Comparing speed measurement methods for evaluating interventions

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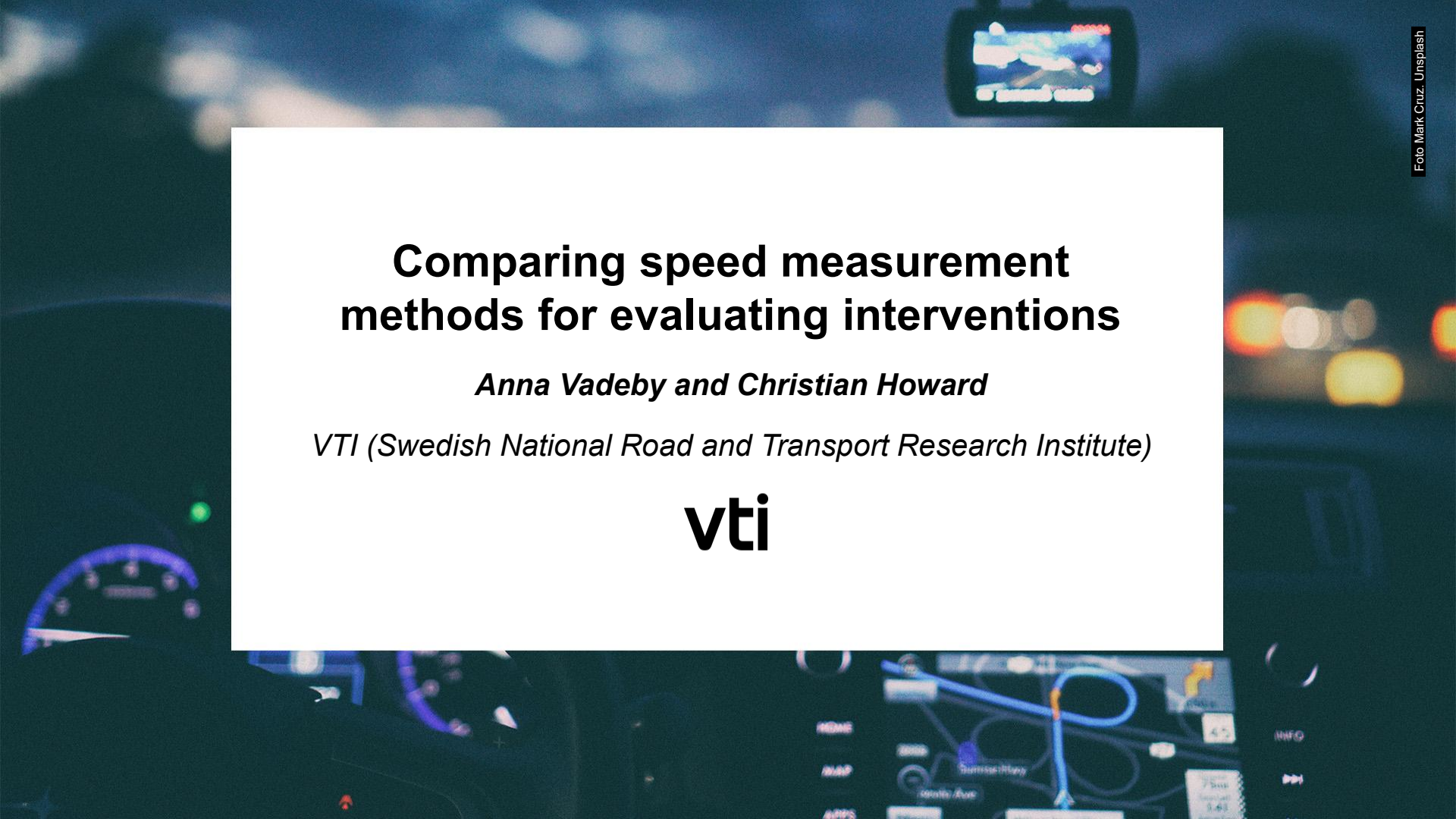

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Background

- Effective speed management is central to the development of a Safe System
- Beyond preventing deaths and serious injuries, it also contributes to other societal goals (sustainable communities, enhancing urban liveability, promoting public health, and equity)
- To evaluate effects of speed interventions, different types of speed measurement methods are often used

