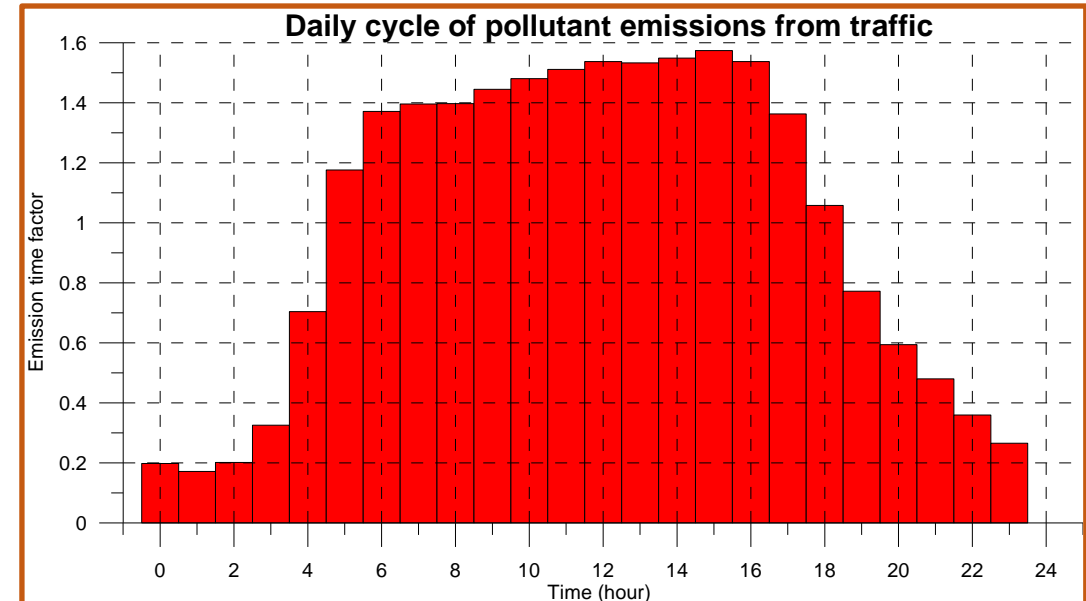
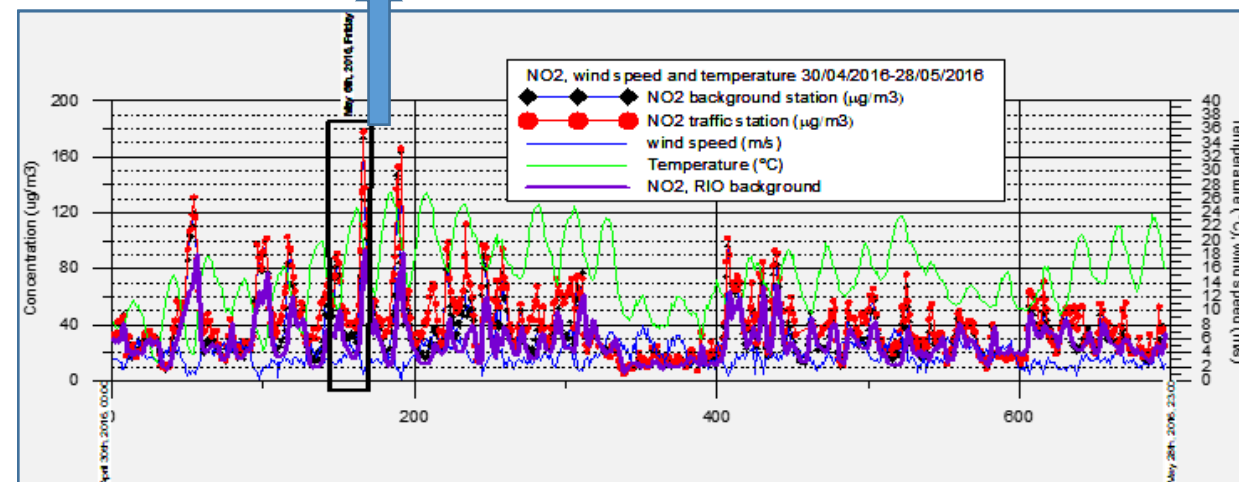
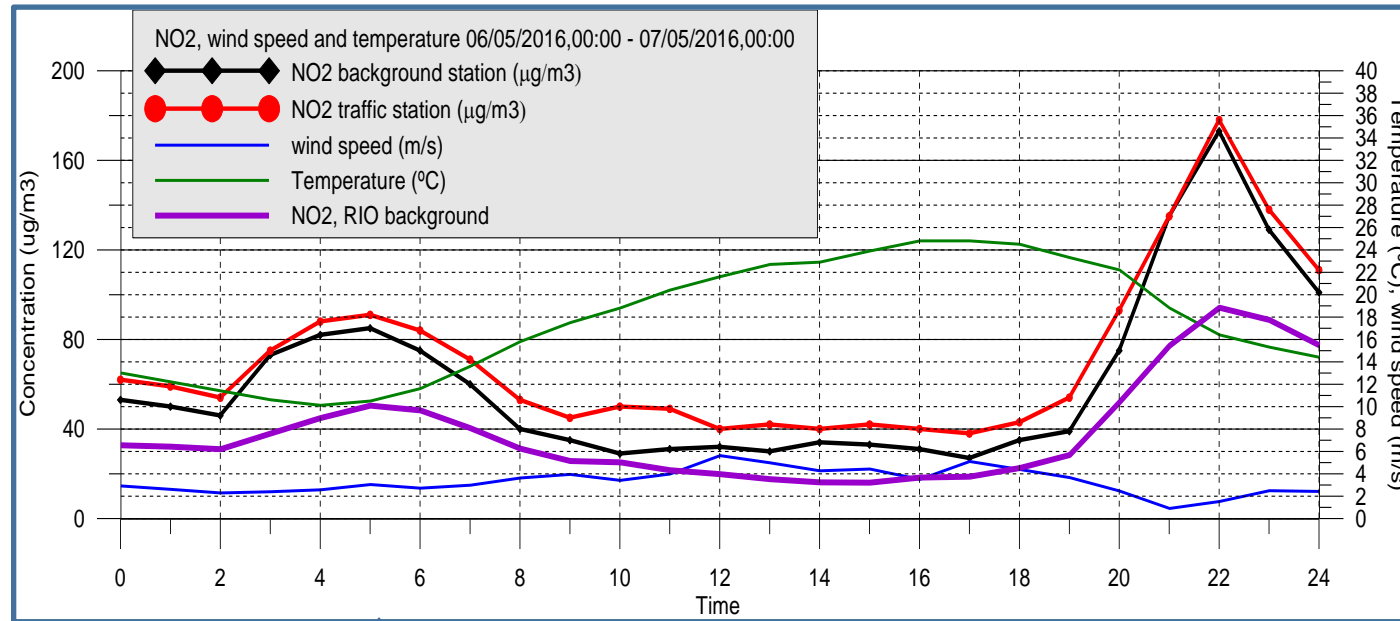


