

Endbericht

Projekt Nr.: 808994

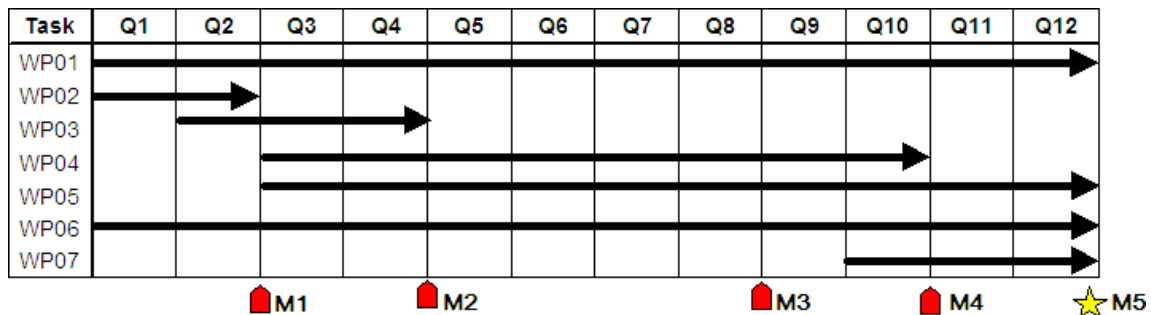
Stichtag des Berichts: 31.10.2006

1. Technischer Endbericht:

1.1. Arbeiten

Die Arbeiten in WEBAIR konnten weitgehend nach Plan abgewickelt werden, und das zweite Projektjahr wurde wie vorgesehen durchgeführt. Nach wie vor gibt es Verzögerungen bei Projektpartnern in Marokko und der Türkei: in beiden Fällen ist WEBAIR das einzige zur Zeit laufende EUREKA project, in Marokko darüberhinaus überhaupt das erste EUREKA Projekt, sodass die nationale Koordinationsstelle erst langsam die notwendigen Verfahren entwickelt. Grundsätzlich ist die Unterstützung Marokkos aber gesichert, ein entsprechendes Fax des *Ministere de l'Education Nationale de l'Enseignement Supérieur, de la Formation des cadres et de la Recherche Scientifique, Royaume de Maroc*, liegt vor. Ebenso sind neue Anwendungen bzw. Fallstudien in der Türkei in Vorbereitung, und zwar sowohl für eine Gruppe von Industriebetrieben in Aliaga (nördlich von Izmir) als auch für die Stadt Istanbul (mit 12,000,000 Einwohnern), womit sowohl industrielle als auch MegaCity Probleme abgedeckt werden können. Darüberhinaus konnten im Rahmen einer Präsentation des Projektes bei der NACA 2006 (National Association for Clean Air) in East London, RSA, das Interesse mehrerer südafrikanischer Institutionen bzw. Firmen an einer Kooperation geweckt werden. Ein Demonstrationsprojekt für den Raum Tshwane (Pretoria) und Johannesburg wurde als weiteres Anwendungsbeispiel begonnen.

Die durchgeführten Aufgaben im zweiten Projektjahr (Q5 bis Q8 des dreijährigen Arbeitsplanes) beinhalten Arbeiten in den Paketen WP1 (Internationale Projektkoordination), WP 4 (Entwicklung, Integration), WP5 (Testphase) und WP6 (begleitende Dokumentation). Gegenüber dem ursprünglichen Arbeits- und Terminplan gab es keine grundsätzlichen Änderungen; allerdings werden Arbeiten aus WP2 (Konzeption, Benutzeranforderungen) teilweise weitergeführt, um die Beiträge und Anregungen der internationalen Partner entsprechend zu berücksichtigen.



1.2. Ergebnisse

Dem Arbeitsplan entsprechend konnten folgende Ergebnisse erzielt werden:

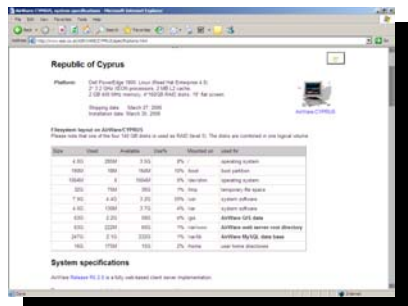
WP1, Projektkoordination:

- Zur Koordination wurden eine Mailingliste (webair@ess.co.at) und eine Homepage für das Projekt eingerichtet: <http://www.ess.co.at/WEBAIR>
- Über den Projekt Web Server sind auch mehrere on-line Demonstrationssysteme sowie das aktuelle Entwicklungssystem mit den jeweiligen on-line user manuals erreichbar;
- Als weiteres Koordinationswerkzeug wurde ein web basiertes on-line interaktives *problem reporting and tracking tool* mit Datenbankunterstützung eingerichtet: <http://80.120.147.30/TOOLS/BUGDB/> (siehe auch WP 5, Testphase)



WP2, Konzeption:

- Erstellen des Pflichtenheftes wurde grundsätzlich im ersten Projektjahr abgeschlossen; allerdings entstehen aus den neuen Anwendungsbeispielen auch neue Anforderungen, die eine entsprechende Weiterführung des Pflichtenheftes erfordern.
- Die Spezifikationen wurden bzw. werden als integrierter Bestandteil des on-line Benutzerhandbuches in HTML implementiert; dazu wird das ursprüngliche Benutzerhandbuch schrittweise auf die neue web-basierte Version erweitert : <http://www.ess.co.at/MANUALS/AIRWARE>
- Eine kurze zusammenfassende Darstellung des momentanen Funktionsumfanges ist in dem angeschlossenen Dokument unter 1.4 Beilagen: AirWare Release 5.3 zu finden.



WP3, Schnittstellendefinition:

Diese wurde im letzten Zwischenbericht (May 2006) ausführlich beschrieben. Wesentliche Erweiterungen haben sich aus der Verwendung globaler numerischer Wettervorhersagen (GFS, NCAR, NOAA) ergeben, die als dynamische Randbedingungen bzw. Anfangsbedingungen für regelmäßige

(tägliche) Simulationsläufe des nicht-hydrostatischen Meteorologischen Vorhersagemodells MM5 (PSU/NCAR mesoscale model) verwendet werden.

Das unten angeführte Codebeispiel für die Region östliches Mittelmeer/Cypern beschreibt den Mechanismus des ftp Datentransfers (alle 24 Stunden cron Mechanismus) des *Global Forecast System (GFS)* vom web server http://nomad5.ncep.noaa.gov/ncep_data/index.html mit einer Auflösung von ca. 0.5 Grad, alle 6 Stunden, d.h 5 Datensätze von je 26MB für jede 24 Stunden Vorhersage. Das zugrundeliegende Modellsystem ist unter <http://www.emc.ncep.noaa.gov/modelinfo/index.html> beschrieben.

```
#!/bin/sh

LISTFILE="listfile.txt"
A="http://nomad5.ncep.noaa.gov/cgi-bin/ftp2u_gfs.sh?\
file=gfs.t12z.pgrbf12&\
file=gfs.t12z.pgrbf18&\
file=gfs.t12z.pgrbf24&\
file=gfs.t12z.pgrbf30&\
file=gfs.t12z.pgrbf36&\
wildcard=&\
all_lev=on&\
all_var=on&\
subregion=&\
leftlon=18&\
rightlon=50&\
toplat=45&\
bottomlat=25&\
results=SAVE&\
rtime=1hr&\
machine=80.120.142.110&\
user=anonymous&\
passwd=&\
ftpdir=%2Fincoming_1hr&\
prefix=&\
dir="

wget -q -t 5 -O $LISTFILE $A

# Determine the list of files
FILES=`grep ftp $LISTFILE | awk -F "" '{print $2}'|grep gfs`
# Count number of files
NFILES=`echo $FILES|wc -w`
# Get the name of the directory where the data are stored
HTTPDIR=`grep http $LISTFILE | awk -F "" '{print $2}'|grep ftp_data`
# Get the files one-by-one
for file in $FILES; do
    localfile=`echo $file | awk -F / '{print $NF}'`
```


WP4, Entwicklung und Integration:

Der momentane Entwicklungsstand ist in mehreren on-line demo Installationen über den Projekt Web Server frei zugänglich.

Der Funktionsumfang ist unter 1.4 Beilagen beschrieben.

WP5: Testphase

Für die fortlaufende Testphase wurden neben Daten aus Helsinki in Zusammenarbeit mit FMI, Finnland, und aus Zypern (mehrere Modelle sowohl für die gesamte Insel als auch mehrere Stadtgebiete) in Zusammenarbeit mit ATLANTIS Cyprus) verwendet. Darüberhinaus wurden einzelne Demoszenarien für einzelne Modelle für den Raum Izmir (Türkei), Casablanca (Marokko) und Tshwane (Pretoria, Republik Südafrika) implementiert. Alle Testdatensätze und Prototypen sind über die Projekt Home-page <http://www.ess.co.at/WEBAIR> erreichbar.

Für die systematische Erfassung und Auswertung aller Probleme bei der Benutzung der Pilotsysteme über das Internet wurde ein ebenfalls Web-basiertes *problem reporting and tracking* System eingerichtet.

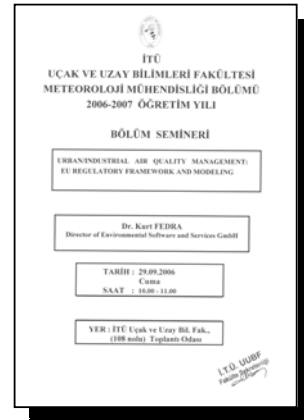
Das System ist datenbankgestützt und erfordert Benutzername and Passwort; Die einzelnen Berichte können nach unterschiedlichen Kriterien sortiert und ausgewählt werden.

