



# INTRODUCTION TO SEMS

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9<sup>th</sup> UCR PEMS Conference and Workshop

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**HORIBA**

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# Introduction to SEMS

## Agenda

- Purpose
- History & Cooperation
- Hardware
- Services
- Comparisons
- Summary



# PURPOSE

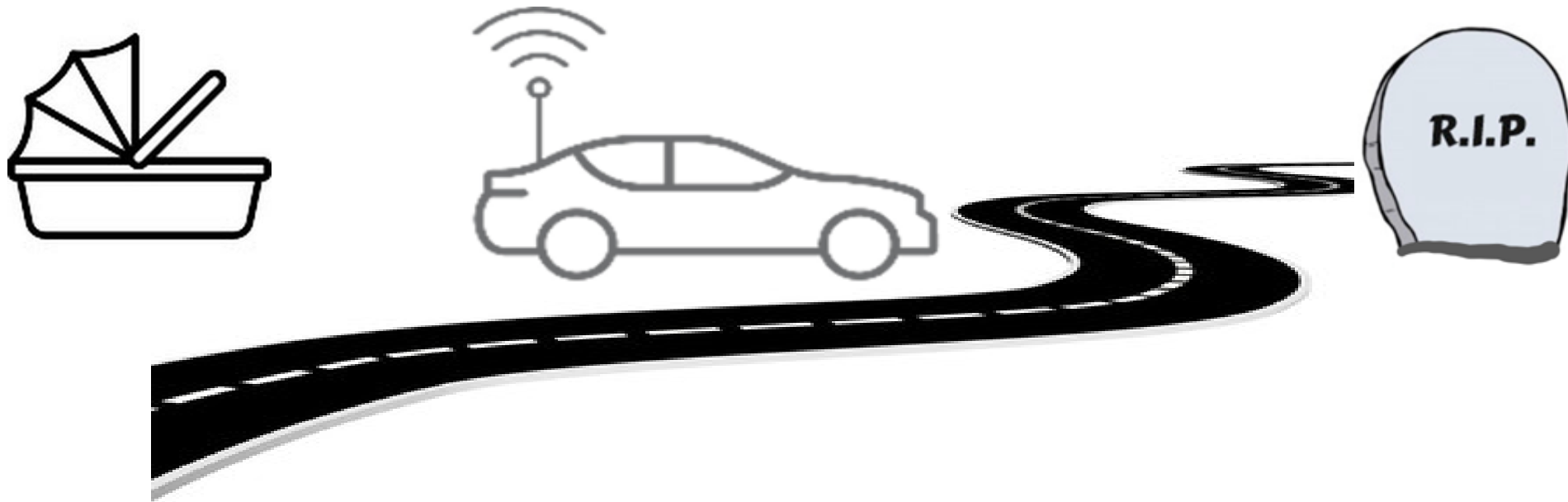
# SEMS: Purpose

Realize of Cradle to Grave Capability

From the first trip...

over the entire life...

