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Executive Summary

HEAVEN (Healthier Environment through Abatement of Vehicle Emission and Noise) is a research project co-funded by the Information Society Technologies Programme of the European Union. In the project consortium, valuable expertise in the field of transport and environment of research institutes, the private sector (leading industry and supporting consultants), and the public sector is combined.

It is the high-level goal of the project to demonstrate a Decision Support System (DSS) which can evaluate the environmental effects (air quality and noise quality - both emissions and dispersion forecasting) of Transport Demand Management Strategies (TDMS) in large urban areas. The EU cities of Berlin, Leicester, Paris, Rome, and Rotterdam as well as the CEEC city of Prague serve as the demonstration sites of the project.

The demonstration in these cities provides a concrete sustainable development perspective and improves the quality of life in European cities by reducing transport-related noise and air pollutant emissions through the innovative combination of efficient TDMS and integrated environmental Information Society Technologies (IST).

It is the third and last year of the HEAVEN project which is dedicated to demonstration.

The present demonstration plan gives an overview of the HEAVEN DSS as it has been realised in Paris: a system capable of producing each hour a modelled description of the current air quality situation which takes into account the actual traffic situation (chapter 2). The system operates on the scale of the entire Ile-de-France region, which hosts the 11 million inhabitants of the agglomeration of Paris. This context (the Paris *demonstration site*) is described in chapter 3.

At the present stage, the system implementation has to be finalised following the results of the system verification (chapter 4). The proper demonstration phase will start with the system going into full operation. Besides making the HEAVEN information available to the general public and to potential professional users, the demonstration phase will be the opportunity for modelling of a set of basic scenarios, and the main period for evaluation. Chapter 5 schedules the planned activities: finalisation of system implementation, scenario modelling, evaluation.

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1.1 Guide to the reader

The present demonstration plan gives an overview of the HEAVEN DSS as it has been realised in Paris: a system capable of producing each hour a modelled description of the current air quality situation which takes into account the actual traffic situation (chapter 2). The system operates on the scale of the entire Ile-de-France region, which hosts the 11 million inhabitants of the agglomeration of Paris. This context (the Paris *demonstration site*) is described in chapter 3.

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1.2 Objectives

The project objectives can be considered on varying scales - on a HEAVEN basis, on a workpackage basis and on a site basis and each of these will now be discussed briefly.

1.2.1 By project

The project's high-level goal is to demonstrate a decision support system (DSS) which can evaluate the environmental effects (air quality and noise quality - both emissions and dispersion forecasting) of Transportation Demand Management Strategies (TDMS) in large urban areas.
This goal has been translated into a concise set of high-level project objectives:

- Improve the basis for decision-making through integrated and real time information on key pollution factors;
- Inform key actors (including the public) on the state of air and noise pollution levels and their effects on health;
- Investigate the data needs of health experts and the implementation of a valid data exchange platform with health authorities;
- Identify the concrete benefits of these measures for sustainable urban development and the quality of life in cities;
- Generate commercial value out of the project;
- Draw conclusions for the implementation of local noise and air action plans.

1.2.2 By package

In WP8, the main objectives are as follows:
• To demonstrate the DSS for evaluating the mobility related pollution in relation to implemented and planned TDMS;
• To demonstrate noise emission forecasting related to mobility strategies;
• To aid in the compliance with EU directives on air [and noise] pollution, national-local pollution strategies.

1.2.3 By site

In HEAVEN, Paris wants to integrate a chain going from real-time traffic data to a quasi real-time modelling of the complete regional traffic situation, to the modelling of pollutant emissions from traffic and other sources, and finally to regional pollutant dispersion modelling and street level pollutant concentration modelling. This means a strong improvement in the description of the current air quality situation in the Ile-de -France region. At the same time, the modelling chain is adapted to off-line scenario modelling, thus increasing strongly the capacity of evaluating the impact of TDMS measures.

In particular, the objective of the Paris partners is to offer an improved decision support for TDMS measures, and to provide a means to citizens as well as professional users to understand and assess the impact of traffic and TDMS measures on the air quality situation.
Paris does not handle noise emissions in Heaven.

1.3 Summary of WPs

WP1: Project Management
The project management consists of the continuous co-ordination and monitoring of the project's progress, paying attention both to end goals and interim goals. Because of the complexity of the project, the management is divided into administrative management and technical co-ordination.

WP2: Dissemination
The goal is to disseminate the outcomes of the project and form consensus on the approach used in HEAVEN. The major milestones are an interim technical workshop and a final conference both to be organised at the European level. Contribution to Key events organised by the Commission and to European and World conferences dealing with the HEAVEN research will be ensured. The outcomes of the project are also made available through a project website. The feasibility of organising a temporary web site for user group consultation and discussion is examined.

