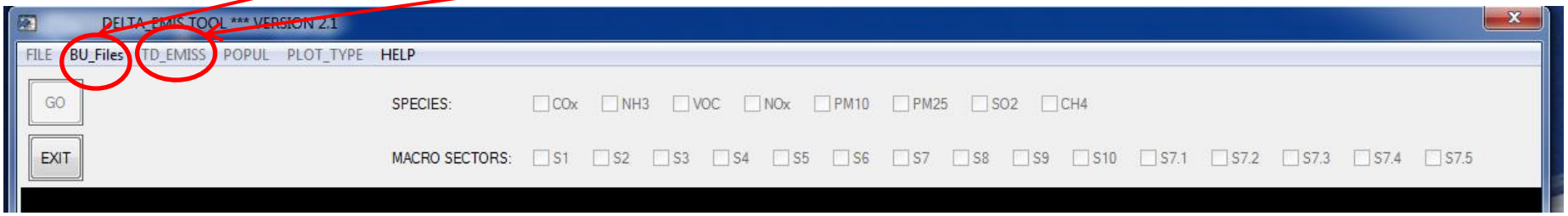
Training
Delta Emission Tool

The Delta-Emission Tool

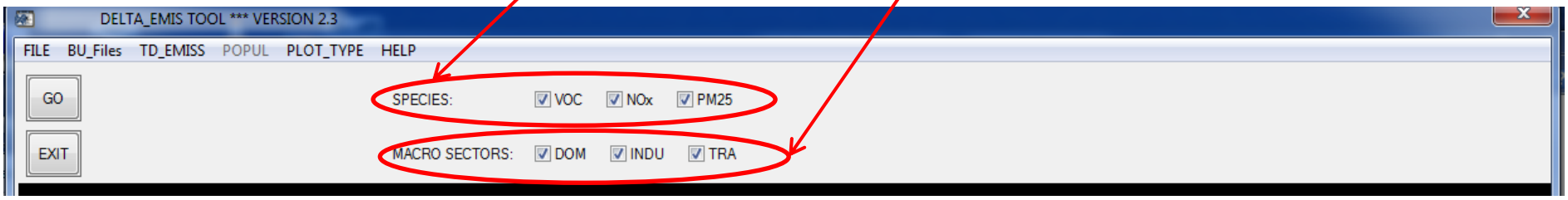
Comparison between 2 emission inventories. A first inventory is called "**Top-Down**" (it is considered as a reference) and the second inventory is called "**Bottom-Up**".

First step: Choose the "Bottom-Up" and "Top-Down" which should be compared



Choose the "BU_Exercise_1" for the Bottom-Up and "EC4MACS" for the Top-Down.

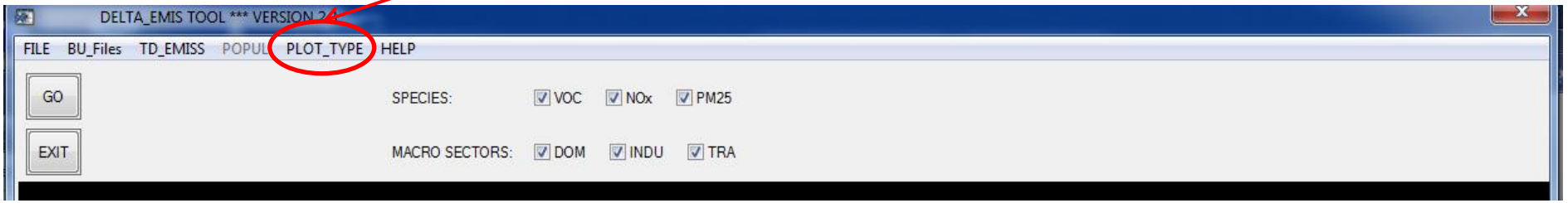
Second step: Choose the "species" and the "macro sectors" you want to compare



Bar-Plot

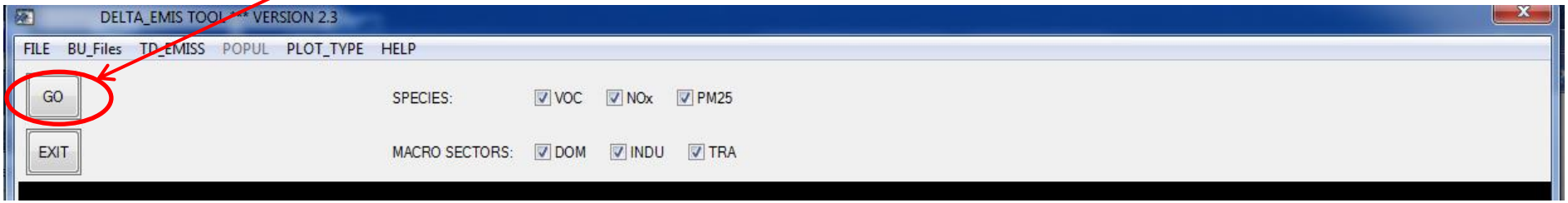
Bar-Plot

Third step: Choose the graphic you want to plot.



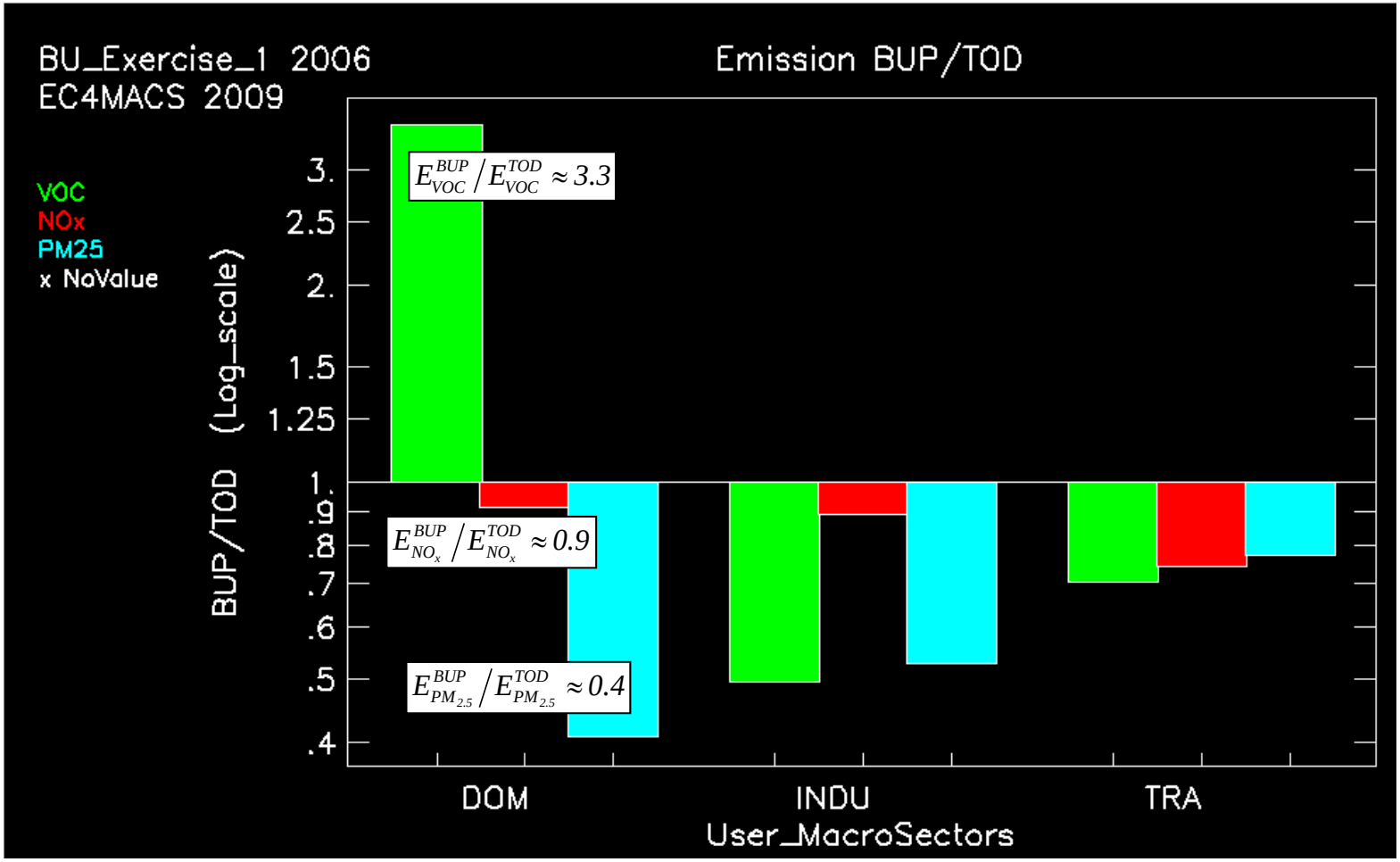
Choose the “TD_BU_Bar” for the plot type.

Fourth step: Plot the graphics.



