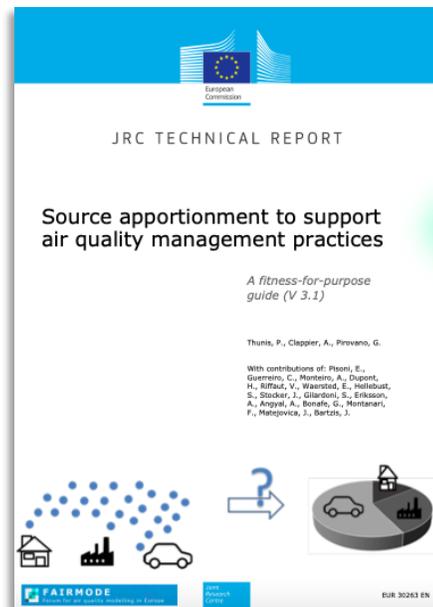


# **NO<sub>2</sub> response to emission reduction scenarios - comparing brute force and tagging source apportionment methods**

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CESAM & Department of Environment and Planning,  
University of Aveiro, Portugal

Information on **origin of air pollution** is essential for **air quality management**, to help identifying **measures to control** air pollution.



## Source apportionment methods

PM

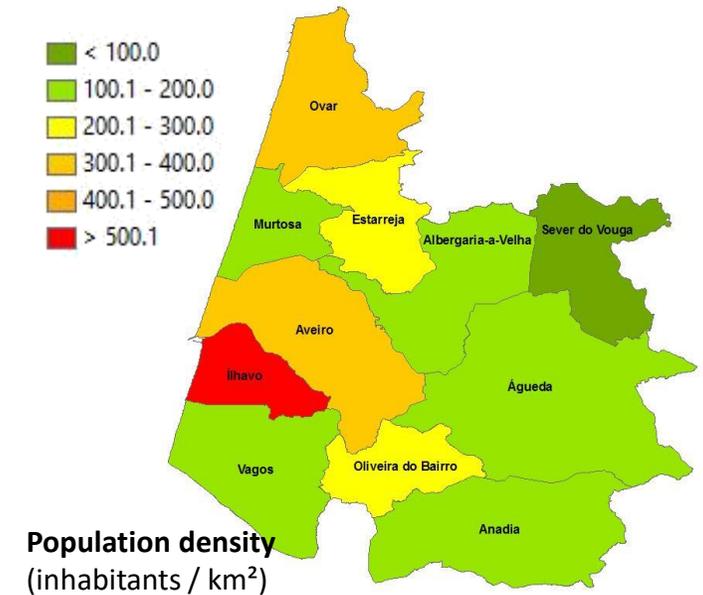
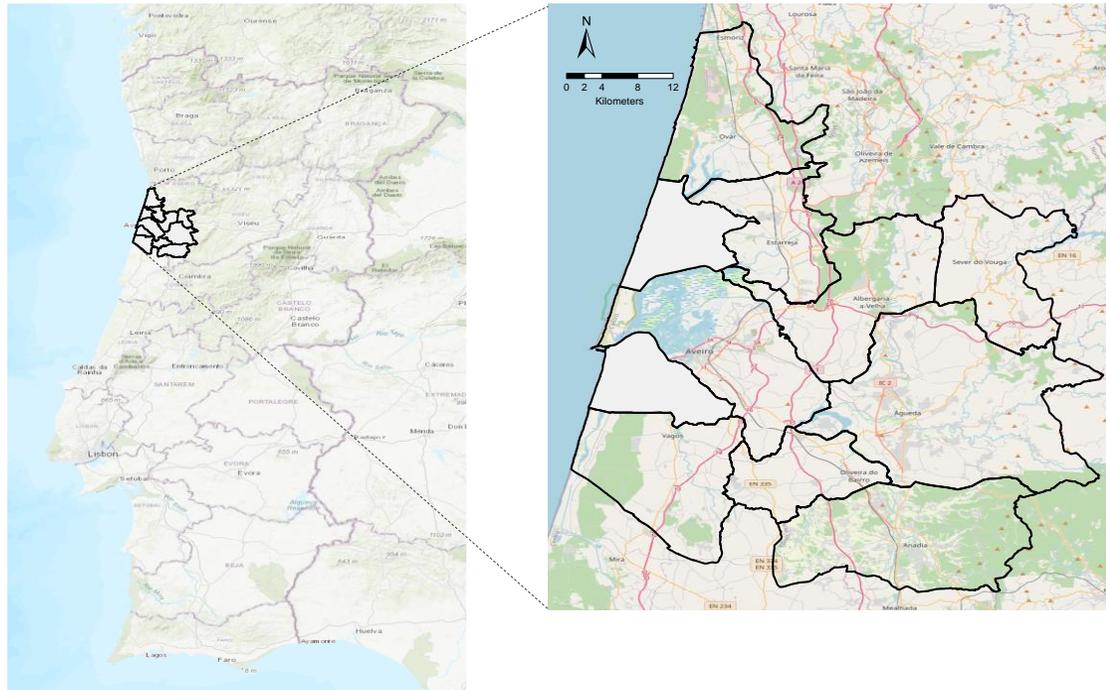
NO<sub>2</sub>

