

Air4EU

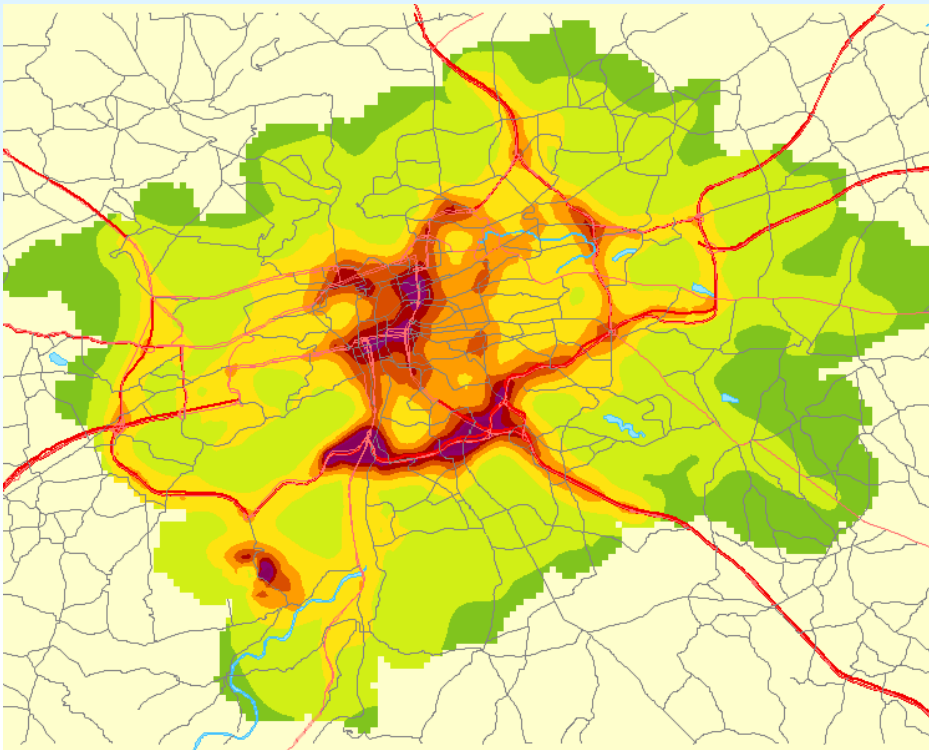
Examples of uncertainty mapping

(work in progress)

Examples of uncertainty mapping using annual mean NO₂ maps from Prague (ATEM)

ATEM model: Statistical Gaussian model

Number of stations available: 12



Assimilation method applied:

Simple combination of monitoring and modelling using linear regression with 0 intercept

$$C_{\text{reg}} = \text{Reg}_{\text{slope}} * C_{\text{mod}}$$

Regression slope: 1.25

Regression R²: 0.35

RMSE model: 11.1 ug/m³

RMSE regression model: 7.6 ug/m³

Examples of uncertainty mapping using annual mean NO₂ maps from Prague (ATEM)

Method 1: Homogenous relative model uncertainty (indicative)

Calculate the normalised RMSE for all stations

$$\text{NRMSE} = (\sum (\text{Mod} - \text{Obs})^2)^{1/2} / \text{Mean}(\text{Obs})$$

Use this as the representative uncertainty for the entire map

Multiply the model field by the NRMSE

Method 2: Kriging of RME (directive)

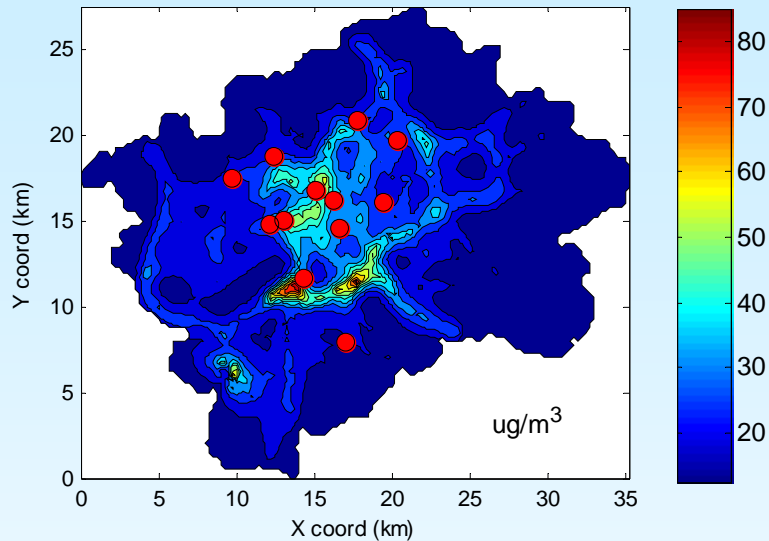
Calculate the Relative Maximum Error (RME) at each station

