

WG4 - Planning: status and roadmap

A. Clappier
A. Monteiro

E-Reporting

I: source apportionment

Regional, urban and local background increment...

(1) Information on source apportionment (Article 13)

(1) Code(s) of exceedance situation (link to G)

(2) Reference year

(3) Regional background: total

(4) Regional background: from within Member State

(5) Regional background: transboundary

(6) Regional background: natural

(7) Urban background increment: total

(8) Urban background increment: traffic

(9) Urban background increment: industry including heat and power production

(10) Urban background increment: agriculture

(11) Urban background increment: commercial and residential

(12) Urban background increment: shipping

(13) Urban background increment: off-road mobile machinery

(14) Urban background increment: natural

(15) Urban background increment: transboundary

(16) Local increment: total

(17) Local increment: traffic

(18) Local increment: industry including heat and power production

(19) Local increment: agriculture

(20) Local increment: commercial and residential

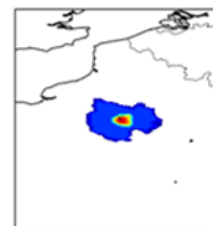
(21) Local increment: shipping

(22) Local increment: off-road mobile machinery

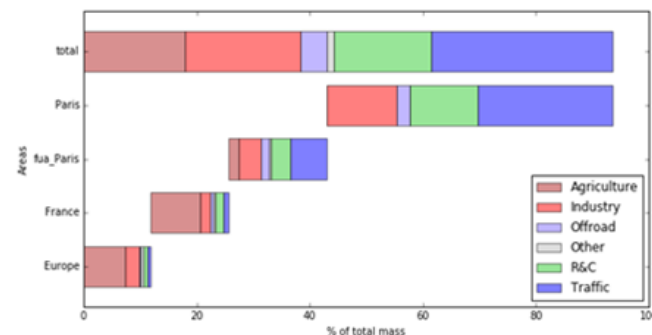
(23) Local increment: natural

(24) Local increment: transboundary

SHERPA Report

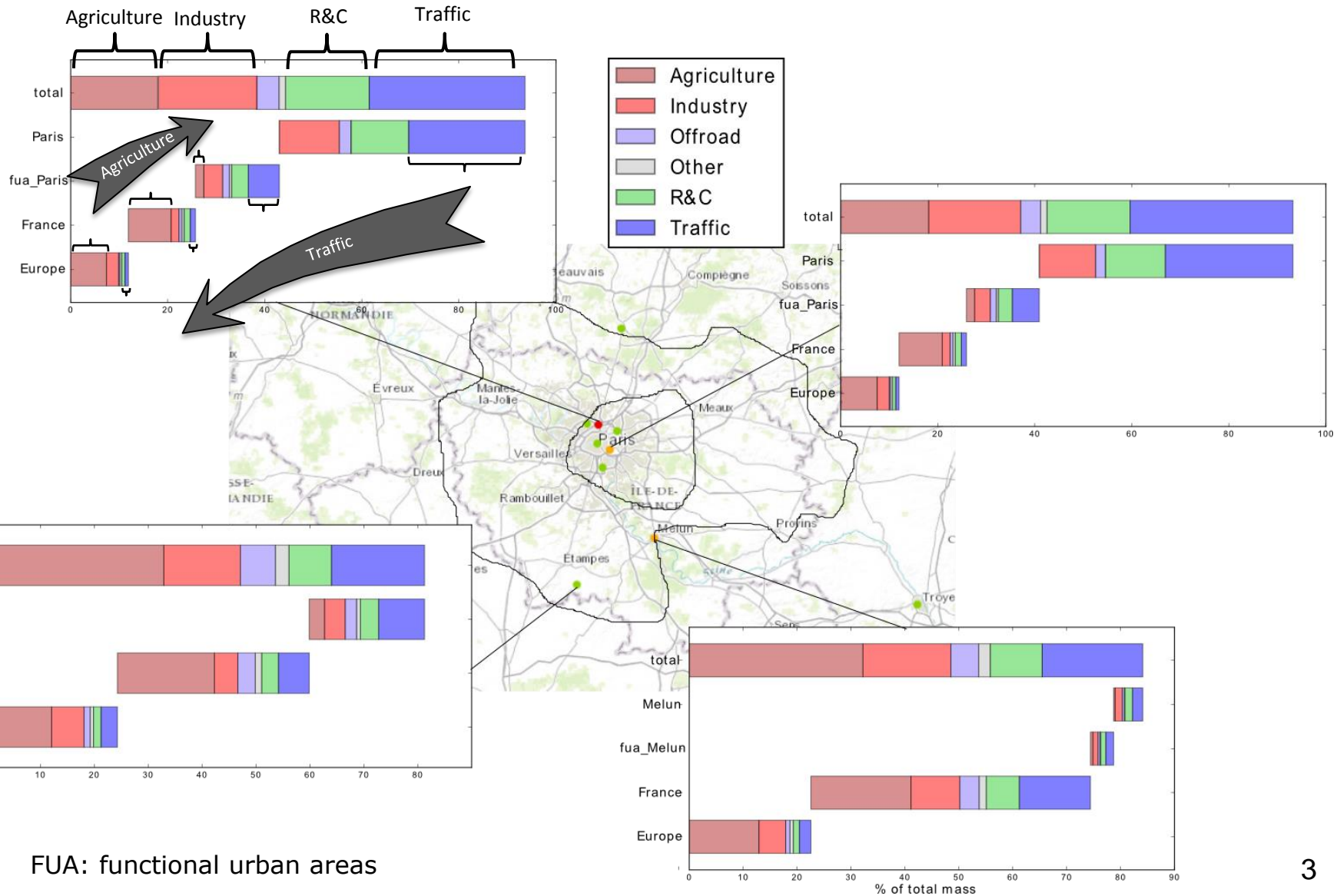


Paris S. Denis (FR04058)
Location: 2.36W, 48.93N
SHERPA: V1.1
AQM: Chimere
Emissions: EC4MACS
Meteq: ECMWF
Pollutant: PM2.5



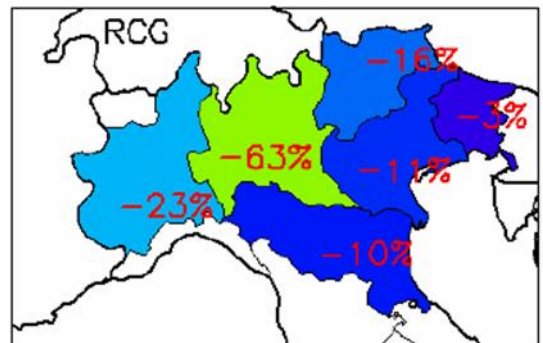
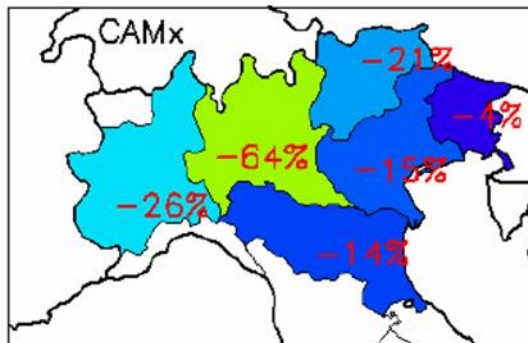
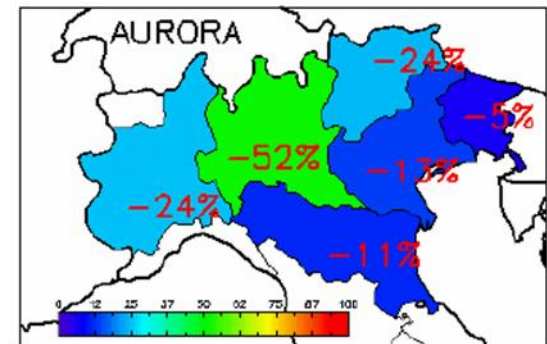
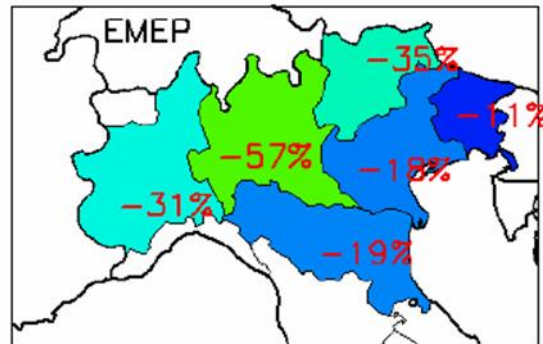
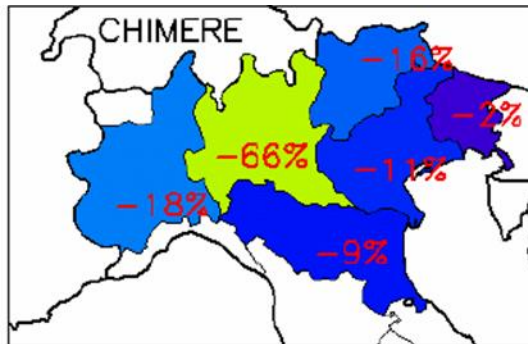
	Europe	France	fua_Paris	Paris	total
Agriculture	7	9	2	0	18
Industry	3	2	4	12	20
Offroad	0	1	1	2	5
Other	0	0	0	0	1
R&C	1	1	3	12	17
Traffic	1	1	6	24	32
Natural+other			6		