- Additivity?
- Consistency?
- Different methods lead to different results?
  - Brute Force
  - Tagging

# Case study | Aveiro region

## Multipolar region

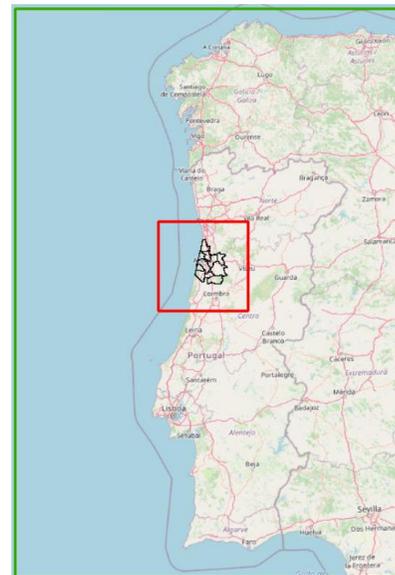
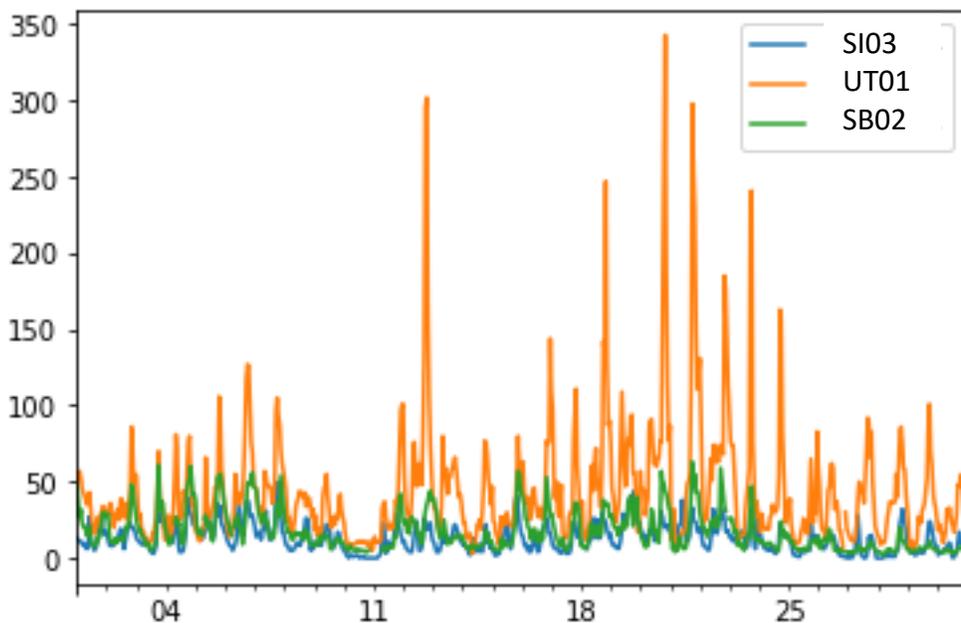
- Urban & Suburban
- Industrial
- Rural