$$\text{RME} = |(\text{Mod} - \text{Obs})| / \text{Obs}$$

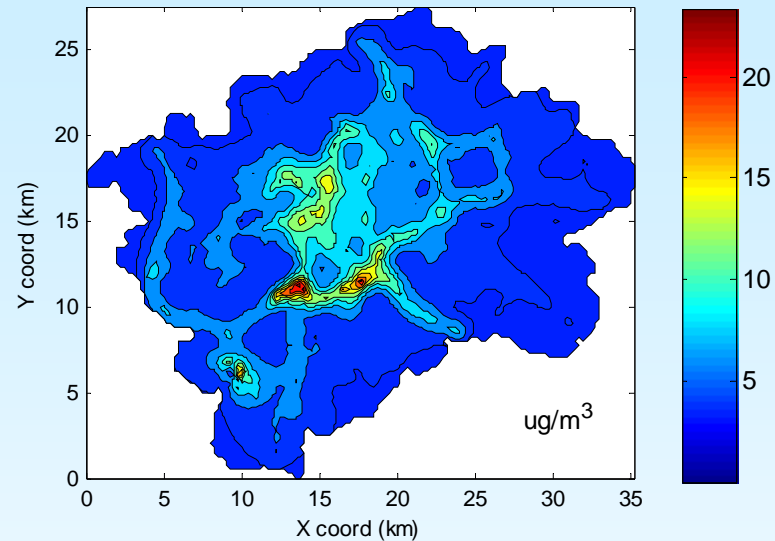
Use kriging to spatially interpolate

Uncertainty mapping using the NRMSE

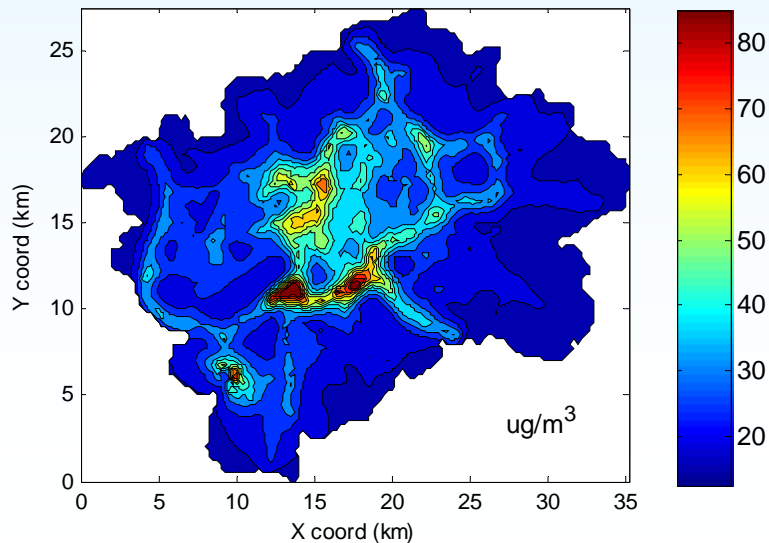
Original model calculations for NO₂ RMSE = 11.08



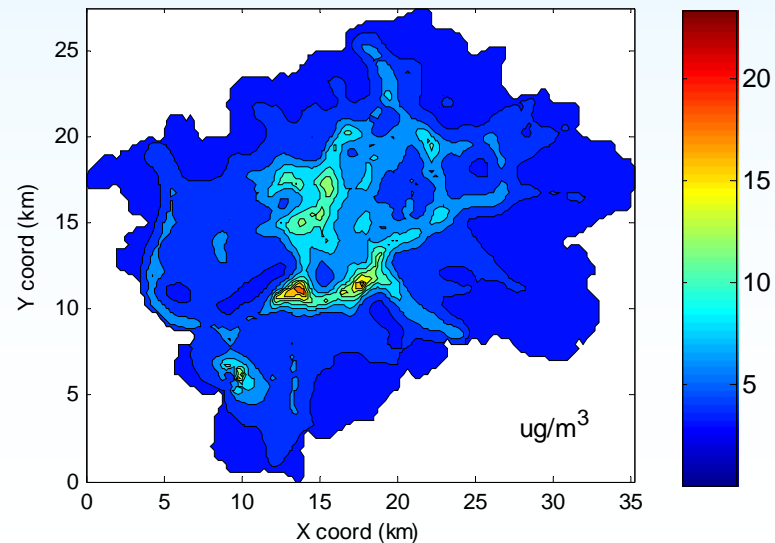
Absolute uncertainty: NRMSE for model 27%



