Harmonisation in AQ Modelling:

< CityDelta, EuroDelta, Follow-up projects >

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Overview

- Harmonisation, support to AQ policy
- CityDelta project
  - Objectives, Methodology, FR
- EuroDelta project
  - Objectives, Methodology
- Future activities
- Conclusions

Need for Harmonisation

- Evaluation of the uncertainty in AQ modelling used for AQ policy.
- Is there a consistent difference between the fine scale (FS, 5km) and the large scale (LS, 50km) models?
- Do AQ models produce consistent responses to emission-reduction policy scenarios, what are the ranges of these responses ?

➔ **What is the robustness of AQ modelling results in the policy context?**

Harmonisation as we see it

- Analysis of individual Modelling results (Validation against Obs)
- Intercomparison of Modelling results (if no Obs)
- Ensemble approach (mean/median of the Models)
- Analysis of the variability around the Ensemble
- Validation of the Ensemble model

➔ **The Ensemble model is a useful tool in the frame of the Harmonisation of the individual model results.**
It is often more robust and looks therefore more appropriate for policy purpose

CityDelta

Policy context: Clean Air For Europe (CAFE)

Launched in 2001 by the European Commission, CAFE is a programme of technical analysis aiming at the development of a long-term, integrated policy advice to protect against negative effects of air pollution on human health and the environment.

Rsulting in Thematic Strategy published Sept 05

Question: Which measures will lead to a cost-effective reduction of air-pollution health-related problems in European Cities? In particular for O3 and PM

CityDelta Objective:
How to include sub-grid effects into a Europe-wide health impact assessment for PM/Ozone?

The JRC has coordinated:
A model inter-comparison exercise for urban-regional scale dispersion models focusing on 8 European cities to identify:

- the systematic differences (delta's) between rural and urban background AQ ("*Scale*"),
- how these delta's depend on emissions ("*Emissions*"),
- how these delta's vary across cities *("Cities")*,
- how these delta's vary across models *("Models")*
- how these delta's vary for PM and O3 *("Pollutants")*.

Driving force
WHO Review of health impacts from air pollution

Damage from long-term exposure to PM2.5
➔CityDelta Indicator: Annual mean PM2.5

New evidence for mortality effects from ozone
➔ CityDelta Indicator: SOMO35 (*)

(*) Sum of exceedances over 35 ppb of the maximum of the daily 8-hour mean O3 concentrations, calculated over the entire year

15 Modelling teams: 7 regional-scale 11 urban-scale

Model	# of levels	Level	Domain	Resolution
CALGRID	11	10m	CITYDELTA	5-10
CAMx	11	10m	CITYDELTA	5-10
CHIMERE local	6: surface-700hPa	SL (50m)	CITYDELTA	5
CHIMERE regional	6: surface-700hPa	SL (50m)	Europe	50
EMEP Unified Model	20: surface-100hPa	1m	EMEP	50
EMEP-v.1	20: surface-100hPa	45m	EMEP	50
EPISODE	6: 25-2500m	2m	CITYDELTA	10
EUROS	4	25m	CITYDELTA	10-50
LOTOS local	3: 0-3500m	ML	CITYDELTA	5-10
LOTOS régional	3: 0-3500m	ML	Europe	50
MOCAGE	47: surface-5hPa	1st level (0-50m)	Paris, Milano	10-50
MUSCAT	22: 0-4400m	1st level (0-33m)	CITYDELTA	10
MUSE	5	10m	CITYDELTA	10
OFIS	2	ML	CITYDELTA	5
REM3 local	4: 0-3000m	SL	CITYDELTA	5
REM3 regional	4: 0-3000m	SL	Europe	50
STEM-FCM	11	10m	CITYDELTA	5
TRANSCHIM	10	50m	CITYDELTA	5-10

