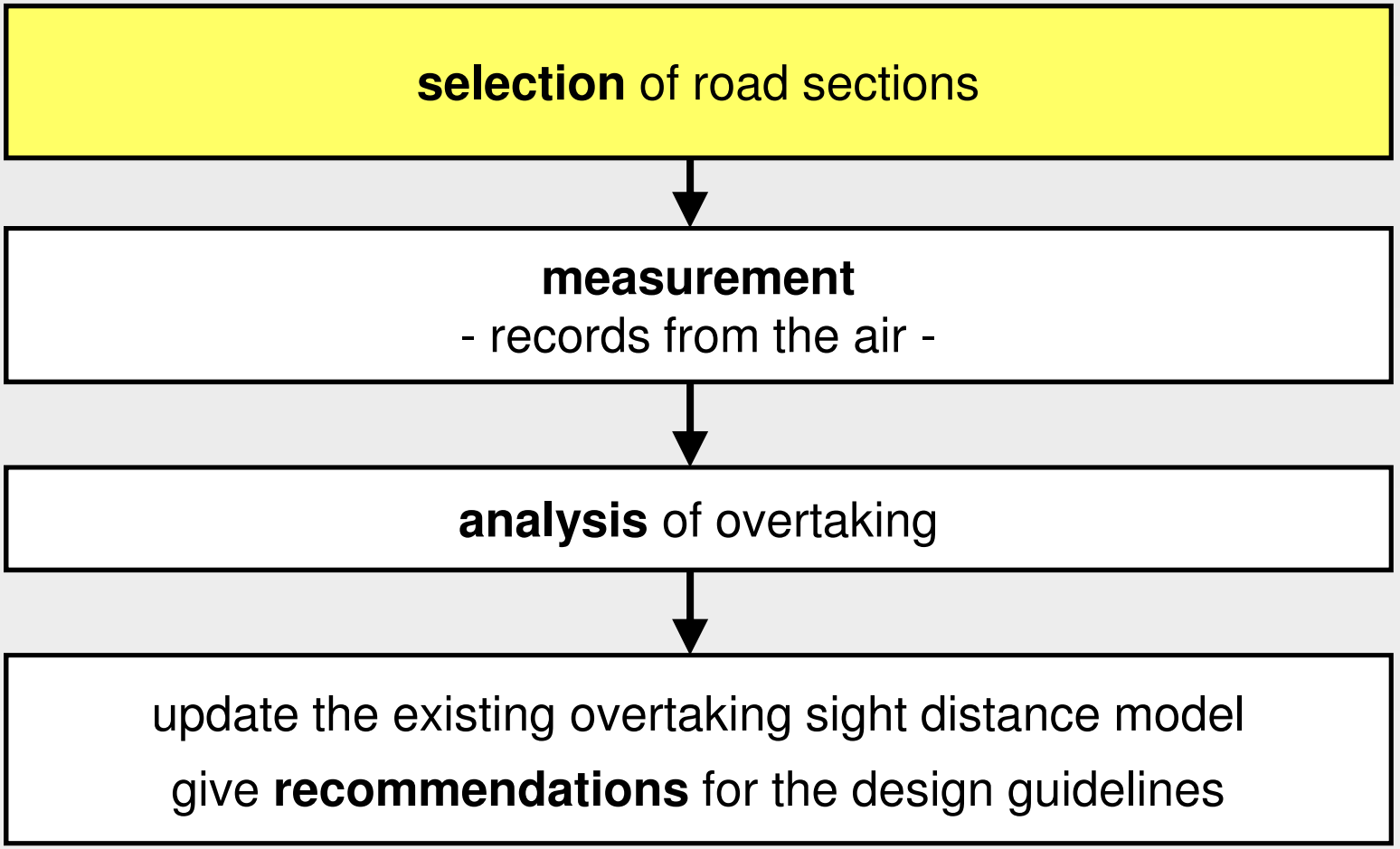
Research project

- regard the changing properties of the vehicles (acceleration)
- variation of the geometric design of the streets (longitudinal gradient, curviness, sight distance)

Research Methodology



Research Methodology



Selection of road sections

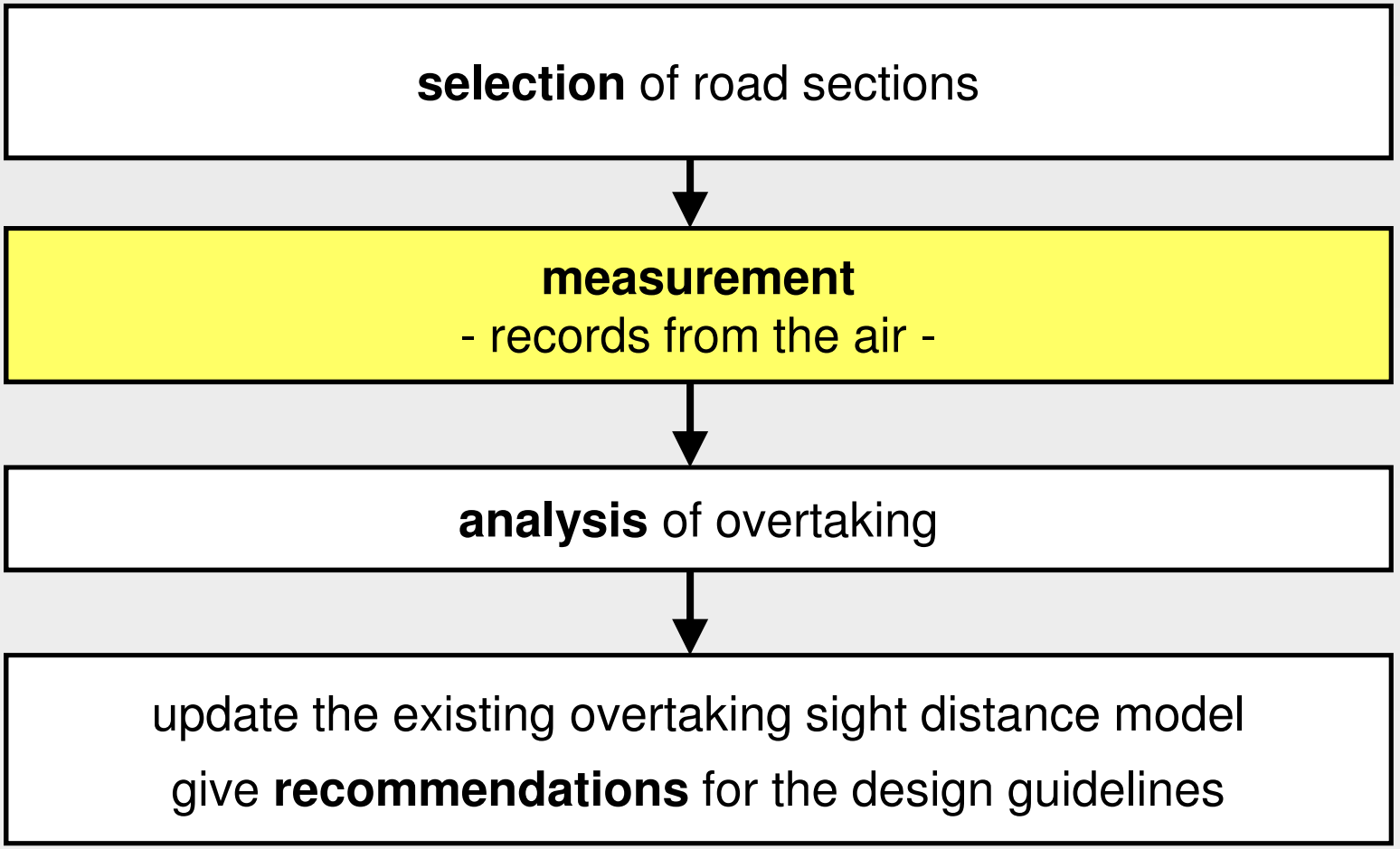
Six test sections with the following characteristics:

