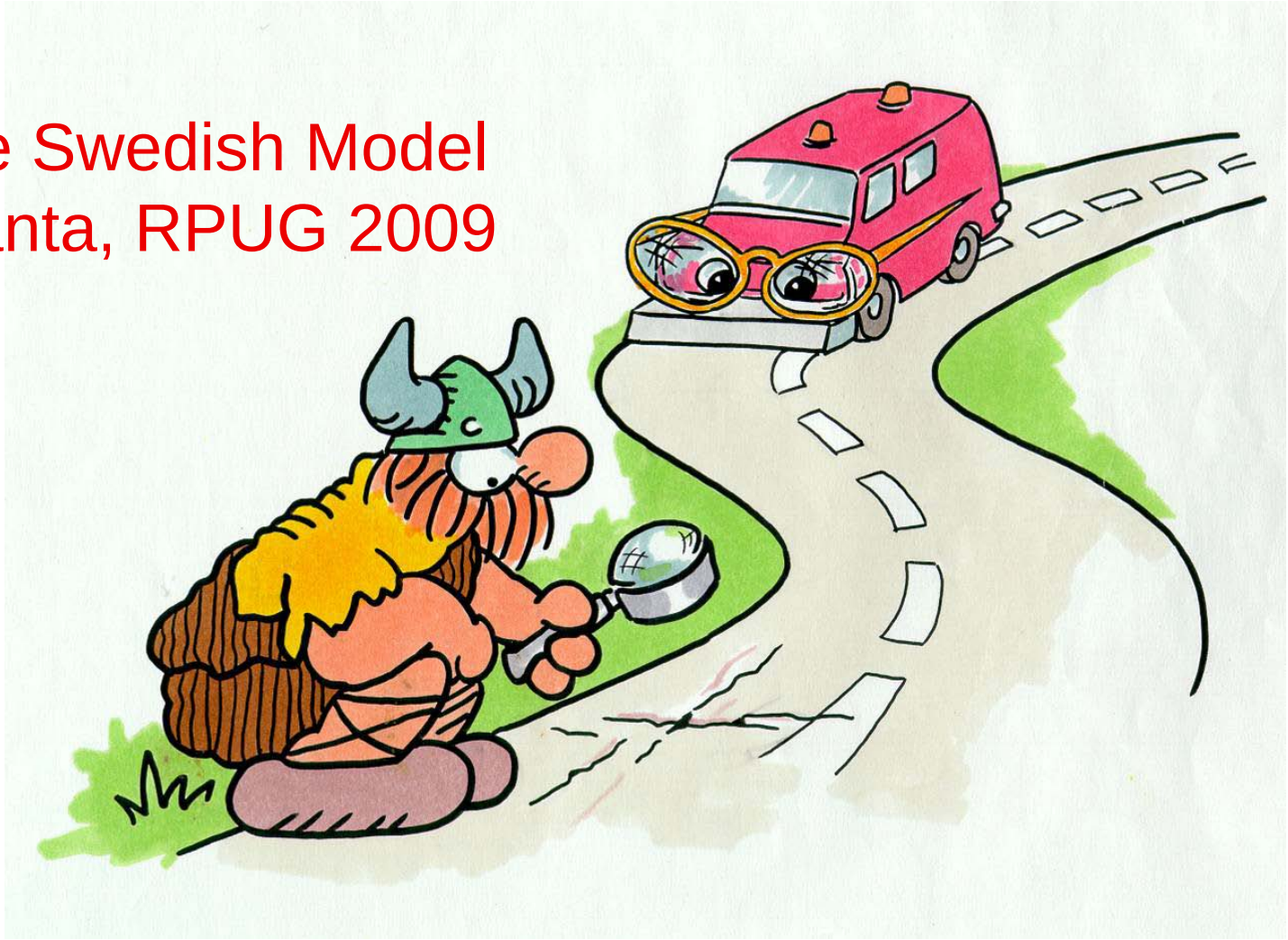
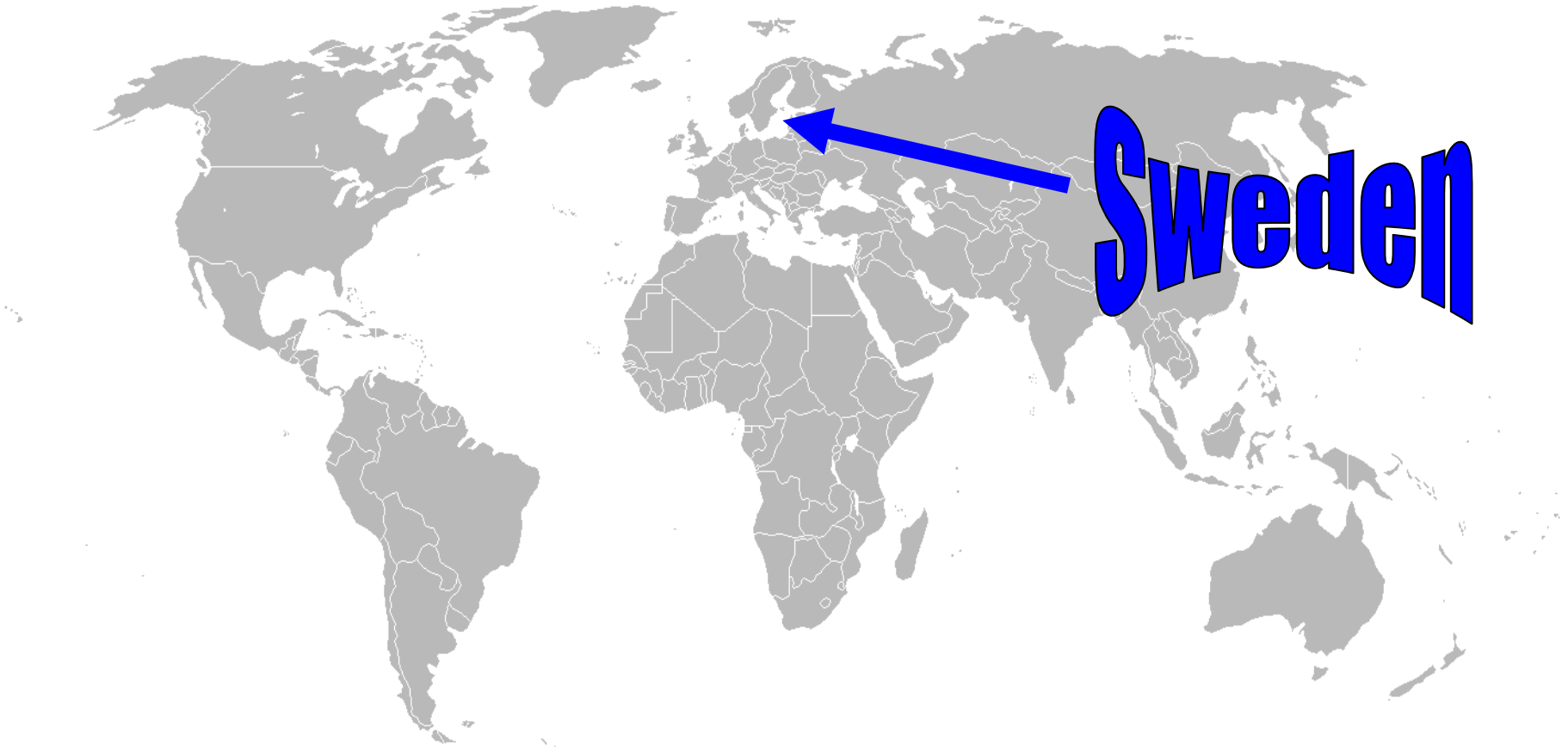
Road Profile Data Quality Control

