Dynamic evaluation

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Concepts

Absolute potency [μg*km²/(m³*kT)]

$$P = -\frac{dC}{dE} \approx -\frac{\Delta C}{\Delta E} = -\frac{C_{E_{\alpha\%}} - C_{E_{0\%}}}{E_{\alpha\%} - E_{0\%}}$$

P provides insight on the intensity or strength of the process. Since it is expressed per kt, it is independent of the available total emissions. This indicator is therefore useful to understand the model behavior.

Absolute potential [μg/m³]

$$\Pi = C_{E_{100\%}} - C_{E_{0\%}} = \frac{C_{E_{\alpha\%}} - C_{E_{0\%}}}{\alpha}$$

$$\Pi = \int_{C_{0\%}}^{C_{100\%}} dC = -\int_{E_{0\%}}^{E_{100\%}} P dE$$

Π provides insight on the maximal impact (if all available emissions are reduced). A high potential could occur even though the potency is low (if a large amount of emissions is available) as well as the reverse if a small amount of emissions is available).

Relative potential [%]

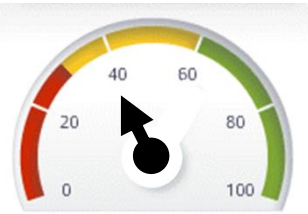
$$\pi = \frac{\Pi}{C_{E_{0\%}}} \approx \frac{C_{E_{\alpha\%}} - C_{E_{0\%}}}{\alpha C_{E_{0\%}}}$$

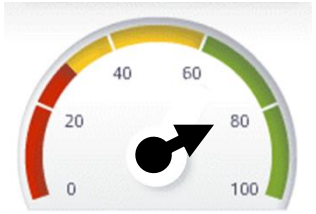
π provides the same information as **Π** but in relative terms. It is mostly useful to policymakers as this gives information on actual options and their associated possibilities. Its drawback is that it mixes everything (meteo, chemistry, emission amounts…).