- stretched alignment (long straights, large curves)
- existing sight distance: 400m < S_H > 1.000 m
- gradient: s < 3,0%
- AADT: 5.000 - 10.000 veh./d
- carriageway width: between 6,50 m - 9,00 m

➡ **parameters should be varied**

Selection of road sections

Research Methodology



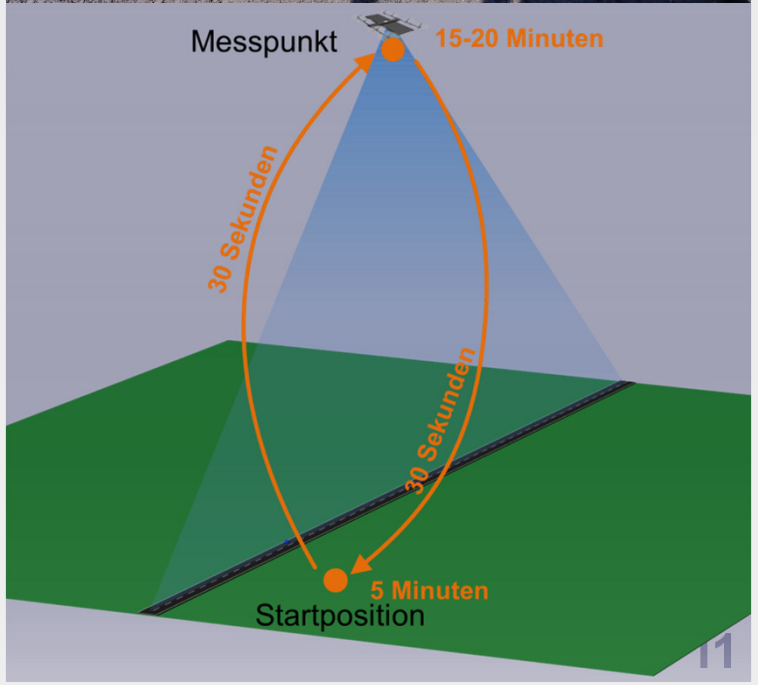
Research Methodology

- Fraunhofer Institute for Transportation and Infrastructure Systems IVI
- drone HORUS – eight rotors
- dimension: 1,3 m x 1,0 m
- empty weight: 1,8 kg
- max. cargo load: 3,5 kg
- max. flight time: 15 - 40min
- max. height: 500m

Research Methodology – procedure of the measurement

- System GoPro Hero 3

- build up the base station
- chose a position in the air
- transmit the GPS-position to HORUS
- drone gets to the position in the air automatically
- fly and record at the position for 15 - 20 min
- automatic return to the base station for changing the battery