Regression model calculations for NO₂ RMSE = 7.59

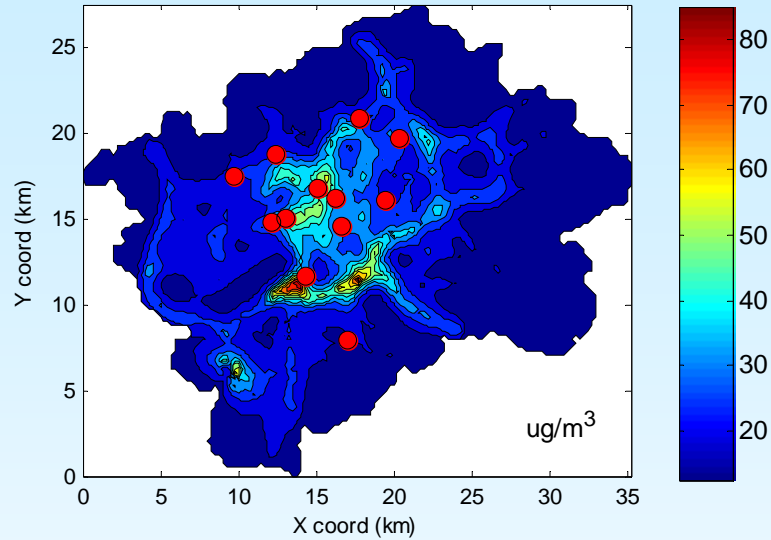


Model uncertainty: NRMSE for regression model 19%

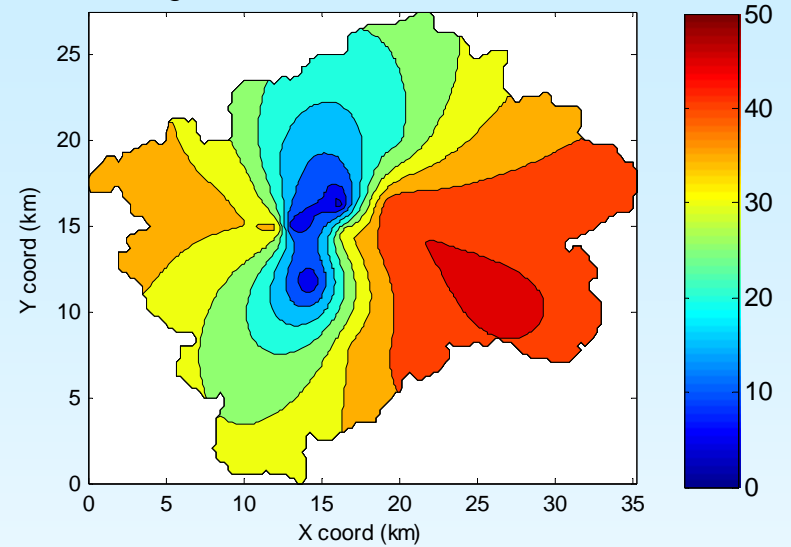


Uncertainty mapping of kriged RME

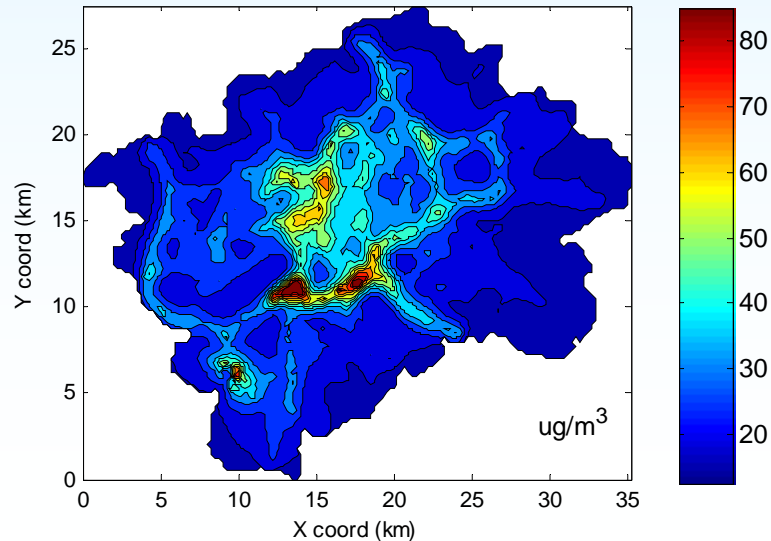
Original model calculations for NO₂ RMSE = 11.08



