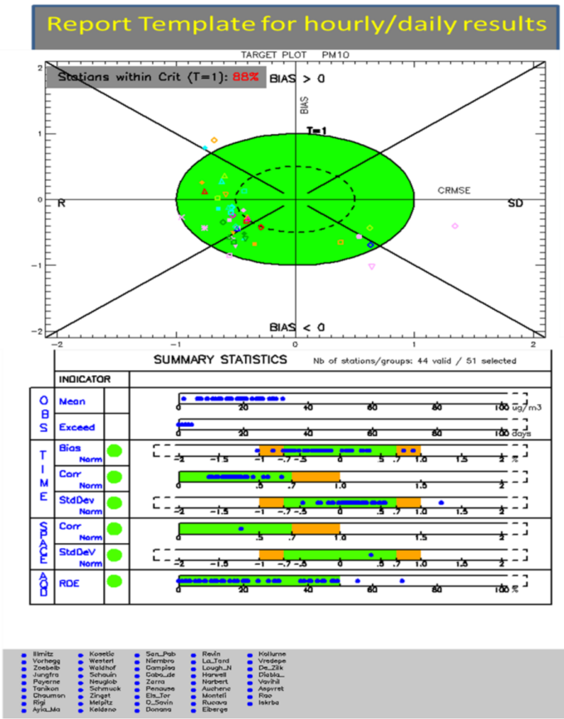
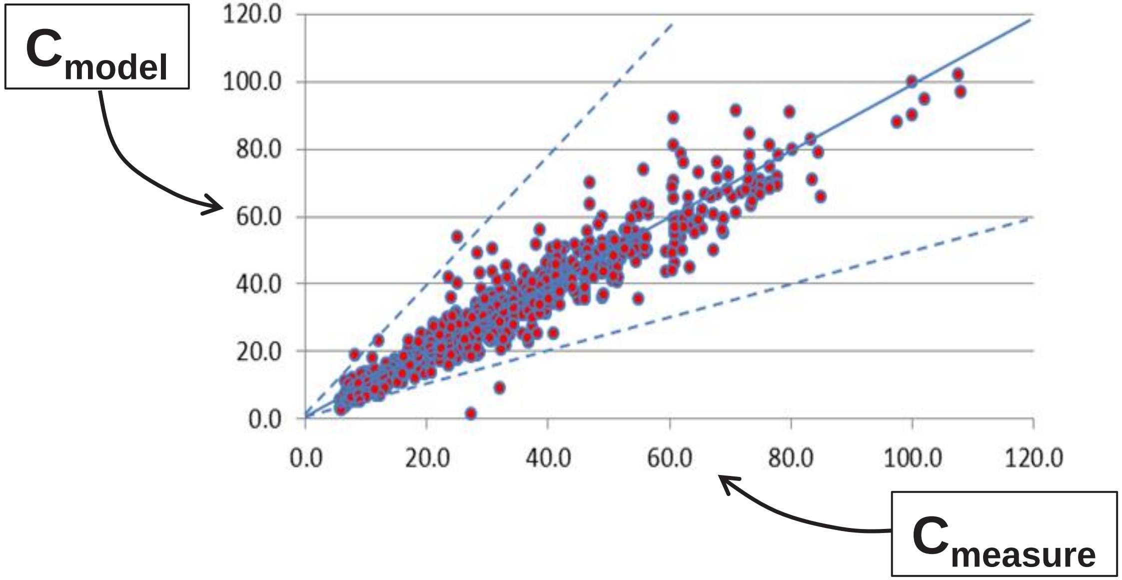
FAIRMODE WG4 - Planning

» Alain Clappier & Philippe Thunis

MODEL VALIDATION

WG 1: Assessment





Validation based on comparisons of observed and modelled concentrations:

⇨ fine to forecast the concentration exceeding the limit values

⇨ but is it adapted for air quality planning?

