CITY-DELTA

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A European model-intercomparison study in support to the CAFE programme on EU environmental legislation

organised by

JRC-IES(coordinator), IIASA, EMEP, TNO-MEP

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An activity in support to the CAFE programme
(http://rea.ei.jrc.it/netshare/thunis/citydelta)

Objective: Exploring changes in urban air quality (CITY) predicted by different atmospheric chemistry-transport (CTM) dispersion models in response to changes in urban emissions (DELTA).

Output: Identifying the range of responses of models towards emission reductions (deltas in emissions) and providing recommendations on how to include urban air-quality into integrated assessment modelling.

Focus: Assessments of health as well as of vegetation impacts require information about the long-term exposure. O3 and PM are currently considered.

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Addressed questions

- What is the influence of local versus regional emission (reductions) on health-relevant matrices for fine particles (PM10, PM2.5) and ozone in urban air?
- How are predictions derived from regional models (e.g. with a spatial resolution of 50*50 km) different from predictions obtained with finer resolved models?
- What is the range of agreement between different scale dispersion models on the level of responses to emission changes?

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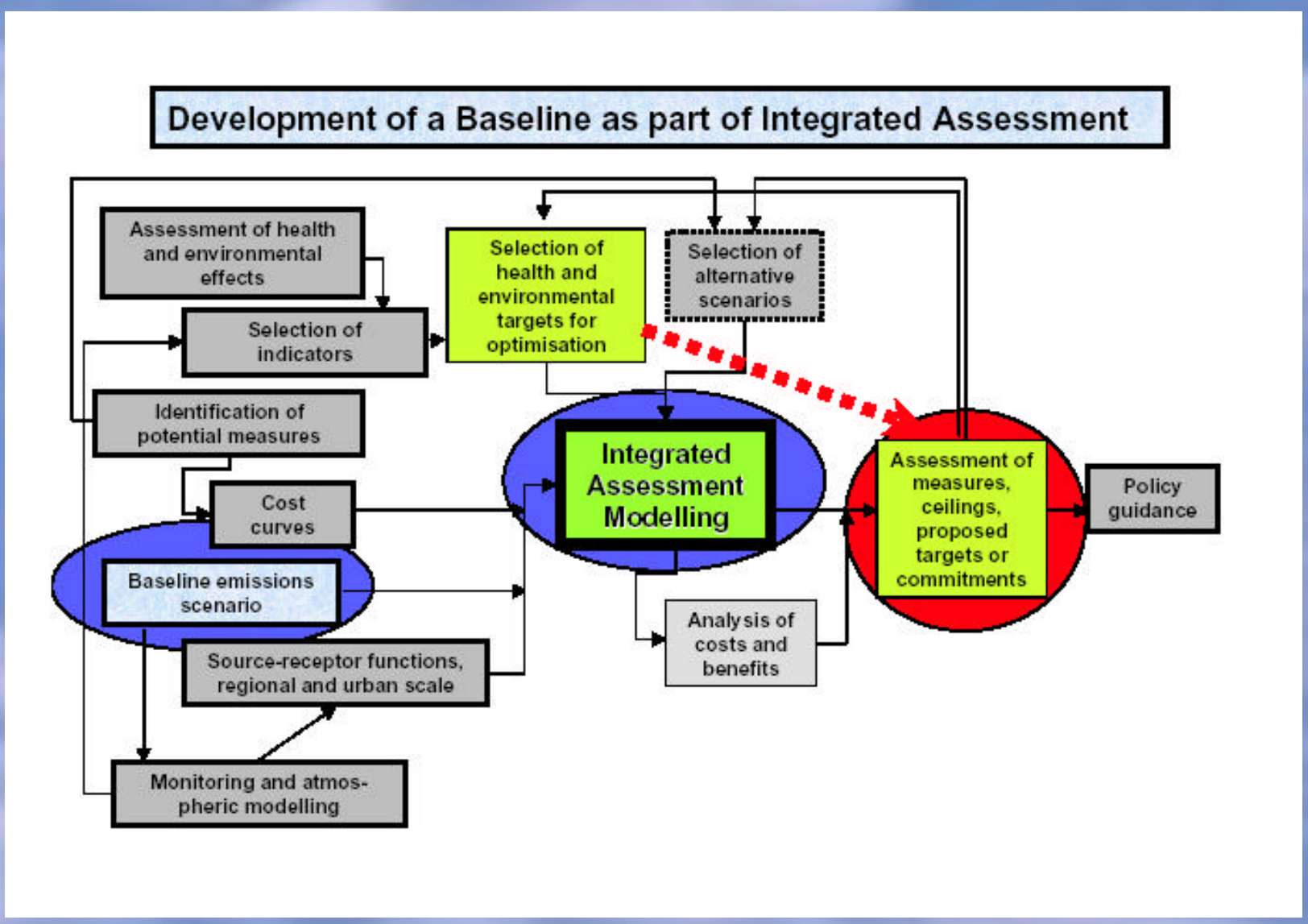
Cities: Comparisons are conducted for a number of European cities with distinct differences in climatic conditions, geographical setting and emission densities.