Aim

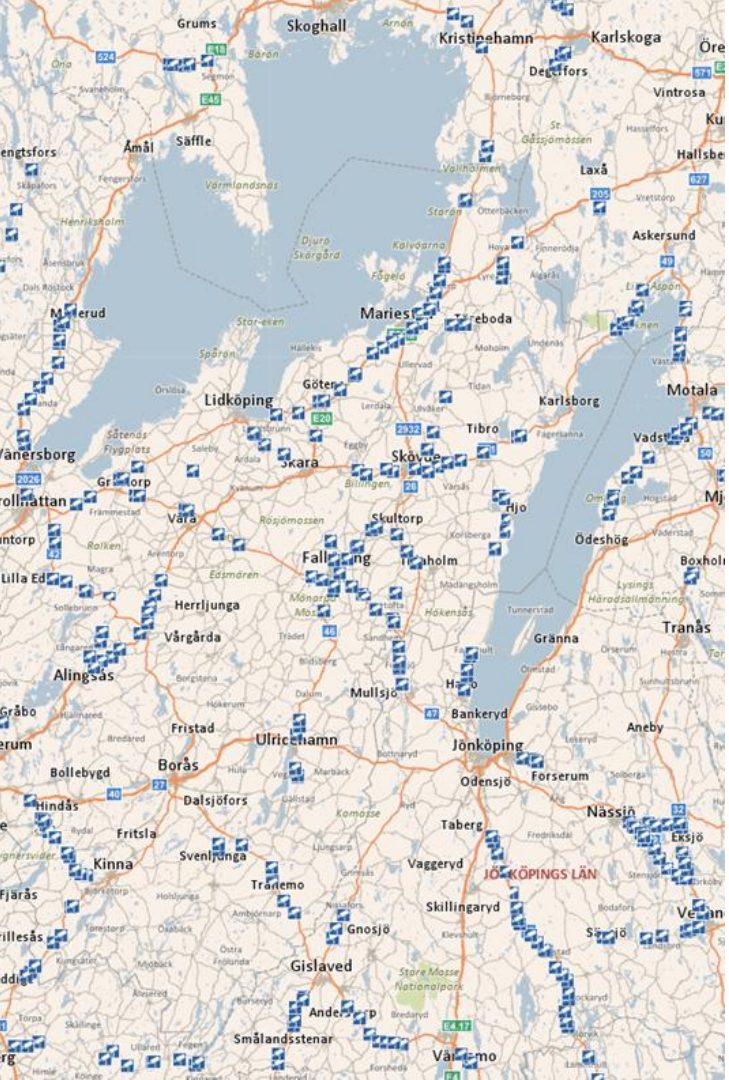
An ongoing study contains two different tasks:

1. Evaluate the effects of speed cameras used in portals in Sweden (before and after study)

2. Analyse and explore different types of evaluation methods at the locations where speed cameras will be applied in 2026.

The aim of this study is to explore 3 different measurement methods often used to evaluate speed management interventions. The different methods studied are:

- pneumatic tubes
- radar
- probe data from INRIX.



Speed cameras in Sweden: Spot speed cameras in a series

- System introduced in 2006
- Mainly on rural roads, speed limit 70, 80 and 90 km/h
- Swedish Transport Administration and the Police are responsible for the camera system
- Speed cameras often set in series with a mean distance between cameras of about 5 km
- Evaluated by Vadeby and Howard (2024)
  - Mean speed decreased by 3.5 km/h
  - Speed compliance increased by 16 %-units
  - Fatalities decreased by 39%

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Method

- Speed measurements during one week in May 2025 at 3 locations in Sweden.
- Two spots near intersections at 2+1 roads and one at a dual carriageway road.
- **Location 1:** Speed limit 70 km/h, AADT 11 000 veh/day. Pneumatic tubes, radar and INRIX.
- **Location 2:** Speed limit 70 km/h, AADT 12 000 veh/day. Pneumatic tubes and INRIX
- **Location 3:** Speed limit 70 km/h, AADT 32 000 veh/day. INRIX.

