FAIRMODE WG4 - Planning

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What do we intend by planning in WG4 ?

.

WG1: assessment ⇨ Base case model validation

WG4: planning ⇨ Scenario model validation

Objective: Quantify the model accuracy when run in scenario mode via a common template with the following characteristics:

- Simplicity
- Comparability
- Overview.

Why do we need something?

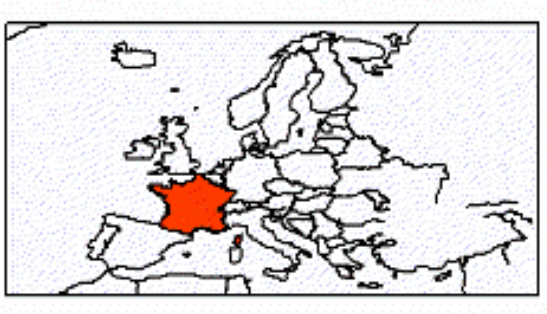
APPRAISAL FP7 project has shown that the **base case simulations are validated in only 40% of the reported cases**,

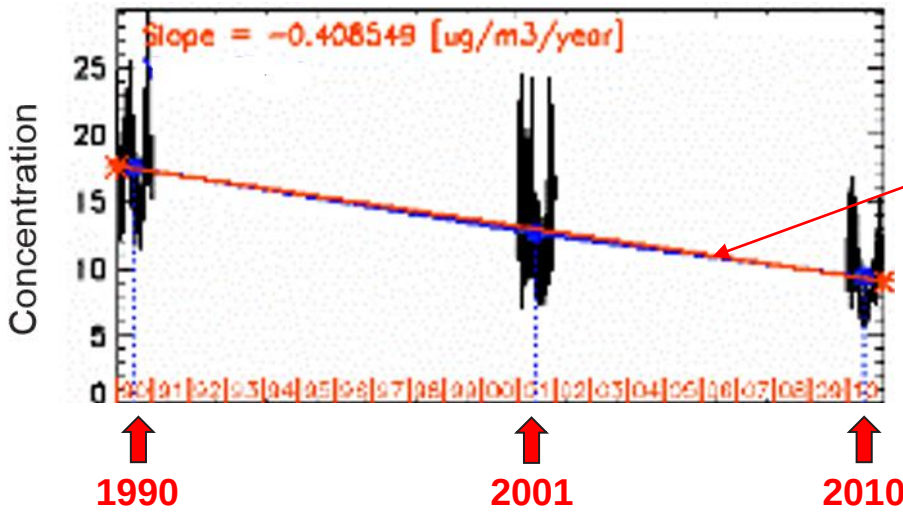
in addition, **scenarios are never validated**.

Indeed, Air Quality Models are used, for a large part, in scenario mode to produce results in order to design abatement strategies.

What is currently done?

Trend analysis: e. g. Eurodelta exercise





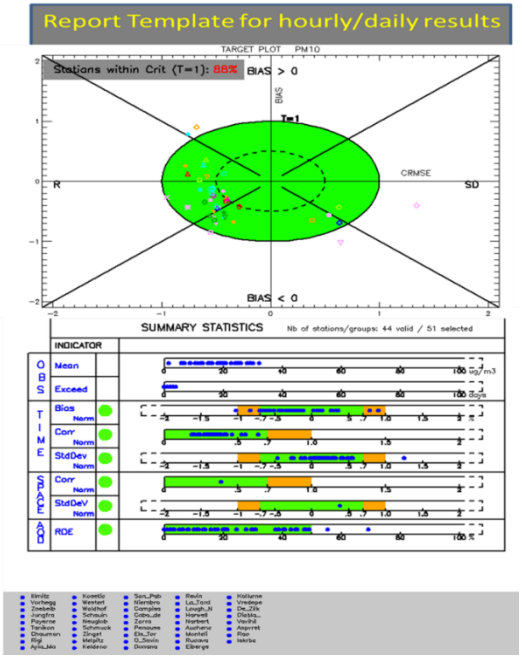
$\Delta C_{model}/\Delta t$ ⇔ $\Delta C_{observation}/\Delta t$

Courtesy: K. Cuvelier

What is currently done?

