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# **An operational system to generate regional background concentrations for Ozone, PM and NO<sub>2</sub> using data-assimilation**

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6th Framework Programme- Policy oriented Research  
Priority 8.1 Topic 1.5 Task 2



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Objective



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Conclusions and Recommendations

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*One of the main problems in urban air quality assessment:*

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*The determination of the background concentrations (BC)*

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
*i.e. which part of the concentration in the city comes from emissions in the city, and which part comes from outside?*

*Objective*

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*Current practice:*

*Results*

 *By observations: Problems with influence by City-emissions: double counting*

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 *By modelling: Problems with limited model-performance*

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To generate regional background concentrations by a combination of modelling and observations

Result: Consistent air quality fields over Europe over years, on an hour-by-hour/daily averaged basis

Result: Reduction of uncertainty

To make these Background concentrations available for City Users ( and for others, regional scales users etc)

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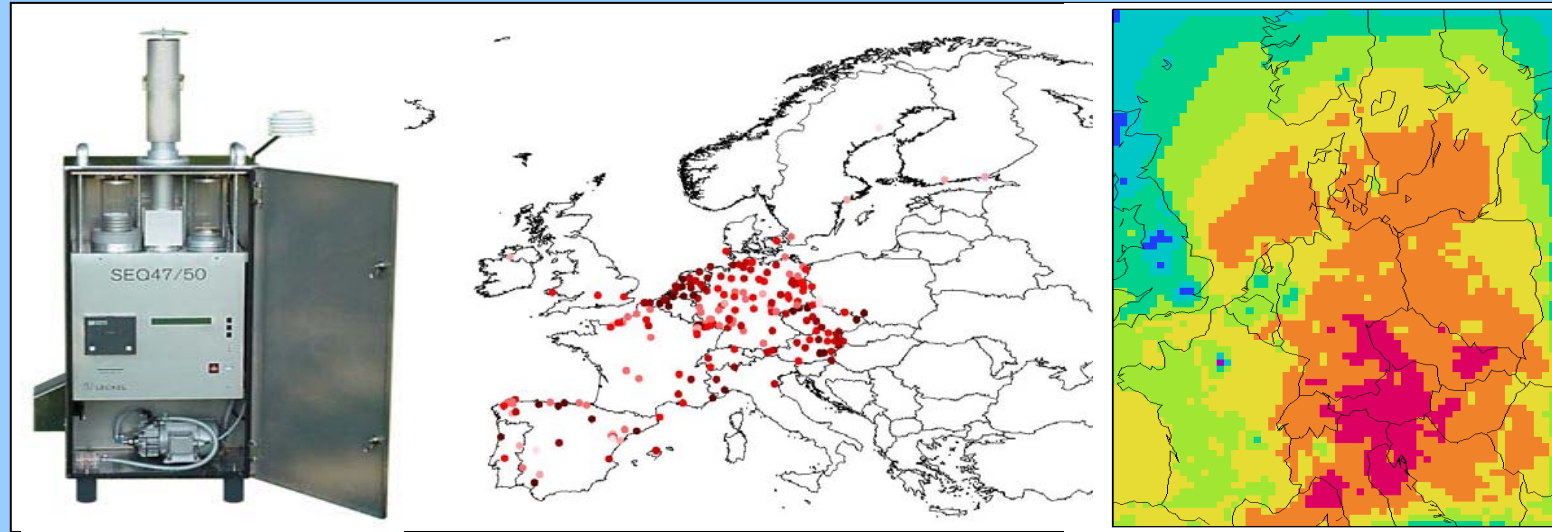
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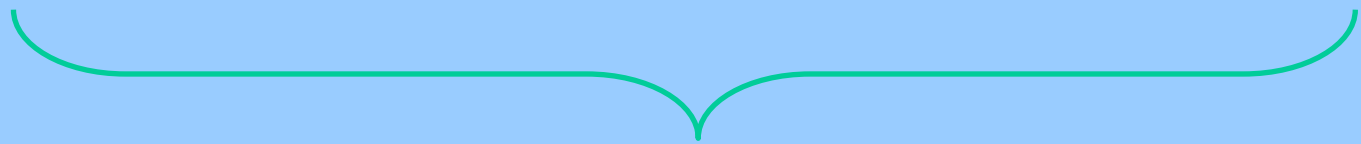
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Measurements

Modelling



To be combined using data assimilation

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Data assimilation is the technique whereby observational data are combined with model output to produce an optimal estimate of the evolving state of the system.