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Method – data collection

Pneumatic tubes

- measures speed at the location of the tubes.
- speed of individual vehicles and vehicle type
- not separate measurements for each lane.

Radar

- radar system on a portal above the road, measures spot speed
- speed of individual vehicles in the different lanes
- difficult to obtain a good classification of vehicle type

Method – data collection and analysis

INRIX probe data

- anonymized traffic data sourced from a wide range of inputs including GPS signals from vehicles and mobile devices, road sensors, and telematics systems
- data commonly used to analyse traffic patterns, vehicle movements, and travel behaviour across road networks
- data collected for a pre-defined road segment and data on minute-level is provided
- road segments studied are between 620 m and 1150 m in length.
- no contain data of individual vehicles, penetration rate and vehicle type not known.

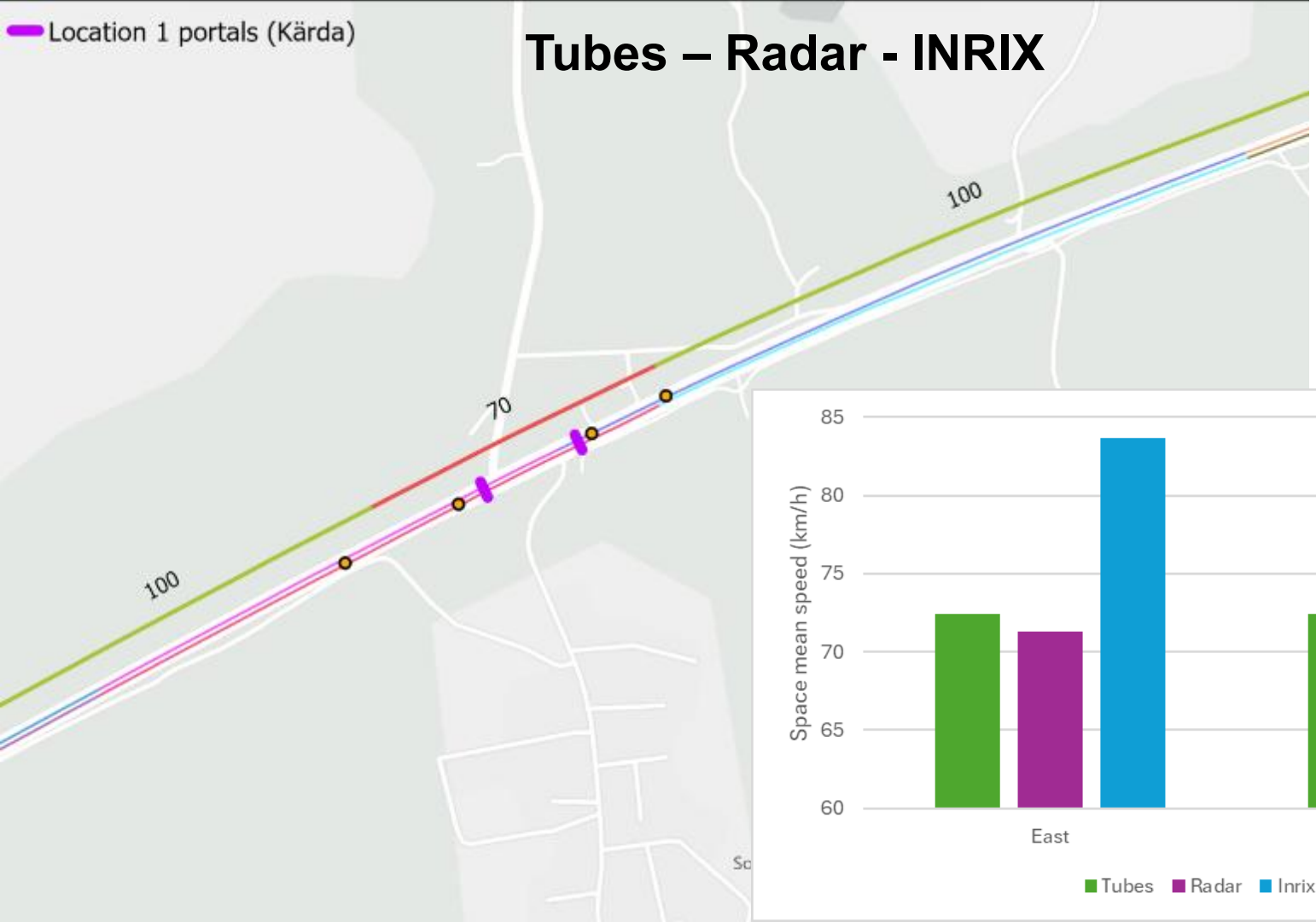
Study not designed for an exact comparison. but rather to investigate whether similar conclusions can be drawn from the different measurements.