CAFE's interest in urban air quality

- **Compliance with limit values of AQ DD, revision of limit values (?)**
- **Health impact assessment for future air quality scenarios**
- **Balancing cost-effectiveness between EU-wide and urban emission controls as a basis for revised national emission ceilings and source-specific legislation**

The CAFE assessment process of DG-ENV



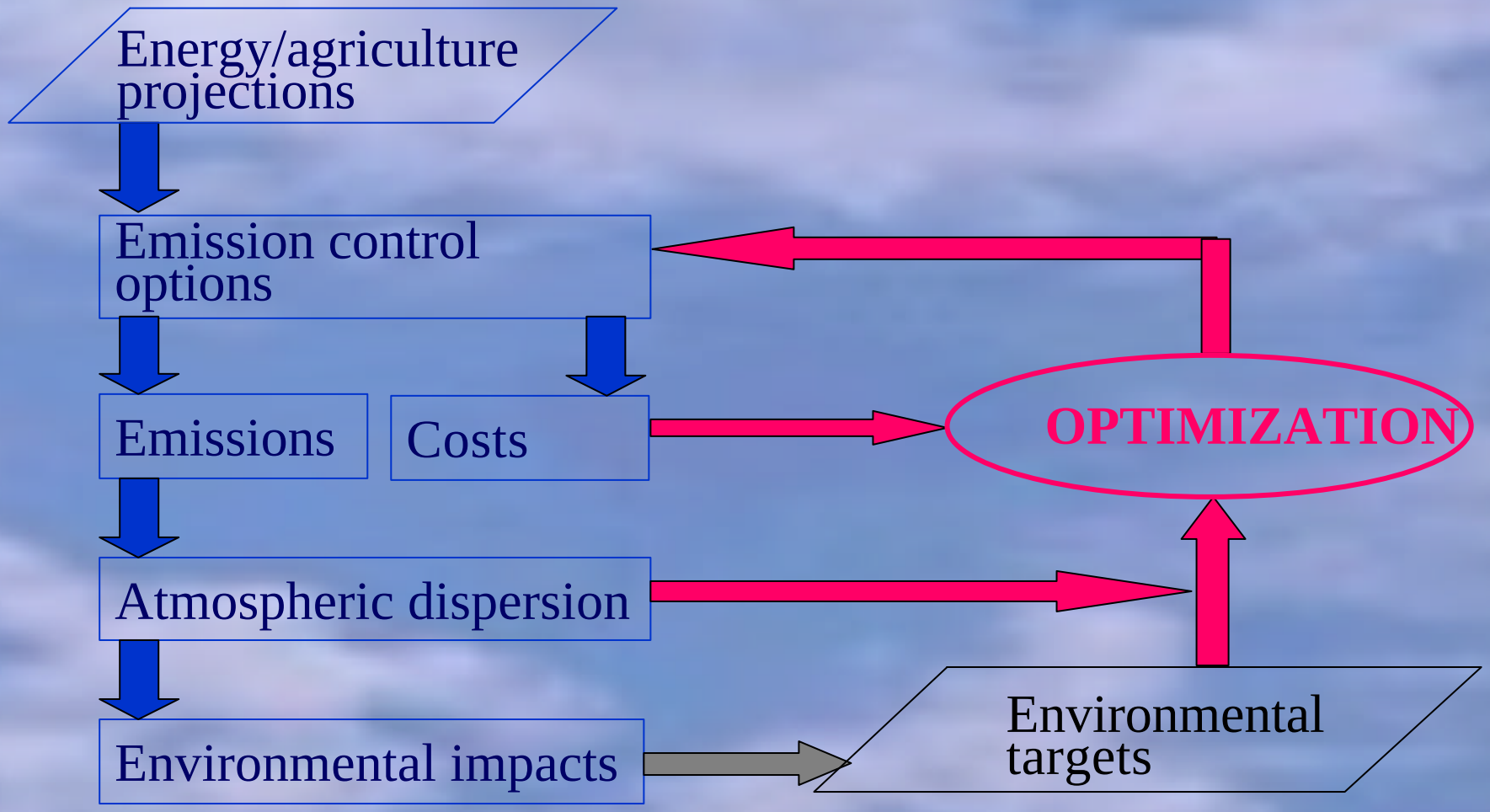
The RAINS model

Purpose:
Integrated assessment of options to control air pollution in Europe

- **Model the full chain from sources to impacts**
- **Multi-effects: acidification, health (O_3, PM), eutrophication, vegetation (O_3)**
- **Grasp full picture, cover all sectors (stationary, mobile, agriculture, industry)**
- **Includes all Europe (48 countries)**
- **Multi-pollutant**

The model: RAINS

developed by IIASA



	Res	Clim. Zone	Sectors	Months	Days	Pollutants	PM	Ref. year	VOC split	Bio	Availa-bility
Milan	5 km	2	CORINAIR (11)	4	3	CO,Nox,SO2, NH3,NMVOC, CH4	PM10 PM2.5 PM1	1997	SAROAD	yes	Yes 07/2002
Paris	3 km	1	SNAP	6	3	CO,CO2,Nox, SO2,CH4,NH3 NMHC		1998 & 1994	GENEMIS	yes	Yes 03/2002
Katowice	5 km	yes	SNAP2	yes	yes	SO2,NO2,CO, NMVOC,NH3, CH4,CO2,N2O	TSP PM10	1999	1991 VOC protocol	yes	Yes 03/2002
Marseille	1 km + 10 km	?	SNAP	yes	yes	SO2,NO,NO2, HNO2,N2O,C O,CO2,CH4		1998	+/- 40 VOC	yes	Escompte > 03 – 06 2002 (?)
Berlin	2 km	Varia-ble	SNAP/ CORINAIR	Temp. dep.	2	All	PM10	1997	CORINAI R / CBM-IV / SAPRC	yes	On request
London	10 km	no	8	factors	factors	Nox, VOC, CO, SO2		1998	10 based on reactivity and struct.	yes	In principle
Prague	1 km		NFR/SNAP	Yearly values		SO2, Nox,PM, VOC,CO	partly	2000	partly	yes	partly
Copenhag en	2 km		traffic		yes	Nox, CO, Benzene	?	1999	CBM-IV	no	yes