**Passive** approach: Modelled fields are synthesized with measurements without a feedback to the model state.

Synthesis is performed as a “finishing touch”

Examples: Kriging, Optimum interpolation

**Active** approach: Modelled fields are synthesized with measurements with a feedback to the model state.

Assimilation is performed on the fly

Examples: Kalman filtering, 3D-VAR

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- The 3-D Eulerian grid model LOTOS- EUROS with Gas phase chemistry and aerosols/PM
- Grid resolution 25 x 25 km<sup>2</sup>, with ability to nest down to 2 x 2 km<sup>2</sup>
- Of intermediate complexity to make long term and data assimilation runs possible
- Ensemble Kalman Filtering as Data-assimilation method ( and tests with OI)
- Ensembles created by putting noise to emissions and dry deposition

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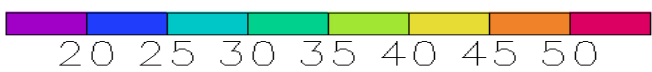
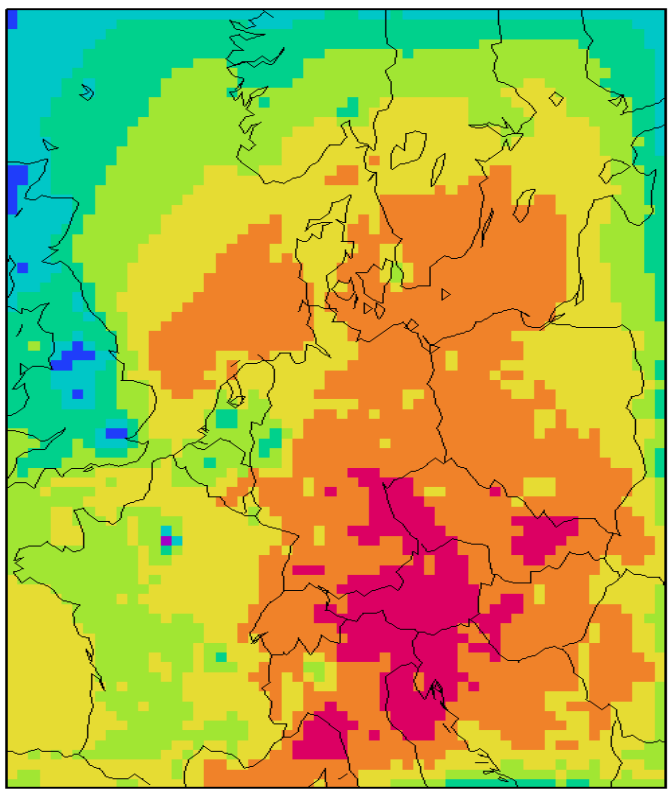
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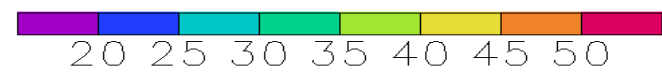
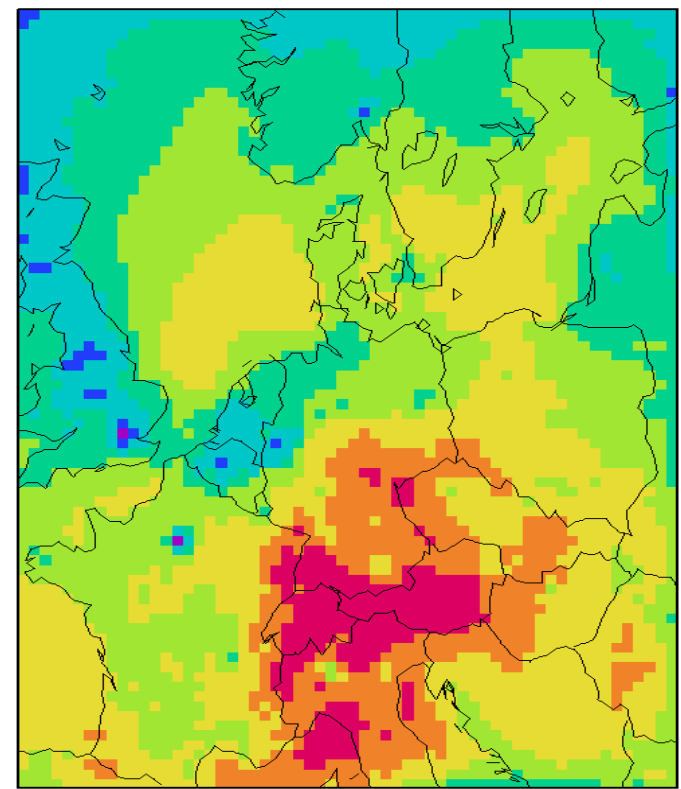
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modelled ozone july 2003



