GEMS

Regional Air Quality

METO-UK, CNRS, MPI-M, KNMI, FMI, DMI, NKUA, METEO-FR, ARPA-SIM, ISAC, met.no, FRIUUK, INERIS, CHMI, EPAI, PIEP, ICSTM

How to enhance and improve Regional Air Quality forecasts, hindcasts and analyses across Europe in the GMES context?
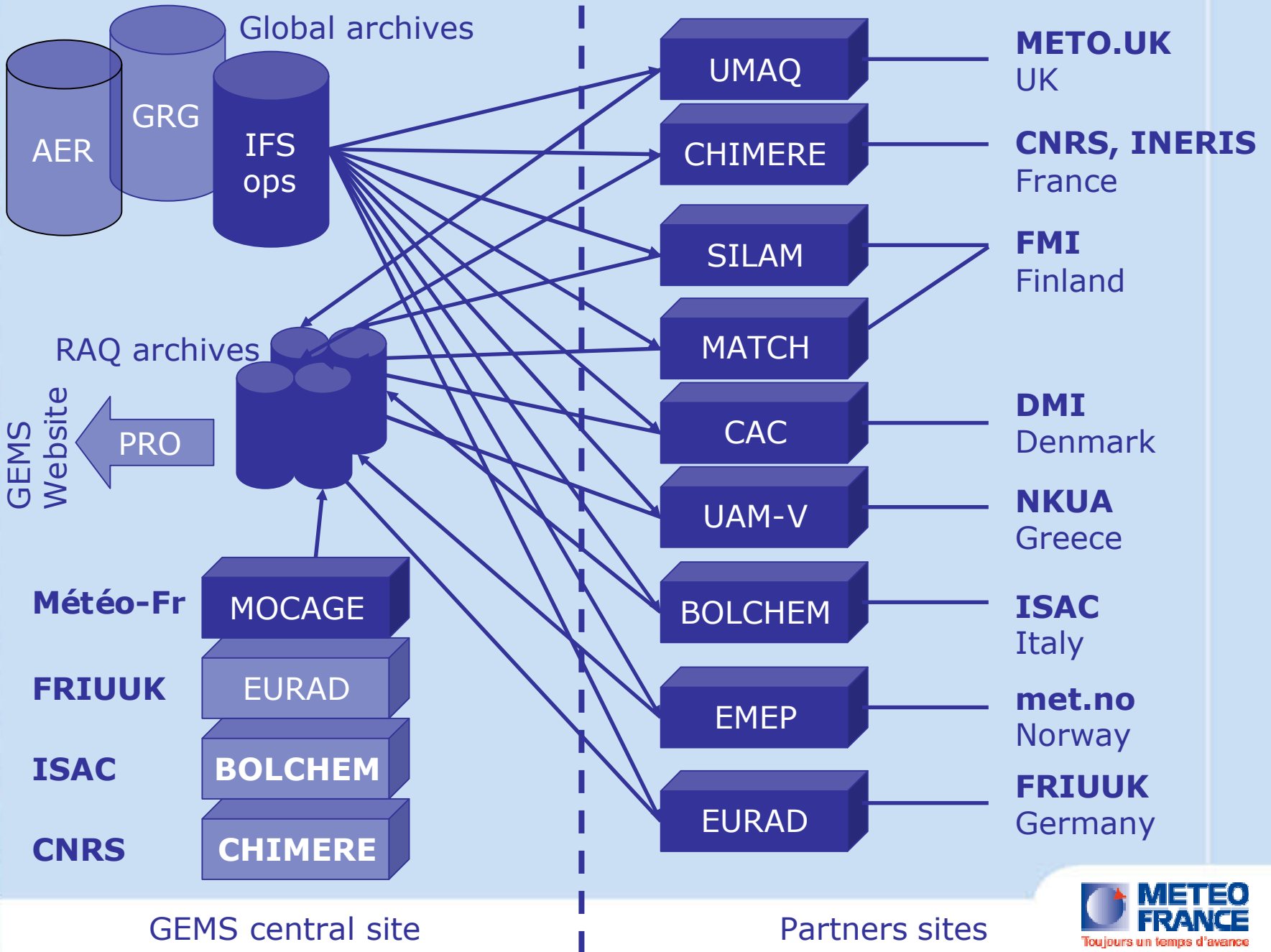
Vincent-Henri.Peuch@meteo.fr

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WP-RAQ1 — Coordination, interfaces and communication between ECMWF and partner institutes — V.-H. Peuch (METEO-FR)