SCOTLAND
Edinburgh
Glasgow
Newtown St Boswells
Dumfries
N. IRELAND
Carlisle
Sunderland
Middlesbrough
Scarborough
Dundalk
Douglas
Preston
Leeds
Liverpool
Sheffield
WALES
Stoke-on-Trent
Nottingham
Birmingham
Norwich
UNITED KINGDOM
Swansea
Abertawe
Oxford
Ipswich
Cardiff
Caerdydd
London
Maidstone
Exeter
ENGLAND
Brighton
Plymouth
Bognor Regis
Calais
English Channel
North Sea
Esbjerg-Harwich
Alborg
Århus
Aarhus
Skive
Viborg
Ringkøbing
DENMARK
Roskilde
Laholm
Helsingborg
Copenhagen
København
Kolding
Odense
Flensburg
Nykøbing
Kiel
Bergen
Rendsburg
Koszalin
Cuxhaven
Lübeck
Bremerhaven
Groningen
Hamburg
Schwerin
Szczecin
Emden
Bremen
NETHERLANDS
The Hague
Den Haag
Amsterdam
Minden
Hannover
BRANDENBURG
Berlin
Cottbus
NIEDERSACHSEN
SACHSEN-ANHALT
Duisburg
Dortmund
Ghent
Gent
Brussels
Bruxelles
Lille
Siegen
SACHSEN
Chemnitz
Legnica
Liberec
BELGIUM
WALLOON REGION
Bonn
HESSEN
THÜRINGEN
Prague
Praha
Frankfurt
Mainz
Würzburg
RHEINLAND-PFALZ
Saarbrücken
Amiens
Le Havre
Caen
Carteret
Rouen
PICARDIE
Reims
Paris
Brest
BRETAGNE
BASSE-NORMANDIE
Metz
LORRAINE
Stuttgart
Rennes
Vannes
Saint-Nazaire
Nantes
PAYS DE LA LOIRE
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Blois
CENTRE
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La Rochelle
Niort
BOURGOGNE
Chalon-sur-Saône
ATLANTIC OCEAN
POITOU-CHARENTES
LIMOUSIN
Mérignac
Clermont-Ferrand
Lyon
Geneva
SWITZERLAND
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Grenoble