assimilated ozone july 2003



EMEP stations used for assimilation

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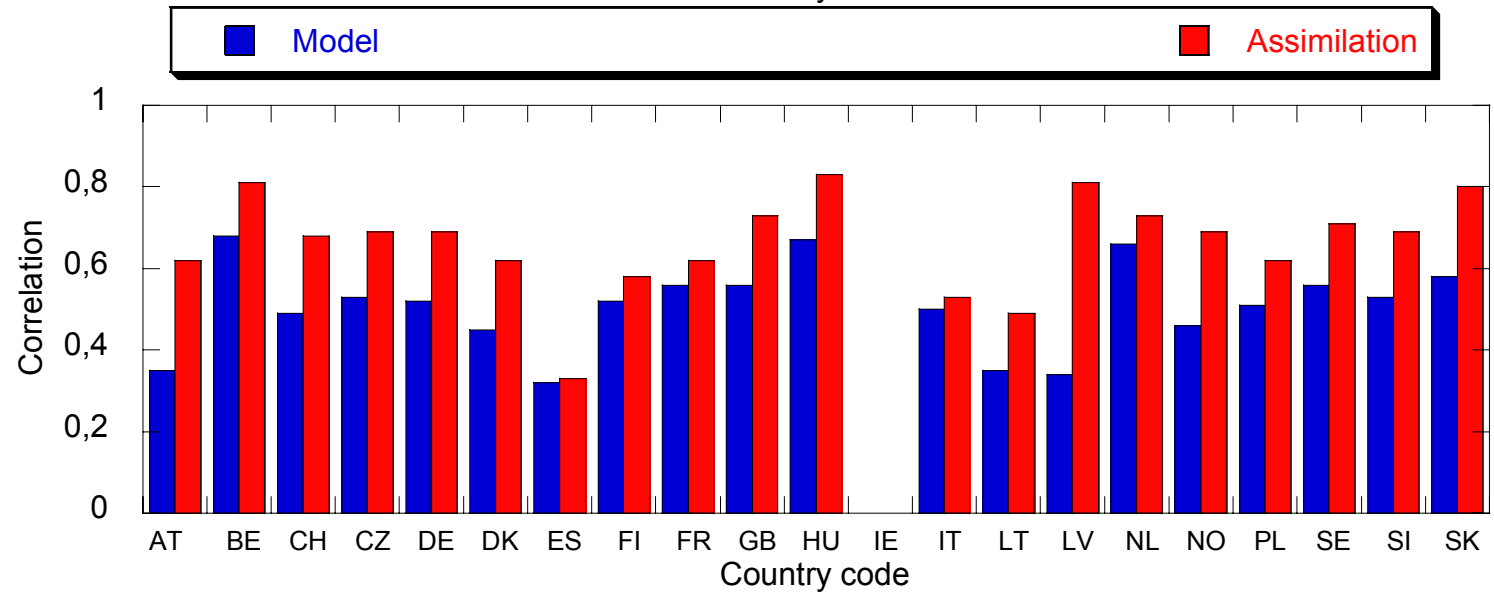
