CT1 - Source apportionment in support AQ management

Source apportionment of NO_2

CT1 Session

06 October 2021

RSE Ricerca Sistema Energetico

European Commission

CT1 Agenda

CT1 – Source apportionment (4 h) Wednesday 06/10

09:15 – 10:45 SA Inter-comparison for NO2 (G. Pirovano)

11:15 – 11:35 A dummy's guide to receptor modelling (V. Riffault)
11:35 – 11:55 Comparison of tagging and brute force source apportionment (C. Belis)
11:55 – 12:15 Tagging and BF: Similar, complementary or designed for different purposes (A. Clappier)
12:15 – 12:45 Discussion

14:00 – 14:20 Proposal for an harmonized nomenclature to report SA results (P. Thunis)
14:20 – 14:40 Summary of parallel sessions (A. Clappier and G. Pirovano)
14:40 – 15:00 REMY: A life project related to SA (G. Maffeis)

NO2 SA Agenda

1. **NO2 SA exercise (9.15-10.30)**
    1. Introduction
    2. Presentation from each modelling group
    3. Conclusions

2. **TNO experience on NO2/NOX SA (10.30 – 10.45)**

Teams (06/10/2021)

Team	Country	contact	email	model	domain	period	Sectors	Receptors & Sectors	31/07/2021	Notes
VITO	Belgium	Wouter Lefebvre	wouter.lefebvre@vito.be	IFDM (Gaussian) + OSPM + RIO	Local domain consisting of Hoogstraten and Wuustwezel communities, rural to suburban area	2017 (hourly)	Traffic & Agriculture	Hoogstraten and Wuustwezel ~~ST1,~~ ~~ST2~~,RT3,RT4,RT5, SB06, RB07, RB08	scen BF 01-03 07-09 13-15 19-21	No other data. Street canyon data cannot be used in the exercise
UAVR	Portugal	Joana Ferreira; Silvia Coelho	jferreira@ua.pt; silviacatarina@ua.pt	CAMX	Aveiro region	10/12/–31/12 2017 (hourly)	Industrial combustion & Traffic	Aveiro (UT01, SB02, SI03)	SCEN BF complete	Check for "ALL" results are needed .Maybe OSAT (scen 00) could be produced at a later stage
IASS	Germany	Tim Butler	Tim.Butler@iass-potsdam.de; Aura.Lupascu@iass-potsdam.de	WRF-Chem	Nested domain over EU and Berlin	2015 February (hourly)	Traffic & Res. Heating	Berlin UB1, UB2, UB3	scen TAG 01-03 07-09 13-15 19-21	Provided also BF run for 01-03 06-09 12-15 18-21, 24
SenUVK	Germany	Andreas Kerschbaumer	andreas.kerschbaumer@senuvk.berlin.de	IMMIS	Both sides built street canyons in urban environment in Berlin	2015 (yearly)	Different road transport fleets	Berlin UT1 (DEBE065)	scen BF 01, 07, 13, 19	Sensitivity analysis: background NOx and/or O3 variations, Meteorological variations: stability parameter, wind-speed. Chemistry scheme - variations
RSE	Italy	Guido Pirovano	Guido.pirovano@rse-web.it	CAMx	Po Valley (5 km resolution)	2010 (hourly)	Industry & Traffic	Milan (UB01); Ravenna (SB02)	scen BF and TAG 04-06 10-12 16-18 22-24	Planning new run over 2017 or 2020 over Milan area at 1 km resolution

Key questions

- *What kind of analysis **would** we perform?*
- *What kind of analysis **could** we perform?*

Are your SA results for NO_2 consistent?
In other words, if your SA result are based on “brute force” impacts, are these behaving linearly over the whole range of emission reductions (0-100%)? If not, to what extent can it be considered consistent?

Are your SA results additive?
In other words, is the sum of the impacts/contributions of two sources equal to the impact/contribution of the combined sources. I.e. for two sources A and B: $C_{AB}=C_A+C_B$?
Is this property influenced by the emission reduction strength?

Are your results influenced by the chemical profile of the considered sources?
In other words, do you obtain different results if you reduce, for a specific source, only NOX emissions instead of all emitted chemical compounds (e.g. VOC, SO2,…)

Are “tagging contributions” comparable to “impacts” for NO2?
If yes, under which conditions? (i.e. emission reduction strength, chemical regime, boundary conditions…)

How sensitive are your results to the regional background?

Can you identify any relationship between NO2 and NOX concentrations in your modelling results?
In other words, can you perform your SA analysis in terms of NOX and then “convert” them to NO2?

