

# Brute Force and Tagging SA results with CAMx for the Aveiro region



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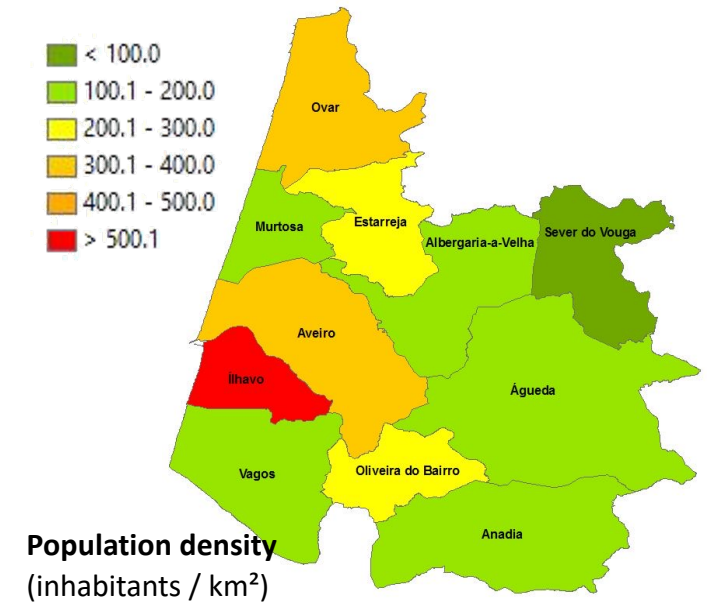
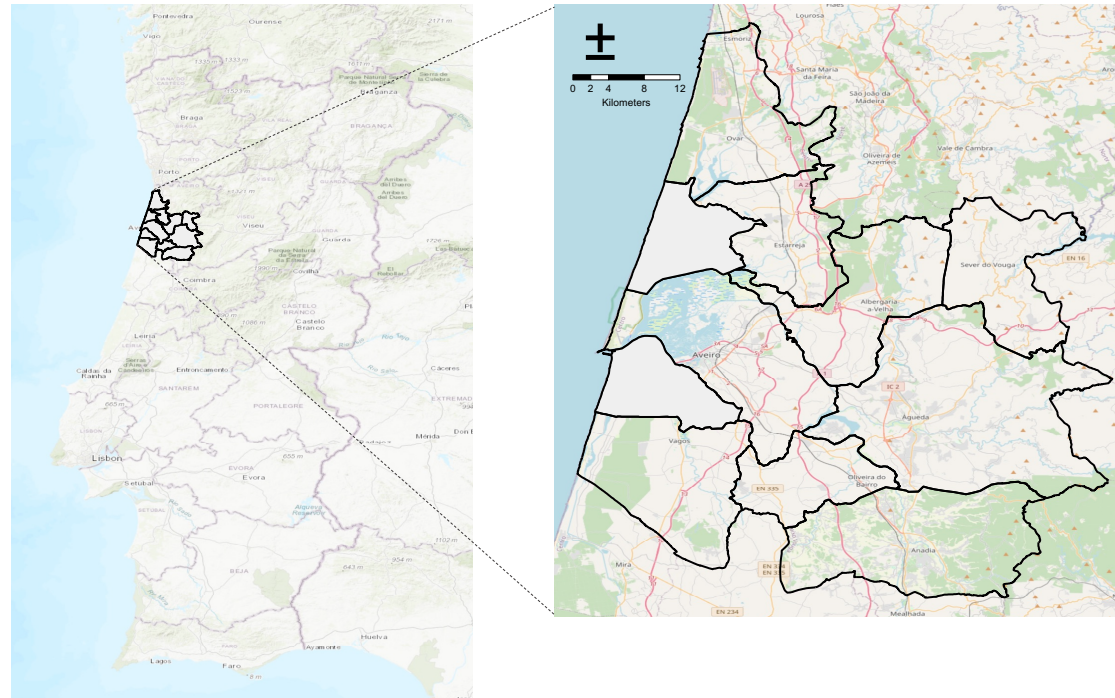
**CT1 – Source apportionment**

**FAIRMODE technical meeting, 18-20 October 2022**

# Case study | Aveiro region

## Multipolar region

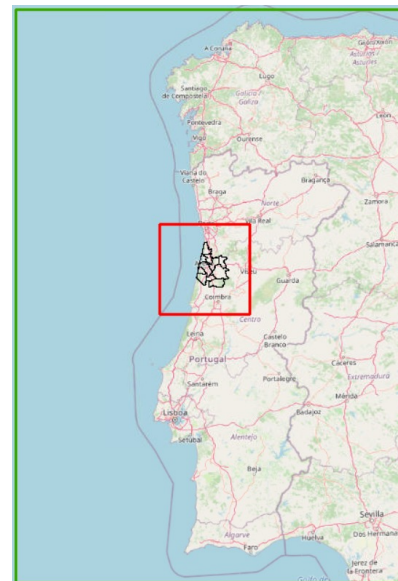
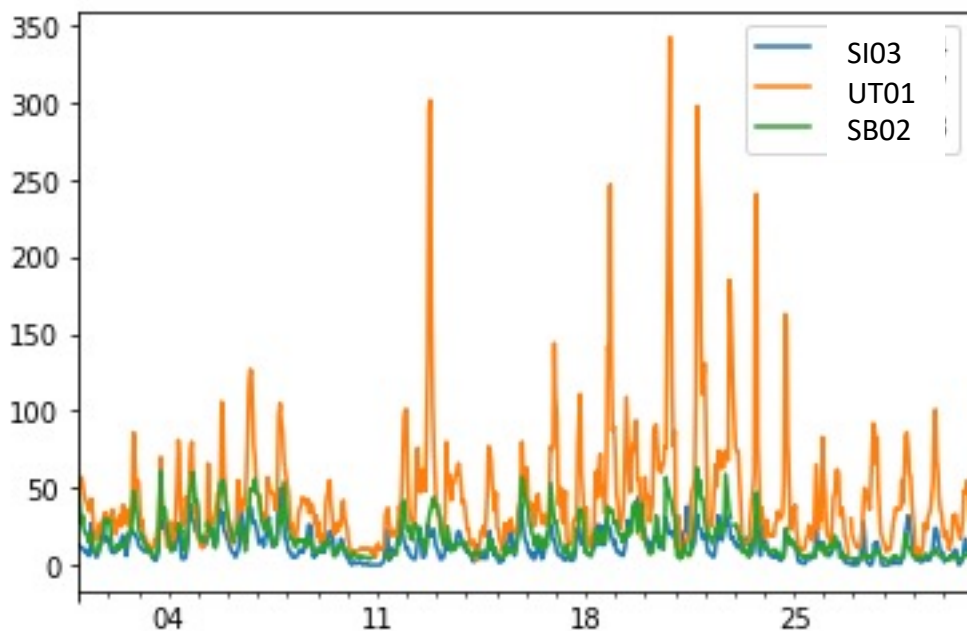
- Urban & Suburban
- Industrial
- Rural