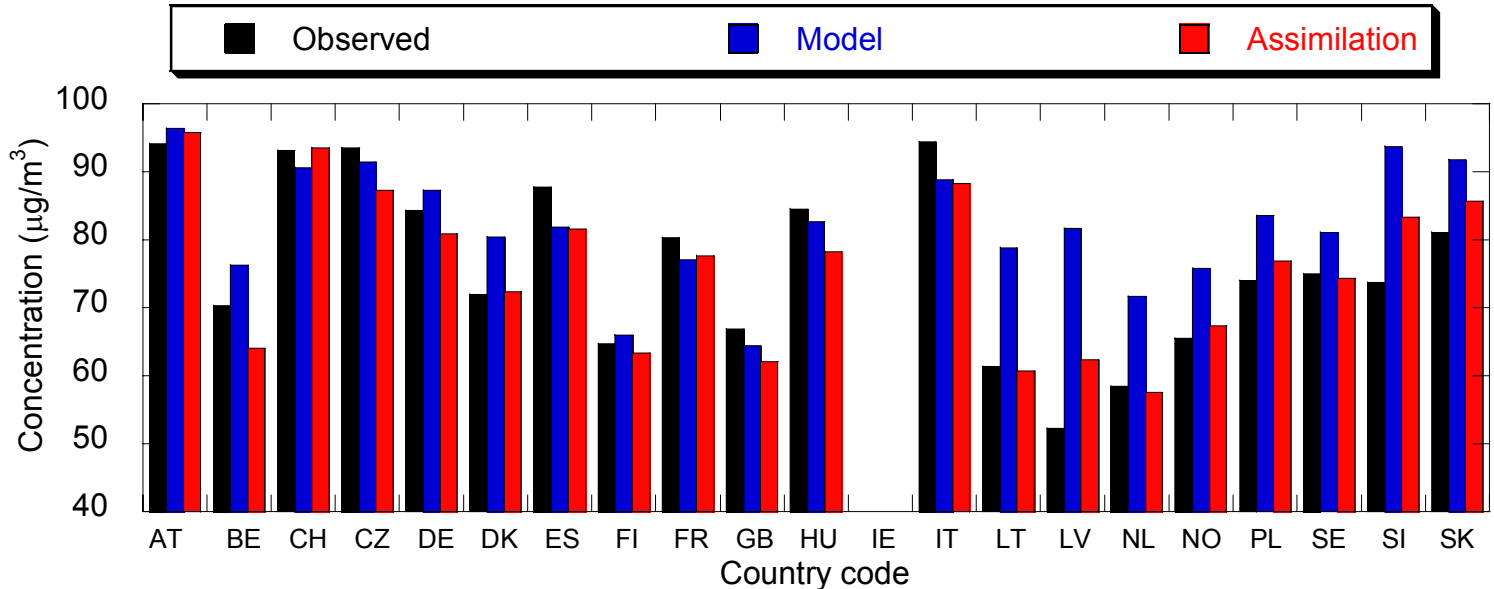
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AIRBASE stations used for validation