WP-RAQ2 — Impact of global-scale boundary conditions, of high-resolution data assimilation and of detailed emissions — H. Elbern (FRIUUK)

WP-RAQ3 — Coordinated access to verification data over Europe — L. Tarrason (met.no)

WP-RAQ4 — Pre-operational near-real-time daily forecasts — G. Bergametti (CNRS)

WP-RAQ5 — Regional simulations over re-analyses periods — D. Jacob (MPI-M)

WP-RAQ6 — Use of GEMS data to assess the public health effects of long-range aerosol and reactive gases — D. Briggs (ICSTM)

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RAQ-1
Coordination, interfaces and communication between ECMWF and partner institutes

The 9+1 models involved have started building-up the GEMS-RAQ configuration. **Satisfactory progress** have been shown at a RAQ meeting in Paris (8-9/12/2005).

All GEMS models will consider the common european domain **(35N-70N ; 15W-35E)** or a larger area for ensemble activities and intercomparison. Vertical and horizontal resolutions depend upon model : start 20-50km, target 5-20km. Nested domains at higher resolution will also be developped.
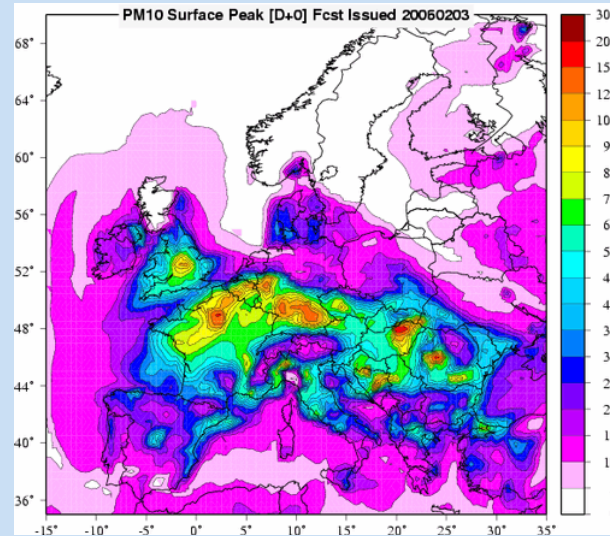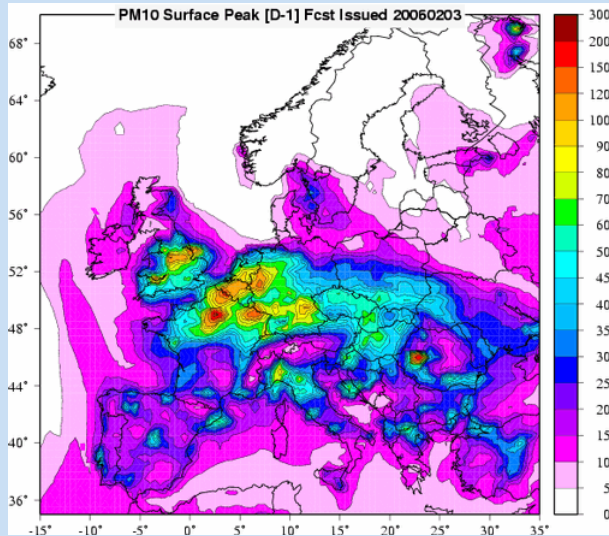
Essentially, the work focussed on the ECMWF ⇨ Partner Institute branch (9 models) or on running at ECMWF (1 model), yet considering only **meteorological forcings**. Discussion on formats for the Partner Institute ⇨ ECMWF branch will be finalized soon : GRIB or NetCDF on a common grid (interpolation left to each partner).
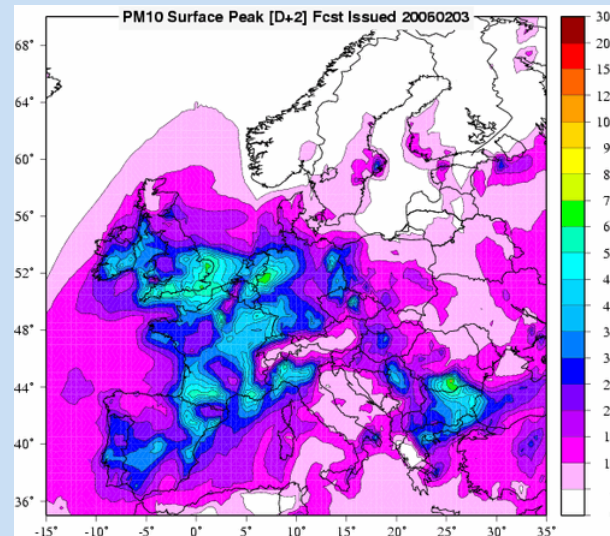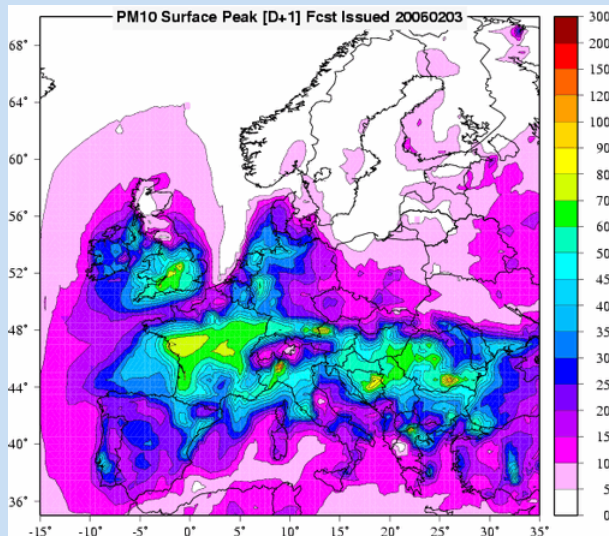
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PM10 forecast with CHIMERE (2006/02/03)