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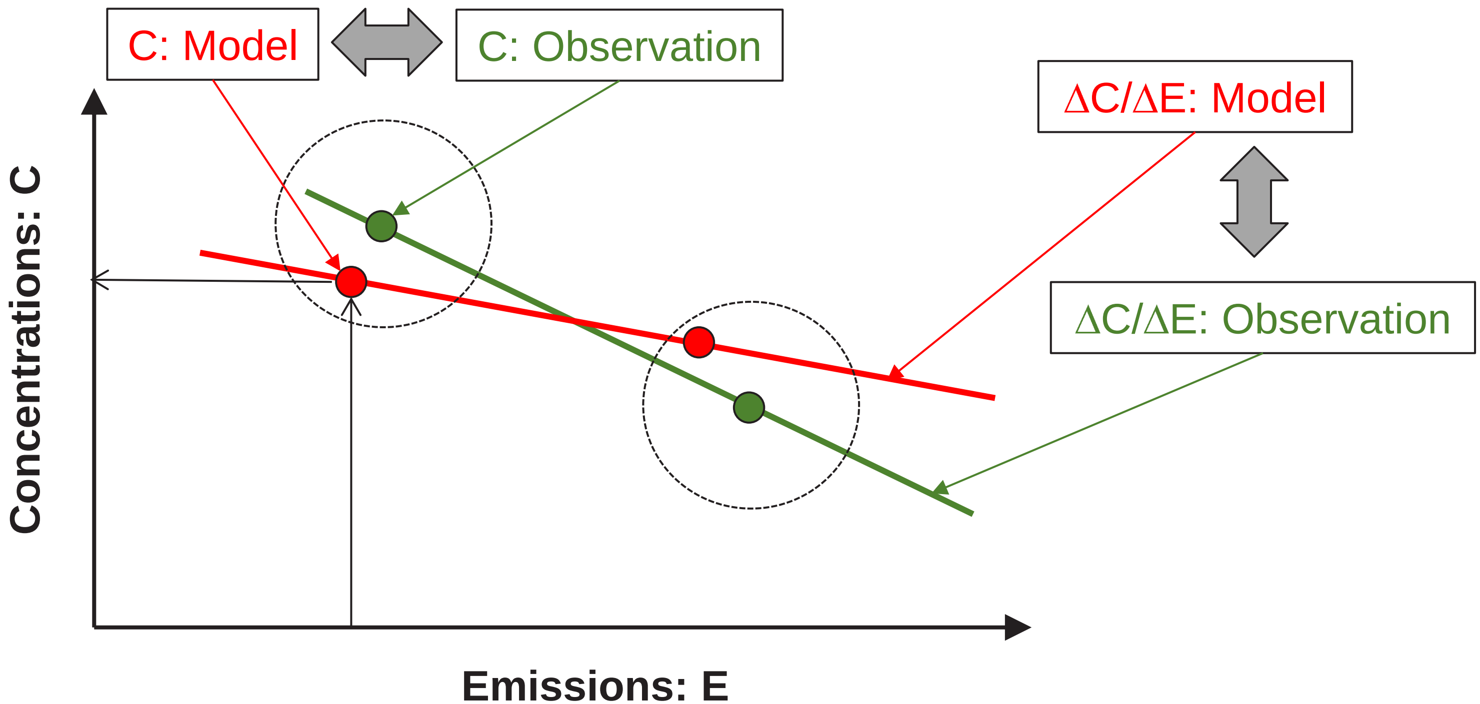
MODEL VALIDATION