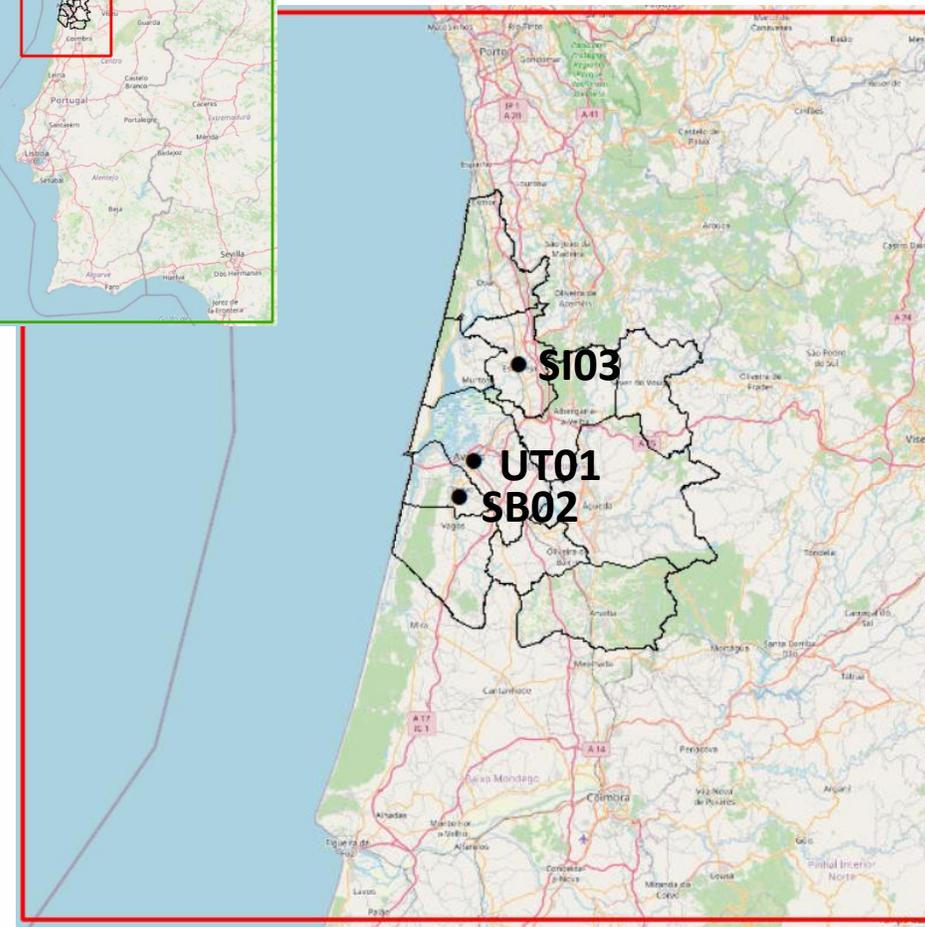
# Modelling setup

## 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

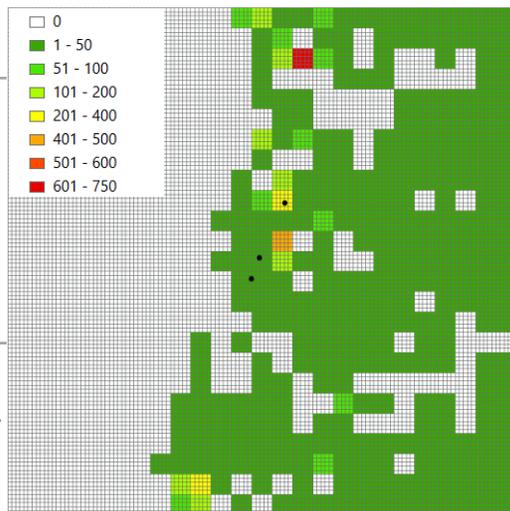
Emissions

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

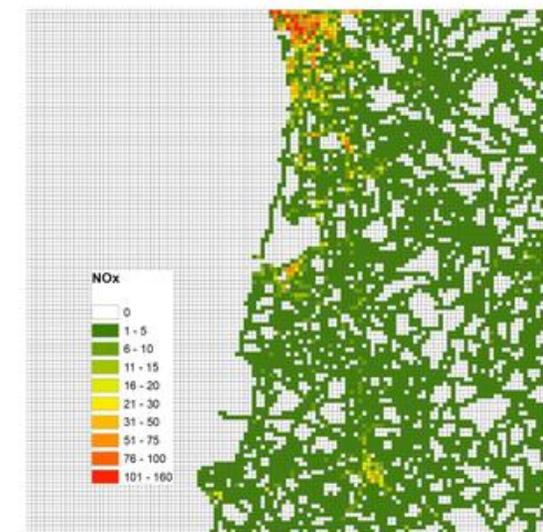
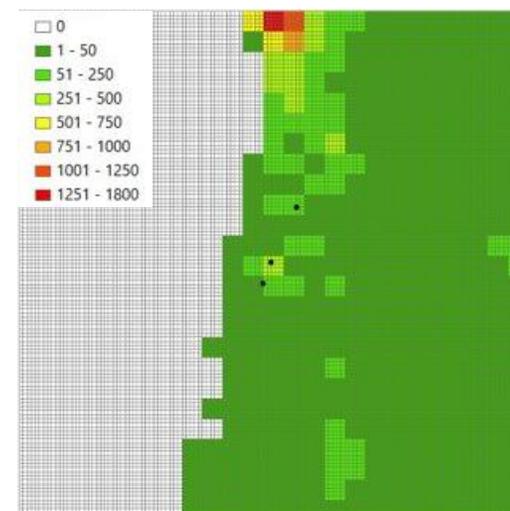
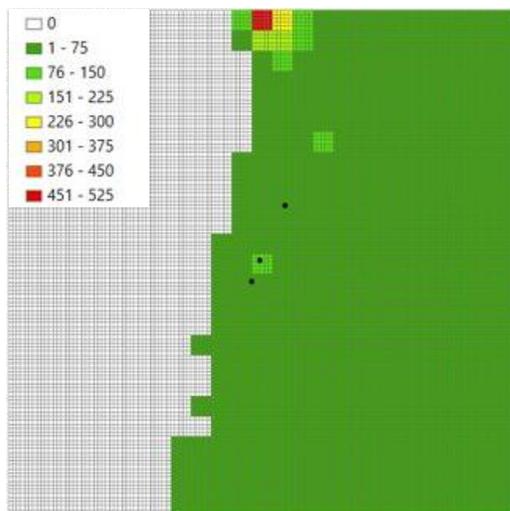
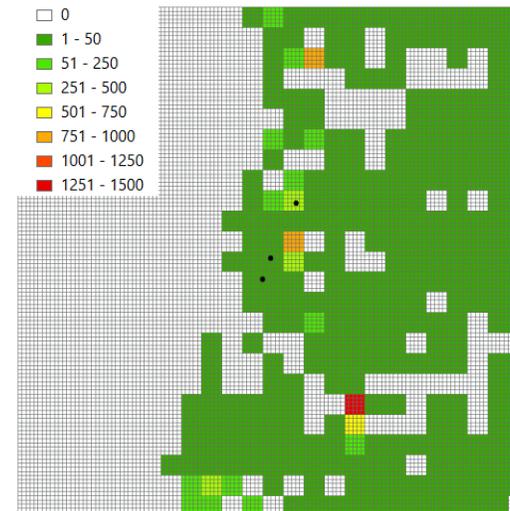
Industrial processes/  
combustion (A)

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 (T) - 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

---

## Outputs of

24 scenarios of BF runs

Tagging run treated to be compared with BF

## @ 3 stations:

UT01 – urban traffic

SB02 – Suburban background

SI03 – Suburban Industrial

Concentrations

Impact

Potential Impact (PI)