Zu den einzelnen Berichten werden Kommentare und Antworten gespeichert und chronologisch dargestellt. Jeder Eintrag wird automatisch an alle in der jeweiligen Verteilerliste Angeführten per e-mail (SMTP) versandt.



WP6, Dokumentation:

Die begleitende Dokumentation ist als on-line Benutzerhandbuch bzw. Reference Manual voll in das System integriert, als HTML Seiten implementiert. Daneben wurden Vorträge bei internationalen Konferenzen bzw. Arbeitstreffen mit prospektiven Projektpartnern gehalten, etwa an der Technischen Universität Istanbul (ITU, September 2006), oder auf der NACA 2006 in East London, SRA (October 2006).

**1.3. Zusammenfassung - Resüme**

Die Arbeiten in WEBAIR konnten weitgehend nach Plan und termingerecht im zweiten Projektjahr wie vorgesehen durchgeführt werden. Lediglich Verschiebungen beim Arbeitsbeginn der internationalen Projektpartner haben zu Verschiebungen im Arbeitspaket WP2, sowie zur teilweisen Verwendung alternativer Testdaten aus mehreren Vorläuferprojekten bezüglich der Entwicklung von Demonstrationsprototypen (für die Partner bzw. als Demos über das Internet zugänglich) geführt: <http://www.ess.co.at/WEBAIR>. Dies konnte aber mit der Anwendung für die Republik Zypern (Labor Inspectorate, Ministry for Labor and Social Insurance) und die damit verbundenen Daten und detaillierten Benutzeranforderungen mehr als kompensiert werden.

Die technische Entwicklung der Komponenten für das web basierte System mit allen wichtigen Funktionen eines Basisystems konnte wie geplant durchgeführt werden und bildet eine solide Basis für den endgültigen Ausbau und die Evaluierung im dritten Projektjahr.

1.4. Beilagen

AirWare <http://www.ess.co.at/AIRWARE>

is a modular, fully interactive and web based



Air Quality Assessment and Management Information System

for national, regional and local, optionally nested application domains. AirWare integrates emission inventories, monitoring data management and analysis, simulation and optimization models, scenario analysis and real-time modeling and regular, automatic forecasting, a public information system component and reporting on regulatory compliance. The system is designed to support European Environmental Directives such as 96/62/EC, 1999/30/CE, 2000/69/CE, or similar national legislation.

AirWare was developed in a number of EU sponsored RTD and EUREKA projects, Including, in chronological order:

- ECOSIM (Environmental Telematics): <http://www.ess.co.at/ECOSIM>
- MUTATE, distance learning: <http://www.ess.co.at/MUTATE>
- AIR-EIA, INFO 2000: <http://www.ess.co.at/AIR-EIA>
- ISIREMM, INCO Copernicus; <http://www.ess.co.at/ISIREMM>
- SUTRA, EESD, City of Tomorrow; <http://www.ess.co.at/SUTRA>
- AIDAIR, EUREKA E! 1388 EUROENVIRON <http://www.ess.co.at/AIDAIR>
- WEBAIR, EUREKA E! 3266 <http://www.ess.co.at/WEBAIR>, funded in part by the Austrian Research Foundation FFG under PNr. 808994.

The latest, currently active and open for new partners international project is WEBAIR, an approved, active (A status) EUREKA project, E! 3266.

WEBAIR addresses urban and industrial air quality assessment and management

<http://www.ess.co.at/WEBAIR> with emphasis on:

1. Internet based applications for easy access, distributed client-server implementation for efficiently shared high-performance computing resources, direct linkage of multiple applications and users/institutions in support of eGovernment initiatives and oriented towards the support of EU environmental Directives, public environmental information system;
2. Real-time aspects, regular forecasting to hourly now-casting with data assimilation (integrating and exploiting existing monitoring networks)
3. Advanced 3D dynamic nested grid models including a nonhydrostatic meteorological forecasting model (MM5), photochemistry (ozone) and PM10/2.5 (CAMx) covering national, regional, and local scales consistently, implemented on high performance computing platforms



System components and functions

AirWare is implemented as a web based client-server system. Client access uses any standard web browser. The primary menu page includes:

- Basic navigation buttons with logout (leads to a new login as an alternative users including system administrator), exit, and help
- A block of links (text strings) to the scheduled forecasting and nowcasting model results
- The main menu, icons for
 - Left column: data bases (general object data base, monitoring data and time series, embedded GIS and MapCatalog, Emission inventory)
 - Right column: model interfaces for scenario analysis
- A final block of text links for system administration functions.



Help pages and on-line manual

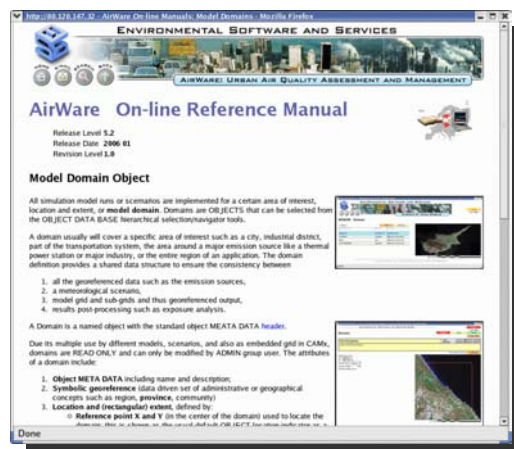
All screens include a green HELP button that leads to a context dependent help and explain page from the on-line user manual.

From the start page, the links lead to the Table of Contents of the on-line user and reference manual system. This table of contents in turn leads to a description of the main menu and its functions.



The individual help pages describe the corresponding functionality, include links to related topics and pages, and all lead back to the Table of Content through the icon in the upper right corner under the title.

The manual pages include numerous screen dumps to illustrate the textual explanations of the corresponding pages. The manual pages combine tutorial components of a user manual with the background and theory of a reference manual.



Scheduled functions

AirWare includes any number of scheduled, automatically executed tasks and functions. These are run either based on a set of entries for the Linux operating

Systems **cron** function in the corresponding **crontab** files, or through the RTXPS real-time expert system that provides rule-based conditional control over the execution of all scheduled tasks.

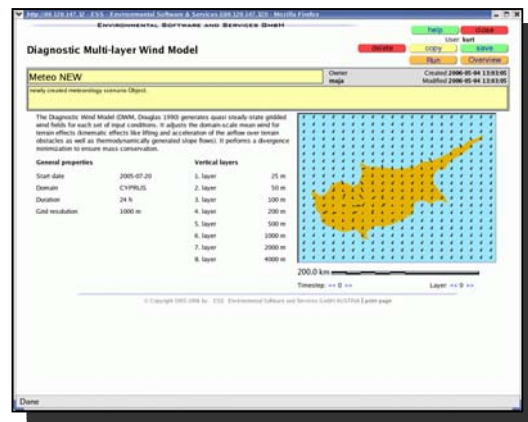
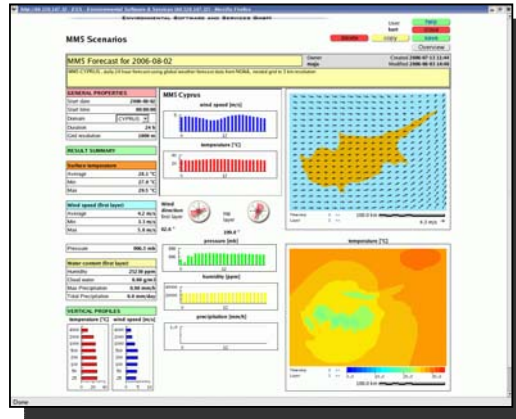
Default schedule includes:

- Daily forecast runs (MM5 or DWM, CAMx, AERMOD, PBM)
 - Hourly now-cast runs (CAMx, AERMOD)
 - Daily data management (several utilities)

Forecast and Nowcast runs

The daily forecasting runs can be configured for 24 or 48 hours duration. They include:

- OPTIONAL: Daily data import from global weather forecast models (optional)
- Daily run of MM5 for the entire domain, down to 3 km resolution;
- Interpolation of MM5 results for CAMx down to 1 km resolution
- ALTERNATIVE: Daily and hourly runs of the 3D DWM diagnostic wind field model for appropriate weather data time series at minimally one or more monitoring stations including an upper atmosphere data set (geostrophic wind)
- CAMx for the entire domain and any nested sub-domains; the model can be run for NO_x, SO₂, PM_x, and ozone
- PBM for all sub-domains (ozone)



The nowcast runs are executed every hour. They use real-time meteorology if available, or the corresponding hourly data from the forecast runs. For the hourly runs of CAMx, the initial conditions are taken from the previous hourly run. The hourly runs include:

- AERMOD, all subdomains, NO_x, SO₂.
- CAMx, master domain and all nested domains: SO₂, NO_x, PM_x, ozone