E-reporting: SHERPA

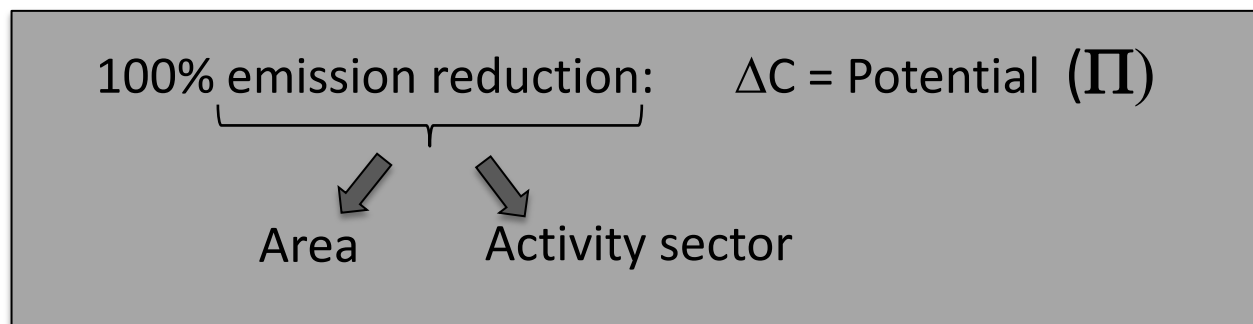


Variability of Model Results: North of Italy

Percentage reduction of PM10



ref: POMI exercise 2008

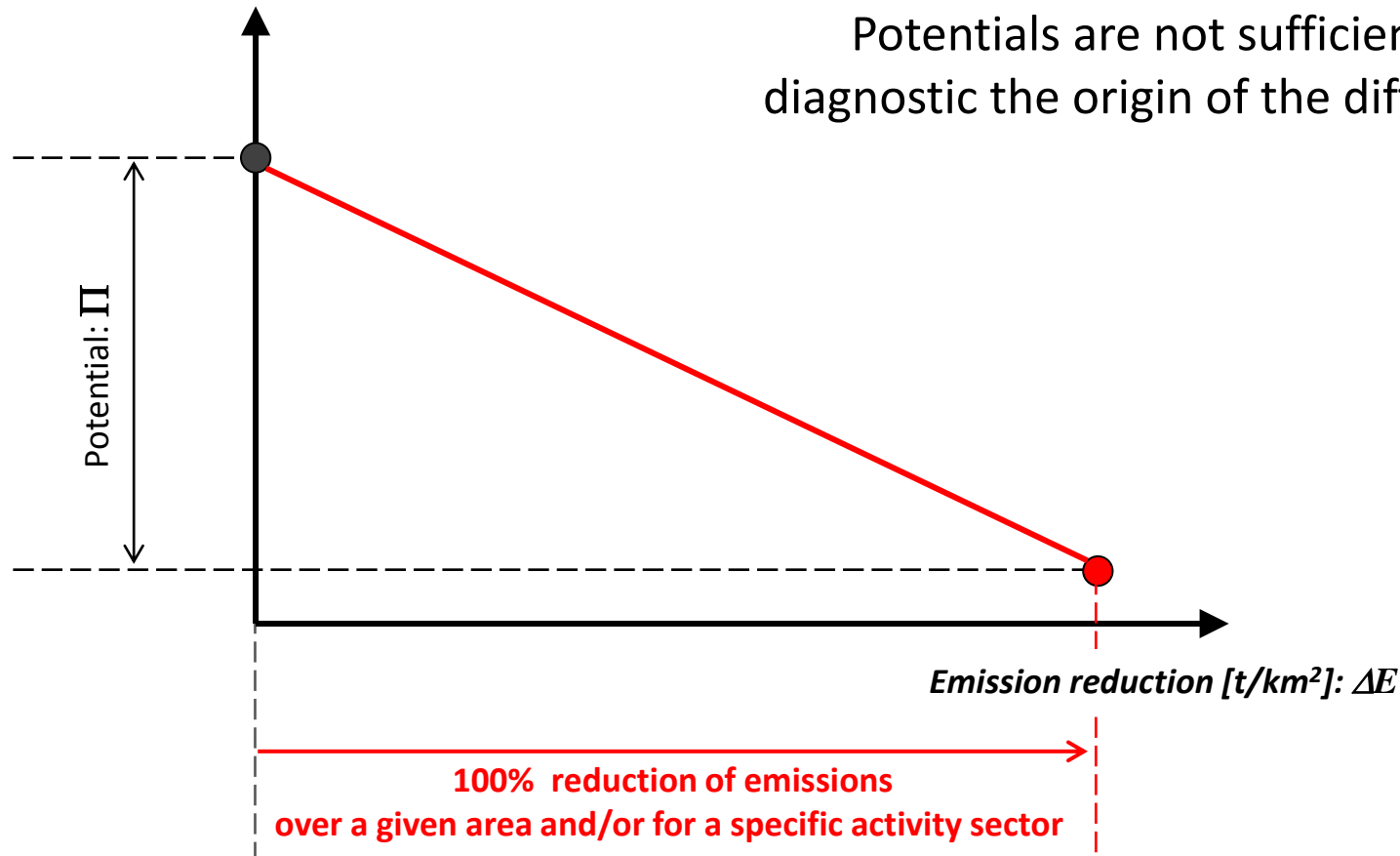


Model Benchmarking: Potentials

100% emission reduction: $\Delta C = \text{Potential } (\Pi)$

Concentration [$\mu\text{g}/\text{m}^3$]: C

Potentials are not sufficient to
diagnostic the origin of the differences

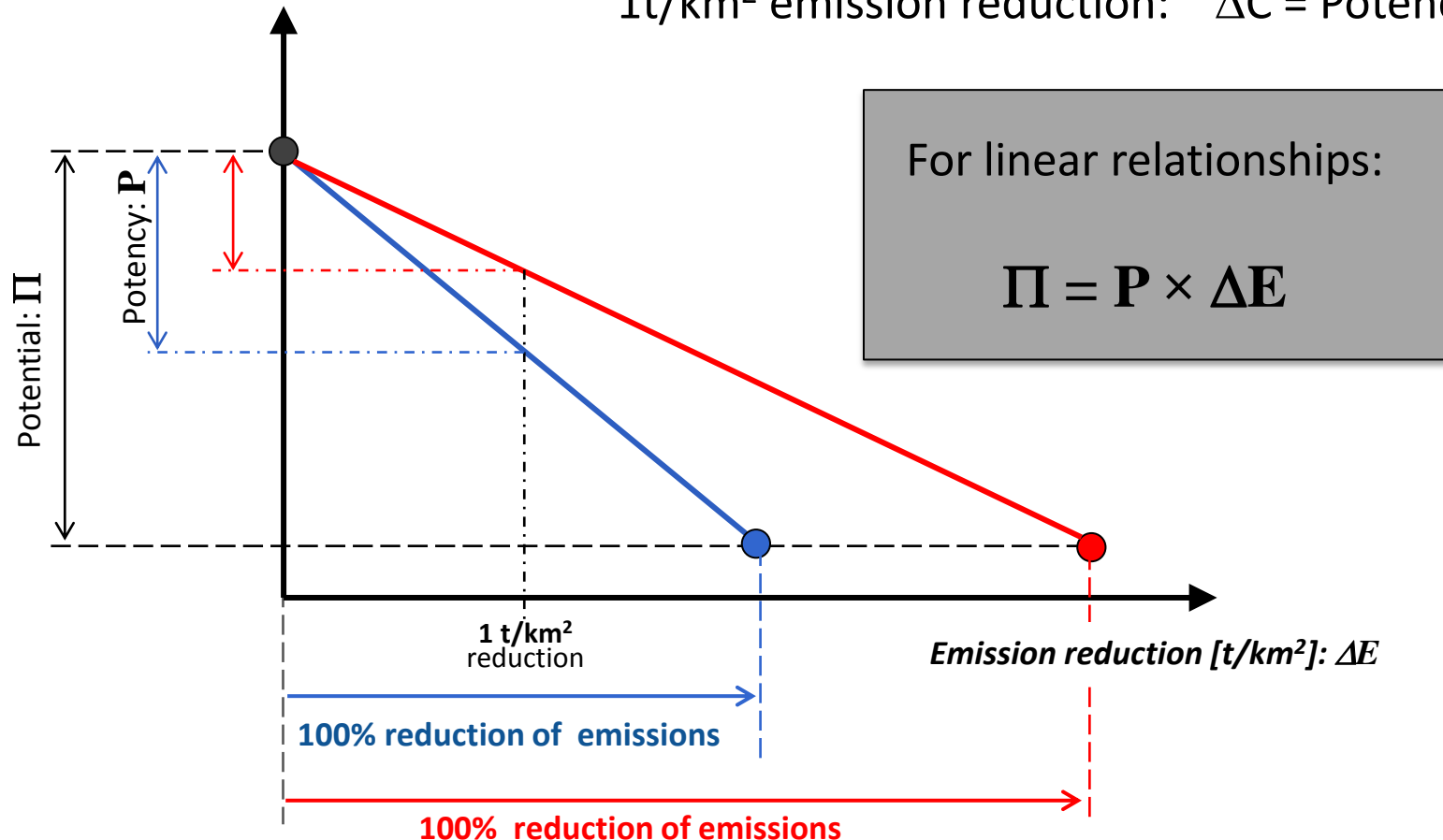


Model Benchmarking: Potentials & Potencies