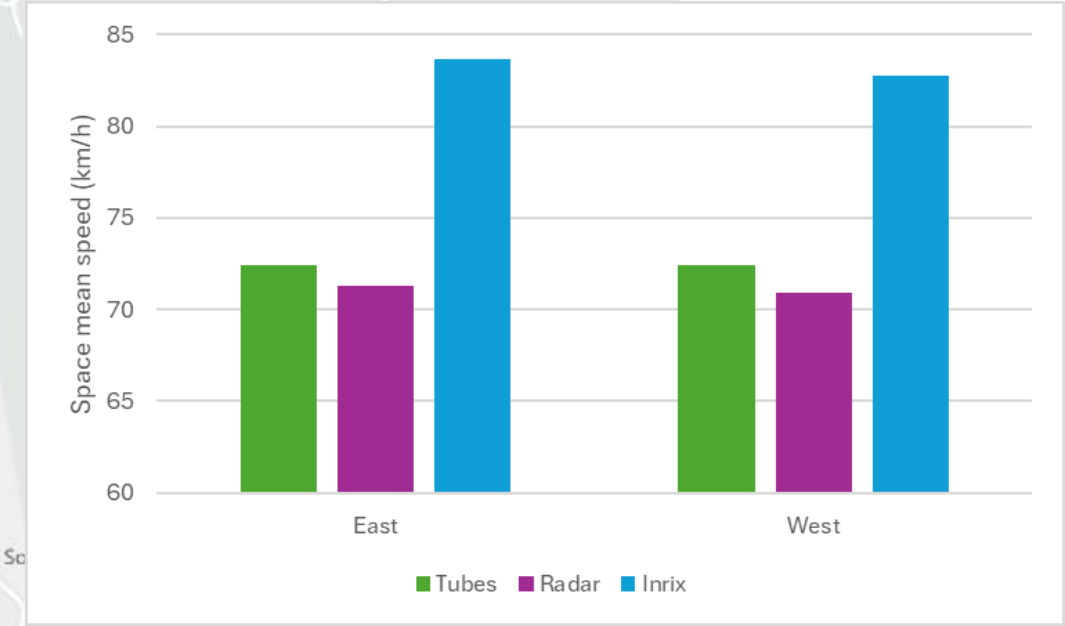
Data from 4 days in May 2025 (96 h)

Outliers removed: (20, 140 km/h)

Results

Tubes – Radar - INRIX





INRIX Space mean speed (L1, L2 and L3)

The length of the road segments are between 600 and 1150 m

	L1		L2		L3	
Direction	Mean Speed Limit	Space mean speed	Mean speed limit	Space mean speed	Speed limit	Space mean speed
1	96	86.9	96	86.4	70	73.8
2	91	82.8	97	85.7	70	69.4