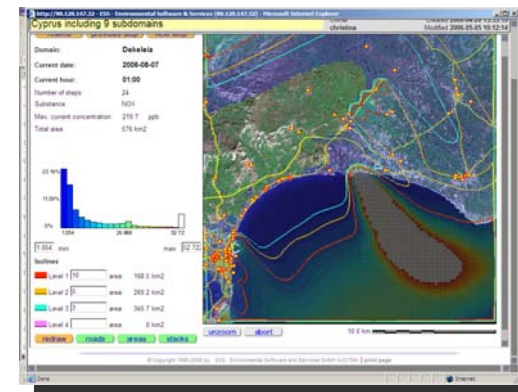
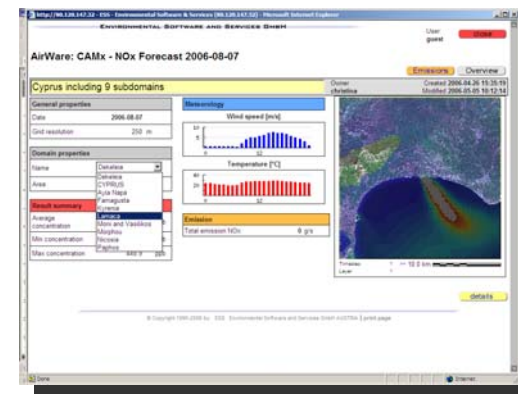
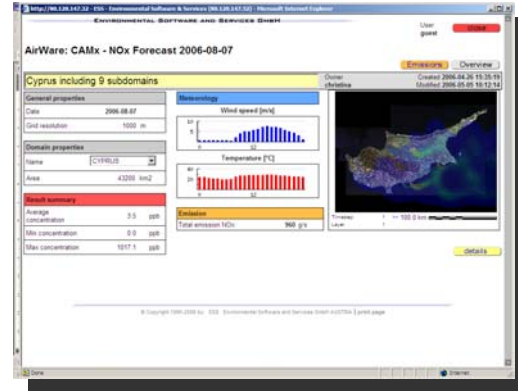
Where air quality data are available in real time, they can be used for data assimilation of the nowcast runs.

CAMx The **C**omprehensive **A**ir quality **M**odel with **e**xtensions (CAMx) is an Eulerian photochemical dispersion model that allows for an integrated *one-atmosphere* assessment of gaseous and particulate air pollution (ozone, PM-2.5, PM-10, air toxics, mercury) over many scales ranging from sub-urban to continental.

CAMx is designed to unify all of the technical features required of state-of-the-science air quality models into a single system that is computationally efficient, easy to use, and publicly available. The model code has a highly modular and well documented structure which eases the insertion of new or alternate algorithms and features.

CAMx simulates the emission, dispersion, chemical reaction, and removal of pollutants in the troposphere by solving the pollutant continuity equation for each chemical species on a system of nested three-dimensional grids. The Eulerian continuity equation describes the time dependency of the average species concentration within each grid cell volume as a sum of all of the physical and chemical processes operating on that volume.

The governing equations are expressed mathematically in terrain-following height (z) coordinates. It considers a horizontal wind vector, net vertical entrainment rate, multiple vertical layers, atmospheric density, and turbulent exchange (or diffusion). The terms on the right-hand side represents horizontal advection, net resolved vertical transport across an arbitrary space- and time-varying height grid, and sub-grid scale turbulent diffusion. Chemistry is treated by simultaneously solving a set of reaction equations defined from specific chemical mechanisms. Pollutant removal includes both dry surface uptake (deposition) and wet scavenging by liquid precipitation (rain).



AERMOD represents the latest of EPA's regulatory dispersion models, derived from the ISC family of models. AERMOD represents a fundamental change from the familiar PG approach to one based on more current planetary boundary layer (PBL) parameterizations. The PG curves are based exclusively on short-range dispersion from ground-level sources. However, ISC2 applications are not limited to low-level short-range situations. For example, ISC2 is routinely used to estimate concentrations from large buoyant elevated sources.

AERMOD currently contains new or improved algorithms for:

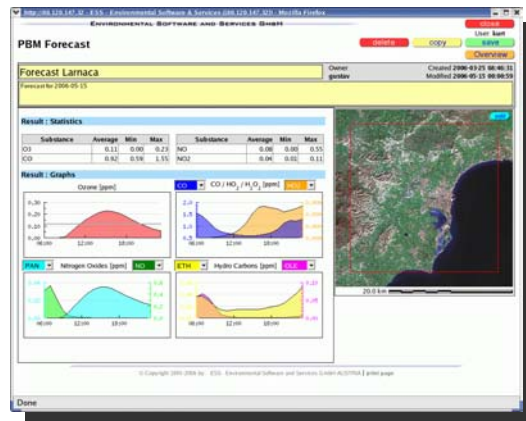
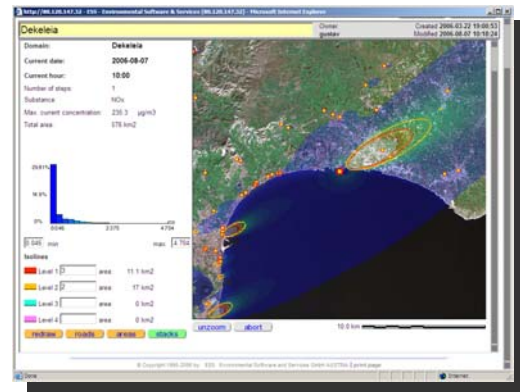
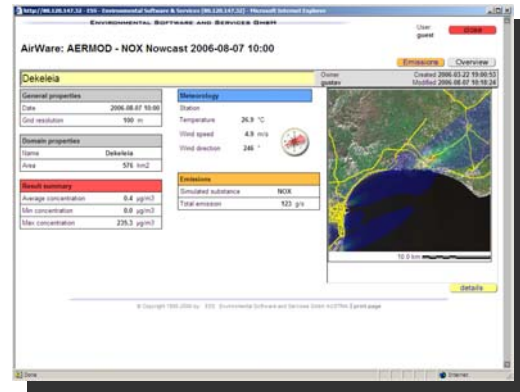
- dispersion in both the convective and stable boundary layers;
- plume rise, buoyancy, and penetration into elevated inversions;
- treatment of elevated, near-surface, and surface level sources;
- computing vertical profiles of wind, turbulence, and temperature;
- treatment of receptors on all terrain (from the surface up to and above the plume height).

AERMOD uses the AERMET meteorological pre-processor and AERMAP terrain corrections. Emissions are extracted from the emission data base automatically (point sources and gridded area/line sources).

PBM: Photochemical Box Model

PBM is a simple numerical air quality model that simulates photochemical smog at an urban scale. The model has been developed by the US EPA, Atmospheric Modeling Branch, Meteorology and Assessment Division, at Research Triangle Park, North Carolina. PBM is also one of the set of models in the AirWare air quality management information system.

The Photochemical Box Model is a stationary single-cell model with a variable height designed to provide volume-integrated hour averages of [03 \(ozone\)](#) and other photochemical smog pollutants of interest for an urban area for a single day of simulation.



PBM is best suited to treat low wind conditions, in presence of sun light. [Data requirements](#) for the PBM include meteorology, air quality, and emission data. The urban area is represented by one or a set of cells, within which chemical reactions are computed in particular to evaluate the concentrations of hydrocarbons and [ozone](#). It may deal with point, line and area sources. The pollutants considered are basically nitrogen oxides and hydrocarbons. The PBM is most appropriate for typical ozone episodes: for application in air stagnation conditions with light and variable winds (generally under 2 m/s). Horizontal dimensions of the box are typically on the order of 10-50 km; the vertical dimension may vary between 0.1 and 2 km. The depth of the mixed layer, or depth of the PBM domain, also follows a diurnal pattern; it can be optionally specified as following a non-linear growth curve.

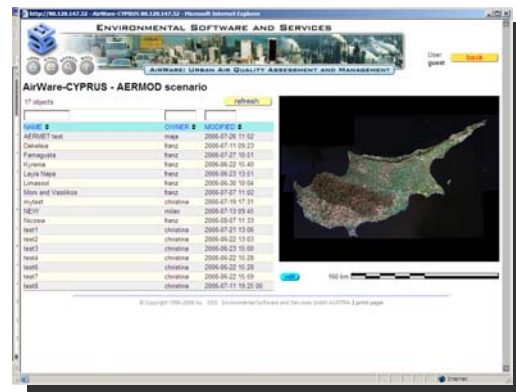
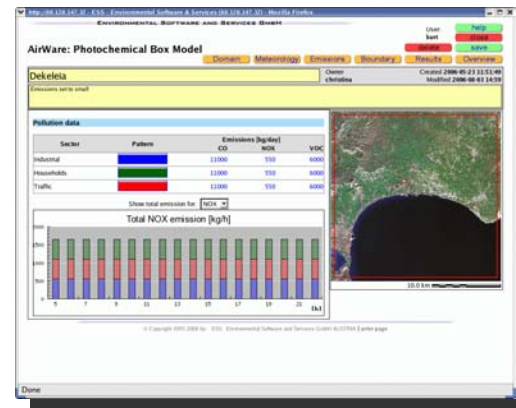
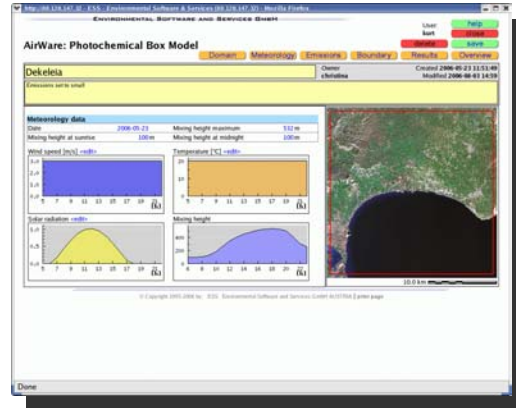
PBM is run once a day (midnight) for the next day or interactively for one day at a time (18 hours, 05:00 to 23:00).

Model scenarios

All the models used for the scheduled hourly and daily runs are also available for interactive scenario analysis. All model scenarios are organised by OBJECT selectors that support their sorting, filtering, selection, and the creation of new scenarios.