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

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

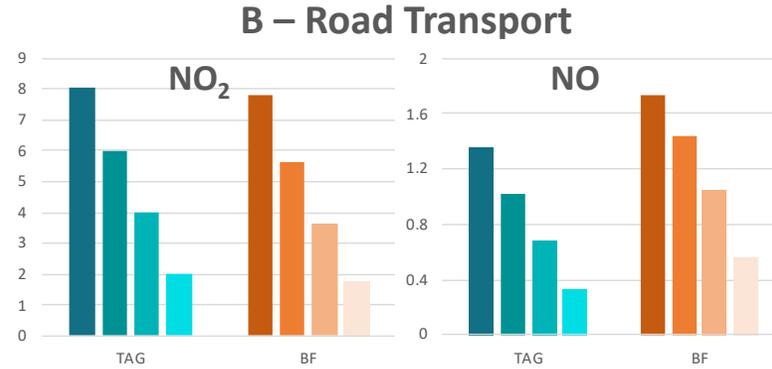
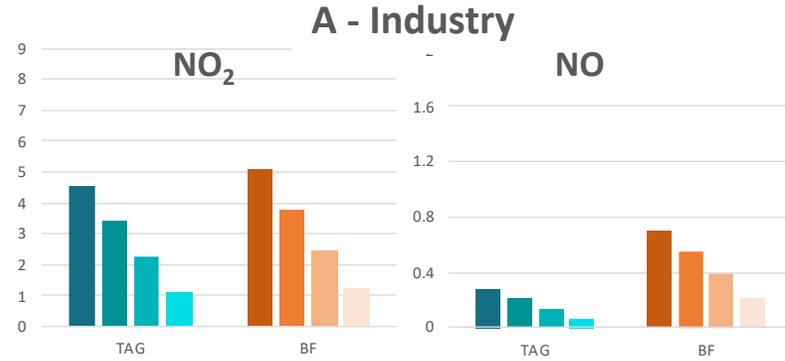
*difference between a model base case simulation (with full emissions) and a simulation in which the source emissions are reduced by a factor  $a$ , divided by  $a$ .*

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

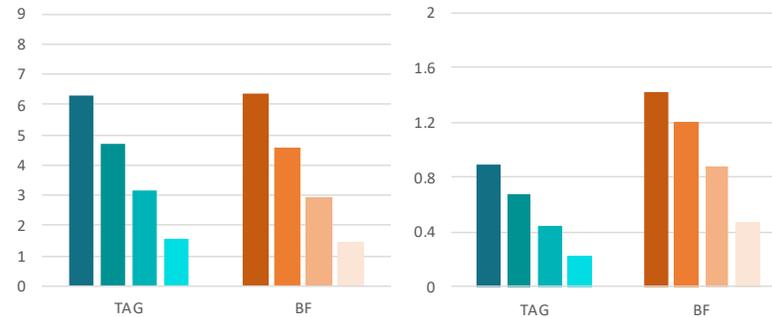
# Results - consistency

## NOx red → Impact

UT01

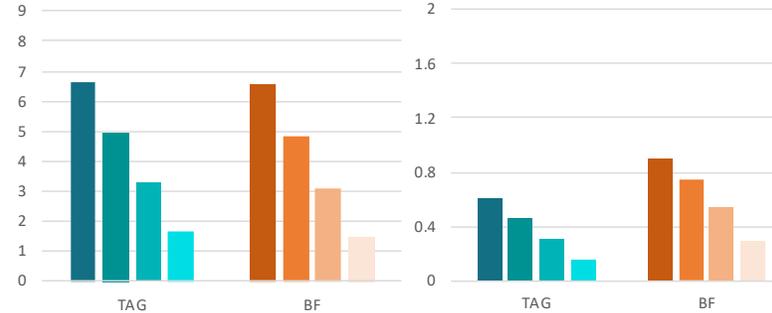
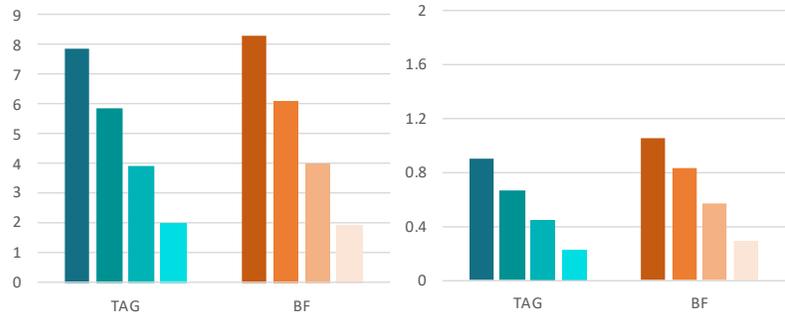