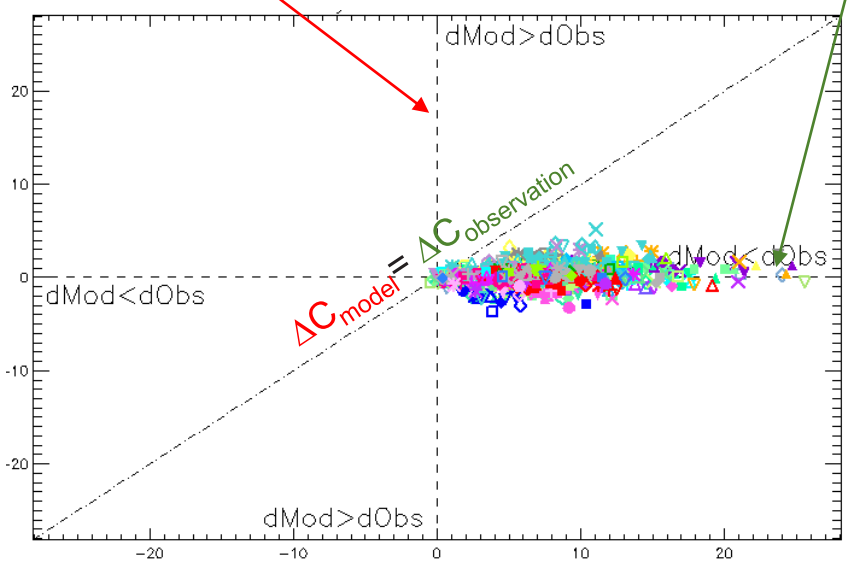
Segregation periods

Example: E_{week} ⇨ C_{week} $E_{week\text{-}end}$ ⇨ $C_{week\text{-}end}$



$\Delta C_{model}=(C_{week} - C_{week\text{-}end})$

$\Delta C_{observation}=(C_{week} - C_{week\text{-}end})$



Courtesy: K. Cuvelier

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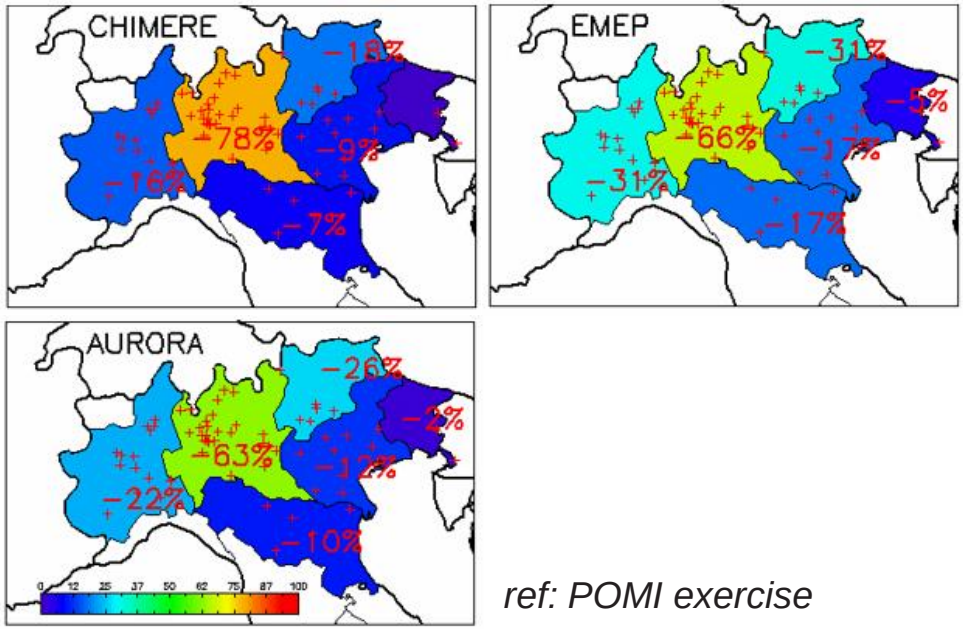
What is currently done?