Day - 1

Day + 0

Day + 1

Day + 2

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For the validation of GEMS-RAQ configuration, **a dispersion test** will be performed as planned. It will be a recent case from the ENSEMBLE project (JRC, S. Galmarini), which allows an evaluation of RAQ models against the median of state-of-the-art/operational dispersion model.
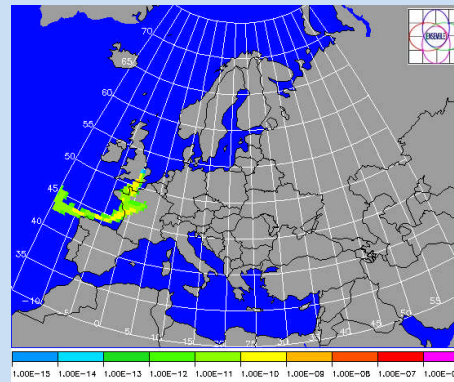
For NRT operations, include **Radon/Lead** in all RAQ models, useful for model comparisons.
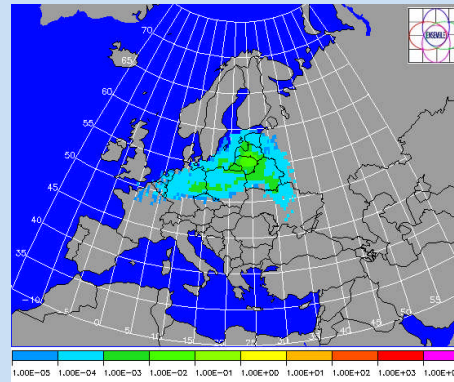
Exercise 11
London (350m agl)
900s
2003/06/11 12:00
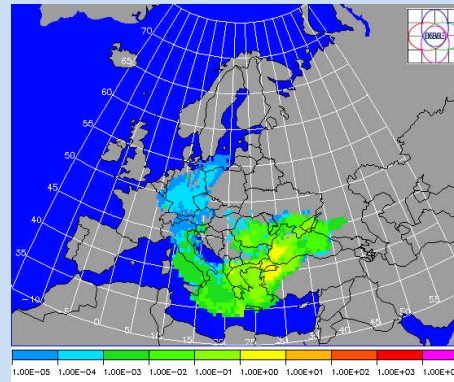
Exercise 13
Malmö (0-500m agl)
6h
2004/11/23 6:00

Exercise 19
Hemel Hempstead (0-1500m agl)
60h
2005/12/12 15:00

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RAQ-2
Impact of global-scale boundary conditions, of high-resolution data assimilation and of detailed emissions

Two main activities planned during the first year : specification of chemical boundaries needed for RAQ and emissions.

For **chemical boundaries**, answers to a questionnaire (AER+GRG) with plans and timing to be finalized in the split sessions. NRT experience at CNRS+INERIS/METEO-FR (Prév'Air) coupling MOCAGE and CHIMERE (GRG). NRT provision of chemical data to ECMWF from global MOCAGE simulations and forecasts (+96h) in METEO-FR, starting spring 2006 and up to the availability of the first GEMS global products (2003, NRT).