Bar-Plot

The Bar-Plot shows ratios between the total emission of the two inventories



Exercise: Bar-Plot interpretation

Use “BU_Exercise_1” for the Bottom-Up and “EC4MACS” for the Top-Down

Questions:

1. There are approximatively 30% more transport emissions in the Bottom-Up than in the Top-Down for VOC, NOx and PM25.
   - ☐ true
   - ☐ false

2. It can be that the transport emissions:
   - ☐ are wrong in the Top-Down inventory and true in the Bottom-Up
   - ☐ are wrong in both inventories
   - ☐ are true in both inventories

Exercise: Bar-Plot interpretation

Emission factors and activities

First, we will assume that:

- the emissions of a macro sector can be computed as the product of an emission factor and an activity.
- the activity in a macro sector are the same for all pollutants.

$$E^{p,S}(x,y) = e^{p,S} \times A^{S}(x,y)$$

$e^{p,S}$ is the emission factors (constant in space and time)

A^{S} is the activity (does not depend form the pollutant)

p, pollutant

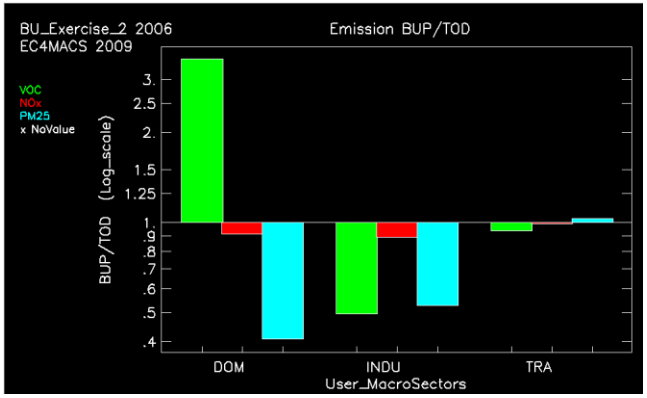
S, macro-sector

Exercise: Bar-Plot interpretation

Another Bottom-Up inventory have been performed: “BU_Exercise_2”. Use this new inventory to plot the Bar-Plot. In this new inventory, only the Traffic emissions have been changed, they are now very close to the one of the Top-Down inventory for all 3 pollutants.

Question:

3. Considering **only the traffic emissions** what is the most probable case between the three following possibilities:
   - emission factors and activities are very different is two inventories
   - emission factors are the almost the same in the two inventories while activities are very different in the two inventories
   - emission factors and activity are almost the same in the two inventories

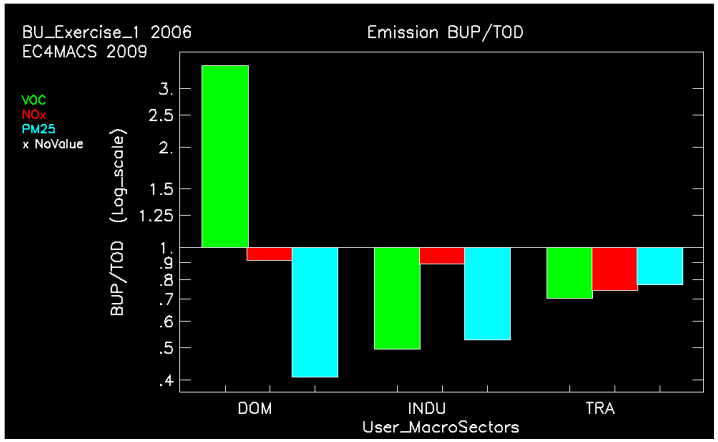


Exercise: Bar-Plot interpretation

Use again the file “BU_Exercise_1” to plot the Bar-Plot.

Question:

4. Considering **only the traffic emissions** what is the most probable case between the three following possibilities:
   - emission factors and activities are very different is two inventories
   - emission factors are the almost the same in the two inventories while activities are very different in the two inventories
   - emission factors and activity are almost the same in the two inventories

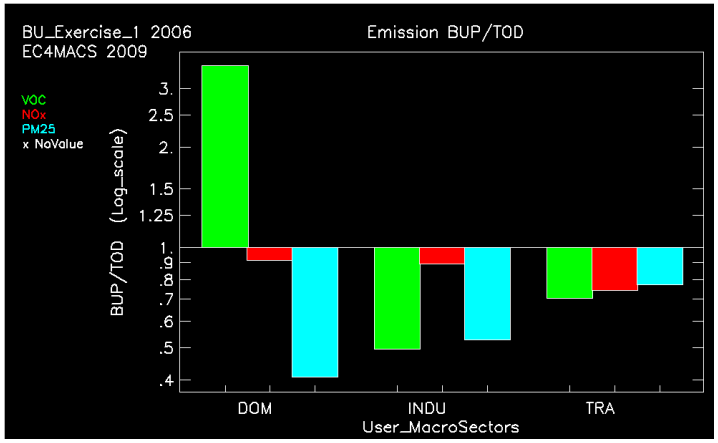


Exercise: Bar-Plot interpretation

Keep the Bar-Plot corresponding to the file “BU_Exercise_1”.

Question:

5. Considering **only the domestic emissions** what is the most probable case between the three following possibilities:
   - emission factors and activities are very different is two inventories
   - emission factors are very different is two inventories while activities are the almost the same in the two inventories
   - emission factors and activity are almost the same in the two inventories



Exercise: Correction

Questions:

1. There are approximatively 30% more transport emissions in the Bottom-Up than in the Top-Down for VOC, NOx and PM25.

   ☐ true

   ☒ false

   The Bottom-Up emissions are lower than the Top-Down, their ratio is approximatively 0.7.

2. It can be that the transport emissions:

   ☒ are wrong in the Top-Down inventory and correct in the Bottom-Up

   ☒ are wrong in both inventories

   ☐ are correct in both inventories

   At least one of the two inventories should be wrong, both cannot be correct

Exercise: Correction

Question:

3. Considering **only the traffic emissions** what is the most probable case between the three following possibilities:
   - ☐ emission factors and activities are very different is two inventories
   - ☐ emission factors are the almost the same in the two inventories while activities are very different in the two inventories
   - ☒ emission factors and activity are almost the same in the two inventories

$$\frac{E_1^{t,VOC}}{E_2^{t,VOC}} \approx \frac{E_1^{t,PM_{25}}}{E_2^{t,PM_{25}}} \approx \frac{E_1^{t,NO_x}}{E_2^{t,NO_x}} \approx 1 \quad \text{then} \quad \frac{e_1^{t,VOC} A_1^t}{e_2^{t,VOC} A_2^t} \approx \frac{e_1^{t,PM_{25}} A_1^t}{e_2^{t,PM_{25}} A_2^t} \approx \frac{e_1^{t,NO_x} A_1^t}{e_2^{t,NO_x} A_2^t} \approx 1 \quad \text{and} \quad \frac{e_1^{t,VOC}}{e_2^{t,VOC}} \approx \frac{e_1^{t,PM_{25}}}{e_2^{t,PM_{25}}} \approx \frac{e_1^{t,NO_x}}{e_2^{t,NO_x}} \approx \frac{A_2^t}{A_1^t}$$

2 possible situations:

$A_1^t \approx A_2^t$ then $e_1^{t,VOC} \approx e_2^{t,VOC}$ $e_1^{t,PM_{25}} \approx e_2^{t,PM_{25}}$ $e_1^{t,NO_x} \approx e_2^{t,NO_x}$

$A_1^t \neq A_2^t$ then, there is an exact compensation between the different emission factors and the activity which is **very improbable**.

Exercise: Correction

Question:

4. Considering **only the traffic emissions** what is the most probable case between the three following possibilities:
   - ☐ emission factors and activities are very different is two inventories
   - ☒ emission factors are the almost the same in the two inventories while activities are very different in the two inventories
   - ☐ emission factors and activity are almost the same in the two inventories

$$\frac{E_1^{t,VOC}}{E_2^{t,VOC}} \approx \frac{E_1^{t,PM_{25}}}{E_2^{t,PM_{25}}} \approx \frac{E_1^{t,NO_x}}{E_2^{t,NO_x}} \approx \alpha$$ then $$\frac{e_1^{t,VOC} A_1^t}{e_2^{t,VOC} A_2^t} \approx \frac{e_1^{t,PM_{25}} A_1^t}{e_2^{t,PM_{25}} A_2^t} \approx \frac{e_1^{t,NO_x} A_1^t}{e_2^{t,NO_x} A_2^t} \approx \alpha$$ and $$\frac{e_1^{t,VOC}}{e_2^{t,VOC}} \approx \frac{e_1^{t,PM_{25}}}{e_2^{t,PM_{25}}} \approx \frac{e_1^{t,NO_x}}{e_2^{t,NO_x}} \approx \alpha \frac{A_2^t}{A_1^t}$$

Same as question 3 but with the following possible situations:

$A_1^t \approx \alpha \times A_2^t$ then $e_1^{t,VOC} \approx e_2^{t,VOC}$ $e_1^{t,PM_{25}} \approx e_2^{t,PM_{25}}$ $e_1^{t,NO_x} \approx e_2^{t,NO_x}$

$A_1^t \neq \alpha \times A_2^t$ then, there is an exact compensation between the different emission factors and the activity which is **very improbable**.