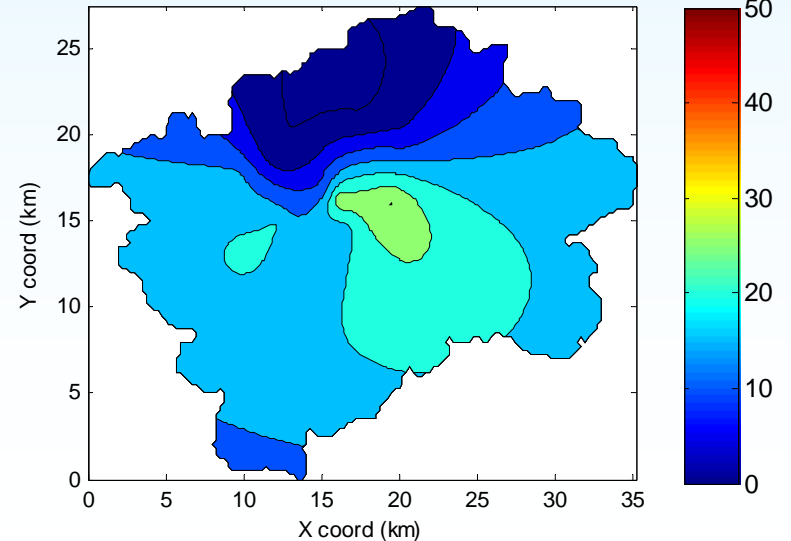
Kriged RME for model as % error



Regression model calculations for NO₂ RMSE = 7.59



Kriged RME for regression model as % error



Examples of uncertainty mapping using annual mean NO₂ maps from Prague (ATEM)

Method 1: Homogenous relative model uncertainty

Gives a general estimate of the model uncertainty

Produces a flat relative field

Produces scaled reproductions of the concentration maps

Same information can be given as a constant value, i.e. no map is actually required

Method 2: Kriging of RME

Gives a spatially varying estimate of relative error

Results in an uncertain error field far from observations

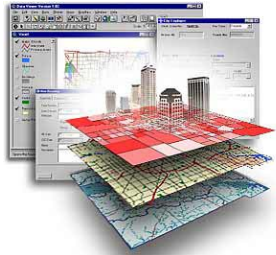
Can this be trusted?

Air4EU

Mapping tool

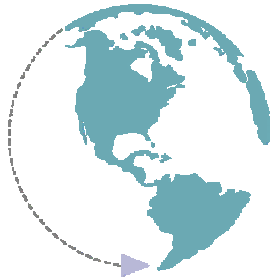
(under development)

Goals to achieve



Produce a web based GIS mapping tool to show air quality data fields for all scales from European to urban to street scale

The mapping tool should be accessible in a friendly and coordinated manner

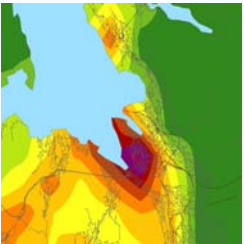
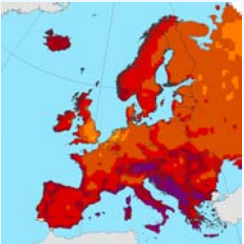
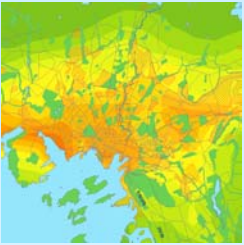


Will show results from Air4EU case studies and contributions from other cities or research institutes

The mapping tool should have a future beyond this project and be generally applicable to a wide range of maps and geographical regions



Air4EU specifications



1. Show coloured contour maps of gridded pollution fields
2. Pollution maps can be concentrations, indicators, etc.
3. Maps can represent different time scales
4. Maps include GIS layers such as streets, sea, etc.
5. Maps at all scales need to be shown
6. 'Extract data' capability
7. 'Zoom' capability
8. Maps imported to a database at NILU
9. All data and maps must be harmonised