For scenarios, the user can select:

- The model domain (selecting from the set of model domains defined, or possibly creating a new domain if required);
- The data and period (hour) depending on the temporal resolution of the model;
- The meteorological conditions by selecting a representative meteorological monitoring station for the Diagnostic Wind field Model DWM (alternatively, historical data for an MM5 run can be downloaded and used; however, to generate a meteorological scenario by MM5 may take several hours.
- The pollutant and corresponding emission values: while these are (as readily available default values) provided automatically from the emission data base, for a scenario run of any model the emission data are organised into an emission scenario, that makes it possible to modify the basic values by



switching on or scaling individual sources for the scenario, or introduce new sources.

- Temporal emission patterns:
 - monthly
 - daily
 - hourly

scaling factors applied to the average emission values.

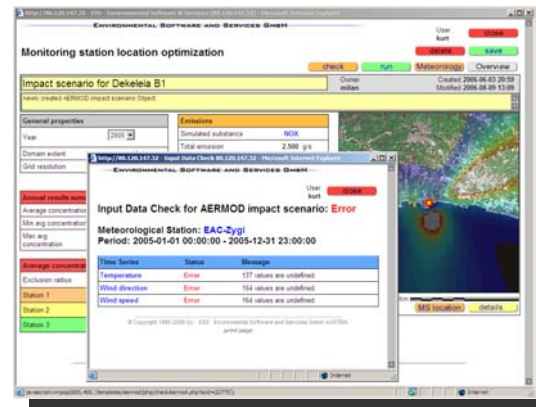
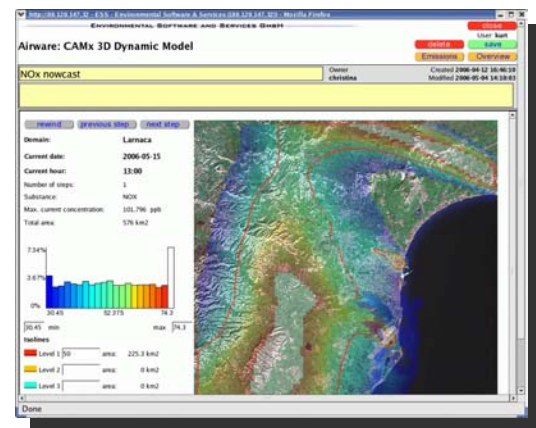
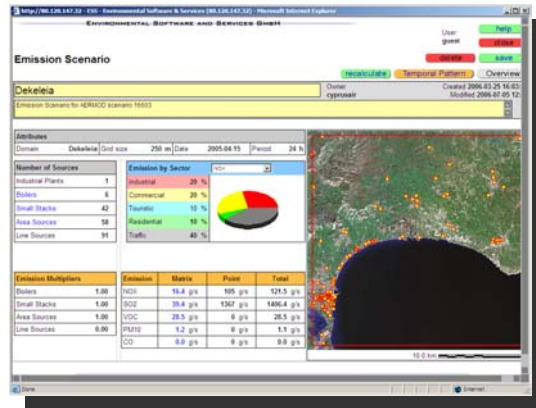
Model output is shown as a transparent colour coded overlay over the default map for the model domain.

The user can specify the parameters for the colour coding (minimum and maximum concentrations), and up to five levels of colour coded isolines.

Arbitrary multi-level zooming is supported,

Additional features going beyond the basic set of models used for the forecast and nowcast runs include:

- A high-resolution convolution model for traffic (line) sources;
- A Multi-PUFF model using 3D wind fields for short, transient emission conditions such as accidental releases or emission mobile sources
- A separate tool to locate monitoring stations for major point sources based on a long-term (annual) model run on an hourly basis (8,760 runs).
- A checking functions for the model scenarios, that ensures a complete meteorological and non-zero emission scenario. For the long-term annual model runs, missing data up to four consecutive hours can be patched automatically. If longer gaps are found in the input data, the model run will be aborted and another input data set (monitoring station and or year) has to be selected.



Locating monitoring stations

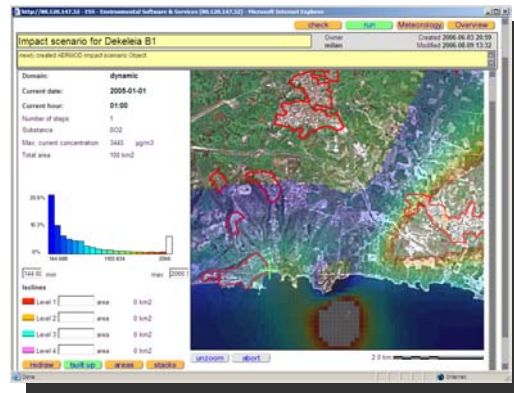
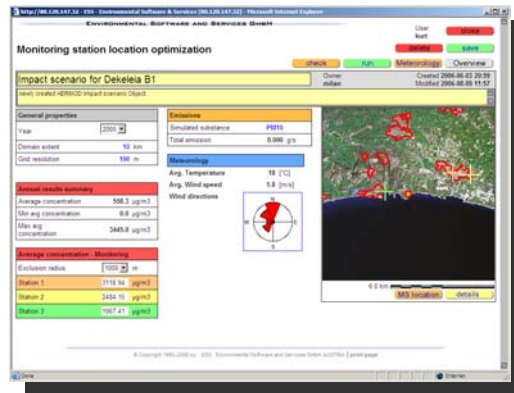
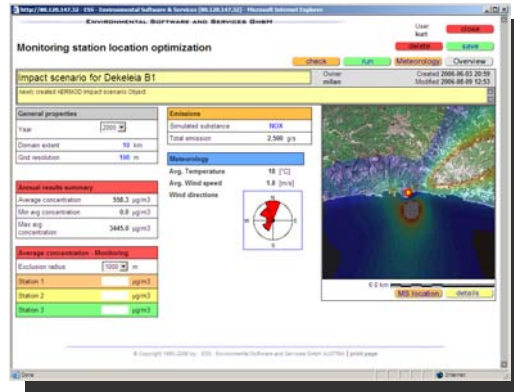
For the location of monitoring stations, the model calculates annual average concentration for a user defined pollutant.

For a user defined

- pollutant (SO₂, NO_x, or PM₁₀)
- domain and resolution,
- period (calendar year) and meteorological scenario (selection of monitoring station)

the resulting ambient concentrations are used to find the locations of maximum annual average over populated areas (as defined by the corresponding thematic map overlay and a set of user defined receptor areas).

AERMOD is run for 8,760 hours, either for a conservative buoyant gas, or for particulates (PM₁₀) including settling/deposition estimates. Up to three locations (indicated by colour coded crosses) with an exclusion radius around them can be identified together with their annual average concentrations for the pollutant selected.



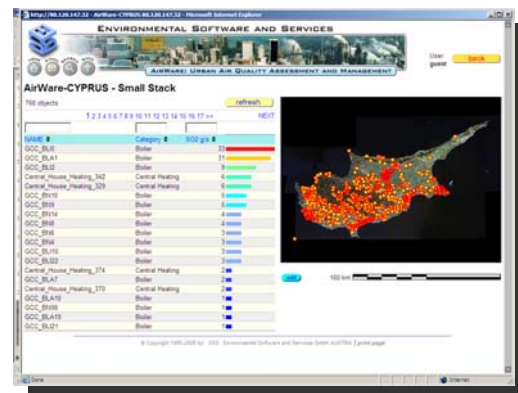
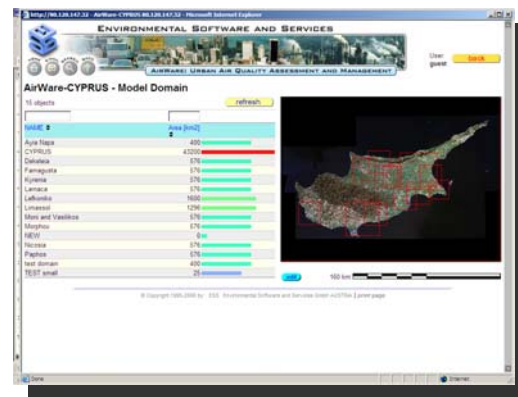
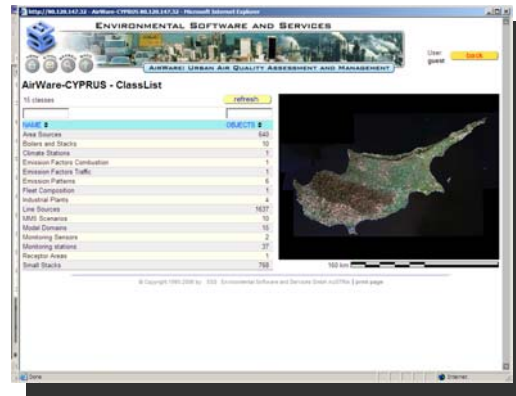
Data Bases

AirWare maintains a set of coordinated OBJECT data bases.

The primary entry and selection mechanism is an object class selector.

The following OBJECT CLASSES are supported (in alphabetical order):

- Area sources
- Boilers and stacks
- Climate stations
- Emission Factors: Combustion
- Emission Factors: Traffic
- Emission Patterns
- Fleet Composition
- Industrial Plants
- Line Sources
- MM5 Scenarios
- Model Domains
- Monitoring Sensors
- Monitoring Stations
- Receptor Areas
- Small Stacks.



Each object class leads to a selector that shows all instances within the class; The listing of all objects can be sorted and filtered by any or all of the attributes shown on the listing, with the possibility to toggle the sorting in ascending or descending order. Standard attributes include the name and major descriptive attributes together with an optional last modification date.