Exercise: Correction

Question:

5. Considering **only the domestic emissions** what is the most probable case between the three following possibilities:
   - ☒ emission factors and activities are very different is two inventories
   - ☒ emission factors are very different is two inventories while activities are the almost the same in the two inventories
   - ☐ emission factors and activity are almost the same in the two inventories

In this situation the total emissions are very different from each other but can be ranked in decreasing order:

$$\frac{E_1^{t,VOC}}{E_2^{t,VOC}} >> \frac{E_1^{t,NO_x}}{E_2^{t,NO_x}} >> \frac{E_1^{t,PM_{25}}}{E_2^{t,PM_{25}}} \quad \text{then} \quad \frac{e_1^{t,VOC}}{e_2^{t,VOC}}\frac{A_1^t}{A_2^t} >> \frac{e_1^{t,NO_x}}{e_2^{t,NO_x}}\frac{A_1^t}{A_2^t} >> \frac{e_1^{t,PM_{25}}}{e_2^{t,PM_{25}}}\frac{A_1^t}{A_2^t} \quad \text{and} \quad \frac{e_1^{t,VOC}}{e_2^{t,VOC}} >> \frac{e_1^{t,PM_{25}}}{e_2^{t,PM_{25}}} >> \frac{e_1^{t,NO_x}}{e_2^{t,NO_x}}$$

The emission factor ratios are very different from each other and there are in the same order as the total emissions. **But nothing can be concluded concerning the activity ratio.**

Diamond-Plot

Diamond-Plot

The Diamond-Plot shows ratios between the total emission of the two inventories as points located on two axis. The coordinate on the horizontal axis are equal to an estimation of the emission ratios while the coordinate on the vertical axis are equal to au estimation of the ratio between the activity.

$$\frac{E_1^{p,S}}{E_2^{p,S}} = \frac{e_1^{p,S}}{e_2^{p,S}} \times \frac{A_1^S}{A_2^S}$$

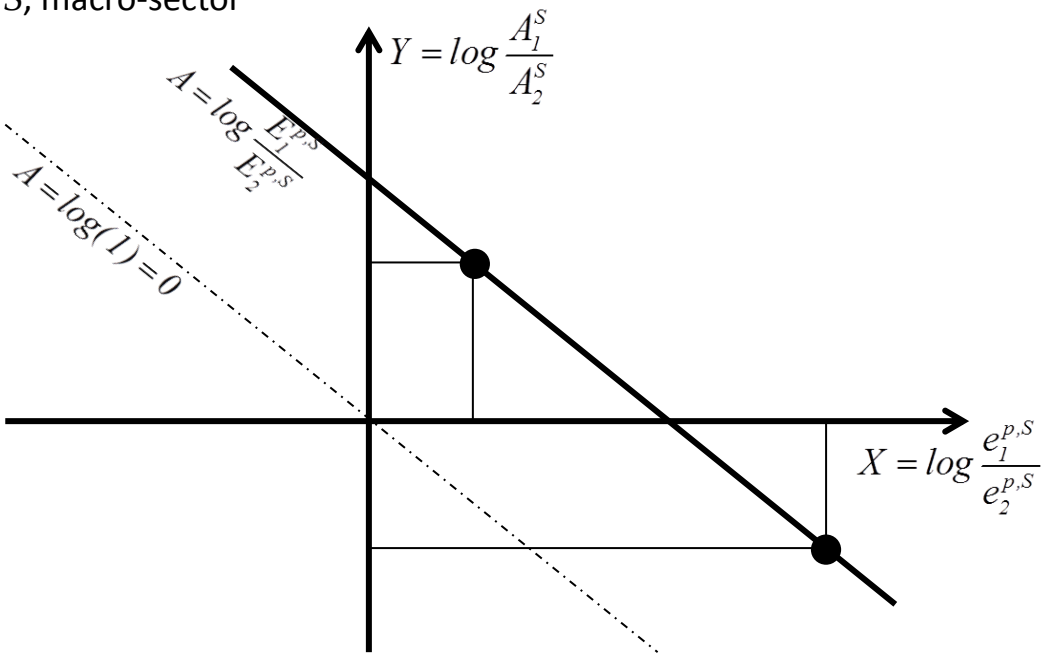
$$\log \frac{E_1^{p,S}}{E_2^{p,S}} = \log \frac{e_1^{p,S}}{e_2^{p,S}} + \log \frac{A_1^S}{A_2^S}$$

$$\log \frac{A_1^S}{A_2^S} = \log \frac{E_1^{p,S}}{E_2^{p,S}} - \log \frac{e_1^{p,S}}{e_2^{p,S}}$$

$$Y = A - X$$

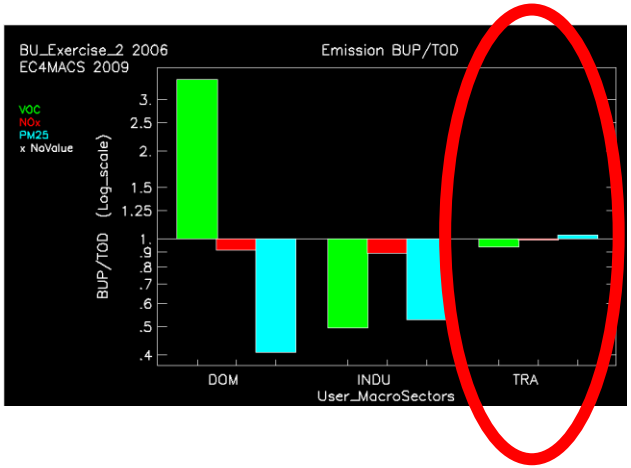
p, pollutant

S, macro-sector

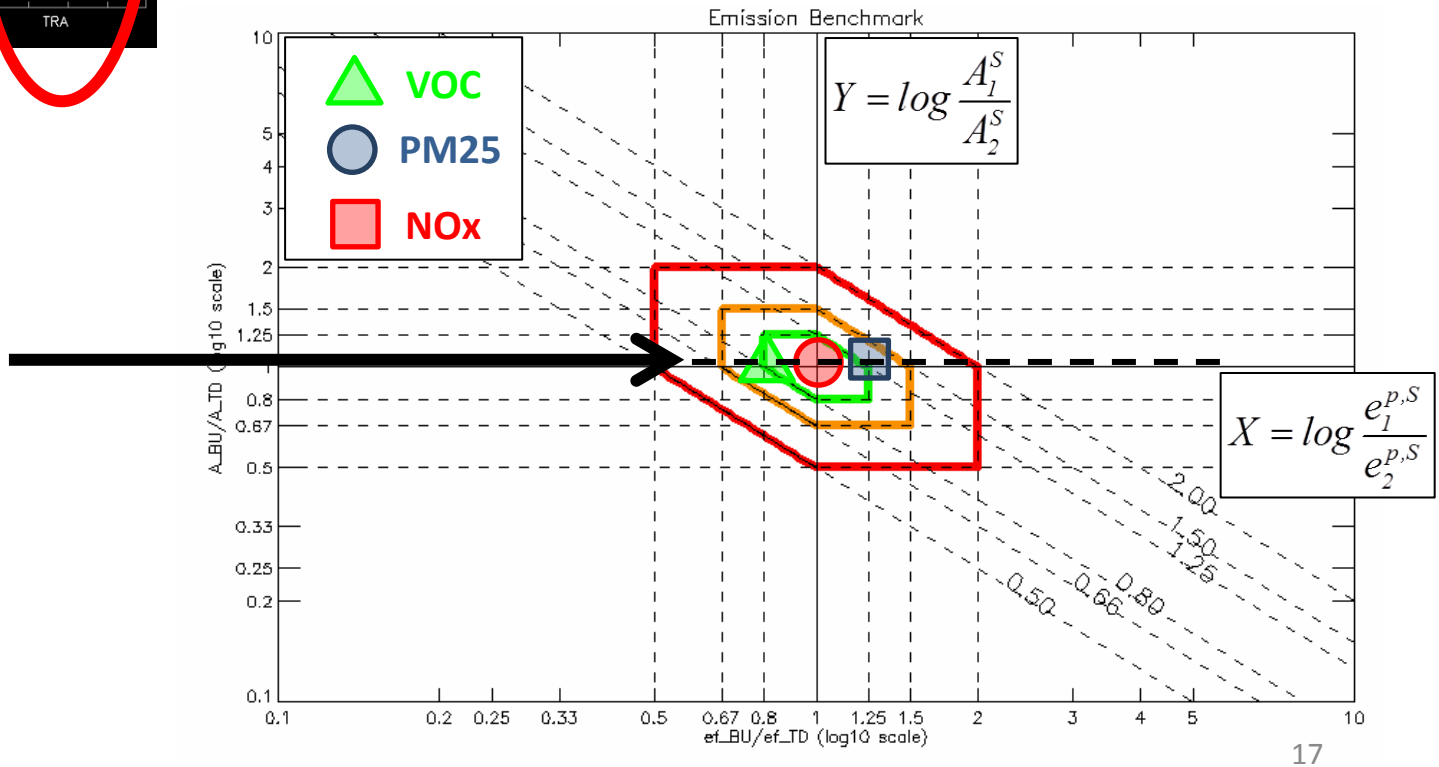


The ratio of total emissions allows to locate the points on the diagonals of the graphics. But they are an infinite number of possibilities to attribute values for X and Y coordinates.