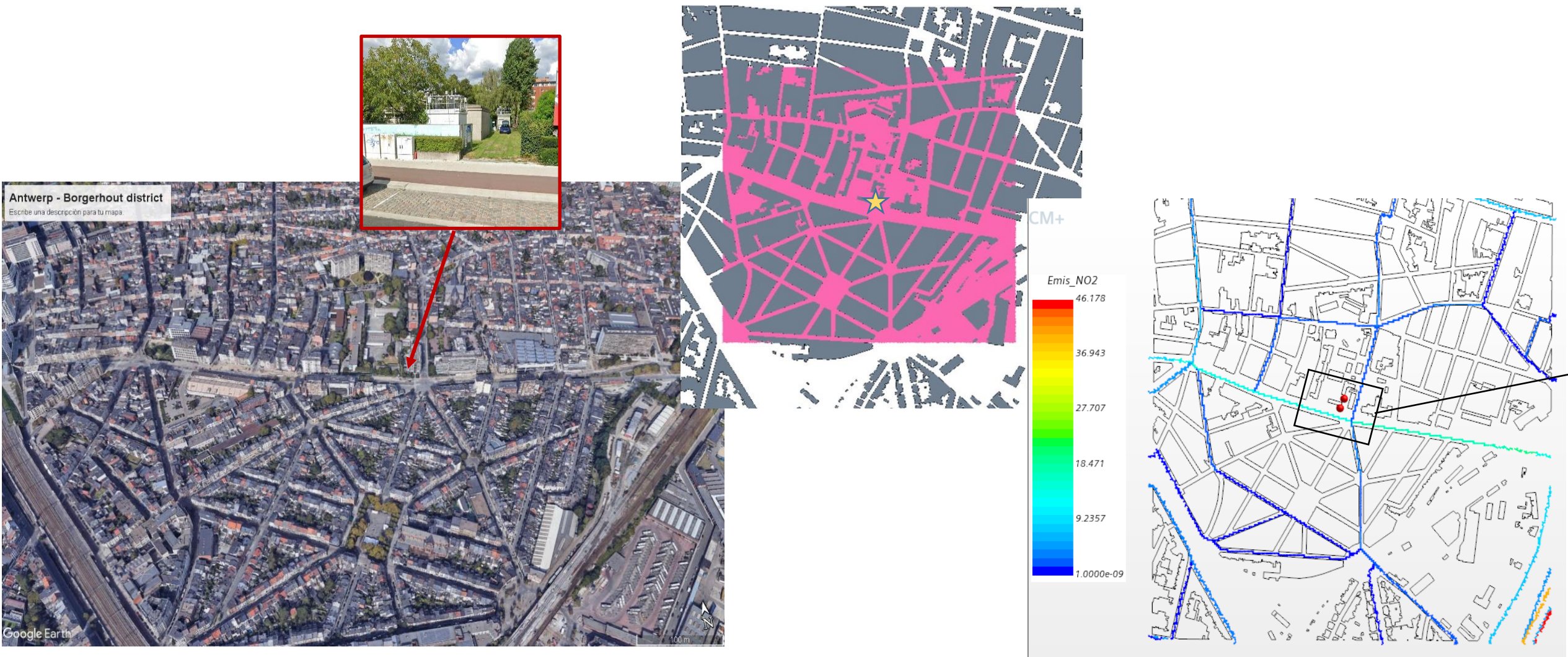
# CT4 Intercomparison exercise. Step 1.