The Swedish Model
Atlanta, RPUG 2009



Road Profile Data Quality Control



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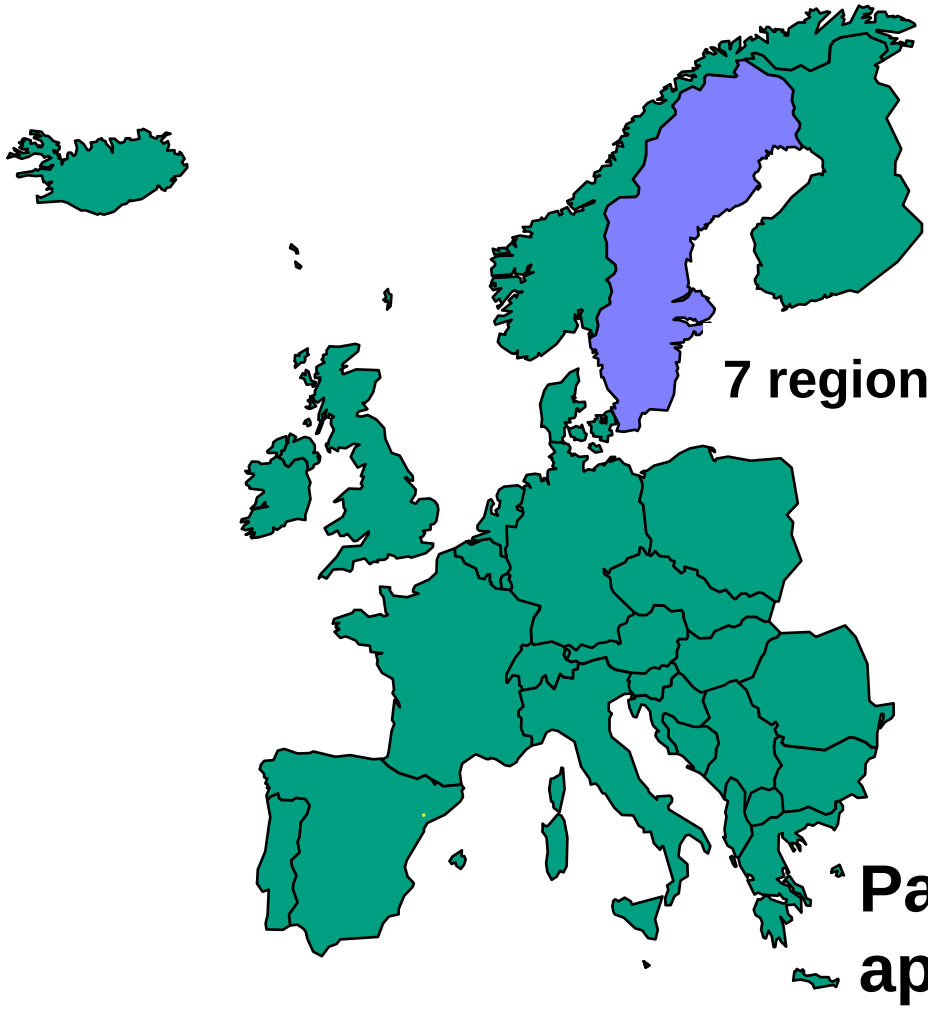
Europe and Sweden