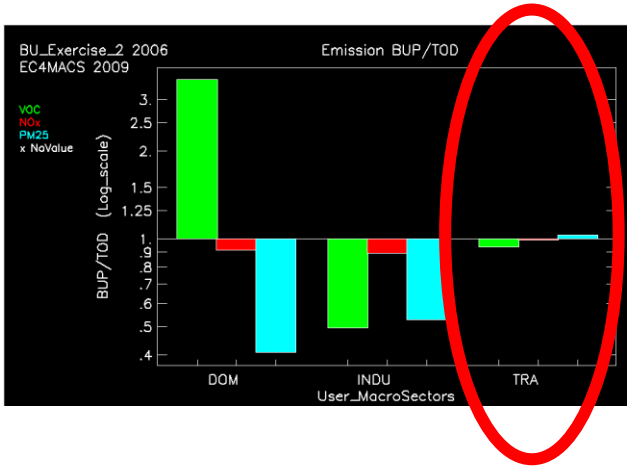
Diamond-Plot



Activity is the same for all pollutants in a specific macro-sector (for example, traffic). Consequently, all the points corresponding to the different pollutants of the same macro-sector are on the **same horizontal line**.



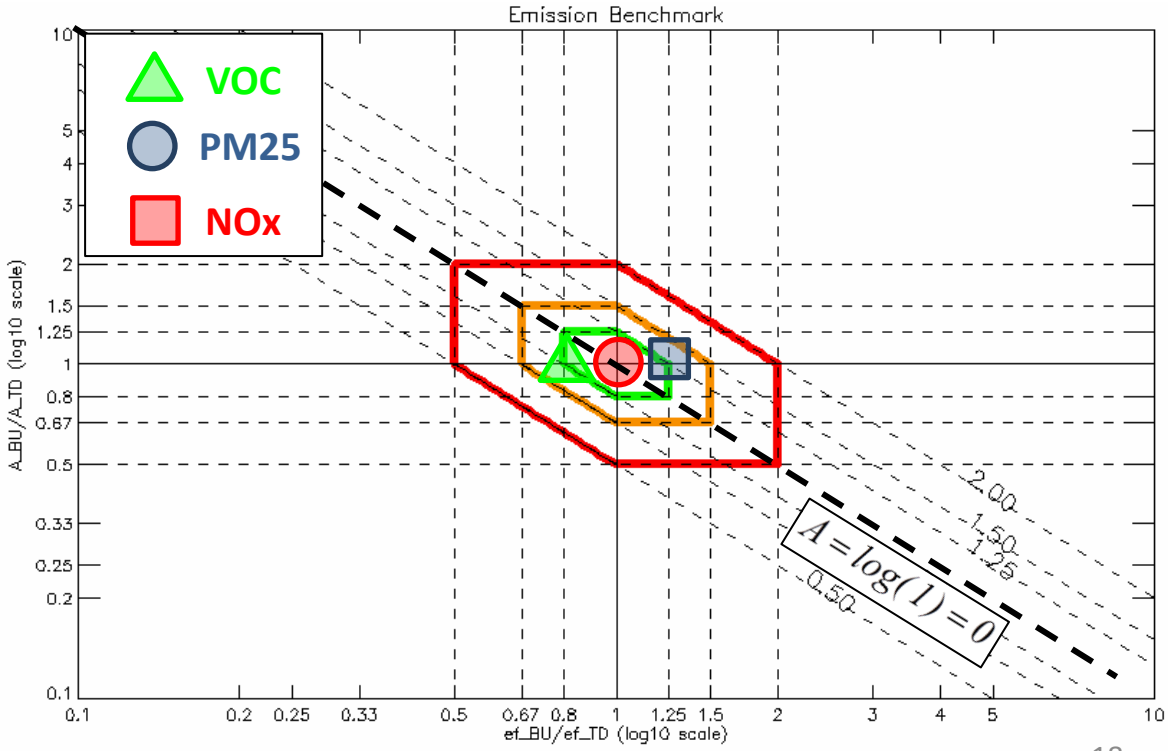
Diamond-Plot



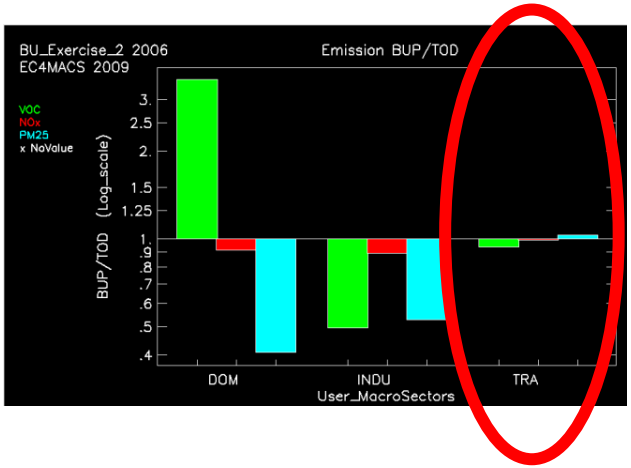
The total emissions ratios are known. It locate the points on the diagonals of the diagram. For example, if

$$\frac{E_1^{t,VOC}}{E_2^{t,VOC}} \approx \frac{E_1^{t,PM_{25}}}{E_2^{t,PM_{25}}} \approx \frac{E_1^{t,NO_x}}{E_2^{t,NO_x}} \approx 1$$

then, the different points are close to the central diagonal ($A=0$)



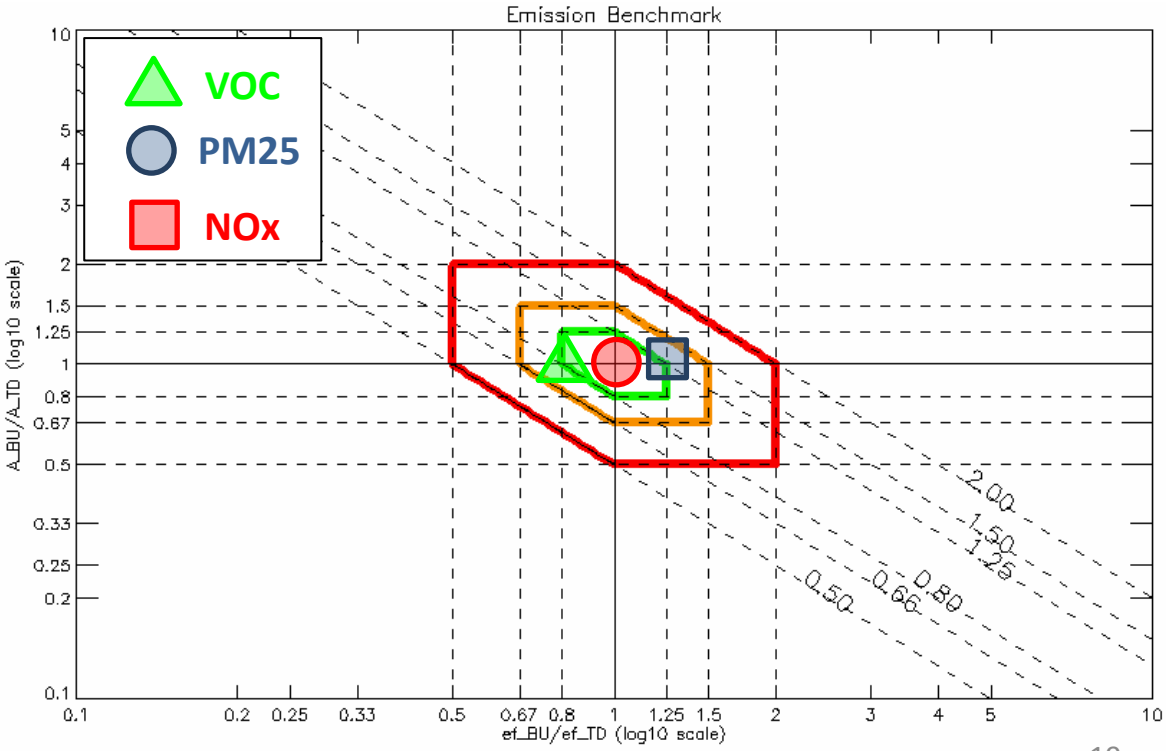
Diamond-Plot



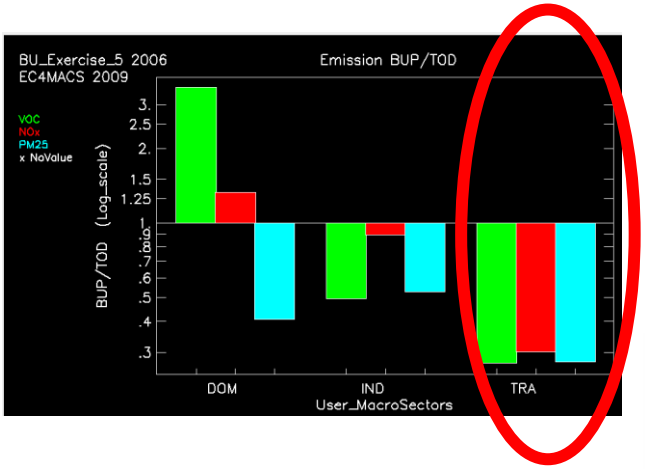
Representation of the **most probable situation**. For example if,