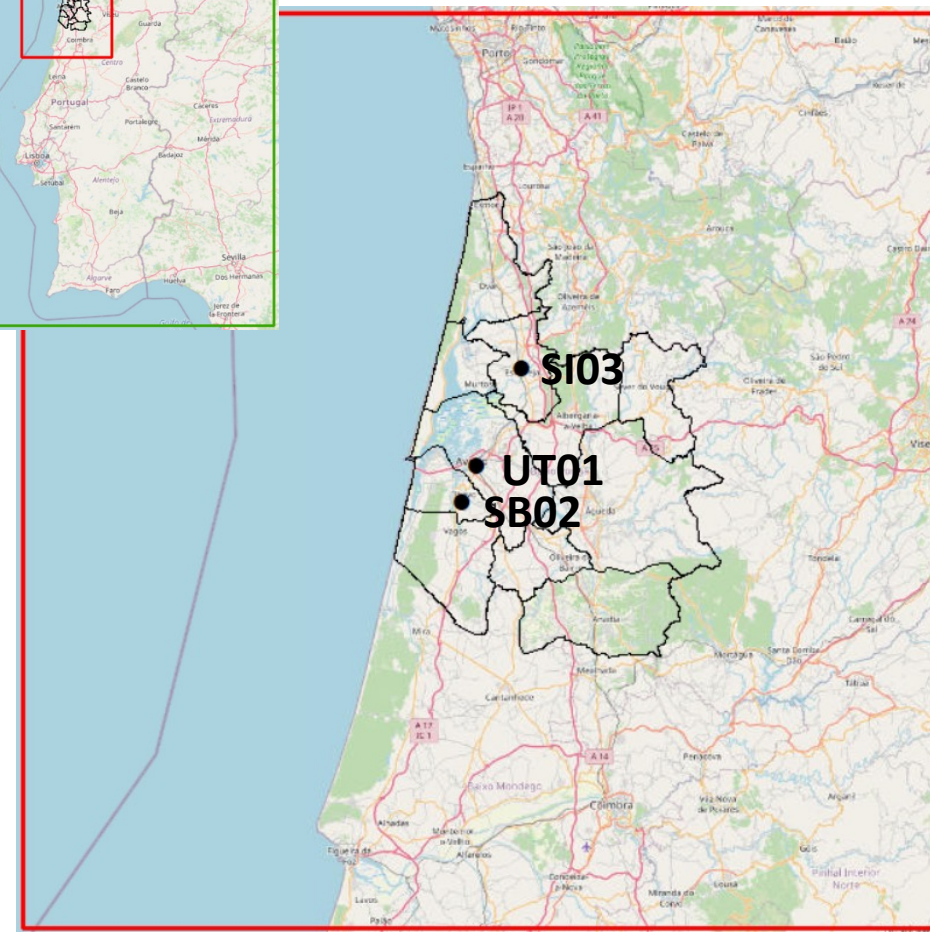
# Modelling setup

## WRF - CAMxv7.10

Chemical mechanism:	CB06
Initial/boundary conditions:	CAM-Chem
Dom & Resol	3 – 25, 5, 1 km resol
Period	10/12/2017 – 31/12/2017