100% emission reduction: $\Delta C = \text{Potential } (\Pi)$

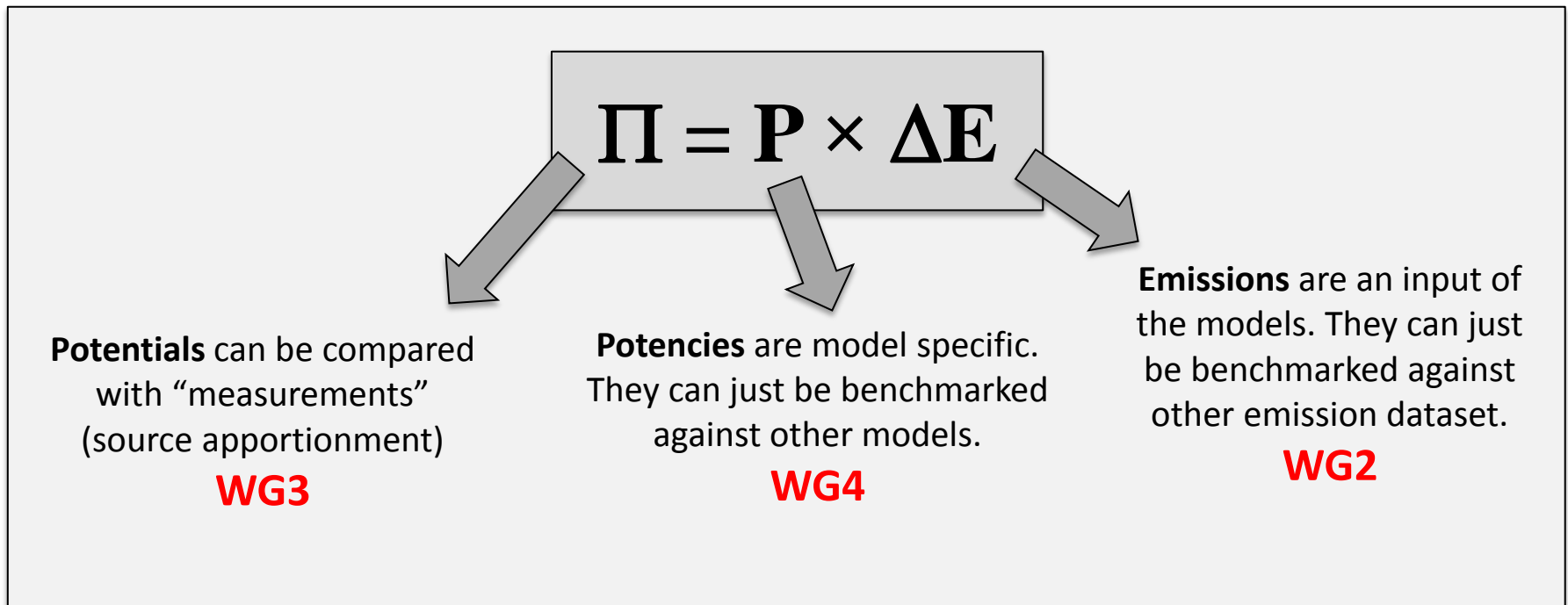
1t/km² emission reduction: $\Delta C = \text{Potency } (\mathbf{P})$

Concentration [$\mu\text{g}/\text{m}^3$]: C



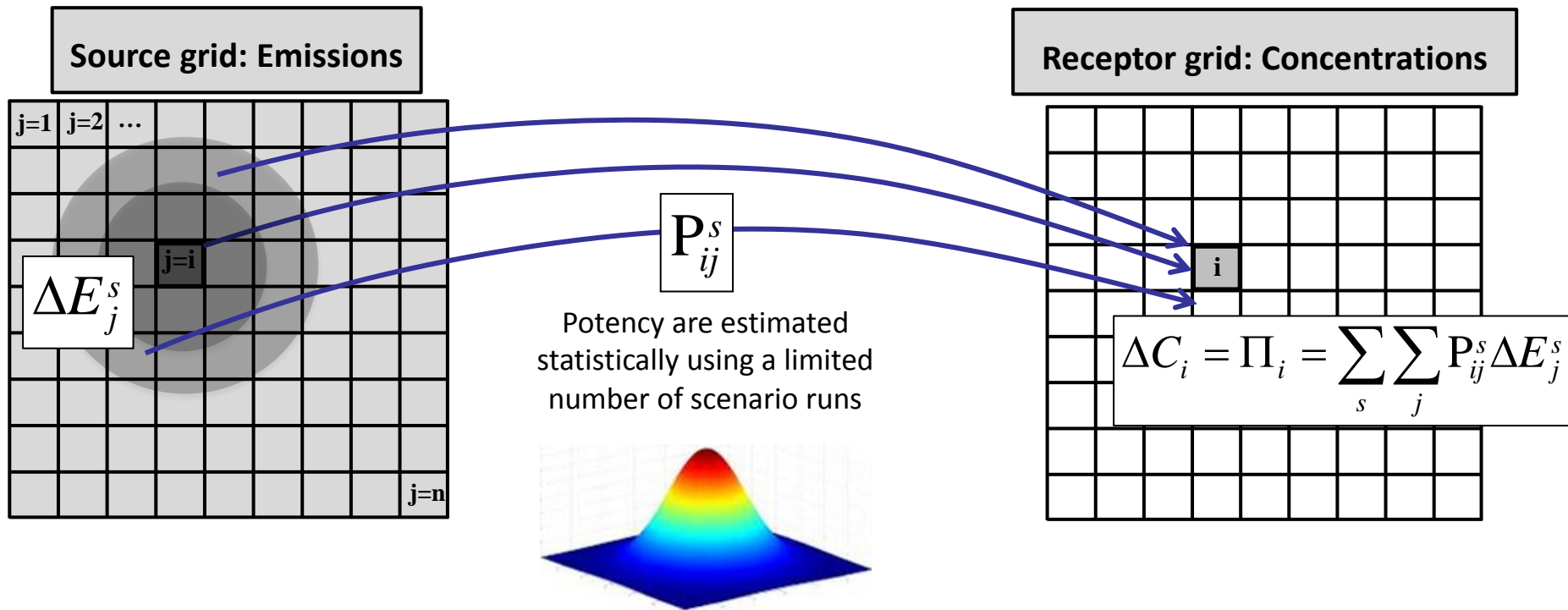
Model Benchmarking: Potencies & potentials

The benchmarking of a model system (Emission + Air Quality models) in dynamic mode involves the verification of emissions and of two indicators: Potential and Potency.



