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AirQUIS

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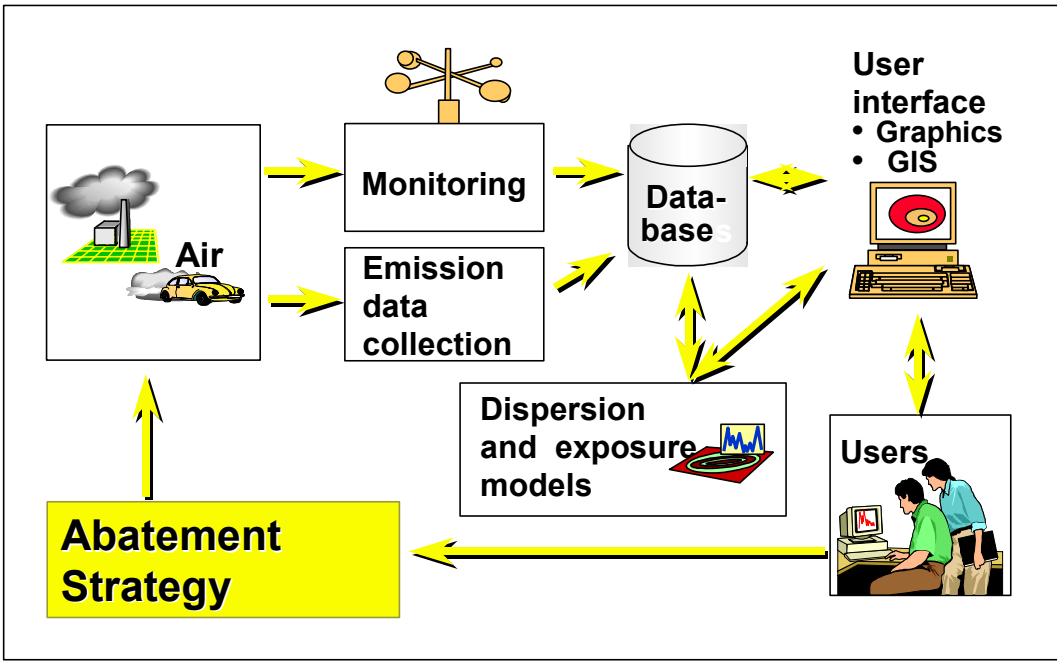
1 What is AirQUIS

1.1 AirQUIS, A GIS based surveillance and planning tool

Based on a Geographical Information System (GIS) platform the Environmental Surveillance and Information System (ENSIS) have been developed to handle air pollution and water pollution problems. AirQUIS is the air pollution related module of this system.

The main objective of a modern environmental surveillance platform of this kind is to enable direct data and information transfer and obtain a remote quality control of the data collection. The system combine monitoring, data presentation and modelling in one package, which enable the user not only to present and evaluate the present situation, but also to undertake environmental planning for a sustainable future. The GIS platform, on which the system is operated, provides easy access to the data and gives a perfect and easily understandable data presentation tool

The ENSIS system contains in addition to AirQUIS and WaterQUIS common modules that are shared by air and water specific parts of the program system. Important common parts are the measurement database, and the graphical user interface including the GIS (geographical information system).



The AirQUIS surveillance and planning system

The user interface is to a large extent a map interface from which spatial distribution of pollution sources, monitoring stations, measurements, model results and other geographically linked objects can be presented. The map interface can also be used as an entrance for making queries to the database

The GIS (Geographical Information System) functionality of the ENSIS system is designed to offer several possibilities for understanding the problems of air pollution.

- The GIS makes it easier to place the air pollution sources at the correct location, for example by making it easy to display the total network of road links in a city.
- GIS presentation of area-distributed consumption of fossil fuels and direct emissions gives a good overview of where to expect high impact of air pollution.
- Viewing the measurement stations on a map with the pollution sources will give an idea of what concentrations one may expect to find at the stations for a given wind direction.
- The GIS makes it easier to search for geographically linked data in the database.
- Displaying results of model calculations as a map can be used for public information on pollution levels at different parts of a city.

1.2 ENSIS/AirQUIS themes

There are three types of data that can be displayed on the map: shape themes, ENSIS themes and data set.

1.2.1 Shape Themes

The Shape Themes are themes that are not connected to data in the ENSIS database. Examples of shape themes may be coastlines, lakes, parks, borders, or anything that will make the map look better and be easier to understand. The user decides which shape themes to display by selecting from a list of available themes. The available themes may be different for different projects. This is organised through the User Manager.

1.2.2 ENSIS Themes

The ENSIS Themes are the GIS representation of the data in the ENSIS database, for example administrative regions, air pollution sources, road links, stations, receptor points. The user decides which themes to display by selecting from a list of all ENSIS themes. All ENSIS themes will be available for all projects, and may be shown on the map, provided they contain data.

1.2.3 Data Set

All data set in the database can be viewed on the map. This may be data distributed on administrative or user defined regions (region data set), data distributed in grids (field data set), data distributed on lines (line data set) or data distributed in points (point data set). The data set may have been entered into the database manually or by import, or the data set may be results of model calculations.

1.3 The AirQUIS components

AirQUIS consists of six components and makes use of an Oracle database. The system has integrated forms and maps developed in VisualBasic and MapObject (GIS):

- A manual data entering application,
- An on line monitoring system,
- A module for online data acquisition and quality control,
- A measurement data base for meteorology and air quality,
- A modern emission inventory data base with emission models,
- Numerical models for transport and dispersion in air of pollutants,
- A module for exposure estimates and population exposure assessment,
- Statistical treatment and graphical presentation of measurements and modelling results,

All objects described above are integrated in a map and menu oriented user-friendly interface with direct link to the databases for measurements, emissions, modelling results and presentation tools. Advanced import/export wizards allow the user to transfer data easily to and from the AirQUIS system

2 Input data for AirQUIS

2.1 The Air Emission Database

2.1.1 Type of Emissions

The sources of air pollution are divided in three categories.

1) Emissions from single activities of some size, like industries, energy production etc., that are linked to single stacks, are treated as point sources.
2) Emissions from road traffic are treated as line sources in the emission database.
3) Emissions from home heating, public and private services, agricultural activities etc., which cannot be represented as a point or line are treated as area sources. These may also be converted to grid.

Regardless of being point, line or area distributed, emission data can be retrieved either as direct emission data for different components, or as a set consisting of consumption data and emission factors for the components for different fuels and activity types. The emission data usually comes as yearly data, and a time factor is used to find the fraction of the yearly value that is valid for a specific period within the year.

2.1.2 Search Criteria for Emissions

The emission data is easily accessed through search for region, field, line or point data sets. The specific industry is accessed through search criteria such as emission type/consumption type. Road links properties may also be accessed and edited easily through search criteriaBy using the functionality search by

polygon/rectangle on geographical areas via the map, the user can find/edit information on emission sources.

2.1.3 Congruent with CORINAIR

The user defines the AirQUIS emission and consumption database structure. It has a hierarchical structure containing of different layers with inter relationships. In Norway, emission data is structured by the Norwegian Bureau of Statistics (SSB) and imported directly into AirQUIS by an efficient import wizard. The structure of the SSB is a simplified version of SNAP95.

2.1.4 Functions

The emission module can calculate all combinations of emissions in an area, such as total emissions of a component in selected areas or divided into source categories in a selected time period. The aggregation tool can also be used to obtain selected values such as maximum, minimum, average, sum and selected percentiles.

2.2 Air Emission Model

The air emission model combines emission, consumption and production from region and point sources with traffic emissions to calculate hourly emissions distributed in fields, lines and/or points. The results may be stored as field, line and/or point data set. Before running the model the emission scenario must be defined. Here the user decides which sources to include, in the use of source selection criteria, see table below.

Source type	Selection choice in scenario setting
Area	Region, consumption type, activity type, product or fuel type
Line	Region, ADT limit, road classes, vehicle classes, traffic factor set
Point	Region, point source, line of business, activity type and fuel

In addition to an air emissions scenario, a meteorology scenario has to be selected in order to handle temperature dependent emission data. It is, for this purpose, possible to use meteorological data from time periods different from the calculation period.

The different parameters and factors determining the emission is easily edited. This can be seen through the windows presented below:

2.3 Time Series Database

The data in the database are organised in data series (measurement time series). The data series are identified by a set of properties that describes the values. The averaging period is set by the data collecting system. The necessary properties to identify data series in the measurement database are given in the table:

Information	Properties describing the data series	Properties describing each value
Where are the measurements taken	Station, Measurement position	
Time step	Length of time step	
What is measured	Medium, Component (Parameter), Unit	
How is this measured	Instrument, Sampling method, Analysis	
When is this measured		From-time, To-time
What was the result		Value
Quality status of the measurements		Quality status flag, Exception flag

2.4 Digitalised Datasets

The AirQUIS system needs map themes to describe the characteristics of the area, such as topography, road co-ordinates, community boarders, local subareas (if any) and population distribution, either in subareas or buildings. Further needs of map themes are dependant on what to be presented and what kind of functionality the Client want. The format of the themes is as shape or ARC/INFO.