Numerical attributes can be indicated with a colour coded proportional horizontal bar, and georeferenced objects like emission sources are shown on the parallel map.

An edit button under the map leads to the MapCatalog, and supports the selection of an alternative default background map for this OBJECT class. The background map can be configured with the MapComposition tool, and the selection at the CLASS level can be overloaded at the level of individual OBJECTS.

Area sources

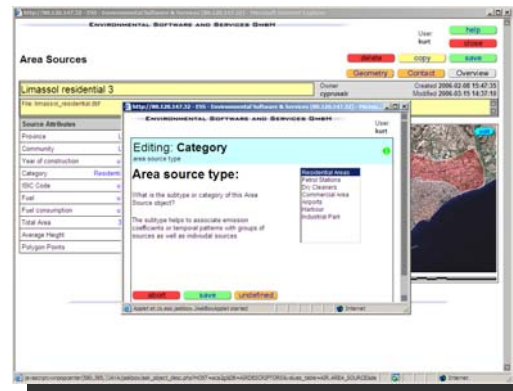
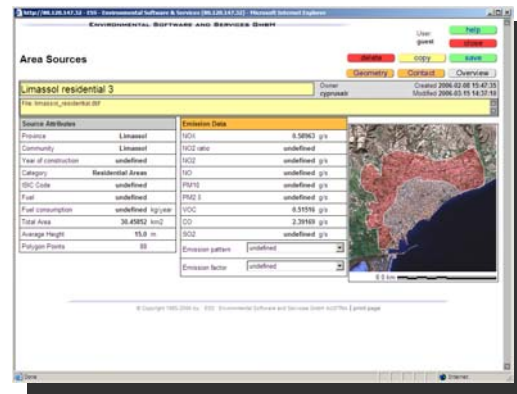
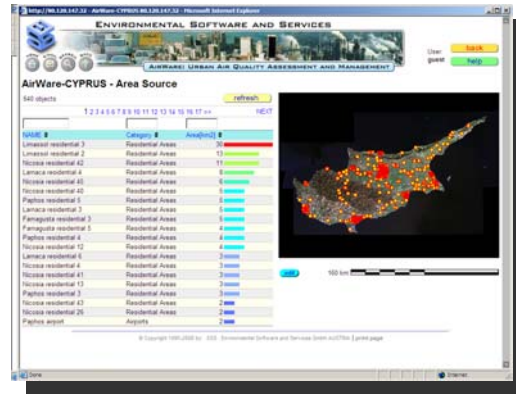
Area sources represent all emissions that are not associated with an individual stack or a line source (road segment).

An area source is characterised by its name, META data describing the source of the information on the emission source, the source geometry (a polygon that the user can import as a ArcView Shape file), and the emission data for the list of pollutants defined in the respective descriptor from the system's knowledge base. The default set of pollutants includes:

CO, NO, NO2, NO/NO2 ration, NOx
SO2, PM-10, PM2.5, VOC.

Source attributes include:

- Location, shape, symbolic address e.g., province and community
- Year of construction if applicable
- Link to a contact address (e.g., for operators of industrial areas, large buildings, airports, etc.)
- Category and industrial/source classification (e.g., ISIC)
- Average emission height
- Fuel type
- Annual fuel consumption
- Emission pattern (over time)
- Emission factors (relating fuel to substance specific emissions)



Boilers and Stacks, Industrial Plants

Boilers and stacks represent major elevated point sources.

They can be grouped into Industrial Plants. Plants have an associated contact address for the owner/operator responsible for the installation.

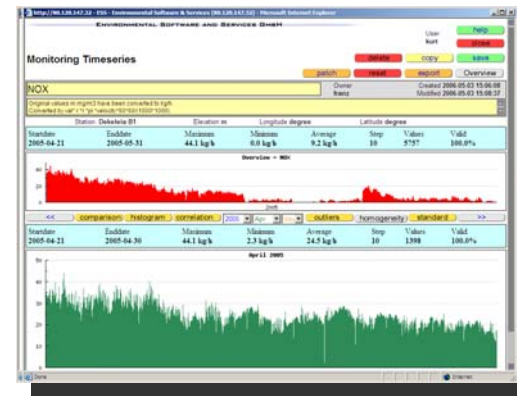
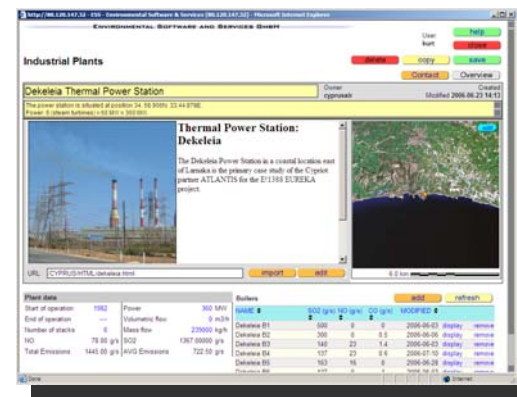
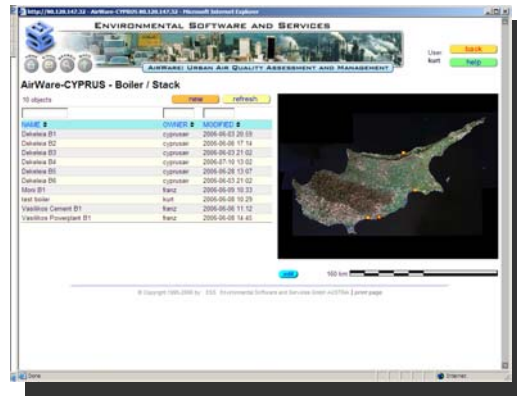
Boilers and Stacks are defined by their name and location, stack parameters (height, diameter, flue gas temperature and speed);

The stack has average emissions for all pollutants together with a user defined and selectable temporal pattern.

To estimate emissions if no direct observations are available, the boiler is also characterised by a fuel and fuel consumption, together with a set of fuel specific emissions coefficients.

Alternatively, for each pollutant one or more time series of emissions can be associated with a boiler/stack.

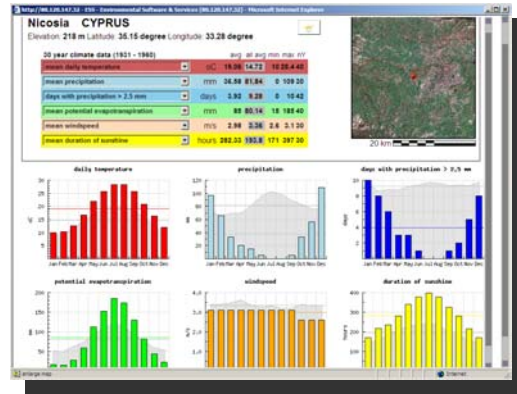
These time series can also be linked to real-time data acquisition and telemetry systems. They are managed by the common time series display and analysis tools.



Climate Stations

Within the master domain of a given application, one or more climate stations can be located. These describe long-term reference climate data over a 30 year period, from 1960 to 1990.

The data consists of monthly averages for a user selected set of climatic variables and the associated statistics.



Emission Factors: Combustion

To estimate emission from fuel type and fuel consumption, a set of emission factors for combustion sources can be defined and associated with individual emission source groups or sources.

The matrix defines one cell each for all fuel type and pollutant combinations. The lists of fuel types as well as pollutants are configured in the systems knowledge base.

Emission Factors: Traffic

To estimate emission from vehicles, a set of tables can be edited, one for each vehicle class as defined in the fleet composition.

For each vehicle class, one factor for each pollutant and (user defined) speed range can be edited.

Together with

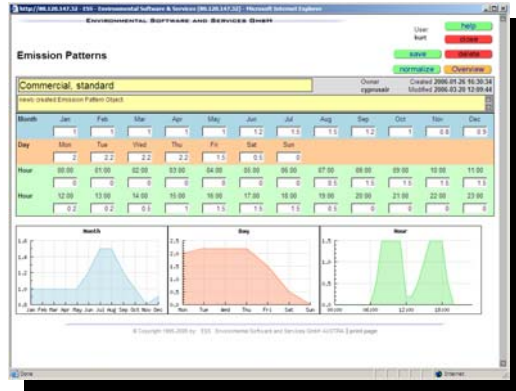
- Temporal patterns
- A cold start fraction
- A cold start correction factor

Emission estimates for vehicular traffic is based on traffic frequencies (by class or global with an associated fleet composition), vehicle class specific emission coefficients (e.g., COPERT) for speed ranges, that can be corrected for cold-start and optionally a road type attribute. Optional temporal patterns can be used to adjust hourly estimates over 24 hour, weekly, or annual/monthly cycles.

Temporal Emission patterns

To estimate emission from annual average values for any arbitrary point in time (month, day of the week, hour of the day) these patterns can be defined in Emission Patterns and associated with each emission source class or individual source.

While the basic multipliers can be specified in any arbitrary (relative) values, a NORMALIZE button will normalize the values provided to ensure an average of 1.0 across any of the three correction factors to guarantee a mass conservative result over the year.

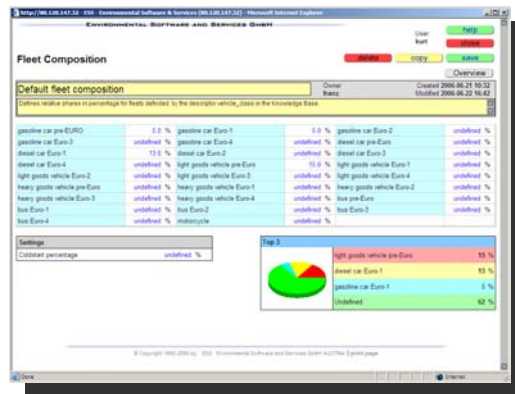


Fleet Composition

For line sources representing road segments, a fleet composition can be defined.