*To simulate a few selected hours from the one-month passive sampler campaigns.*

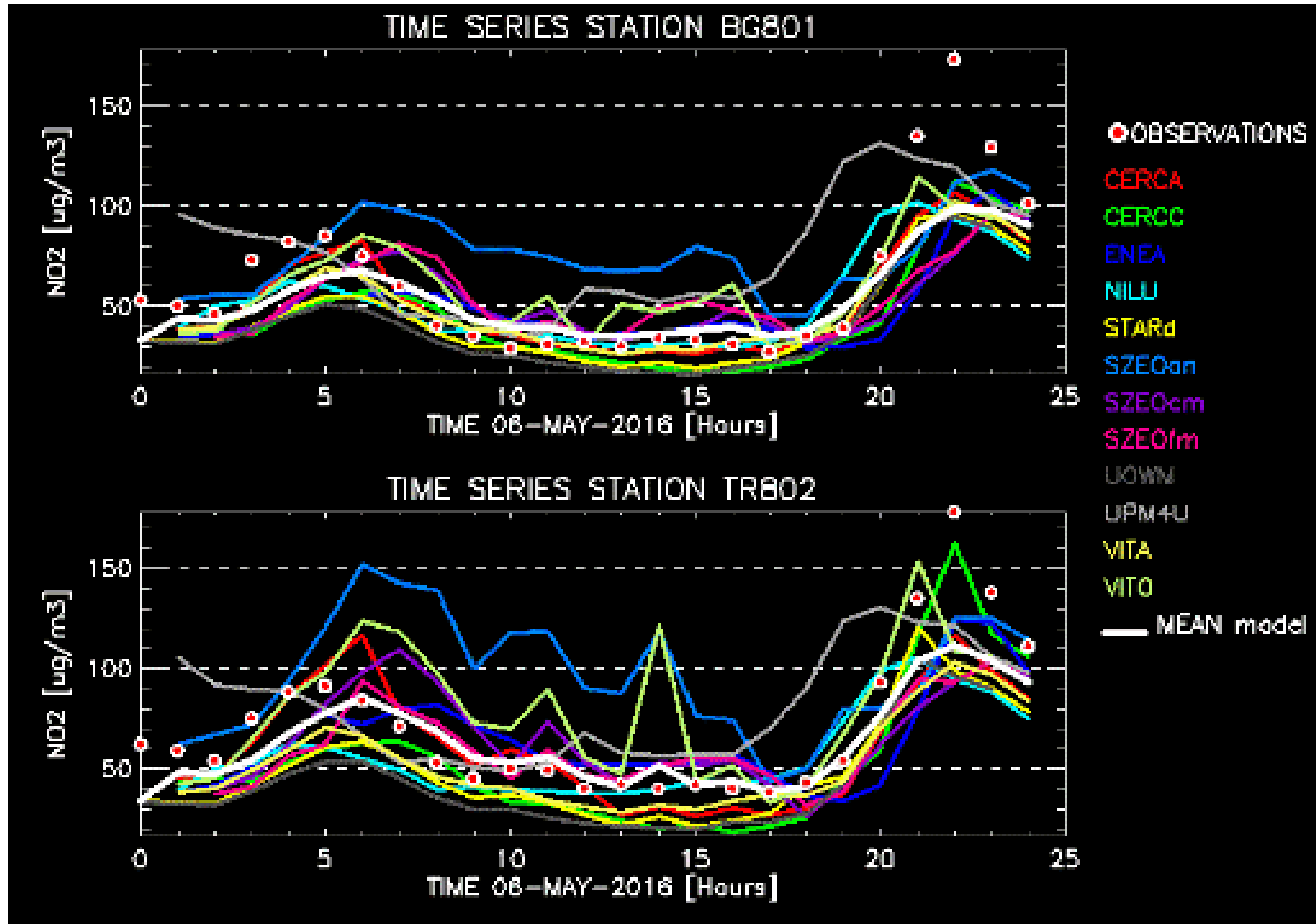
- *May 6<sup>th</sup>, 2016 selected to simulate.*
- *The model results would be compared with AQ stations data*
- *Models results would be intercompared.*



# Step 1. Traffic and background stations



# Step 1. Time Series CT4 Tool



# Step 1. Statistics – Traffic station

MODEL	STATION	MEAN OBS	MEAN-MOD	DEVOBS	DEVMOD	Correl	Bias	NMbias	MFB	Error	RMS	MFE	TARGET	FAC2
SZE-ANSYS	TRAFFIC	71,4	97,5	37,3	29,5	0,37	26,1	0,37	0,35	36,9	45,7	0,44	1,22	0,67
SZE-COARSE	TRAFFIC	71,9	66,5	38,1	24,0	0,63	-5,5	-0,08	-0,03	22,8	29,5	0,31	0,77	1,00
SZE-FINE	TRAFFIC	71,9	62,5	38,1	21,9	0,78	-9,5	-0,13	-0,08	20,0	26,3	0,28	0,69	1,00
UPM-PALM4U	TRAFFIC	71,4	80,9	37,3	26,8	0,66	9,5	0,13	0,18	23,0	29,2	0,30	0,78	0,92
ENEA-PMSS	TRAFFIC	71,4	64,5	37,3	24,5	0,78	-6,8	-0,10	-0,05	19,8	24,3	0,29	0,65	0,96
CERC-CIEMAT	TRAFFIC	71,4	54,1	37,3	36,7	0,97	-17,3	-0,24	-0,34	17,5	19,6	0,35	0,52	0,92
CERC-ADMS	TRAFFIC	71,4	61,7	37,3	29,2	0,85	-9,7	-0,14	-0,15	16,8	21,9	0,25	0,59	1,00
CIEMAT	TRAFFIC	71,0	48,7	36,6	26,0	0,93	-22,3	-0,31	-0,38	22,3	27,1	0,38	0,74	1,00
UOWM	TRAFFIC	69,3	42,4	36,4	24,5	0,96	-27,0	-0,39	-0,51	27,0	30,6	0,51	0,84	0,92
VITO-OPENFOAM	TRAFFIC	69,7	79,8	37,2	32,7	0,63	10,2	0,15	0,15	22,7	31,3	0,29	0,84	0,96
VITO-ATMOSTREET	TRAFFIC	71,4	52,3	37,3	22,4	0,97	-19,1	-0,27	-0,28	19,1	24,9	0,28	0,67	1,00
NILU-EPIISODE	TRAFFIC	71,4	56,7	37,3	21,2	0,86	-14,7	-0,21	-0,18	18,4	26,1	0,25	0,70	1,00

- Most of the models simulate quite well the time evolution of NO<sub>2</sub> concentration ( $R^2 > 0.70$  → SZE-FINE, ENEA-PMSS, CERC-CIEMAT, CERC-ADMS, CIEMAT, UOWM, VITO-ATMOSTREET, NILU).
- Most of the models subpredict NO<sub>2</sub> concentration (SZE-COARSE, SZE-FINE, ENEA-PMSS, CERC-CIEMAT, CERC-ADMS, CIEMAT, UOWM, VITO-ATMOSTREET, NILU).
- 3 models overpredict (SZE-ANSYS, UPM, VITO-OPENFOAM).
- MFE ranges between 0.25 and 0.51.
- Most of models FAC2 > 0.90 and Target < 0.90 except SZE-ANSYS .