SB02



- 100% reduction NOx
- 75% reduction NOx
- 50% reduction NOx
- 25% reduction NOx

SI03

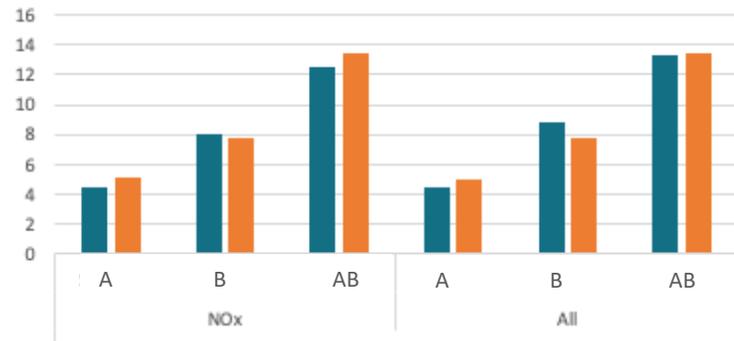


# Results – Brute Force vs Tagging

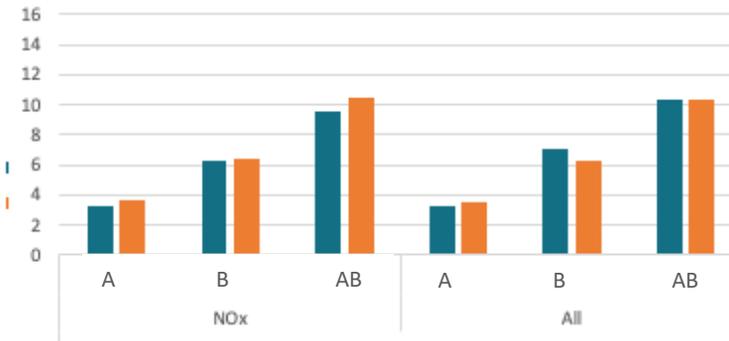
NOx / ALL 100% red → PI

NO<sub>2</sub>

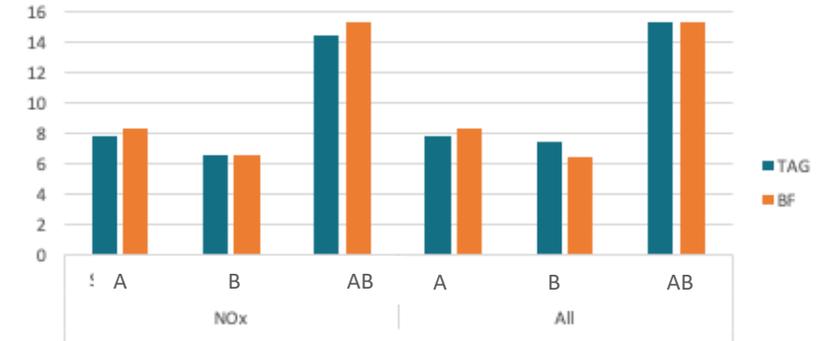
## UT01



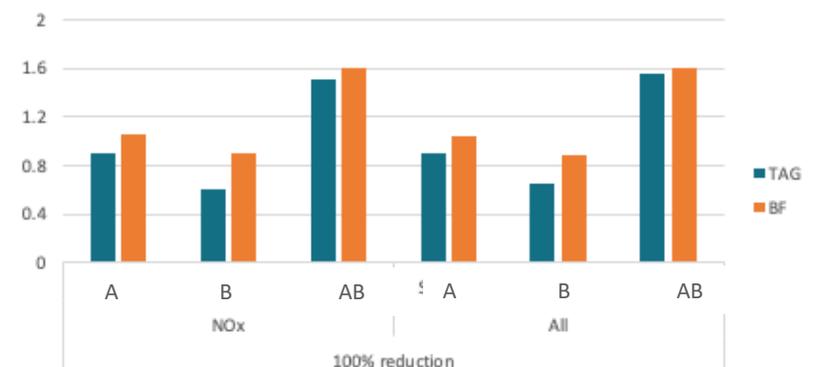
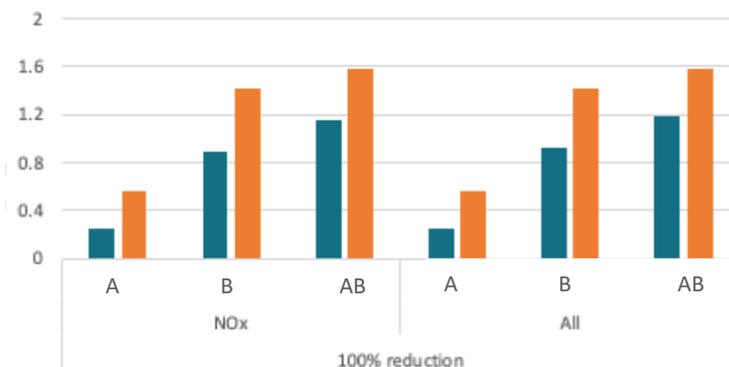
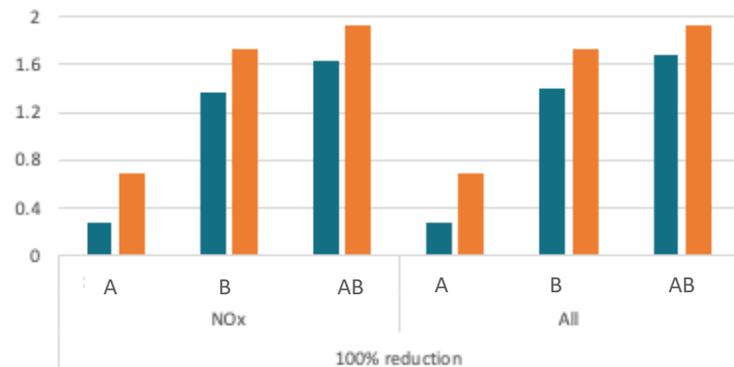
## SB02