For **emissions** : major need for anthropogenic dataset (hourly/weekly/monthly/annual) over the GEMS european domain and at a 5km resolution ;work by NKUA on biogenic emissions in Mediterranean area will be presented at the RAQ split session.

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1. O3
2. NO
3. NO2
4. PAN
5. HNO3
6. SO2
7. CO
8. CH4

Exemple of GRG BC (extended version)

9. « C2H6 » : Ethane (+ haloalkanes)
10. « nC4H10 » :n-Butane (+ prop.,butanes,higher alk.,arom.)
11. « C2H4 » :Ethene (+ haloalcenes)
12. « C3H6 » :Propene (+ higher alcenes)
13. « OXYL » :Orthoxylene (+ benzene, halobenz.,phenols,cresols,styrenes)
14. « C5H8 » :Isoprene (+ dienes)
15. « APINEN » :Alpha-pinene (+ terpenes)
16. HCHO
17. « CH3CHO » :Acetaldehyde (+ other higher aldehydes)
18. GLYOX
19. MGLYOX
20. « CH3COE » :Methyl ethyl ketone (+ ketones)

PREV'AIR

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Emissions : major discussion item at the RAQ Paris meeting…

• The EMEP inventory is a reference in Europe, up-to-date and generaly of good quality (though country totals are the ones reported by each country, though gridding in the country includes some degree of uncertainty, though some time profiles are crude). The emissions are distributed in activity sectors, which is adapted. It is ~50km, and hence does not meet all RAQ needs (**5km**).

Two options were discussed :

• Use a **common GEMS** inventory. Needed to be able to compare models and be able to identify why skill scores differ,… It would be a major outcome of GEMS to have an european emissions dataset shared by a large number of groups involved in RAQ foreacasting. Ideal case : identify synergies with other efforts (or new specific project) to build-up a new inventory ; or adopt a common downscaling strategy of EMEP emissions.
• Each model keeps with its own **specific emissions**, in order not to unbalance the models by providing new emissions ; interesting for ensemble, given the uncertainties on emissions.
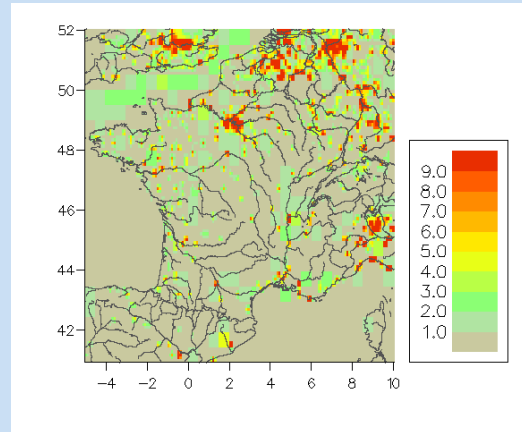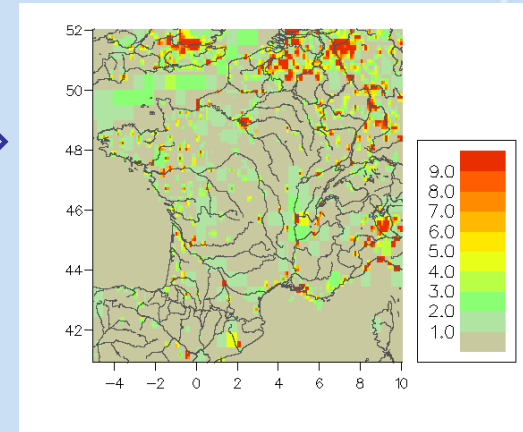
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EMEP

Urban fraction

Final
(+Paris,Marseilles)
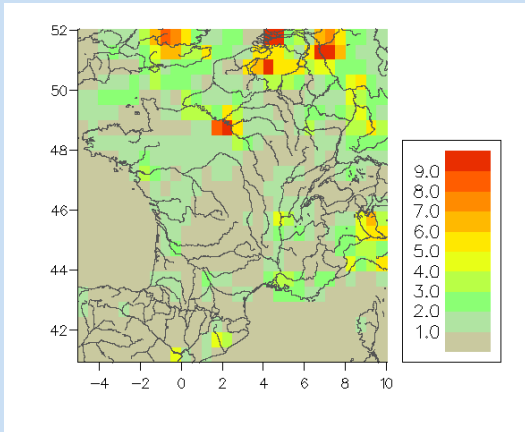
NO
Urban
(3mth)

Ozone
Urban
(3mth)