WP3: Validation Co-ordination
WP3 assists both the verification and the demonstration stages of the project. Firstly, a draft validation plan has been developed, in close co-operation with the local evaluation managers, who are responsible for performing the actual evaluation in WP7 and WP8. Secondly, the local evaluation work, both for the verification and the demonstration phase, is be guided through advice and direct assistance. Verification of systems has been done in WP7, evaluation of the demonstration's impacts in WP8. WP3 is responsible for co-ordinating the results from the verification and demonstration phases and for incorporating them into a Final Evaluation Report.

WP4: User Requirements and Implementation Framework
This WP has focused on a detailed analysis of the needs of the different DSS and Information system users: decision makers, system operators and end-users. The draft user requirements have formed an input to WP5 for the design of the DSS and Information system and to WP3 for the preparation of the draft validation plan.

WP5: Functional Specifications/System architecture
WP5 has developed the specifications for DSS and Information systems on the basis of the requirements captured by WP4. The work has been performed in each site according to local particularities and constraints, and following a common and structured approach, which helps to identify commonalties between sites. The underlying purpose of this work package is to design the functions and architectures suitable to support tasks presented above.

WP6: Build Integrated Systems
Starting from the functional architectures and the systems design provided by WP5 and based on the actual existing implementations, WP6 has identifed the set of components and actions to be undertaken in order to grant the implementation of the DSS and Information System. WP6 includes the identification of the components required to fulfil the specifications provided by WP5; the selection, validation and improvement of the environmental models; and the detailed specification of the central Decision Support System (DSS).

WP7: System Verification
At first, the operating performance of the system has been assessed by focussing on indicators like number of breakdowns, log-files and speed of the system.
Secondly the acceptance by users interviewed in the context of WP3. Users have been asked if the system meets their requirements and if the information supplied is clear.
Thirdly, a user panel consisting of a small group of citizens has given its opinion on the information provided to the general public.
In this stage, some changes to be made to the systems before the large-scale demonstration within work package 8 could be indicated.

WP8: Large Scale Demonstration
The on-site implementation and real-life operation of the systems of both the DSS and the information platforms occurs in Workpackage 8. All the system component integration also occurs (traffic monitoring, environmental monitoring, emissions and dispersion models, etc.). The demonstration will reflect modifications made in response to the verification phase (WP7), both in terms of technical

performance and in terms of the outputs (content and form). Additional minor adjustments will proceed during the demonstration period, according to the milestone schedule. Once the system is in operation, the DSS will be used to evaluate a host of TDMS strategies implemented and/or planned for the different sites, including road pricing initiatives, express roads, traffic calming measures, etc. During this stage, the evaluation of the system performance and impacts will occur.

WP9: Exploitation and Business Planning
This workpackage assesses the added value and the exploitation possibilities of the suite of HEAVEN end products, in particular the DSS for evaluating TDM strategies, the information integration platform, and any of the refined models incorporated into these end products. This workpackage will provide a detailed Exploitation and Business Plan for the industrial partners, identifying what market possibilities they identify for the developments completed in this project.

The following diagram displays how each work package inter-relates with the others.