WG 4: Planning



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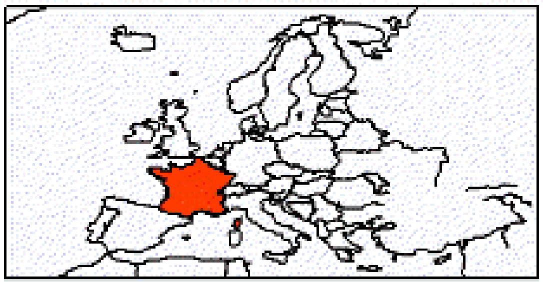
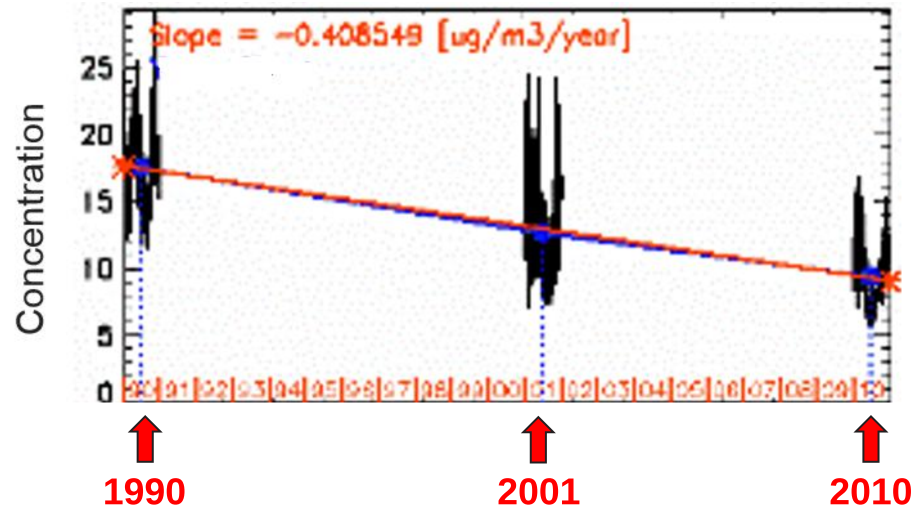
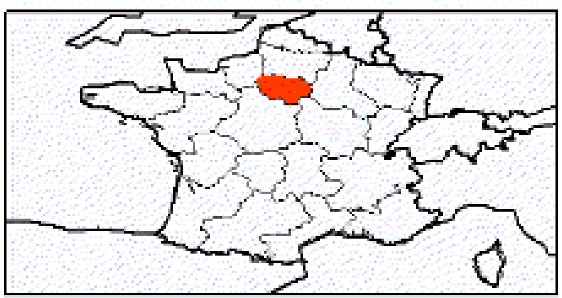
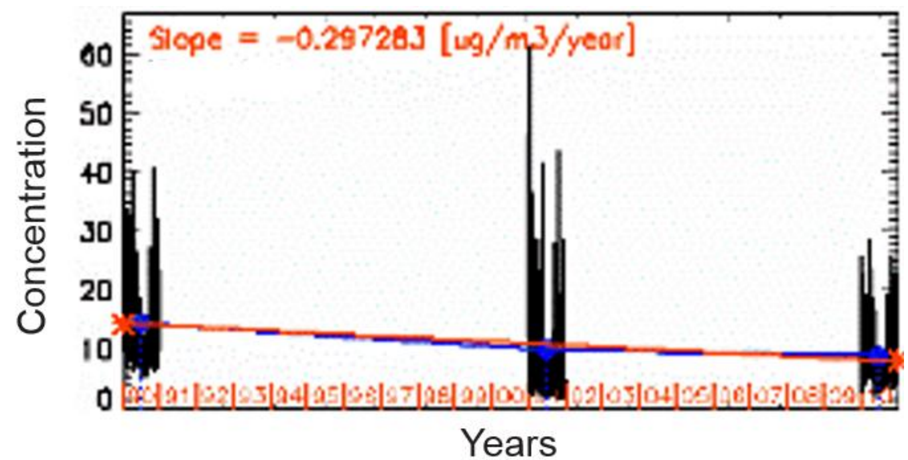
METHODOLOGY