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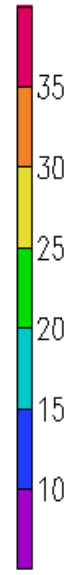
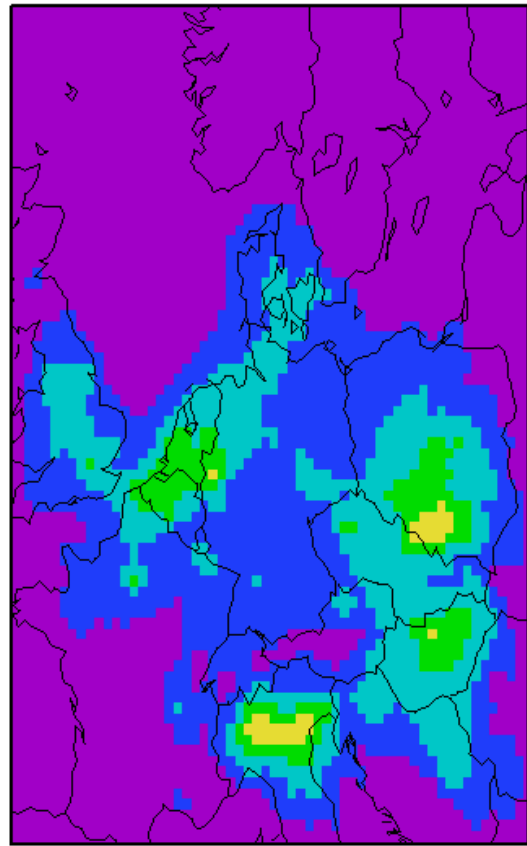
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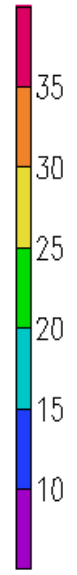
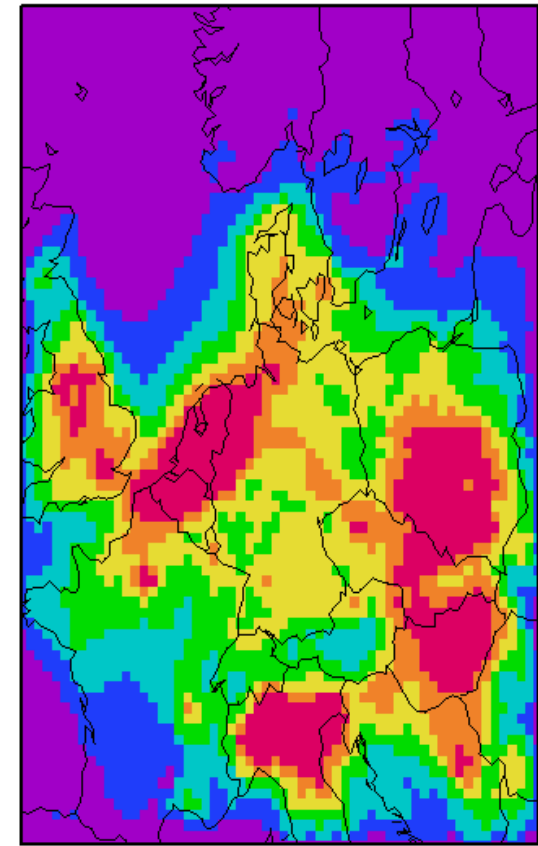
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## Model



## Assimilation



PM10 fields for spring 2003

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- Air quality fields are made over Europe by combining modelling and observations
- Information of the model uncertainty can also be provided from the Ensemble Kalman approach
- The system: LOTOS-EUROS + data assimilation is operational, and can be used to produce air quality fields for other years.
- The produced air quality fields for O<sub>3</sub>, PM<sub>10</sub>, and NO<sub>2</sub>, PM<sub>2.5</sub> or other species can be used as Background Concentrations by City Users
- The method will be disseminated as part of Air4EU with the recommendations

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- To avoid problems with double counting it is recommended:
  - That the urban scale model is used over extended areas, like 100 x 100 km<sup>2</sup> or more (City-Delta). Or the meteorology of the urban scale model is on an hour-by-hour basis consistent with the meteorology on the regional scale ( requires careful checking)

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For discussion:

Can the system, model + data assimilation also be used for scenario's? Note that in general the necessary noise/adaptation factors for the emissions do not differ much from the factor 1.

It may be possible to analyse the scenario results by using:

1. Only the model
2. The model with passive data assimilation ( the delta's)
3. The model with active data assimilation