Model Benchmarking: SHERPA

SHERPA estimate statistically **potencies** in order to calculate **potentials** in every grid cell using the **emissions** in every cells.



SHERPA calculates potencies and potentials which are specific to the CTM used to trained its Source/Receptor relationships: SHERPA can be used as **benchmarking tool** able to compare different models in dynamic mode

Status: Indicators estimation



Indicators to support the dynamic evaluation of air quality models

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HIGHLIGHTS

- Proposed indicators to evaluate air quality models for dynamic evaluation.
- Proposed diagrams to evaluate emission reduction impacts on concentrations.
- Assessment of the robustness and non-linearity of model responses.
- Diagram and indicators are useful for policy-maker and model developers.

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 Dynamic evaluation
 Air quality modelling
 Performance indicators

ABSTRACT

Air quality models are useful tools for the assessment and forecast of pollutant concentrations in the atmosphere. Most of the evaluation process relies on the "operational phase" or in other words the comparison of model results with available measurements which provides insight on the model capability to reproduce measured concentrations for a given application. But one of the key advantages of air quality models lies in their ability to assess the impact of precursor emissions reductions on air quality levels. Models are then used in a dynamic mode (i.e. response to a change in a given model input data) for which evaluation of the model performances becomes a challenge.

The objective of this work is to propose common indicators and diagrams to facilitate the understanding of model responses to emission changes when models are to be used for policy support. These indicators are shown to be useful to retrieve information on the magnitude of the locally produced impacts of emission reductions on concentrations with respect to the "external to the domain" contribution but also to identify, distinguish and quantify impacts arising from different factors (different precursors). In addition information about the robustness of the model results is provided. As such these indicators might reveal useful as first screening methodology to identify the feasibility of a given action as well as to prioritize the factors on which to act for an increased efficiency.

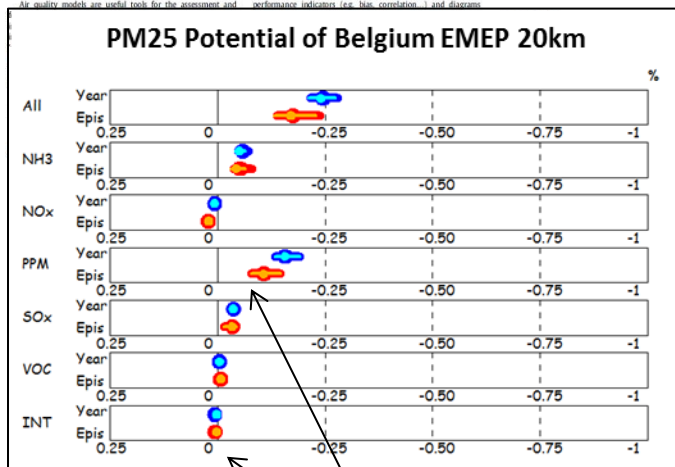
Finally all indicators are made dimensionless to facilitate the comparison of results obtained with different models, different resolutions, or on different geographical areas.

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1. Introduction

which provides insight on the model capability to reproduce measured concentrations for a given application. Several statistical performance indicators (e.g. bias, correlation, 1) and diagrams

Air quality models are useful tools for the assessment and



low level of non linearity



Quantification of non-linearities as a function of time averaging in regional air quality modeling applications

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HIGHLIGHTS

- Methodology to quantify non-linearities in air quality model responses.
- The non-linearity quantification methodology is applied to daily, monthly and yearly averaged concentrations.
- Seasonal dependencies are analyzed for both PM10 and O3 compounds.
- Quantification of non-linearity is useful for policy-maker to ensure robust strategies.

ARTICLE INFO

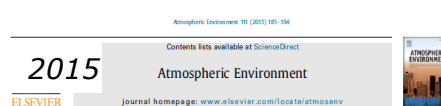
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 Time averaging
 Integrated assessment modelling
 Surrogate models

ABSTRACT

Air quality models which are nowadays used for a wide range of scopes (i.e. assessment, forecast, planning) see their intrinsic complexity progressively increasing as better knowledge of the atmospheric chemistry processes is gained. As a result of this increased complexity potential non-linearities are implicitly and/or explicitly incorporated in the system. These non-linearities represent a key and challenging aspect of air quality modelling, especially to assess the robustness of the model responses. In this work the importance of non-linear effects in air quality modelling is quantified, especially as a function of time averaging. A methodology is proposed to decompose the concentration change resulting from an emission reduction over a given domain into its linear and non-linear contributions for each precursor as well as in the contribution resulting from the interactions among precursors. Simulations with the LOTUS-EMIS model have been performed by 700 over three regional geographical areas in Europe for this analysis. In all three regions the non-linear effects for PM10 and PM2.5 are shown to be relatively minor for yearly and monthly averages whereas they become significant for daily average values. For Ozone non-linearities become important already for monthly averages in some regions. An approach which explicitly deals with monthly variations seems therefore more appropriate for O3. In general non-linearities are more important at locations where concentrations are the lowest, i.e. at urban locations for O3 and at rural locations for PM10 and PM2.5. Finally the impact of spatial resolution (model by comparing coarse and fine resolution simulations) on the degree of non-linearity has been shown to be minor as well. The conclusions developed here are model dependent and runs should be repeated with the particular model of interest but the proposed methodology allows with a limited number of runs to identify where efforts should be focused in order to include the relevant terms into a simplified surrogate model for integrated assessment purposes.

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Dynamic evaluation of air quality models over European regions

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HIGHLIGHTS

- Air quality model responses to emission reduction scenarios are presented.
- Maximum potential for local emission abatement is identified.
- Relative importance of the various precursor emissions is assessed.
- Degree of non-linearity
- Three case studies in EU.

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Keywords:
 Policy indicators
 Air quality planning
 Emission reductions
 Non-linearity

1. Introduction

Air quality models, testing air quality, is the way largely based on measurements, or, of the 2008 European Directive on Ambient Air Quality Standards (Directive 2008/50/EC), should be developed and used.

Regarding assessment (or operational model evaluation, i.e. the

model to complement monitoring data. This is the result, among others, of the 2008 European Directive on Ambient Air

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Screening of the EMEP source receptor relationships: application to five European countries

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Abstract In this work, a methodology based on the calculation of non-linearities with respect to NH3 (all countries) and

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Status: SHERPA improvement



Research article
On the design and assessment of regional air quality plans: The SHERPA approach

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Governance

ABSTRACT

Although significant progress has been made in Europe regarding air quality, problems still remain acute for some pollutants, notably NO_x and Particulate Matter (fine and coarse fractions) in specific regions/cities. One issue regarding air quality management in governance, i.e. the selection of appropriate and cost-effective strategies over the area controlled by policy makers. In this work we present a new approach to integrated assessment modeling focusing on regional and urban aspects. One of the key added values is spatial flexibility, namely the possibility to assess the contributions from different regions to air quality at any given location. The SHERPA tool is shown to be particularly helpful in addressing the following tasks: source allocation, governance and the assessment of scenario impacts. Application of the methodology over the London area for yearly averaged PM_{2.5} concentrations demonstrates these features. Given that it is possible to use the SHERPA interface with other types of data, SHERPA can also be seen as a means to foster harmonization in the field of model evaluation.