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Santander
Baracaldo
PAIS VASCO
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Toulouse
Mende
Alès
PROVENCE-ALPES-CÔTE D'AZUR
Marseille
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Monaco
Genoa
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EMILIA-ROMAGNA
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Firenze
Pesaro
Ancona
Vitoria
NAVARRA
LA RIOJA
Béziers
Perpignan
Andorra
Saragossa
Zaragoza
Soria
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Cuenca
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CORSE
Bastia
Piombino
TOSCANA
Perugia
MARCHE
Terni
Pescara
Adriatic Sea
Rome
Roma
LAZIO
ABRUZZO
MOLISE
Foggia
Bari
CAMPANIA
PUGLIA
Naples
Napoli
BASILICATA
Taranto
Brindisi
SARDEGNA
Olbia
Tyrrhenian Sea
Sartène
Split
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Banja Luka
Belgrade
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Šiauliai
Panevėžys
LATVIA
LITHUANIA
RUSSIA
Kaliningrad
KALININGRAD
Gdańsk
Olsztyn
Białystok
Grodno
BELARUS
Grudziądz
Bydgoszcz
POLAND
Poznań
Warsaw
Warszawa
Łódź
Kalisz
Wrocław
Opole
Kielce
Radom
Lublin
Brest
VOLYN
Tychy
Kraków
Rzeszów
Ostrava
SLOVAKIA
UKRAINE
LVOV
Uzhhorod
Nyíregyháza
CZECH REPUBLIC
Plzeň
Brno
Nürnberg
Amberg
Písek
Tábor
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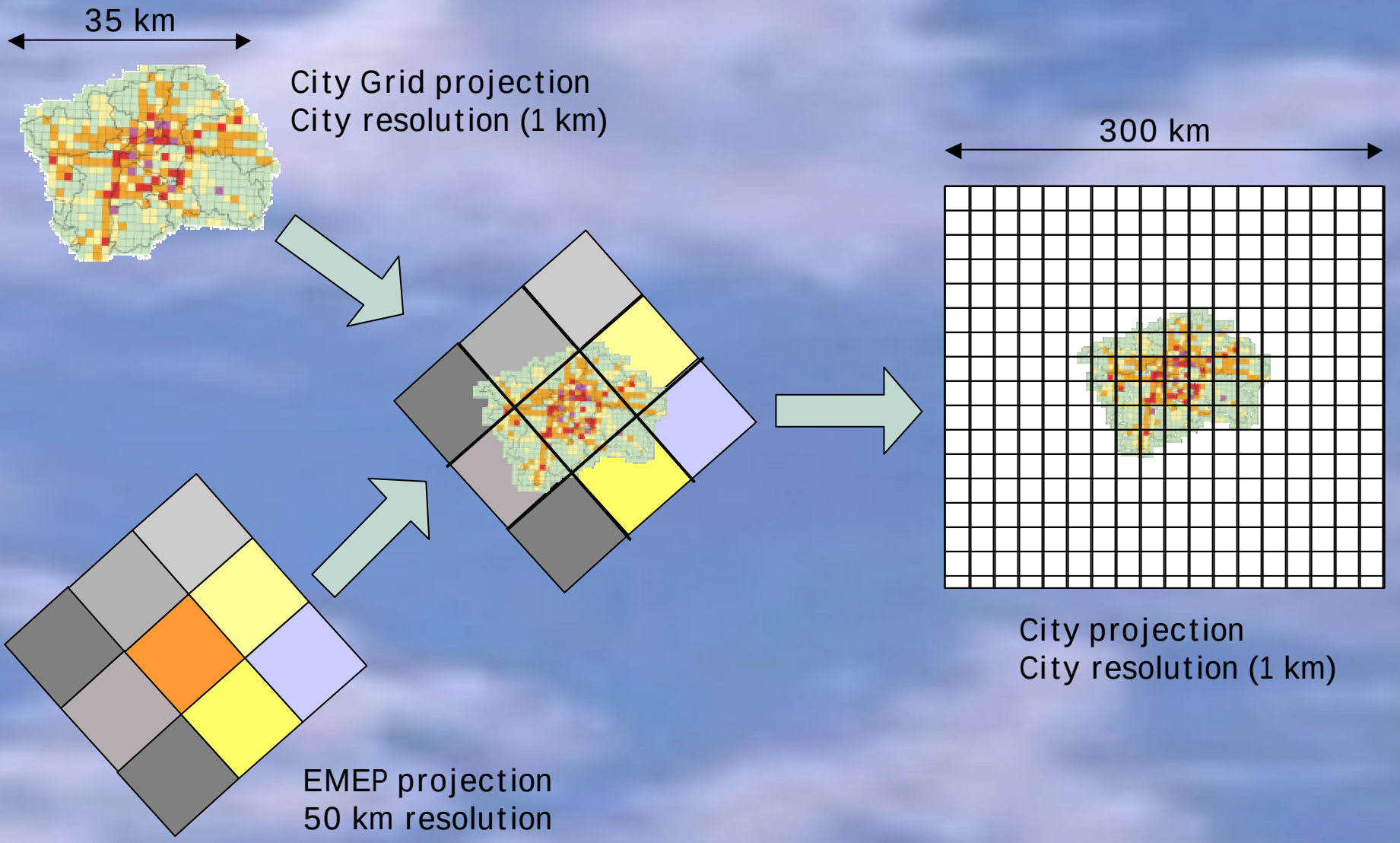
Model – City - Scenario