This is done in two steps:

- Definition of vehicle classes in the Knowledge base
- Definition of their relative share within the overall vehicle frequencies in any transportation network or set of road segment.



Together with the fleet composition, a cold start fraction can be defined.

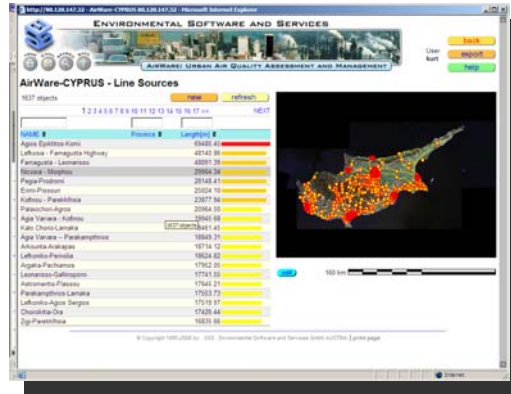
For all Emission Factors as well as for the Fleet Composition, any number of named instances can be defined and associated with the respective emission source class.



Line Sources

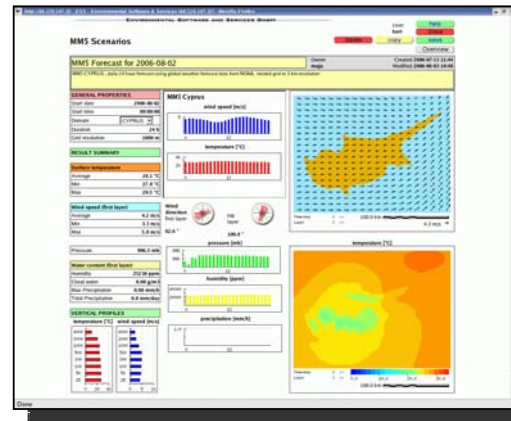
Line sources are defined by the location and geometry by one or more (poly)line segments. Together with a name and length, their attributed include:

- Province and community
- Road type and ID
- Average speed
- Fleet composition and/or vehicle frequencies for the individual fleet categories
- Emissions (for all pollutants) in g/s and km



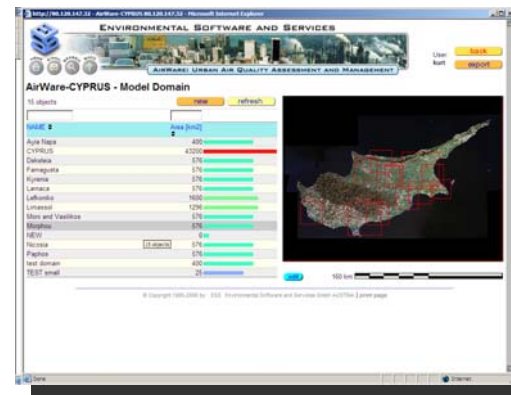
MM5 Scenarios

Scenarios for the optional 3D dynamic meteorological forecasting model MM5 (PSU/NCAR) include sets of matrices for the individual vertical layers, parameters, and time steps of the meteorological scenarios. They include both vector and scalar data.

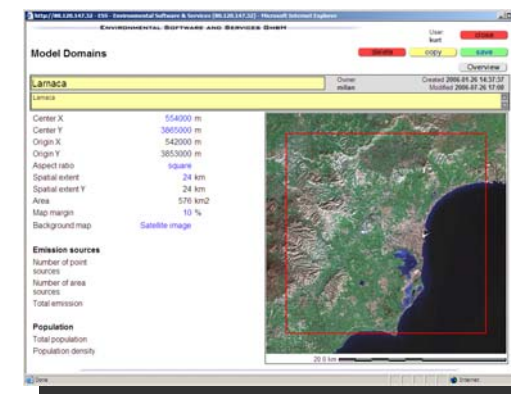


Model Domains

For all models and scenario, a model domain is selected and used. Model domains are named georeferenced objects, that define location, shape and extent of the area covered by the model grid, and for which all pre-processing steps (meteorology and emission calculations) are performed.



New domains can be defined interactively by the user as named objects, and subsequently be chosen for model scenarios or local emission inventories. For a model scenario, a default background map can be selected from the MapCatalog.



Monitoring Stations and Data

The management of monitoring data (meteorology, emissions, ambient air quality) is a core feature of AirWare. This includes data acquisition in real time from remote telemetry sensors and SCADA systems.

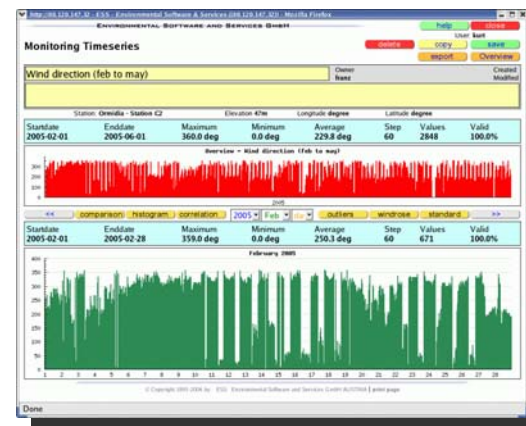
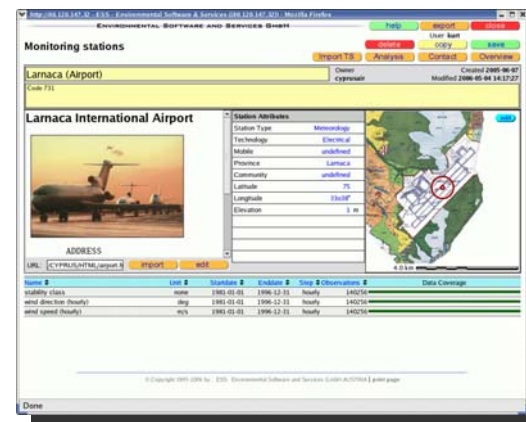
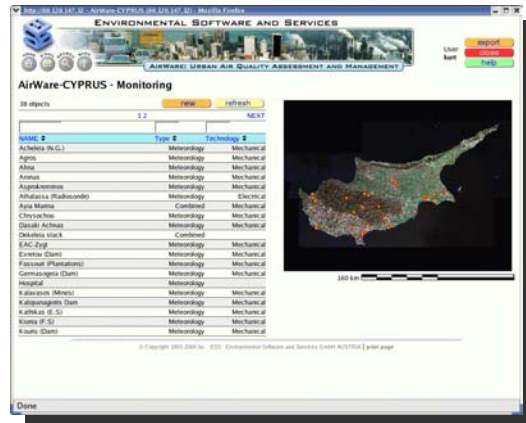
The entry point is a listing of all monitoring stations by name and type, together with a map indicating their locations.

Individual monitoring stations list the set of parameters and time series available there. This can also include real-time data sets that are updated on a regular schedule automatically, e.g., every hour from remote sensors and telemetry connections.

Basic attributes for monitoring stations include

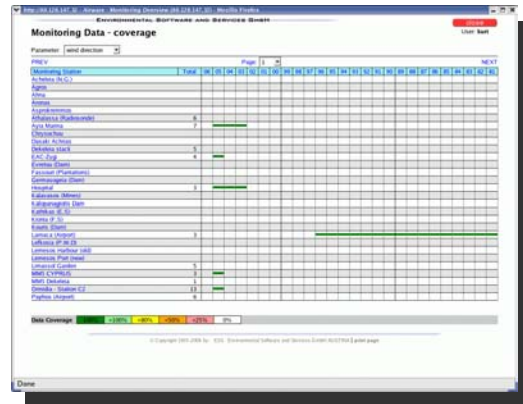
- name and location shown also on a local background map
- a hypertext description with optional imagery,
- start of operations,
- a link to an operator institution and administrative or technical contact,
- a description of the monitoring equipment and sensors,
- the list of data sets (time series) available.

For the individual time series a range of display and analysis features is available. There is also a data import function that supports spread-sheet (csv) file formats and a file browser on the local clients.



Time Series Analysis

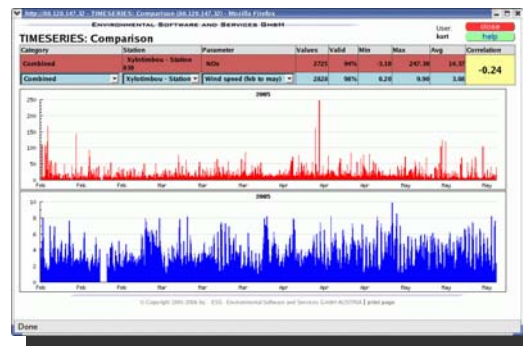
As an auxiliary tools, an overview of all stations and their data holdings can be generated from the administration panel (text links at the bottom of the main menu page)



The main time series analysis page shows for any given parameter two windows on top of each other, the upper window with an overview of the entire time series, the lower window a “zoomed” representation of a shorter interval that displays all individual values.