7 regions + main office

Pavement management budget app. 300 million Euro

Sweden

Sweden:

- **Land area:**

  450 000 km^2 (major variations in the density of population)

- **Population:**

  9 million people

- **2000 km north to south (major variations in climate conditions)**

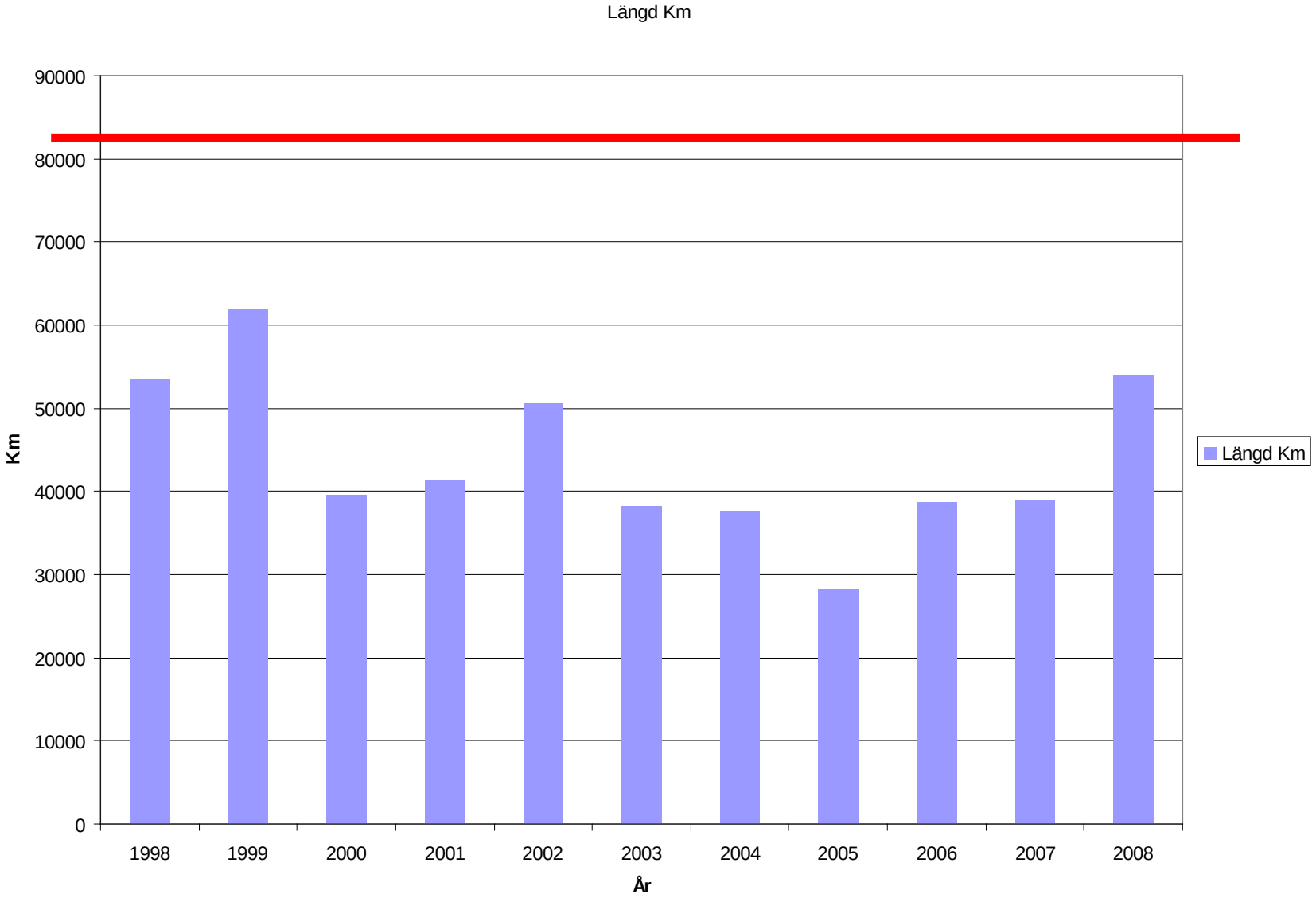
Swedish roads:

- **100 000 km state roads**
- **40 000 km local (communal) roads**
- **300 000 km private roads (1/4 with state subsidies)**

Road surface monitoring in Sweden

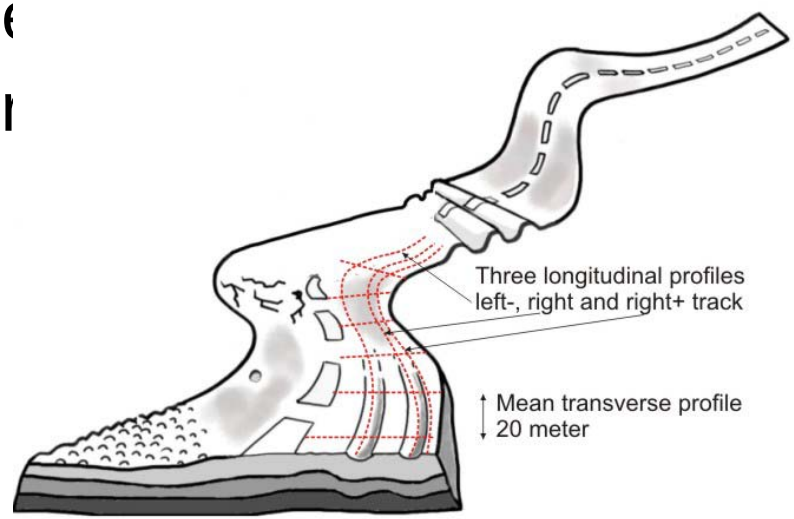
- Road surface monitoring of the state network has regularly been conducted since 1987
- The monitoring service was outsourced 1996 and the first procurement was done.
- Since then a new procurement and control has been done 2000, 2004 and now 2009.