	OFIS	LOTOS	MOCAGE	STEM	CHIMERE	CMAQ	THOR	AURORA	EUROS	UAQAM	CMAQ-CAMX	MUSCAT	EURAD-FFA	EURAD	UAM-IV	CALGRID	MCCM	REM3	TRANSCHIM	MARS	
	Moussiopoulos	Builtjes	Broecheton	Pirovano	Vautard	Ferreira	Berkowicz	Mensink	De Leeuw	De Leeuw	Bedogni	Helmuth	Hass	Memmesheimer	Andronopoulos	Gabusi	Schaedler	Graff	Philippe	Moussiopoulos	
Ozone	●				●		●		●			●	●	●			●	●	●	●	11
PM	●				●?				●	●		●	●	●			●?	●		●	10
Copenhagen																					
Ozone	●	●			●		●		●				●	●						●	8
PM	●	●			●?				●	●			●	●						●	8
Katowice																					
Ozone	●				●		●		●			●	●				●			●	8
PM	●				●?				●	●		●	●				●?			●	8
London																					
Ozone	●	●	●?		●		●		●						●					●	8
PM	●	●			●?				●	●										●	6
Marseille																					
Ozone	●		●		●	●	●		●						●		●			●	9
PM	●																				
Milan																					
Ozone	●	●	●?	●	●		●				●	●				●				●	10
PM	●	●		●?	●?			●		●	●	●								●	9
Paris																					
Ozone	●	●	●?		●		●		●				●	●					●	●	10
PM																					
Prague																					
Ozone	●	●			●		●		●					●						●	7
PM	●	●			●?				●	●				●						●	7