Model inter-comparison exercise e.g: Citydelta, Eurodelta, POMI, etc…

% reduction **ΔPM / PM** over North Italy



ref: POMI exercise

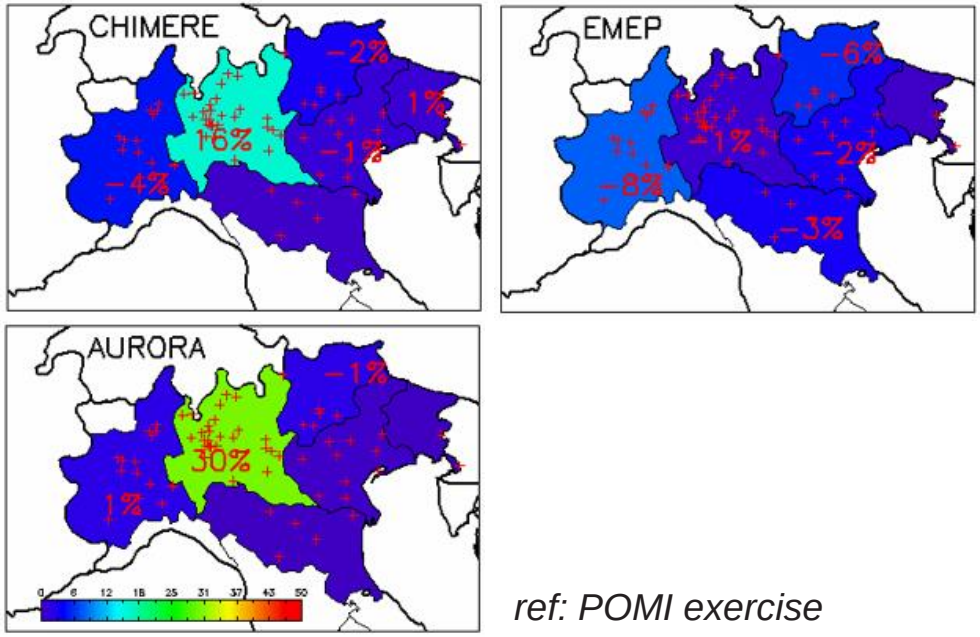
ΔE/E = 100% over Lombardia

ΔC/C over different North Italian regions

What is currently done?

Model inter-comparison exercise

% reduction ΔO_3 / O_3 over North Italy



ref: POMI exercise

$\Delta E/E = 100\%$ over Lombardia

$\Delta C/C$ over different North Italian regions

What did we propose so far?

Potency concept

We proposed simple indicators to quantify the model responses to emission reduction and facilitate model inter-comparison.

$$p = -\frac{\Delta C/C}{\Delta E/E}$$

α is the % emission reduction over a given area, then: $$p = \frac{\Delta C}{\alpha C}$$

ΔE/E < 0 → ΔC/C > 0

ΔE/E < 0 → ΔC/C < 0

0

-0.5

-1

ΔE/E=100% → ΔC/C=0%
ΔE/E= 50% → ΔC/C=0%
Emission reduction has no effects on concentrations

ΔE/E=100% → ΔC/C=50%
ΔE/E= 50% → ΔC/C=25%

ΔE/E=100% → ΔC/C=100%
ΔE/E= 50% → ΔC/C= 50%
Full emission reduction reduces all concentrations

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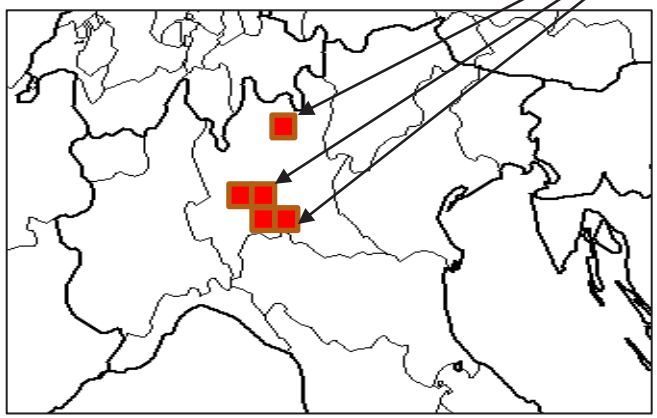
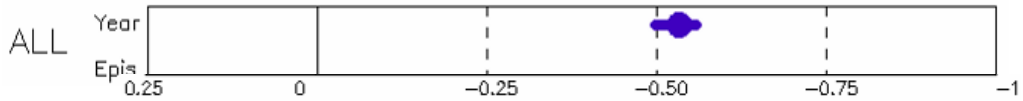
What did we propose so far?

Potency concept

only the cells containing concentrations greater than the 95% percentile



Yearly averaged **PM**



$$p \approx 0.5 \qquad \Delta E/E = 100\% \Rightarrow \Delta C/C = 50\%$$

What did we propose so far?

Potency concept

Potencies can be computed for each precursors.