$$\frac{E_1^{t,VOC}}{E_2^{t,VOC}} \approx \frac{E_1^{t,PM_{25}}}{E_2^{t,PM_{25}}} \approx \frac{E_1^{t,NO_x}}{E_2^{t,NO_x}} \approx 1 \quad \text{then}$$

$$\frac{A_1^t}{A_2^t} \approx 1 \qquad \frac{e_1^{t,VOC}}{e_2^{t,VOC}} \approx 1 \qquad \frac{e_1^{t,PM_{25}}}{e_2^{t,PM_{25}}} \approx 1 \qquad \frac{e_1^{t,NO_x}}{e_2^{t,NO_x}} \approx 1$$

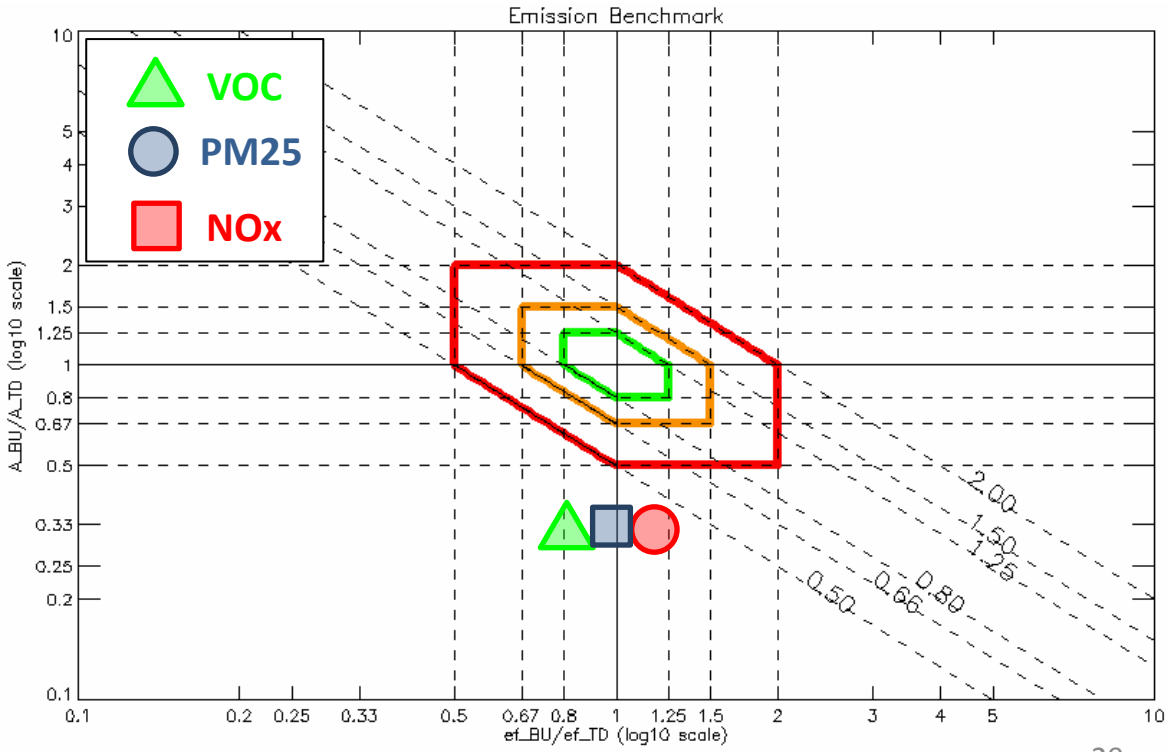


Diamond-Plot

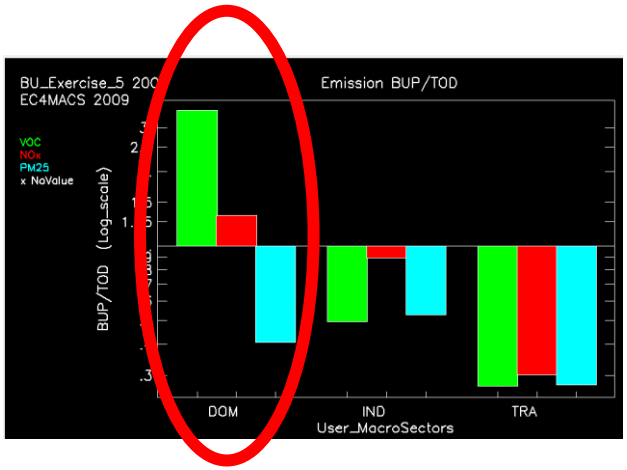


An other example: if, $\frac{E_1^{t,VOC}}{E_2^{t,VOC}} \approx \frac{E_1^{t,PM_{25}}}{E_2^{t,PM_{25}}} \approx \frac{E_1^{t,NO_x}}{E_2^{t,NO_x}} \approx 0.3$ then

$$\frac{A_1^t}{A_2^t} \approx 0.3 \qquad \frac{e_1^{t,VOC}}{e_2^{t,VOC}} \approx 1 \qquad \frac{e_1^{t,PM_{25}}}{e_2^{t,PM_{25}}} \approx 1 \qquad \frac{e_1^{t,NO_x}}{e_2^{t,NO_x}} \approx 1$$



Diamond-Plot



An other example: if, $\frac{E_1^{t,VOC}}{E_2^{t,VOC}} >> \frac{E_1^{t,NO_x}}{E_2^{t,NO_x}} >> \frac{E_1^{t,PM_{25}}}{E_2^{t,PM_{25}}}$

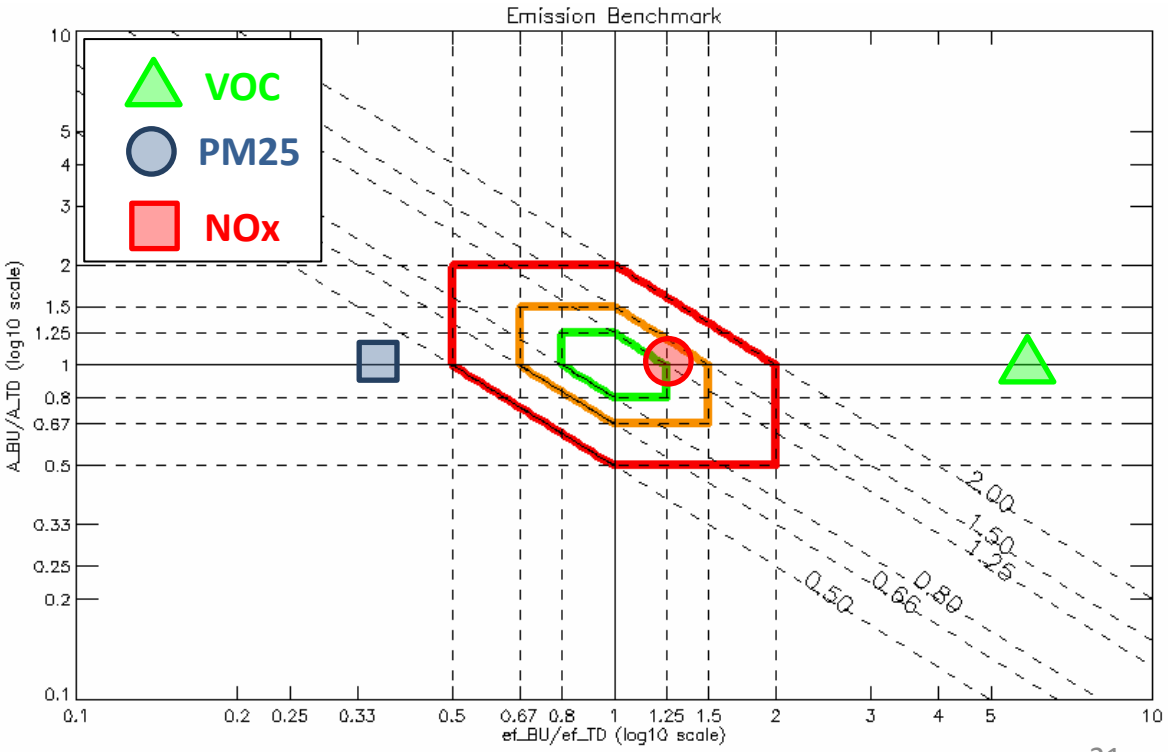
then, at least, two of the three emission factor ratios are far from 1:

$$\frac{e_1^{t,VOC}}{e_2^{t,VOC}} >> \frac{e_1^{t,PM_{25}}}{e_2^{t,PM_{25}}} >> \frac{e_1^{t,NO_x}}{e_2^{t,NO_x}}$$