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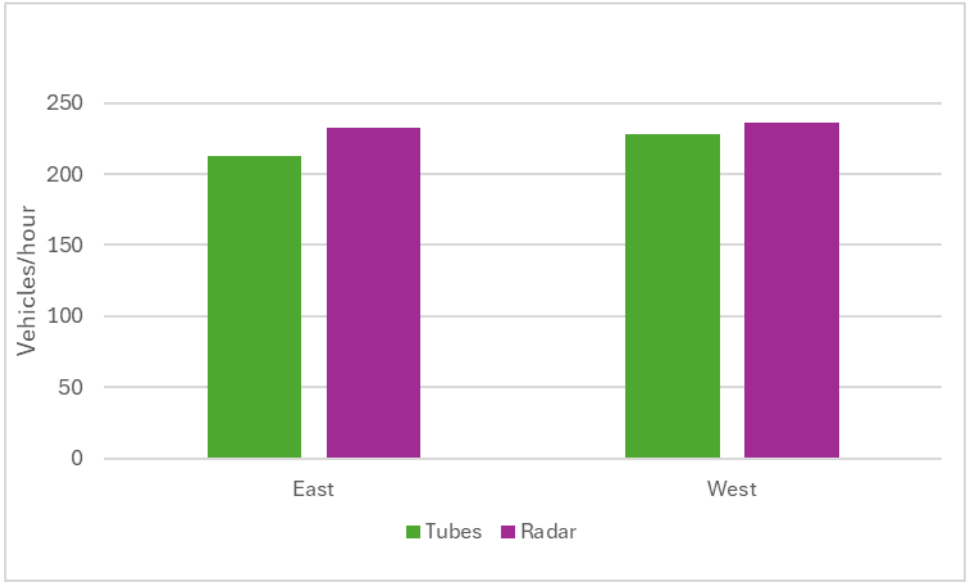
Comparing tubes and radar (L1)
vehicles/hour



Radar seems to observe between 3–10 % more vehicles than the pneumatic tubes

Differences not statistically significant

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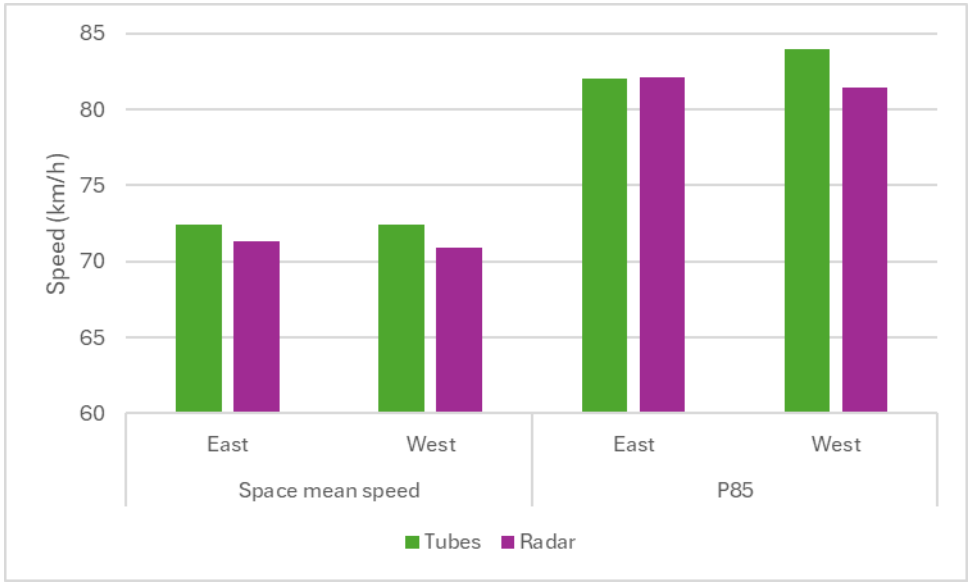
Comparing tubes and radar (L1)



Pneumatic tubes estimate the **space-mean-speeds** to be about 1 km/h higher than measured by radar