Trend analysis



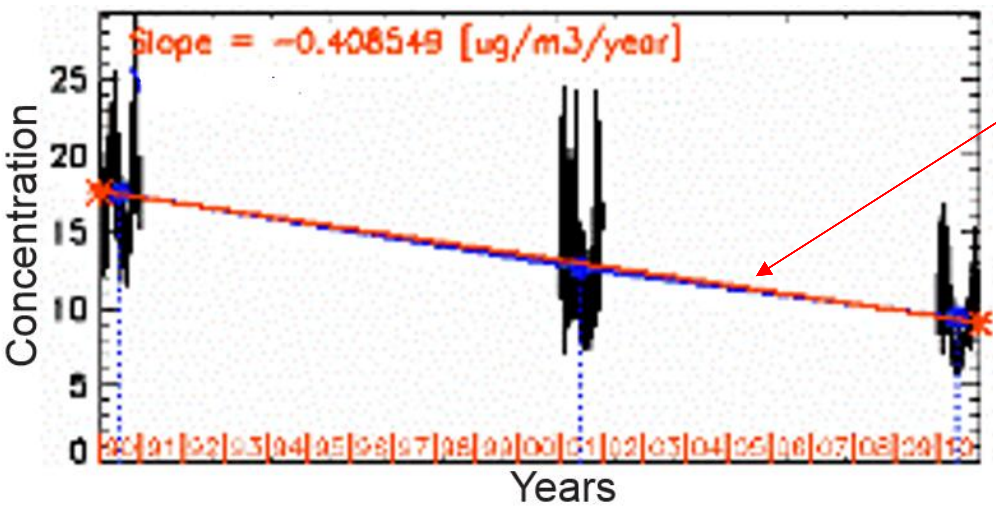






METHODOLOGY

Trend analysis



ΔC/Δt: Model ⟷ ΔC/Δt: Observation

ΔC/ΔE: Model ? ΔC/ΔE: Observation

ΔE: Model ? ΔE: Real

Advantages: Comparison between model and observations (≈ reality).

Drawbacks: Past data availability; emission inventories, observations (concentrations, meteo…).

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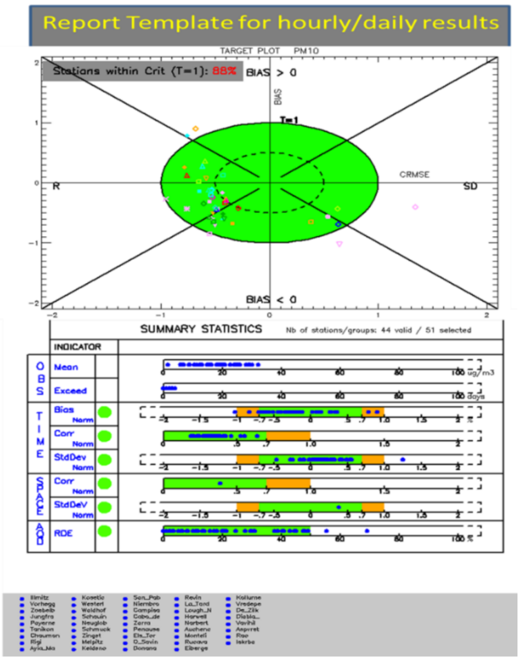
METHODOLOGY

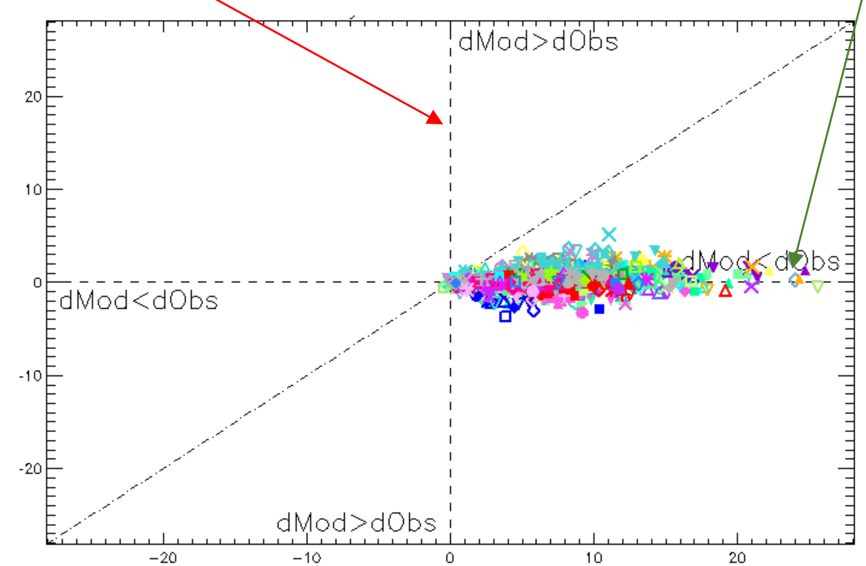
Segregation periods

<u>Example</u>: E_{week} ⇨ C_{week} $E_{week\text{-}end}$ ⇨ $C_{week\text{-}end}$