Air4EU mapping tool demonstration and capabilities

Pollutant map:

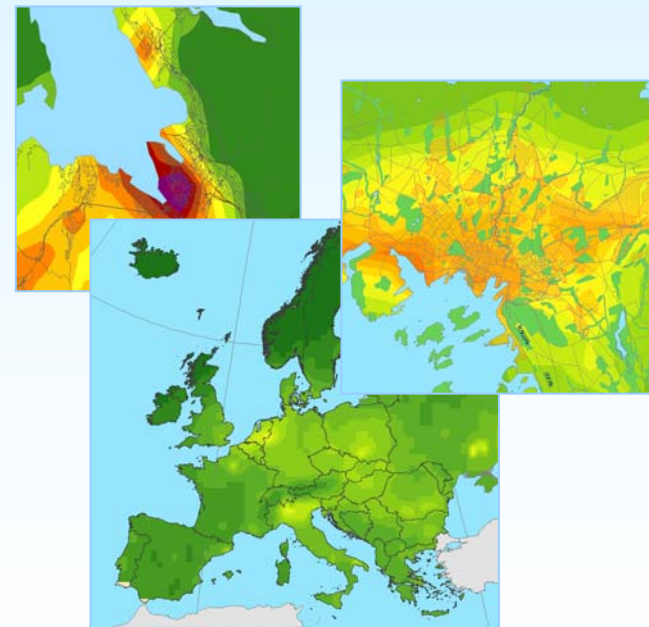
Refers to the air quality data fields, e.g. contour map of concentration field or indicator.

GIS layers:

Map containing landuse, roads names, street etc.

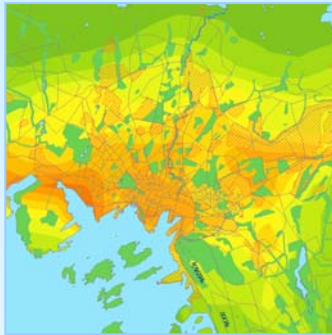
Region/City	Pollutant	Indicator	Period	Mapping method	Map Type
BERGEN	PM10	MEAN	2003	MODELLING	ASSESSMENT
DRAMMEN	NO2	MEAN	2003	MODELLING	ASSESSMENT
EUROPE	PM10	MEAN	2005	MODELLING	ASSESSMENT

Region (source)	Pollutant	Indicator	Period	Mapping Method	Mapping Type	View
OSLO (Air4EU)	BEHZNE	MEAN	2003	MODELLING	ASSESSMENT	<input type="checkbox"/>
OSLO (Air4EU)	NO2	MEAN	2003	MODELLING	ASSESSMENT	<input type="checkbox"/>
OSLO (Air4EU)	PM10	MEAN	2003	MODELLING	ASSESSMENT	<input type="checkbox"/>
OSLO (Air4EU)	PM25	MEAN	05/2022 - 05/2023	MODELLING	ASSESSMENT	<input type="checkbox"/>

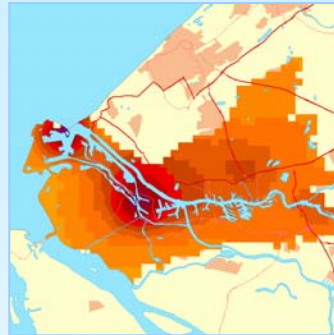


<http://dev0.nilu.no/users/ral/prosjekter/air4eu/index.cfm?fa=home.main>

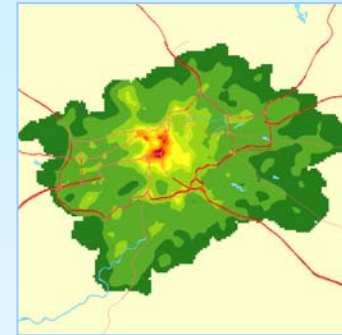
Current maps available



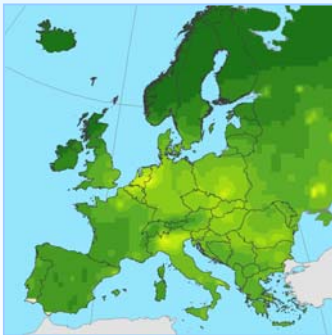
Oslo (PM10)



