

# WG PEMS MEASUREMENTS: REAL DRIVING EMISSIONS FOR LIGHT DUTY VEHICLES

Ligterink, N.E. (Norbert)

**TNO** innovation  
for life

# ISOLATED ACTIVITIES, LITTLE COLLABORATION (YET)

related, but 3 very different items!

- › **Developments in RDE legislation for PEMS testing:**
  - › JRC guidance document for testing
  - › accreditation for In-Service Conformity RDE testing
  - › plans for surveillance and monitoring
  - › accuracy and operational issues with PEMS
- › **Post-dieselgate “business”**
  - › independent testing for *ranking* (Emission Analytics, ADAC, greenNCAP)
  - › differentiating vehicles, without taken care of the range of conditions
- › **On-road testing testing for real-world emission factors:**
  - › COPERT, HBEFA, VERSIT+ now all use on-road test data
  - › “normal use” issues (driving behaviour, payload, temperature)
  - › test programs tend to “explode” to cover “all conditions”

# TNO ON-ROAD TEST PROGRAM 2017: 14 TESTS PER VEHICLE

No.	Trip-ID+ payload%	Date	Start- time	Duration	Distance	Average velocity	Ambient-temperature Avg/min/max			CO <sub>2</sub>	NO <sub>x</sub>	NH <sub>3</sub>
				[s]	[km]	[km/h]	[°C]			[g/km]	[mg/km]	[mg/km]
1	RDE C-28%	2017-5-11	8:25	5998	73.0	43.8	16	13	18	115	39	0.6
2	Motorway-28%	2017-5-8	10:49	3800	87.4	82.8	12	10	16	110	38	0.1
3	RDE H-28%	2017-5-8	12:51	5690	72.7	46.0	15	14	17	120	57	0.2
4	Congest H-28%	2017-5-8	15:01	6153	85.0	49.7	16	13	20	113	52	0.2
5	Congest C-95%	2017-5-9	7:43	5736	82.9	52.0	12	9	13	113	48	0.2
6	City-95%	2017-5-9	9:28	4871	28.5	21.1	12	11	14	157	96	0.6
7	Rural-95%	2017-5-9	11:14	4813	64.6	48.3	13	12	15	113	45	0.3
8	RDE H-95%	2017-5-9	12:56	6276	70.6	40.5	14	12	17	172	217	0.9
9	City-to-City-95%	2017-5-9	14:46	2672	21.5	28.9	15	13	18	140	101	2.4
10	RDE C-55%	2017-5-10	7:54	6000	72.6	43.5	10	9	12	133*	70	1.1
11	Short-trip-55%	2017-5-10	9:45	424	4.2	35.5	12	11	15	136	100	1.0
12	Delivery-trip-55%	2017-5-10	10:05	1943	13.4	18.2	12	11	14	169	128	1.2
13	ISC H-55%	2017-5-10	11:33	8107	121.0	53.7	15	13	20	114	38	0.4
14	City-to-City-55%	2017-5-10	13:53	2668	21.5	28.9	15	13	17	135	88	0.5
<b>Total</b>					<b>818.9</b>					<b>127</b>	<b>70</b>	<b>0.5</b>

# UNDERSTANDING ON-ROAD TESTING

## *COMPLETE RECORD KEEPING IS ESSENTIAL*

- › *test description and driver instructions should include:*
  - › **driving behaviour:**
    - › distance to car in front, braking distance before anticipated stop
    - › gear shifting
    - › airco usage, sport mode, stop-start enabling, etc.
    - › maximal throttle and engine speed
  - › **vehicle selection and conditioning**
    - › aftermarket adaptations, pre-test maintenance, etc.
    - › payload, cold start, etc.
  - › **ambient conditions**
    - › temperature, precipitation, wind, etc.