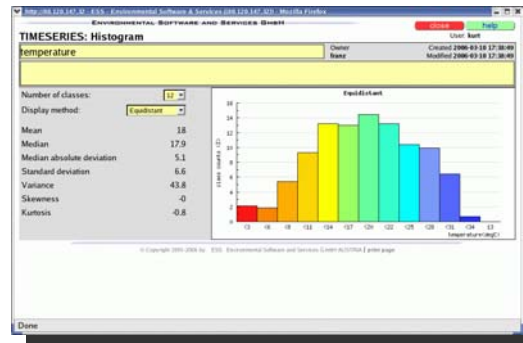
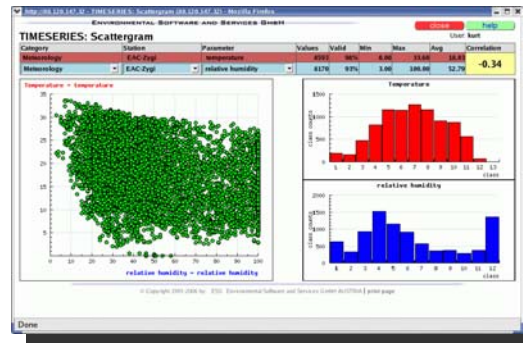
Analysis functions include:

- direct comparison of two time series data sets
- regression analysis
- histogram
- outlier detection



Auxiliary functions include:

- Data import (.csv format)
- Data patching (up to four hours for hourly data, using linear interpolation and straight extrapolation of wind direction data)



Emission inventories

Emission data are organised by:

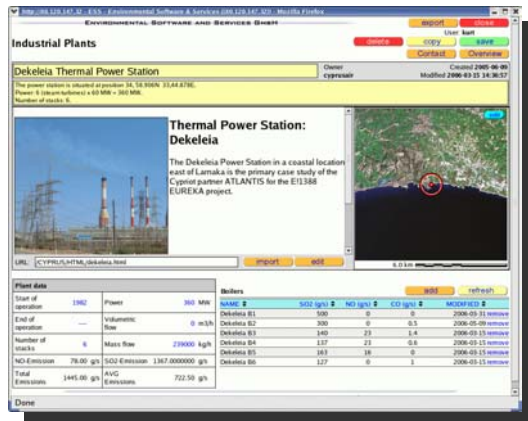
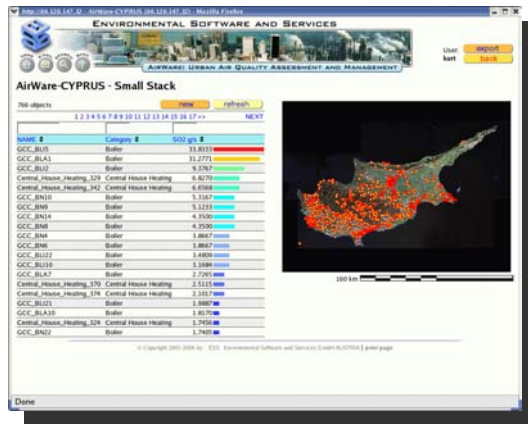
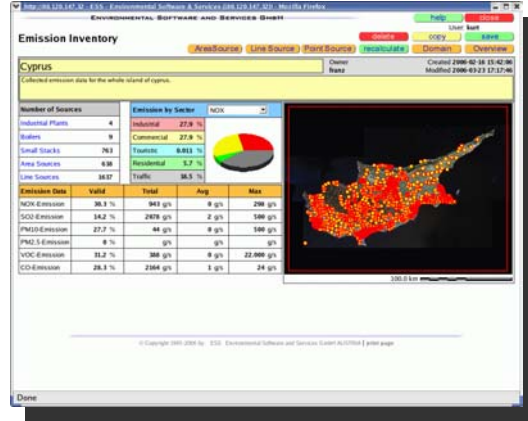
- Model domains including the overall master domain
- Source types:
 - boiler and major stacks, optionally integrated into industrial plants, see above;
 - small stacks
 - area sources
 - line sources (road segments)

For each source type, a selection mechanism with the standard sorting and filtering functionality and parallel map display is available.

For each source, data include: Name and location, type, selected attributes such as fuel type and consumption, An optional emission time series for major stacks, stack parameters, and an average emission value for each pollutant.

Additional attributes of emission data at the individual source level include:

- Temporal emission patterns
- Emission coefficients



Embedded GIS and MapCatalog

AirWare manages a set of background maps and tools for map composition as background for its georeferenced objects and model results.

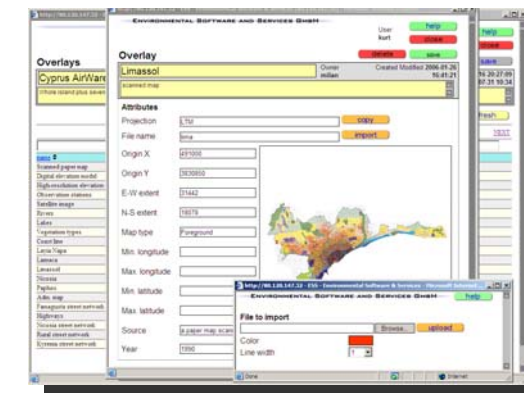
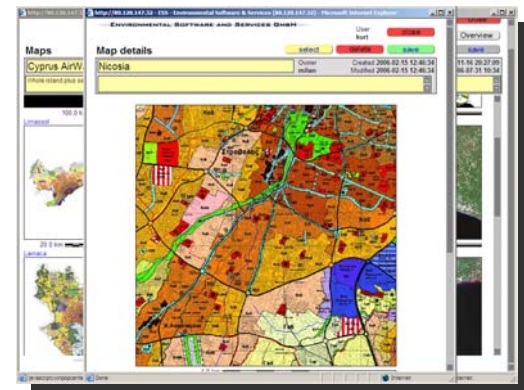
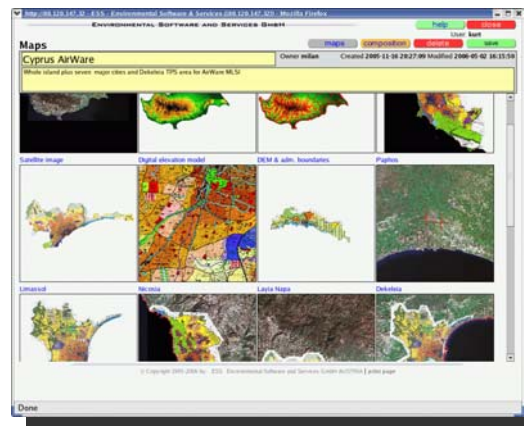
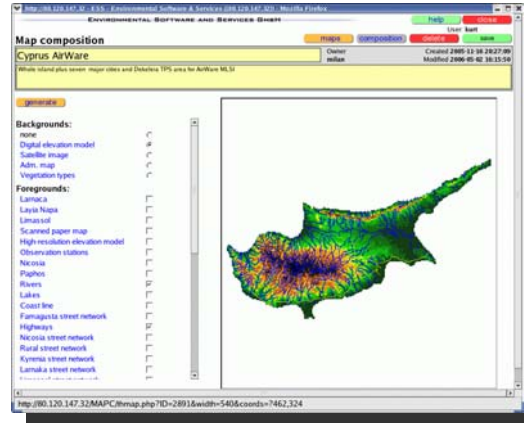
The entry tool is the MapComposer, started with the default map defined for the master domain. The user can select from the list of all available map layers one (opaque) background layer, and one or more foreground topics (usually line features).

The resulting maps can be stored as named objects in the MapCatalog, from where they can be selected as background for any and all object classes and objects. The MapCatalog also provide a preview feature for all maps in the MapSet.

The MapSet defines the overall location, extent, projections, and coordinate system for all the maps in an application.

The individual map layers or topics can be previewed from either a listing of all overlays (triggered by a button) or from the individual layers listed at the MapComposer level.

At the overlay level, map data (ArcView shapefile) can be imported from the client PC file system, using a local file browser and import dialog that can also define the colour and style of the imported feature.



Support Functions

The set of support functions is accessible from the set of text links at the bottom of the main menu page.

The auxiliary and administrative functions include:

- User management: to add/delete user and grant selective access privileges
- Knowledge Base editor: editing the DESCRIPTORS and RULES for the expert system
- Generic matrix import function for model input data
- Monitoring DB overview: summary of monitoring stations and time series data set, temporal coverage
- Generic matrix import function for model input data
- SysLog data base: chronological log messages from all scheduled processes
- Problem reporting: interactive interface to a problem report and solutions data base

User Management

Access to the AirWare system is by user name and password, with user organized in grouped with different access rights, controlled by the application, and can also be restricted to domains and IP addresses at the level of the web server.

Users are assigned to GROUPS which are defined by the set of services or functions they can access.

For adding and deleting a user, or to modify her status, a simple interactive editor to configure the underlying data base is available. The tool is only accessible for users in the ADMIN group.