# Step 1. Statistics – Traffic station

## Morning peak:

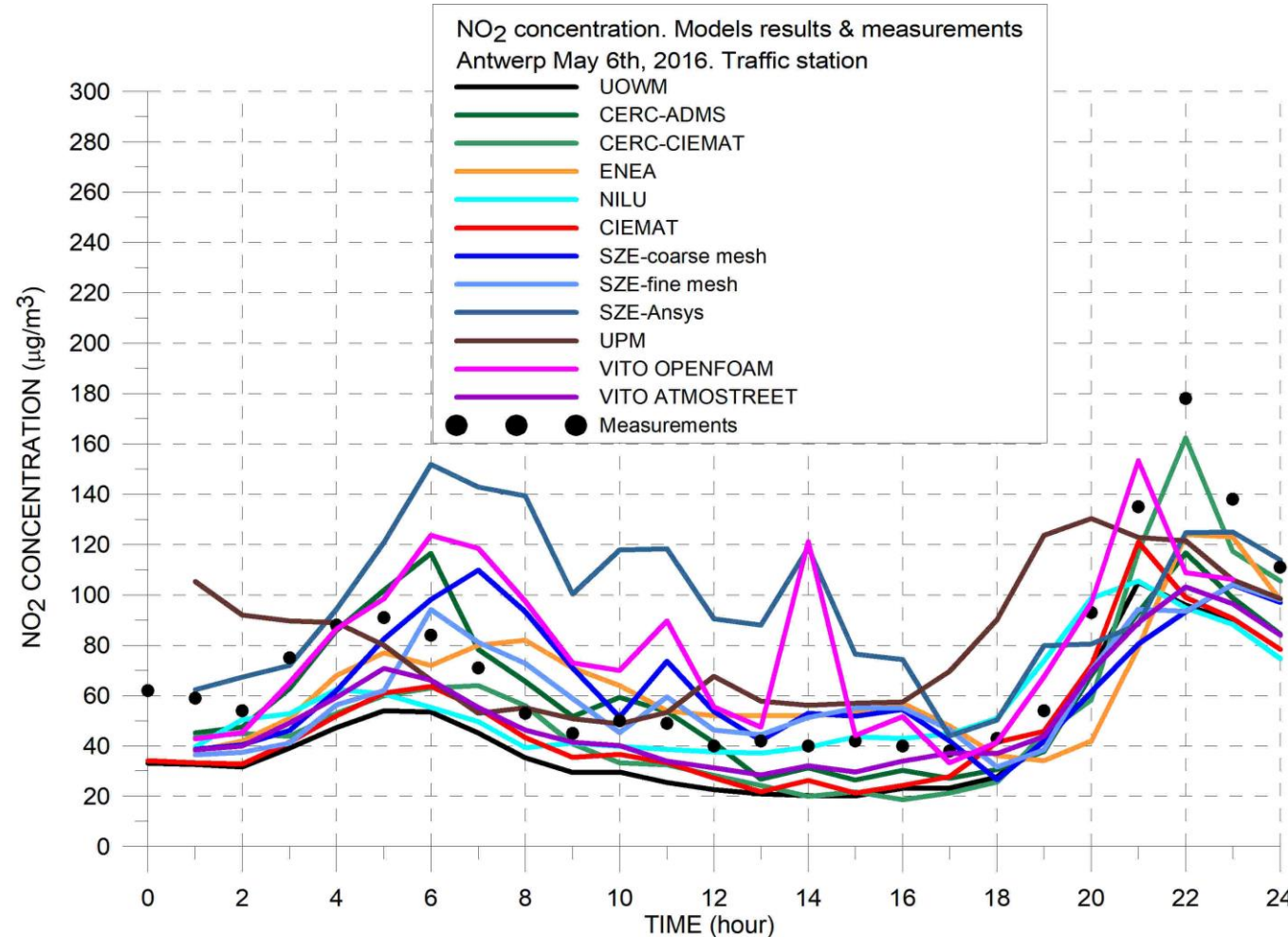
- The predicted morning peak appears at same hour than observations only for VITO-ATMOSTREET and UOWM,
- NILU peak is hour before,
- Peak for the remaining models appears 1-3 hour afterwards.
- SZE-Ansys, SZE-Coarse, CERC –ADMS and VITO-OPENFOAM overpredict this peak,
- SZE-FINE almost match the morning peak, whereas the remaining models underpredict the peak. UPM does not predict morning peak.

## Night peak:

- Predicted on time by VITO-ATMOSTREET, CERC-ADMS, SZE-ANSYS and ENEA.
- 2 models (SZE-COARSE and FINE) predict a 1-hour lagged peak,
- Rest of the models predicts the peak 1-2 hours before.
- All models under predict the peak, with a difference of around  $80 \mu\text{g}/\text{m}^3$  in many cases.
- All models (except SZE-ANSYS) predict that night peak is higher than morning peak.
- SZE with fine mesh significantly improves the results with coarse mesh

## Daytime low concentrations:

- Well predicted at the daytime by most of the models:
- Some of them underpredict by  $10\text{-}20 \mu\text{g}/\text{m}^3$ ,
- 2 models overpredict by  $20 \mu\text{g}/\text{m}^3$ ,
- Two models have an anomalous behavior with very high concentrations in some hours (SZE-Coarse and VITO-OPENFOAM)



# Step 1. Statistics – Background station

MODEL	STATION	MEAN OBS	MEAN-MOD	DEVOBS	DEVMOD	Correl	Bias	NMbias	MFB	Error	RMS	MFE	TARGET	FAC2
SZE-ANSYS	BACKGROUND	61,7	76,6	39,4	20,0	0,62	14,9	0,24	0,33	29,0	34,1	0,46	0,87	0,63
SZE-COARSE	BACKGROUND	62,2	53,1	40,2	19,6	0,69	-9,1	-0,15	-0,05	21,2	30,9	0,33	0,77	0,91
SZE-FINE	BACKGROUND	62,2	55,1	40,2	19,6	0,69	-7,1	-0,11	-0,01	21,7	30,5	0,34	0,76	0,96
UPM-PALM4U	BACKGROUND	61,7	75,9	39,4	29,2	0,66	14,2	0,23	0,28	25,2	32,5	0,39	0,83	0,88
ENEA-PMSS	BACKGROUND	61,7	49,5	39,4	21,1	0,79	-12,2	-0,20	-0,12	20,0	28,3	0,33	0,72	0,92
CERC-CIEMAT	BACKGROUND	61,7	45,0	39,4	27,5	0,92	-16,7	-0,27	-0,30	17,5	24,1	0,32	0,61	0,96
CERC-ADMS	BACKGROUND	61,7	52,0	39,4	25,8	0,96	-9,6	-0,16	-0,12	11,4	18,9	0,16	0,48	1,00
CIEMAT	BACKGROUND	61,3	43,2	38,6	23,6	0,96	-18,2	-0,30	-0,32	18,2	24,7	0,32	0,64	1,00
UOWM	BACKGROUND	59,7	38,9	38,5	23,2	0,97	-20,8	-0,35	-0,41	20,8	26,7	0,41	0,69	0,96
VITO-OPENFOAM	BACKGROUND	60,0	59,3	39,4	23,1	0,85	-0,6	-0,01	0,08	17,1	22,7	0,28	0,58	1,00
VITO-ATMOSTREET	BACKGROUND	61,7	50,6	39,4	22,9	0,97	-11,1	-0,18	-0,12	13,3	21,1	0,19	0,54	1,00
NILU-EPISEDE	BACKGROUND	61,7	52,3	39,4	22,9	0,88	-9,4	-0,15	-0,08	15,8	23,7	0,22	0,60	1,00