125 x 125 cells, 1km<sup>2</sup>



# Modelling setup

WRF - CAMxv7.10

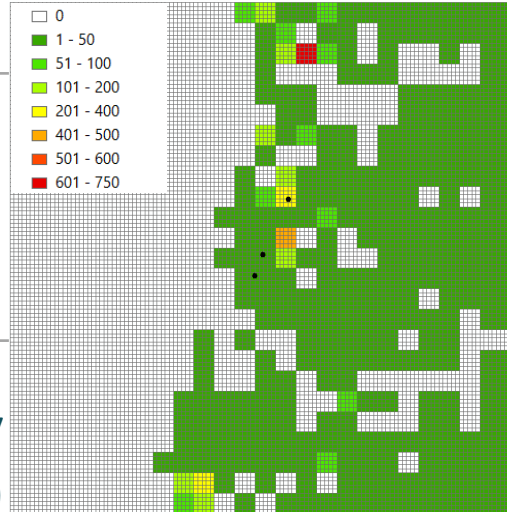
Emissions

EMEP 0.1<sup>o</sup>, disaggregated to D2 and D3 with proxies by SNAP sector

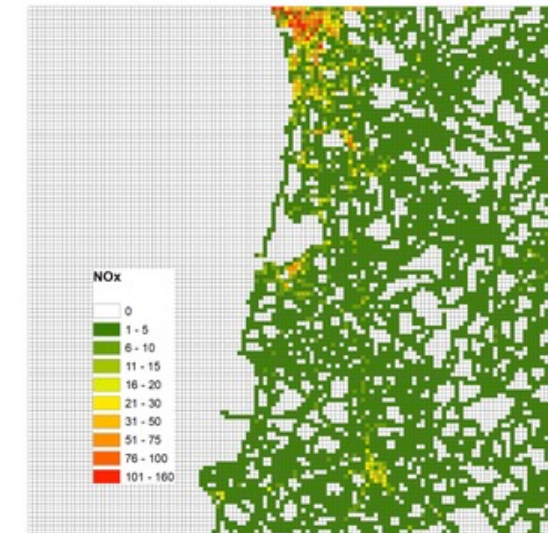
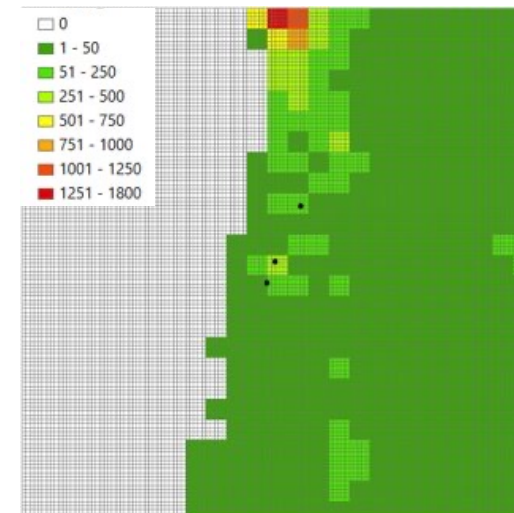
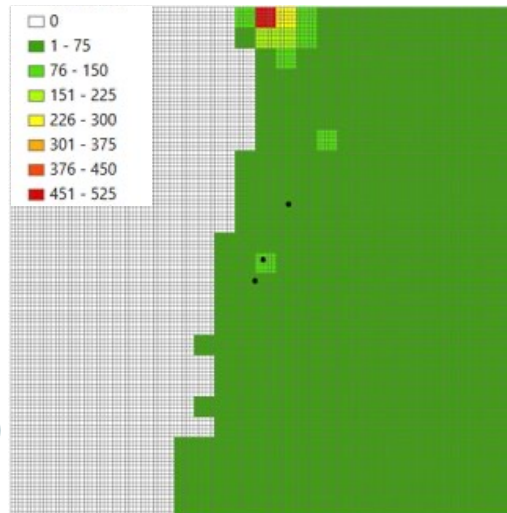
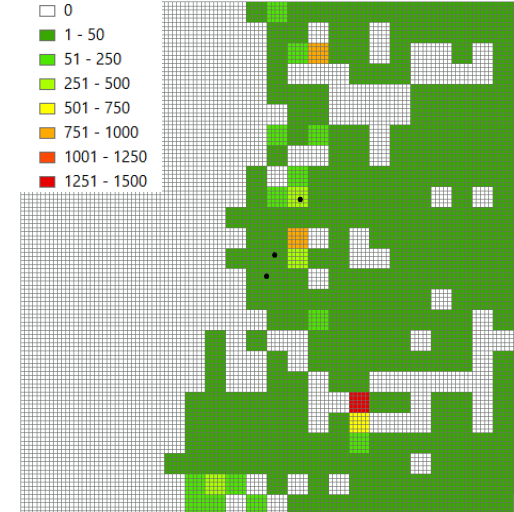
Industrial processes/  
combustion (A)

Road transport (B)

NMVOC



NOx



## Scenarios and Source apportionment methods

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### 24 scenarios (as a combination of):

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<b>Emission reductions:</b>	<ol style="list-style-type: none"><li>1. 25%</li><li>2. 50%</li><li>3. 75%</li><li>4. 100%</li></ol>
<b>Applied to:</b>	<ol style="list-style-type: none"><li>1. NO<sub>x</sub></li><li>2. ALL pollutants</li></ol>
<b>From sectors:</b>	<ol style="list-style-type: none"><li>1. Industrial processes/combustion (A)</li><li>2. Road transport (B)</li><li>3. A&amp;B</li></ol>

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### Brute Force (BF)

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**Runs:** Individual simulation of each of the 24 scenarios

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### Tagging (TAG) - OSAT (NO<sub>2</sub>)

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**Source groups:**

1. NO<sub>x</sub> from industry
2. NO<sub>x</sub> from road transport
3. Other Poll from industry
4. Other Poll from road transport
5. Other sectors

**Receptor areas:** Location of the 3 air quality measurement sites

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# Analysis and Results

## Outputs of

24 scenarios of BF runs  
Tagging run

## @ 3 stations:

UT01 – urban traffic  
SB02 – Suburban background  
SI03 – Suburban Industrial

Concentrations

Impact

**Potential Impact (PI)**

$$I = \Delta C(a)$$

$$PI = \Delta C(a) / a$$

*difference between a model base case simulation (with full emissions) and a simulation in which the source emissions are reduced by a factor  $a$ , divided by  $a$ .*