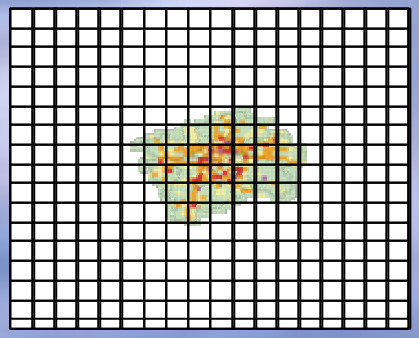
City - Meteo

	Schaedler NCAR (1 deg)	Builtjes FUB (0.25 x 0.5 deg)	Memmesheimer MM5 (TBD)	Broocheton ALADIN (10 km)	Hass MM5 (2 km)	Helmuth DWD-LM (30-? km)	Vautard ECMWF (40 km)	Ferreira NCEP (2.5 deg)	Berkowicz ETA (39 km)	Graff TRAMPER (2 km)	Mensink ARPS (4 km)
Berlin	R		Y	R	Y	R	R		Y	R	
Copenhagen		R	Y	R	Y		R		Y		
Katowice	R			R	Y	R	R		Y		
London		R		R			R		Y		
Marseille	R			R			R	N	Y		?
Milan		R		R		R	R		Y		
Paris		R	Y	R	Y		R		Y		
Prague		R	Y	R			R		Y		

Aggregation



Emission format



$$\times \; f_{clim} \; (3) \times f_{season} \; (4) \times f_{day} \; (3) \times f_{hour} \; (24)$$

N sectors (11) x M pollutants (10)

→ { One chemical speciation profile from VOC (11) to SAROAD
One chemical speciation profile for each PM class (4)

Milan: for each of the 110 grids, 3 x 4 x 3 x 24 = 864 factors
plus 1 climatic grid

Each 300 x 300 km city grid with FS resolution and projection
Format: ASCII, SAROAD VOC speciation, EPA PM speciation

Intercomparison scenarios

Comparison between	EMEP model run	and city model run using	
	European emissions	regional (200 km) emissions	city emissions
1	**CLE**	**CLE**	**CLE**
2	**CLE+NOx**	**CLE+NOx**	**CLE+NOx**
3	**CLE+VOC**	**CLE+VOC**	**CLE+VOC**
4	**CLE+NOx+VOC**	**CLE+NOx+VOC**	**CLE+NOx+VOC**
5	**CLE+PM2.5**	**CLE+PM2.5**	**CLE+PM2.5**
6	**CLE+PMcoarse**	**CLE+PMcoarse**	**CLE+PMcoarse**
7	**CLE**	**CLE**	**CLE+NOx**
8	**CLE**	**CLE**	**CLE+VOC**
9	**CLE**	**CLE**	**CLE+NOx+VOC**

CLE: Emissions in 2010 with current legislation

Output format

O3

Surface hourly values
period: 6 months (April to September)
=> daily max 8-hr mean
=> AOTx (AOT40, AOT60, AOT30)