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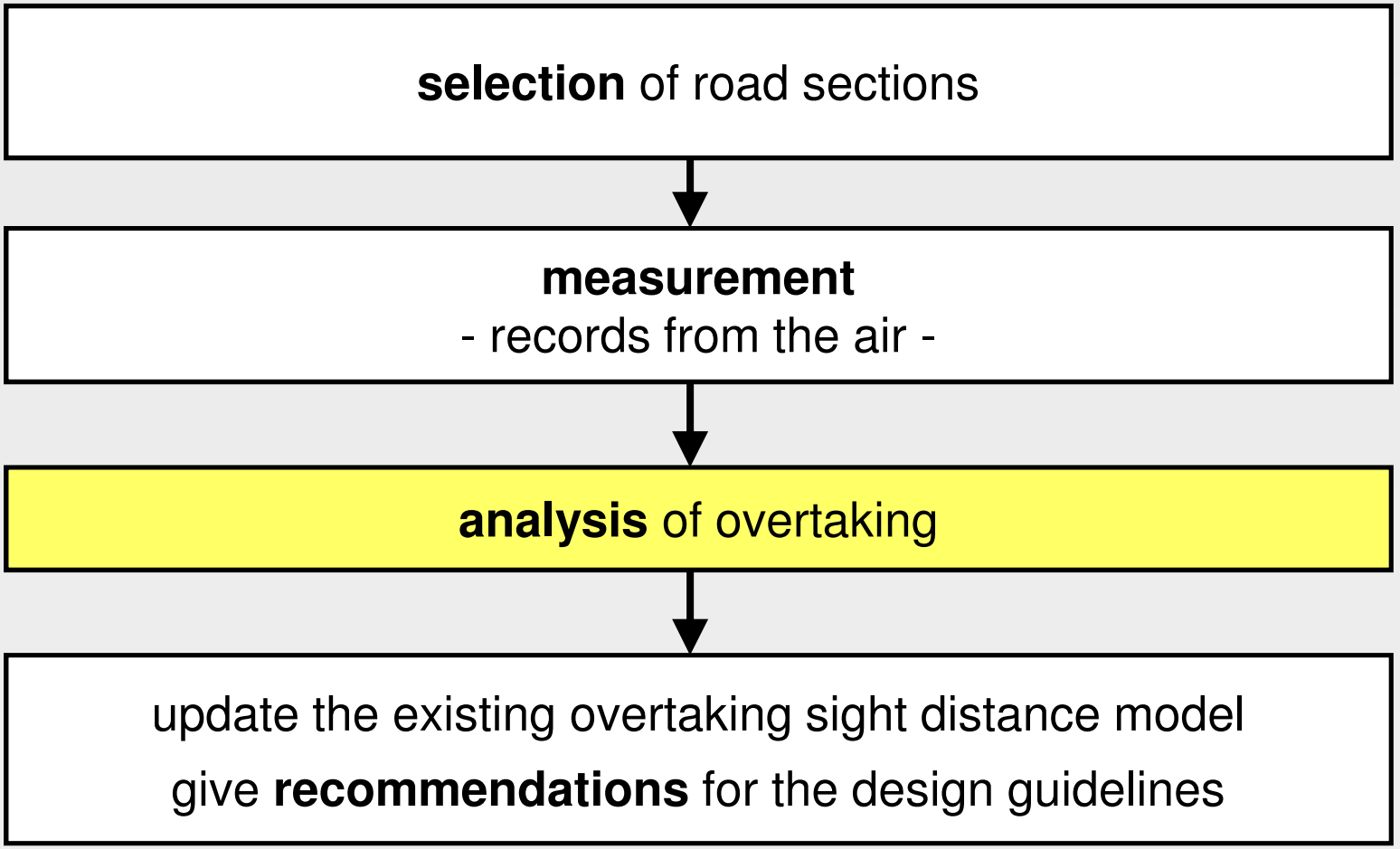
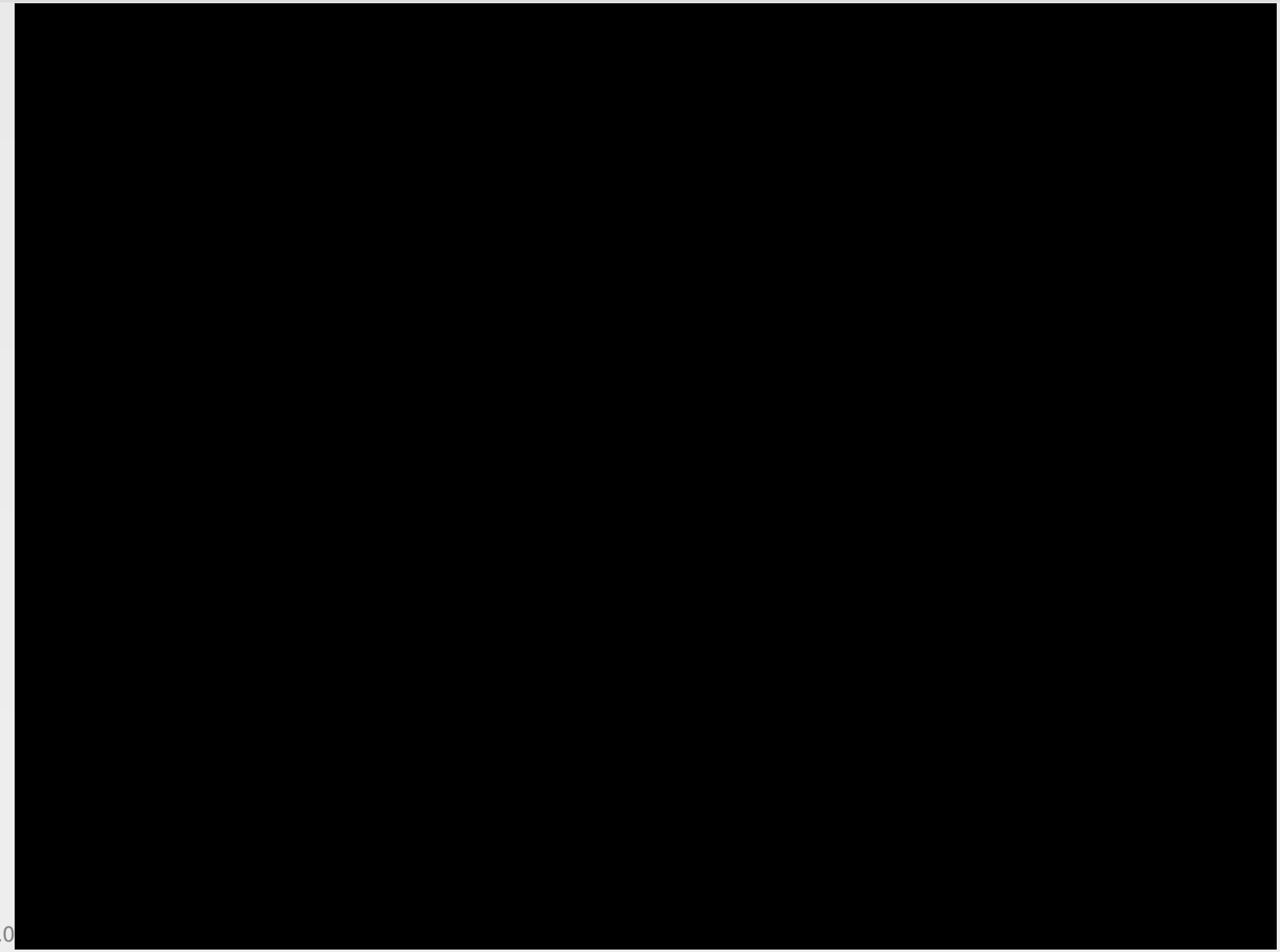