*$a = 100\%, 75\%, 50\%, 25\%$*

# Results – Brute Force - consistency

NOx red → PI

UT01

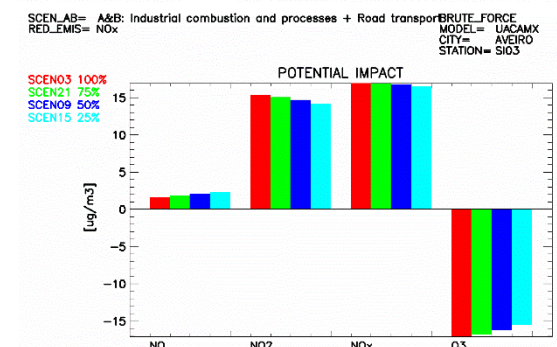
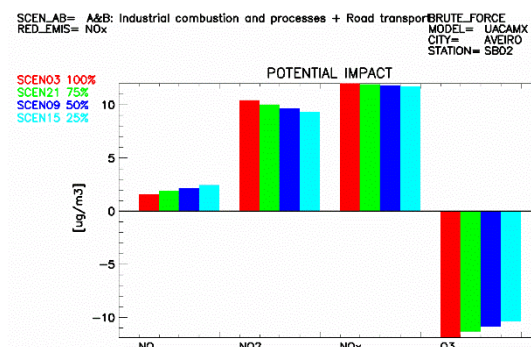
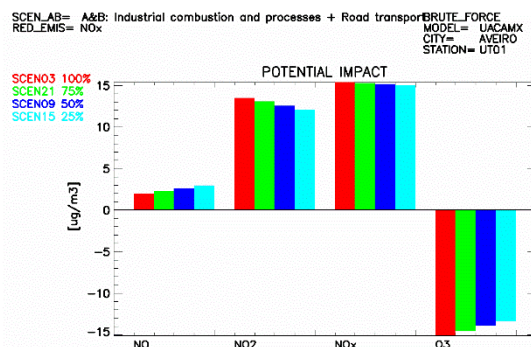
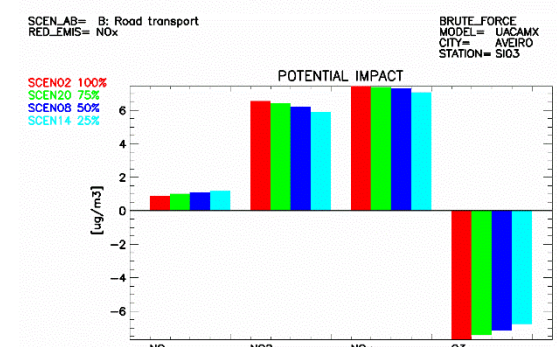
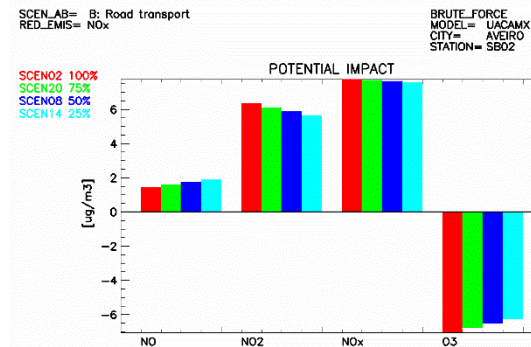
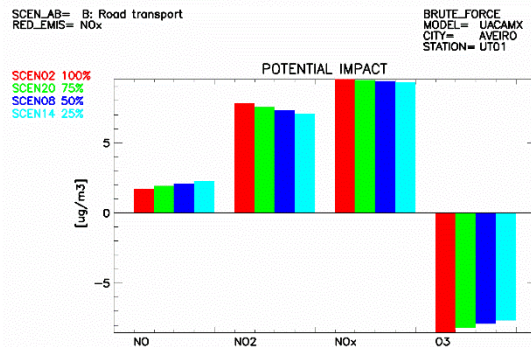
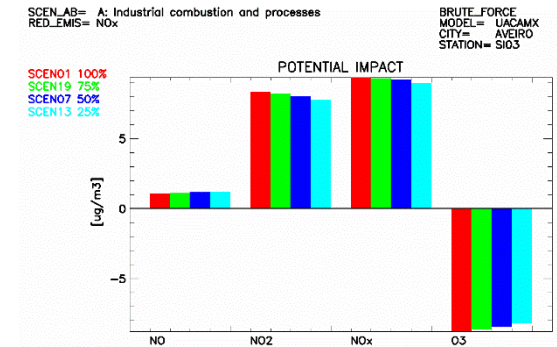
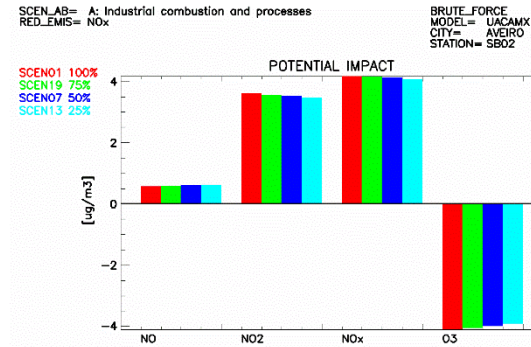
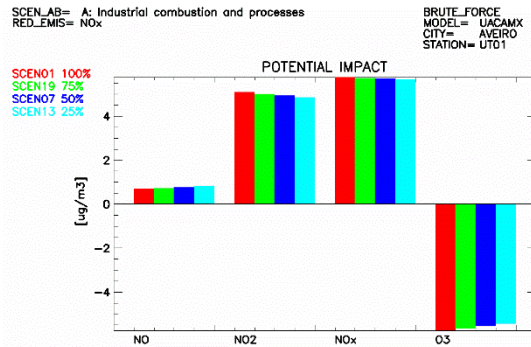
SB02