Answers

Team	Country	model	domain	period	Sectors	Receptors & Sectors	Cities	Rec.	BF	TAG	Cons.	Addit.	NOX vs ALL	TAG vs BF
VITO	Belgium	IFDM (Gaussian) + OSPM + RIO	Local domain consisting of Hoogstraten and Wuustwezel communities, rural to suburban area	2017 (hourly)	Traffic & Agriculture	Hoogstraten and Wuustwezel ~~ST1, ST2~~,RT3,RT4,RT5, SB06, RB07, RB08								
UAVR	Portugal	CAMX	Aveiro region	10/12/–31/12 2017 (hourly)	Industrial combustion & Traffic	Aveiro and other cities (UT01, SB02, SI03)								
IASS	Germany	WRF-Chem	Nested domain over EU and Berlin	2015 February (hourly)	Traffic & Res. Heating	Berlin UB1, UB2, UB3								
SenUVK	Germany	IMMIS	Both sides built street canyons in urban environment in Berlin	2015 (yearly)	Different road transport fleets	Berlin UT1 (DEBE065)								
RSE	Italy	CAMx	Po Valley (5 km resolution)	2010 (hourly)	Industry & Traffic	Milan (UB01); Ravenna (SB02)								

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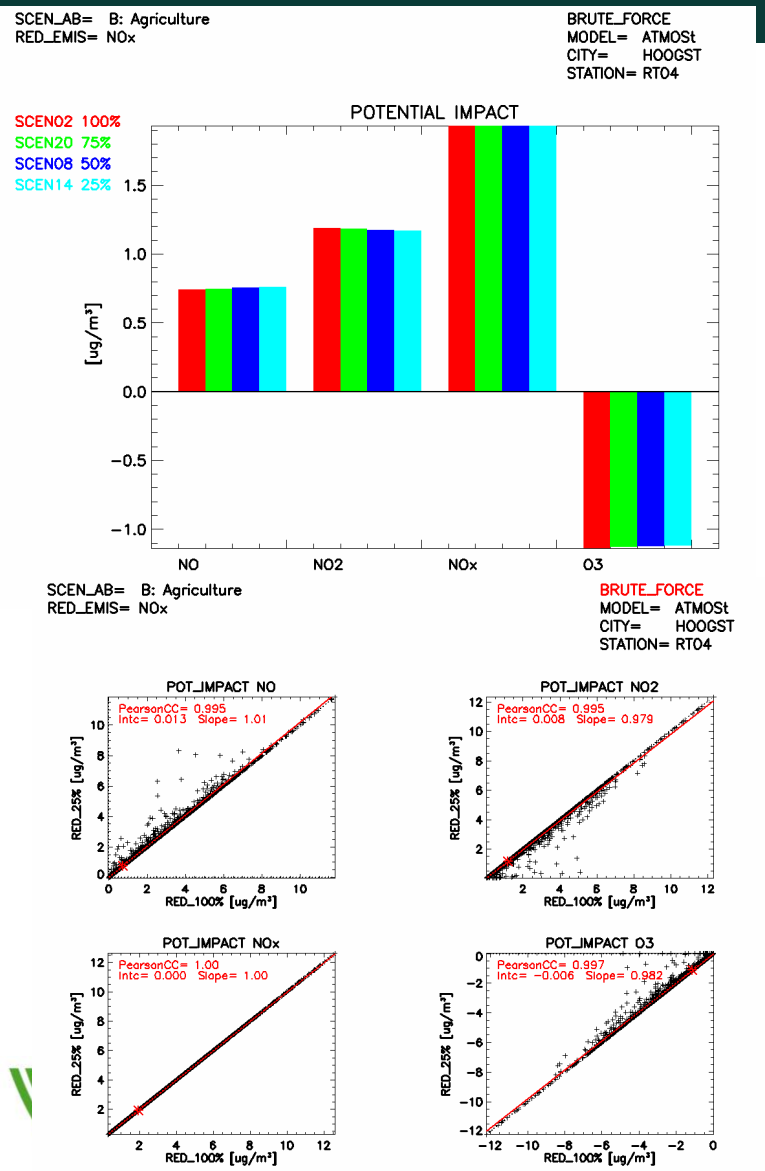
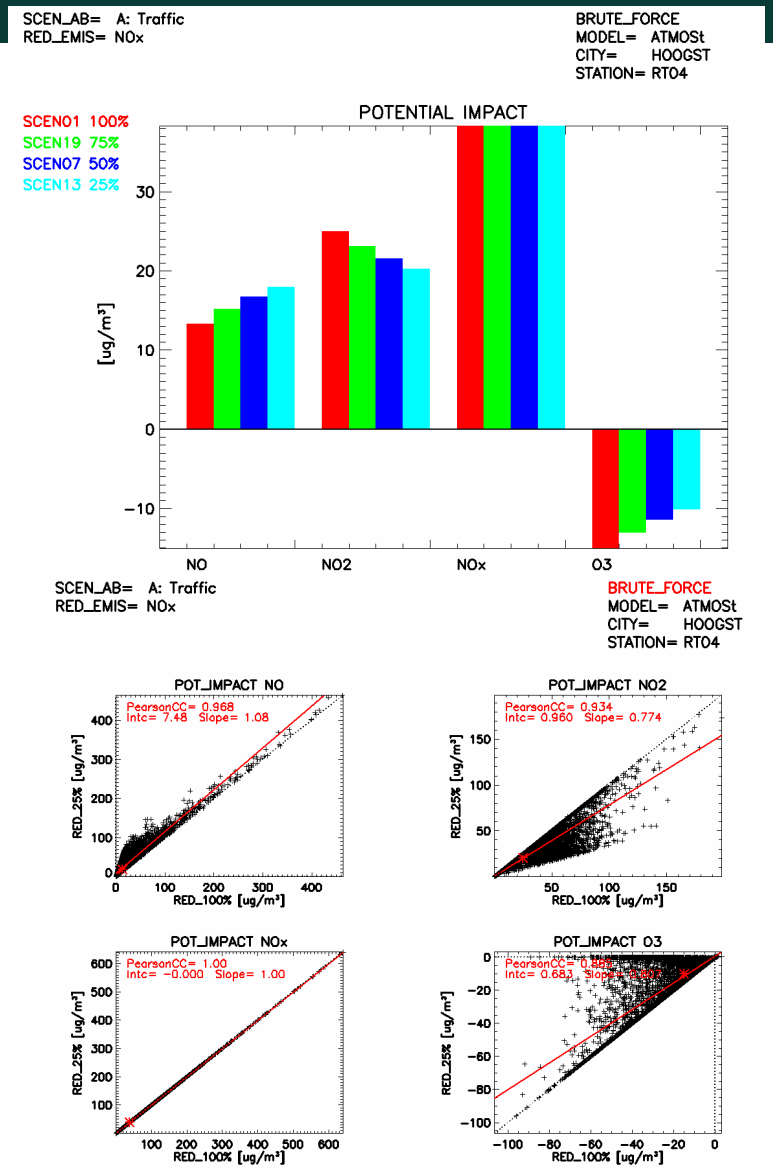
ATMOSt - Consistency – NOX reduction – RT04