Analysis of overtaking

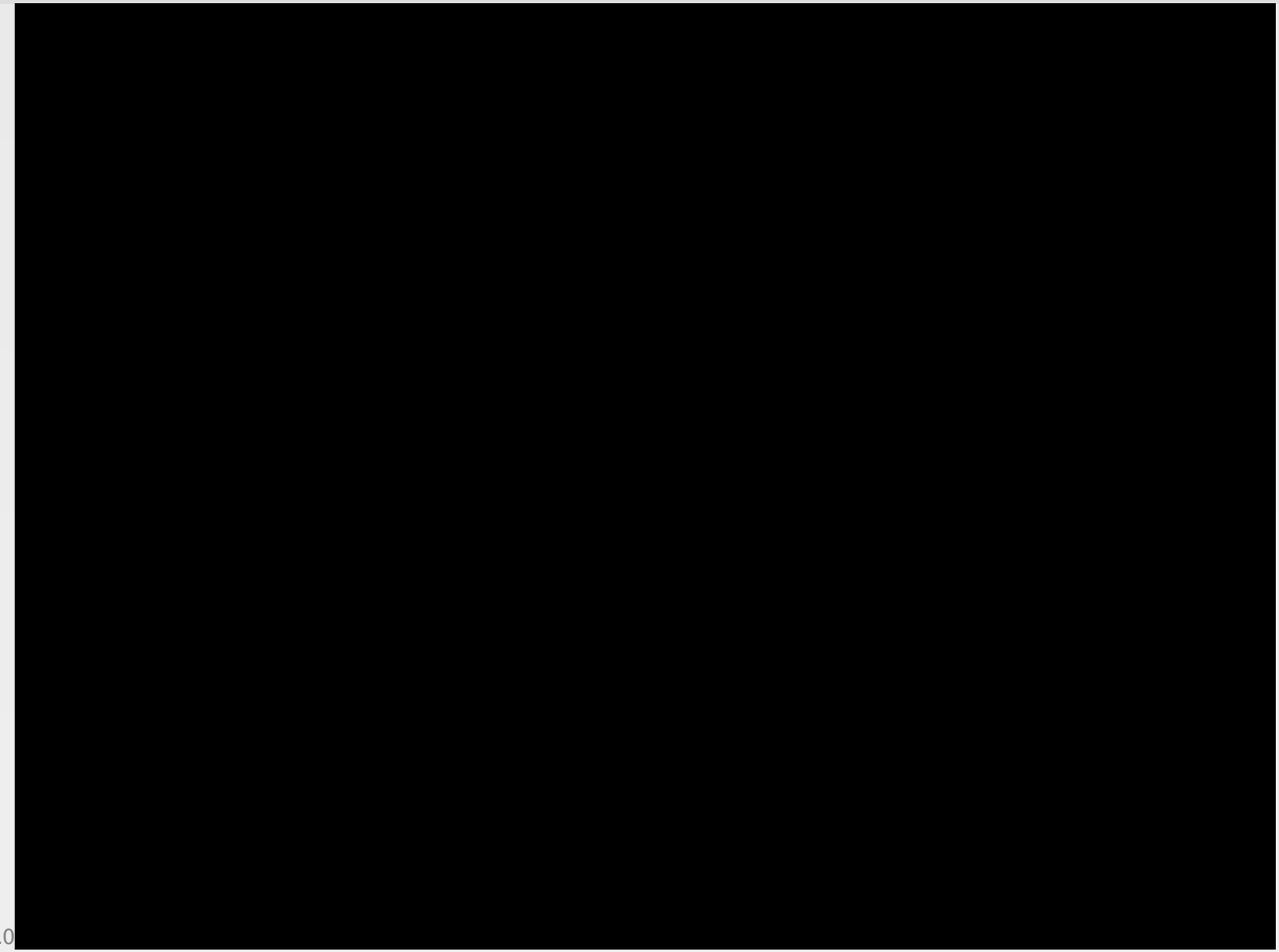
Differentiate the overtaking in:

- the participants: car – car
  car – truck
  car – farm traffic
- traffic: with/ without oncoming traffic
- kind: flying overtaking
  accelerated overtaking
- type: single overtaking
  active multi overtaking
  passive multi overtaking

Kind: flying, type: single overtaking



Kind: accerlerated, type: activ multi overtaking



Analysis of overtaking

Evaluated information

- speed
  - of the slow vehicle at the beginning and the end of the overtaking
  - of the fast vehicle at the beginning and the end of the overtaking
  - average speed of the oncoming vehicle
- traveled distances during the overtaking
  - of the slow vehicle
  - of the fast vehicle when it changes the lane on the oncoming direction, when it drives on the oncoming lane and when it moves back
  - of the oncoming vehicle

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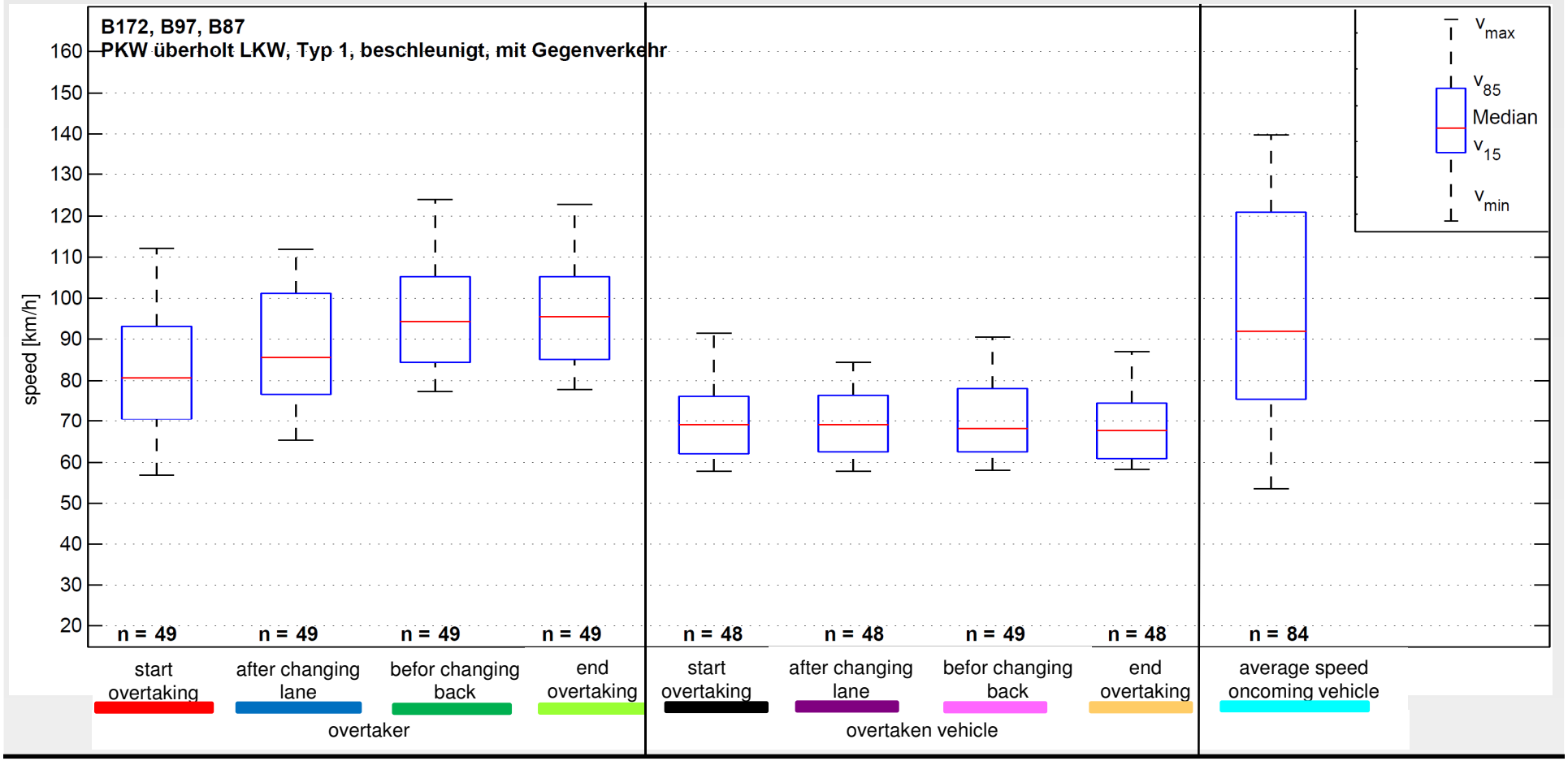
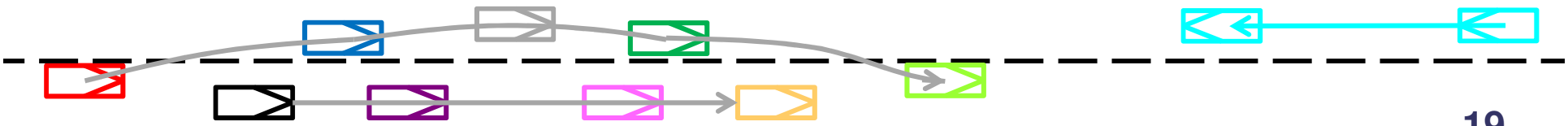
Analysis of overtaking