NAME	FIRST	LASTNAME	CREATED	MODIFIED	ACTIVE	BY	GROUP
admin	Admin	user	1979-01-01	2006-06-05	yes	admin	ADMIN
phruca			2006-04-03	2006-04-03	yes	admin	OPTIMA
phruca			2004-10-16	2005-01-21	yes	kur	OPTIMA
user	Cam	Carlskay	2005-10-05	2005-10-24	yes	admin	OPTIMA
hendina	Christina		2004-10-20	2005-01-27	yes	admin	ESS
col	Maryam	Haffen	2004-05-18	2005-02-17	yes	kur	OPTIMA
col			2005-01-20	2005-01-21	yes	kur	OPTIMA
col	Ricardo	Wohrny	2004-10-16	2005-01-20	yes	kur	OPTIMA
farz	Farz		1979-01-01	2004-06-10	yes	kur	ESS
farz_col	Farz	Karim	2005-01-23	2005-04-04	yes	farz	external
galina	galina	hennricher	1979-01-01	2004-02-19	yes	kur	ESS
gunt	gunt	gunt	2004-02-19	2004-03-29	yes	kur	QUEST
kol	Dirge	Helmuth	2006-06-24	2006-06-24	yes	kur	OPTIMA
intergeo	intergeo		2005-10-19	2005-10-19	yes	kur	OPTIMA
kol			2004-10-16	2004-10-22	yes	kur	OPTIMA
kol	Dir	De Krueters	2004-10-23	2004-10-23	yes	kur	OPTIMA
kol			2004-10-16	2004-10-22	yes	kur	OPTIMA
kol			1979-01-01	2005-06-29	yes	kur	ESS
kol	Kurt	Fuchs	2006-08-02	2006-08-02	yes	kur	ESS
kol			1979-01-01	2005-06-29	yes	kur	ESS
kol	Yang	Liu	2005-09-12	2005-09-12	yes	admin	CHINA
kol			2006-03-16	2006-03-16	yes	admin	ESS

ESS - UserManagement - edit User

Username: admin Created: 1979-01-01 by admin Modified: 2006-08-09

Firstname: Admin user Lastname:

Email Address: admin@ess.de

Group: ADMIN

Active: Password: admin

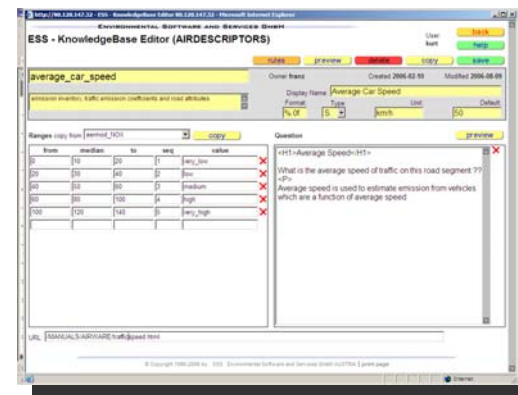
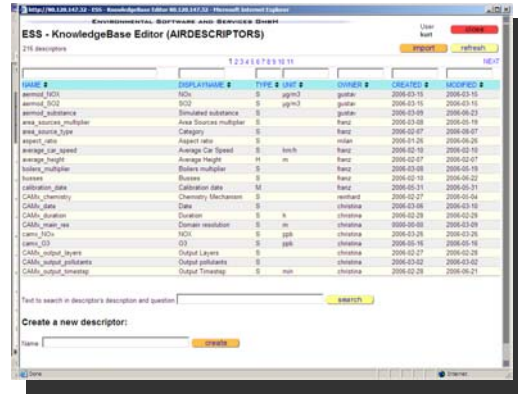
Groups: ADMIN, CHINA, ESS, external, OPTIMA, QUEST, USERS

Knowledge Base Editor

The Knowledge Base contains the definition of all variable that are used as attributes for OBJECTS together with any optional RULES processing them.

The definitions include:

- Descriptor internal name and display name
- Descriptor TYPE (variable (text), symbolic, hybrid)
- Unit and display format
- Range of legal values, numerical and/or symbolically
- Question text for the interactive editor (HTML format)
- Optional link to a help/explain page
- Optional list of RULES for that Descriptor

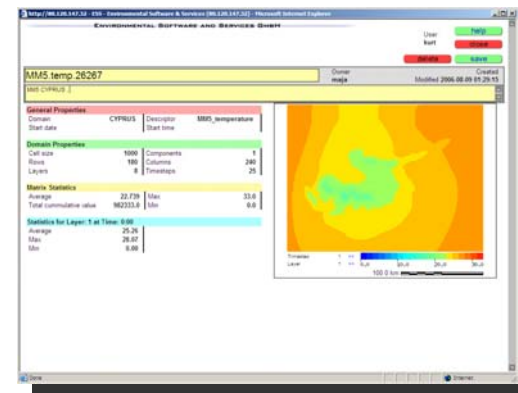
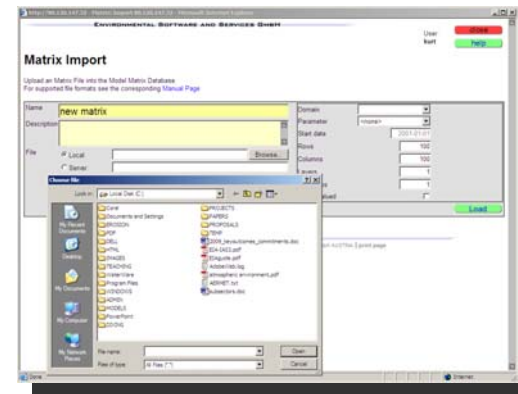


Matrix Import Function

Import data for several Database simulation models can be imported with a dedicated import dialog including a local (client side) file browser.

The data format imported is binary, for example created by ArcInfo GIS. Examples would be DEM, or initial and boundary conditions for models.

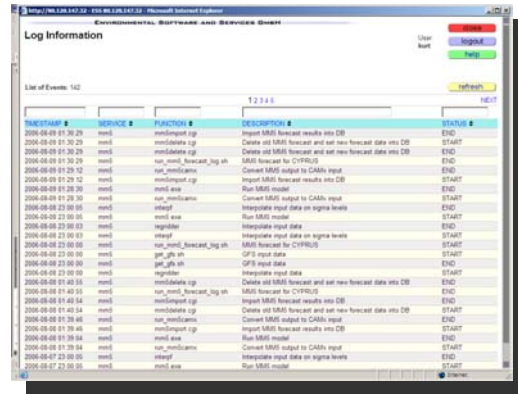
A pre-viewer for the matrix data shows a colour coded interpretation of the raw data together with the descriptive and meta data for the data set..



System Log Files

All scheduled processes on the main servers are logged chronologically to a common data base.

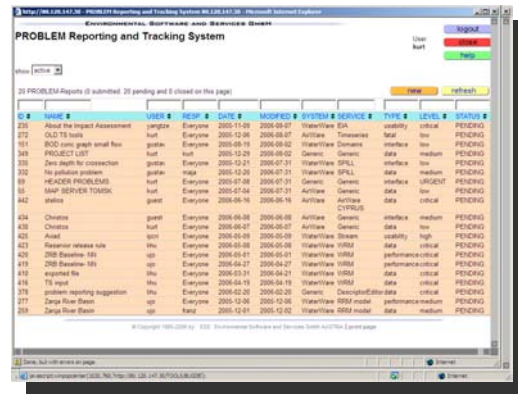
The log entries include a time stamp, server name, the main services, specific function, process ID, status information (e.g., START, END, ABORT, ERROR, etc) and a short description and eventual error message for debugging purposes.



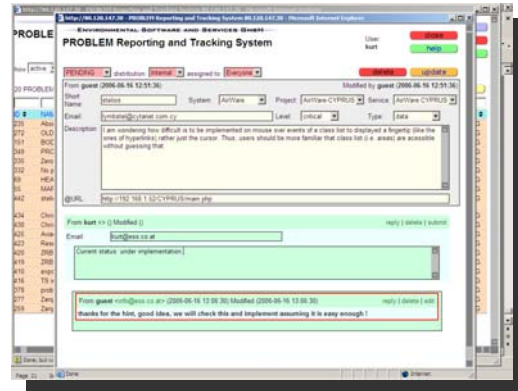
Problem Report Data Base

As part of the remote user support functions, an on-line data base of all problem reports, queries and questions, and answers and solutions is maintained by the main mirror and support server.

Entries are maintained in several topical groups, chronologically, by service or tool, level of urgency, user, responsible support person, etc. and lead to a set of editors to manage and track the problem report and ensuing dialog.



The system keeps track of reports and all comments and text messages, which are automatically sent to the originator of the report and the responsible support team by eMail.



Implementation

AirWare is implemented as a client-server system under Linux Open Source operating system, using any standard web browser as client. Servers include the Apache web server, MySQL or ORACLE data base servers, a main application server, GIS/MapServer, and a compute server optionally using high-performance compute cluster hardware for distributed parallel computing. For an on-line implementation example and demo (Republic of Cyprus) see:

<http://www.ess.co.at/AIRWARE/CYPRUS>

3. Verwertung:

Die Projektergebnisse tragen unmittelbar zur nächsten Generation des AirWare Systems und seiner Umstellung auf Internet-Technologien bei.

In Zusammenarbeit mit unserem Partner ATLANTIS in Zypern ist ESS an einem Projekt für das „Ministry of Labor and Social Insurance, Labor Inspectorate“ der Republik Zypern tätig. Die Ergebnisse des Projekts WEBAIR sollen in zukünftige Versionen des Systems (im Rahmen eines zweijährigen Wartungsvertrages) integriert werden. Ebenso werden die neuen Entwicklungen und Funktionen für einen vom Ministerium mehrfach verschobenen, nun vor Ende 2006 erwarteten „call for tender“ für einen Emissionskataster in Zypern angeboten werden, für den bereits zentrale Elemente im System implementiert wurden.

Darüberhinaus sind mit den Partnern bzw. prospektiven Partnern in Marokko, der Türkei, Malta (als neuem interessenten) und Russland mehrere kommerzielle Projektanträge in Vorbereitung. Außerhalb der Partnergruppe arbeitet ESS GmbH mit einer Gruppe in Südafrika (Airshed PTY Ltd) and der Vorbereitung mehrerer Angebote für kommunale Anwendungen. Aus Korea (wo eine Teilnahme an EUREKA Projekten offensichtlich mit nationalen Mittel gefördert wird) gibt es ebenfalls Anfragen zur Anwendung des Systems.

DDr. Kurt Fedra
Director, ESS GmbH

Gumpoldskirchen 2006 10 31