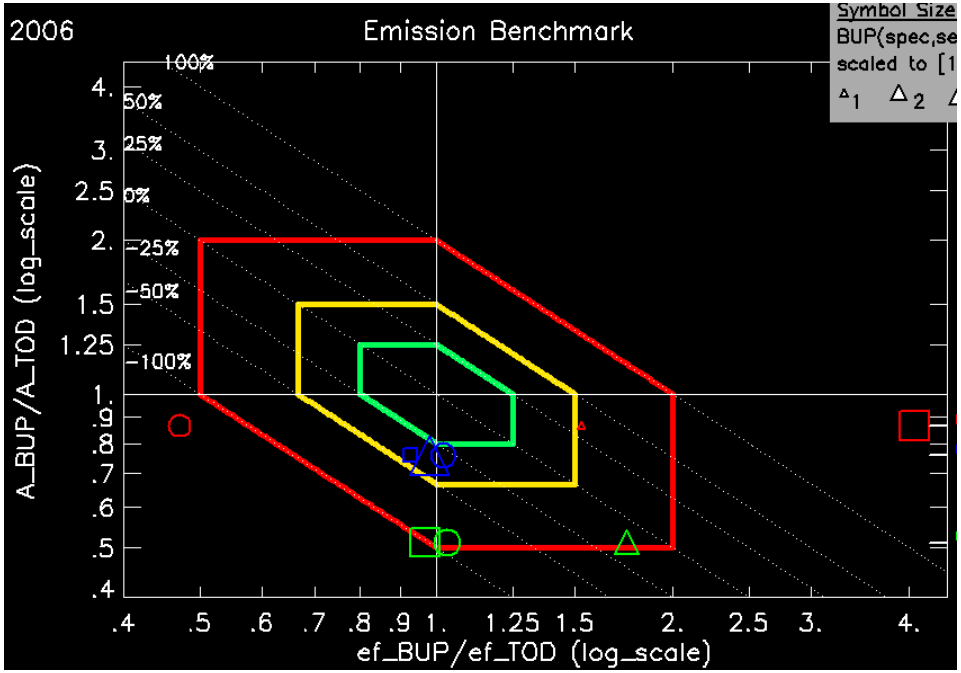
Nothing can be clearly concluded concerning the activities:

$$\frac{A_1^t}{A_2^t} \approx ?$$

Location on vertical axis is not significant.



Exercise: Diamond-Plot interpretation

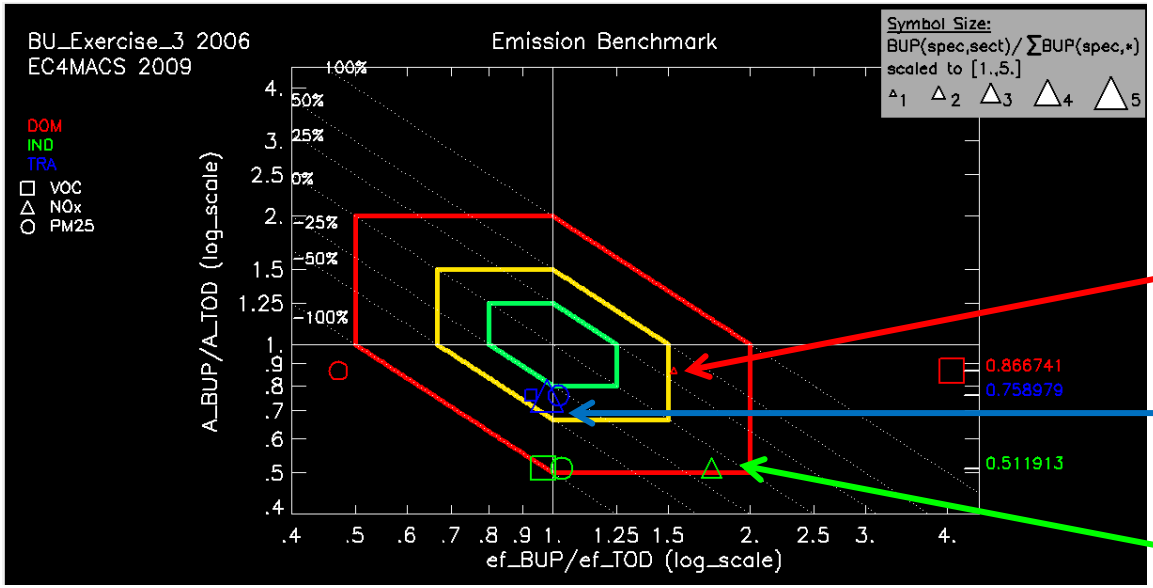


Question:

6. Which of these three statements is (or are) correct. This Diamond-Plot compare two inventories for:
   - ☐ 3 pollutants
   - ☐ 9 pollutants
   - ☐ 3 macro-sectors

Diamond-Plot

The **symbol sizes** are proportional to the percentage of emissions of each macro-sector for a specific pollutants (calculated for the BUP inventory).



For NOx emissions (triangle symbols):

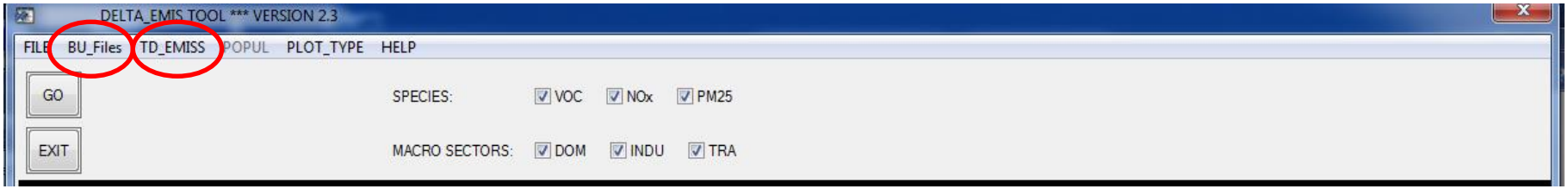
lower fraction in DOM sector

larger fraction in TRA sector

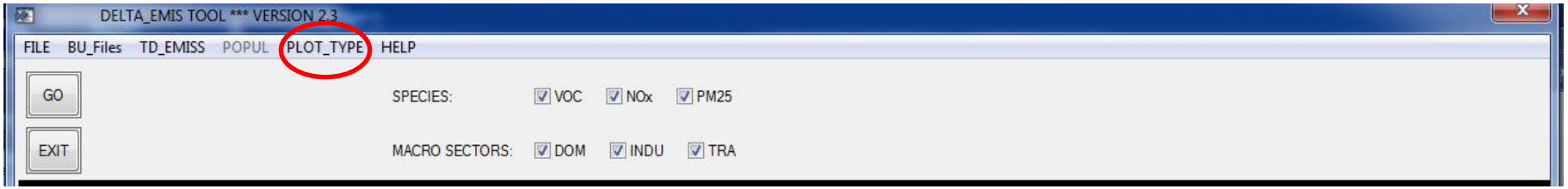
medium fraction in IND sector

Diamond-Plot

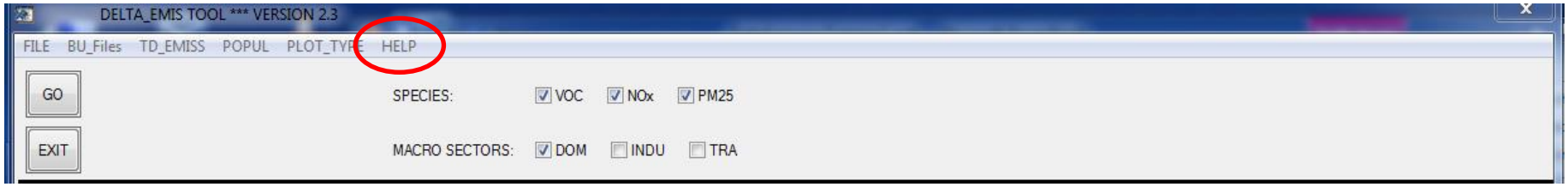
Choose the “BU_Exercise_3” for the Bottom-Up and “EC4MACS” for the Top-Down :



Select the “TD_BU_Diamond” option in the PLOT_TYPE list.