SI03

A - Industry

B - Transport

AB



# Results – Brute Force - consistency

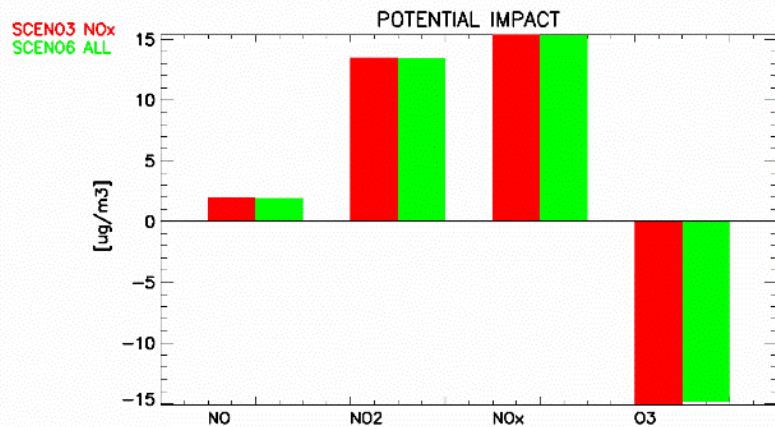
NOx vs ALL, 100% red → PI

UT01

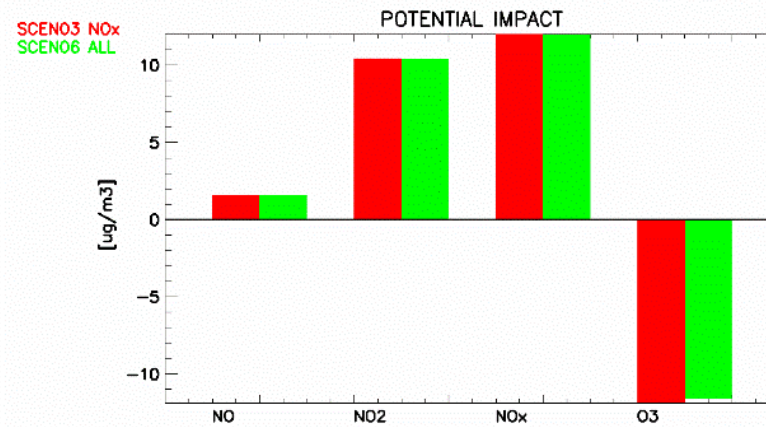
SB02

SI03

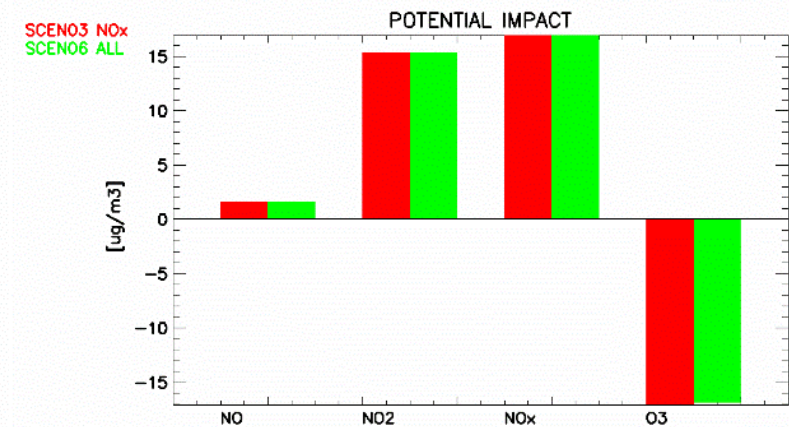
SCEN\_AB= A&B: Industrial combustion and processes + Road transport BRUTE\_FORCE  
RED\_%= 100%  
MODEL= UACAMX  
CITY= AVEIRO  
STATION= UT01



SCEN\_AB= A&B: Industrial combustion and processes + Road transport BRUTE\_FORCE  
RED\_%= 100%  
MODEL= UACAMX  
CITY= AVEIRO  
STATION= SB02



SCEN\_AB= A&B: Industrial combustion and processes + Road transport BRUTE\_FORCE  
RED\_%= 100%  
MODEL= UACAMX  
CITY= AVEIRO  
STATION= SI03



AB

Same results for A and B individually, and for all reductions



# Results – Brute Force - consistency

NOx red → PI red25 vs red100

UT01

SB02

SI03

SCEN\_AB= B: Road transport  
RED\_EMIS= NOx

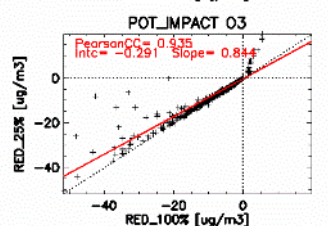
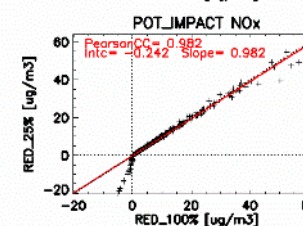
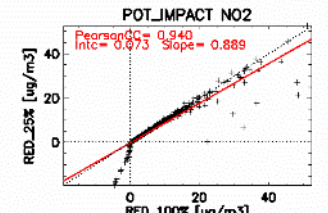
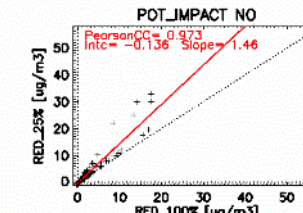
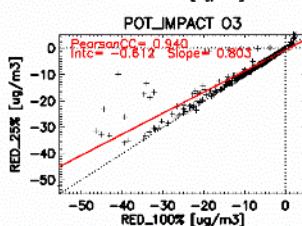
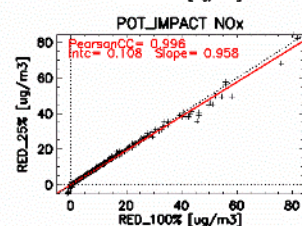
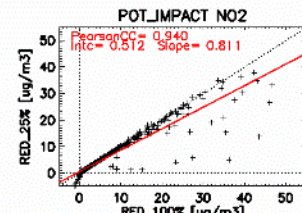
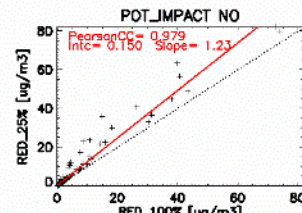
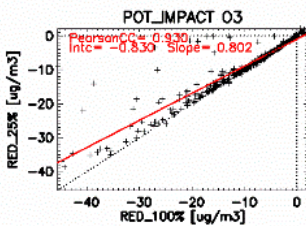
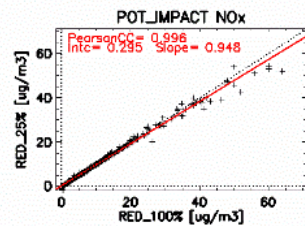
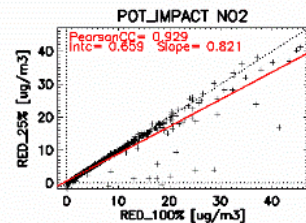
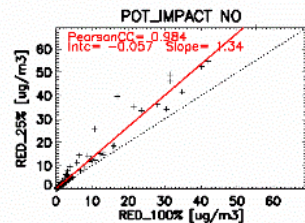
BRUTE\_FORCE  
MODEL= UACAMX  
CITY= AVEIRO  
STATION= UT01