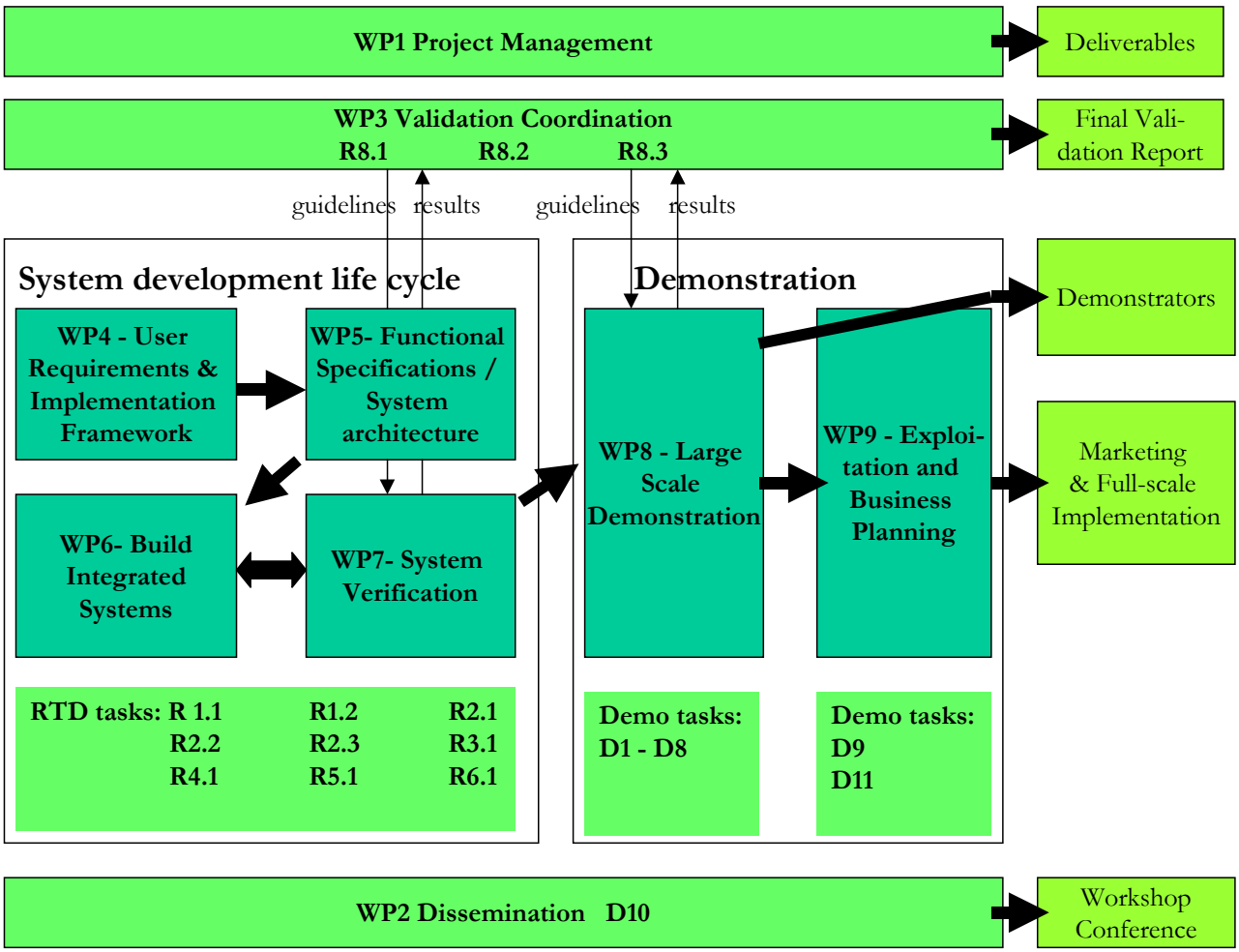

Figure 1: Interrelations between workpackages and RTD and demonstration tasks

1.4 HEAVEN System Concept

The HEAVEN DSS combines near real-time traffic flow information into emission models so as to analyse the contribution of mobile sources to air quality and noise. In order to estimate emissions based on current traffic levels and on planned demand management scenarios, the system can operate on-line, based on current traffic and environmental information, and off-line, based on planned traffic and environmental conditions and pre-defined TDMS.

The diagram in Figure XXX shows the dynamic data processing and modelling chain that supports the on-line operation of the system. The near real-time input information concerning traffic, air quality, noise and meteorological conditions is processed and archived for use during off-line operation.