8 Cities:

London

Paris

Prague

Berlin

Copenhagen

Katowice

Milan

Marseille

8 Emission Scenarios

0 --- 1999

1 --- 2010 CLE: Current Legislation

2 --- 2010 NOx MFR: Maximum Feasible Reduction

3 --- 2010 NOx (CLE+MFR)/2

4 --- 2010 VOC MFR

5 --- 2010 NOX and VOC MFR

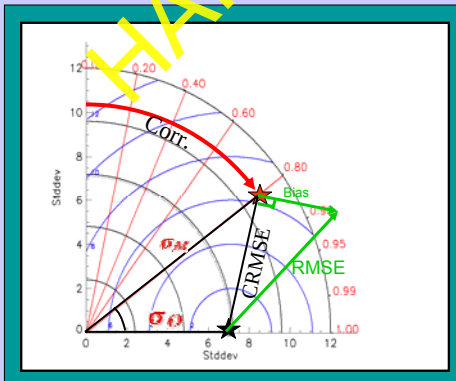
6 --- 2010 PMcoarse MFR

7 --- 2010 PM2.5 MFR

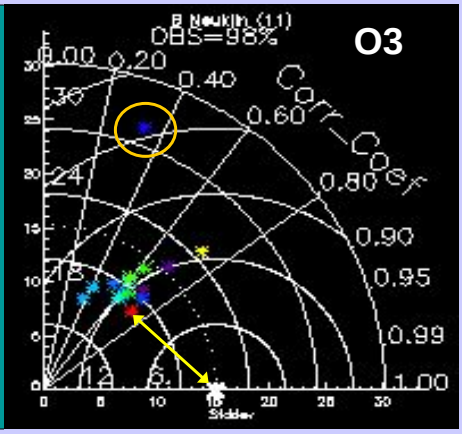
NOx	CLE-1999	MFR-1999
Prague	-34%	-62%
Milan	-36%	-53%
Paris	-42%	-65%
Berlin	-38%	-50%

- Meteo: 1999 provided by Meteo-France (Aladin 10 km) or calculated.
- Boundary conditions: provided by EMEP or calculated.
- Long term simulations: full year for PM, 6 months for O3
- Outputs delivered with resolution of 5-10 or 50 km

Model Validation: - The "Taylor" plots - The "Ensemble" model

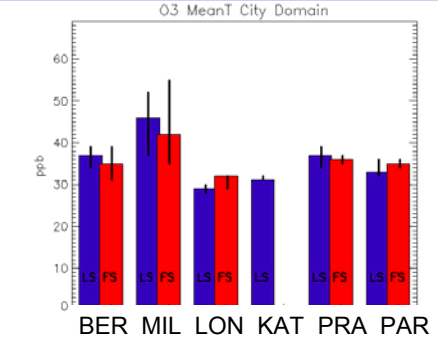


K.E.Taylor, 2001, JGR, 106, 7183-7192

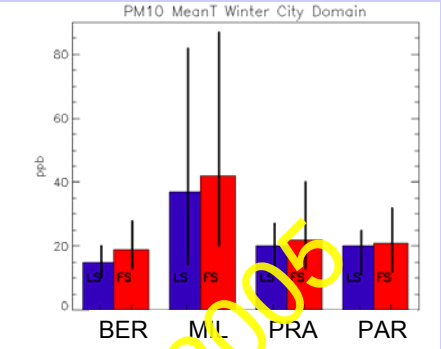


“Delta” Interpretation (City-Model)

O3 Summer Mean



PM10 Winter

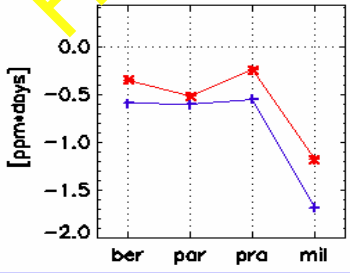


Fine scale Ensemble
Large scale Ensemble

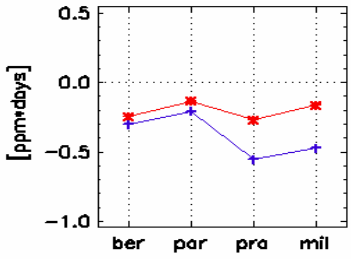
“Delta” Interpretation (Emission-Scale)

SOMO35
(CityDomain)