Absolute Potency

European Commission

$km/litre$

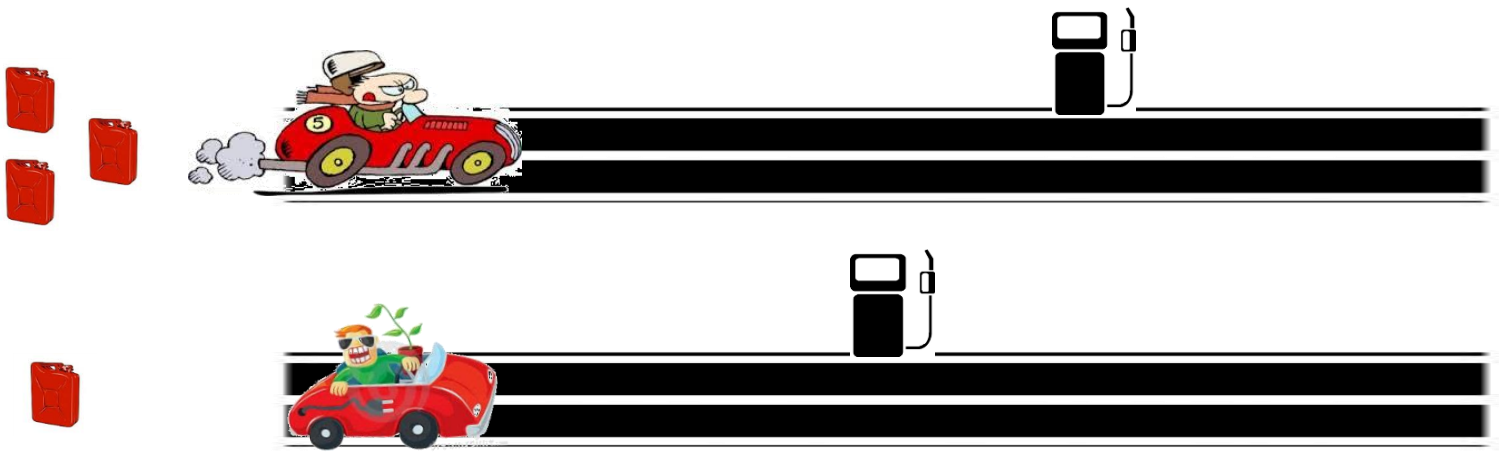


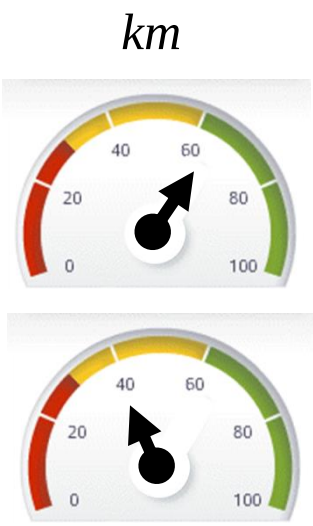


Modeled emission efficiency

$$\frac{\Delta C}{\Delta E}$$

Absolute Potential

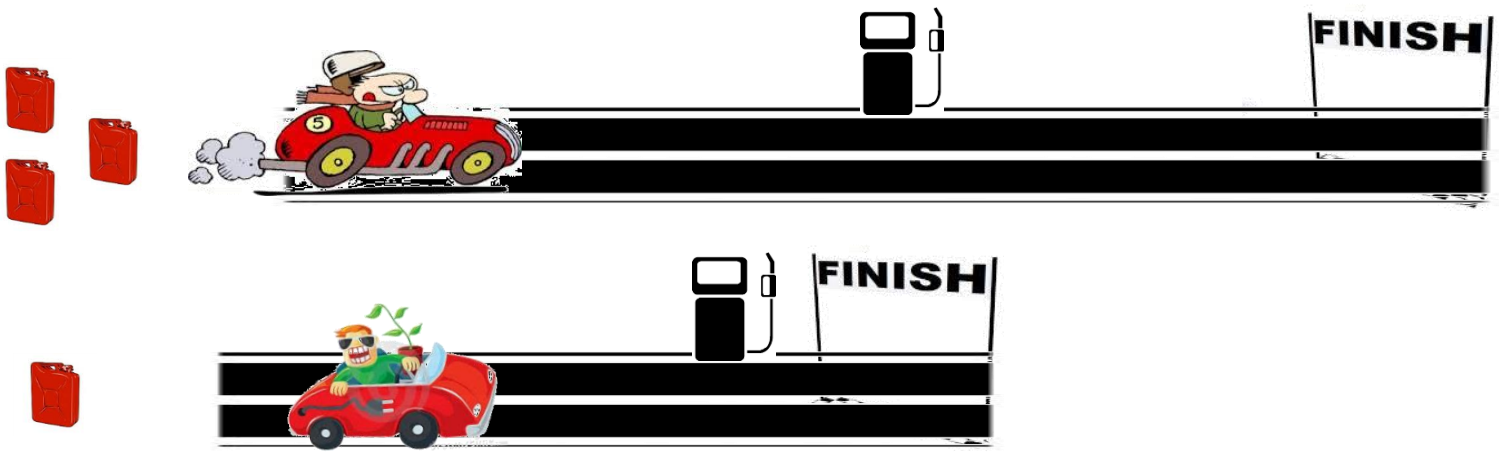


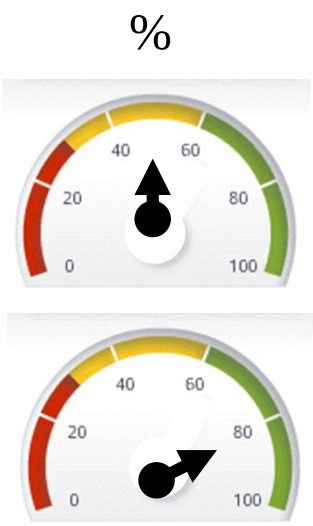


Modeled emission efficiency
X
Available emissions

ΔC

Relative Potential

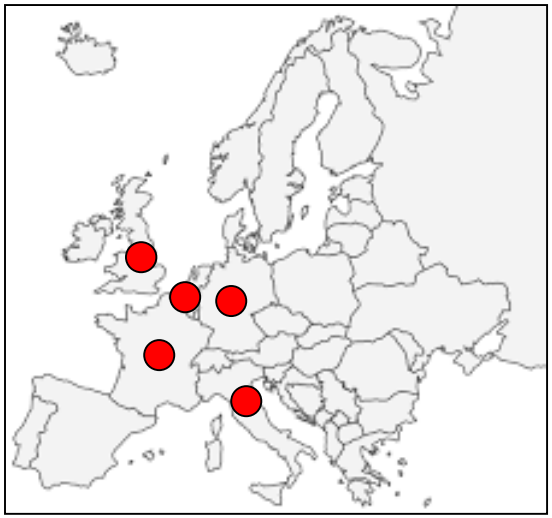




Modeled emission efficiency
X
Available emissions