- Most of the models simulate quite well the time evolution of NO<sub>2</sub> concentration ( $R^2 > 0.70$  → ENEA-PMSS, CERC-CIEMAT, CERC-ADMS, CIEMAT, UOWM, VITO-OPENFOAM, VITO-ATMOSTREET, NILU).
- In some cases,  $R^2$  is higher for background than for traffic station (SZE-ANSYS, SZE-COARSE, ENEA-PMSS, CERC-ADMS, CIEMAT, UOWM, VITO-OPENFOAM, NILU).
- Most of the models subpredict NO<sub>2</sub> concentration (SZE-COARSE, SZE-FINE, ENEA-PMSS, CERC-CIEMAT, CERC-ADMS, CIEMAT, UOWM, VITO-ATMOSTREET, NILU).
- 2 models overpredict (SZE-ANSYS, UPM) and VITO-OPENFOAM has Bias almost 0.
- MFE ranges between 0.16 and 0.46. Lesser than the case of traffic station.
- Most of models FAC2 > 0.90 except SZE-ANSYS and UPM. All models Target < 0.90.

# Step 1. Statistics – Background station

## Morning peak:

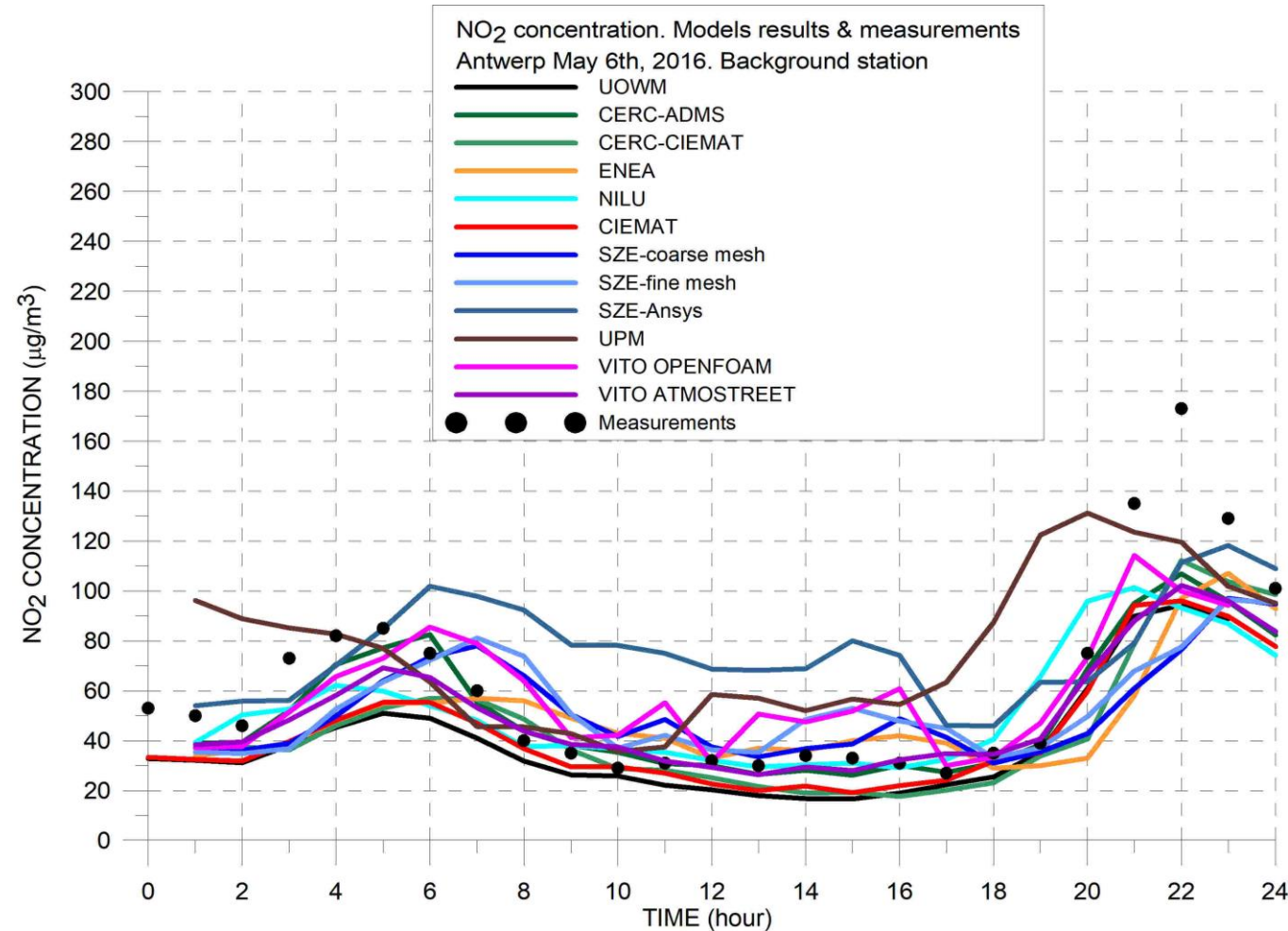
- Better simulated in magnitude than for traffic station by the models,
- One model overpredict it (SZE-Coarse), and most of the remaining ones underpredict it by 10-40  $\mu\text{g}/\text{m}^3$ .
- Respect to the timing, same behavior as the traffic station case.