If the Client want to prepare or present digitalised data in MapInfo, Norgit will develop a module for direct conversion between MapInfo and shapes to obtain full flexibility between MapInfo and AirQUIS.

2.5 Climatological Database

All meteorological data are stored as time series. Climatological statistics can be achieved by the use of the statistical packages Windrose, Stabfreq and Metfreq presented under point 3. In this way joint frequency distribution of wind speed, wind direction and atmospheric stability can be calculated.

2.6 Database Solution

The database used in the AirQUIS system is the ORACLE relational database version 7.3.4 or higher on server.

2.7 Air Emission Model

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3 Applications

3.1 Air surveillance and management system

The software system AirQUIS has been adapted to meet the needs of different clients. The system normally includes data retrieval, databases, and data presentations, modelling and air quality management systems. A complete AirQUIS system is supplied according the client specifications.

This also provides the development of emission inventories, dispersion models and exposure assessment. Measurements of air quality and meteorology together with model results may be presented to evaluate the contribution from different sources to the air quality of the selected area. The system has been applied in this mode in Oslo, Sarpsborg/Fredrikstad and in the Telemark region in Norway, in Yantai, China in Botswana and is being developed for Haifa, Israel, Stockholm Sweden and for the Saudi Electric Co. in Saudi Arabia.

The system may present hourly, daily and monthly concentration distributions, as well as next-day predictions, forecasts and early warnings based upon population exposure. The user-friendly planning tool may, for example, estimate the change in air quality impact if a road is closed or transport composition and patterns are changed, or a factory reduces or changes its emissions.

3.2 Impact assessment

Regulatory risk assessment in air pollution management includes a consideration of hazard identification, exposure-response relationships, exposure assessment and quantitative risk characterization. Numerical models, which are part of the

AirQUIS system, may estimate the exposure of harmful pollution to human health, materials and the ecosystem.

Dose-relationships are being used to evaluate the impact and to perform a complete impact and damage assessment. For the environmental impact on buildings and building materials (Our Cultural Heritage) a sub module of AirQUIS, CorrCOST has been developed. The system was used in Norway to evaluate the economic impact of air pollution on building material in Oslo and in other areas of Norway. NILU is working in co-operation with other research institutes within the field of environmental impact assessment.

3.3 Cost-benefit analyses

The Cost-benefit analyses (CBA) are a highly interdisciplinary task. The CBA should provide a benefit-cost ratio based on monetarised costs and benefits, and be accompanied by a description of the non-monetarised items that also should be considered.

Monetary valuation of control actions, and of the effects on health and the environment, may be different in concept and vary substantially from country to country. NILU has conducted such CBA of possible measures for reducing the extent of pollution damage in several major urban areas in Asia. The World Bank project “URBAIR” was a forerunner for these analyses. All the various possible measures are cost estimated and put together in relation to calculated reductions in air pollution and the consequences for damage impact.

3.4 AQMS

An Air Quality Management and Planning System (AQMS) was established in the city of Guangzhou (6 mill. inhabitants) in South China. The core of the system was the GIS based AirQUIS system. The system is applied to develop action plans for air quality improvement in a cost-efficient manner. The project was a co-operation effort between the NORCE consortium of Norwegian institutes (with NILU as the leading institute) and research and municipal government institutions in Guangzhou. The nature of the project was "knowledge and tools transfer.

Appendix A

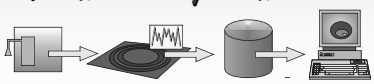
What is AirQUIS? - Overheads presented

What is AirQUIS

GIS based surveillance and planning tool

The air pollution part of ENSIS

ENvironmental Surveillance and Information System



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ENSIS developed:

- Sensors and monitors
- Data retrieval and quality control
- Statistical and numerical models
- Data presentation graphics
- Geographical information systems (GIS)

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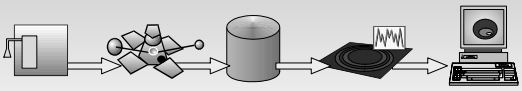
Integrated air pollution monitoring and planning



Sensor monitor → Data transfer → Data base → QA → Models → GIS

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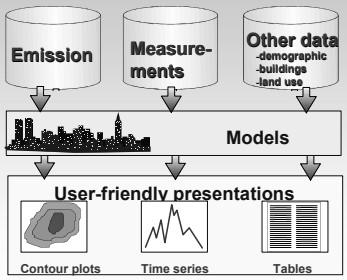
ENSIS For information and planning



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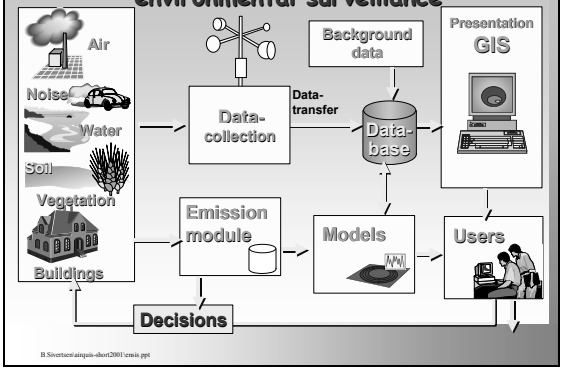
ENSIS A modern system for environmental surveillance



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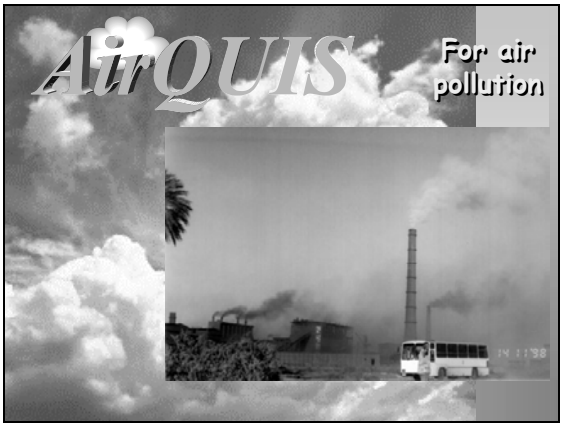
AirQUIS For air pollution



AirQUIS

6 modules

- Emissions
- Meteorology / wind
- Dispersion models
- Statistics
- Exposure
- GIS platform

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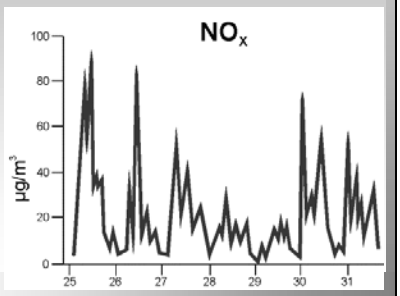
AirQUIS

Oslo

Measured concen-trations



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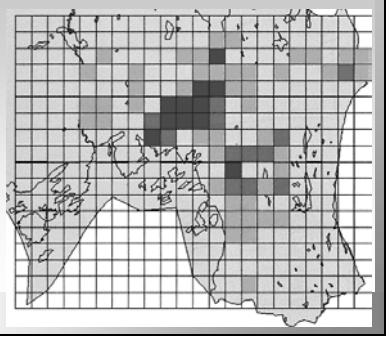
AirQUIS

Example from Oslo

Emission inventories
Based on consumption statistics



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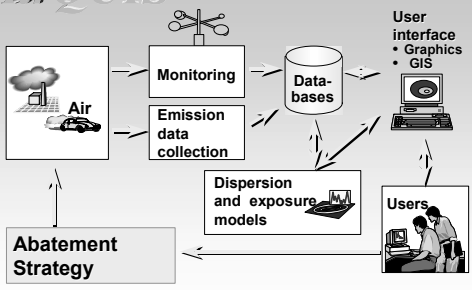
AirQUIS



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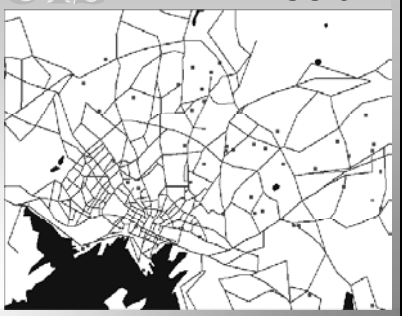
AirQUIS

Oslo

Emission inventory from traffic data



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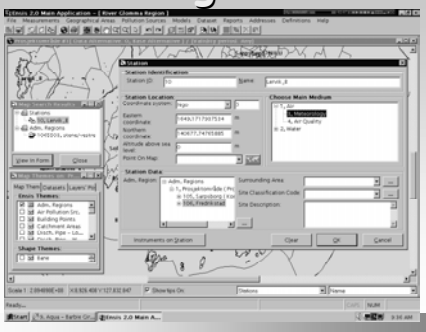
Monitoring station

GIS platform



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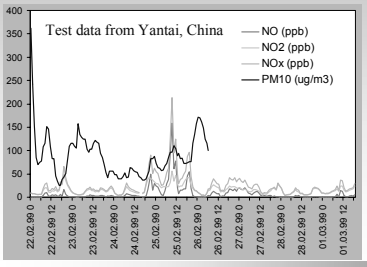
Automatic data acquisition system (ADACS)