/
Concentration

$$\frac{\Delta C}{C}$$

Application: EMEP



5 countries: DE, FR, IT, UK and BE

2 reductions: 15 and 40%

Scenarios: NOx, VOC, SO2, PPM, NH3 and ALL

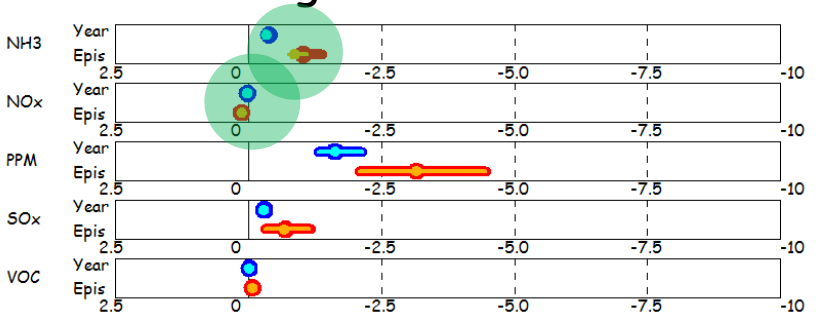
Year: 01/01/2012 → 31/12/2012

Potencies

PM10 Urban stations

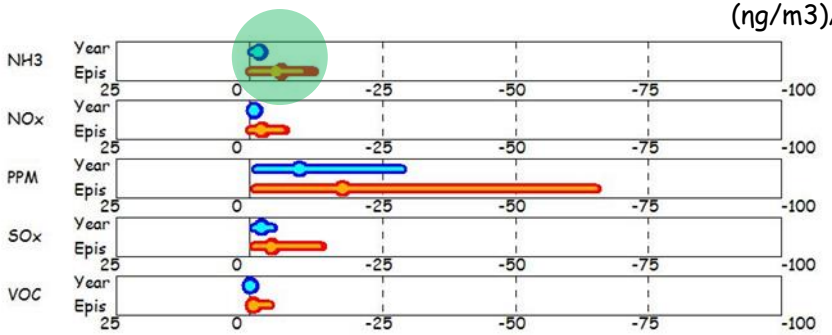
European Commission

Belgium

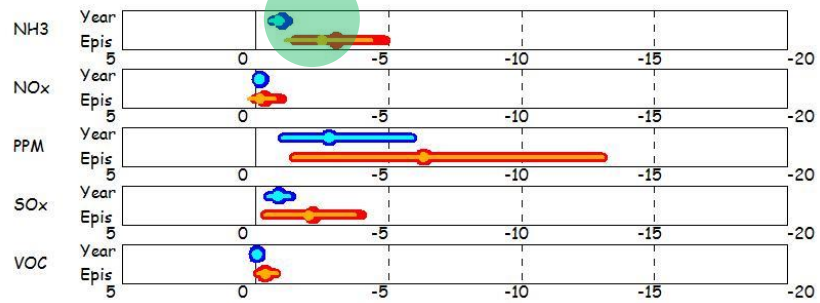


France

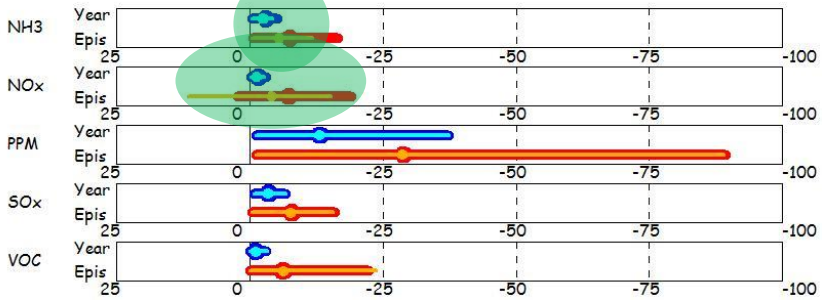
(ng/m3)/(kT/km2)