$\Delta C=(C_{week} - C_{week\text{-}end})$: Model

$\Delta C=(C_{week} - C_{week\text{-}end})$: Observations



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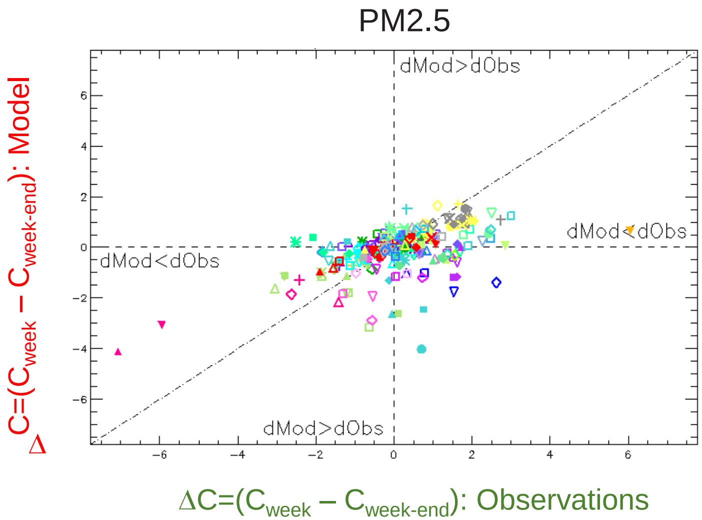
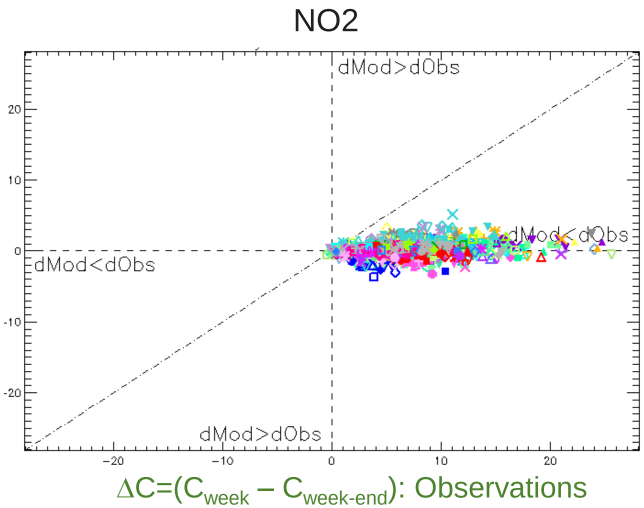
Segregation periods