→ *what is normal? what is the effect of variation in normal use?*

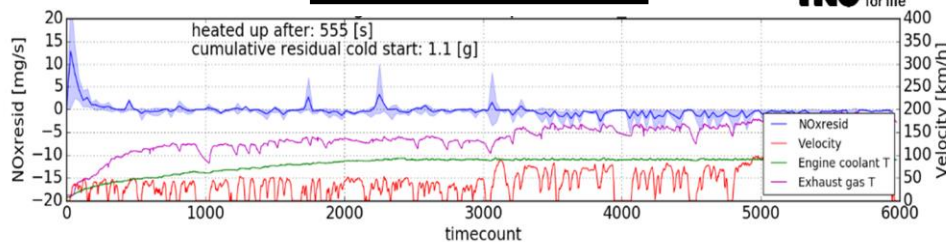
# NAN

## NOT A NUMBER

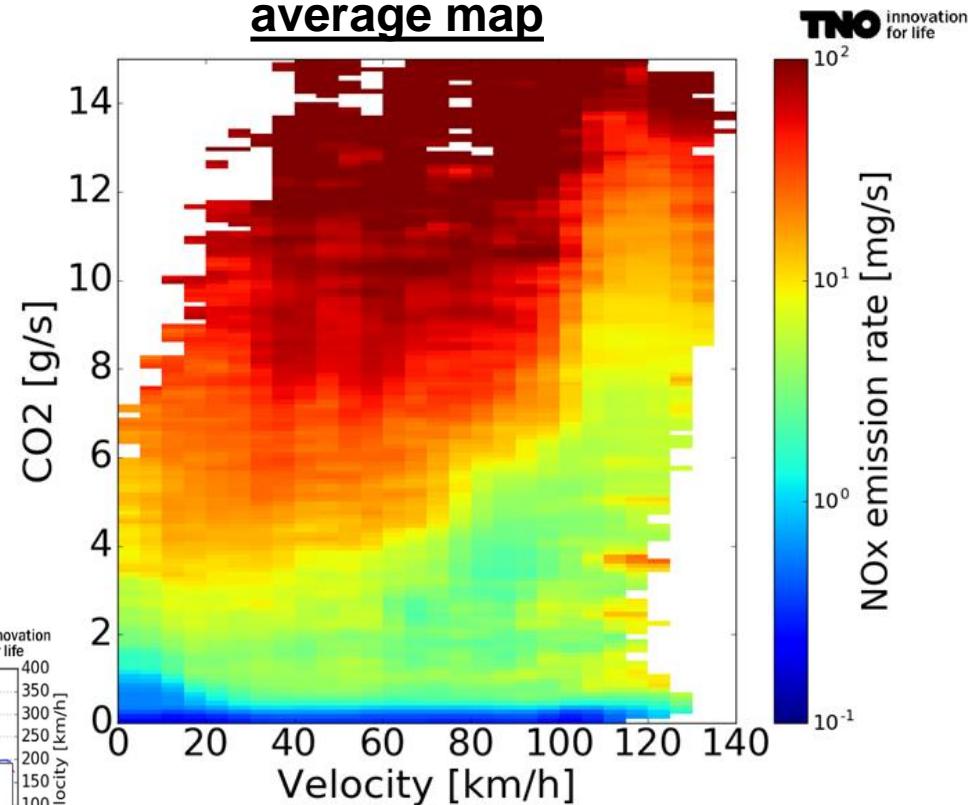
challenge in communication and emission modelling:

characterising emission performance per vehicle independent of the test execution, driving behaviour, and payload.

deviations plot



average map



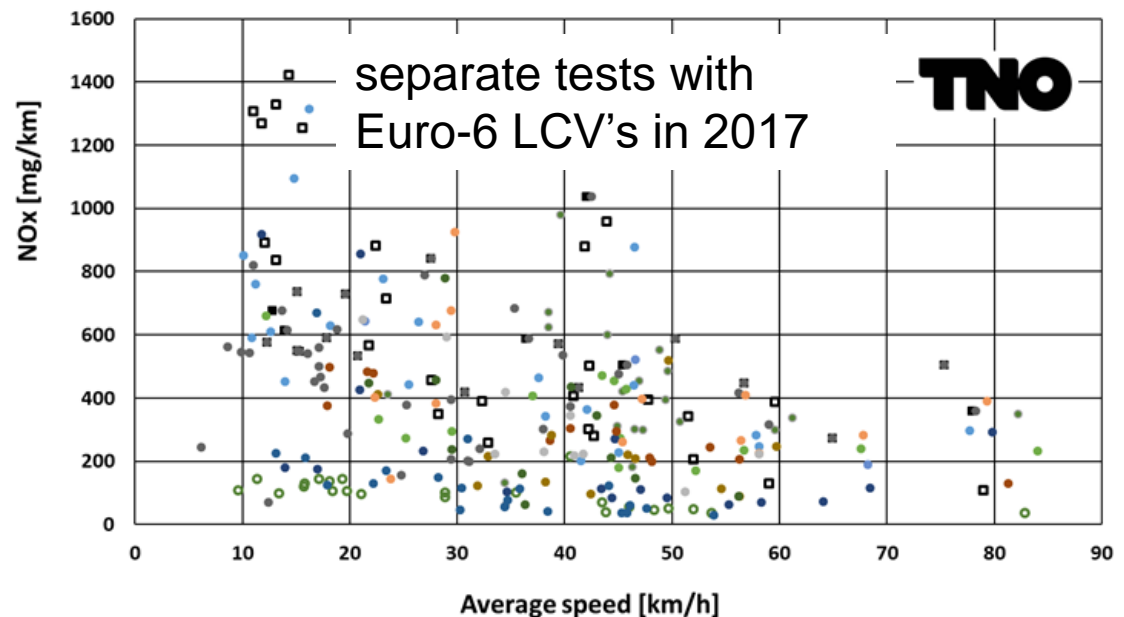
# TNO SHIFT TO SEMS, MORE TESTING, AND MONITORING

- › very limited relation between real-world emissions and ambient temperature:
  - › only relevant as deviation from type-approval levels?