p_{ALL} → ALL

p_{NO_x} → NOx

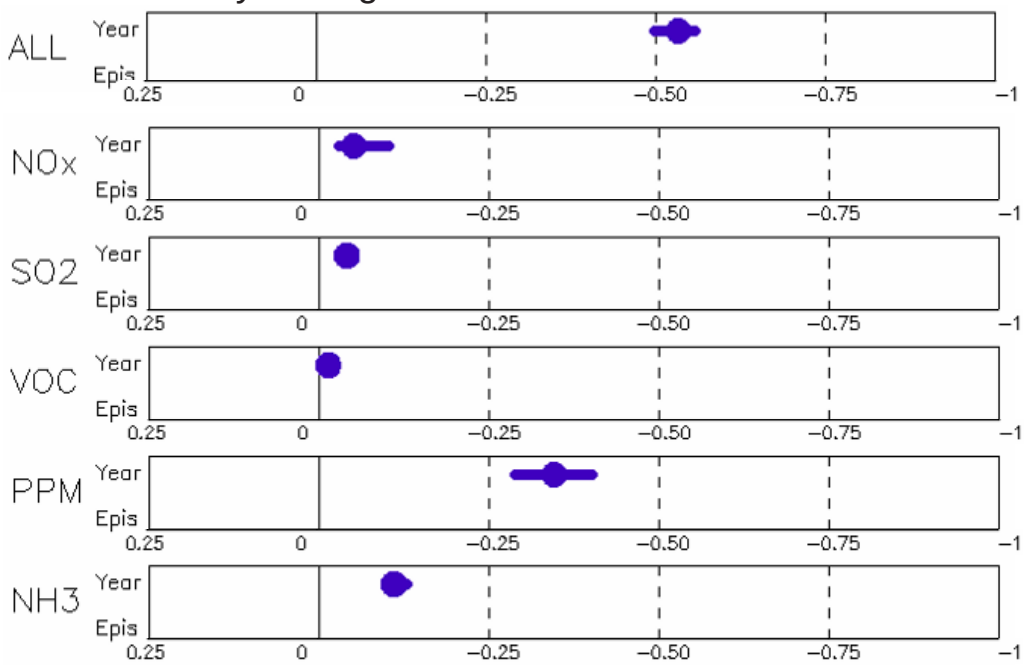
p_{SO_2} → SO2

p_{VOC} → VOC

p_{PPM} → PPM

p_{NH_3} → NH3

Yearly averaged **PM**



The PPM produce the main contribution to the PM formation, then NH_3 and NO_x.

What did we propose so far?

Potency concept

If the relation between precursor and concentration is linear the potency is constant for every percentage emission reduction.

$p^{50\%}_{ALL}$ $p^{30\%}_{ALL}$ ⇒

$p^{50\%}_{NO_x}$ $p^{30\%}_{NO_x}$ ⇒

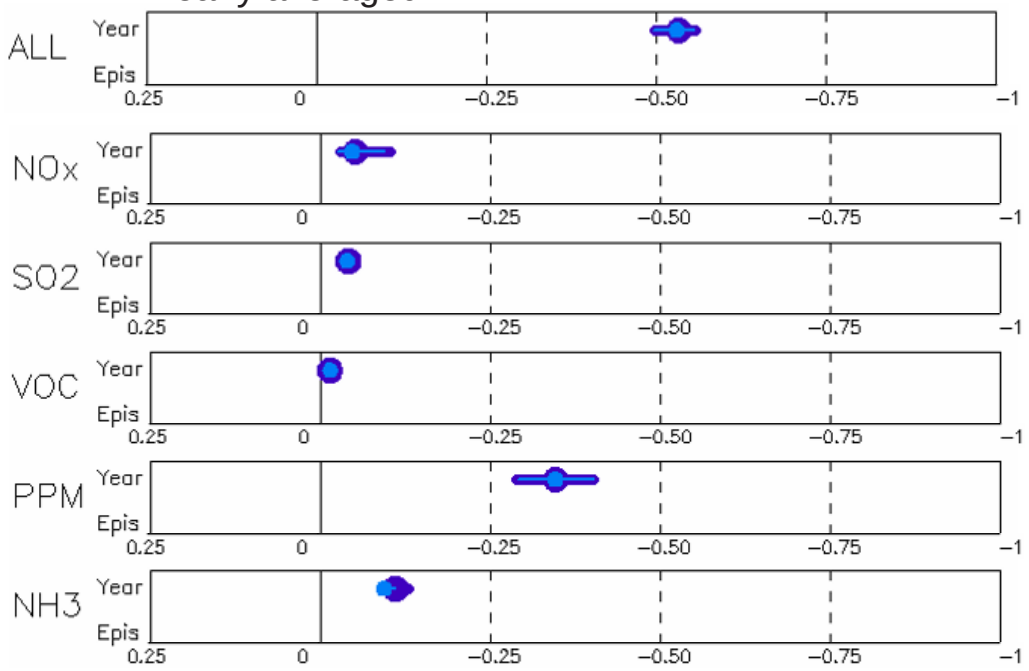
$p^{50\%}_{SO_2}$ $p^{30\%}_{SO_2}$ ⇒

$p^{50\%}_{VOC}$ $p^{30\%}_{VOC}$ ⇒

$p^{50\%}_{PPM}$ $p^{30\%}_{PPM}$ ⇒

$p^{50\%}_{NH_3}$ $p^{30\%}_{NH_3}$ ⇒

Yearly averaged **PM**



$p^{50\%} \approx p^{30\%}$ the non-linearity is weak.

What did we propose so far?