## SI03



NO



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

Differences between BF and TAG for NO

# Results - additivity

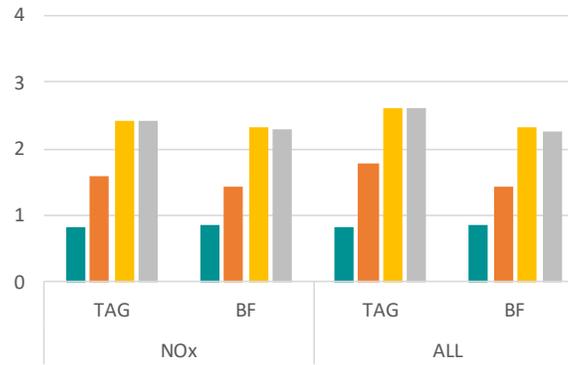
NO<sub>x</sub>/ALL 25% red → Impact

AB vs A+B

## UT01



## SB02



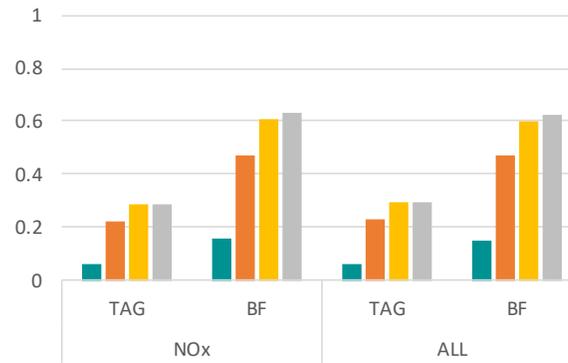
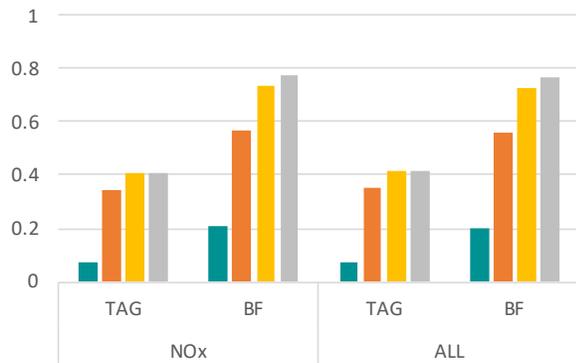
## SI03