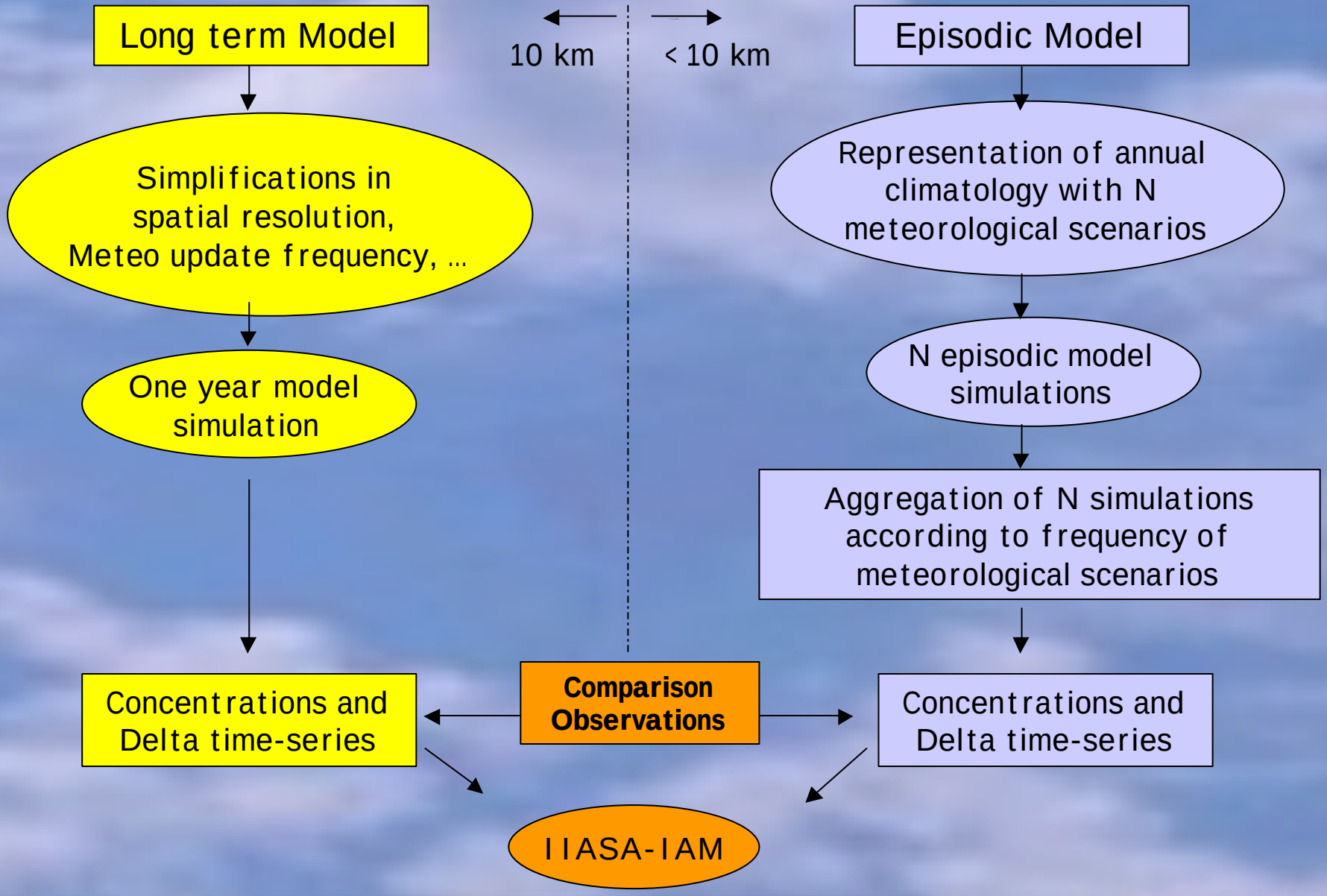
PM2.5 & PM10

Surface daily values
period: 12 months

One file per pollutant, per scenario and per city in a predefined lat-lon Grid with 10 km spatial resolution. Disk space (O3: 16Mb ; PM: 1.3Mb)

Format: netCDF (Fortran scripts provided by JRC)

Long vs short term



Validation

- Selection of representative measurement stations
- Comparison of model results with EU legislation indicators (O3 8h average, alert and information thresholds, number of exceedance days,…
- Inter-comparison of model deltas on same indicators
- Visualisation on Web site
- More specific validation according to modellers discussion & suggestions