- ATMOSt is fully consistent for NOX
- Does it mean that dispersion processes do not influence SA results?

- NO2 results at 25% are generally lower than corresponding P.I. at 100%
- Any idea about the “cloud” you obtain pairing P.I. at 25 and 100%?

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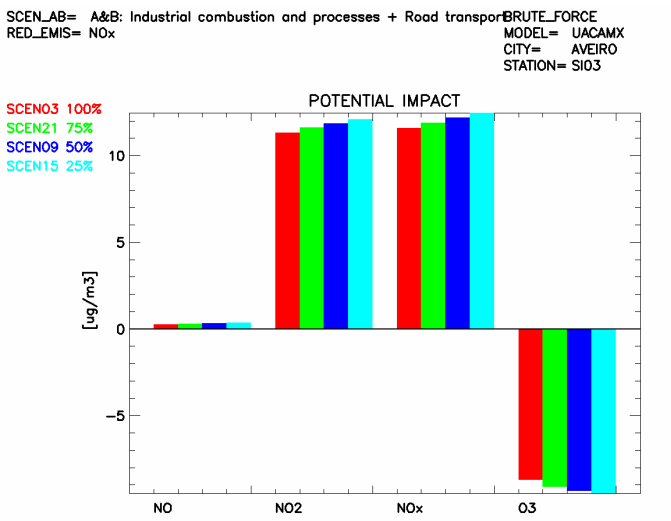
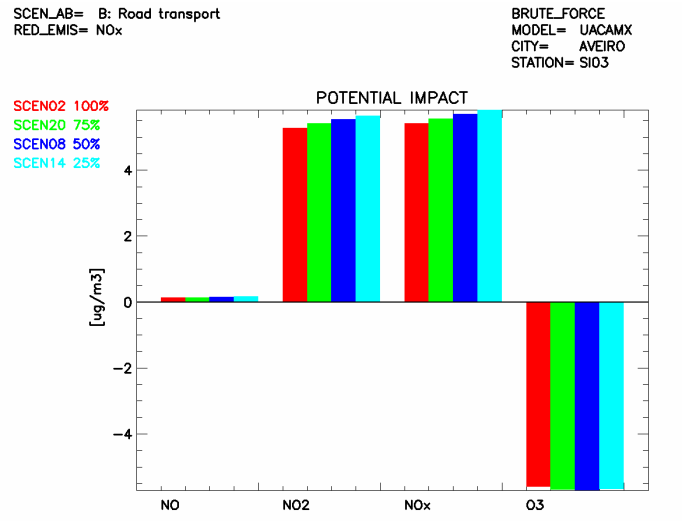
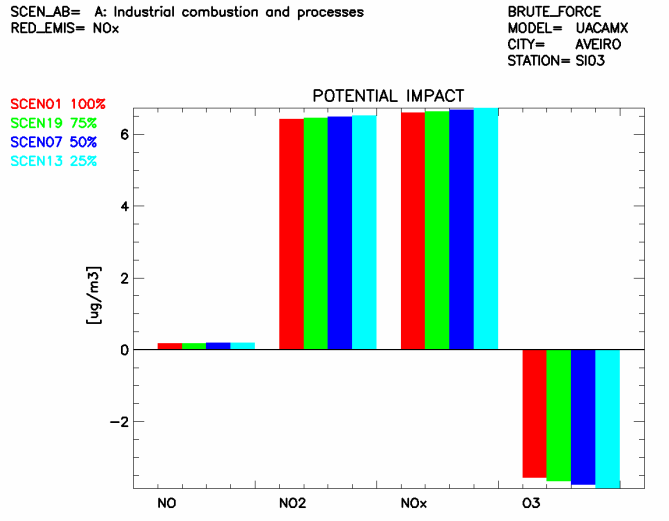
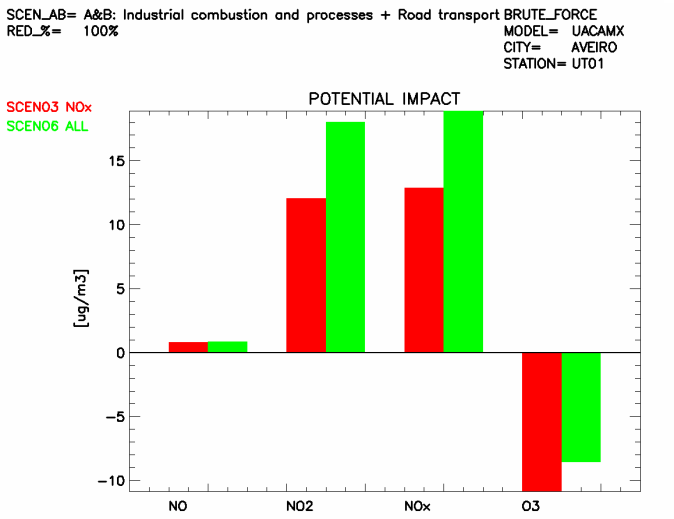
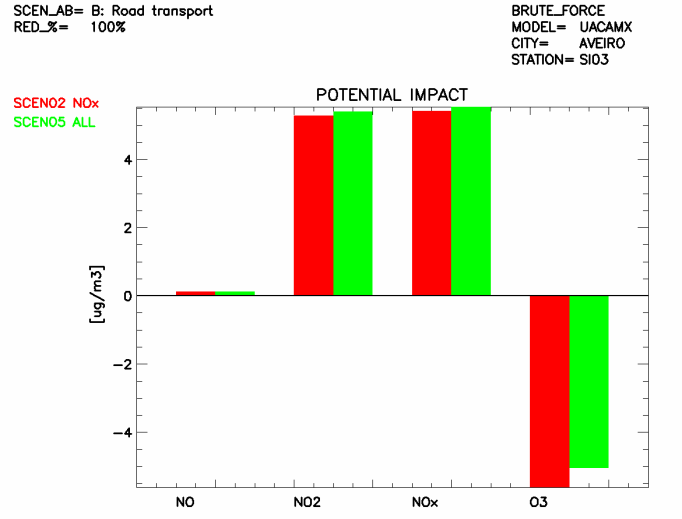
UACAMX - Consistency – NOX vs ALL - SI03