- › 800+ km testing cover  
Dutch emissions factors

not always the full PEMS:

- limited testing time
- cumbersome
- faults

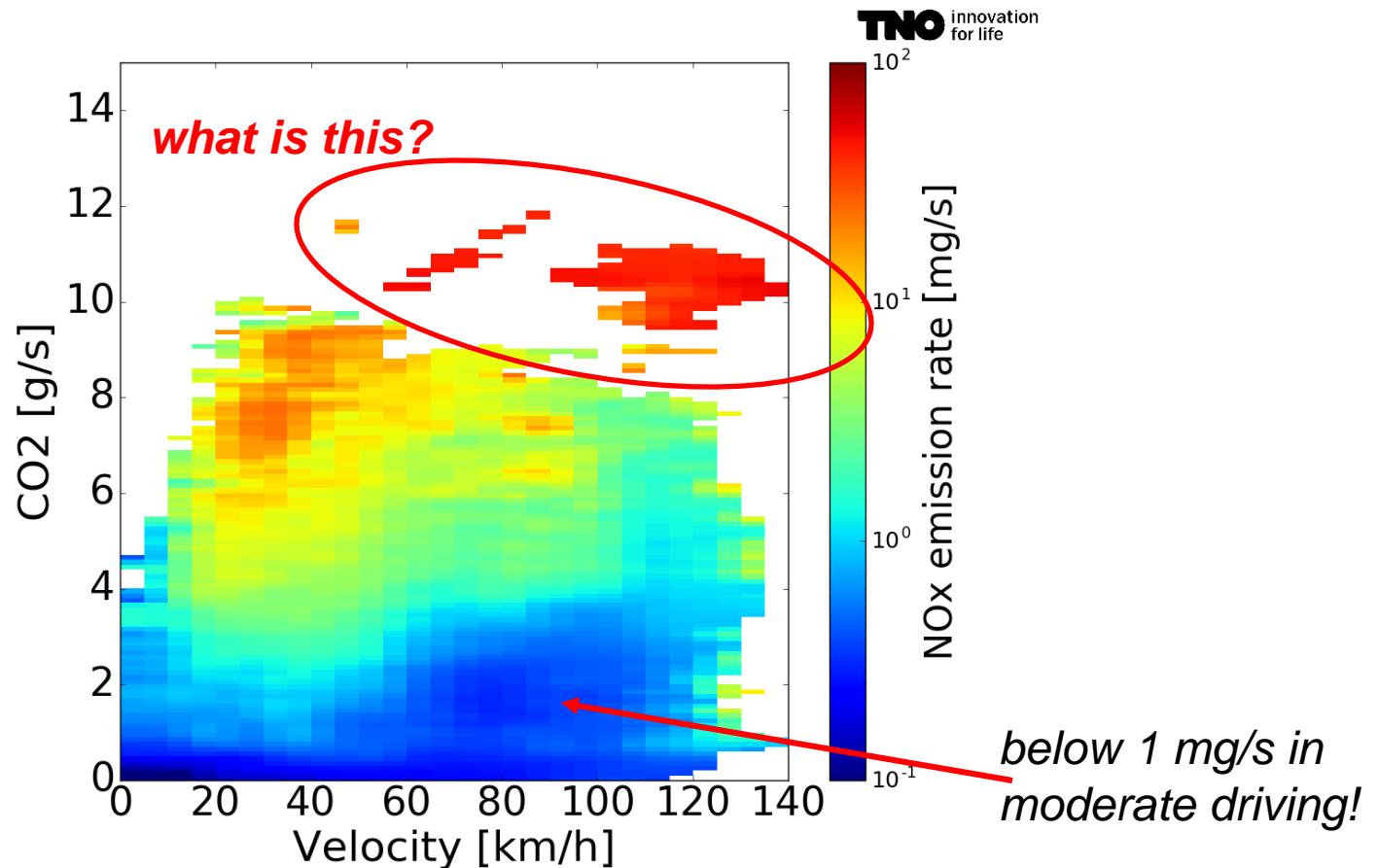


# COMMON PROBLEMS WITH PEMS

- › safety issues with HC (explosive gases on board)
  - › no HC testing in some countries
- › NO and NO<sub>2</sub> not always separate
  - › NO<sub>2</sub>/NO<sub>x</sub> fraction (relevant for air quality) often noisy, incorrect
- › flow measurement accuracy can be tricky, or plain wrong
  - › Pitot tube commonly used
  - › inlet air measurements, typically easier, and more accurate
- › no PM measurement
  - › recently developed PN-PEMS (but what is the use of PN?)

# MEET THE CLEANEST CAR, SO FAR

## ... STILL A REASON TO DRIVE DECISIVELY ECO





# THANK YOU FOR YOUR ATTENTION



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contact:  
[norbert.ligterink@tno.nl](mailto:norbert.ligterink@tno.nl)