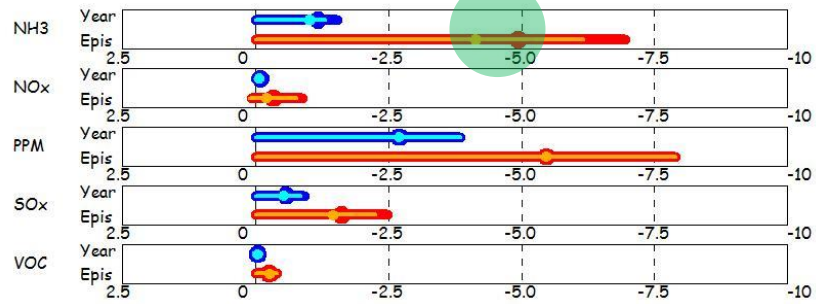
Germany



Italy



UK



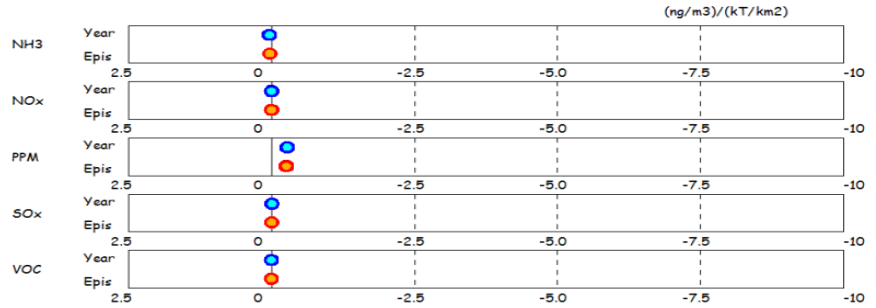
- IT potencies always the largest (meteo?)
- Largest non-linearities for NH3 & NOx IT
- In all countries, PPM potencies dominate
- NOx positive potencies in Belgium