Potency concept

$$p_{ALL} = p_{NO_x} + p_{SO_2} + p_{VOC} + p_{PPM} + p_{NH_3} + p_{int}$$

$p_{ALL}^{50\%}$ $p_{ALL}^{30\%}$ ⇒

$p_{NO_x}^{50\%}$ $p_{NO_x}^{30\%}$ ⇒

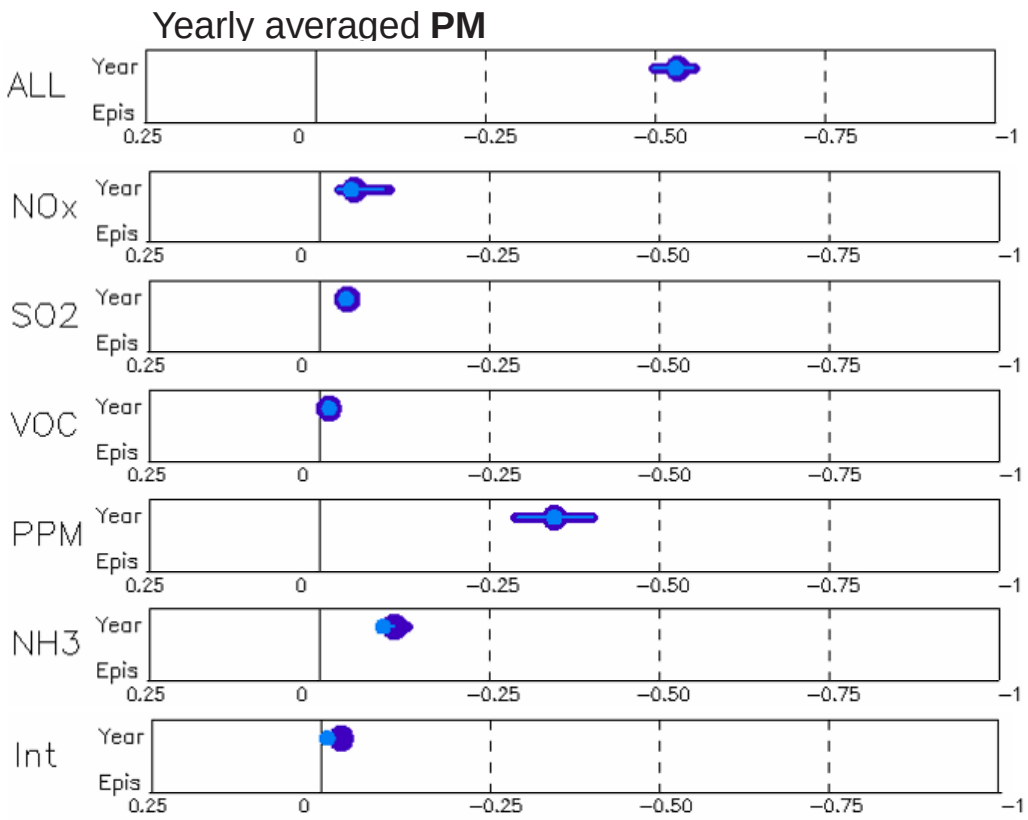
$p_{SO_2}^{50\%}$ $p_{SO_2}^{30\%}$ ⇒

$p_{VOC}^{50\%}$ $p_{VOC}^{30\%}$ ⇒

$p_{PPM}^{50\%}$ $p_{PPM}^{30\%}$ ⇒

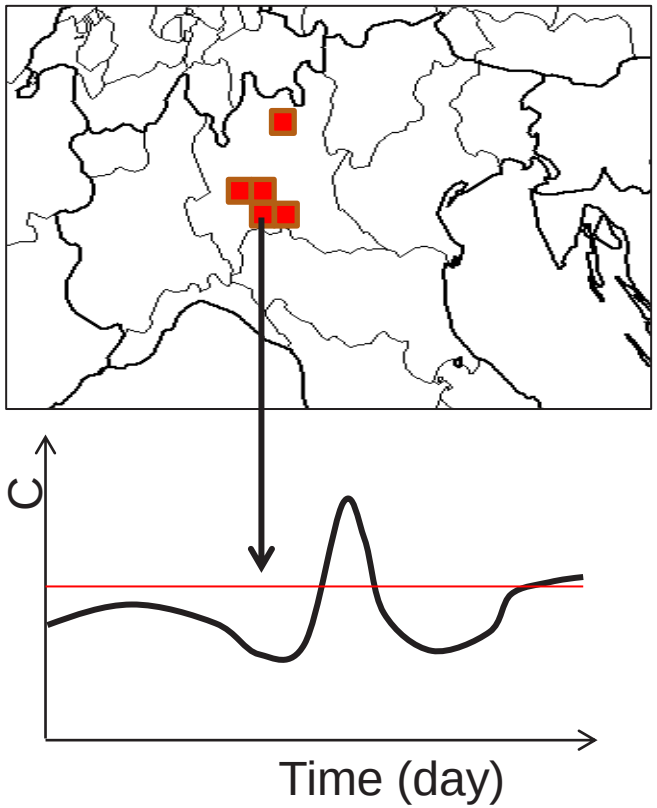