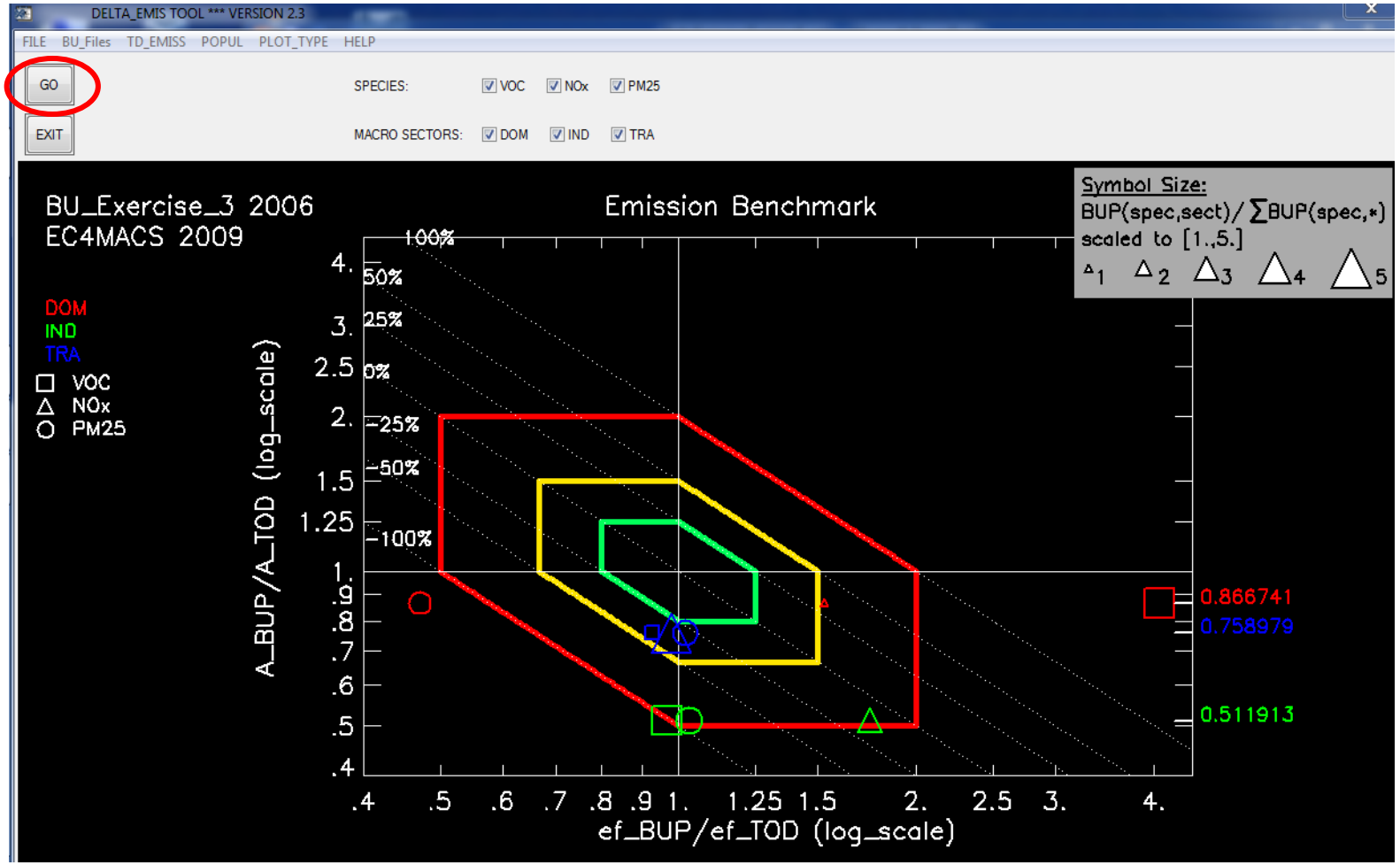


In “HELP” select option “Diamond_Norm” and then “Norm=6”.



Diamond-Plot

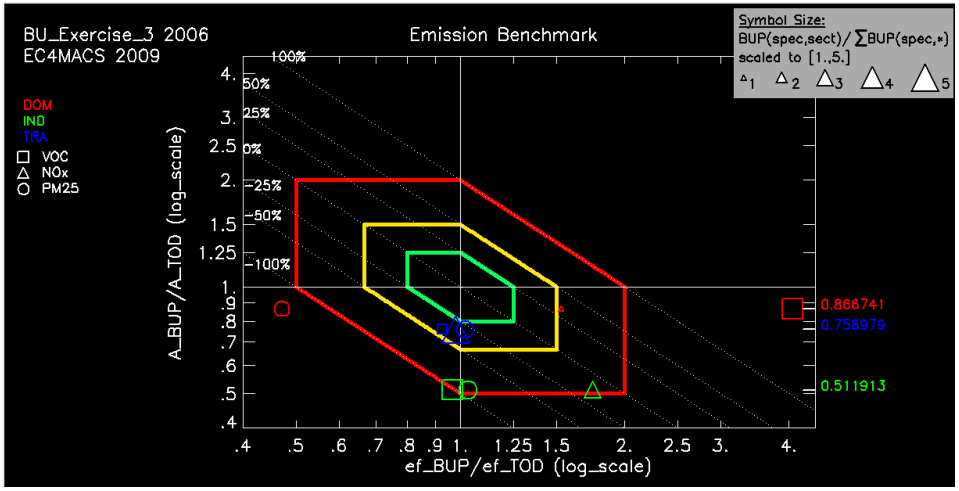
Plot the graphic:



Exercise: Diamond-Plot interpretation

Question:

7. Considering **traffic emissions** (**TRA**) which of these two statements is (or are) correct:
   - ☐ emission factors in the two inventories are very different for all pollutants
   - ☐ most likely the activity are larger in the TOD inventory than in the BUP inventory



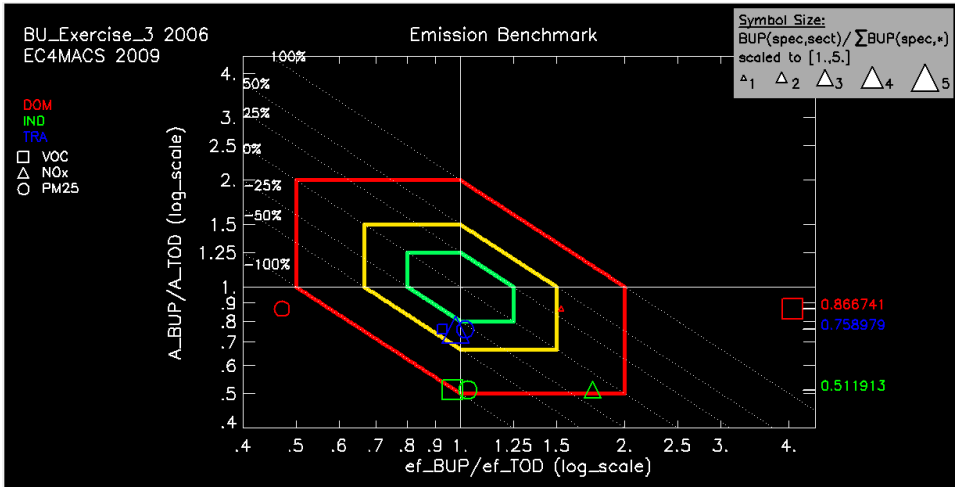
Exercise: Diamond-Plot interpretation

Question:

8. Considering **industrial emissions** (**IND**) which of these two statements is (or are) correct:

   ☐ emission factors for NO_x is most probably larger in the BUP than in the TOD

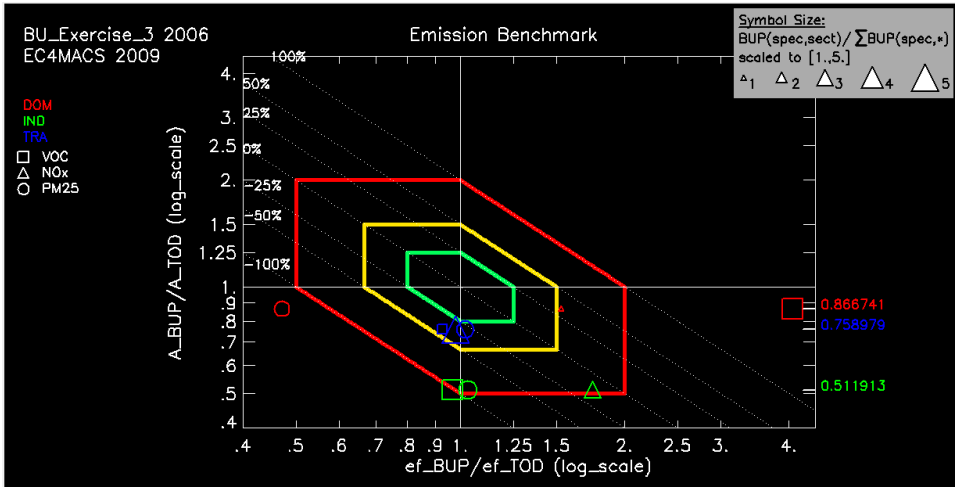
   ☐ most likely the activity are larger in the TOD inventory than in the BUP inventory