Joint Research Centre

Potencies

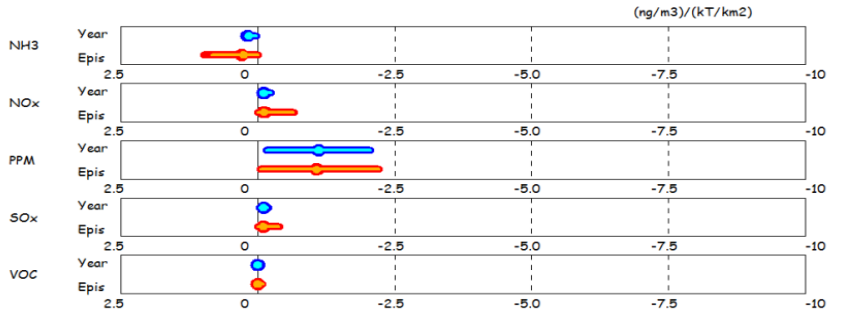
PMco Urban stations

Belgium

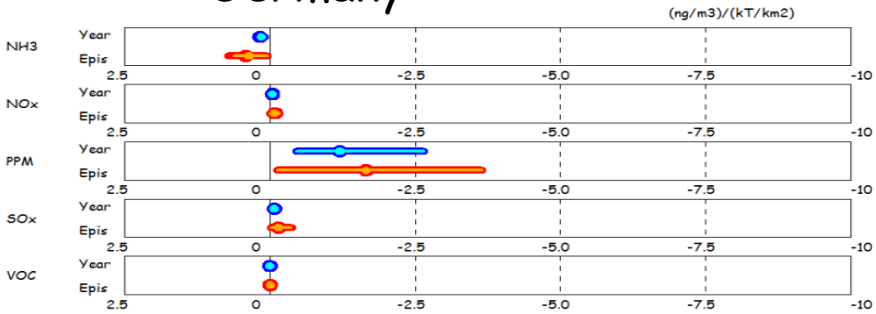


France

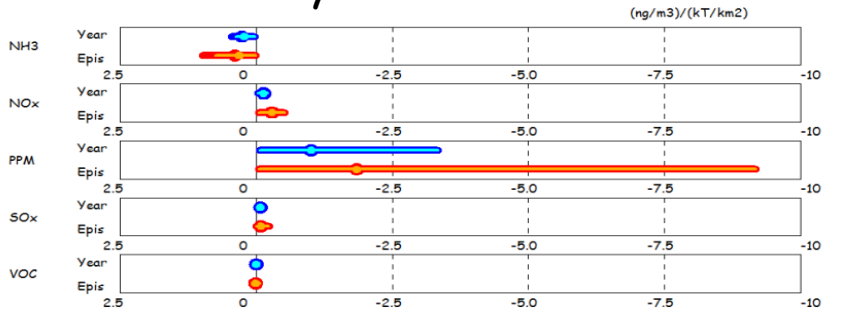
(ng/m3)/(kT/km2)