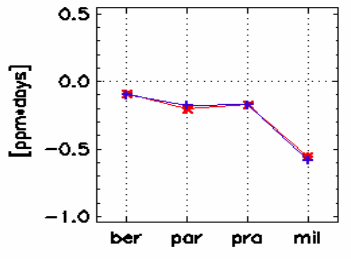
CLE-2000



NOx Reduction

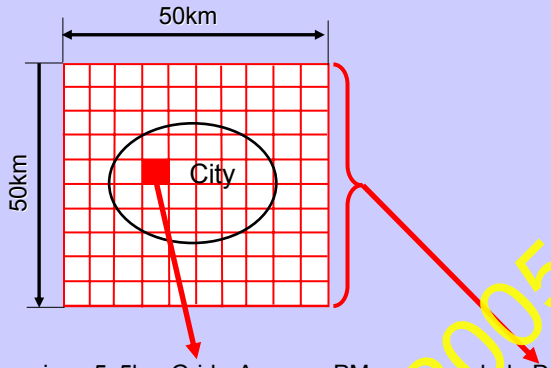


VOC Reduction



Fine scale Ensemble
Large scale Ensemble

Functional relationships: Basic Approach



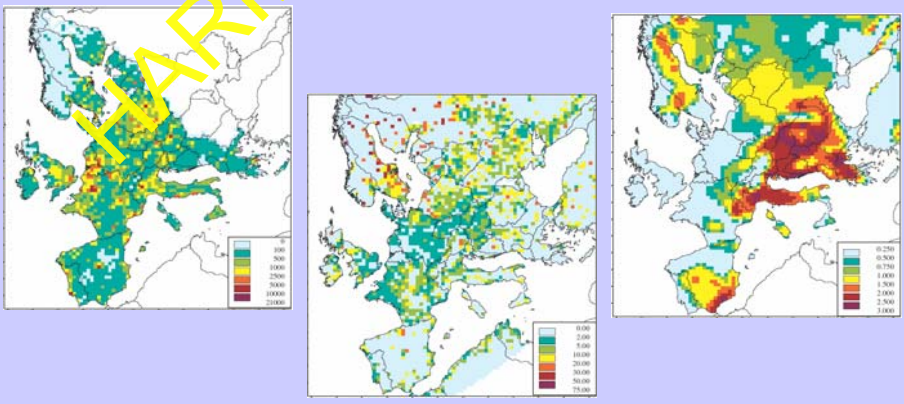
Delta Conc = PM_{conc} in a given 5x5km Grid - Average PM_{conc} over whole Domain

Delta Emis = ED in a given 5x5km Grid - Average ED over whole Domain

Correlate: Delta Concentration vs Delta Emission Density

Emission densities

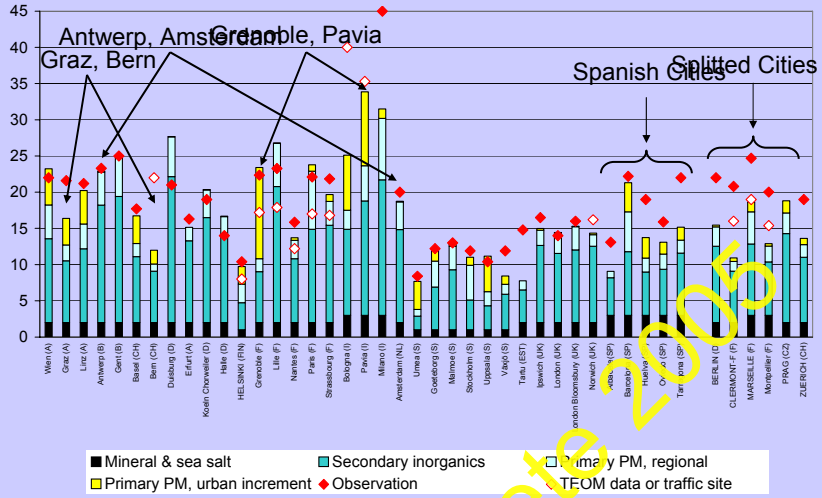
Wind speed



Population density ratios

$$PPM_{urb} = PPM_{EMEP} + ED_{EMEP}(PD_{urb} / PD_{EMEP} - 1) * (k1 - k2*V_{wind})$$

Validation against observations
Urban background PM2.5 [µg/m^3]



Discussion

- A first approach for addressing urban air quality for Europe-wide health impact assessment has been developed and implemented – based on observations and City-Delta results
- Urgent need for validation with monitoring data, hampered by lack of PM2.5 sites.
- Presently, grid average wind speed used. No consideration of topography. City-specific wind speeds should improve.
- Which emission/population density is representative for a city (how to draw city borders)? This determines directly the size of the urban increment.