Anne.Dufour@meteo.fr

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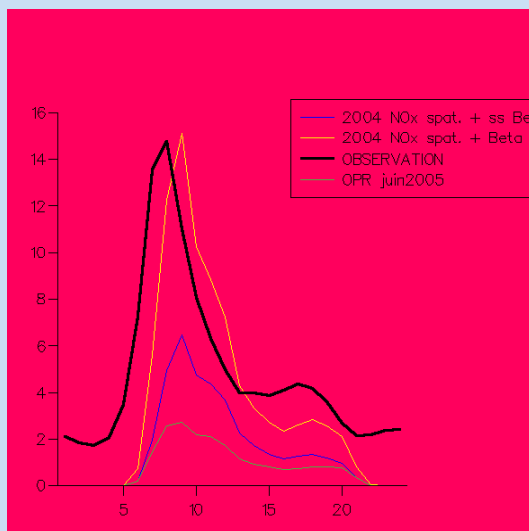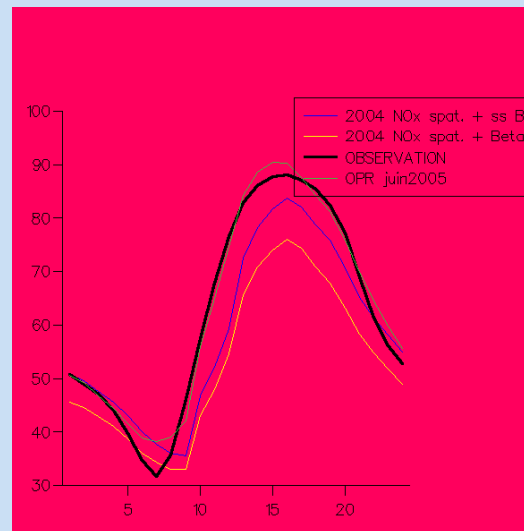
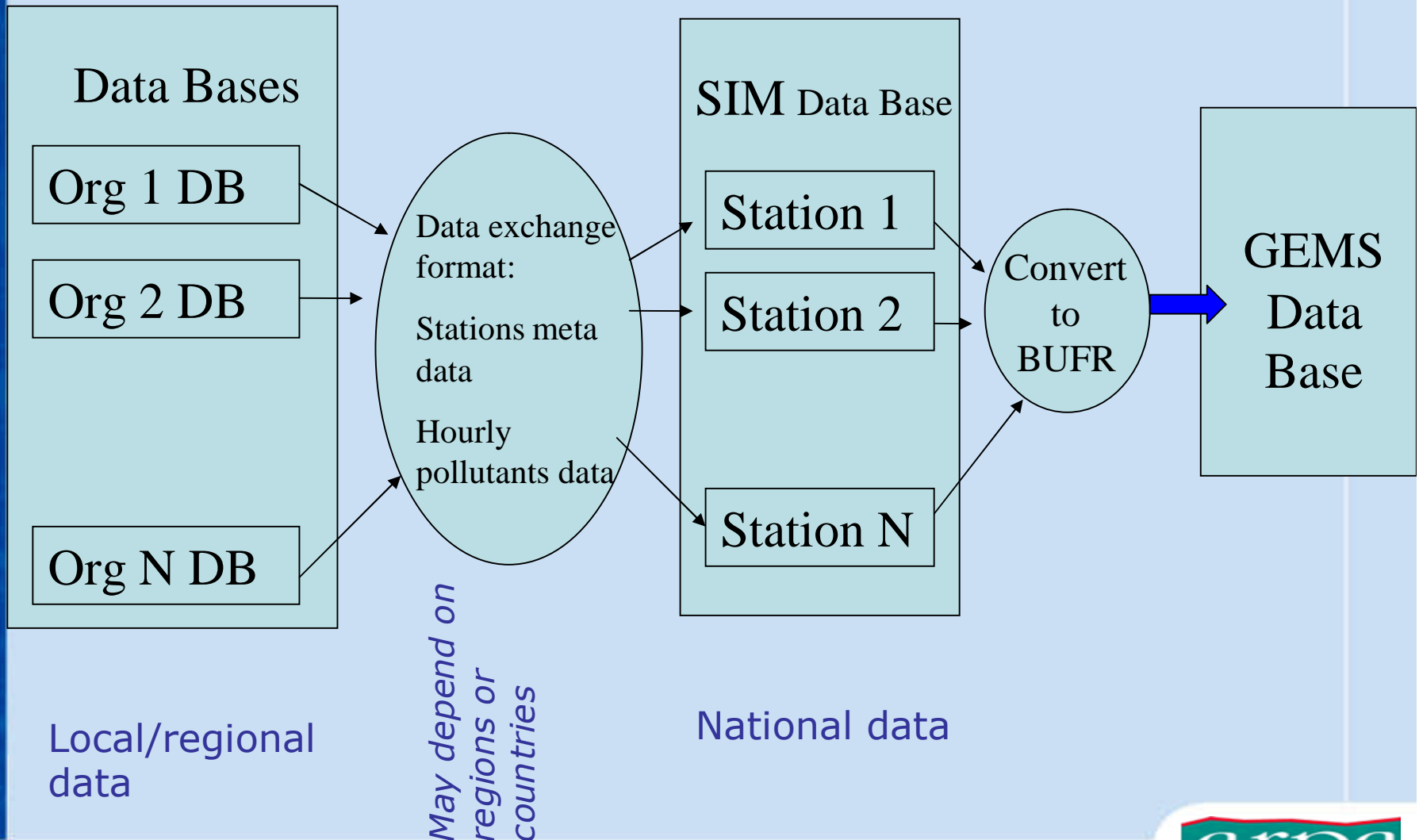## RAQ-3
### Coordinated access to verification data over Europe