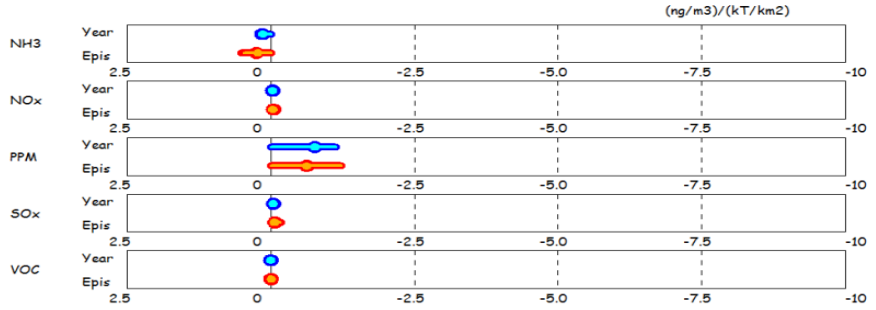
Germany



Italy



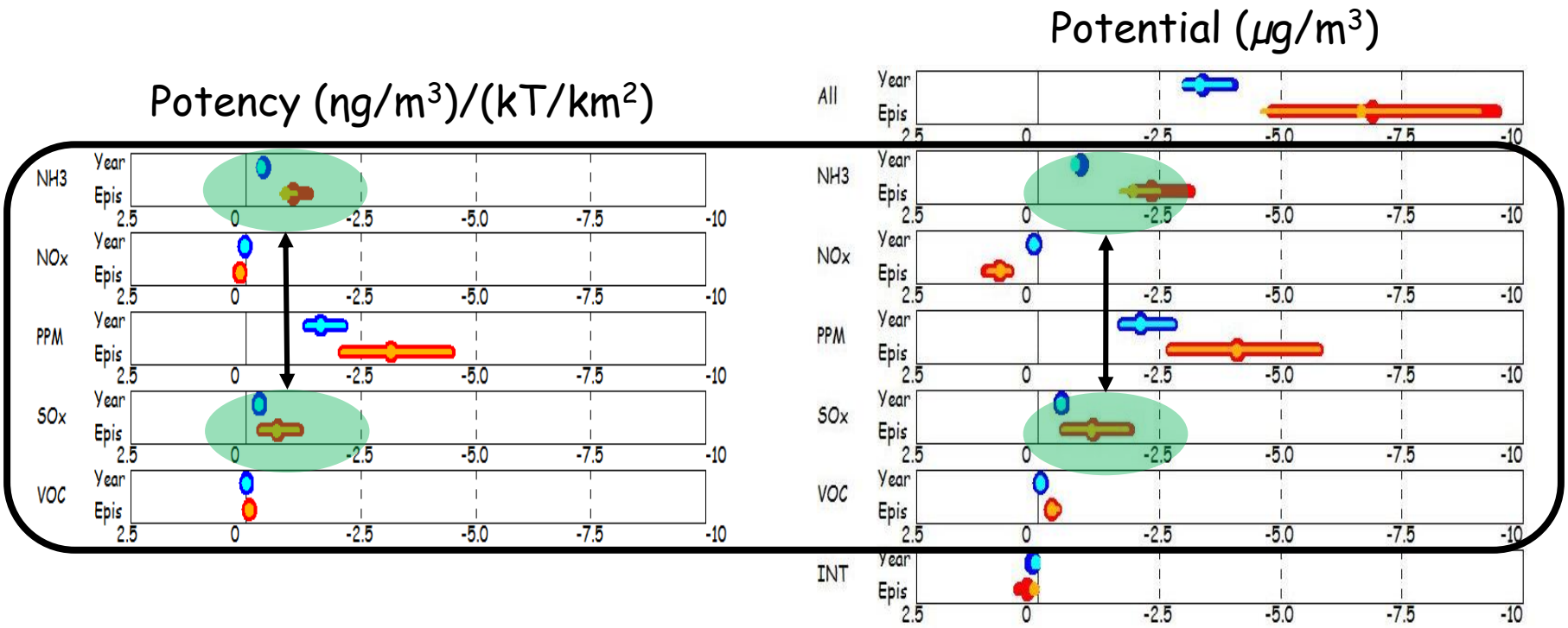
UK



- ❑ PPM emission ↘ ⇨ largest ↘ in conc
- ❑ VOC emission ↘ ⇨ ↔ in conc
- ❑ SO2 and NOx emission ↘ ⇨ ↘ in conc
- ❑ NH3 emission ↘ ⇨ ↗ in conc

Potency, abs. & rel. potentials

Belgium urban PM10



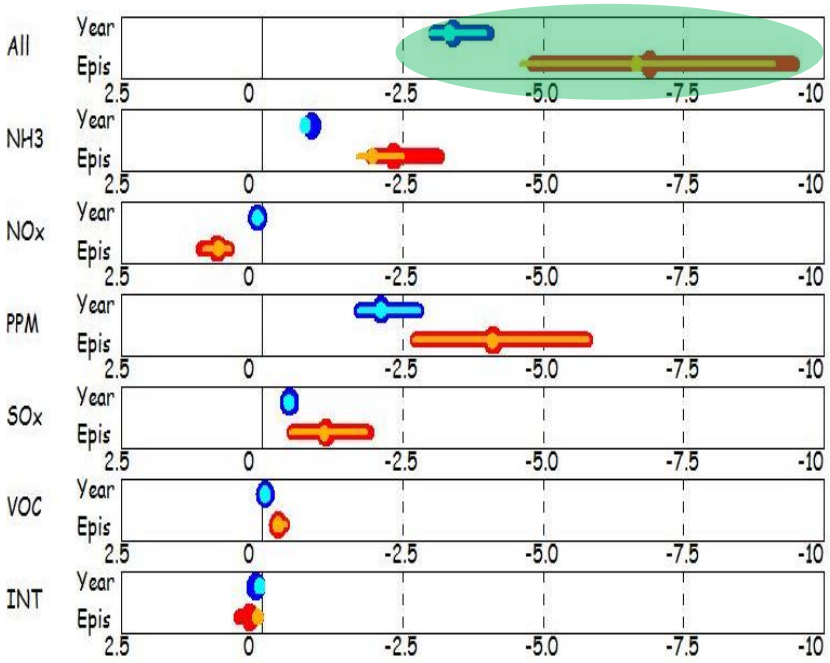
The potential includes information about (1) the potency and (2) the amount of available emissions. Ranking might therefore be modified if a large potency is associated to low emissions amounts or if a low potency is associated to high emission amounts