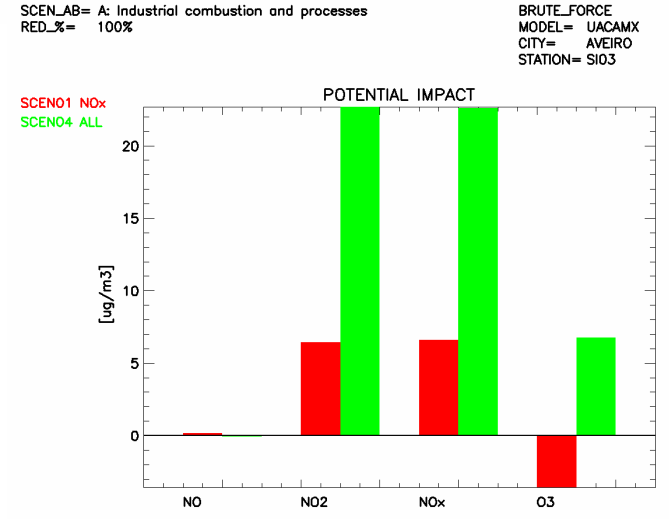






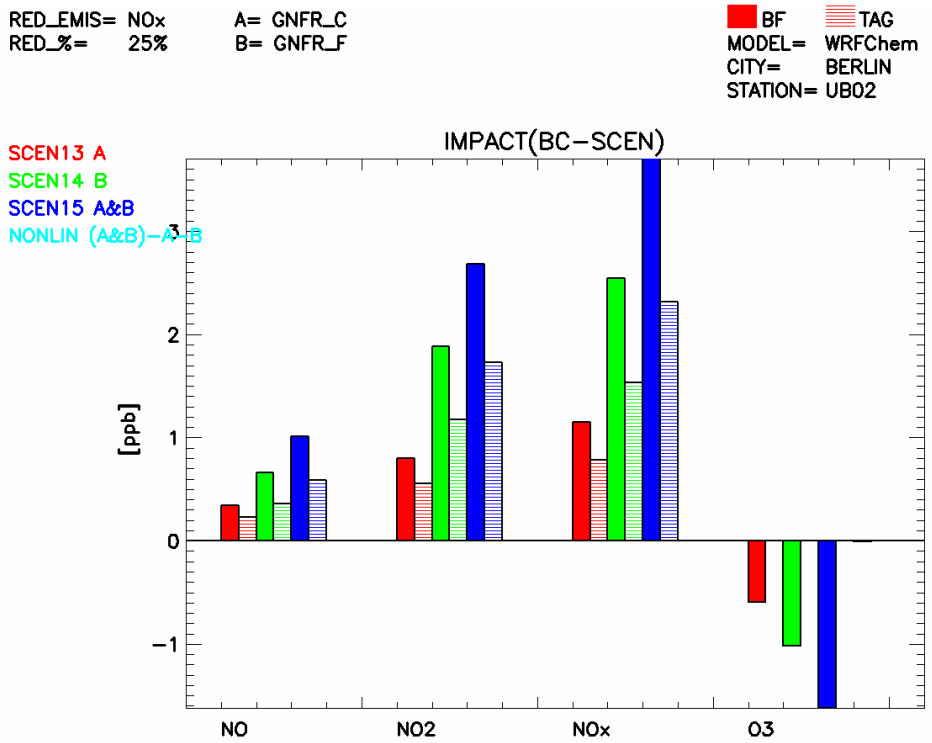


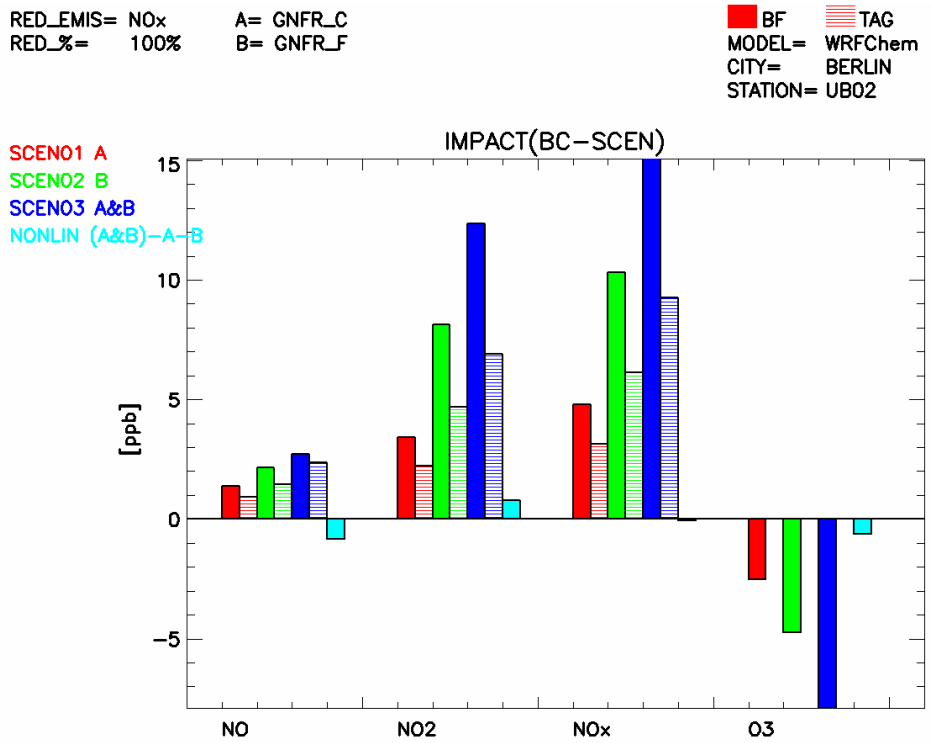




Differences in SI03 are related to Industry (also in other sites…)

WRFCHEM - Additivity – NOX reduction – 25 vs 100% - TAG vs BF





NO2 results are additive for TAG, by definition, at all sites and for all reduction strengths
Of course they do not represent “impacts” but “contributions”
Results are substantially additive also for BF
TAG and BF are different but showing the same ranking