SCEN\_AB= B: Road transport  
RED\_EMIS= NOx

BRUTE\_FORCE  
MODEL= UACAMX  
CITY= AVEIRO  
STATION= SB02

SCEN\_AB= B: Road transport  
RED\_EMIS= NOx

BRUTE\_FORCE  
MODEL= UACAMX  
CITY= AVEIRO  
STATION= SI03

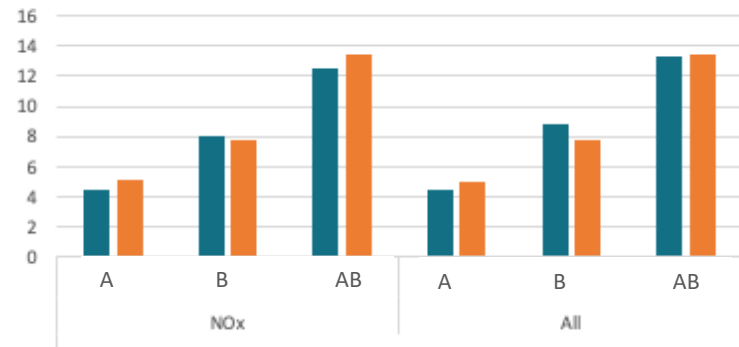


Correlation >0.98 for all stations except for Road Transport

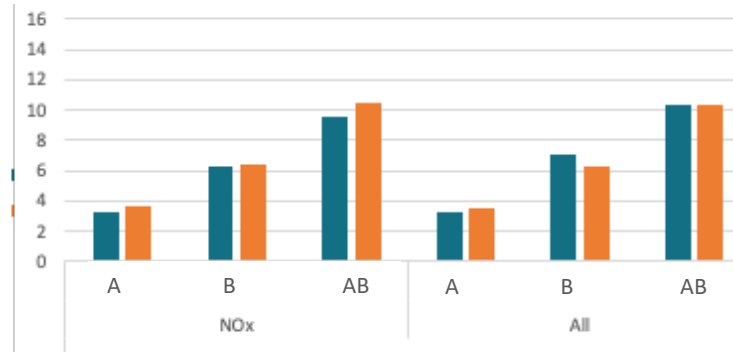
# Results – Brute Force vs Tagging

NOx / ALL 100% red → PI

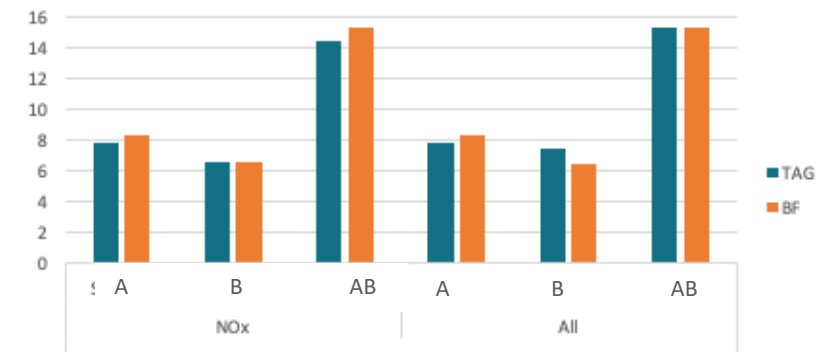
## UT01



## SB02

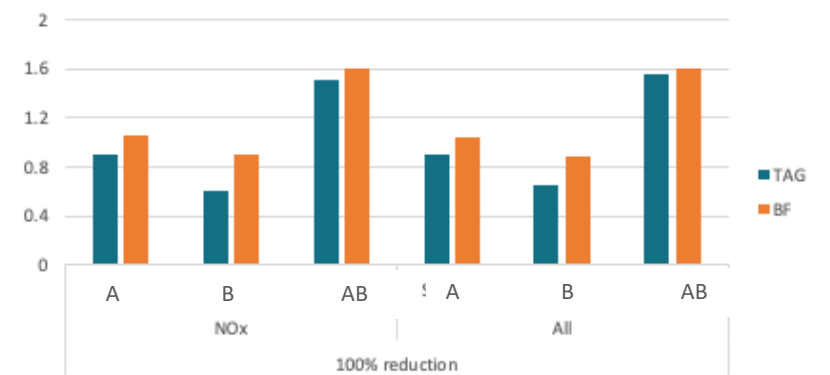
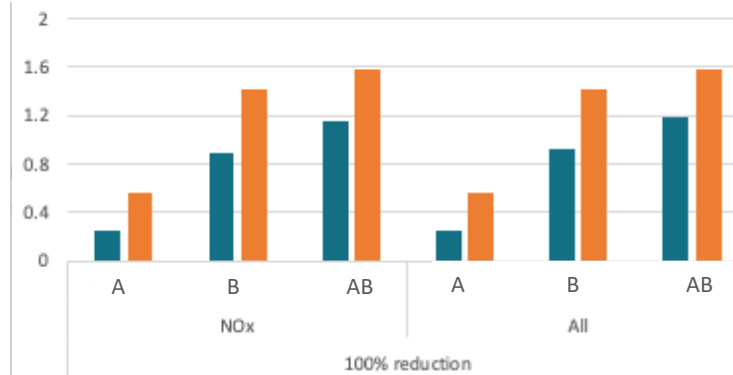
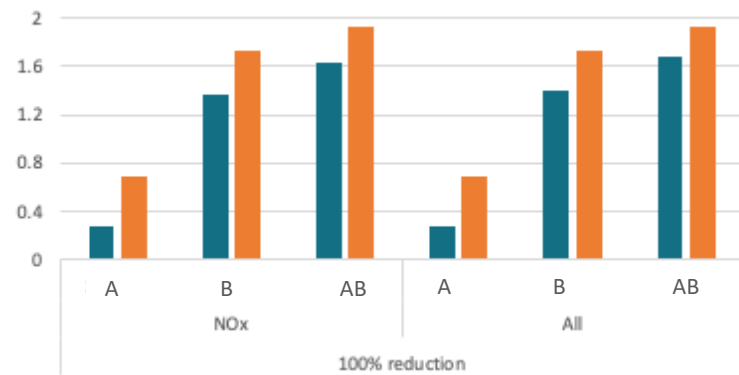