Potency, abs. & rel. potentials

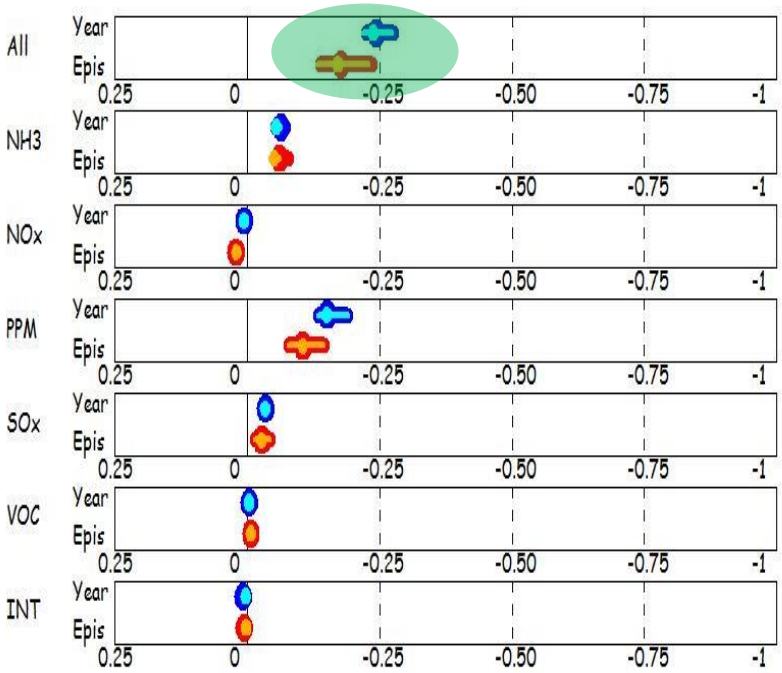
Belgium urban PM10

European Commission

Potential ($\mu g/m^3$)



Relative potential (%)



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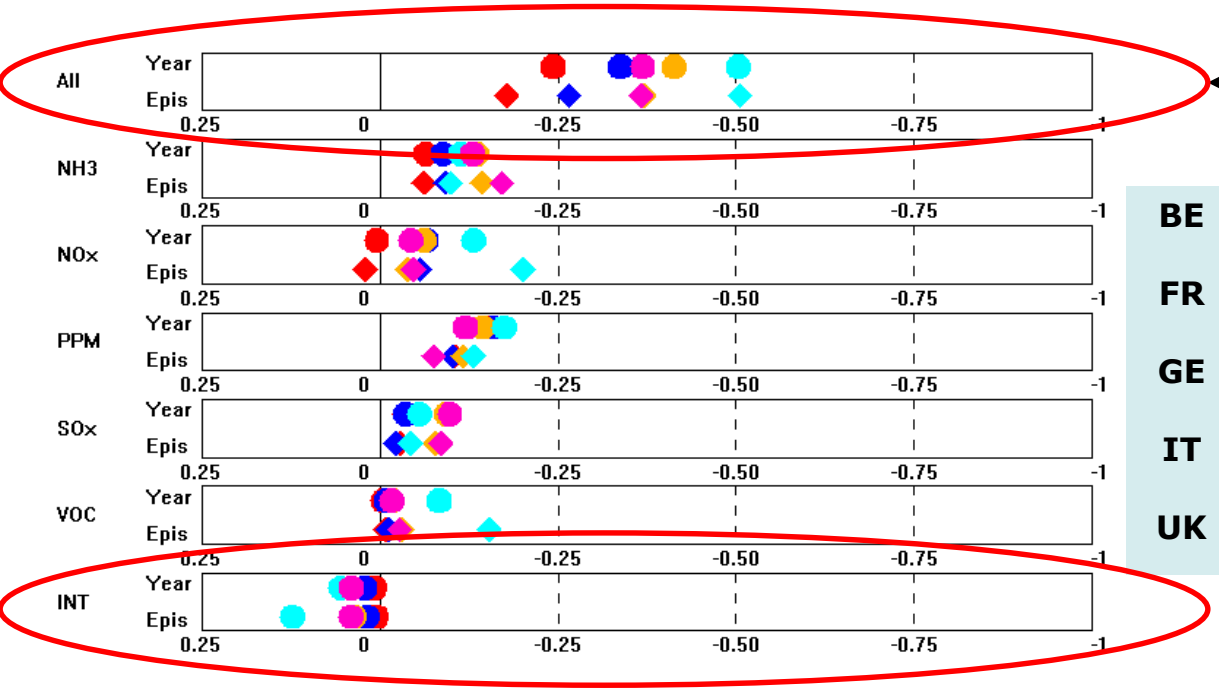
Rel. potentials