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1. Introduction

Although significant progress has been made in Europe regarding air quality in recent decades (EEA, 2015), problems still remain acute for some pollutants. In 2015, 22 out of 28 EU countries reported exceedances of the 2008 Air Quality Directive (AQD, 2008) limit values for O₃, NO₂ and/or Particulate Matter (PM₁₀ and PM_{2.5}) (EEA, 2015). While air quality exceedances were in the past widespread across Europe, they now tend to be restricted to specific regions like the Po Valley, the South of Poland area or the area for PM₁₀ and cities for NO₂ (Deschuyter et al., 2015). Countries and regional authorities have the legal obligation of designing and assessing the impacts of air quality plans whenever exceedances occur but they generally lack the proper tools to do so (APPRAISAL, 2013).

With the current situation characterized by regional and/or local (city) hot spots, EU integrated assessment modeling (IAM) needs however to be complemented by regional and local approaches. It is in this context that GAINS-EU was recently extended to cover city scale simulations and measurements (Deschuyter et al., 2015). In some countries, national versions of GAINS, also based on finer scale modeling, have been implemented to balance regional and/or sectoral emission reductions in the most cost-efficient manner (e.g. GAINS Italy in (Pizzari et al., 2009)). Similar tools, developed on the basis of different assumptions, have also been applied in some regions (e.g. RIAT, Caravita et al., 2012) but their use remains limited. The same holds for dedicated city-scale IAM tools (e.g. BRUTAL, Orluy et al., 2009) that focus on local strategies. The main purpose of IAM tools is to support policy makers in



A new approach to design source-receptor relationships for air quality modeling

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ABSTRACT

Air quality models are often used to simulate how emission scenarios influence the concentration of primary as well as secondary pollutants in the atmosphere. In some cases, it is necessary to replace these air quality models with source-receptor relationships, to mimic in a faster way the link between emissions and concentrations. Source-receptor relationships are therefore also used in Integrated Assessment Models, when scenario responses need to be known in very short time. The objective of this work is to present a novel approach to design a source-receptor relationship for air quality modeling. Overall the proposed approach is shown to significantly reduce the number of simulations required for the training set and to bring flexibility in terms of emission source definition. A regional domain application is also presented, to test the performance of the proposed approach.

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1. Introduction

Air quality models are complex tools which include detailed representations of the transport, diffusion and chemical processes taking place in the atmosphere. These models work at various horizontal and vertical resolutions and account for the non-linear interactions in each of the processes previously mentioned.

One of the main advantages of AQ models is the possibility to assess the impact of emission changes on concentration levels. The easiest approach is to modify the emissions accordingly, run the model and check the resulting concentrations. This is generally referred to as using a model in "scenario mode". One of the consequences of the high complexity of AQ models is their associated CPU time implying that AQ models can only be run for a limited set of scenarios due to this important constraint. If the number of required scenarios becomes prohibitive, one way out is to design

is constructed to link the emission changes to the concentration changes. The same type of simplified model is also very useful in scenario mode when a user wishes to assess the impact of several possible emission reductions on concentrations without requiring the long computation times that come with running the full AQ model.

Many examples of this approach do exist in literature. Seibert and Frank (2004) developed linear-source receptor relationships to compute the transport of atmospheric trace substances with a Lagrangian particle dispersion model. Simpson et al. (1997) and Tarasick et al. (2004) used the Eulerian EMEP model as a basis to compute country-to-country source-receptor relationships over a European domain, considering a multi-annual time-frame. At the national scale, Vignati et al. (2014) used a similar approach over Spain with the Atmospheric Evaluation and Research Integrated model for Spain (AERIS). This model allows for assessing the impact



Adding spatial flexibility to source-receptor relationships for air quality modeling

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Air quality modeling
Source-receptor relationships

ABSTRACT

To cope with computing power limitations, air quality models that are used in integrated assessment applications are generally approximated by simpler expressions referred to as "source-receptor relationships" (SRR). In addition to speed, it is desirable for the SRR also to be spatially flexible (application over a wide range of situations) and to require a "tight setup" (based on a limited number of full Air Quality Models - AQM simulations) but "spatial flexibility" and "tight setup" do not naturally come together and a good compromise must be ensured that preserves "accuracy", i.e. a good comparability between SRR results and AQM.

In this work we further develop a SRR methodology to better capture spatial flexibility. The updated methodology is based on a cell-to-cell relationship, in which a left-shape function links emissions to concentrations. Maintaining a cell-to-cell relationship is shown to be the key element needed to ensure spatial flexibility, while at the same time the proposed approach to link emissions and concentrations guarantees a "tight set-up" phase. Validation has been performed on different areas and domain types (countries, regions, provinces throughout Europe) for precursors reduced independently or contemporarily. All runs showed a bias around 10% between the full AQM and the SRR. This methodology allows assessing the impact on air quality of emission scenarios applied over any given area in Europe (region, set of regions, countries), provided that a limited number of AQM simulations are performed for training.

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1. Introduction

Like in any other policy area, modeling tools are nowadays commonly used in the field of air pollution, to support policy makers in choosing the best options to improve air quality (Pisoni et al., 2006; Terrenoire et al., 2015). Air quality models (AQMs) indeed represent the best (and only) instruments to assess and assess the impact of future policy options. But because these models include the current state of the art in terms of physical and chemical concentration of the considered atmospheric pollutants in

to possible air quality plans.

This problem is exacerbated when AQMs are used in the frame of complex integrated assessment modeling (IAM) tools. IAMs have been extensively used in different policy related scales/contexts, as e.g. at the international level in support to preparation of the IRTAP (United Nations Economic Commission for Europe "Air Convention") Gothenburg protocol (Aarnæs et al., 2011), at European level in the frame of the National Emission Ceilings and Air Quality Directive (Deschuyter et al., 2015), or at the national/local scales to elaborate plans and scenarios to improve air quality (Pisoni et al., 2016).



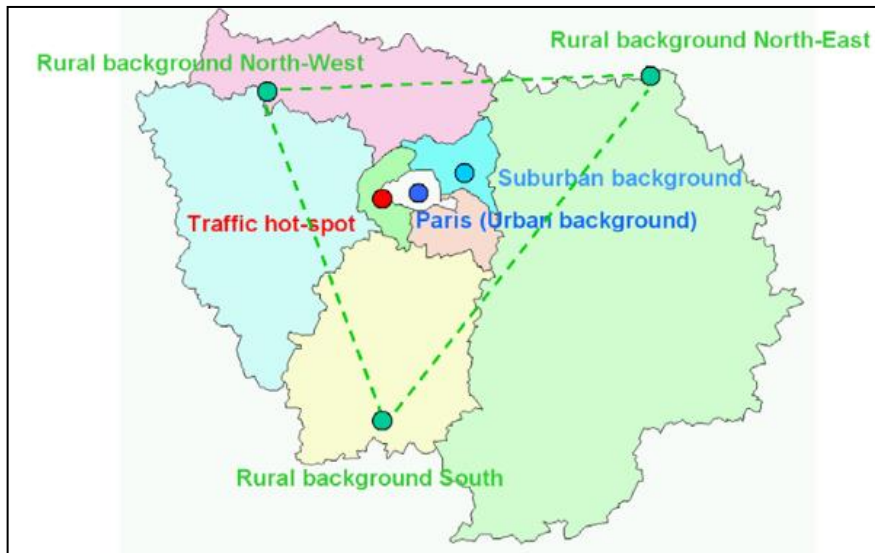
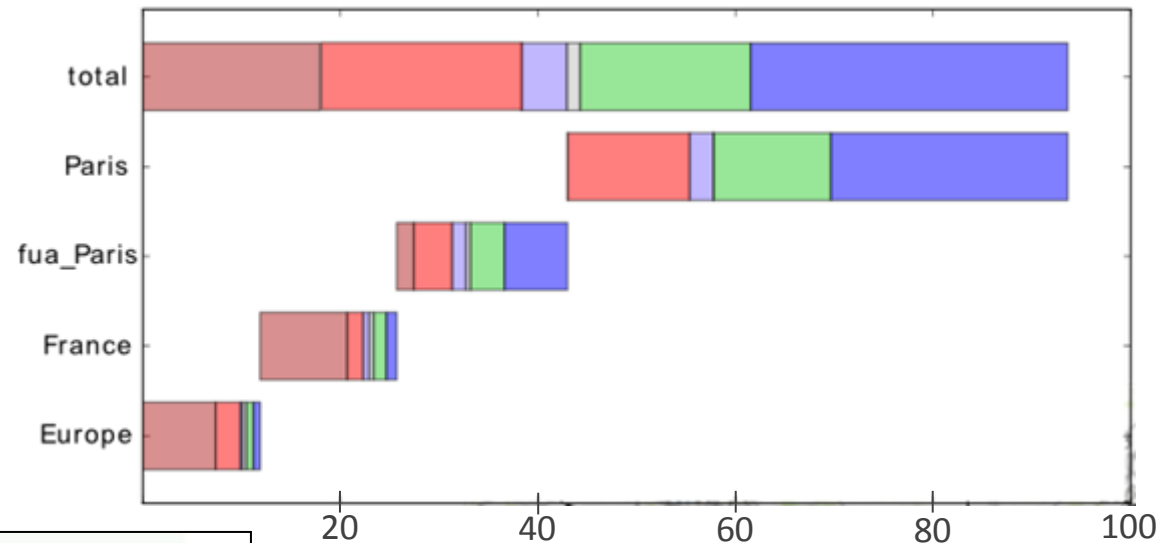
A new version of SHERPA will available at the end of the month:
- improvement of SRR
- E-reporting