■ A  
■ B  
■ AB  
■ A+B

NO<sub>2</sub>

NO



Additive results in general of TAG and BF for NO<sub>2</sub>

For NO, BF not additive in some cases

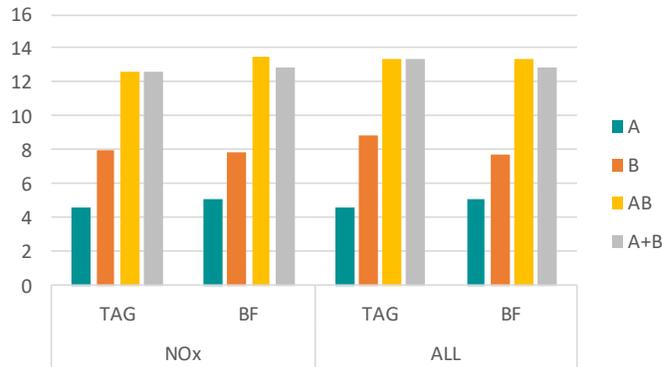
# Results - additivity

NO<sub>x</sub>/ALL 100% red → Impact

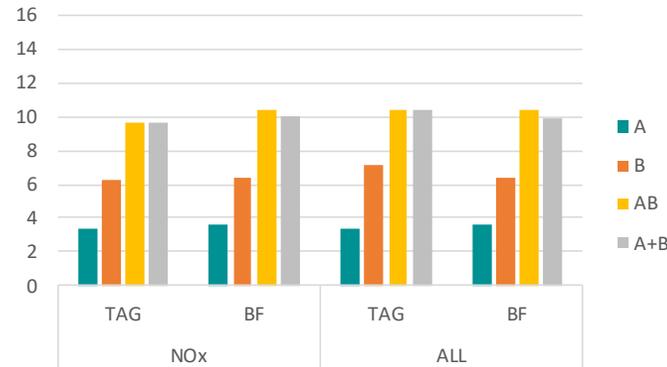
AB vs A+B

NO<sub>2</sub>

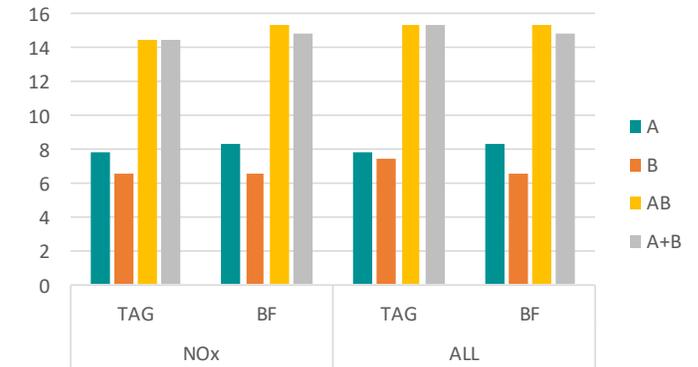
UT01



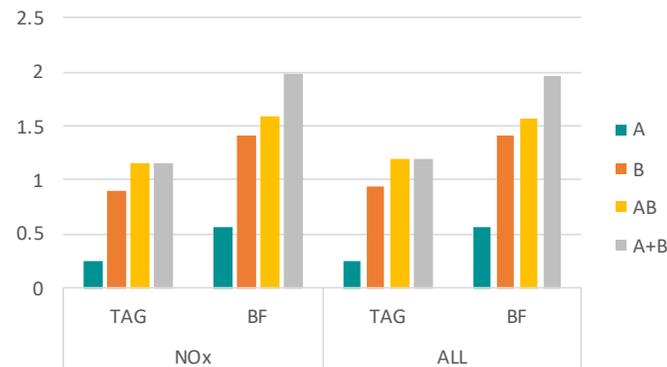
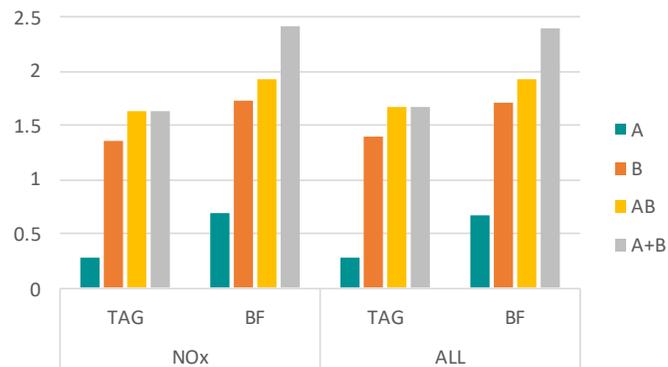
SB02



SI03



NO



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

BF – not additive, especially for NO

-  Source apportionment can help on the definition of emission reduction measures for air quality management, but...
-  A comprehensive understanding of the pollutants, their sources and impacts for the region of interest is needed
-  Additivity and consistency properties are an advantage to save time and resources to get a clear evaluation of potential measures, but they are not always verified!
-  A combination of SA methods should be applied to guarantee a deep assessment and to avoid erroneous conclusions

**Obrigada!**

**Thank you!**

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