## Night peak:

- All models underpredict it by 40-80  $\mu\text{g}/\text{m}^3$ .
- The timing is similar to the case of the traffic station

## Daytime low concentrations:

- Predictions are quite good,
- The same models (than in the traffic station) underpredicting or overpredicting but the differences between observations and predictions seem to be lower than the case of the traffic stations.

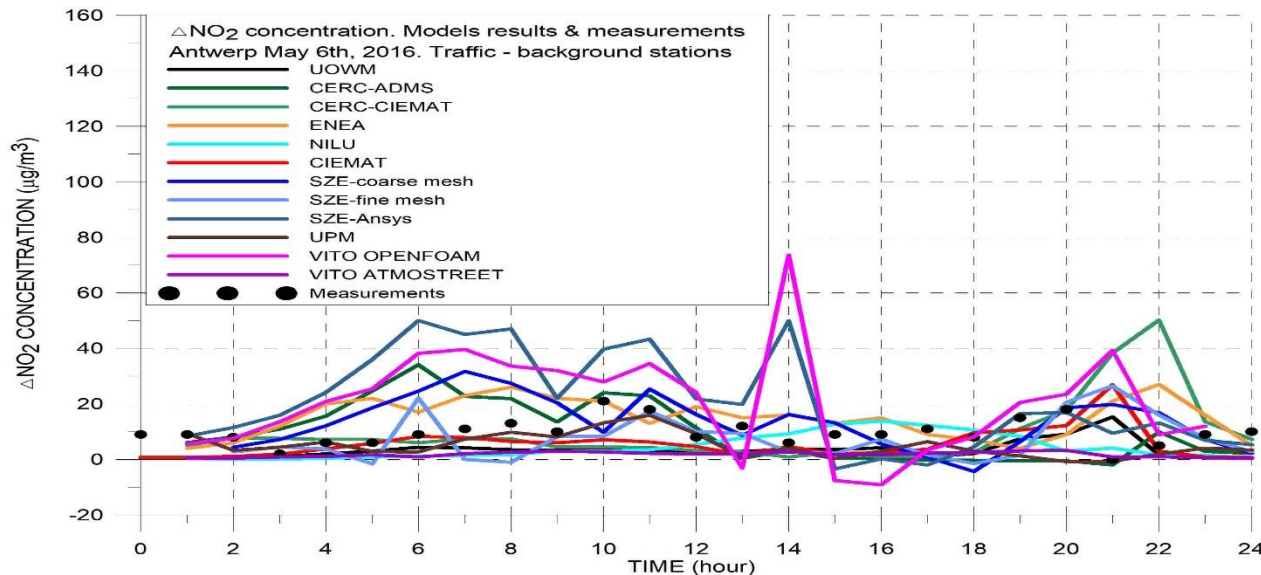


MODEL	STATION	MEAN OBS	MEAN-MOD	DEVOBS	DEVMOD	Correl	Bias	NMbias	MFB	Error	RMS	MFE	TARGET	FAC2
SZE-ANSYS	TRAFFIC	71,4	97,5	37,3	29,5	0,37	26,1	0,37	0,35	36,9	45,7	0,44	1,22	0,67
SZE-ANSYS	BACKGROUND	61,7	76,6	39,4	20,0	0,62	14,9	0,24	0,33	29,0	34,1	0,46	0,87	0,63
SZE-COARSE	TRAFFIC	71,9	66,5	38,1	24,0	0,63	-5,5	-0,08	-0,03	22,8	29,5	0,31	0,77	1,00
SZE-COARSE	BACKGROUND	62,2	53,1	40,2	19,6	0,69	-9,1	-0,15	-0,05	21,2	30,9	0,33	0,77	0,91
SZE-FINE	TRAFFIC	71,9	62,5	38,1	21,9	0,78	-9,5	-0,13	-0,08	20,0	26,3	0,28	0,69	1,00
SZE-FINE	BACKGROUND	62,2	55,1	40,2	19,6	0,69	-7,1	-0,11	-0,01	21,7	30,5	0,34	0,76	0,96
UPM-PALM4U	TRAFFIC	71,4	80,9	37,3	26,8	0,66	9,5	0,13	0,18	23,0	29,2	0,30	0,78	0,92
UPM-PALM4U	BACKGROUND	61,7	75,9	39,4	29,2	0,66	14,2	0,23	0,28	25,2	32,5	0,39	0,83	0,88
ENEA-PMSS	TRAFFIC	71,4	64,5	37,3	24,5	0,78	-6,8	-0,10	-0,05	19,8	24,3	0,29	0,65	0,96
ENEA-PMSS	BACKGROUND	61,7	49,5	39,4	21,1	0,79	-12,2	-0,20	-0,12	20,0	28,3	0,33	0,72	0,92
CERC-CIEMAT	TRAFFIC	71,4	54,1	37,3	36,7	0,97	-17,3	-0,24	-0,34	17,5	19,6	0,35	0,52	0,92
CERC-CIEMAT	BACKGROUND	61,7	45,0	39,4	27,5	0,92	-16,7	-0,27	-0,30	17,5	24,1	0,32	0,61	0,96
CERC-ADMS	TRAFFIC	71,4	61,7	37,3	29,2	0,85	-9,7	-0,14	-0,15	16,8	21,9	0,25	0,59	1,00
CERC-ADMS	BACKGROUND	61,7	52,0	39,4	25,8	0,96	-9,6	-0,16	-0,12	11,4	18,9	0,16	0,48	1,00
CIEMAT	TRAFFIC	71,0	48,7	36,6	26,0	0,93	-22,3	-0,31	-0,38	22,3	27,1	0,38	0,74	1,00
CIEMAT	BACKGROUND	61,3	43,2	38,6	23,6	0,96	-18,2	-0,30	-0,32	18,2	24,7	0,32	0,64	1,00
UOWM	TRAFFIC	69,3	42,4	36,4	24,5	0,96	-27,0	-0,39	-0,51	27,0	30,6	0,51	0,84	0,92
UOWM	BACKGROUND	59,7	38,9	38,5	23,2	0,97	-20,8	-0,35	-0,41	20,8	26,7	0,41	0,69	0,96
VITO-OPENFOAM	TRAFFIC	69,7	79,8	37,2	32,7	0,63	10,2	0,15	0,15	22,7	31,3	0,29	0,84	0,96
VITO-OPENFOAM	BACKGROUND	60,0	59,3	39,4	23,1	0,85	-0,6	-0,01	0,08	17,1	22,7	0,28	0,58	1,00
VITO-ATMOSTREET	TRAFFIC	71,4	52,3	37,3	22,4	0,97	-19,1	-0,27	-0,28	19,1	24,9	0,28	0,67	1,00
VITO-ATMOSTREET	BACKGROUND	61,7	50,6	39,4	22,9	0,97	-11,1	-0,18	-0,12	13,3	21,1	0,19	0,54	1,00
NILU-EPIISODE	TRAFFIC	71,4	56,7	37,3	21,2	0,86	-14,7	-0,21	-0,18	18,4	26,1	0,25	0,70	1,00
NILU-EPIISODE	BACKGROUND	61,7	52,3	39,4	22,9	0,88	-9,4	-0,15	-0,08	15,8	23,7	0,22	0,60	1,00