Measurement data are transferred to the computer centre and automatically stored into the AirQUIS database

Or: manually imported

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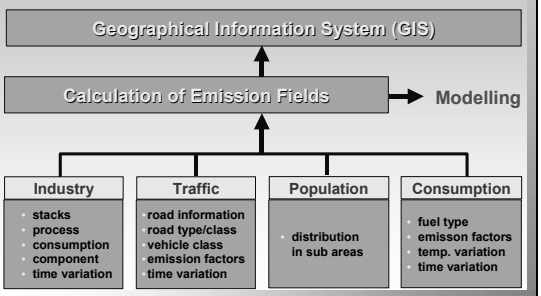
Emission Data Base



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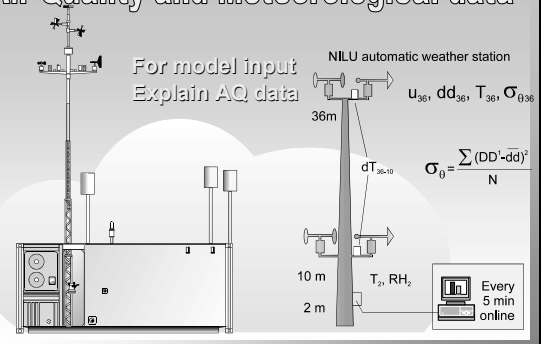
Air Quality and Meteorological data



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Models

AirQUIS

Wind
- Meteorological pre-processor
- Wind field models

Emission Model
- Traffic and stationary sources

Dispersion Models
- Urban scale grid model
- sub-grid point source model
- street and road models

Effect Models
- Population exposure
- Impact on materials and buildings

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Data bases

AirQUIS

- **Emission Inventory Database**
  - *Consumption*
  - *Production*
  - *Emission*
  - *Traffic*
  - *Activity classification*
  - *Emission factors*
- **Measurement Database**
  - *Air quality & meteorology*
  - *Stations & instruments*
  - *Measured time series and grab samples*

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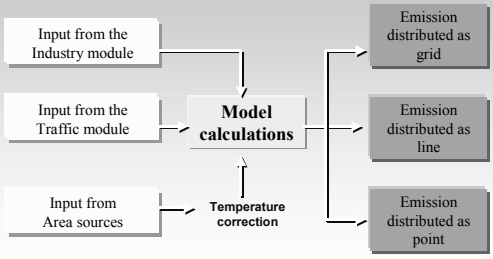
The Emission Model

AirQUIS



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Presentations

AirQUIS

Statistical and Graphical Presentation Tools
- Maxima, minima, averages
- Percentiles
- Cumulative frequency distribution
- Wind rose and meteorology frequency distributions

User Interface
- For viewing and editing data in all databases
- Integrating GIS

Automatic Data Acquisition System
Manual Data Acquisition System

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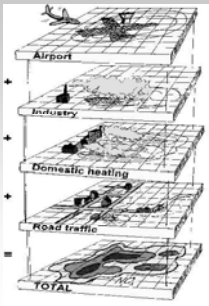
Dispersion modelling



- Spatial distribution of pollutant concentrations
- Source contribution quantification
- Effects of suggested measures
- Exposure Estimates
- Forecasting

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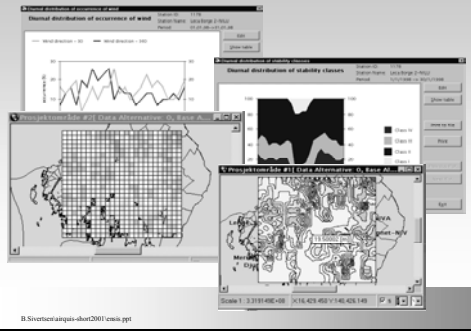
Data presentations



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Model calculations

AirQUIS

Oslo:

Seasonal average concentration of NO_2 ($\mu g/m^3$)

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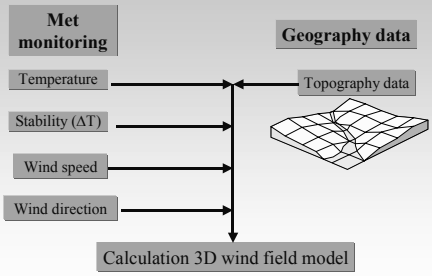
Wind field model



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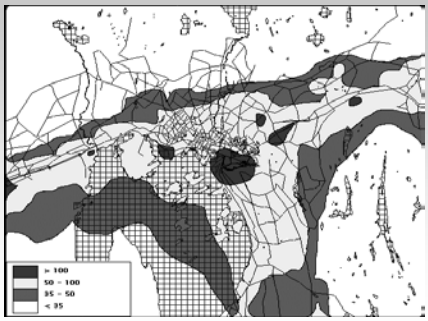
Forecasted concentrations in Oslo

NO_2 ($\mu g/m3$)

24h forward



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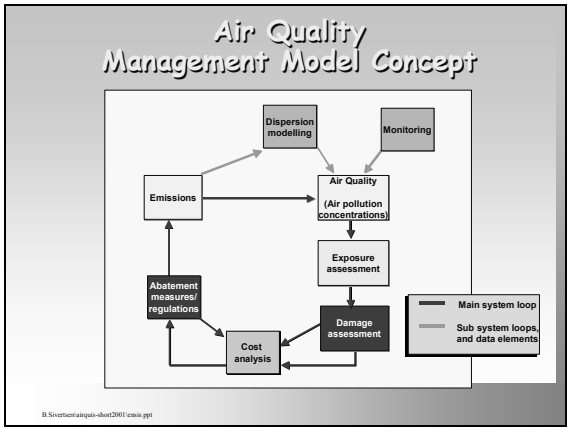
Air Quality
Management Model Concept
Dispersion modelling
Monitoring
Emissions
Air Quality
(Air pollution concentrations)
Exposure assessment
Abatement measures/ regulations
Damage assessment
Cost analysis
Main system loop
Sub system loops, and data elements
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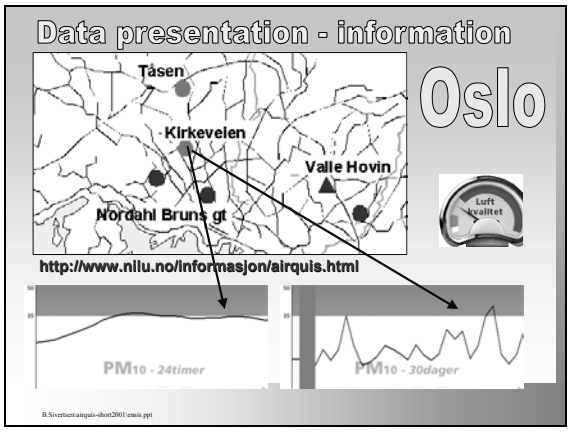
Data presentation - information
Tåsen
Kirkevelen
Valle Hovin
Nordahl Bruns gt
Oslo
Luft kvalitet
http://www.nilu.no/informasjon/airquis.html
PM10 - 24timer
PM10 - 30dager
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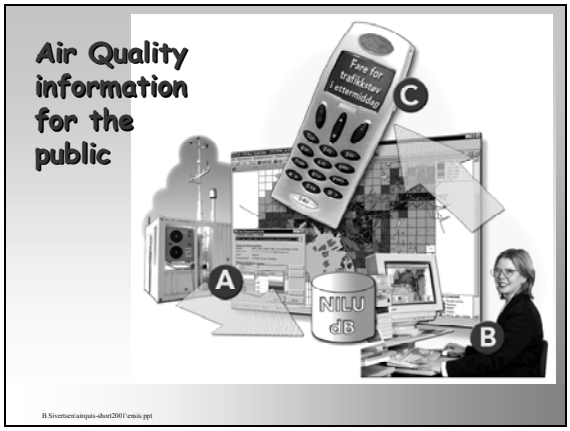
Air Quality information for the public
Fare for trafikkstøy i ettermiddag
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Appendix B

Input data for AirQUIS - Overheads presented

Assistance to Romania for transposition and implementation of the EU AQ Directives

Input data for AirQUIS

- Emissions and sources
- Air quality (background)
- Winds
- Stability/turbulence
- Climatology
- Population
- Topography

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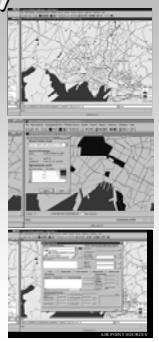
Emissions Inventory

Domestic emissions area sources (tables)

Traffic Line Sources (map)

Industry Point Sources (map)



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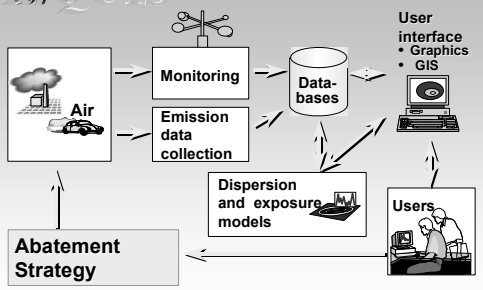
AirQUIS



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Emission data

to AirQUIS

Geographical Information System (GIS)

Point Sources	Line Sources	Area Sources
stacks process consumption component time variation	road information road type/class vehicle class emission factors time variation	fuel type emisson factors temp. variation time variation

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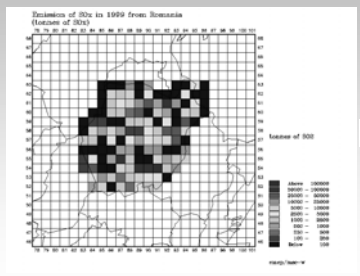
Emission data

- **Completeness:**
  All sources included
- **Consistent:**
  Same definitions applied by all countries.
  Appropriate and up-to-date emissions factors
- **Transparent:**
  Contains all information necessary
  to check how emission estimates are obtained.