➔ **Follow-up: CityDelta3 - MediDelta**

EuroDelta

A project to evaluate uncertainty in source-receptor relationships used in AQ policy

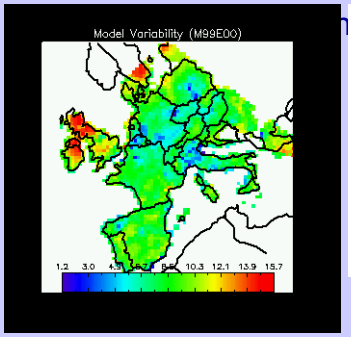
- 6 regional models: EMEP, MATCH, REM3, CHIMERE, LOTOS,TM5
- 28 different emission scenarios in 2000, 2010 and 2020 with area specific reductions (FR, GE, IT, NMS)
- Use of the ENSEMBLE approach

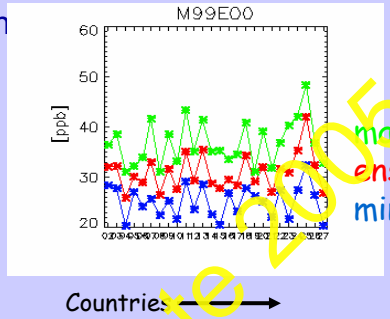
- Objectives : - Source-receptor variability
  - Spatial variability
  - Meteorological variability
  - Confidence limits for policy purposes

Mean Ozone

BaseCase: Emissions 2000, Meteo 1999

- Differences between model results of about 10 ppb in the rural areas and over the countries ; largest differences in winter
- Model variabiliy of 10 ppb represents about 40% of the ensemble value





Why such differences between models in base year calculations?

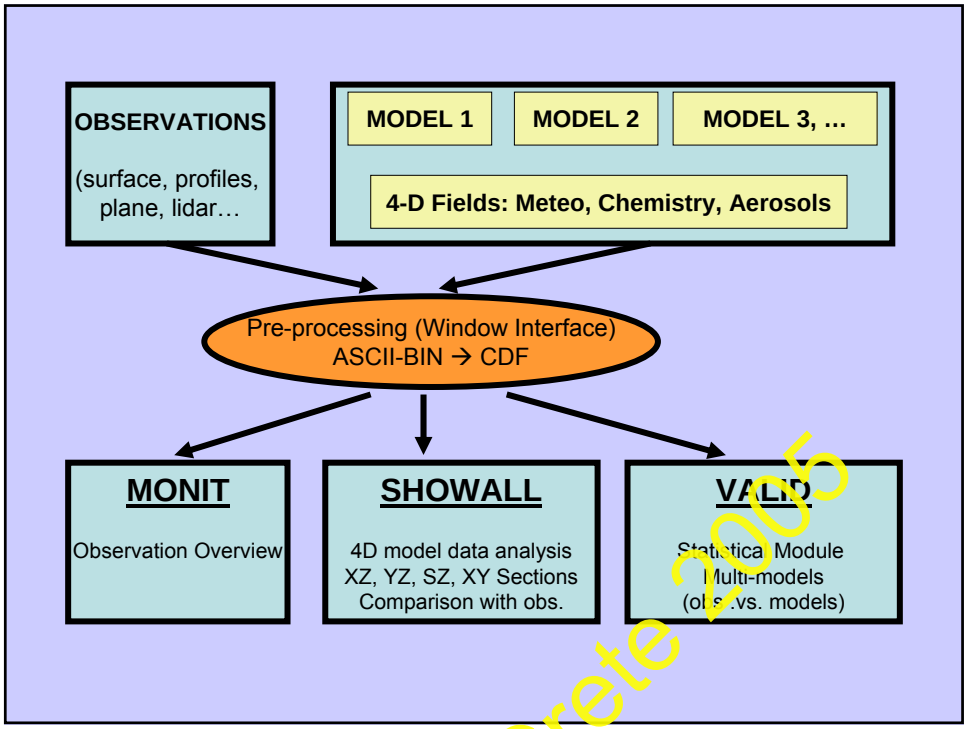
- ⇨ Boundary conditions?
  - ⇨ Input of O3 and precursors in the domain
- ⇨ Vertical exchanges?
  - ⇨ Paramerisation of vertical mixing
- ⇨ Biogenic contributions?
  - ⇨ Models calculate biogenic emissions internally