PM10 with 40% abatement



IT > GE > UK > FR > BE

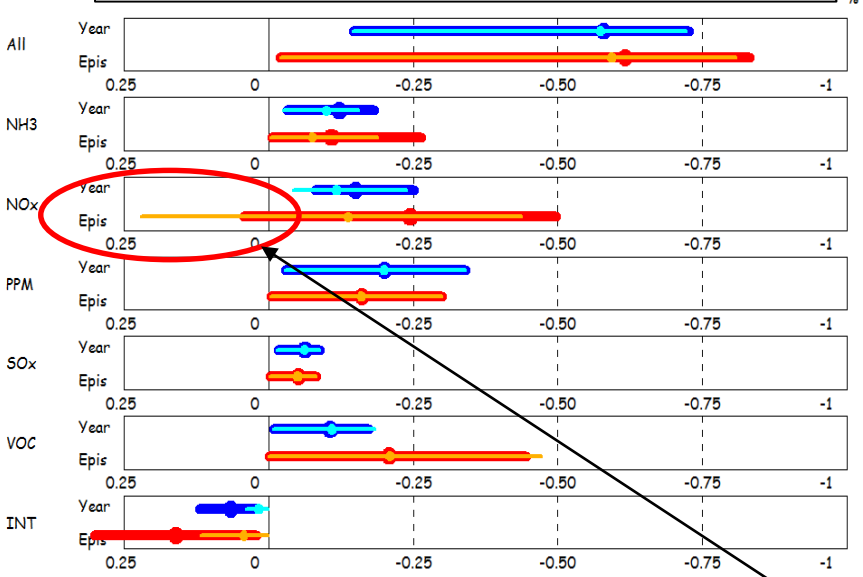
BE	PPM > NH3 > SOx > VOC ≈ NOx
FR	PPM > NH3 > NOx > SOx > VOC
GE	NH3 ≈ PPM > SOx ≈ NOx > VOC
IT	PPM ≈ NOx > NH3 > VOC > SOx
UK	NH3 > PPM ≈ SOx > NOx > VOC

PM10 Rel. potentials in Italy

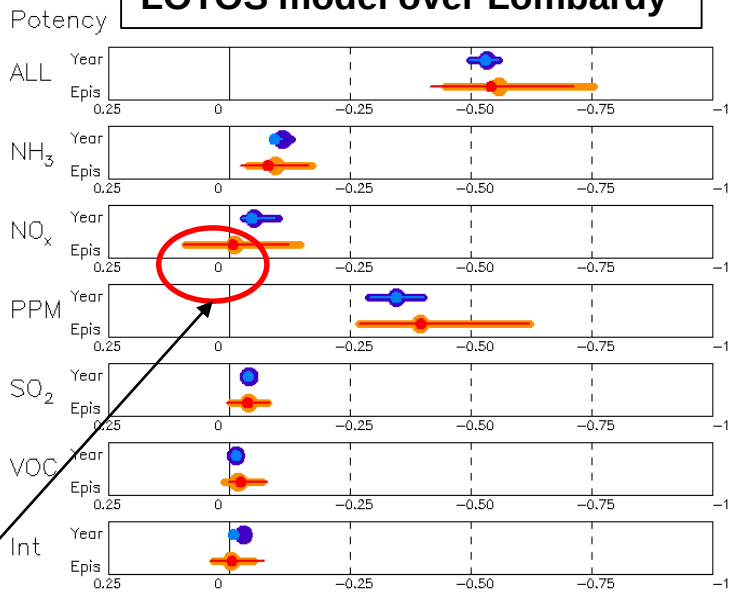
EMEP vs. LOTOS

European Commission

EMEP model over Lombardy (red IT)



LOTOS model over Lombardy



Positive potentials due to NOx reduction. A reduction of NOx can lead to an increase of PM concentration during an episode. The same trend is observed for the EMEP and LOTOS models.

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Conclusions

- Indicators are useful to inter-compare models on common basis
- Indicators do not provide an evaluation of the model performances but can help understand model processes and associated non-linearities
- To do: NO2, O3, episodes…
- More datasets would be welcome (volunteers?)
- Features are included in DELTA (advanced options)