B Sivertsen\AQMS\Romania2.ppt

Emission data from CORINAIR



Emissions by sector

⇩

Identify positions

⇩

Add traffic data

⇩

Estimate gridded emissions

B Sivertsen\AQMS\Romania2.ppt

Point sources, stack data

Industry ID	Stack ID	Stack name	Validity Period	X Co-ordinate	Y Co-ordinate	Height above Sea Level (m)	Stack height (m)	Inner Stack Diameter (m)	Outer Stack Diameter (m)	Gas Temp (C)	Gas Velocity (m/s)	Gas Flow Rate (m^3/s)	Building Height	Building Width
1	1001	Stack 1001	1970-2020	569110	6621355	5	10	0.30	0.60	200		0.058333	20	50
1	1002	Stack 1002	1970-2020	569110	6621355	10	10	0.32	0.62	230		0.166667	15	45
1	1003	Stack 1003	1970-2020	569110	6621355	5	11	0.55	0.85	220		0.305556	16	60
2	2001	Stack 2001	1970-2020	569371	6623222	20	17	1.00	1.30	220		2.944444	10	70
2	2002	Stack 2002	1970-2020	569509	6623416	33	20	0.60	0.90	220		1.472222	15	12
3	3001	Stack 3001	1970-2020	568934	6620650	44	68	0.45	0.75	220	15		17	10
4	4001	Stack 4001	1970-2020	568019	6623245	50	25	0.70	1.00	235	15		12	50
4	4002	Stack 4002	1970-2020	569176	6623410	6	10	1.00	1.30	200	15		16	30
5	5001	Stack 5001	1970-2020	566052	6623407	8	16	0.40	0.70	237		0.055556	7	40
6	6001	Stack 6001	1970-2020	566052	6623407	10	16	0.40	0.70	237		0.083056	16	50
7	7001	Stack 7001	1970-2020	569000	6623000	11	10	1.00	1.30	200	15		18	30
8	8001	Stack 8001	1970-2020	567495	6624047	30	16	0.50	0.80	200	15		19	40
9	9001	Stack 9001	1970-2020	569009	6622794	40	16	0.70	1.00	240		0.122778	14	80

Input data may be prepared by EPIs in pre-pepared excel sheets!

Emission factors (f)

- **From literature:**
  - check – boiler
  - – type of oil
  - – refinering
  - – raw material characteristics
  - – operating conditions
- **E.g.: SO_X**
  - – sulphur content in fuel
  - – sulphur retained in ashes
  - – control efficiency
  - – type of process

Point sources, stack data

CRT	Industry identification number	Stack name	Time of inventory	Validity Period	X Coord	Y Coord	High above sea level	Stack height (m)	Stack diameter (m)	Gas temp. (°C)	Gas velocity (m/s)	Gas Flow rate (m3/s)	SO2(t/y)	Nox	PM
	CET Grozavesti	Cos 1	1.02.2001	2000	425309	4921379	75	60	4,2	150	3,03	42,03	403,813	449,9768	40,47589
	CET Grozavesti	Cos 2	1.02.2001	2000	425309	4921379	75	55	3,2	170	4,06	56,2	377,137	302,0843	38,72528
	CET Grozavesti	Cos 3	1.02.2001	2000	425309	4921379	75	55	3,2	180	3,8	52,68	295,886	292,695	42,03853
	CET Grozavesti	Cos 4	1.02.2001	2000	425309	4921379	75	55	3,2	150	3,8	52,42	379,383	236,9694	32,87378
	CET Grozavesti	Cos 5	1.02.2001	2000	425309	4921379	75	55	3,2	150	3,41	47,3	211,935	328,2621	43,70777
	CET Grozavesti	Cos 6	1.02.2001	2000	425309	4921379	75	55	3,2	200	6,9	95,52	402,324	301,2173	35,81895
	CET Grozavesti	Cos 7	1.02.2001	2000	425309	4921379	75	55	3,2	200	9,83	136,1	495,624	1088,906	162,5047
28	CET Progresul	Cos 1	1.02.2001	2000	428607	4914197	75	230	9,5	125	2,01	142	3912,71	310,1892	32,81698
	CET Progresul	Cos 2	1.02.2001	2000	428607	4914197	75	30	3,2	160	4,8	38,71	223,808	1091,393	162,8945
	CET Progresul	Cos_3	1.02.2001	2000	428607	4914197	75	30	3,2	160	6,95	115,7	186,102	476,8836	53,77685

Traffic data

Define road links

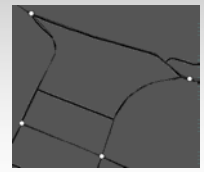
Digital maps

Point Sources in Bucharesti

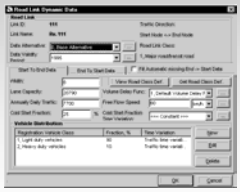
Line Distributed Data
Road Traffic

- Road Nodes & Sub - Nodes
- Road Link Geographical Definition
- Road Link Physical Properties
- Road Link Classification
- Traffic Volume and Distribution
- Traffic Flow Properties

On road links :
Collect traffic data
Traffic volume – dynamic data
- develop emission factors

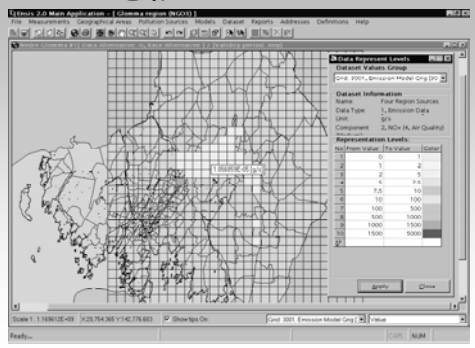


Road nodes

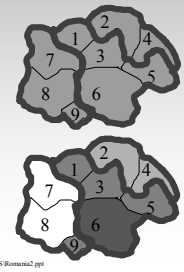


Input data prepared in excel sheets

Emission Model

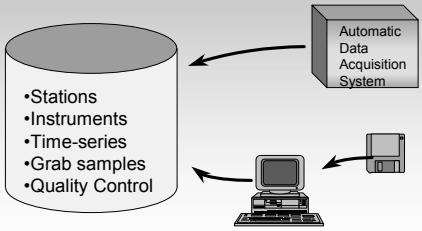


Area Distributed Data
-on Administrative Districts



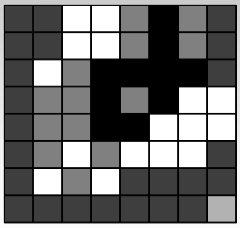
- **Administrative District Level Definition**
- **Administrative District Definition**
- **Data distributed on Administrative Districts:**
  - **Emissions**
  - **Consumption**
  - **Population**
  - **etc.**

Measurement Database



Manual Data Acquisition System

Area Distributed Data in Fields



A Field is a set of Data that are distributed in one of the defined Grids

Air Quality data

Information	Properties describing the data series	Properties describing each value
Where are the measurements taken	Station, Measurement position	
What is measured	Medium, Component (Parameter), Unit	
How is this measured	Instrument, Sampling method, Analysis	
When is this measured		From-time, To-time
What was the result		Value
Quality status of the measurements		Quality status flag, Exception flag

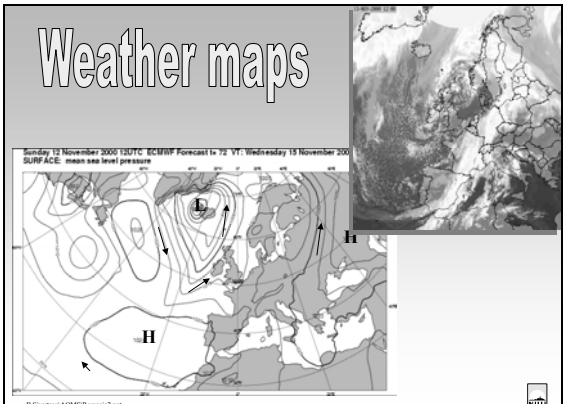
Input data

Recommended format:

Start Time (dd.mm.yyyy hh:mi)	End Time Time (dd.mm.yyyy hh:mi)	Wind Direction [deg], Station: Name	Wind Speed [m/s], Station: name	NO2 [ug/m³] Station: name	O3 [ug/m³], Station: name
02.01.2000 06:00	02.01.2000 07:00	194.2	4.5	26.8	9.4
02.01.2000 07:00	02.01.2000 08:00	190.5	5.3	23.8	20.5
02.01.2000 08:00	02.01.2000 09:00	187.3	5	12.8	40.7
02.01.2000 09:00	02.01.2000 10:00	172.9	3.7	10.7	44.4
02.01.2000 10:00	02.01.2000 11:00	185.5	3.2	11.1	44.4
02.01.2000 11:00	02.01.2000 12:00	222.7	5.2	6.1	49.9
02.01.2000 12:00	02.01.2000 13:00	243.5	3	6.3	48.1
02.01.2000 13:00	02.01.2000 14:00	284.2	4.5	4.8	57.3
02.01.2000 14:00	02.01.2000 15:00	281.4	3.4	9.5	51.8
02.01.2000 15:00	02.01.2000 16:00	267.2	4.1	9.5	55.4
02.01.2000 16:00	02.01.2000 17:00	267.7	4.5	5.4	61
02.01.2000 17:00	02.01.2000 18:00	270.9	6.1	10.5	53.6
02.01.2000 18:00	02.01.2000 19:00	288.3	4.2	7.3	55.4

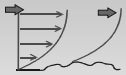
B Sivertsen\AQMS\Romania2.ppt

Weather maps



B Sivertsen\AQMS\Romania2.ppt

Meteorological data



- ✓ Wind direction (deg)
- ✓ Wind speed (m/s)
- ✓ Temperature (K)
- ✓ Vertical temp.gradient (deg)
- ✓ Turbulence
- ✓ Mixing heights
- ✓ Relative humidity (%)
- ✓ Precipitation (mm)
- ✓ Pressure (mb)

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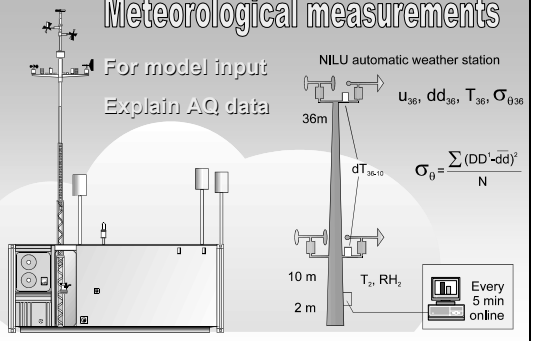
Meteorological measurements

For model input

Explain AQ data



B Sivertsen\AQMS\Romania2.ppt

Wind - Vântul

Wind generated at different scales
Generat la scări diferite:

- Scara sinoptica (harti meteo)
- Mezoscara (uscat/mare, munte/vale)
- Locala (dirijare, diferente de nivel, strazi, cladiri)
- Micro scara (turbulenta)

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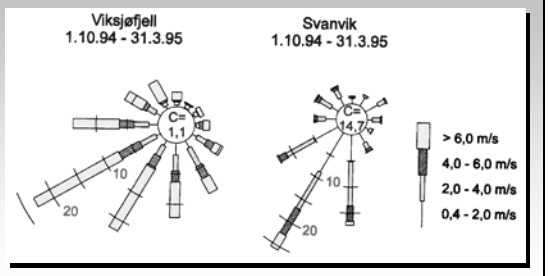
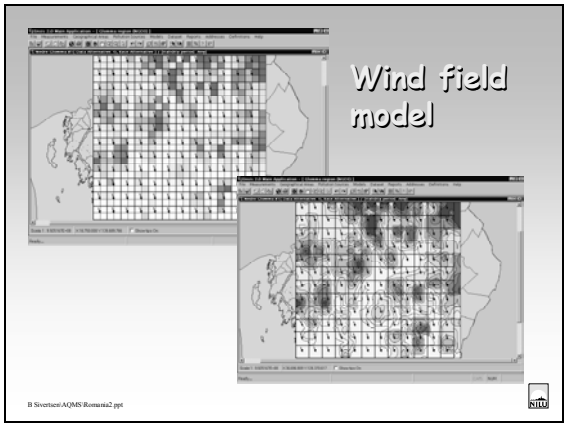
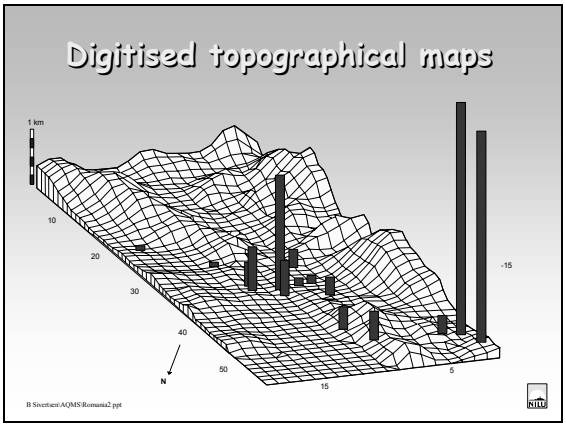
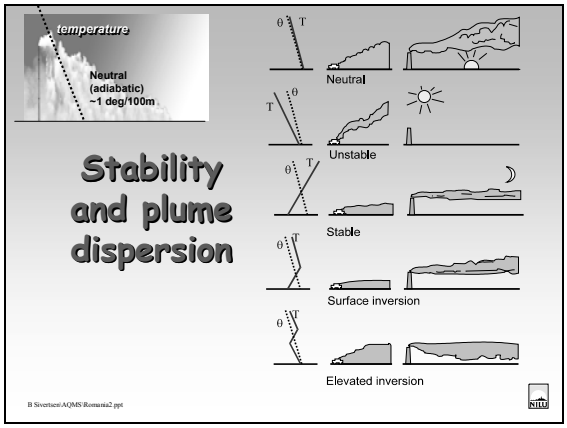
Wind roses

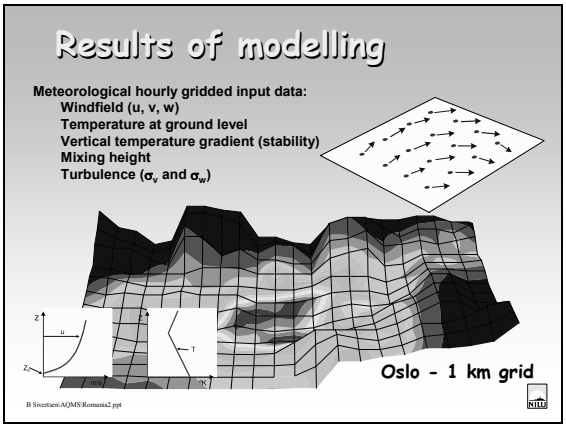


B Sivertsen\AQMS\Romania2.ppt

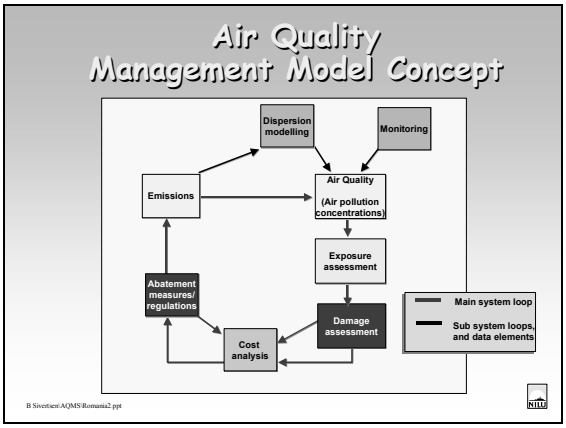

Wind field model
B Sivertsen\AQMS\Romania2.ppt
NILU


Digitised topographical maps
1 km
10
20
30
40
50
15
5
-15
N
B Sivertsen\AQMS\Romania2.ppt
NILU


temperature
Neutral
(adiabatic)
~1 deg/100m
Stability and plume dispersion
Neutral
Unstable
Stable
Surface inversion
Elevated inversion
B Sivertsen\AQMS\Romania2.ppt
NILU


Results of modelling
Meteorological hourly gridded input data:
Windfield (u, v, w)
Temperature at ground level
Vertical temperature gradient (stability)
Mixing height
Turbulence (σ_v and σ_w)
Oslo - 1 km grid
B Sivertsen\AQMS\Romania2.ppt
NILU


Night time surface inversion
Temp.
14 1'98
B Sivertsen\AQMS\Romania2.ppt
NILU


Air Quality Management Model Concept
Dispersion modelling
Monitoring
Emissions
Air Quality
(Air pollution concentrations)
Exposure assessment
Abatement measures/ regulations
Damage assessment
Cost analysis
Main system loop
Sub system loops, and data elements
B Sivertsen\AQMS\Romania2.ppt
NILU