Evaluated information

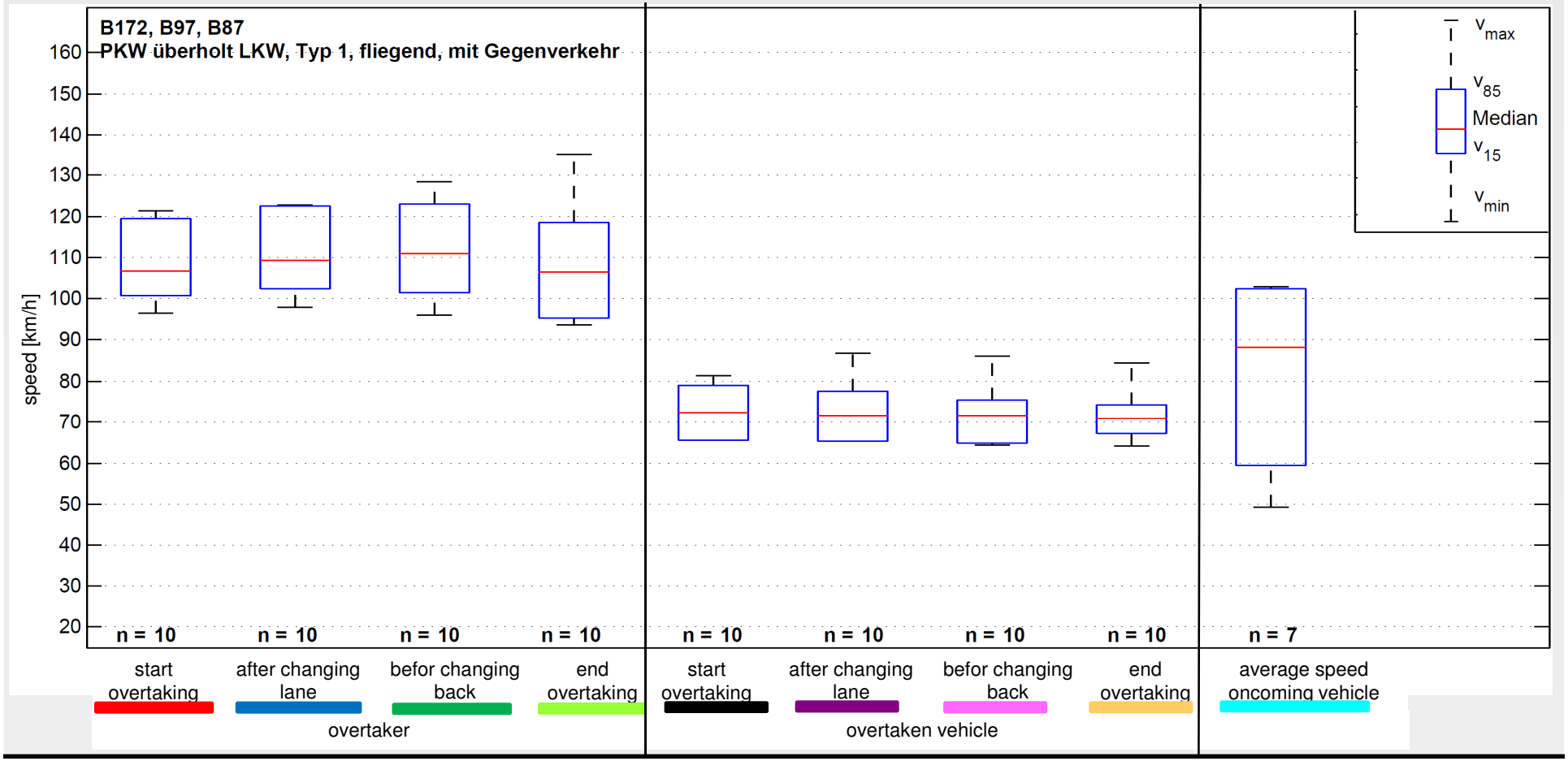
- distances between the fast and the slow vehicle
  - when the fast vehicle starts to change to the oncoming lane
  - when the fast vehicle starts to change back
- the distance between the fast vehicle and the oncoming vehicle at the end of the overtaking

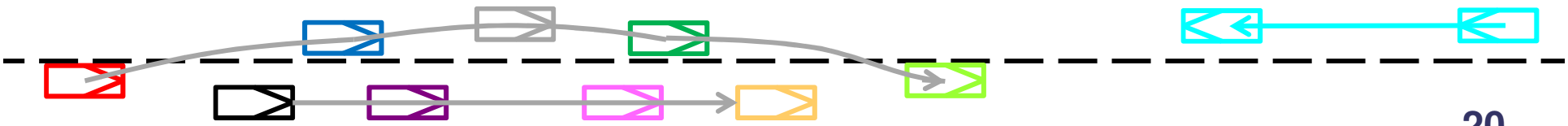
Speed: car - truck with oncoming traffic – accelerated single overtaking





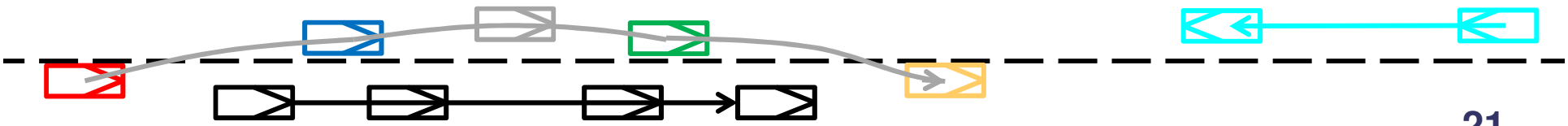
Speed: car - truck with oncoming traffic – flying single overtaking