$p_{NH_3}^{50\%}$ $p_{NH_3}^{30\%}$ ⇒

$p_{int}^{50\%}$ $p_{int}^{30\%}$ ⇒

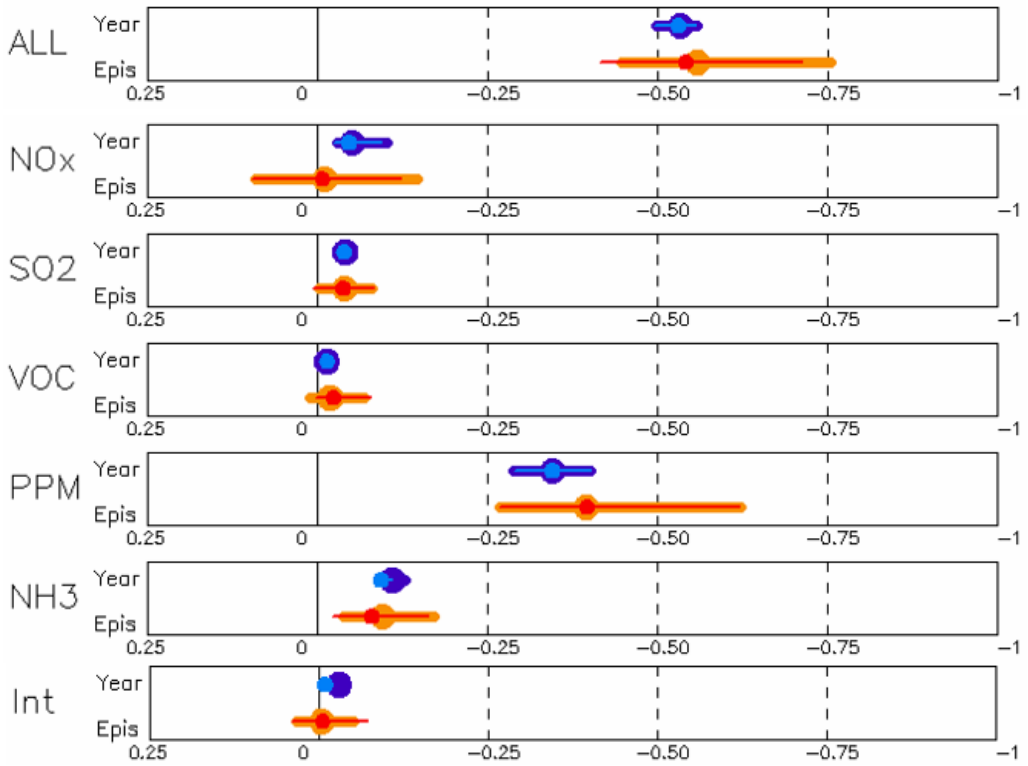


What did we propose so far?

Potency concept



Yearly averaged & daily episodes **PM**



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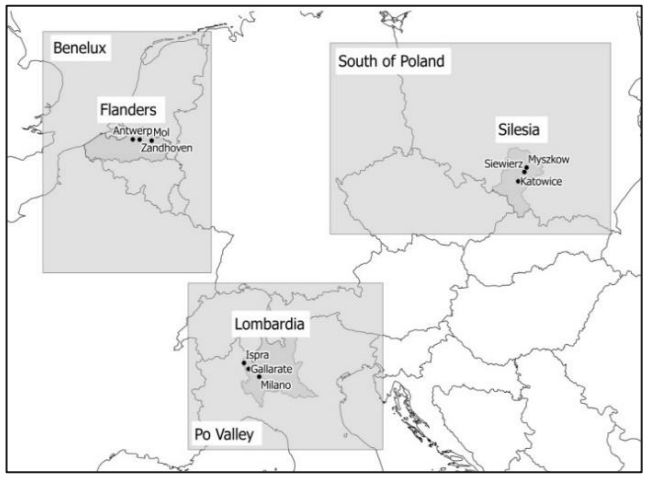
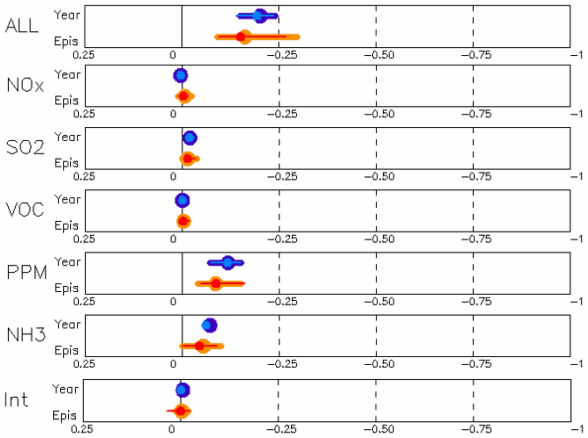
What did we propose so far?