## SI03



NO<sub>2</sub>

NO



Consistent results for NO<sub>2</sub>

Differences between BF and TAG for NO

# Results – Brute Force vs Tagging



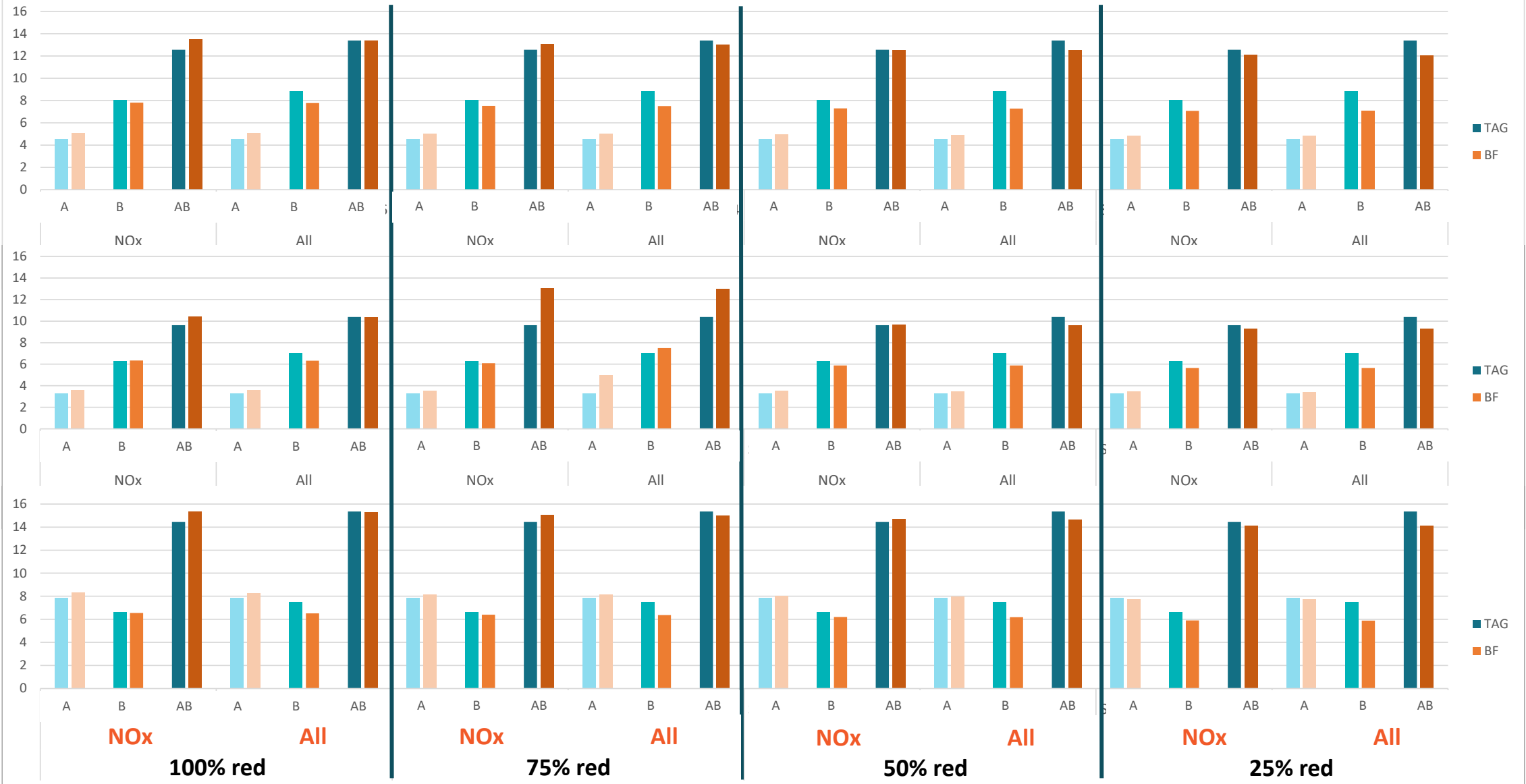
NOx / ALL red → Potential Impact

NO<sub>2</sub>

UT01

SB02

SI03



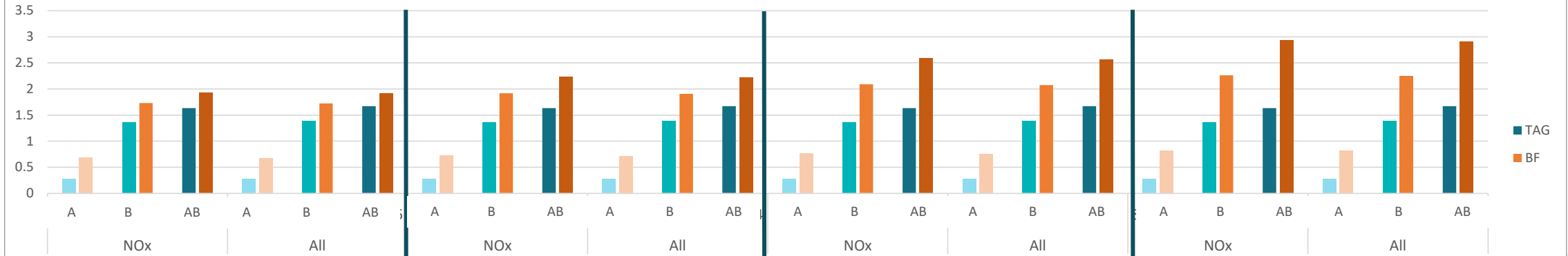
# Results – Brute Force vs Tagging



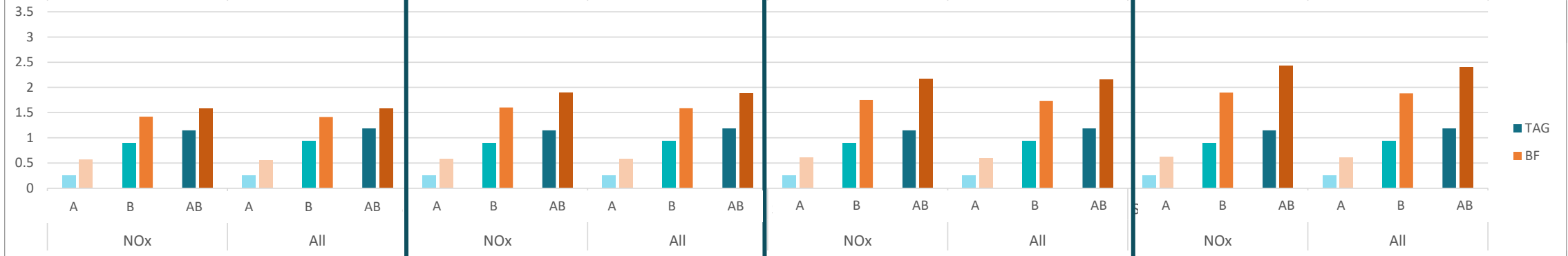
NOx / ALL red → Potential Impact

NO

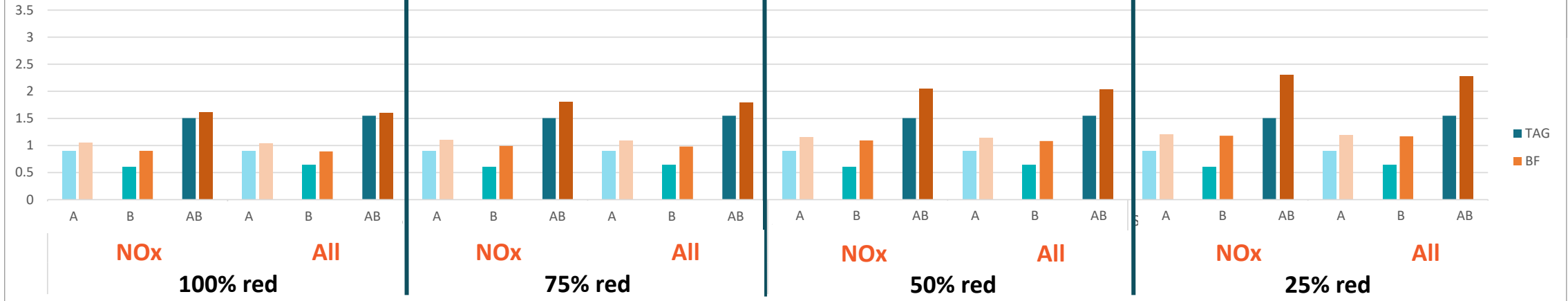
UT01



SB02



SI03



# Results - additivity

NO<sub>x</sub>/ALL 100% red → PI

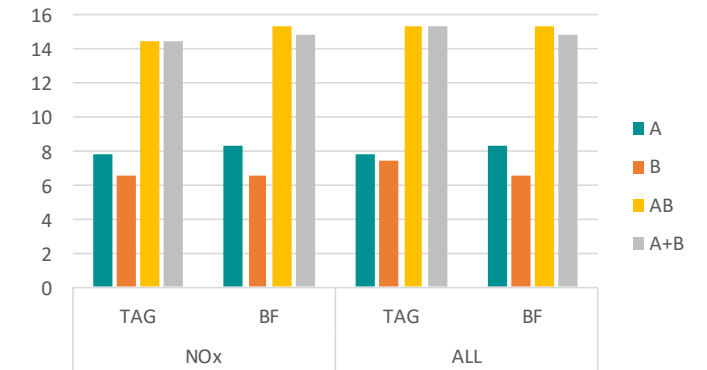
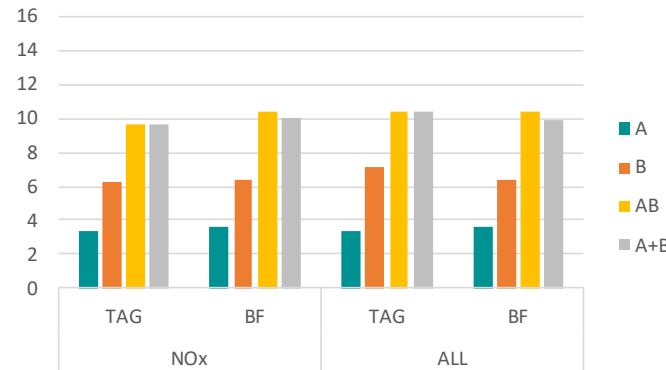
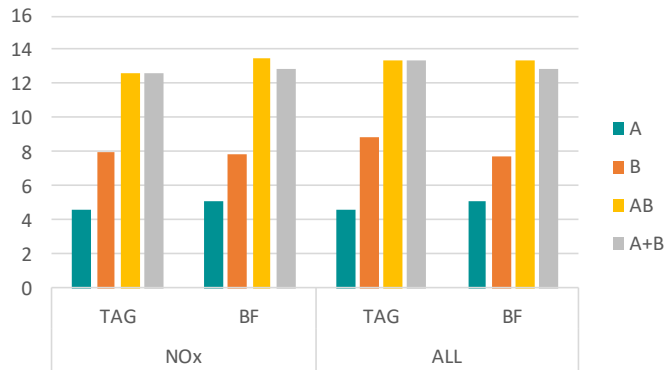
AB vs A+B

## UT01

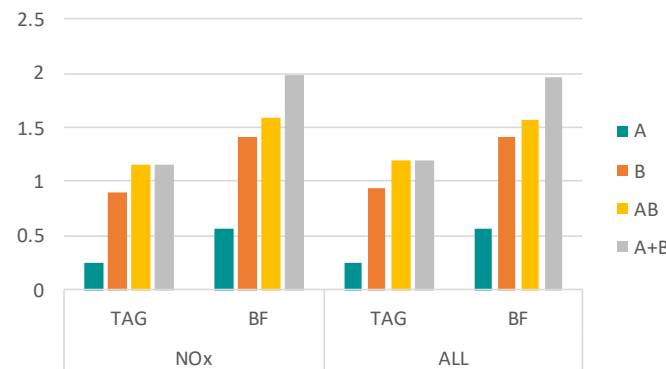
## SB02

## SI03

NO<sub>2</sub>








NO



Additive results of TAG for NO<sub>2</sub> and NO, considering both NO<sub>x</sub> and ALL reductions

BF – not additive for NO

# Final Remarks

-  Brute Force and Tagging source apportionment methods were applied and compared for 3 locations in the Aveiro region
-  In general, consistency and additivity properties were verified at all reduction strengths, for NO<sub>x</sub> and ALL reductions, and for the 3 sites.
-  Differences between BF and TAG increase with the decrease of reduction strength, and were higher for NO.
-  NO<sub>x</sub> and ALL reductions results are similar for BF and slightly different for TAG, especially for NO<sub>2</sub>
-  A combination of SA methods should be applied to guarantee a deep assessment and to avoid erroneous conclusions

# Brute Force and Tagging SA results with CAMx for the Aveiro region



**Thank you!**

Joana Ferreira

**CT1 – Source apportionment**

FAIRMODE technical meeting, 18-20 October 2022