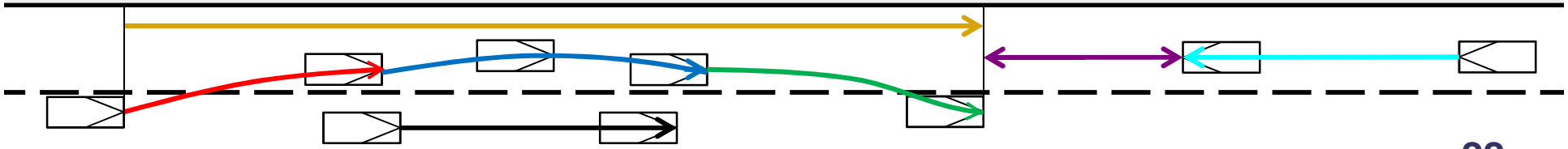
Tentative results: speed – single overtaking with oncoming traffic

V_{85} [km/h]	car – truck	
	accelerated	flying
$V_{85,truck, average}$	75	78
$V_{85,car, start}$	92	120
$V_{85,car, after changing lane}$	101	123
$V_{85,car, befor changing back}$	105	123
$V_{85,car, end}$	105	119
$V_{85,oncoming traffic}$	120	102

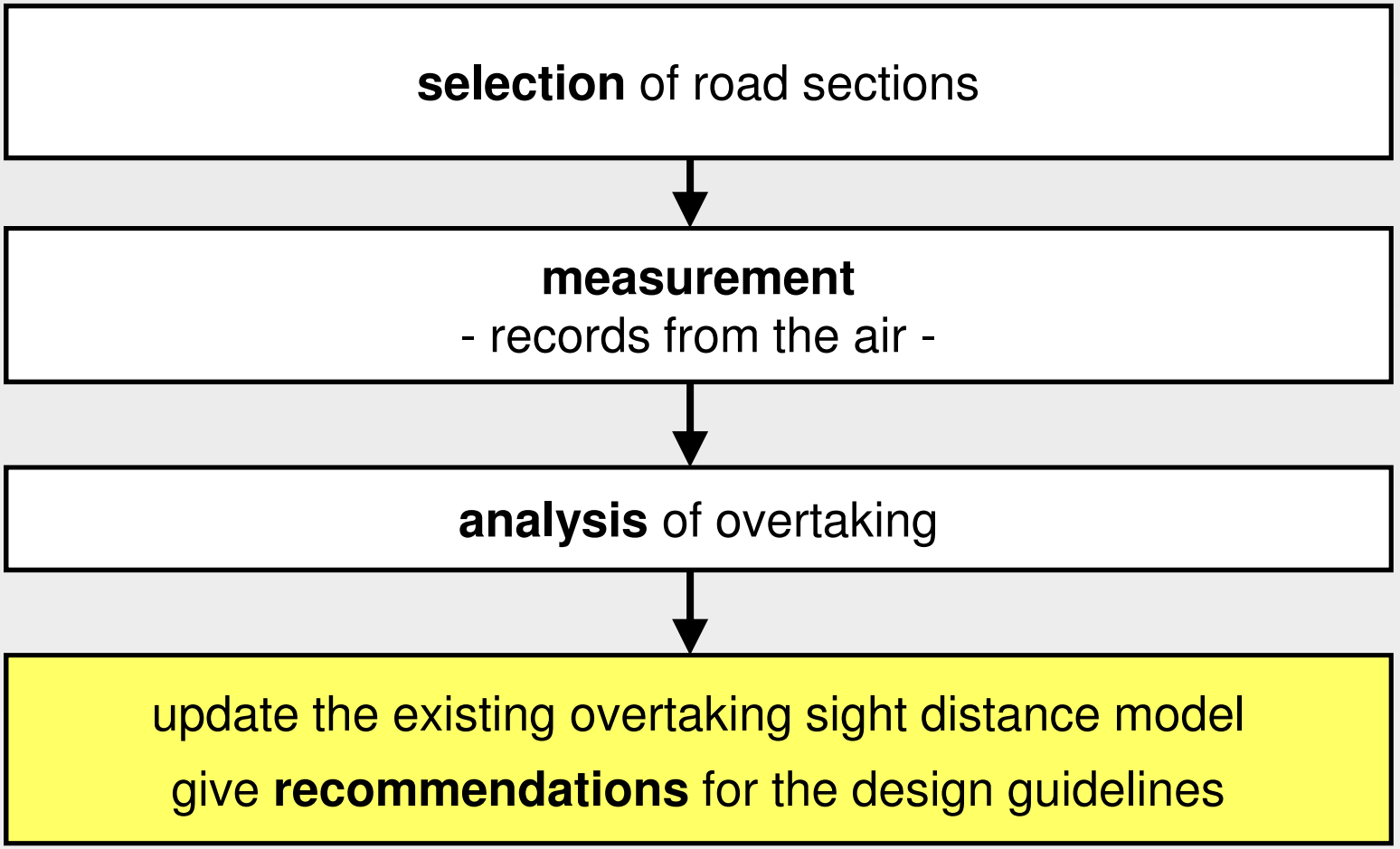


Tentative results: ways – single overtaking with oncoming traffic

distance [m] – 50% percentile	car – truck	
	accelerated	flying
truck	155	175
change on oncoming lane	50	60
on oncoming lane	100	120
change back on own lane	50	60
whole way of the overtaking	**210**	**290**
distance between car and oncoming vehicle	200	205
oncoming vehicle	225	210

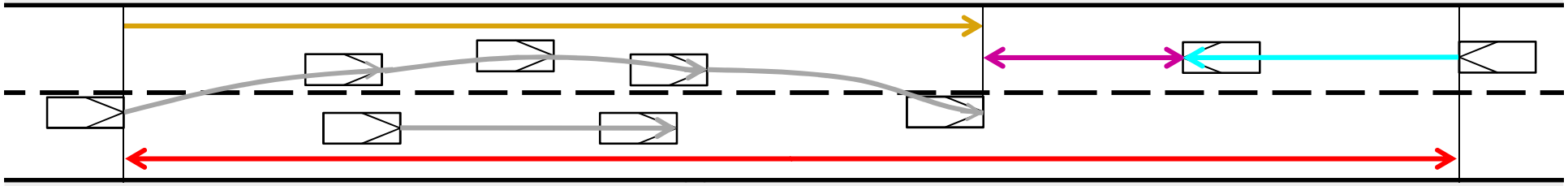


Research Methodology



Tentative results: Values for the overtaking sight distance

distance [m]	car – truck	
	accelerated	flying
overtaking distance (50% - percentile)	210	290
distance between car and oncoming vehicle (approximately 15% - percentile)	100	100
oncoming vehicle (50% - percentile)	225	210
required sight distance for a safe overtaking Σ	535	500



Questions

- Which models for the overtaking sight distance exists?
  - research projects
  - used parameters
  - measured ways and distances or based on experience
- Did the design guidelines include these models?
- Which design parameter are based on these models?
- Are there different overtaking sight distances depending on the geometric design?
- On how many amount of length of the overtaking sight distance have to exist?