Roadmap: WG4

- Support the e-reporting process.
- Use SHERPA as a benchmarking tool for models and emission inventories.
- Develop methodologies to quantify the emission contributions from each spatial scales (urban, regional, national, European and extra-European) in order to validate air quality model estimations.
- To provide overall support to model users (SHERPA, air quality models...) in their planning activities (measures, model scenarios).
- Contribute to the harmonization of the specifications used to classify abatement measures that can be selected at the regional/local scales.

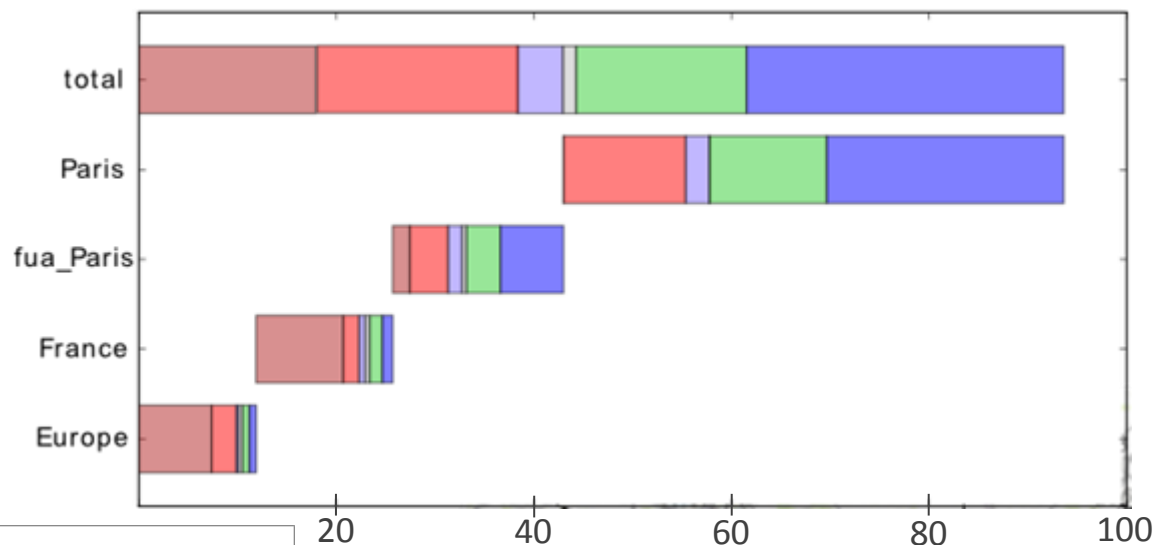
Roadmap: interaction WG4-WG3

Spatial Source Apportionment

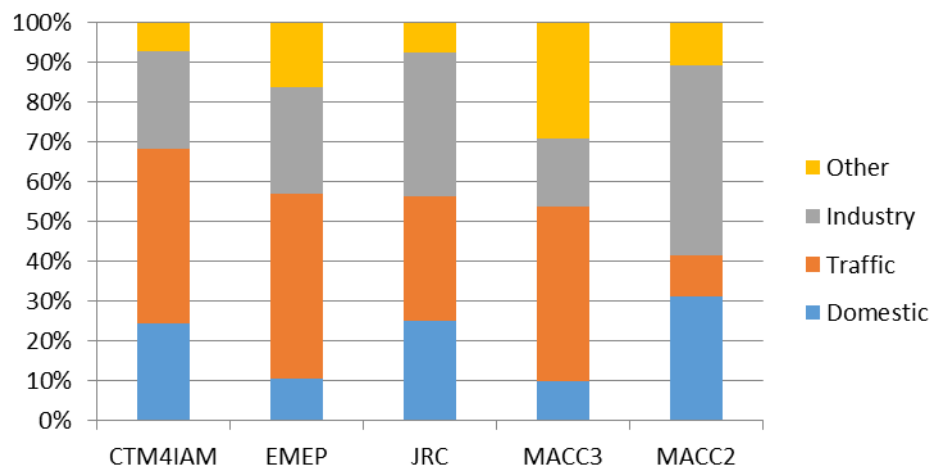


Roadmap: interaction WG4-WG2

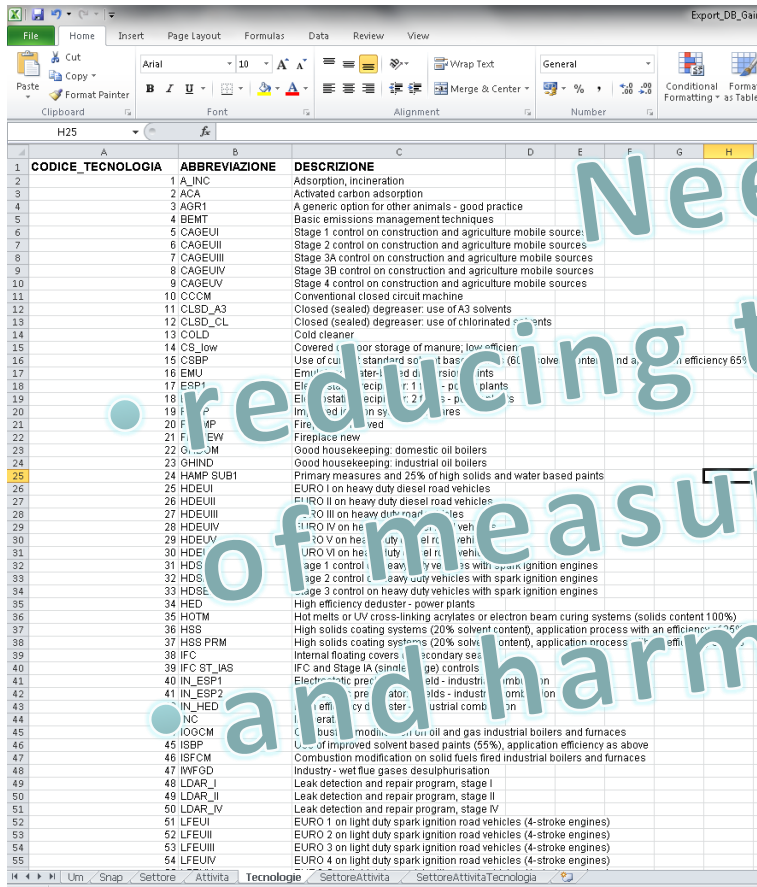
Emissions-concentrations: SRR



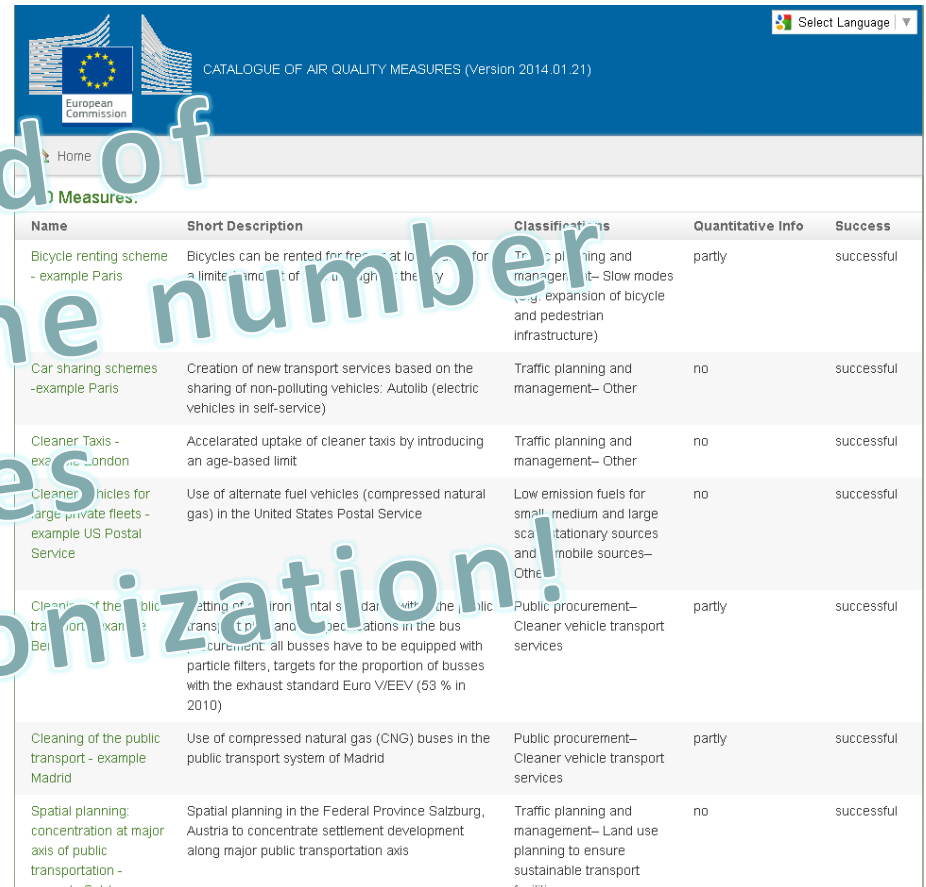
PPM Emissions in Paris



Last meeting in June...



CODICE_TECNOLOGIA	ABBREVIAZIONE	DESCRIZIONE
1	A_INC	Adsorption, incineration
2	ACA	Activated carbon adsorption
3	AOR1	A generic option for other animals - good practice
4	BEMT	Basic emissions management techniques
5	CAGEUI	Stage 1 control on construction and agriculture mobile sources
6	CAGEUII	Stage 2 control on construction and agriculture mobile sources
7	CAGEUIII	Stage 3A control on construction and agriculture mobile sources
8	CAGEUIV	Stage 3B control on construction and agriculture mobile sources
9	CAGEUV	Stage 4 control on construction and agriculture mobile sources
10	CCCM	Conventional closed circuit machine
11	CLSD_A3	Closed (sealed) degreaser: use of A3 solvents
12	CLSD_CL	Closed (sealed) degreaser: use of chlorinated solvents
13	COLD	Cold cleaner
14	CS_low	Covered indoor storage of manure, low efficiency
15	CSPB	Use of cut standard solvent based (60% solvent) and a efficiency 55%
16	EMU	Emulsion water based solvents
17	ESP1	Electrostatic precipitator: 11 - plants
18	ESP2	Electrostatic precipitator: 21 - plants
19	ESP3	Electrostatic precipitator: 31 - plants
20	ESP4	Electrostatic precipitator: 41 - plants
21	FEW	Fireplace new
22	FEW	Fireplace new
23	OHND	Good housekeeping: domestic oil boilers