Important item of discussion at the Paris meeting :

• National AQ data will be an important component of verification data, both for NRT operations (unvalidated) and hindcasts (2003, part of 2004). National MoU terms and country by country review of the situation in the RAQ split session. Prototype studies in Italy and Poland (ARPA-SIM, PIEP). Agreements will be sought for the GEMS period (purely scientific and technical objectives). However, there is a need for preparation of the post-GEMS phase : regional and national agencies, EEA,…

• Existing databases with Stingent QC/QA criteria will also be necessary, as we aim at quantifying the enhancement of hindcasts using GEMS chemical boundaries (AER, GRG) and regional high-resolution data assimilation. Discussions at the RAQ split session.

• BUFR (extended) will be used for the storage and usage of AQ data. Work on data and metadata (ARPA-SIM, ECMWF)

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Prototype system in Italy. Very similar in Poland (PIEP) :

Data Bases

Org 1 DB

Org 2 DB

Org N DB

Data exchange format:

Stations meta data

Hourly pollutants data

May depend on regions or countries

SIM Data Base

Station 1

Station 2

Station N

Convert to BUFR

GEMS Data Base

Local/regional data

National data

arpa SIM

Day-Night seasonal departures of O₃ and CO on vertical profiles over FRANFURT   [0m ➡ 9km, 1994 ⇨ 2004]
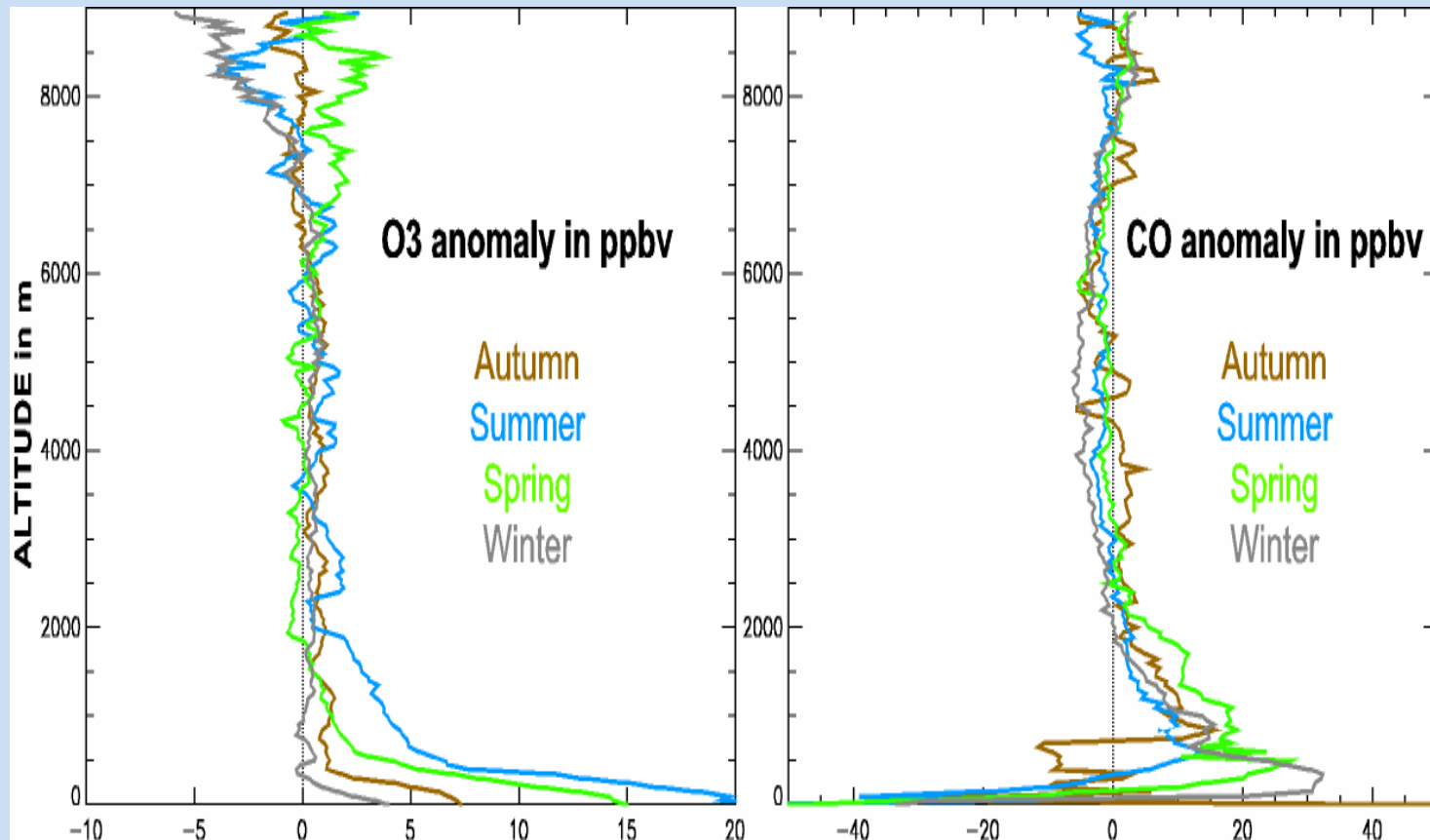
RAQ-4
Pre-operational near-real-time daily forecasts