Lane kilometers measured

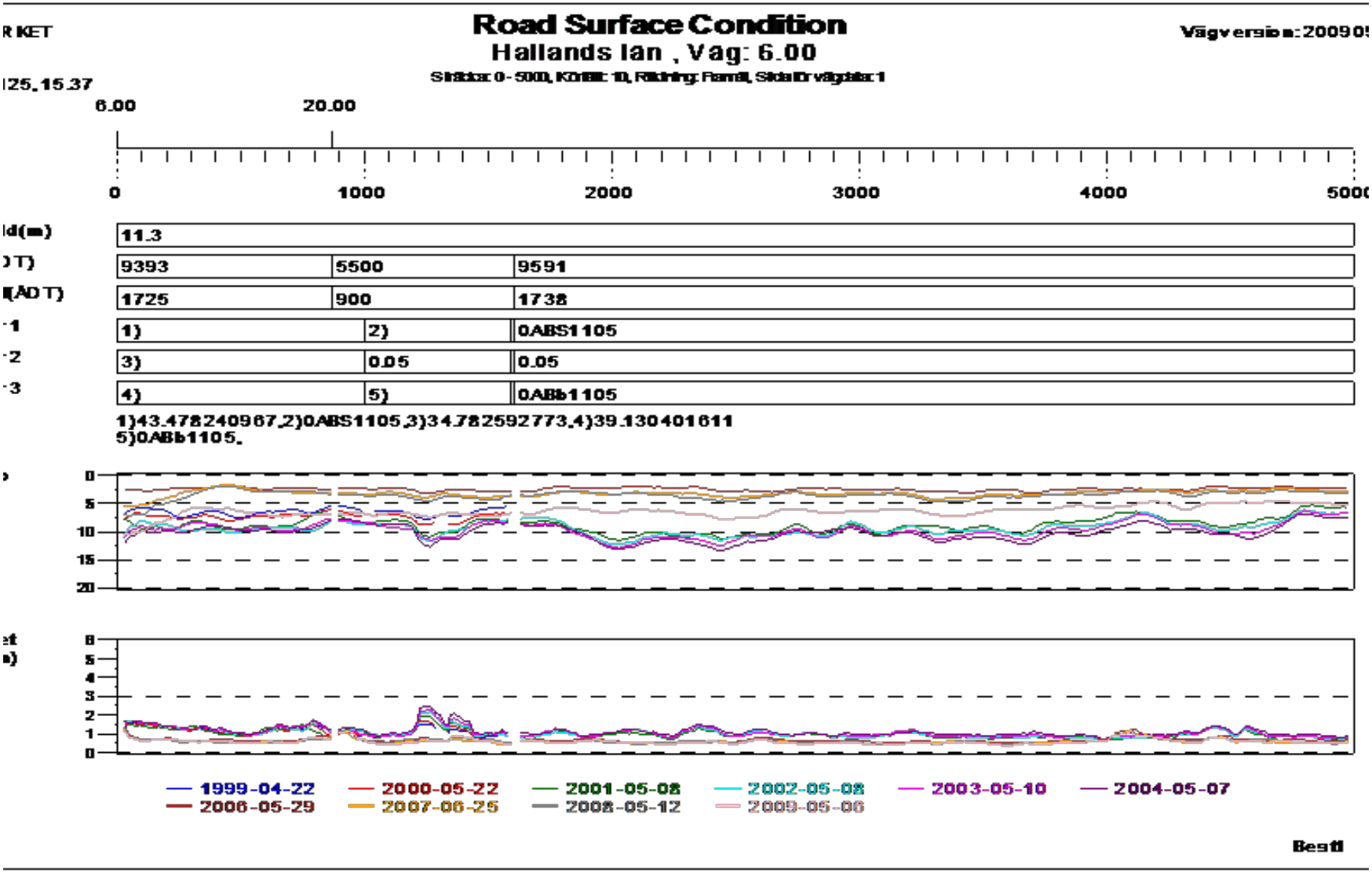


Main parameters

- Three longitudinal profiles (0.1 meter)
- Transverse profile (1 meter)
- Rut depth, max, left and right (20 meter)
- IRI, left and right (20 meter)
- Macrotexture, MPD in three tracks (1 meter)
- Megatexture, two tracks (1 me
- Curvature, Hilliness (20 meter
- Crossfall (1 meter)
- Digital images (20 meter)



A graphic view from the PMS



Road surface monitoring quality

The purpose and use of road surface monitoring data:

- Data to support pavement management system
- Performance control e.g. at new constructions
- Active monitoring during road construction and maintenance
- Research purposes, e.g. studies of maintenance effects from different actions or budget levels

A need to know the quality of the delivered data!

Road surface monitoring quality

» We need to have an established long term (sustainable) and absolute accuracy on all indicators!

1. They are used to make decisions (allocate budget) to reach agreed road standard including safety, emissions and accessibility levels. Societal economics
2. Performance control, Commercial economics

The main monitoring difficulties

- Measure and position amounts of data, maybe 100-200 km per day and vehicle
- Operator skills; repeat the same road line
- Deliver data in time
- Internal control functions, only deliver reliable data
- Data formats

Different levels of quality control

- **Sensor control**

The accuracy of a sensor e.g. laser sensor

- **Application control**

The ability to measure e.g. rut depth

- **Total function control**

The ability to deliver the relevant and reliable data in time.

Total function control

Total function control includes a combination of application control and additional tests.

Additional tests are

» *Reproducibility accuracy*

the accuracy of different equipment of the same type and different operator teams

» *Repeatability accuracy on road network*

This test includes the ability to measure large amounts of road surface characteristics from extensive road net work and process and delivery the result in time

Overview of quality tests
Road Surface Monitoring Services

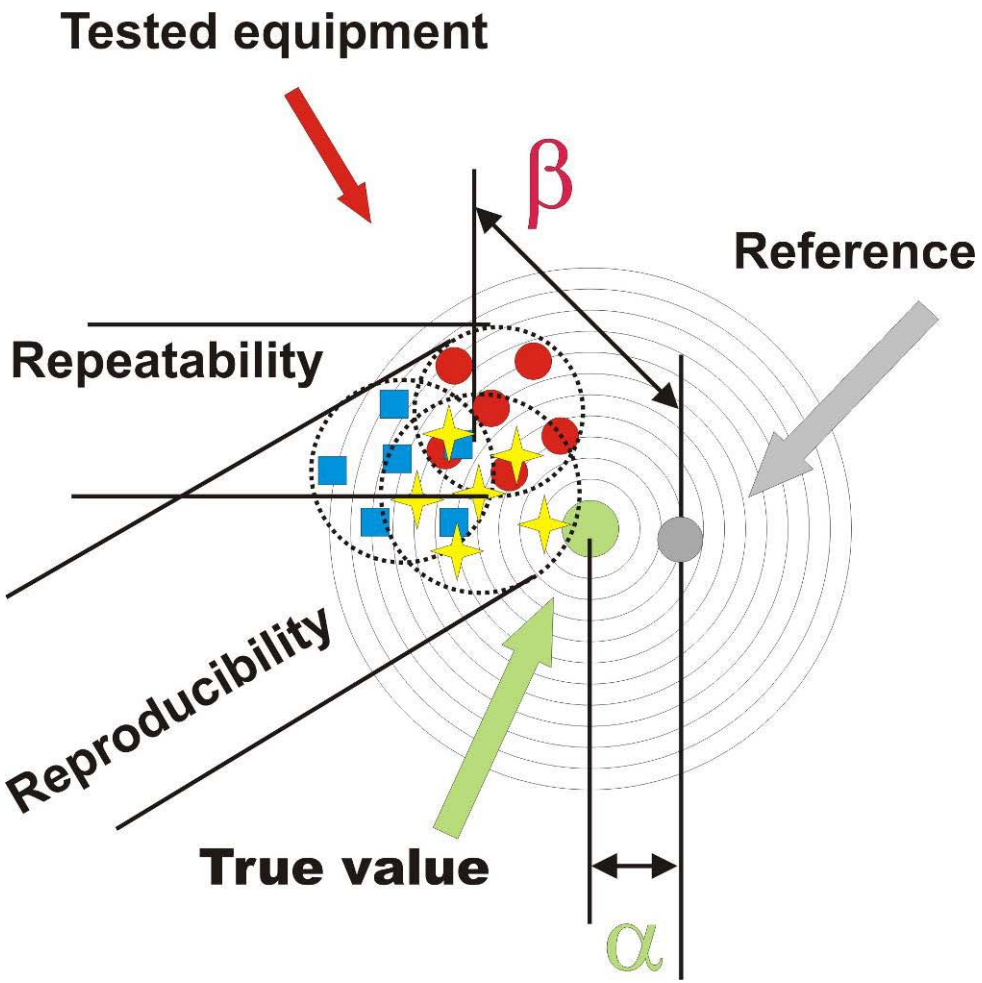
- Qualified to take part in procurement process
- Control during the contract period (4 years)