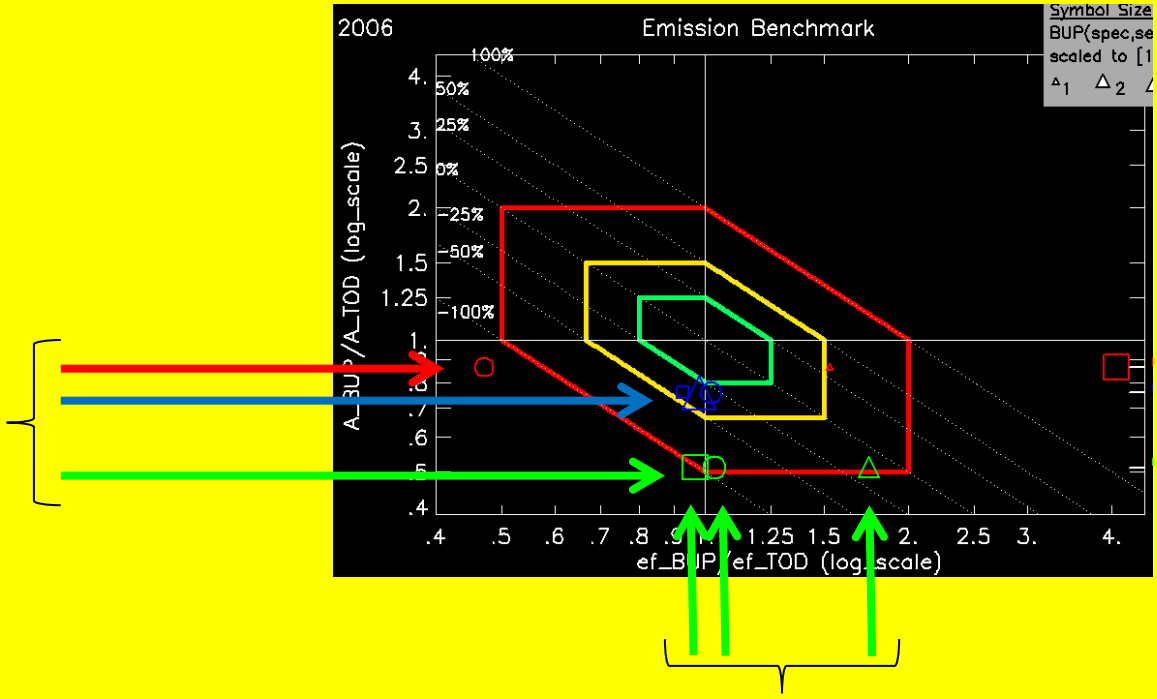
Exercise: Diamond-Plot interpretation

Question:

9. Considering **domestic emissions** (**DOM**) which of these two statements is (or are) correct:
   - ☐ emission factors for, at least, two pollutants are certainly very different in the two inventories
   - ☐ activities are certainly larger in the TOD than in the BUP



Exercise: Correction



3 horizontal lines
=> 3 macro-sectors

3 symbols per line => 3 pollutants

Question:

6. Which of these three statements is (or are) correct. This Diamond-Plot compare two inventories for:

   ☒ 3 pollutants

   ☐ 9 pollutants

   ☒ 3 macro-sectors

Exercise: Correction

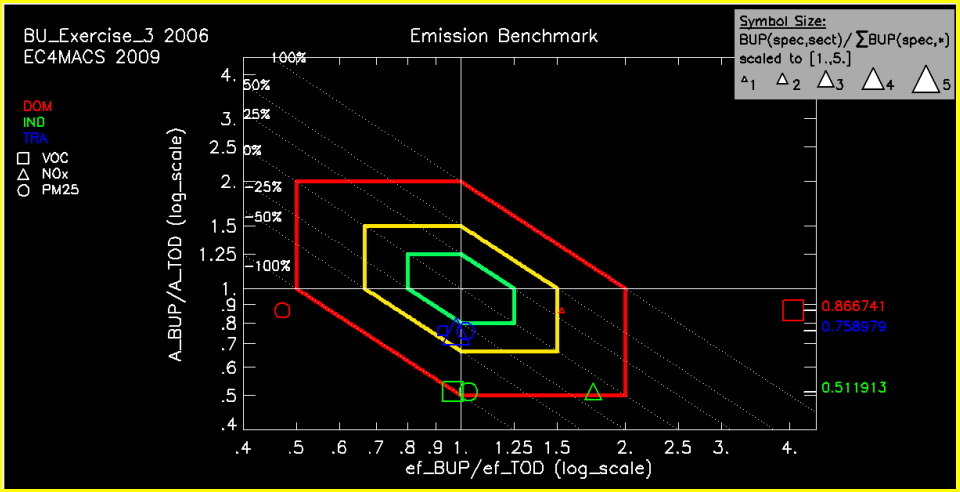
Question:

7. Considering **traffic emissions** (**TRA**) which of these two statements is (or are) correct:

   ☐ emission factors in the two inventories are very different for all pollutants

   ☒ most likely the activity are larger in the TOD inventory than in the BUP inventory

Horizontal distances between all points are very small => the estimation of activity ratio is reliable and emission factors ratios are most likely very similar in the two inventories.



Exercise: Correction

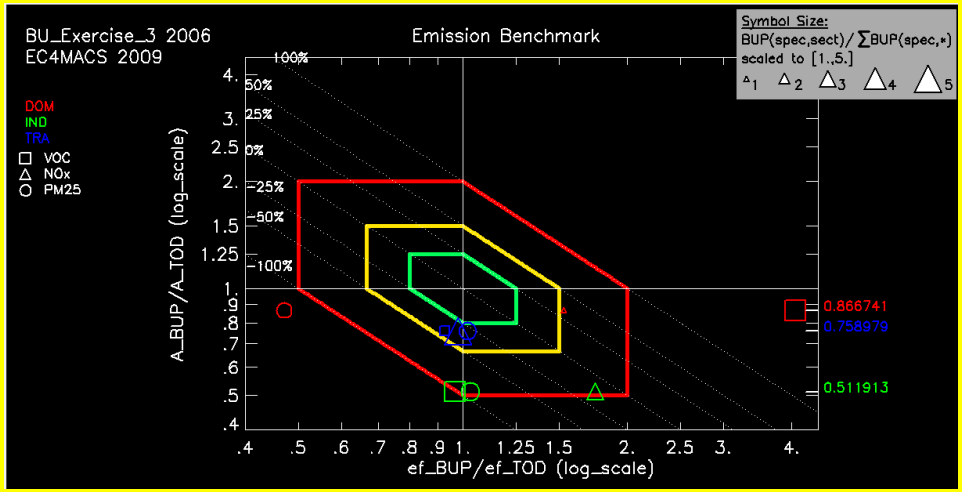
Question:

8. Considering **industrial emissions** (**IND**) which of these two statements is (or are) correct:

   ☒ emission factors for NO_x is most probably larger in the BUP than in the TOD

   ☒ most likely the activity are larger in the TOD inventory than in the BUP inventory

Horizontal distance between PM25 and VOC is very small but NOx is far from the others => Estimation of the activity ratio is reliable. The emission factors ratios for PM25 and VOC are most likely very similar in the two inventories while they are probably very different for NOx.



Exercise: Correction

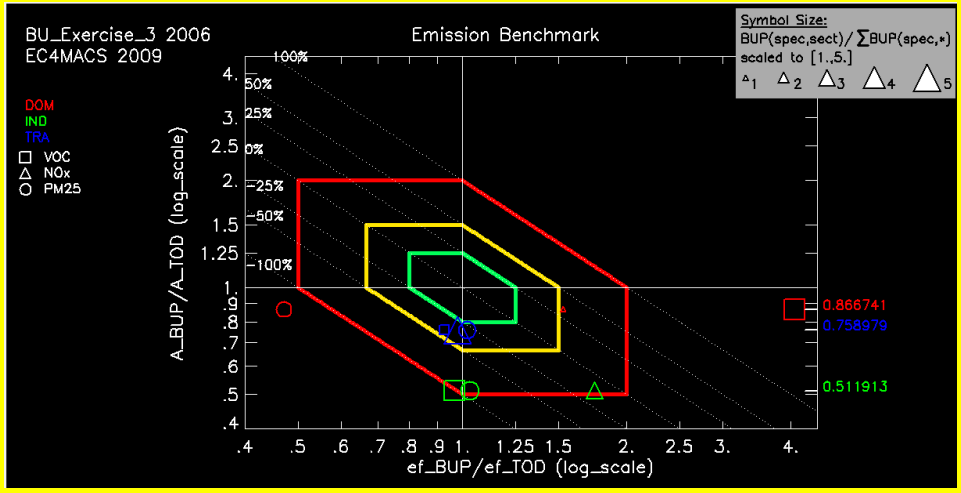
Question:

9. Considering **domestic emissions** (**DOM**) which of these two statements is (or are) correct:

   ☒ emission factors for, at least, two pollutants are certainly very different in the two inventories

   ☐ activities are certainly larger in the TOD than in the BUP

Horizontal distances between the points are very large => Nothing can be concluded for the activity ratio.
But we can conclude for sure that they are discrepancies between emission factors of the two inventories.

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