until the last trip



# SEMS: Purpose

Additional Real World Emission Data

## Real World Measurement

**SEMS**  
Smart Emissions Measurement System

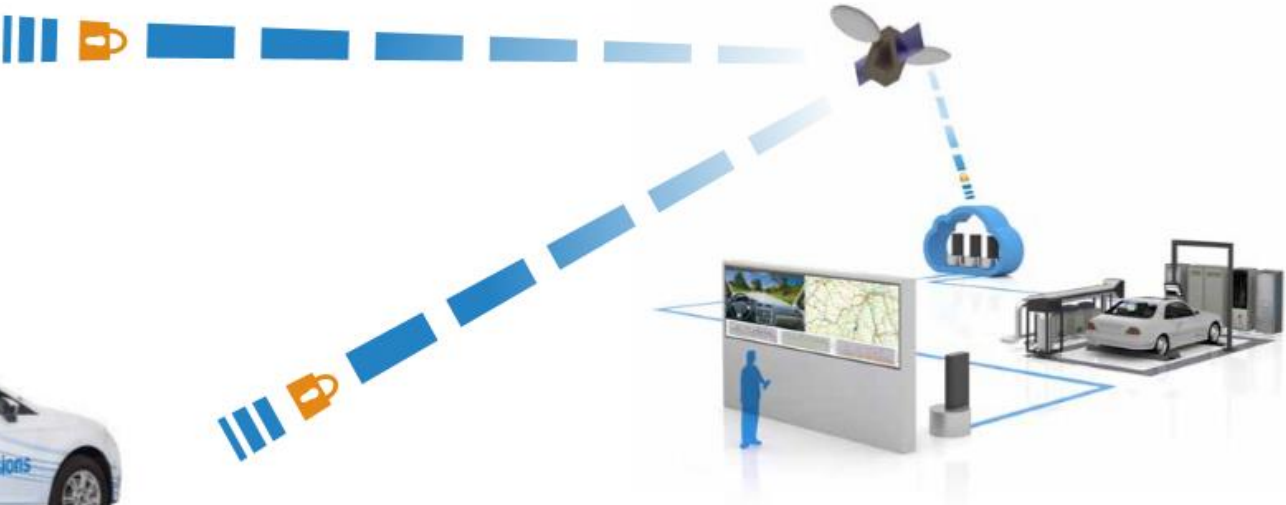


**OBS-ONE**  
On-Board Emissions Measurement System



## Lab Management

**STARS ENTERPRISE**  
The Next Generation Enterprise Lab Management



# HISTORY AND COOPERATION

# SEMS: History and Cooperation

2012

2018 cooperation

Future

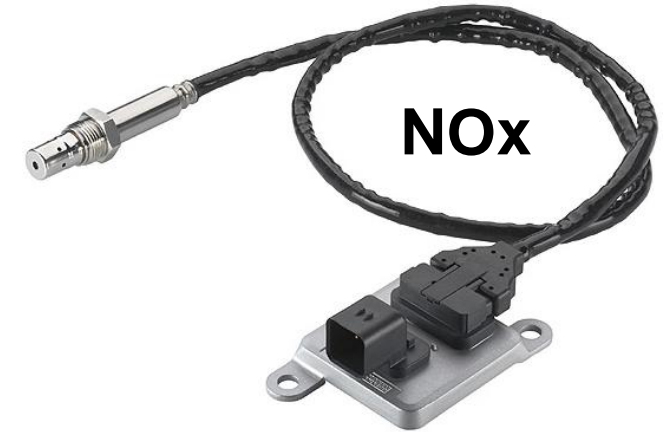


# HARDWARE



# SEMS: Hardware Integration

Commercially Available Industrial and Automotive Hardware Components



# SEMS: Hardware Integration

## Sensors

Tailpipe Extention



PEMS Method

Integrated on Vehicle



Preferred Solution



# SEMS: Hardware Integration

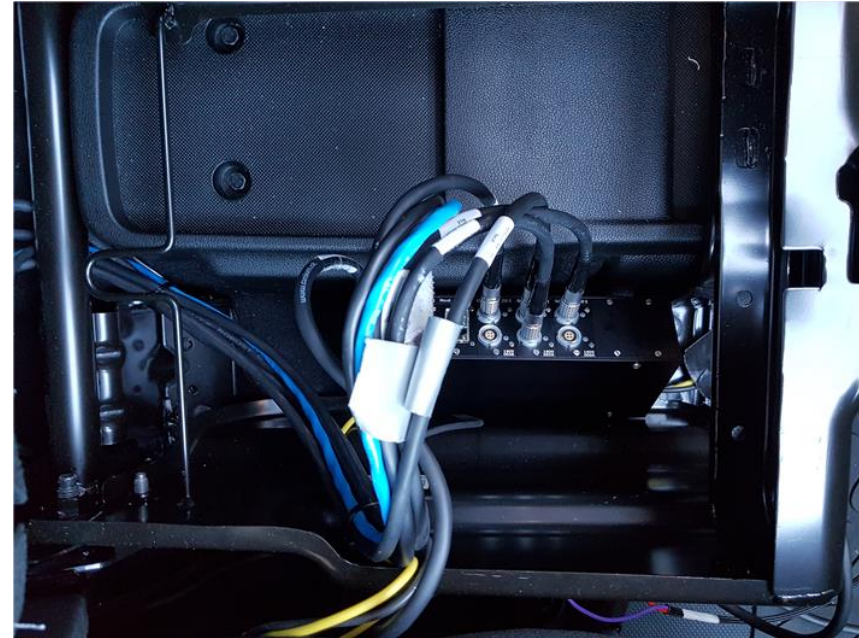
## Datalogger and Mobile Device

### Quick Installation



### Short Test Durations

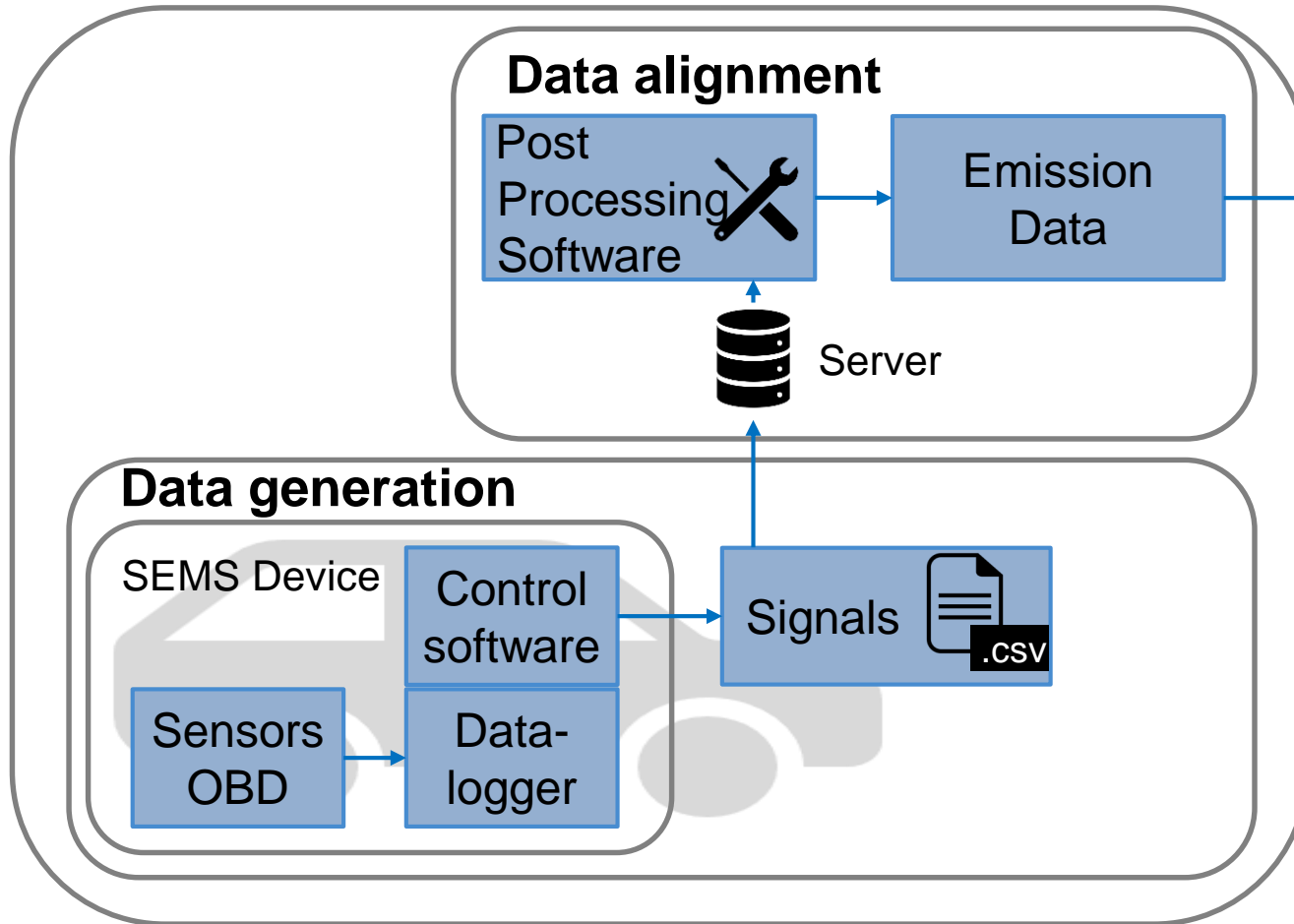
### Integrated Installation



### Long Test Durations

# SEMS: Structure

## Basic Assemblies



## SEMS Services – „The product“

### Emission data

- Emission



### Data analysis

- Graphical representation
- Database generation
- Analysis

### Data related consulting

- Strategic
- Technical
- Business

# APPLICATION AND SERVICES

# SEMS: Application and Services

SEMS Application Available on the STARS ENTERPRISE Platform

The screenshot shows a web browser window with the URL <https://172.30.128.180>. The page displays the HORIBA STARS ENTERPRISE logo and a navigation menu with four icons: RESOURCES, RESULTS, USERS, and SEMS. A grey box with the text "SEMS App in ENTERPRISE Suite" and an upward-pointing arrow is positioned below the SEMS icon. The footer of the page contains the copyright notice "© 2018 HORIBA Test Automation Ltd. All rights reserved." and the HORIBA logo. The Windows taskbar at the bottom shows the search bar and various application icons.

# SEMS: Application and Services

## Test Data Files in a Global Database

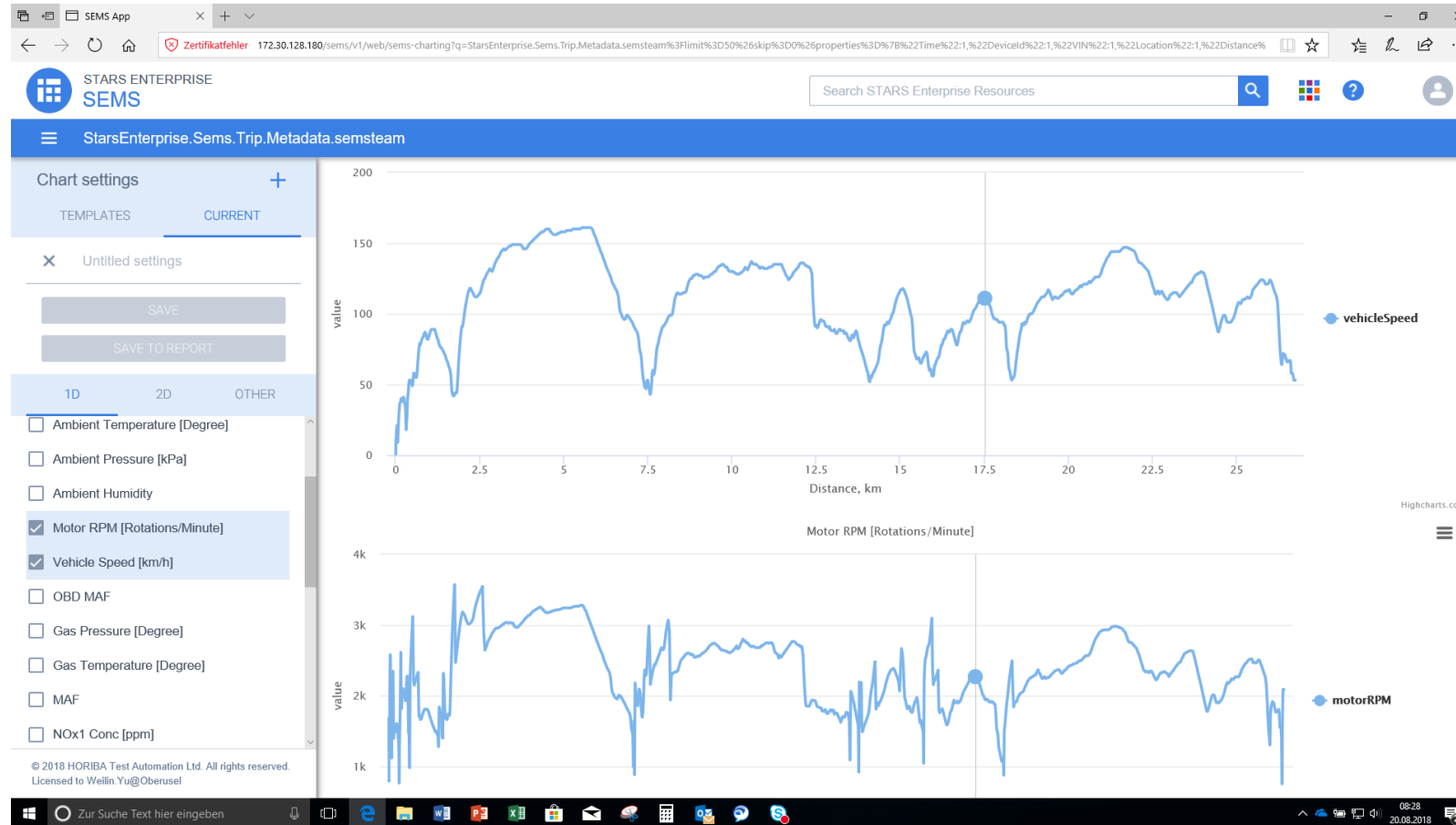
The screenshot shows the SEMS application interface. The browser address bar displays the URL: `172.30.128.180/sems/v1/web/?q=StarsEnterprise.Sems.Trip.Metadata.semsteam%3Flimit%3D50%26skip%3D0%26properties%3D%7B%22Time%22%2C%22DeviceId%22%2C%22VIN%22%2C%22Location%22%2C%22Distance%22%2C%22Durat`. The application header includes the SEMS logo and a search bar. The main content area features a table with the following columns: Type, Time, DeviceId, VIN, Location, and Distance [km]. The table contains 20 rows of data, including trip information for CustomA and semsteam users. A sidebar on the left provides navigation options for user-specific trip info. A watermark 'Access by users' is overlaid on the sidebar area.