ΔC/ΔE: Model

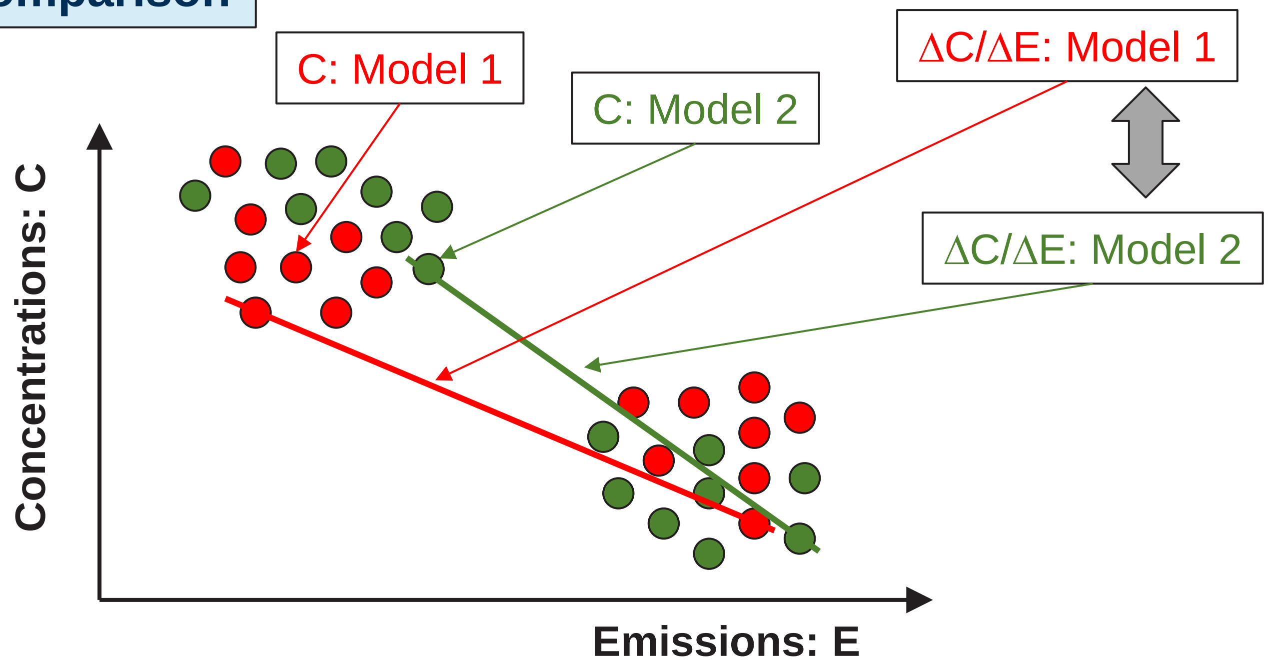
ΔC/ΔE: Observation

Advantages: Comparison between model and observations (≈ reality).
Easy to set up

Drawbacks: No control on the emission abatement level

METHODOLOGY

Model inter-comparison



Advantages: Control on emission abatement level

Drawbacks: No reference to reality (i.e. observations)
Difficulties to synthesize the information which should be compared

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Discussion - Open questions

- Do you have any experience of model validation for planning?
- Would it be useful to improve the existing methods used to validate models for planning?

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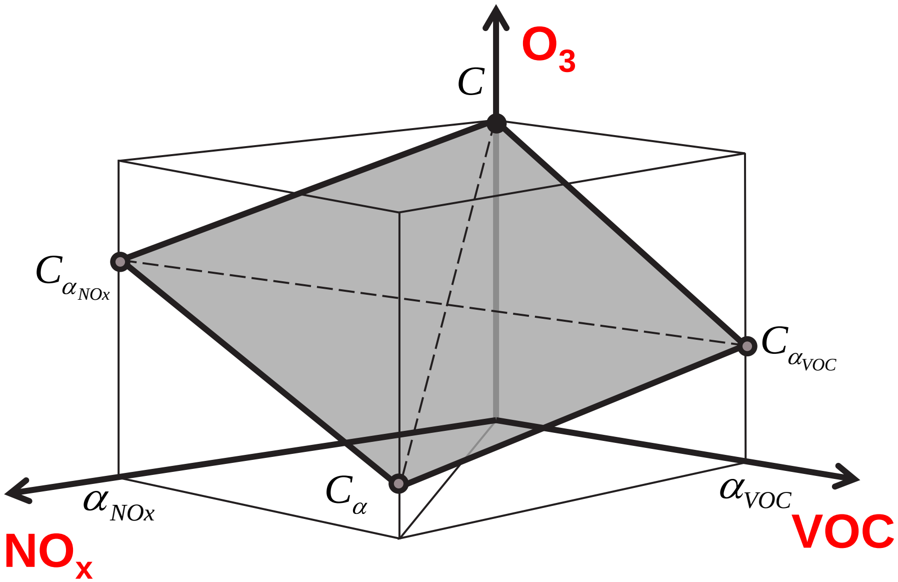
The emissions of a series of precursors like NO_x, VOC, SO_2, NH_3, PPM gives pollutant concentrations like PM or O_3.