Appendix C

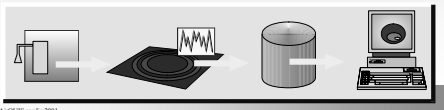
AirQUIS applications - Overheads presented

AirQUIS

In operation and planned

Applications in:

"Scandinavia
"Europe
"Middle east
"Asia (China)
"Africa



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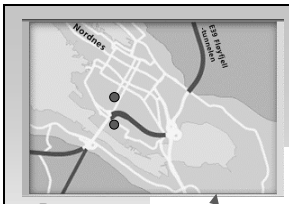
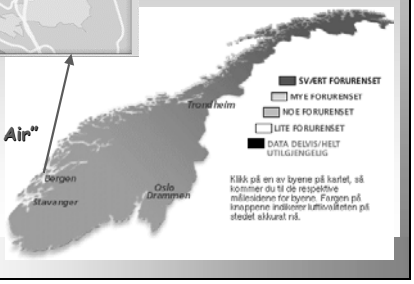
Norway

"Better City Air"



Bergen

"Better City Air" cities to report



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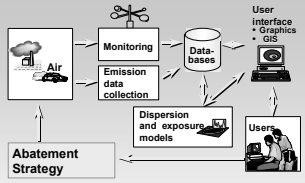
NILU AQM World wide

- China
- Haifa
- SaudiArabia
- Stockholm
- SouthAfrika
- HoChiMinhCity
- Emirates
- ++++



Assistance to Romania for Transposition and Implementation of the EU Ambient Air Quality Directives

- Environmental laws
- Preliminary assessment
- Air data, data base
- Air dispersion modelling
- AirQUIS GIS based platform

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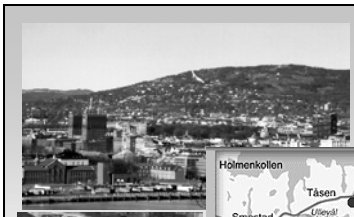
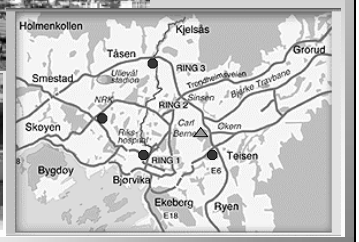
Oslo





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AirQUIS Applications

- Monitoring and data dissimination
- Environment impact assessment
- Surveillance and A.Q. management
- A.Q. forecasting and early warning
- Optimal abatement strategies
- A.Q. information systems

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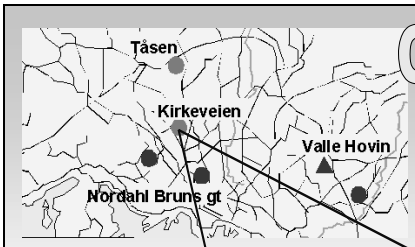
Oslo



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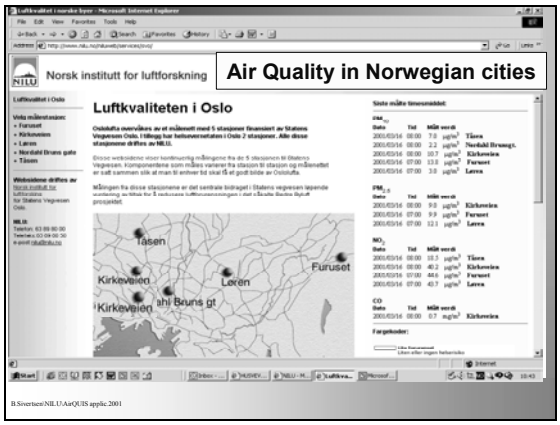
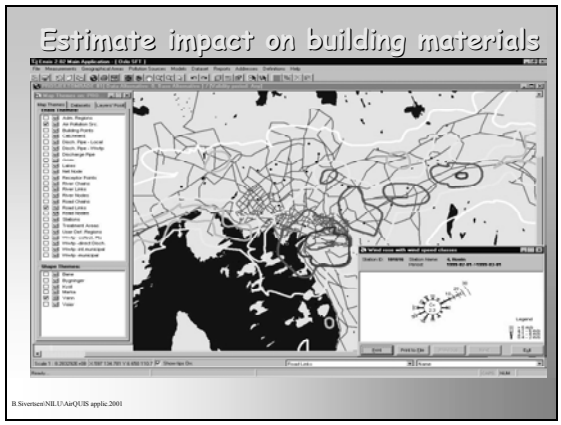
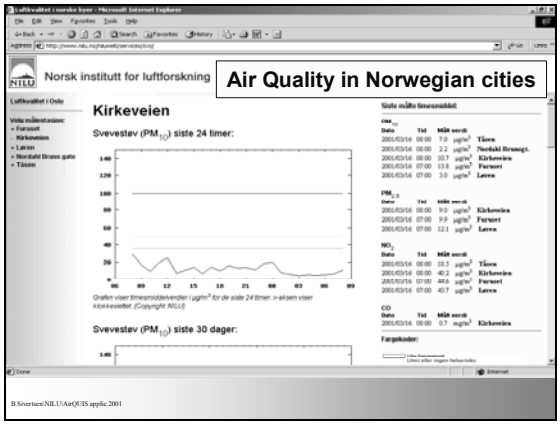
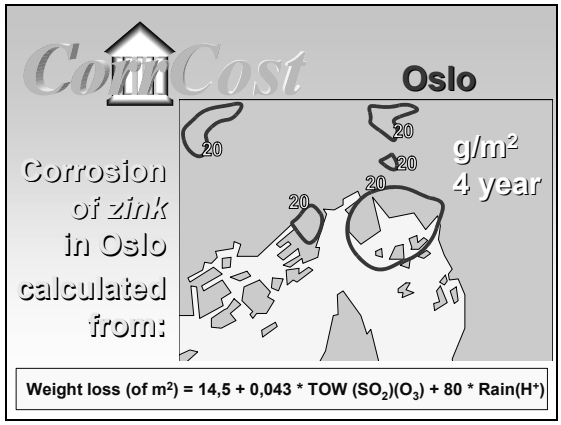
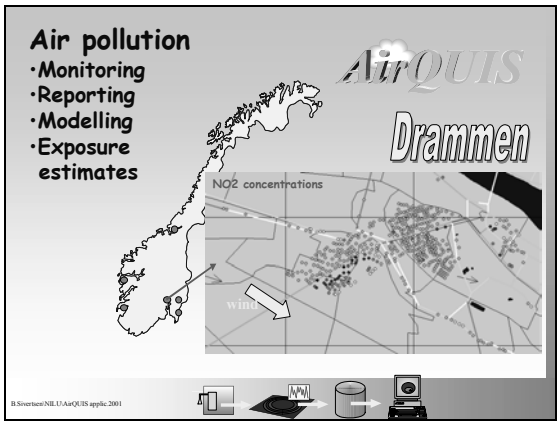
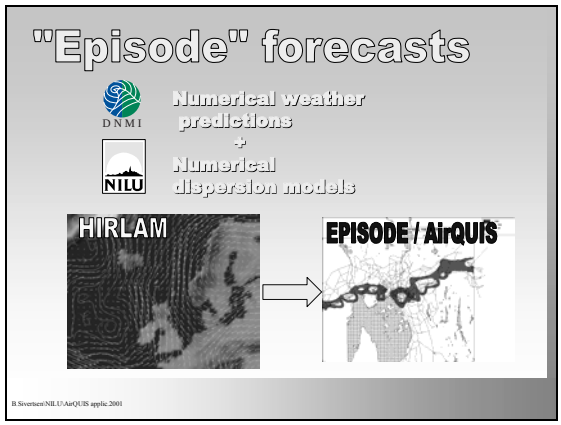

Norsk institutt for luftforskning
Air Quality in Norwegian cities
Luftkvaliteten i Oslo
Tåsen
Kirkeveien
Løren
Furuset
Kirkeveien
Jahn Bruns gt
B.Sivertsen\NILU\AirQUIS applic.2001


Estimate impact on building materials
B.Sivertsen\NILU\AirQUIS applic.2001


Norsk institutt for luftforskning
Air Quality in Norwegian cities
Kirkeveien
Svevestøv (PM10) siste 24 timer:
Svevestøv (PM10) siste 30 dager:
B.Sivertsen\NILU\AirQUIS applic.2001


ICP
Corr Cost
Oslo
Corrosion of zink in Oslo calculated from:
20
20
20
20
20
g/m2
4 year
Weight loss (of m2) = 14,5 + 0,043 * TOW (SO2)(O3) + 80 * Rain(H+)


Air pollution
·Monitoring
·Reporting
·Modelling
·Exposure estimates
AirQUIS
Drammen
NO2 concentrations
wind
B.Sivertsen\NILU\AirQUIS applic.2001


"Episode" forecasts
DNMI
Numerical weather predictions
+
NILU
Numerical dispersion models
HIRLAM
EPISODE / AirQUIS
B.Sivertsen\NILU\AirQUIS applic.2001