24	OHND	Good housekeeping: industrial oil boilers
25	HAMP SUB1	Primary measures and 25% of high solids and water based paints
26	HDEUI	EURO I on heavy duty diesel road vehicles
27	HDEUII	EURO II on heavy duty diesel road vehicles
28	HDEUIII	EURO III on heavy duty diesel road vehicles
29	HDEUIV	EURO IV on heavy duty diesel road vehicles
30	HDEUV	EURO V on heavy duty diesel road vehicles
31	HDEI	EURO VI on heavy duty diesel road vehicles
32	HDS	Stage 1 control on heavy duty vehicles with spark ignition engines
33	HDS	Stage 2 control on heavy duty vehicles with spark ignition engines
34	HDS	Stage 3 control on heavy duty vehicles with spark ignition engines
35	HED	High efficiency deduster - power plants
36	HOTM	Hot melts or UV cross-linking acrylates or electron beam curing systems (solids content 100%)
37	HSS	High solids coating systems (20% solvent content), application process with an efficiency of 55%
38	HSS PRM	High solids coating systems (20% solvent content), application process with an efficiency of 55%
39	IFC	Internal floating covers - secondary sea
40	IFC ST_IAS	IFC and Stage IA (simultaneous) controls
41	IN_ESP1	Electrostatic precipitator: 11 - industrial combustion
42	IN_ESP2	Electrostatic precipitator: 21 - industrial combustion
43	IN_HED	High efficiency deduster: 11 - industrial combustion
44	IN_HED	High efficiency deduster: 21 - industrial combustion
45	IOGCM	Cold combustion modification of oil and gas industrial boilers and furnaces
46	ISBP	Use of improved solvent based paints (55%), application efficiency as above
47	ISFCM	Combustion modification on solid fuels fired industrial boilers and furnaces
48	INFJ	Industry - wet flue gases desulphurisation
49	LDAR_I	Leak detection and repair program, stage I
50	LDAR_II	Leak detection and repair program, stage II
51	LDAR_IV	Leak detection and repair program, stage IV
52	LFEUI	EURO 1 on light duty spark ignition road vehicles (4-stroke engines)
53	LFEUII	EURO 2 on light duty spark ignition road vehicles (4-stroke engines)
54	LFEUIII	EURO 3 on light duty spark ignition road vehicles (4-stroke engines)
55	LFEUIV	EURO 4 on light duty spark ignition road vehicles (4-stroke engines)