Type	Time	DeviceId	VIN	Location	Distance [km]
[Icon]	14.8.2018 17:01:51	001	VF77BBHY6HJ823536	Oberursel - Ober-Mörlen ...	26,744
[Icon]	14.8.2018 17:01:51	001	VF77BBHY6HJ823536	Oberursel - Ober-Mörlen ...	26,744
[Icon]	2.8.2018 06:20:01	001	VF77BBHY6HJ823536-Part2	Butzbach - Oberursel - Ro...	31,471
[Icon]	15.8.2018 05:56:31	001	VF77BBHY6HJ823536	Wetzlar - Butzbach - Linden	26,334
[Icon]	14.8.2018 17:01:51	001	VF77BBHY6HJ823536	Oberursel - Ober-Mörlen ...	26,744
[Icon]	15.8.2018 06:41:55	001	VF77BBHY6HJ823536	Oberursel	3,443
[Icon]	15.8.2018 06:57:35	001	VF77BBHY6HJ823536	Oberursel	3,487
[Icon]	13.8.2018 16:11:36	001	Rollertest-Phase1	Oberursel	3,045
[Icon]	13.8.2018 16:11:36	001	Rollertest-Phase2	Oberursel	4,736
[Icon]	13.8.2018 16:11:36	001	Rollertest-Phase4	Oberursel	8,846
[Icon]	13.8.2018 16:11:36	001	Rollertest-Phase3	Oberursel	6,563
[Icon]	13.8.2018 16:11:36	001	VF77BBHY6HJ823536	Oberursel	7,453
[Icon]	13.8.2018 16:28:16	001	VF77BBHY6HJ823536	Oberursel	16,361
[Icon]	6.8.2018 10:25:46	001	VF77BBHY6HJ823536	Waldsolms - Usingen - But...	15,394
[Icon]	2.8.2018 08:02:21	001	VF77BBHY6HJ823536	Butzbach - Oberursel - Ro...	31,471
[Icon]	2.8.2018 08:19:01	001	VF77BBHY6HJ823536	Butzbach - Oberursel - Ro...	31,471
[Icon]	2.8.2018 09:47:29	001	VF77BBHY6HJ823536	Oberursel	3,262
[Icon]	2.8.2018 09:36:03	001	VF77BBHY6HJ823536	Oberursel	3,427