# Step 1. Statistics – Difference (Traffic – Background)

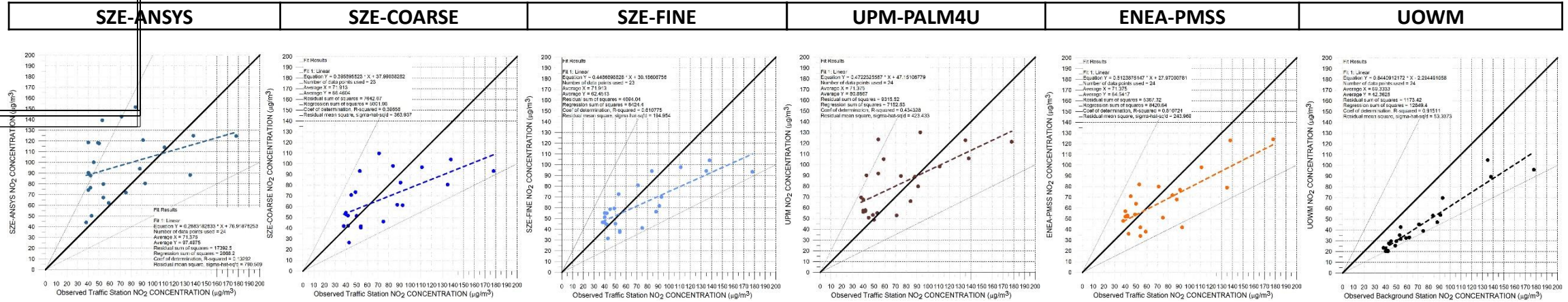
MODEL	STATION	MEAN OBS	MEAN-MOD	DEVOBS	DEVMOD	Correl	Bias	NMbias	MFB	Error	RMS	MFE	TARGET	FAC2
SZE-ANSYS	DELTA	9,7	20,9	4,9	17,2	0,26	11,2	1,15	0,23	15,1	19,7	1,14	4,07	0,38
SZE-COARSE	DELTA	9,7	13,4	5,0	9,2	0,09	3,7	0,38	-0,06	9,1	10,5	1,06	2,12	0,30
SZE-FINE	DELTA	9,7	7,4	5,0	8,0	0,00	-2,3	-0,24	-0,67	7,3	9,5	1,10	1,92	0,35
UPM-PALM4U	DELTA	9,7	5,0	4,9	4,3	0,44	-4,8	-0,49	-0,59	5,1	6,7	0,67	1,39	0,42
ENEA-PMS	DELTA	9,7	15,1	4,9	7,0	-0,17	5,4	0,55	0,37	8,7	10,4	0,72	2,15	0,54
CERC-CIEMAT	DELTA	9,7	9,2	4,9	11,6	-0,33	-0,5	-0,06	-0,39	8,5	13,7	0,86	2,83	0,46
CERC-ADMS	DELTA	9,7	9,6	4,9	10,5	0,19	-0,1	-0,01	-0,33	8,6	10,5	0,96	2,16	0,38
CIEMAT	DELTA	9,7	5,6	4,8	5,5	-0,07	-4,1	-0,43	-0,68	6,4	8,5	0,86	1,78	0,52
UOWM	DELTA	9,7	3,5	4,9	3,2	0,00	-6,2	-0,64	-0,98	7,5	8,4	1,15	1,74	0,17
VITO-OPENFOAM	DELTA	9,7	20,5	5,0	18,8	0,01	10,8	1,12	12,48	16,2	21,9	-11,16	4,41	0,39
VITO-ATMOSTREET	DELTA	9,7	1,7	4,9	0,9	0,58	-8,0	-0,82	-1,24	8,1	9,1	1,41	1,87	0,00
NILU-EPIISODE	DELTA	9,7	4,4	4,9	4,4	0,08	-5,3	-0,55	-0,87	6,9	8,1	1,17	1,68	0,33



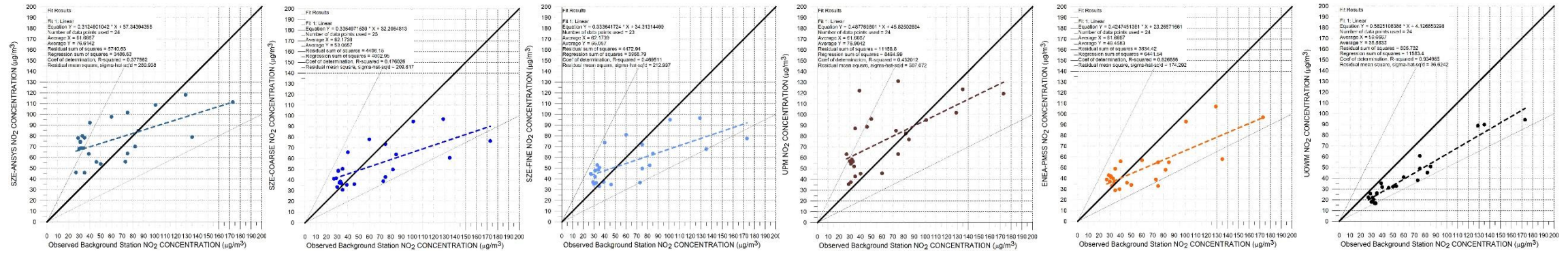
- All models fail. Very low  $R^2$ , FAC2. High error and target.