East: P85 is the same for tubes and radar

West: P85 estimated 2.6 km/h higher for tubes

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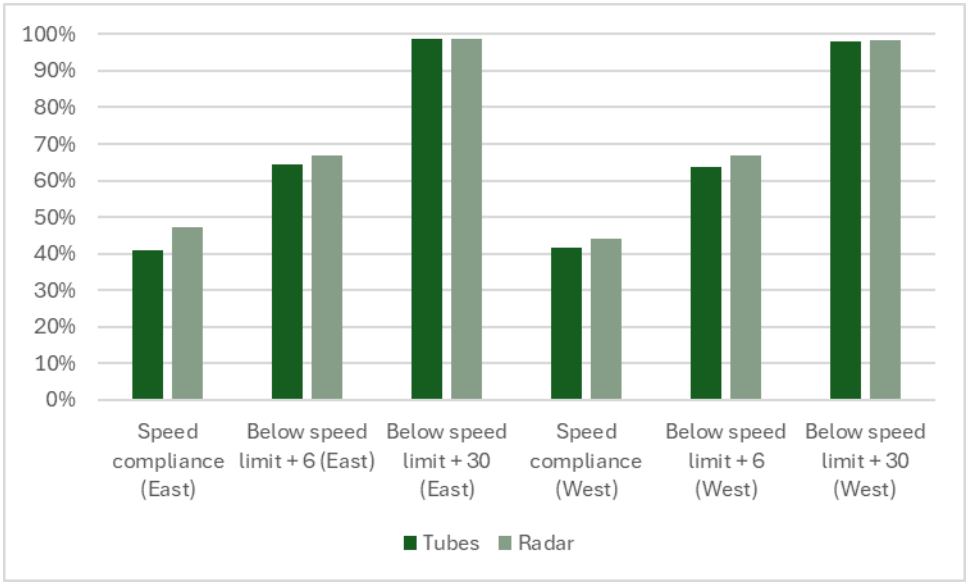
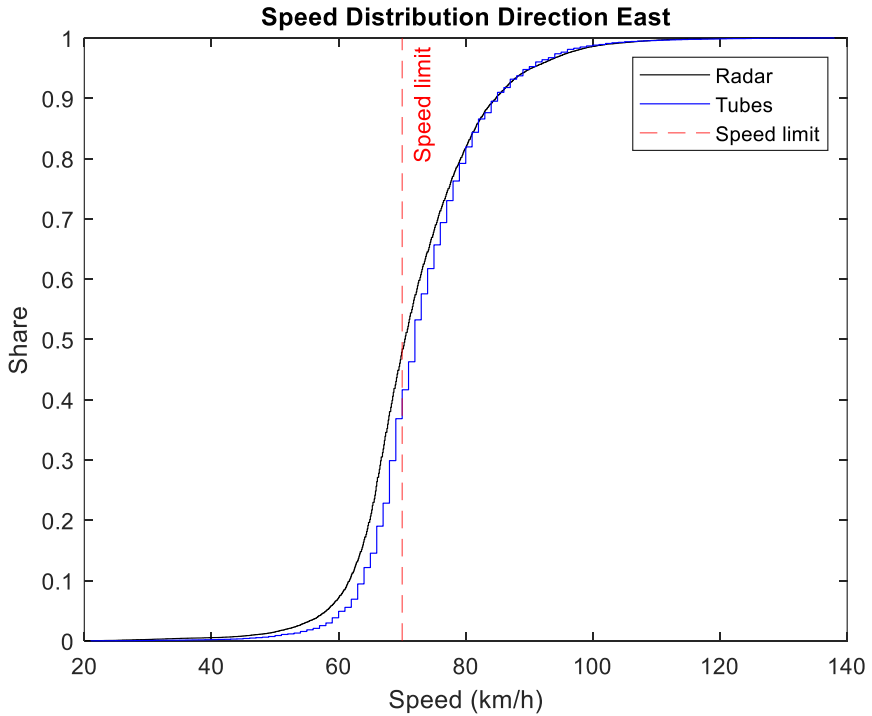
Speed compliance and speed distribution





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Conclusions

- The main aim with the measurements is to evaluate the effects of speed cameras used in portals in Sweden (before and after study)
- This study is not designed for exact comparisons. Investigates whether similar conclusions can be drawn from the different measurements.
- Each method showed advantages and limitations.
    - **Pneumatic tubes** provide detailed data on individual vehicle speeds and types but cannot differentiate lanes.
    - **Radar systems** mounted above the road, offer lane-specific data but struggle with vehicle classification
    - **INRIX data** derived from GPS and telematics, covers longer segments and offers minute-level resolution but lacks individual vehicle data and known penetration rates. One limitation is that the road segments are pre-defined and it need to be investigated how well the covers the location of interest. No possibility to estimate speed complaince.
- Results show that radar detects slightly more vehicles than pneumatic tubes and reports lower space mean speeds, leading to higher estimated speed compliance.
- The shape of the speed distribution is similar between radar and tubes, suggesting consistency in traffic behaviour.
- INRIX data reflects higher mean speeds due to the inclusion of road segments with higher speed limits.
- The study highlights the importance of selecting appropriate measurement methods based on the evaluation context.

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Thank you for listening!
Questions?
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