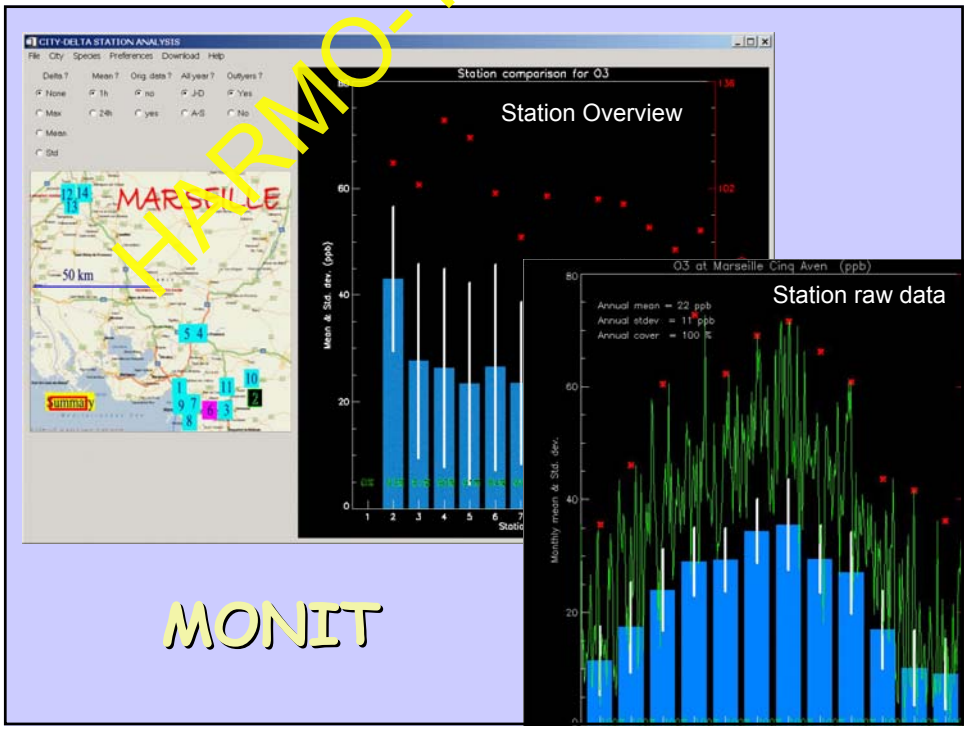
http://rea.ei.jrc.it/netshare/thunis/citydelta