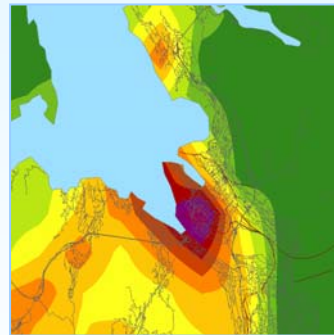
Rotterdam (PM10)



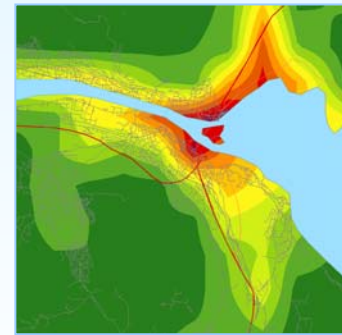
Prague (Benzene)



Europe (PM10)



Bergen (NO2)



Drammen (NO2)

Selection tool

1. The selection tool allow the user to search pollutants maps available which are registered on the Air4EU web map server.

The screenshot shows the Air4EU web application interface. At the top, the logo 'Air4EU' is displayed next to the text 'Air Quality Mapping For Europe' and 'A product of Air4EU'. To the right, it says 'Developed by NILU The Norwegian Institute for Air Research' with the NILU logo. Below the header, there are four navigation icons: 'Mapping Room', 'Information', 'Contact us', and 'Home'. A text block explains the mapping room's functionality, mentioning that selection can be made using 6 defining map properties and that for multiple selection, the CTRL key should be used. Below this is the 'Map properties' section with six dropdown menus: 'Region/City' (BERGEN, DRAMMEN, EUROPE), 'Pollutant' (BENZENE, NO2, PM10), 'Indicator' (MEAN), 'Period' (2003, 2005), 'Mapping method' (MODELLING), and 'Map Type' (ASSESSMENT). A 'RESET SEARCH' button is located below these menus. At the bottom, a table displays the search results with columns for Region (source), Pollutant, Indicator, Period, Mapping Method, Mapping Type, and View. The table contains four rows of data. Below the table are 'CLEAR ALL' and 'VIEW' buttons.

Map properties

Region/City: BERGEN, DRAMMEN, EUROPE
Pollutant: BENZENE, NO2, PM10
Indicator: MEAN
Period: 2003, 2005
Mapping method: MODELLING
Map Type: ASSESSMENT

RESET SEARCH

Region (source)	Pollutant	Indicator	Period	Mapping Method	Mapping Type	View
OSLO (Air4EU)	BENZENE	MEAN	2003	MODELLING	ASSESSMENT	<input type="checkbox"/>
OSLO (Air4EU)	NO2	MEAN	2003	MODELLING	ASSESSMENT	<input type="checkbox"/>
OSLO (Air4EU)	PM10	MEAN	2003	MODELLING	ASSESSMENT	<input type="checkbox"/>
OSLO (Air4EU)	PM25	MEAN	05/12/22 - 05/12/23	MODELLING	ASSESSMENT	<input type="checkbox"/>

CLEAR ALL VIEW

2. The filename contains all the necessary information, in the format of string of keyword.

3. The search is carried out using the pollutant filename

REGION_POLLUTANT_INDICATOR_PERIOD_MAPPINGMETHOD_MAPTYPE.*

Map properties

REGION_POLLUTANT_INDICATOR_PERIOD_MAPPINGMETHOD_MAPTYPE.*

Region/City	Pollutant	Indicator	Period	Mapping method	Map Type
Region/City >> BERGEN DRAMMEN EUROPE	Pollutant >> BENZENE CO NO2	Indicator >> AOT40 MEAN PERCENTILE	Period >> 2000 2001 2002	Mapping Method >> ASSIMILATION MODELLING MONITORING	Map Type >> ASSESSMENT UNCERTAINTY VARIABILITY
<input type="button" value="RESET SEARCH"/>					

REGION

Describe the geographical region covered by the map.
PARIS, EUROPE, NORWAY, OSLO etc.

POLLUTANT

This describe the pollutant addressed.
PM10, PM25, O3, NO2, CO, BENZENE and SO2

INDICATOR

The relevant indicator for the given pollutant.
MEAN; AOT40; SOMO35, PERCENTILE

PERIOD

The relevant indicator for the given pollutant.
MODELLING; MONITORING; ASSIMILATION

MAPPINGMETHOD

Indicate the methodology used for creating the maps.
MEAN; AOT40; SOMO35, PERCENTILE

MAPTYPE

Indicate what the map is showing.
ASSESSMENT, UNCERTAINTY, VARIABILITY