C : Pollutant concentration (O_3) without any emission reduction

α_{NOx} is the relative emission change of a first precursor (NO_x) $\alpha_{NOx} = \Delta E_{\alpha_{NOx}} / E_{NOx}$

α_{VOC} same but for a second precursor (VOC)

$C_{\alpha_{NOx}}$: Pollutant concentration after reduction of the first precursor only

$C_{\alpha_{VOC}}$: same but after reduction of the second precursor only

C_{α} : Pollutant concentration after reduction of all precursors

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INDICATORS

POTENCIES for a single precursor:

Absolute potency: $$P_{\alpha_{NOx}} = \frac{\Delta C_{\alpha_{NOx}}}{\Delta E_{\alpha_{NOx}}}$$ Pollutant concentration change over the emission change of NO_x only.

α_{NOx} is the relative emission change of the precursor: $\alpha_{NOx} = \Delta E_{\alpha_{NOx}} / E_{NOx}$

Relative potency: $$p_{\alpha_{NOx}} = \frac{\Delta C_{\alpha_{NOx}} / C}{\Delta E_{\alpha_{NOx}} / E_{\alpha_{NOx}}} = \frac{\Delta C_{\alpha_{NOx}} / C}{\alpha_{NOx}}$$ Relative concentration change over the relative emission change of NO_x only.

No more emissions !

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POTENCIES for several precursors:

Absolute potency: $$P_\alpha = \frac{\Delta C_\alpha}{\Delta E}$$

Pollutant concentration change over the emission change of all the precursor (NO_x and VOC).

α the relative change of the total emission: $\alpha = \Delta E / E$ $\quad E = \sum_k E_k$

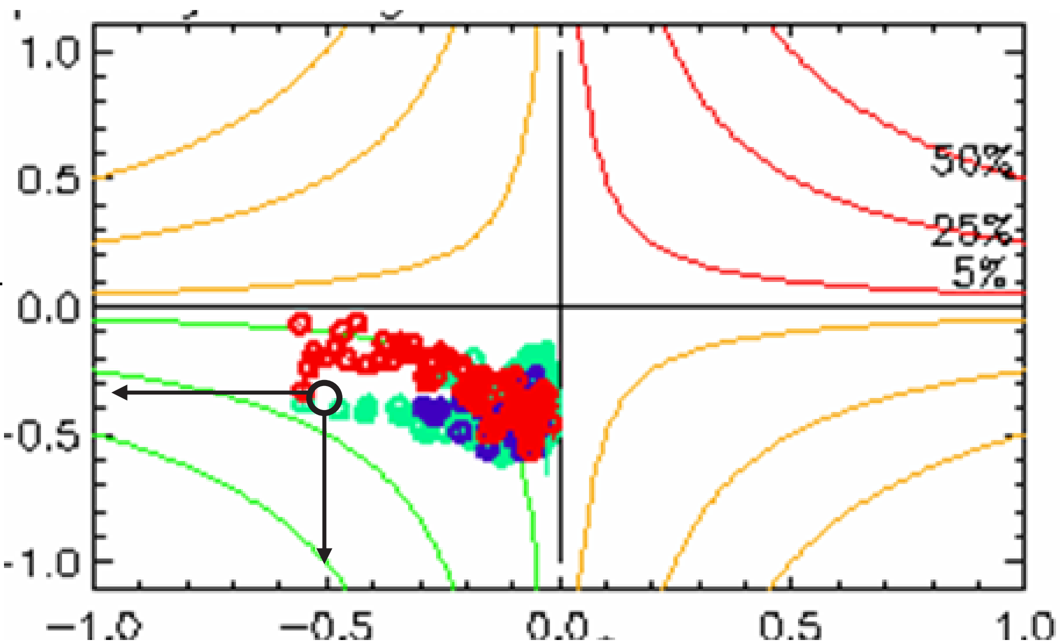
Relative potency: $$p_\alpha = \frac{\Delta C_\alpha / C}{\alpha}$$

Relative concentration change over the relative emission change of all the precursor (NO_x and VOC).