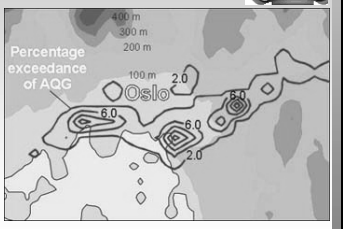
Measures to reduce air pollution

Oslo

Immediate action:
PM_{10} > 100 µg/m3
> 20 000 persons
forecasted 24h ahead

Reduce speed < 60 km/h

NO2 conc. > 200 µg/m3
cars older than 1989
prohibited 0900-2100

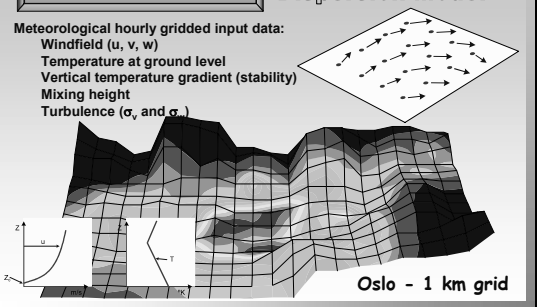


B.Sivertsen\NILU\AirQUIS applic.2001

EPISODE

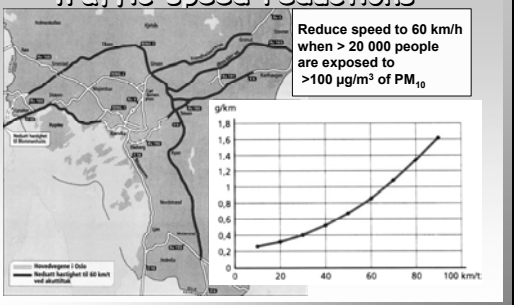
The Numerical Dispersion Model

Meteorological hourly gridded input data:
Windfield (u, v, w)
Temperature at ground level
Vertical temperature gradient (stability)
Mixing height
Turbulence (σ_v and σ_w)



B.Sivertsen\NILU\AirQUIS applic.2001

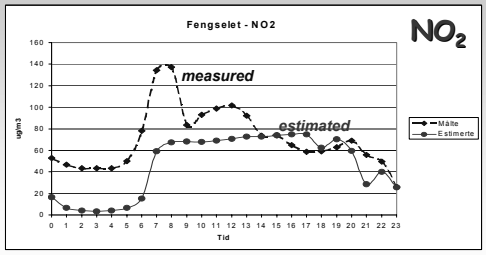
Immediate Action on traffic speed reductions



B.Sivertsen\NILU\AirQUIS applic.2001

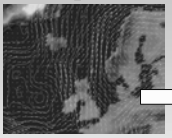
Model evaluation, Bergen

19 November 1998 , 00-23:00 hrs

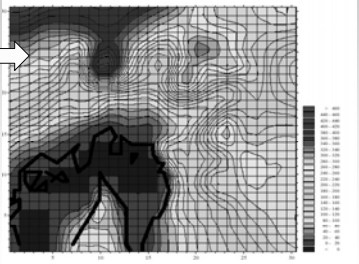


B.Sivertsen\NILU\AirQUIS applic.2001

Air pollution forecast models



Figur A2. Topografi benyttet i MM5 for 1 km området. Kystlinjen er hentet fra annet datasett.



HIRLAM 50
(Weather forecast
50 - 10 km grid)

Mesoscale
PSU/NCAR
MM5 model
1 km grid sacale

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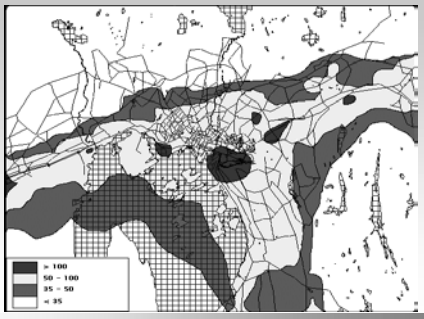
Forecasted concentrations in Oslo

NO_2
(µg/m3)

24h
forward



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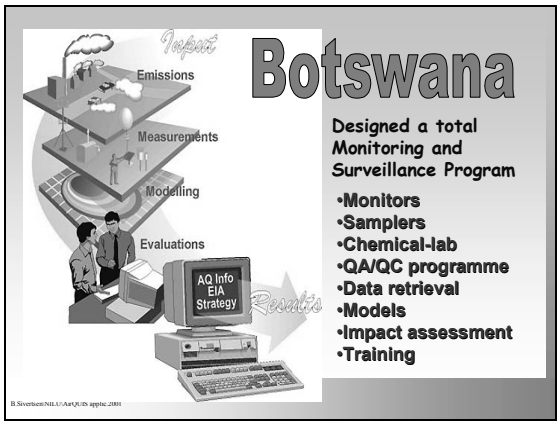
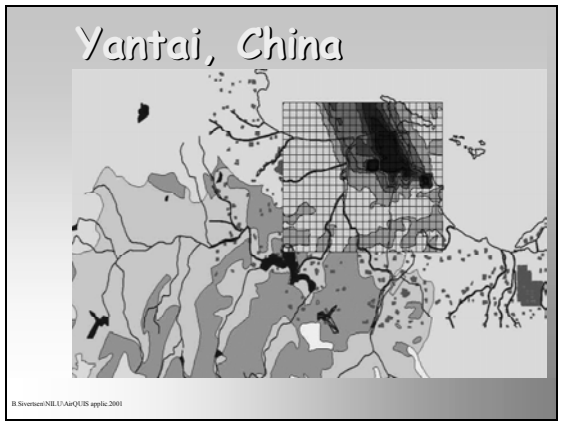
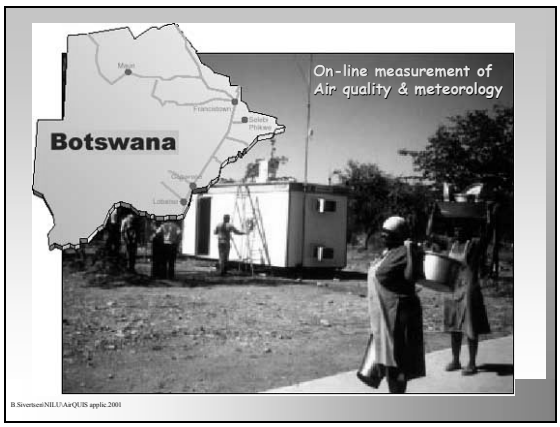
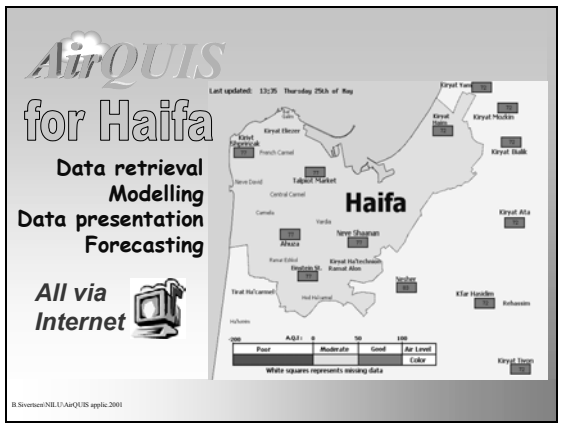
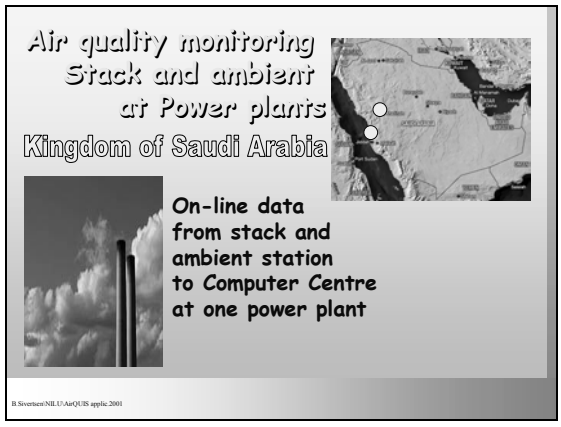

Input
Emissions
Measurements
Modelling
Evaluations
AQ Info
EIA
Strategy
Results
Botswana
Designed a total Monitoring and Surveillance Program
•Monitors
•Samplers
•Chemical-lab
•QA/QC programme
•Data retrieval
•Models
•Impact assessment
•Training
B.Sivertsen\NILU\AirQUIS applic.2001


Yantai, China
B.Sivertsen\NILU\AirQUIS applic.2001


Botswana
On-line measurement of
Air quality & meteorology
B.Sivertsen\NILU\AirQUIS applic.2001


AirQUIS
for Haifa
Data retrieval
Modelling
Data presentation
Forecasting
All via
Internet
Haifa
B.Sivertsen\NILU\AirQUIS applic.2001


Mongolia
China
Korea
India
Yantai, China
Goal and objectives for the project:
• Develop and establish an environmental management and planning system; "Environmental Surveillance and Information System" (ENSIS) forYantai,
• evaluate, update and improve the air and water monitoring system by additional measurements,
• transfer tools and knowledge including QA/QC and training
B.Sivertsen\NILU\AirQUIS applic.2001