CD-rom available with Results

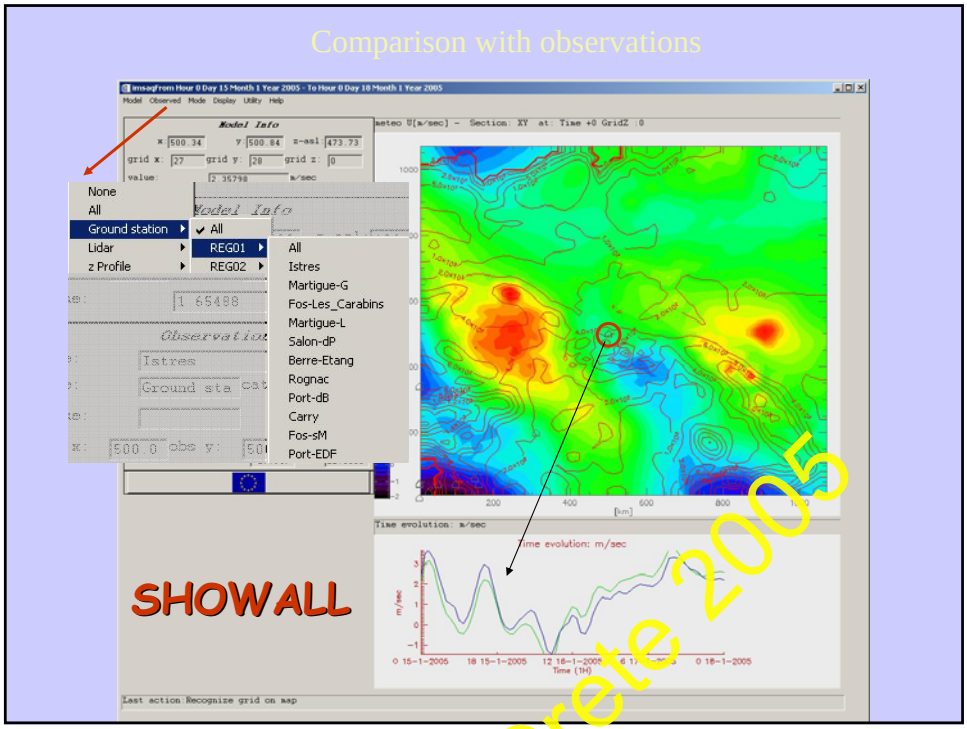
http://rea.ei.jrc.it/netshare/thunis/eurodelta

Tools of common interest (not yet wiki)

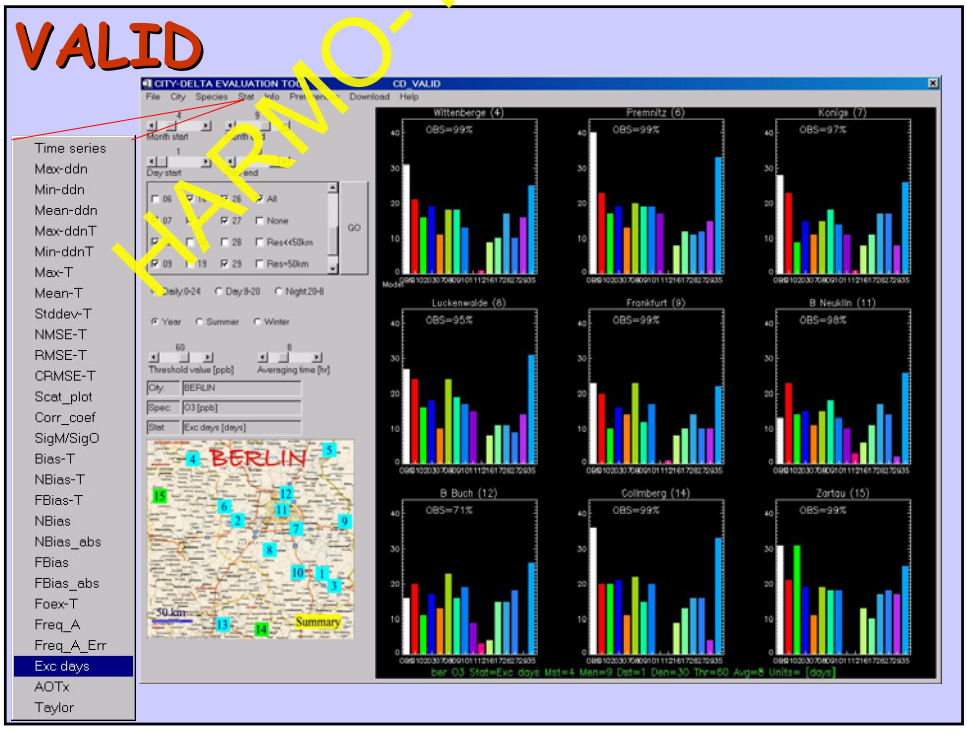




Comparison with observations



VALID



- This evaluation tool is freely available on request to JRC

- We can present the current version in more detail (Wednesday afternoon) Please contact me if you are interested