Procurement process, Technical tests

- Comparisons tests on special sections against reference device
- Object performance control
- Extensive road network measurements

•During the contract period control measurements are done. 5% has to be re-measured!

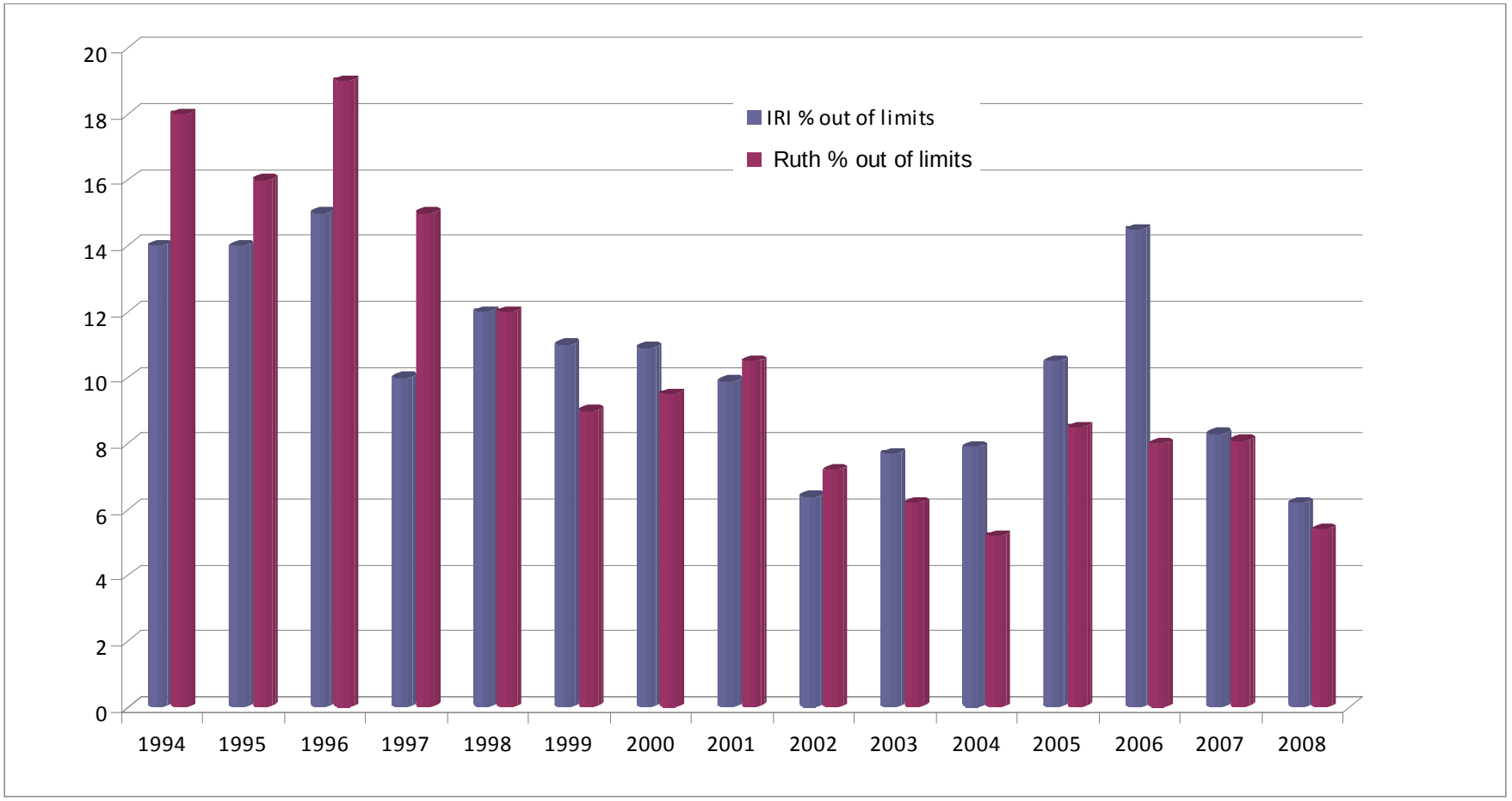
Quality factors



- Post processing
- Data format
- Internal check
- Data delivery

Successful concept!