Questions

- What are the conditions for overtaking restrictions?
  - decision criteria's
  - responsibility
- How is the restriction shown to the driver (marking, signs)?
- Are there guidelines for the road marking?
- Correspond the overtaking model to the model of road marking?

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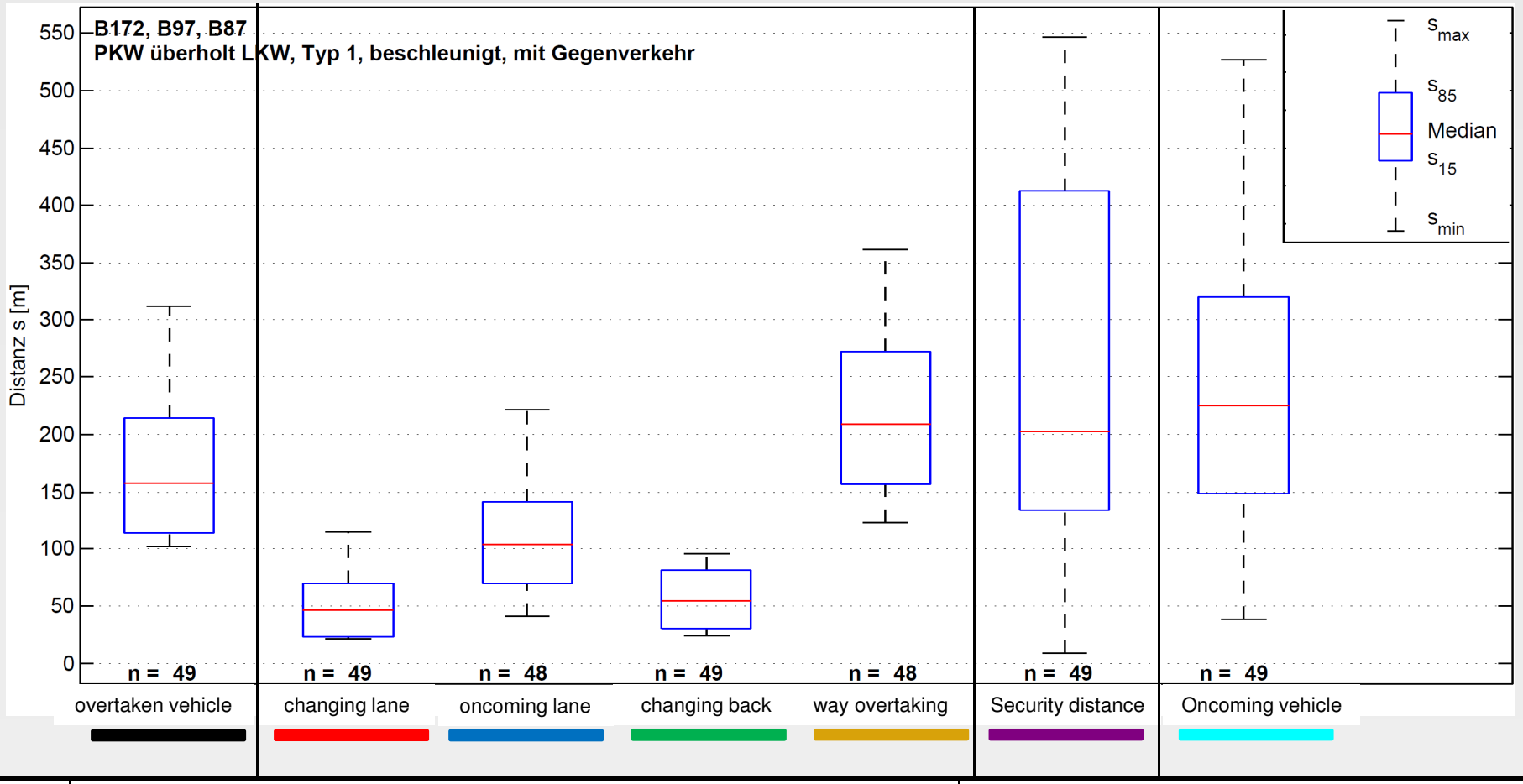
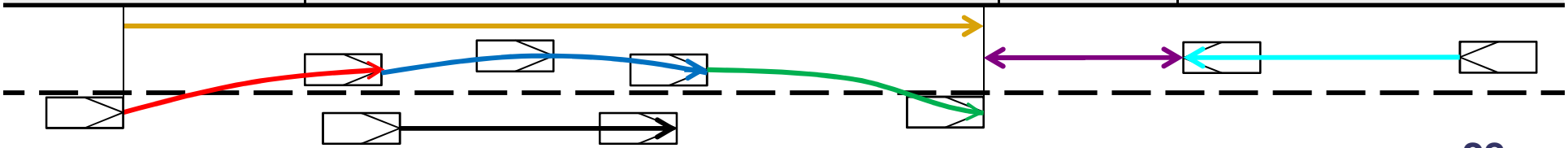
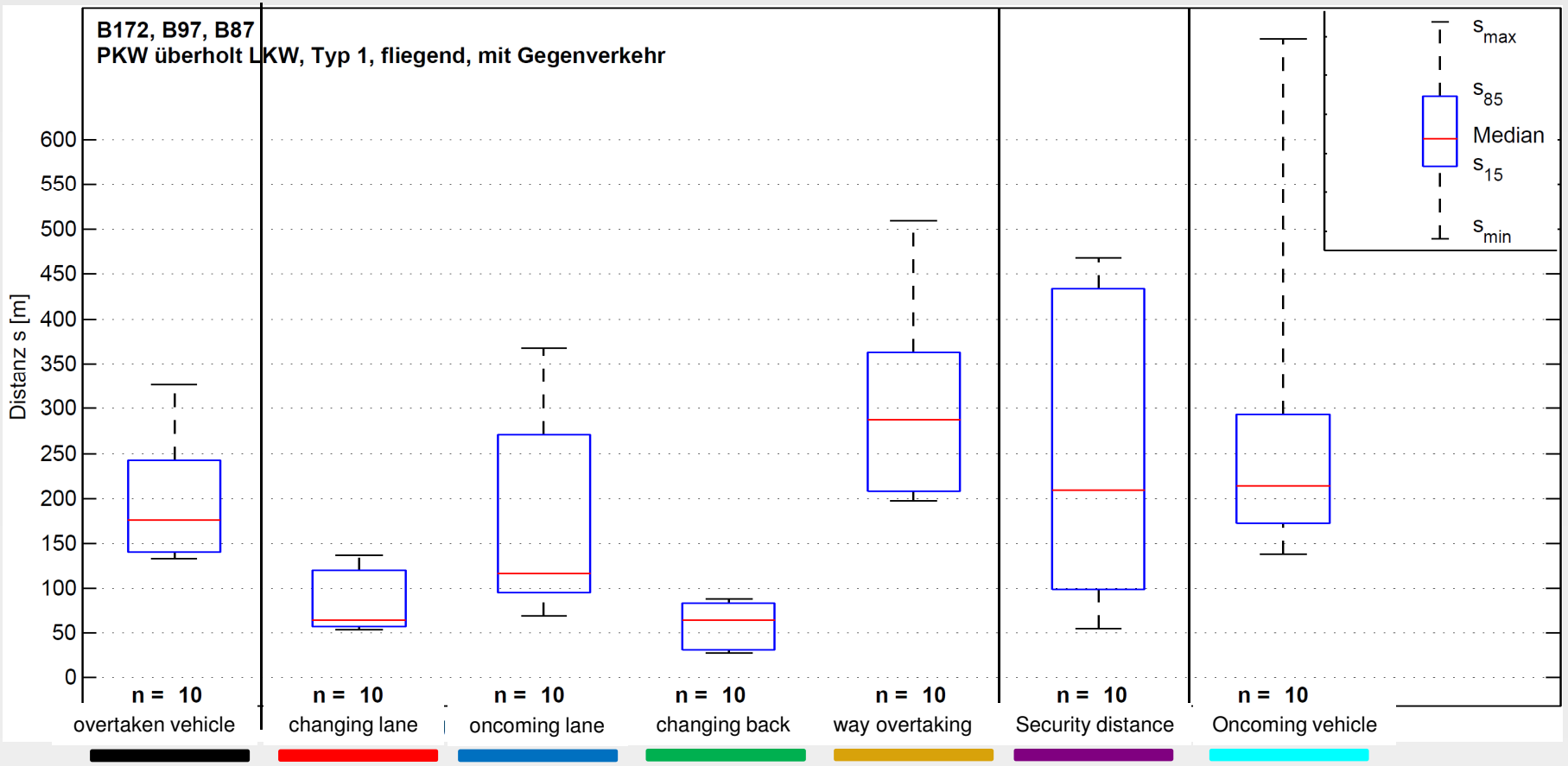
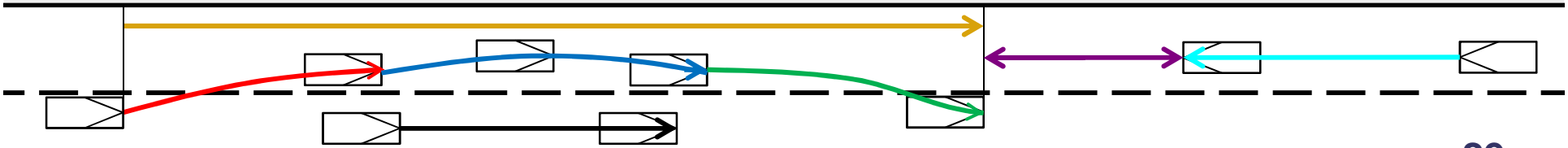
Distance: car - truck with oncoming traffic – accelerated single overtaking