Potency concept

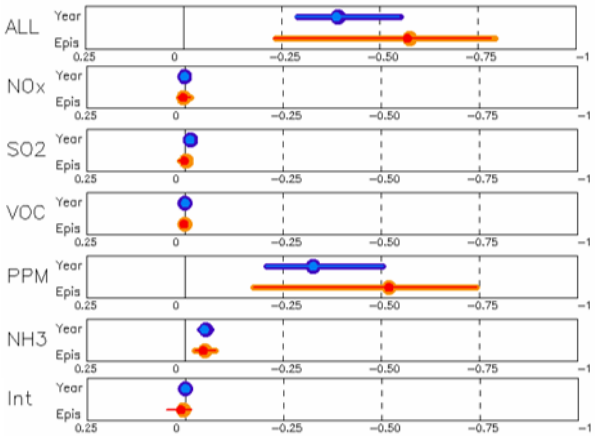
3 European regions:



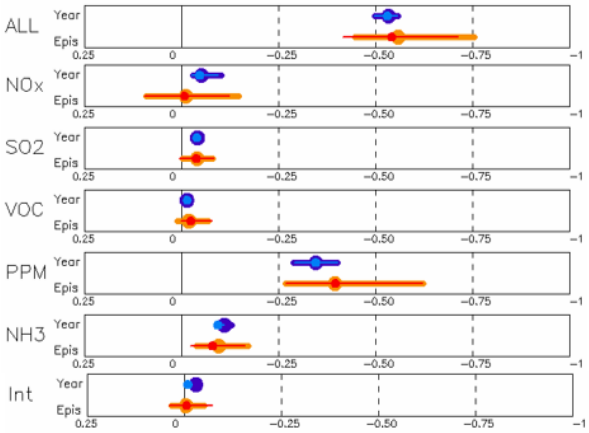
PM in Flanders



PM in Silesia



PM in Lombardia



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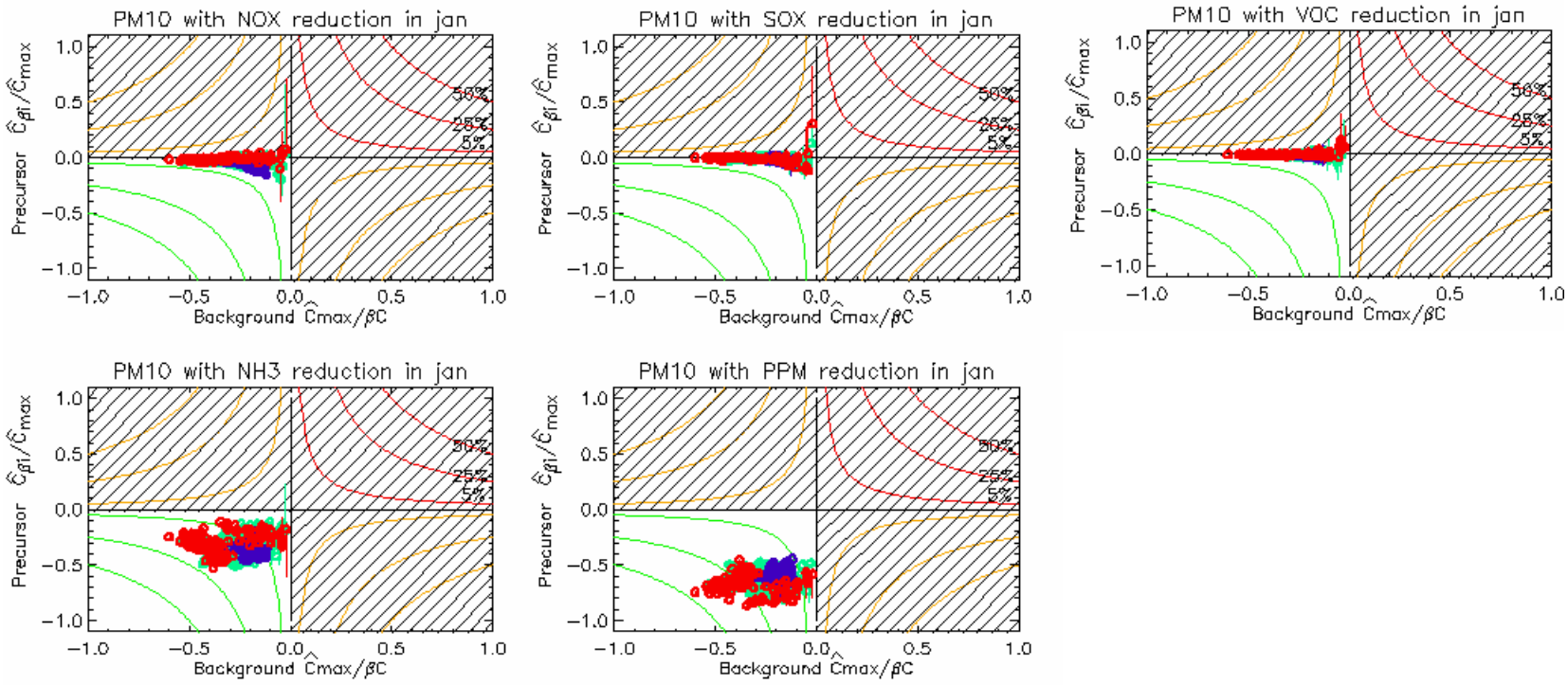
What did we propose so far?