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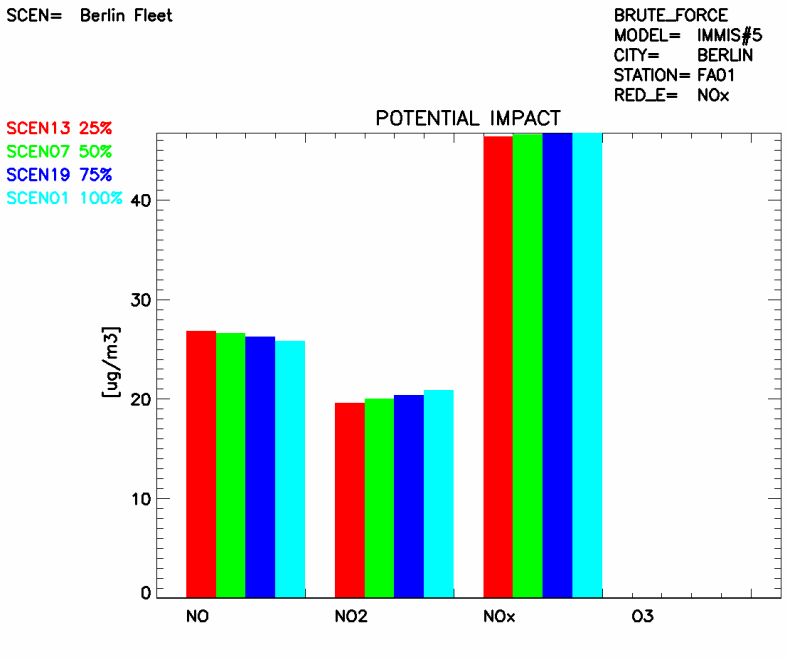
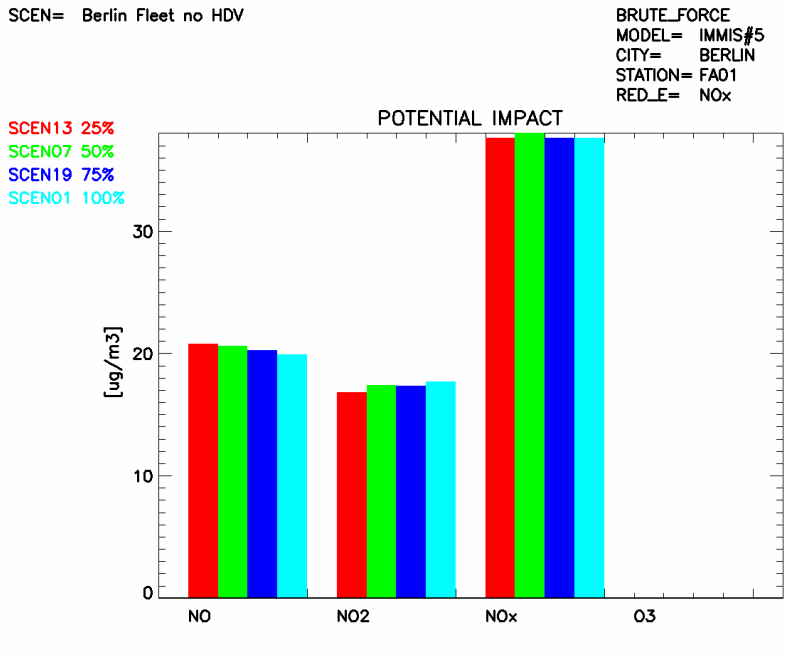
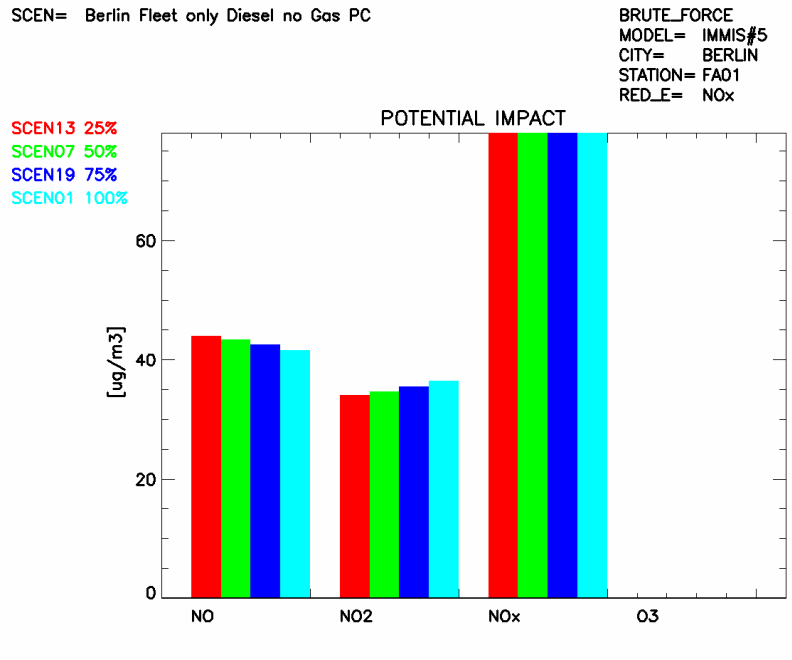
IMMIS - Consistency – NOX reduction – Yearly mean values







Results are substantially consistent for all reduction strengths, with a minor increase from 25 to 100%
Looking at xls files it seems that such (minor) inconsistency is related to ZNO2_PC_M
(i.e. NO2 term from photochemistry).
Do you agree?