All data files collected globally

# SEMS: Application and Services

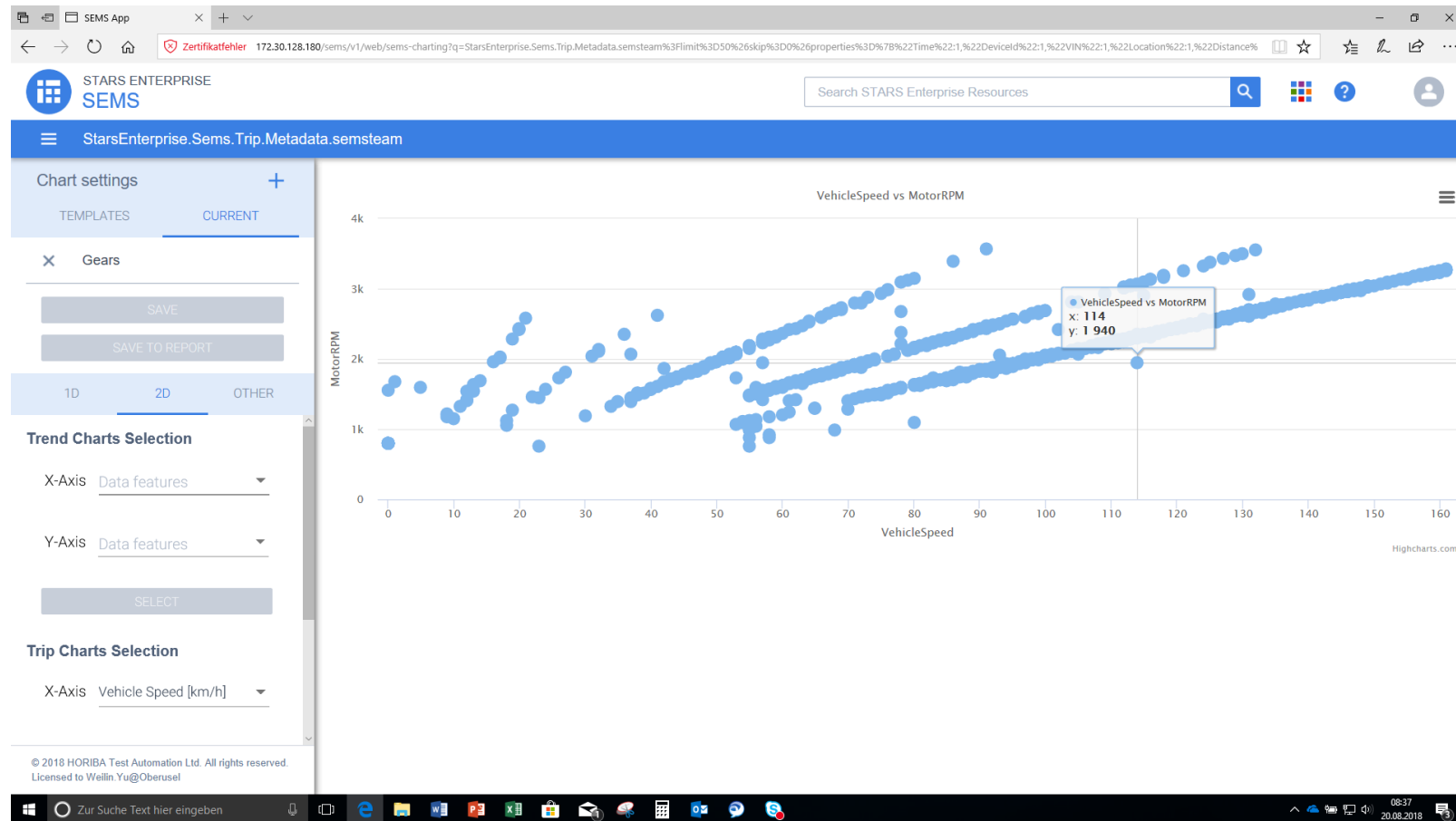
## One Dimensional Charts





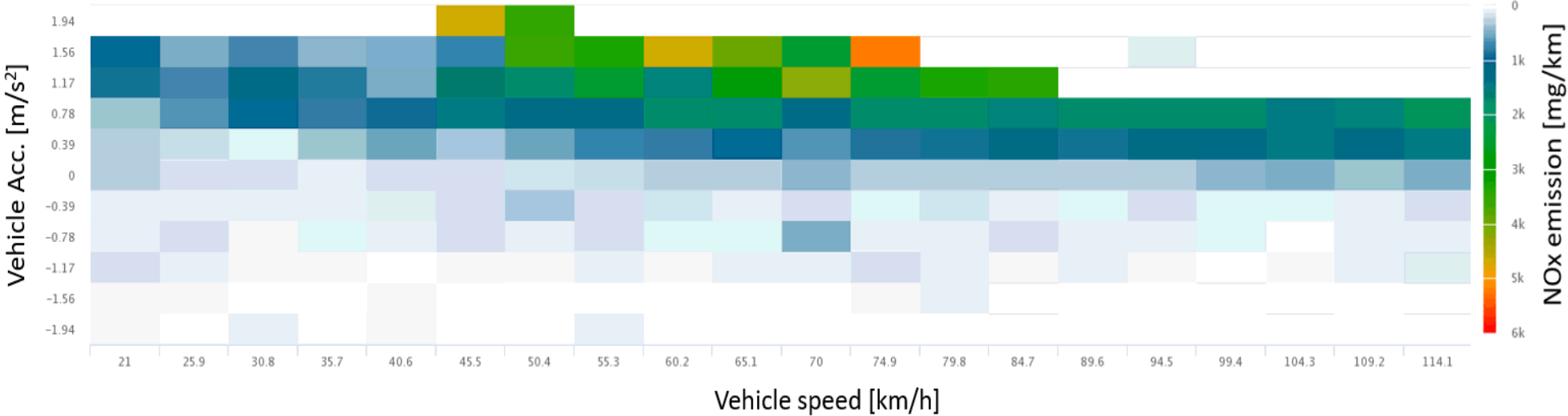
# SEMS: Application and Services

## Two Dimensional Charts



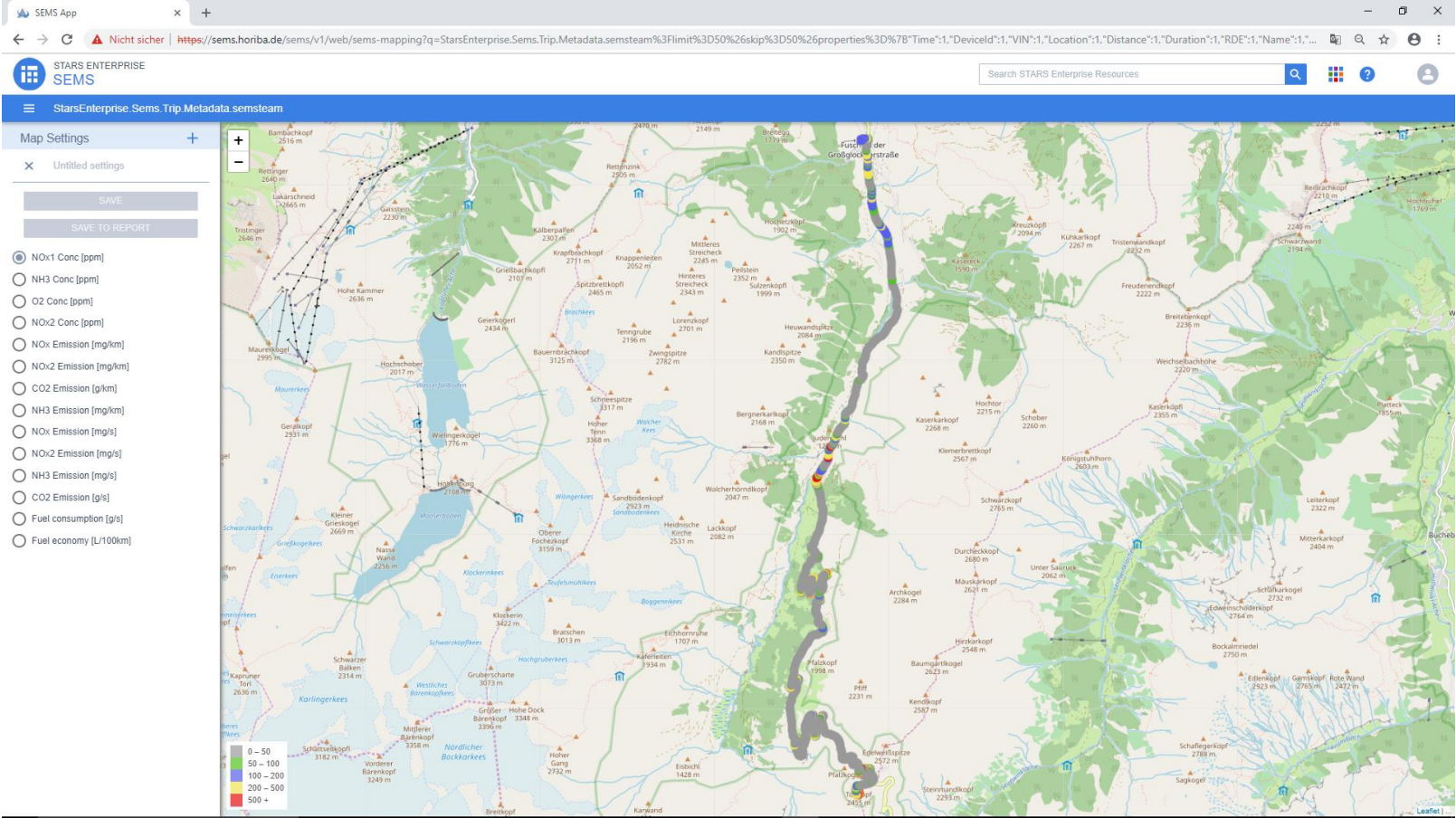
# SEMS: Application and Services

## Three Dimensional Chart



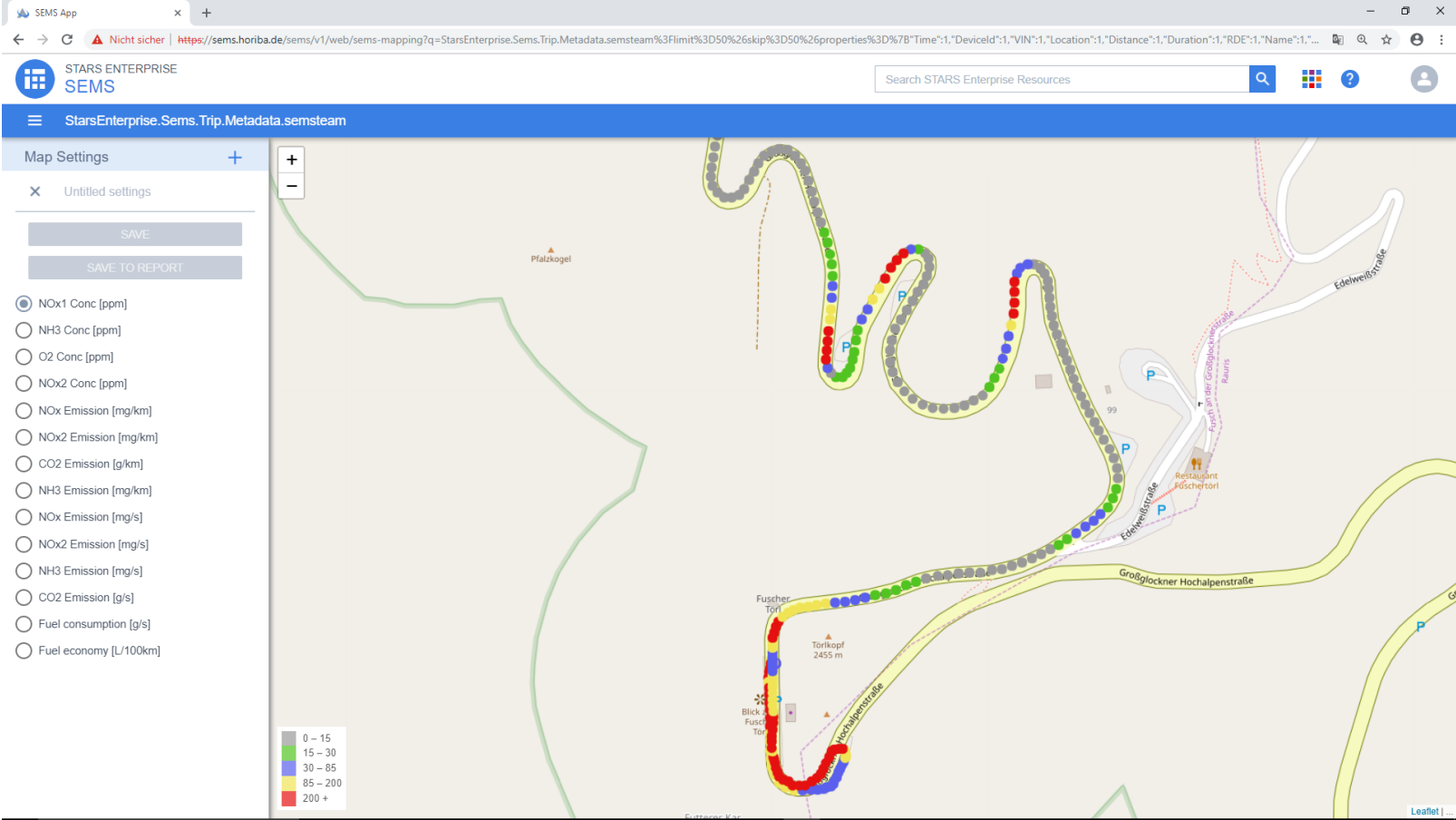
# SEMS: Application and Services

## Individual Trip Maps



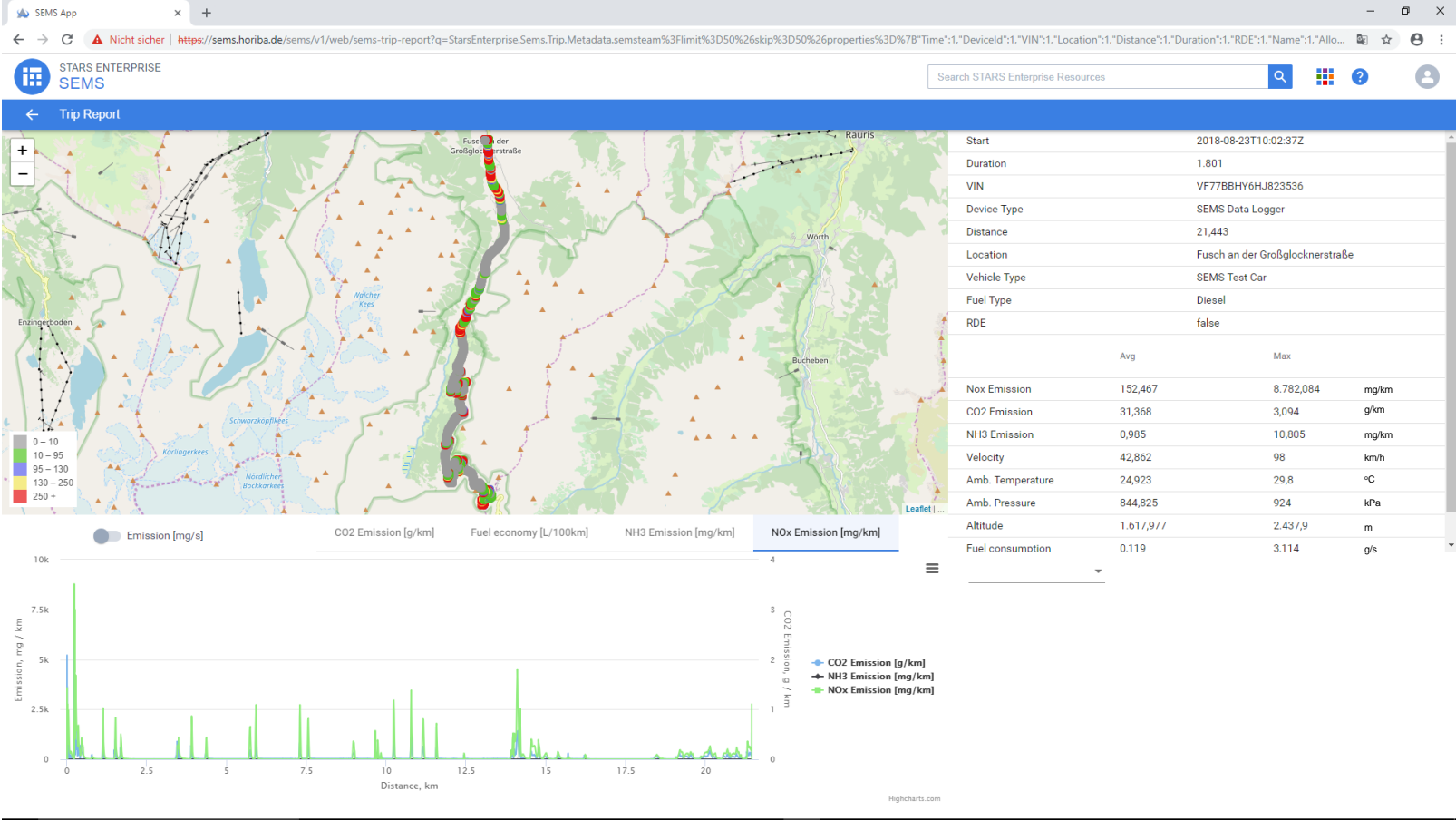