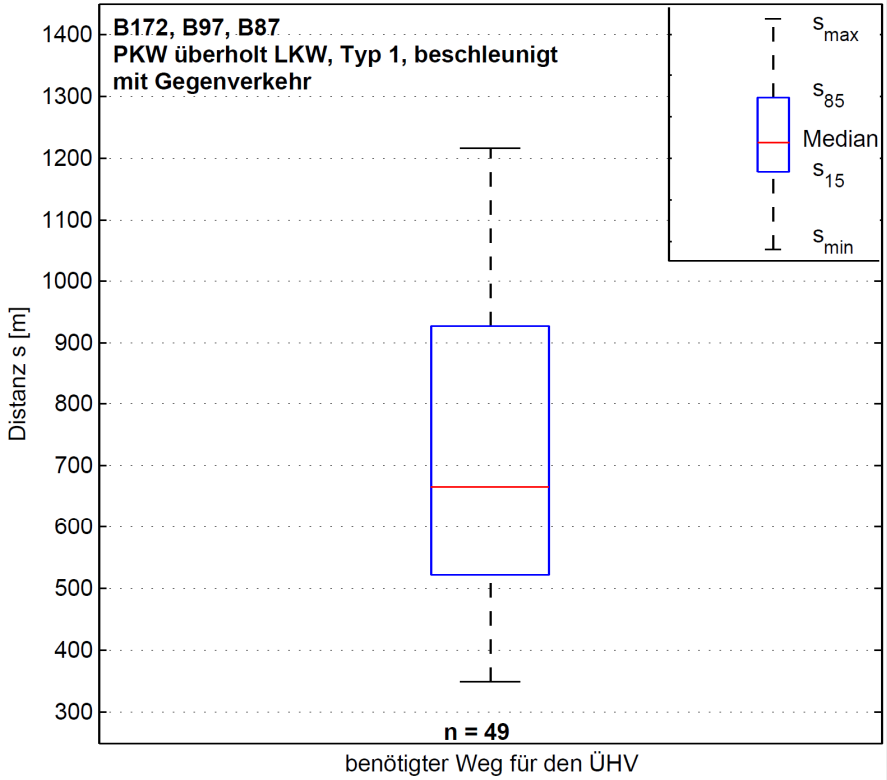
Distance: car - truck with oncoming traffic – flying single overtaking

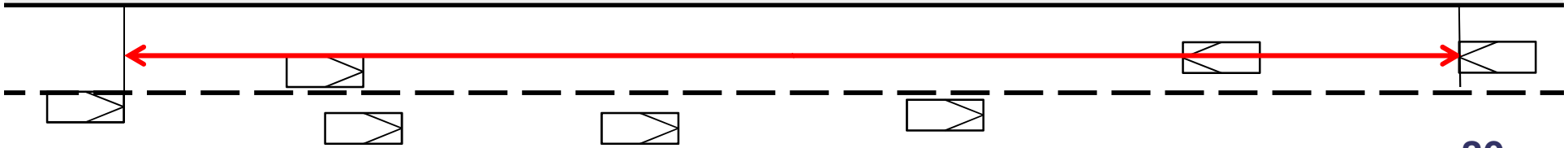




overtaking distance

car - truck with oncoming traffic – accelerated single overtaking





Tentative results: overtaking distances

distance [m]	car - car		car - truck	
	accelerated	**flying**	**accelerated**	**flying**
85%-Quantil	**850**	850	**920**	950
50%-Quantil	**610**	620	**670**	690
15%-Quantil	**470**	550	**510**	610