Potency concept

other graphical representations (presented last year)



What did we propose so far?

Potency concept

Δ-planning tool draw graphics of potencies starting from 11 scenarios.

Datasets have been delivered and will be analyzed:

Contact	Model	Location of reductions
TNO & VITO	LOTOS-EUROS & AURORA	Europe
TNO	LOTOS-EUROS	BENELUX
VITO	AURORA	Belgium
Univ. Aveiro	TAPM	Porto region

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What is currently done?

Different methods

Trend analysis & Segregation periods

ΔC_{model} ⟺ $\Delta C_{observation}$

ΔC are calculated using different emission levels BUT also different meteorological situations.

Model inter-comparison

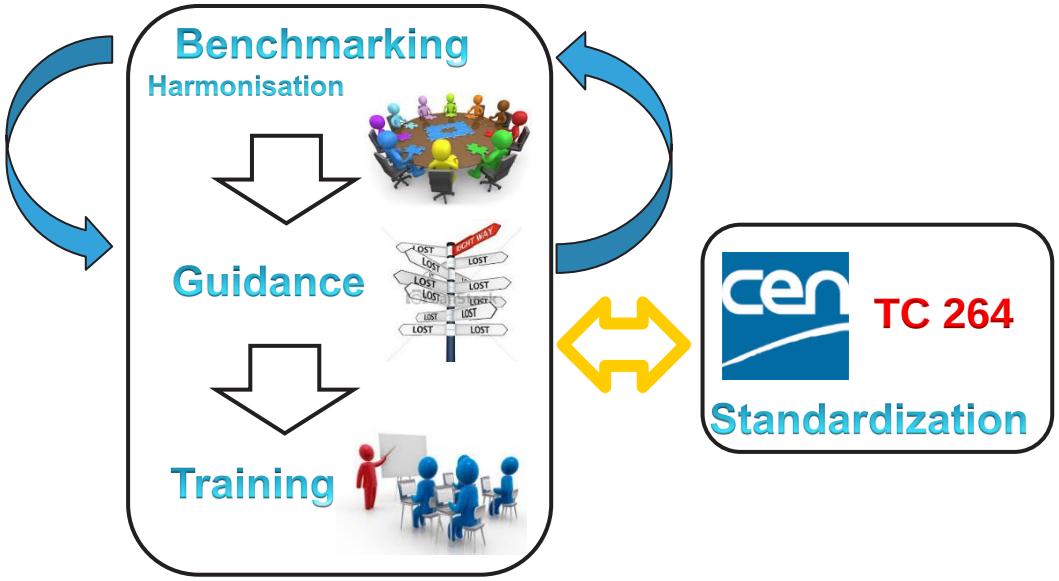
$\Delta C_{model} / \Delta E_{model}$ or $(\Delta C_{model}/C_{model}) / (\Delta E_{model}/E_{model})$

$\Delta C/\Delta E$ depend only from different emissions BUT there is no possible comparison with observations.

What do we propose?

We could not identify a fully satisfying approach to validate a model used in scenario mode.
The potency approach developed in the framework of FAIRMODE-WG4 can certainly help for results interpretation but it is still not a real validation methodology (no comparison with observations).

- ⇨ Need of further brainstorming
- ⇨ Group volunteers (around 5)
- ⇨ Preliminary **Guidance**



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