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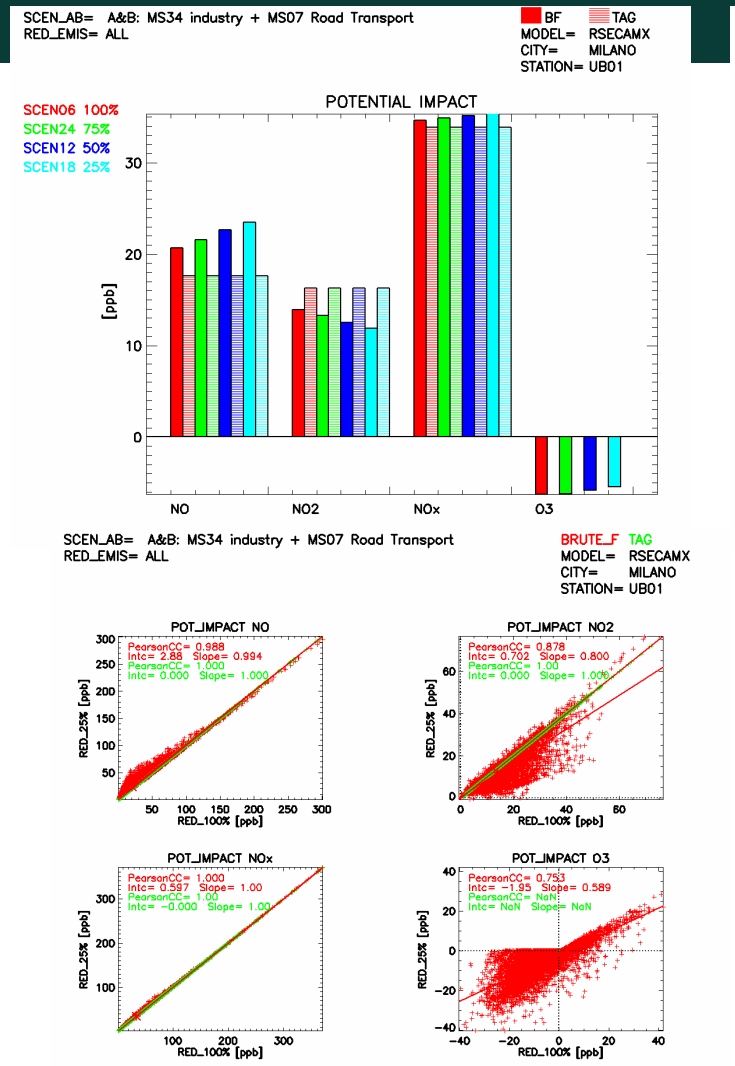
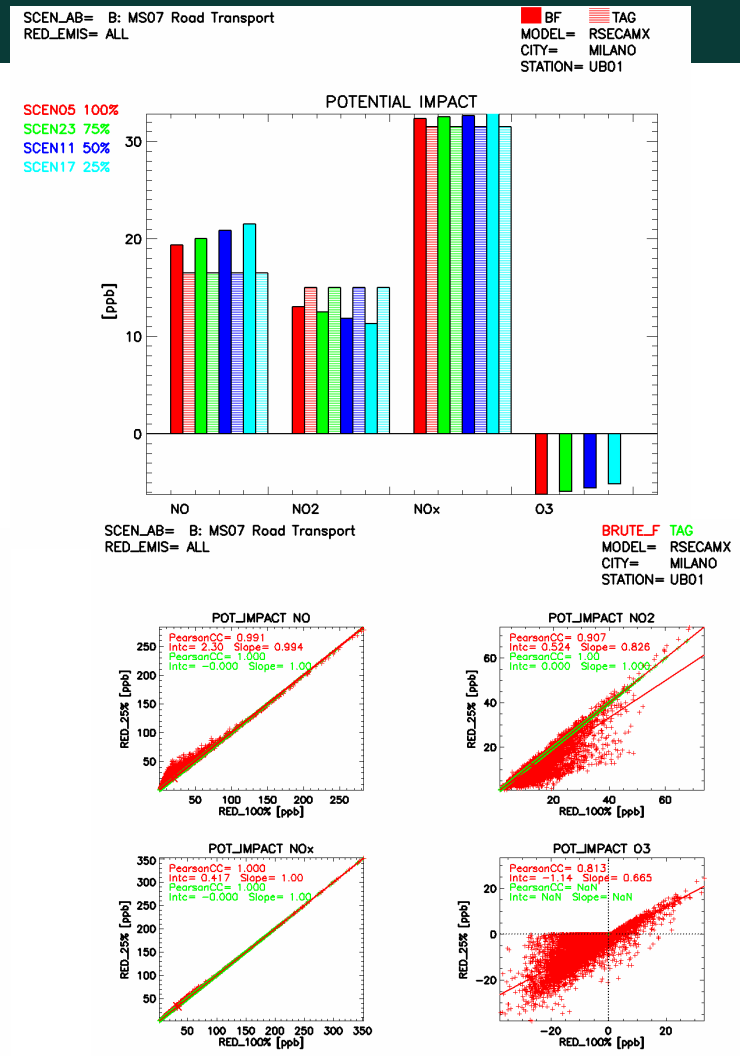