Results from control measurements during contract period



Test sections, 2009

» Road Network, 4 Routes ➔1500 km

One route 5 runs, the other routes twice with cross wise changing of operators and vehicle

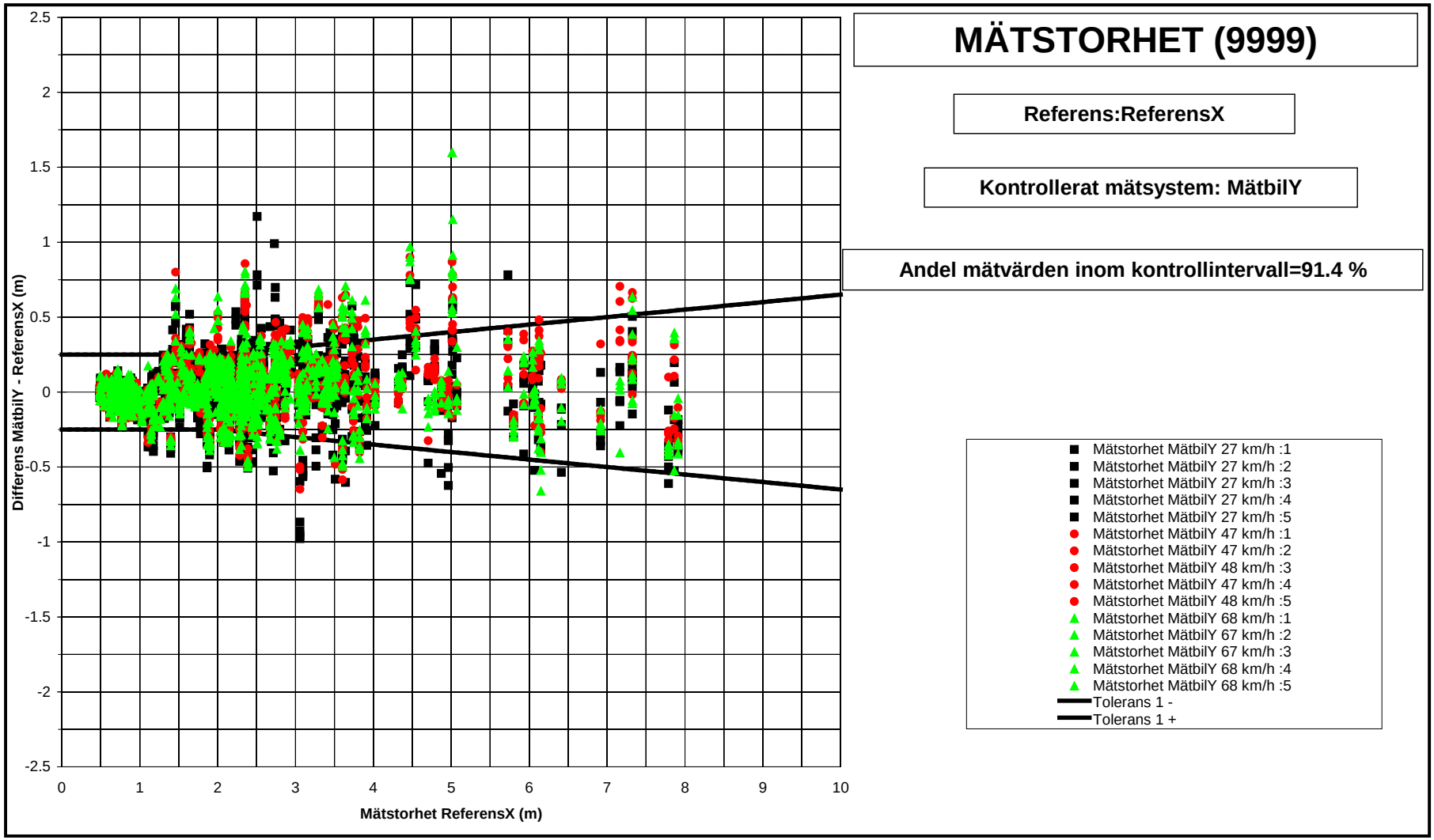
Six test sites (800-1200 and 20-100 meter)

Each site should be measured 5 times in three speeds (30, 50 and 70 km/h)

Three additional sites for crack measurements

Two sections for performance control

The assessment method



Control during the contract period

- 5% has to be re-measured with different operators and measurement vehicle.
- All measured parameters are controlled.
- The data is compared on 400 meters averages values.