# SEMS: Application and Services

## Zoom and Resolution Feature on Trip Maps



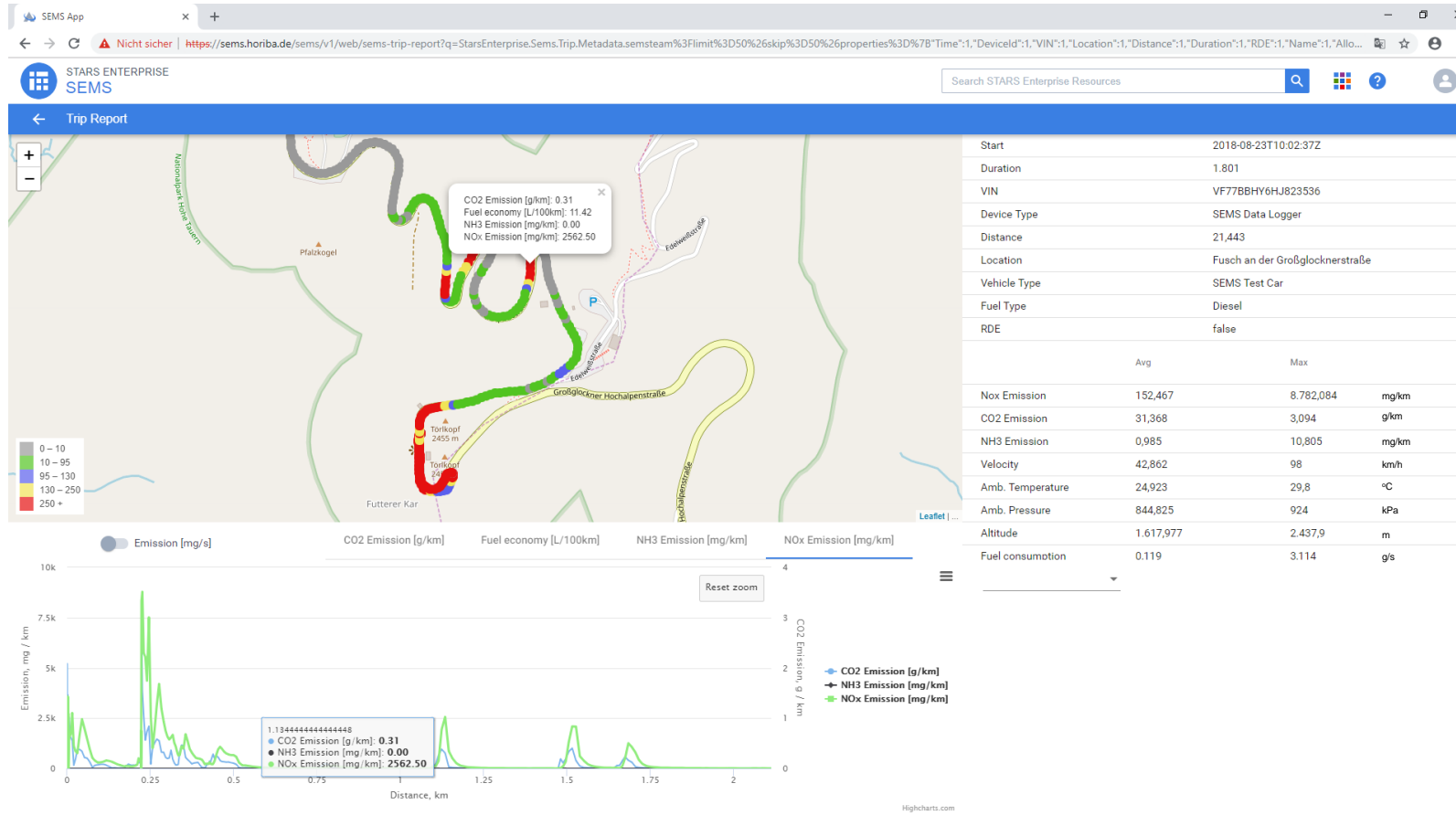
# SEMS: Application and Services

## Trip Report



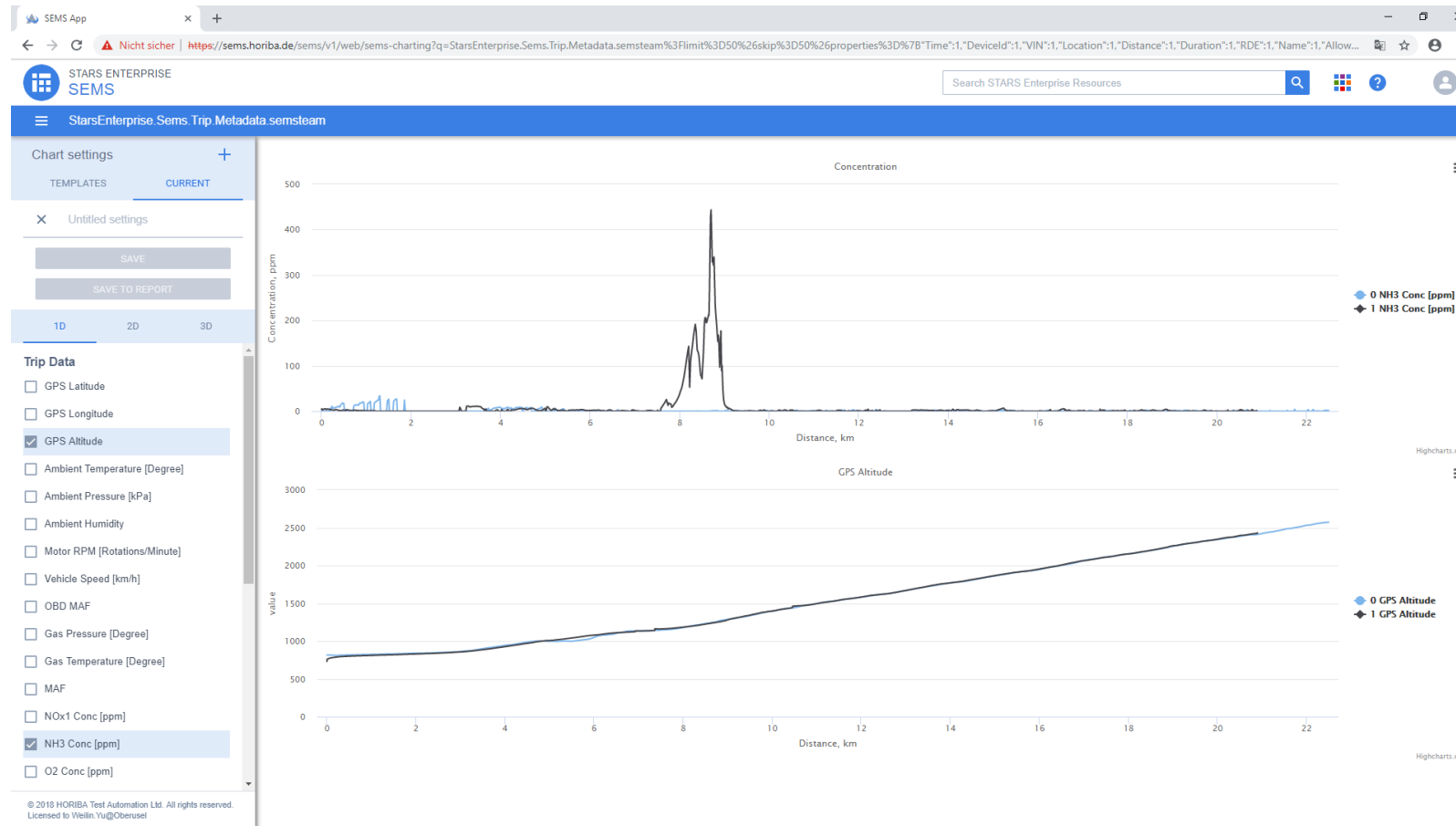
# SEMS: Application and Services

## Trip Report Zoom and Synchronization



# SEMS: Application and Services

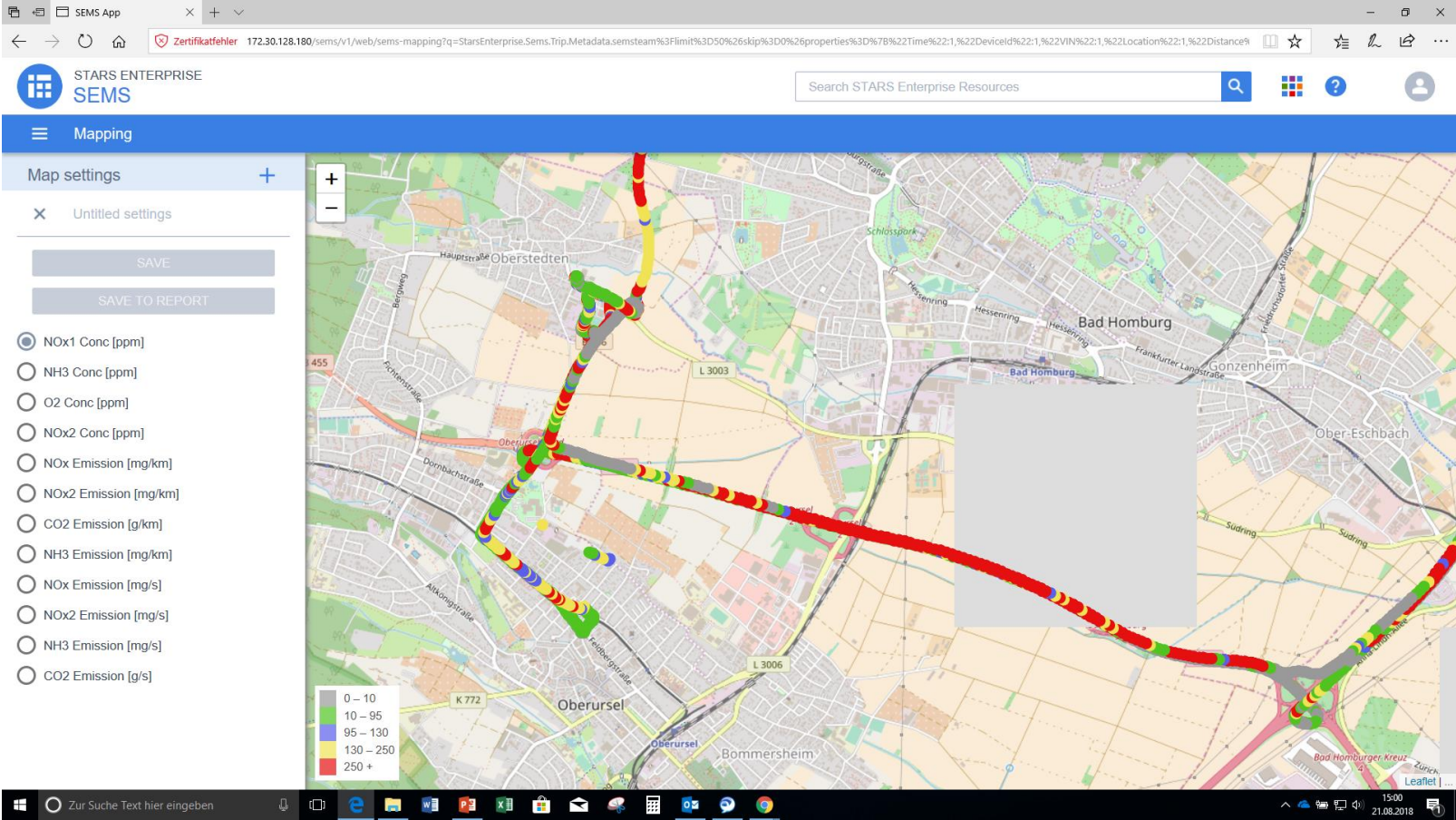
## Multiple Trip Summary





# SEMS: Application and Services

## Multiple Trip Mapping

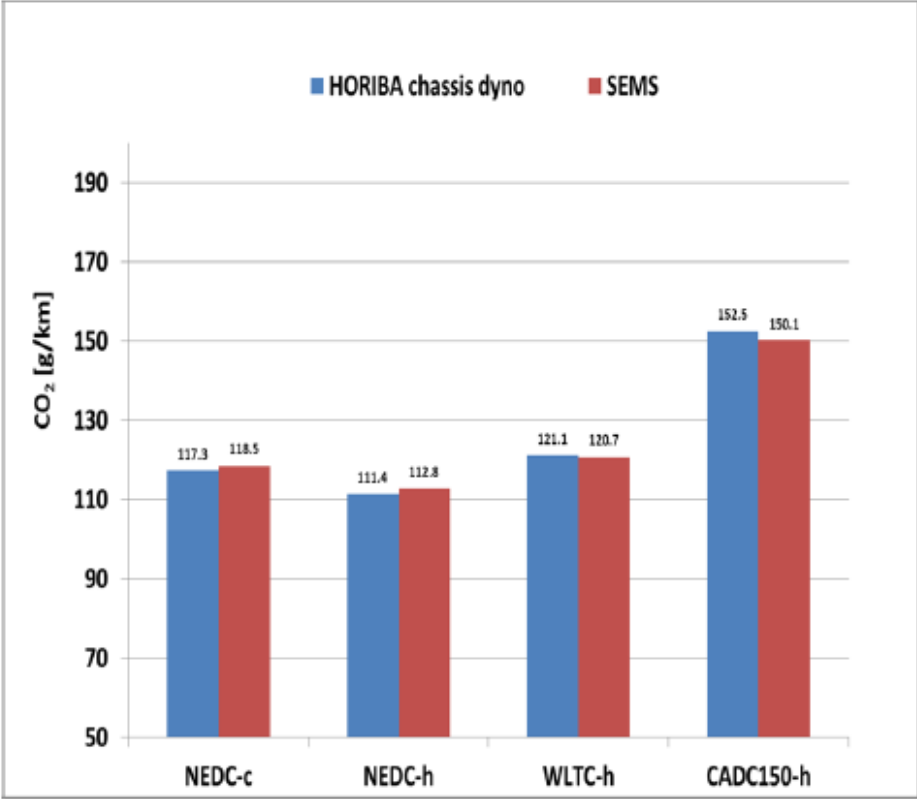




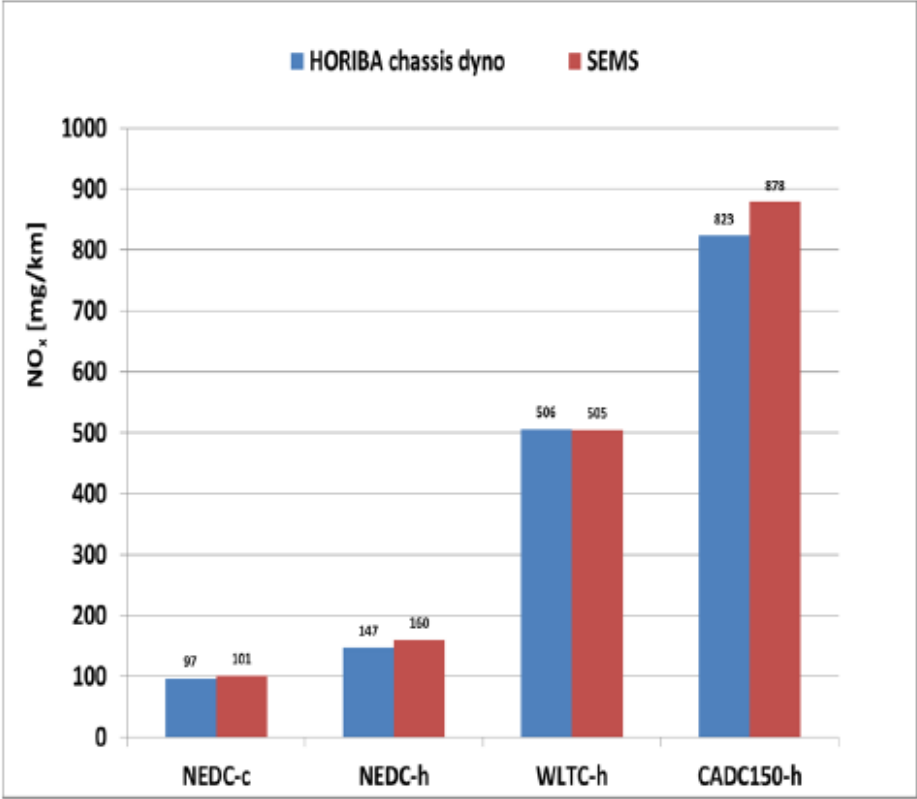