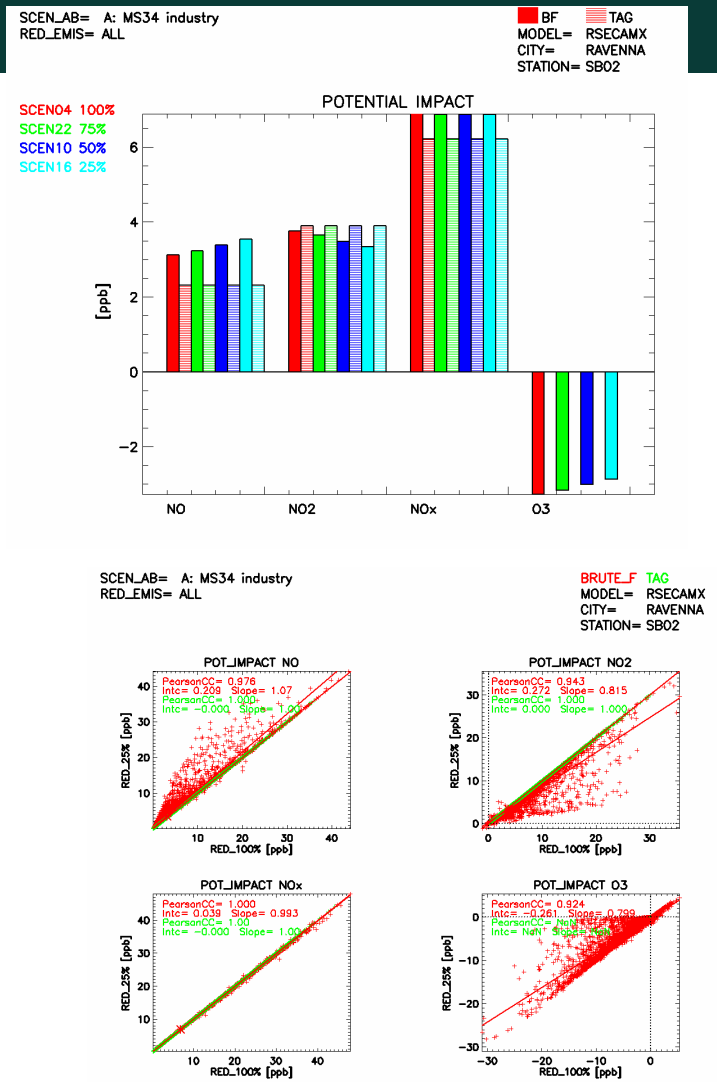
RSE CAMx - Consistency – ALL reduction – TAG vs BF