# Step 1. Scatter-Plots (1/2)

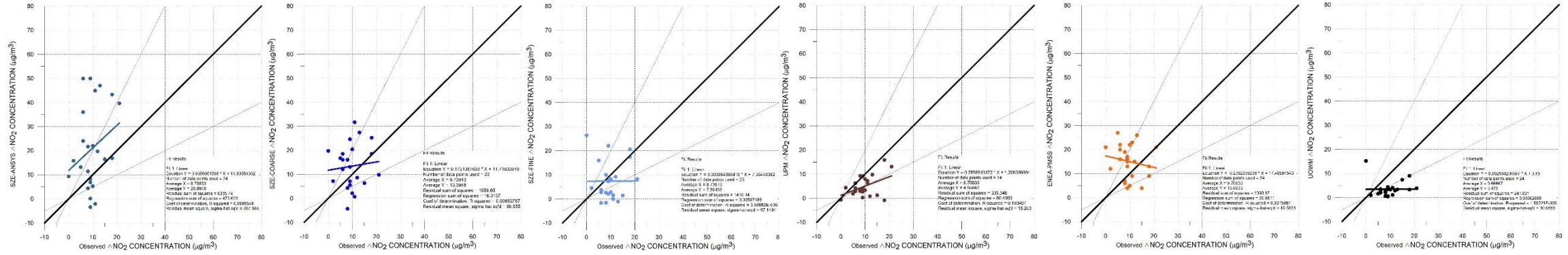
TRAFFIC STATION



BACKGROUND STATION



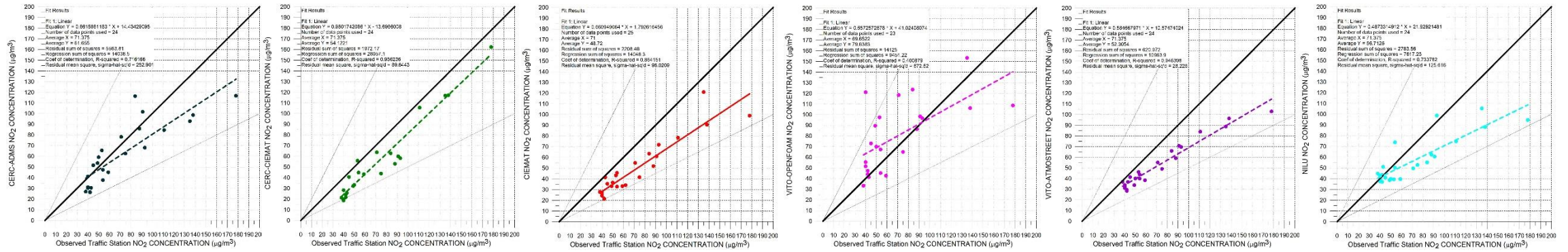
DIFFERENCE



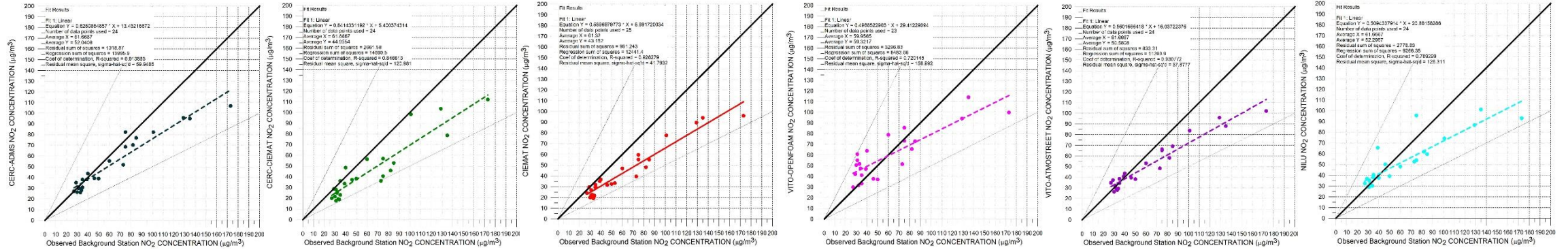
# Step 1. Scatter-Plots (2/2)

	CERC-ADMS	CERC-CIEMAT	CIEMAT	VITO-OPENFOAM	VITO-ATMOSTREET	NILU-EPIISODE
--	-----------	-------------	--------	---------------	-----------------	---------------

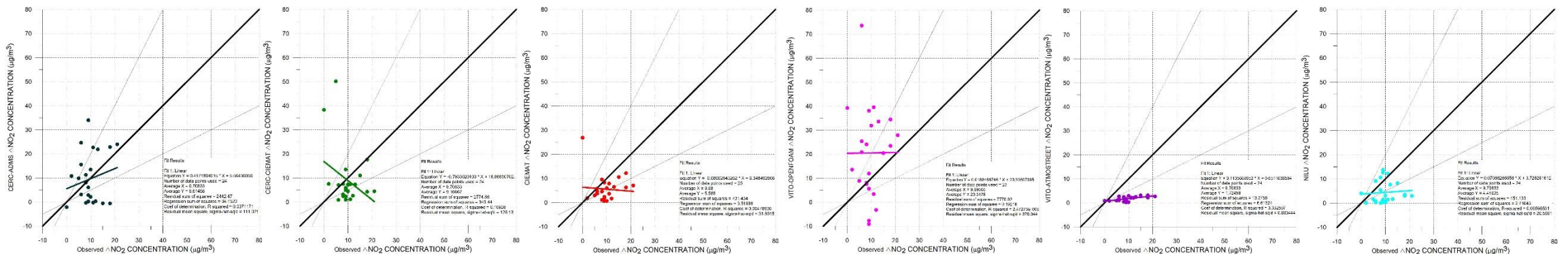
TRAFFIC STATION



BACKGROUND STATION



DIFFERENCE



# Step 1. Comments

- Most of the models simulate quite well time evolution of NO<sub>2</sub> concentration but most underpredict
- Problems with the timing of the concentration peaks in several models.
- All models underpredict the night peak
- It seems that the models simulate better background station concentrations than the traffic ones.
- All models fail in predicting the concentration difference Traf-Bg