# COMPARISONS

# SEMS: Comparison

## Measurement Accuracy



CO<sub>2</sub> Deviation: – 1.6 to 1.3%



No<sub>x</sub> Deviation: – 0.1 to 8.8%

# SEMS: Comparison

WLTC 3 - Separated into 4 speed cycles

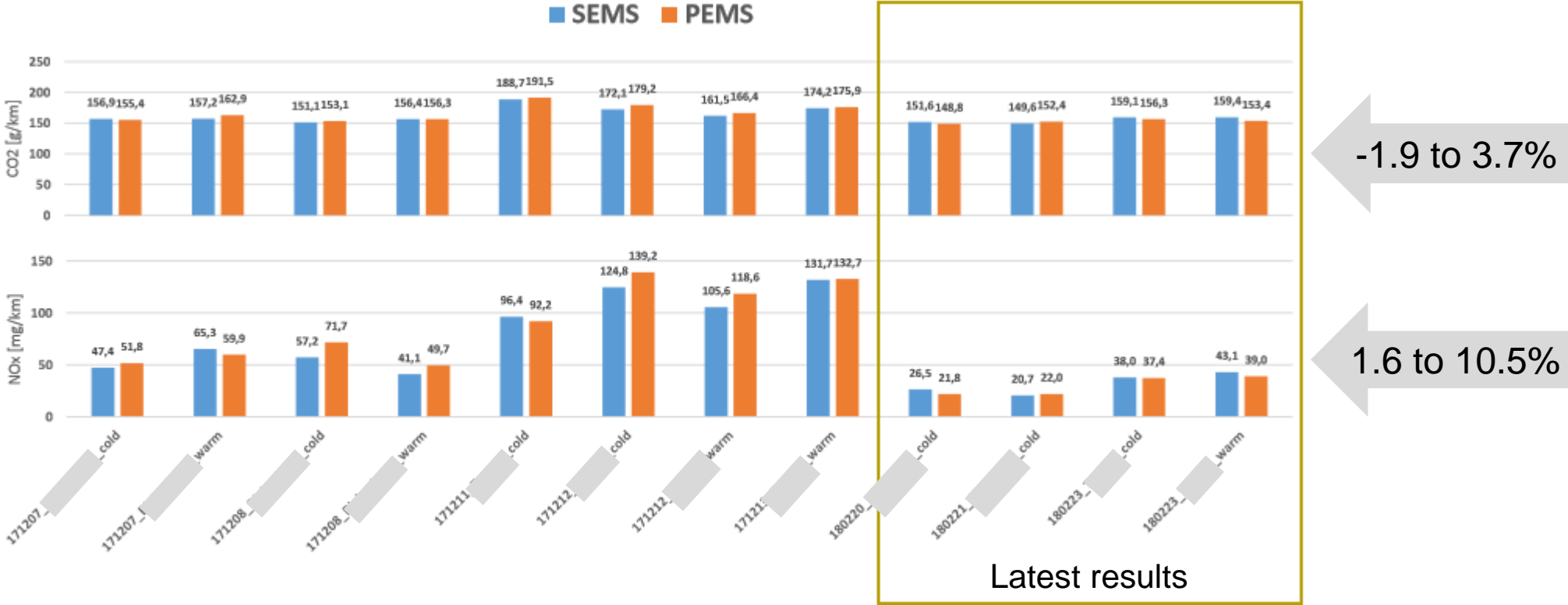
	NOx [mg/km]	CO2 [g/km]	Fuel Economy [l/100km]
WLTC Low-Speed	387.1	181.8	6.9
SEMS Low-Speed	370.5	188.3	6.8
WLTC Medium-Speed	149.9	138.6	5.2
SEMS Medium-Speed	137.6	142.8	5.2
WLTC High-Speed	188.0	134.8	5.1
SEMS High-Speed	176.6	134.3	4.9
WLTC Extra-High-Speed	539.4	182	6.9
SEMS Extra-High-Speed	533.0	182.2	6.6

WLTC-SEMS Deviation	Feb, 20th 2019	Nox - mg/km [%]	CO2 - g/km [%]	Fuel Economy - l/100km [%]
Low-Speed		-4.3	3.6	-1.4
Medium-Speed		-8.3	3.1	0.0
High-Speed		-6.1	-0.4	-3.9
Extra-High-Speed		-1.2	0.1	-4.3
Average		-5.0	1.6	-2.4

WLTC-SEMS Deviation	Feb. 21st 2019	Nox - mg/km [%]	CO2 - g/km [%]	Fuel Economy - l/100km [%]
Low-Speed		-4.5	1.1	-3.0
Medium-Speed		-10.8	-0.3	-3.8
High-Speed		-5.5	-0.5	-5.9
Extra-High-Speed		-2.2	0.0	-2.9
Average		-5.7	0.1	-3.9