The main activity in this workpackage was related to the study and definition of approach for meaningful evaluation and comparison of partner hindcasts and forecast over GEMS domain

Measures for assessing forecast of basic chemical species

Measures specific to user communities: air quality indices for human health and crop damage

Tasks Allocated for specific issues, to be included in final report:

Review existing procedures (incl. questionnaires)

Results of literature review

Review of impact metrics : human health, crop damage

Issues related to observation sites

City level forecast issues

Recommendations

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RAQ-4
Pre-operational near-real-time daily forecasts

Forecast evaluation proposed to have three
levels of validation:

Use of existing metrics (NRMSE, bias, correlation)

Additional Metrics (Taylor diagrams, odds ratio skill
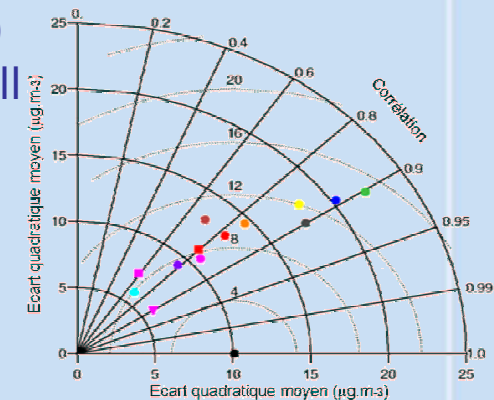score based on thresholds)

User metrics (human health, crop damage)

Software development:

Technical specification written by WP_4.1 team

Based on 'Verify/MetPy' system developed at
ECMWF: to allow central verification and user-
tailored metrics

Sample forecast of METEO-FR just transferred
to ECMWF (July 2005, 0-24h hourly
forecasts) for implementation tests

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RAQ-6
Use of GEMS data to assess the public health effects of long-range aerosol and reactive gases
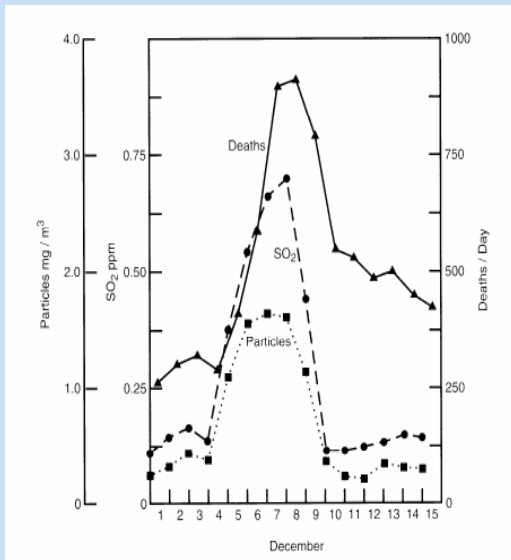
Concentrations of SO2 and « smoke » as well as the death rate during the 1952 smog episode [from Wilkins, 1954]