Control during the contract period

All parameters

» Systematic errors (Control-Production)

» Repeatability, correlation (Linear regression)

» Within limits (+- band limits)

Longitudinal profile

» Longitudinal alignment until maximum correlation

» Correlation

» Production standard deviation/Control standard deviation

Laser RST, Profilograph

Reference method
Volvo TVP, cross profile and cross fall

Reference method

The Primal, longitudinal profile

Reference method
rod and level support for hilliness, curvature and longitudinal profile

Reference method

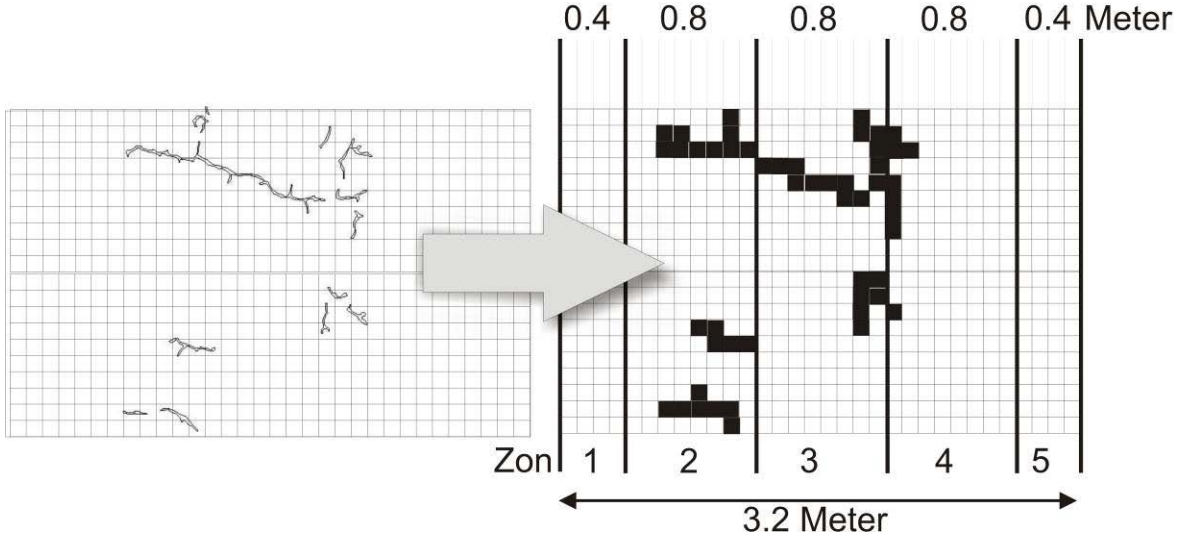
Detailed positioning with GPS

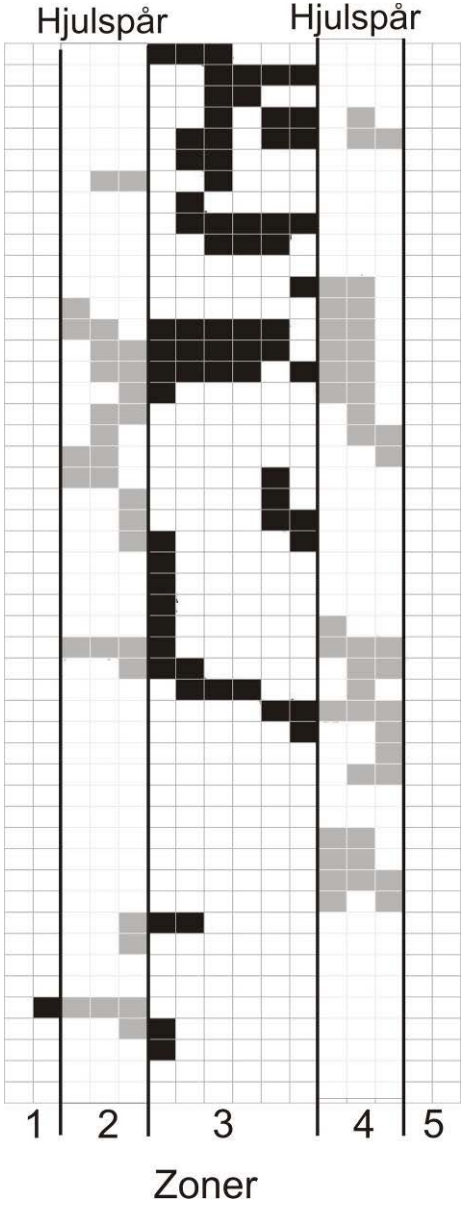
Crack measurement reference

Crack indicator

One square is 0.1*0.1 meter. If a crack is detected inside the square it turns black.

The indicator is:
Percentage black squares per 20 meter road in 5 zones, 2 outside ruts, 2 in ruts and 1 between ruts





Crack measurement systems in Sweden

Thank you for your attention!