# SEMS: Comparison

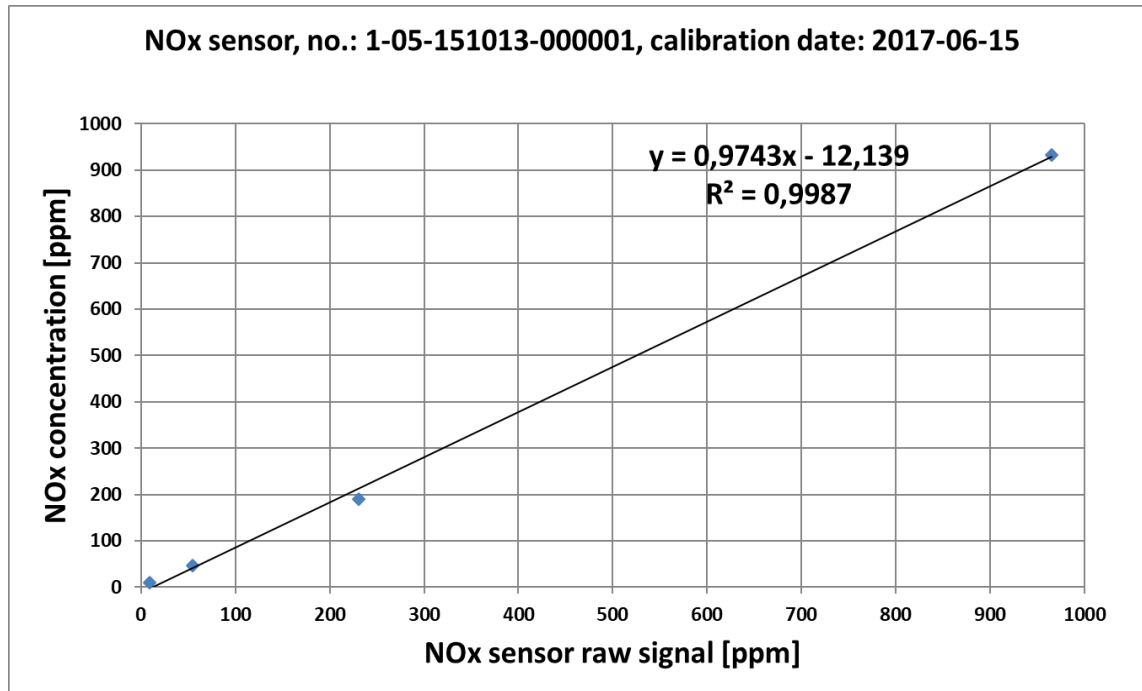
## Comparison to PEMS



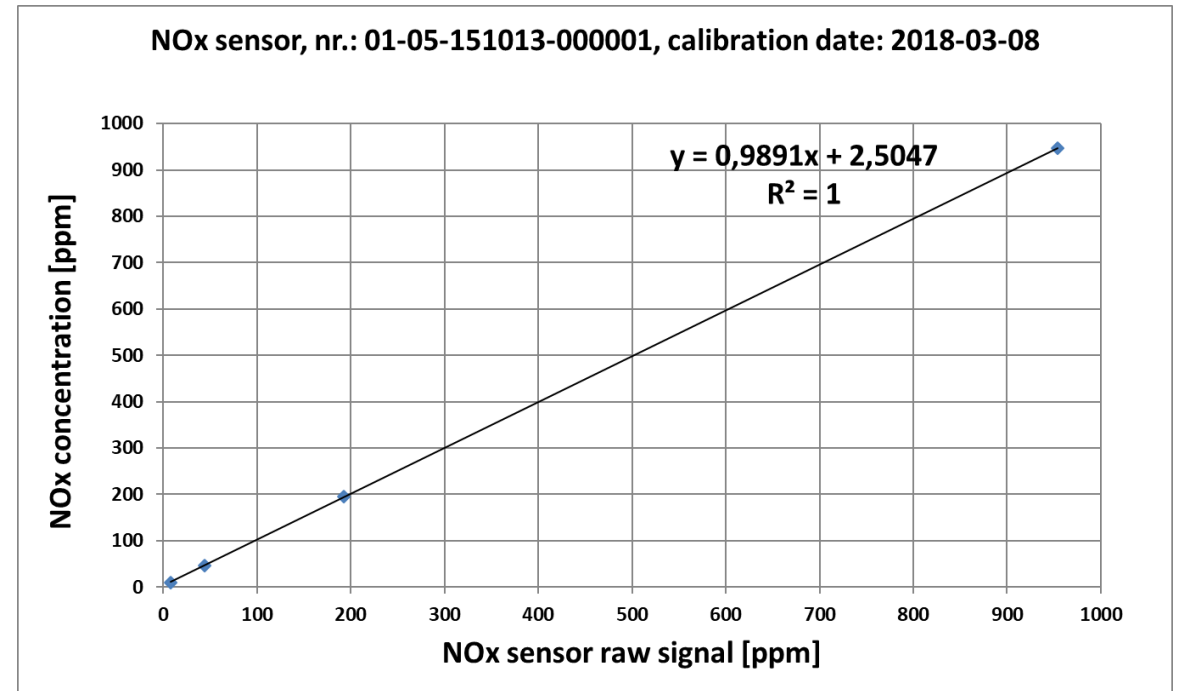
# SEMS: Comparison

## Nox sensor calibration

### NOx calibration June 2017

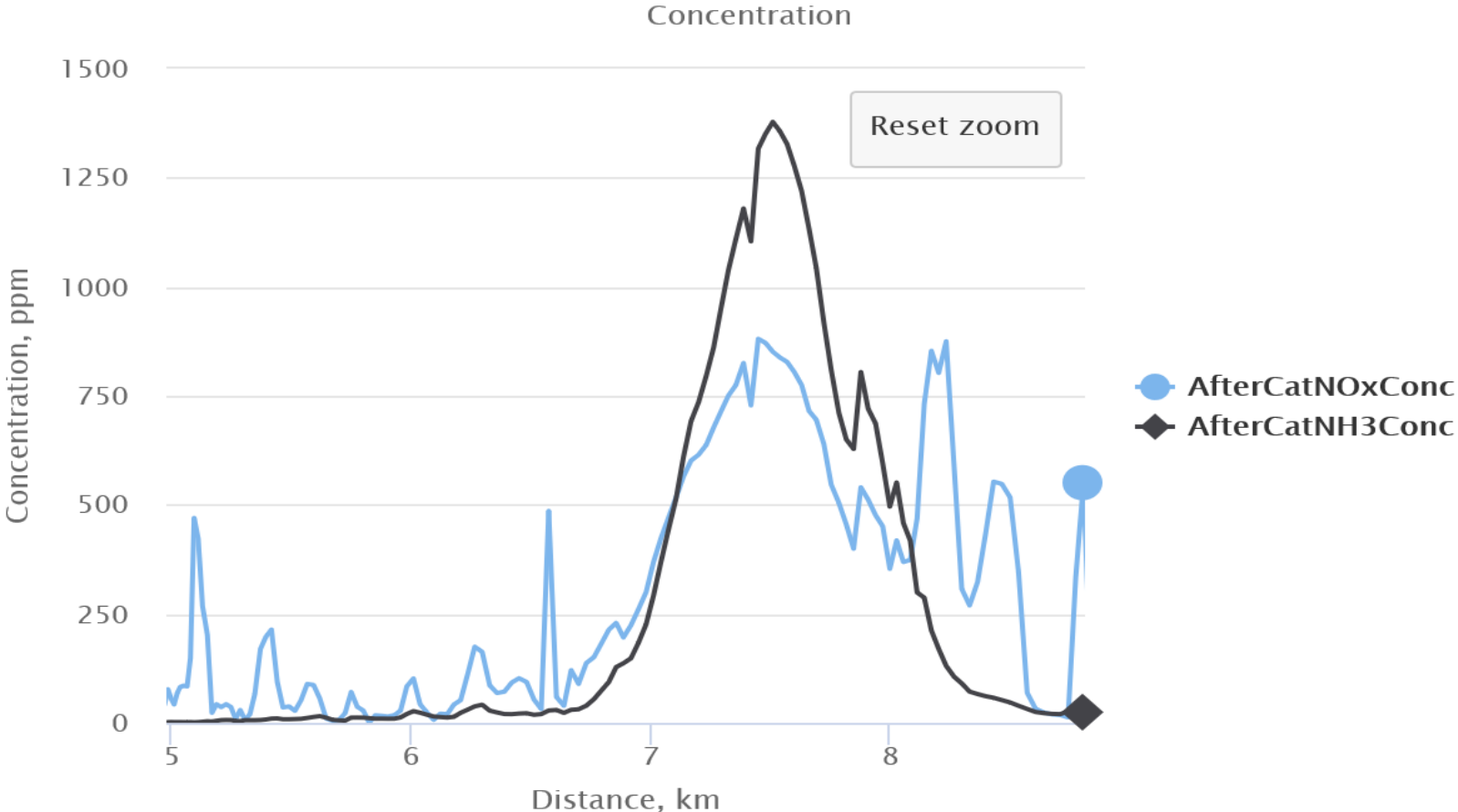


### NOx calibration March 2018



# SEMS: Comparison

Cross-sensitivity of NH3 to NOx



# SUMMARY

# SEMS: Summary

- HORIBA and TNO have developed a more flexible device to meet the increasing demand for RDE and other on-road or on-vehicle testing
- SEMS can be utilized as a screening tool for real driving emissions and is able to accommodate larger vehicle populations than PEMS
  - larger populations increase utility of statistical analysis and assist with identifying anomalies and outliers

## SEMS Features:

- Small and lightweight
- Easier and faster installation than PEMS
- Sufficient accuracy for non-compliance applications
- **An independent database and dataprocessing offer**





**HORIBA**

# Contact

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# Thank you

Omoshiro-okashiku  
Joy and Fun

おもしろい  
おもしろく

眞峰  


**HORIBA**

Cảm ơn

감사합니다

ありがとうございました

Dziękuję

धन्यवाद

Grazie

Merci

谢谢

நன்றி

ขอบคุณครับ

Obrigado

Σας ευχαριστούμε

Děkuji

شُكْرًا

Tack ska ni ha

Danke

Большое спасибо