Air quality monitoring
Stack and ambient
at Power plants
Kingdom of Saudi Arabia
On-line data
from stack and
ambient station
to Computer Centre
at one power plant
B.Sivertsen\NILU\AirQUIS applic.2001

Air quality monitoring programme for the Kingdom of Saudi Arabia

Objectives:
1. Develop and establish GIS based on-line AQ monitoring and planning system for the Kingdom
2. Evaluate need for new monitoring sites – install operate and train

Development of Air Quality Management Strategy

Assessment
- Sources
- Monitor
- Exposure
- Source - exposure
- Contributions to exposure
- Damage

Control
- Control options
- Cost - benefit
- Control strategy
- Investment plan

Surveillance
- Develop institutions
- AQ Information System

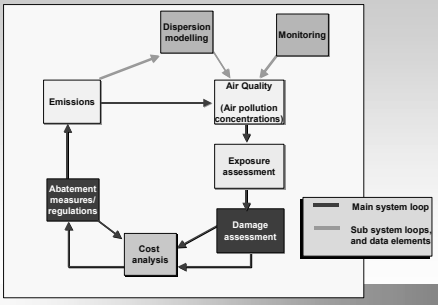
HoChiMinh City

Environmental Improvement Project

- NORAD funded 800 000 USD (+Danida+ADB)
- by DOSTE (Dept of Science, Techn. & Env.)
- Danida 4 monitoring sites
- NORAD 6 monitoring sites
- Adaption, Training & Operations

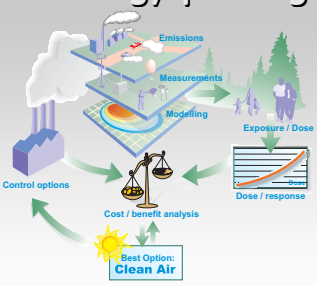
Capacity building
Reference laboratory
Training
Abatement strategies

Air Quality Management Model Concept

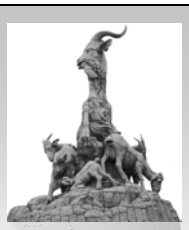


Abatement strategy planning

Main objective: Identify actions to improve air quality

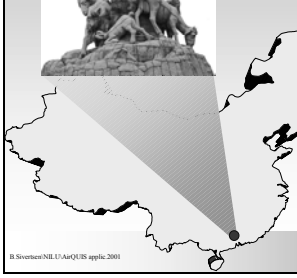


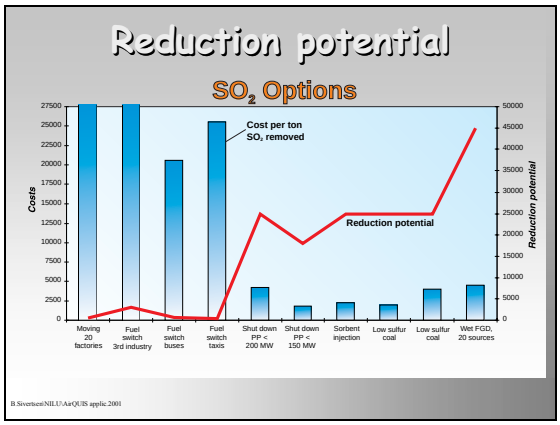
most cost-effective options

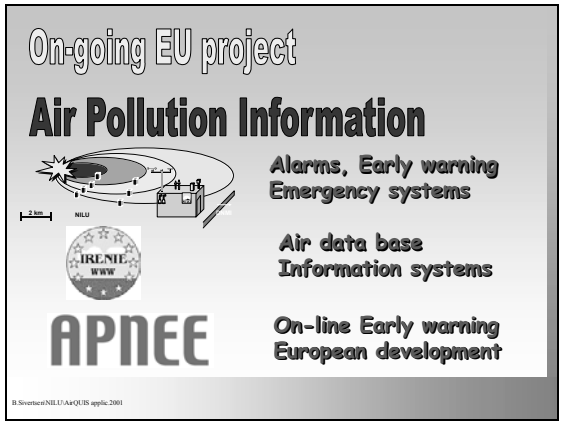


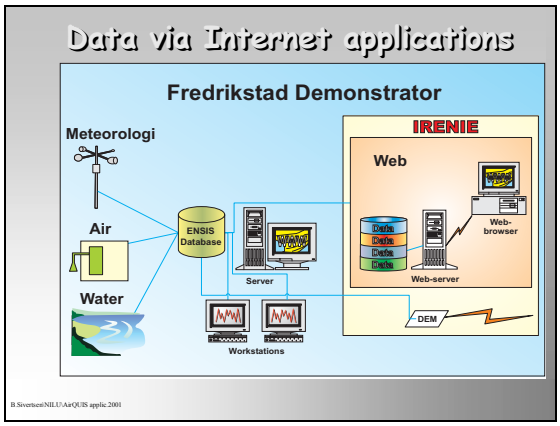
Guangzhou, China

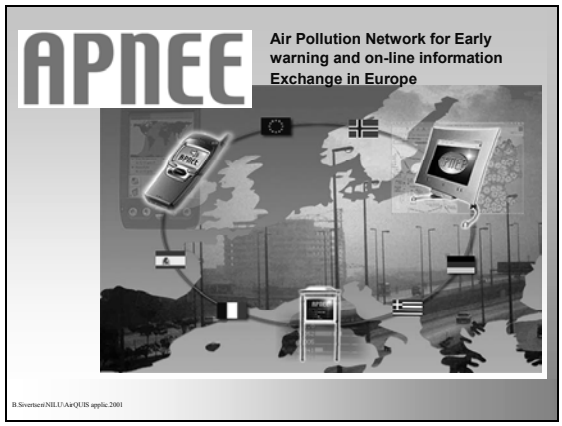
Air Quality management and Planning System

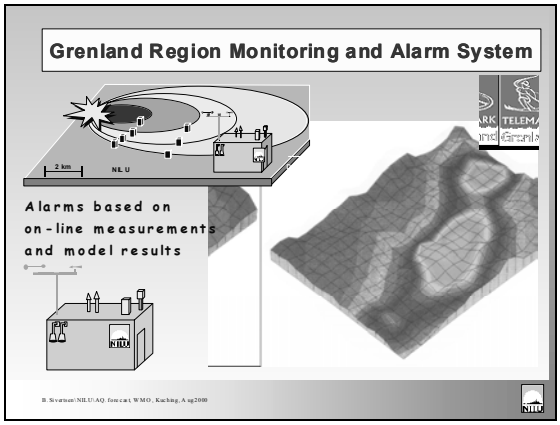


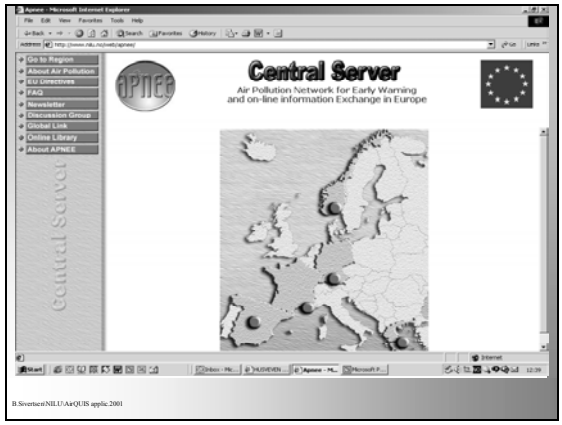

Reduction potential
SO2 Options
Cost per ton SO2 removed
Reduction potential
Costs
Reduction potential
Moving 20 factories
Fuel switch 3rd industry
Fuel switch buses
Fuel switch taxis
Shut down PP < 200 MW
Shut down PP < 150 MW
Sorbent injection
Low sulfur coal
Low sulfur coal
Wet FGD, 20 sources
B.Sivertsen\NILU\AirQUIS applic.2001


On-going EU project
Air Pollution Information
Alarms, Early warning
Emergency systems
Air data base
Information systems
On-line Early warning
European development
APNEE
IRENIE
2 km
NILU
B.Sivertsen\NILU\AirQUIS applic.2001


Data via Internet applications
Fredrikstad Demonstrator
Meteorologi
Air
Water
ENSIS Database
Server
IRENIE
Web
Web-browser
Web-server
DEM
Workstations
B.Sivertsen\NILU\AirQUIS applic.2001


APNEE
Air Pollution Network for Early warning and on-line information Exchange in Europe
B.Sivertsen\NILU\AirQUIS applic.2001


Grenland Region Monitoring and Alarm System
2 km
NILU
Alarms based on
on-line measurements
and model results
B. Sivertsen\NILU\AQ forecast, WMO, Kuching, Aug2000


Central Server
Air Pollution Network for Early Warning
and on-line information Exchange in Europe
Central Server
B.Sivertsen\NILU\AirQUIS applic.2001

ENSIS

AirQUIS

Received

The European IT Prize

1999

B.Sivertsen/NILU/AirQUIS applic.2001