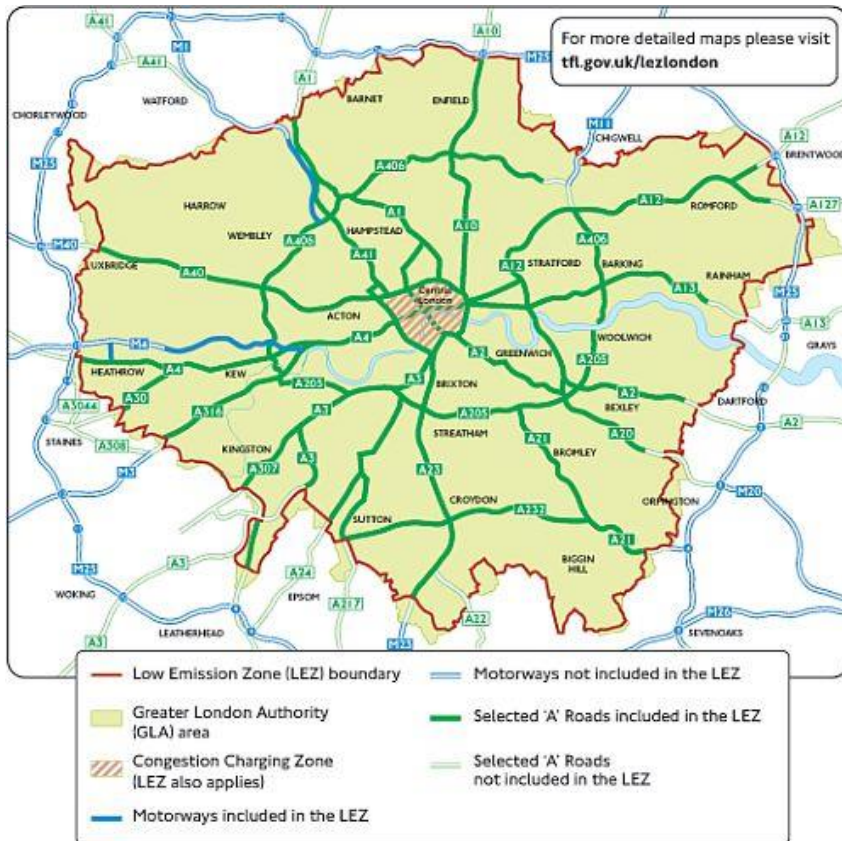


Name	Short Description	Classification	Quantitative Info	Success
Bicycle renting scheme - example Paris	Bicycles can be rented for free at local authorities for a limited amount of time through the city	Traffic planning and management- Other (e.g. expansion of bicycle and pedestrian infrastructure)	partly	successful
Car sharing schemes - example Paris	Creation of new transport services based on the sharing of non-polluting vehicles: Autolib (electric vehicles in self-service)	Traffic planning and management- Other	no	successful
Cleaner Taxis - example London	Accelerated uptake of cleaner taxis by introducing an age-based limit	Traffic planning and management- Other	no	successful
Cleaner vehicles for large private fleets - example US Postal Service	Use of alternate fuel vehicles (compressed natural gas) in the United States Postal Service	Low emission fuels for small medium and large stationary sources and mobile sources- Other	no	successful
Cleaning of the public transport system - example Berlin	Setting of a minimum standard with the public transport and specifications in the bus procurement: all busses have to be equipped with particle filters, targets for the proportion of busses with the exhaust standard Euro V/EEV (53 % in 2010)	Public procurement- Cleaner vehicle transport services	partly	successful
Cleaning of the public transport system - example Madrid	Use of compressed natural gas (CNG) buses in the public transport system of Madrid	Public procurement- Cleaner vehicle transport services	partly	successful
Spatial planning: concentration at major axis of public transportation - example Salzburg	Spatial planning in the Federal Province Salzburg, Austria to concentrate settlement development along major public transportation axis	Traffic planning and management- Land use planning to ensure sustainable transport facilities	no	successful

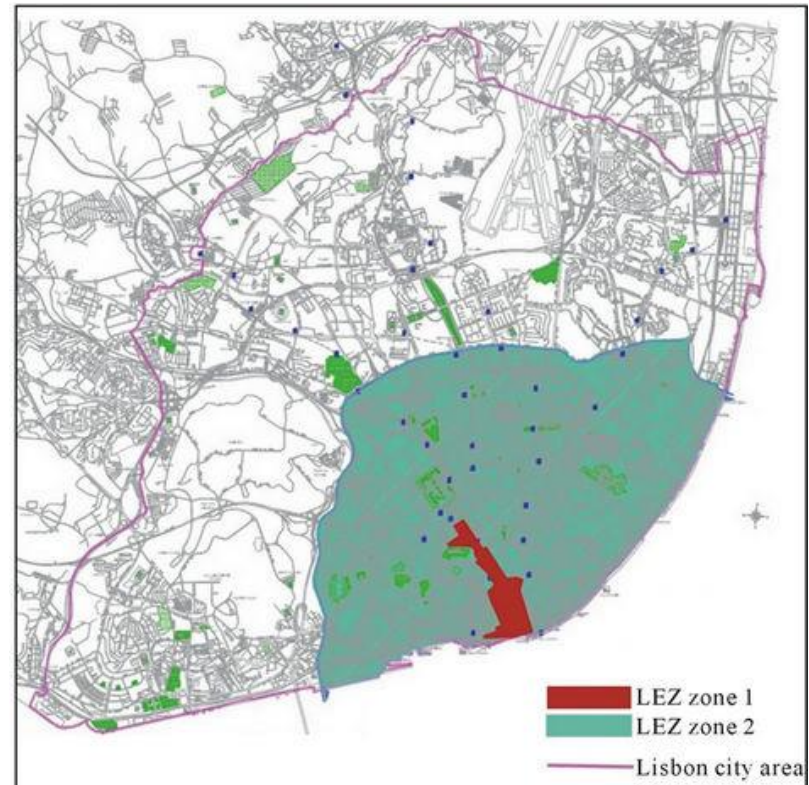
Why is there a need for harmonization?

Example: Low Emission Zone

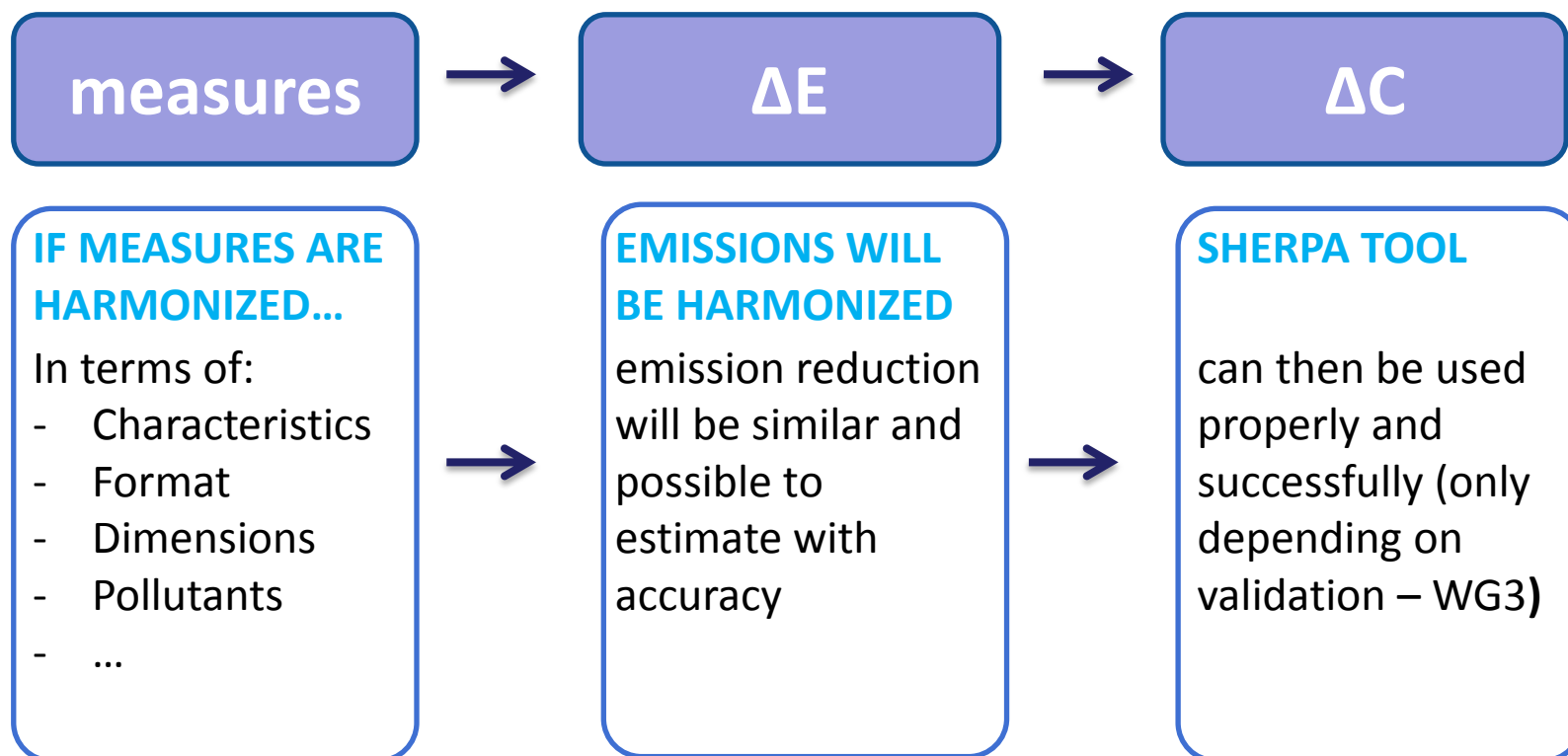
In LONDON



In LISBON



Why there is a need of harmonization?



Questions

Is there a need for continued benchmarking?

How can we best support plans & programs?

The measure database: A useful step forward?



Heel hartelijk bedankt