P.I. shows greater differences on hourly basis, when comparing 25 and 100% reduction
TAG results are consistent by definition, but they represent “contributions” not “impacts”

Modelling teams…

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Preliminary conclusions

Consistency

- NO2 brute force results are consistent for all models for **average values**, with minor differences generally not influencing the overall analysis of the role of the different sources
- On **hourly basis BF results for NO2 are more scattered**, pointing out that there are several situations where SA results are not consistent
- Discrepancies are not related to peak values, but to a wide range of NO2 values
- Discrepancies are probably related to the influence of the non-linearity in NO-NO2-O3 chemistry
- NOX results are generally consistent for all models

Additivity

- NO2 brute force results are additive for all models for **average values**, with minor differences generally not influencing the overall analysis of the different sources (single vs combined)
- On **hourly basis BF results for NO2 are more scattered**, pointing out that there are several situations where SA results are not additive
- Discrepancies are not related to peak values, but to a wide range of NO2 values
- Discrepancies are probably related to the influence of the non-linearity in NO-NO2-O3 chemistry
- NOX results are generally additive for all models

Role of chemical profiles (NOX vs ALL)

- Reducing only NOX emissions instead of all sector emissions (e.g. NVOC) does not introduce relevant differences in SA results. According to the model setup, the user can consider both choices for a first guess analysis

TAG vs BF

- Results for TAG are consistent and additive by definition, but they represent contributions not impacts!
- Results for TAG and BF are overlapping for NOX (as expected)
- Results show some discrepancies for NO2, but the approaches provide coherent information about the role of the different sources for yearly mean values

Next steps

- **Additional analysis from modelling groups**
  (to be discussed with modelling teams…)
  - Completing the dataset with missing scenarios
  - Performing ad hoc analysis with subset of data
  - Performing additional runs for sensitivity analysis
  - …
- **Drafting of the contribution for the Guidance (next plenary meeting)**
- **Scientific publication (beginning of 2022?)**

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