INDICATORS

Relative impact of NO_x reduction on PM10 over Po Valley

$$J = \frac{p_{\alpha_{NOx}}}{I_{max}}$$



$$I_{max} = \max\left[p_{\alpha} ; p_{\alpha_{NOx}} ; p_{\alpha_{VOC}} ; \ldots \right]$$

$$I_{max} = 0.5$$

$$\Delta C_{\alpha} / C = 0.5 \times \alpha$$

$$\Delta C_{\alpha} / C = 0.5 \times 20\% = 10\%$$

$$\Delta C_{\alpha} / C = 0.5 \times 30\% = 15\%$$

$$J = 0.25$$

a NO_x reduction lead 25% of the maximum reduction

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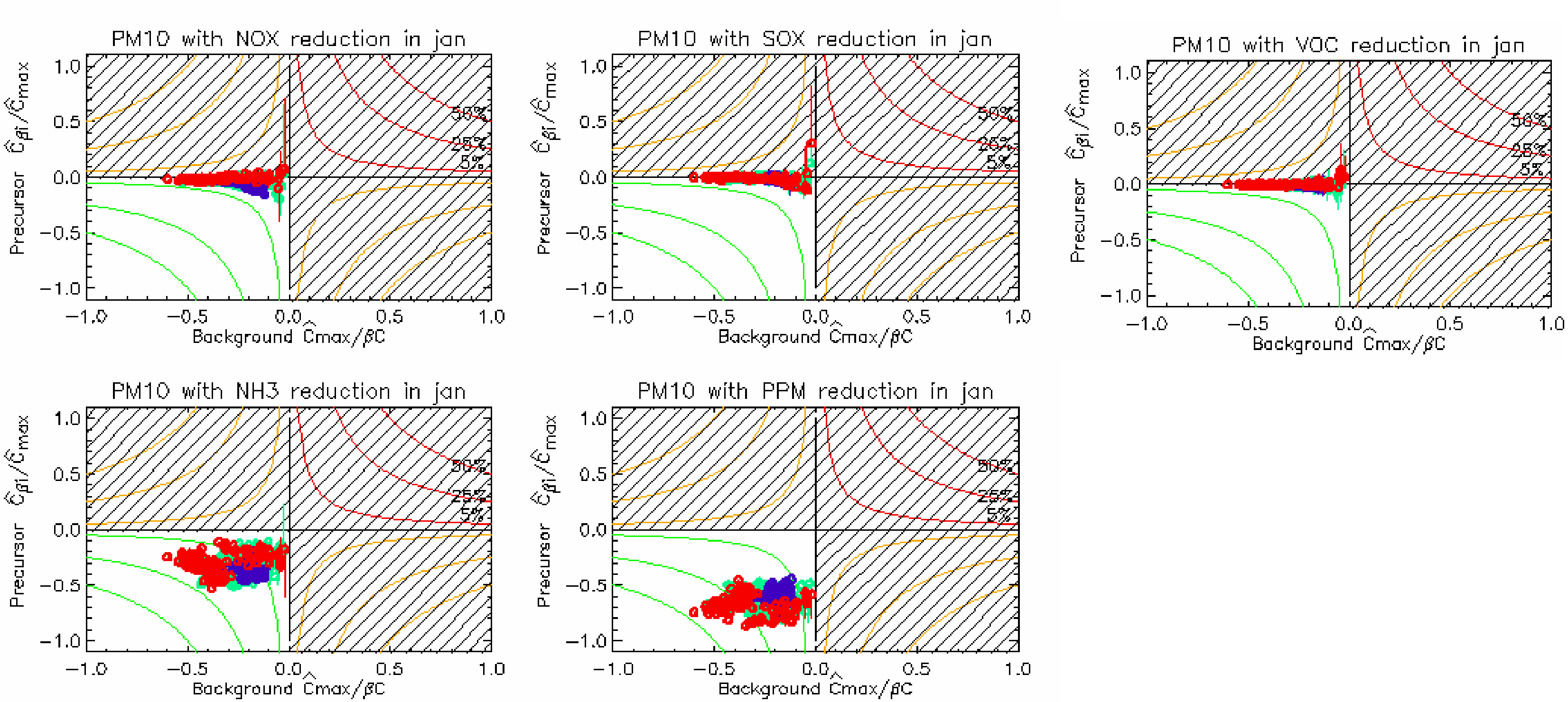

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Participation and Requirements

Test the indicators

- “Decision making” abatement run?

- Inter-comparison abatement run?

  common region, emission inventories.

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Thank you