"London" Smog: primary pollution (sulfur dioxide, aerosols, soot,…)
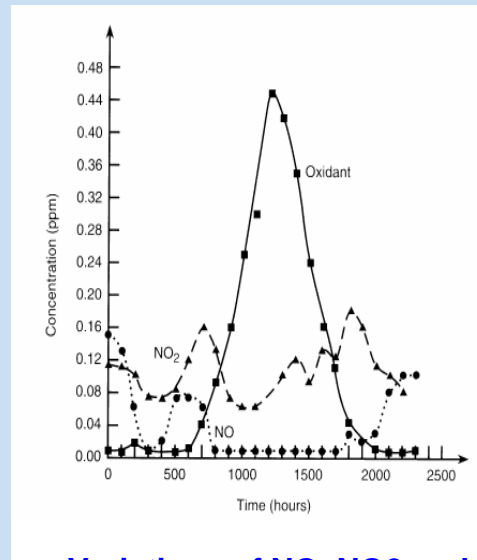
Variations of NO, NO2 and total oxydant in Pasadena, California, on 23/07/1973 [from Finlayson-Pitts and Pitts, 1977]

"Los Angeles" Smog: secondary pollution (ozone and photochemical oxidants)

Preliminary studies have to be carried out to identify the types of health effects that can be meanifuly studied using GEMS-RAQ data.

Concerns about the spatial scale of impacts and confusing factors (temperature, humidity,…)

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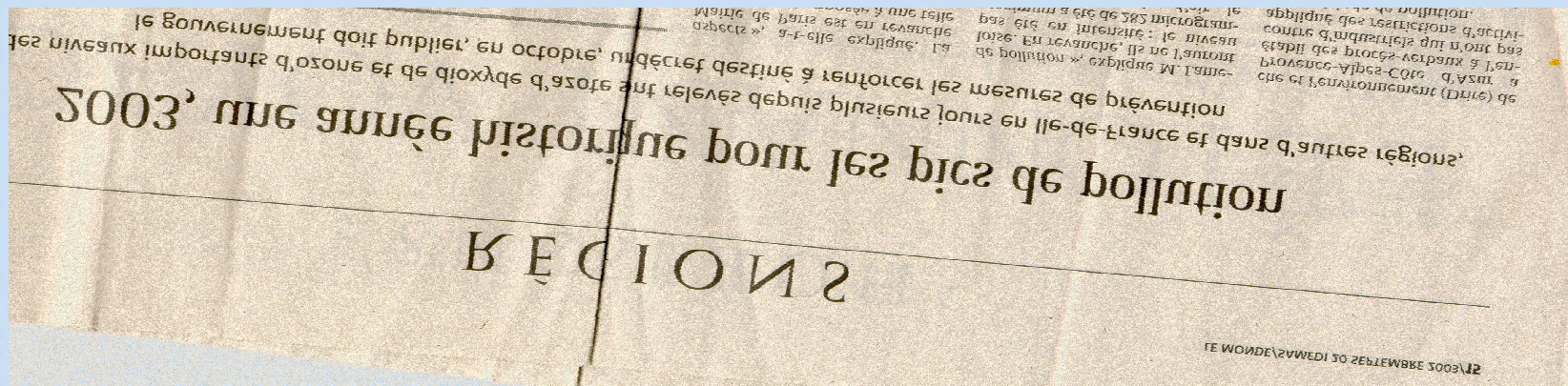
The first part of activities concern national studies of AQ/health : the UK and Eire national studies will be conducted jointly (ICSTM, EPAI) ; Czech republic (CHMI).

The choice of the period (early 2003 to spring 2004) for RAQ hindcats activities is justified by interesting cases of both types of pollution (see split session).

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RAQ Advisory Board

The board will have its first meeting this thursday. Most members will participate to the present assembly :

- Valentin.Foltescu (SHMI, Sweden)

- Tim Haigh (EEA)

- Robert Höller (UBA, Austria)

- Nathalie Poisson (ADEME, France)

- Alfred Trukenmüller (UBA, Germany)

- (Beatriz Navascues, tbc, INM, Spain)