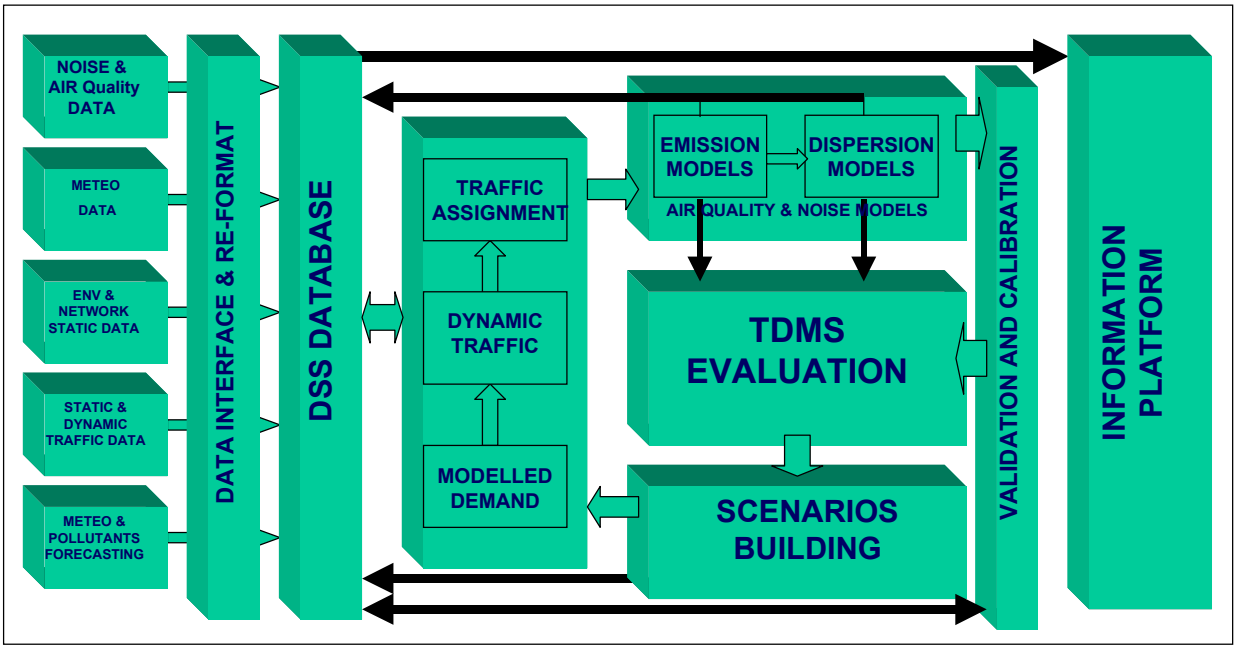

Figure 2: The dynamic Data Processing and Modelling Chain of the HEAVEN DSS

The main operational characteristics of the HEAVEN DSS emerge from the processes drawn in the diagram above.

i. Data exchange from external sources to the DSS models

The input data for the DSS come from several external sources:

- Near real-time dynamic Traffic, Air Quality, Noise and Meteorological data come from specific infrastructures and monitoring systems. Type of data, spatial and time resolution, accuracy, etc, depend on the features of the monitoring systems. The data exchange is performed on-line to ensure near real-time data processing.
- Static and infrequently updated data - such as data representing the traffic network, the land use, the built environment, statistics and forecasts concerning traffic, pollution and meteorological conditions, the model configuration parameters, etc – are provided by specialised institutions, bodies and data bases. This data exchange is performed off-line.

In general, specific interfaces are required to interact with the different data sources and to hide the possible complexity of the on-line connection with the monitoring systems. The storage of data in the HEAVEN data base is normally performed after manipulation, pre-processing and reformatting of raw data. Dynamic data are fed into the DSS modelling chain only after validation.

ii. Dynamic traffic data processing

- *The (validated) dynamic traffic information is employed to update in near real-time the traffic status in the monitored network and to improve the traffic demand model. Traffic assignment in the whole network represents the last element of the traffic models chain.*
- Also the output of the traffic models undergo validation procedures both to ensure consistency of the information for the subsequent models chain, and to contribute to the traffic models calibration and tuning.
- Near real-time and modelled traffic data are then fed into the environmental models for emissions estimation.
- Finally, the monitored traffic conditions contribute to the evaluation of the impact of the TDMS under analysis and constitutes one component of the TDMS application scenario.

iii. Dynamic Air Quality and Noise data processing

- *The (validated) dynamic air quality, noise and meteo data are employed to compute the traffic related emissions in near real-time, and so to feed the pollutant dispersion estimation and the noise levels computation. Concentration of pollutants and noise levels are then computed for key points and areas in the network taking care of background dispersions possibly modelled through specific models.*

- Also the output of the Air Quality and Noise models undergo validation procedures both to ensure consistency of the information produced, and to contribute to the environmental models calibration and tuning.
- Finally, modelled emissions and measured and modelled Air Quality and Noise levels are the main information for the evaluation of the impact of the TDMS under analysis.

iv. Information exchange between the DSS Data Base and the Information Platform

- All the input information and DSS model results are stored in the system data-base. The entire or a part of this set of information can be transferred to the Common Information Platform and disseminated according to user related access restrictions.
- Dissemination is performed through several format (tables, maps, etc)

v. Scenarios building

- Through the scenarios building, the operator can define the context for the off-line evaluation of new TDMS in the view of optimising the environmental impact of the traffic.
- Scenarios are also built by the system automatically by recording the contextual conditions where the TDMS is currently actuated.

vi. TDMS Evaluation

- *The evaluation of the performance of a TDMS in the context of a planned or actual scenario is made through the comparison between the traffic, emissions, air quality and noise modelled output based on this scenario and the traffic, emissions, air quality and noise modelled output based on a reference situation.*
- This process bases on automatic and manual procedures for data collection, selection and computation but the system operator plays a key role to set the operational conditions to perform the evaluation. The system operator steers the evaluation process through a specific Operator Interface.

These processes are asynchronous and each of them is driven by the frequency of the input information updating and by the expected updating frequency of the output.

The characteristics of the site DSS' reflect the general characteristics of the HEAVEN DSS, although duly customised according to the peculiarities of the site (availability and type of the data sources external to the system, models adopted, operational constraints, etc).

2 System description in Paris

2.1 System architecture

Paris HEAVEN system is constituted of many modules : interfaces, traffic modelling module, emissions and pollution modelling modules, Web site, which take part of three main processes : data collection, input processing and modelling, information and dissemination of the results (figure 10). A brief description of each module is made here, an explicit description having been done earlier in the D6.1.

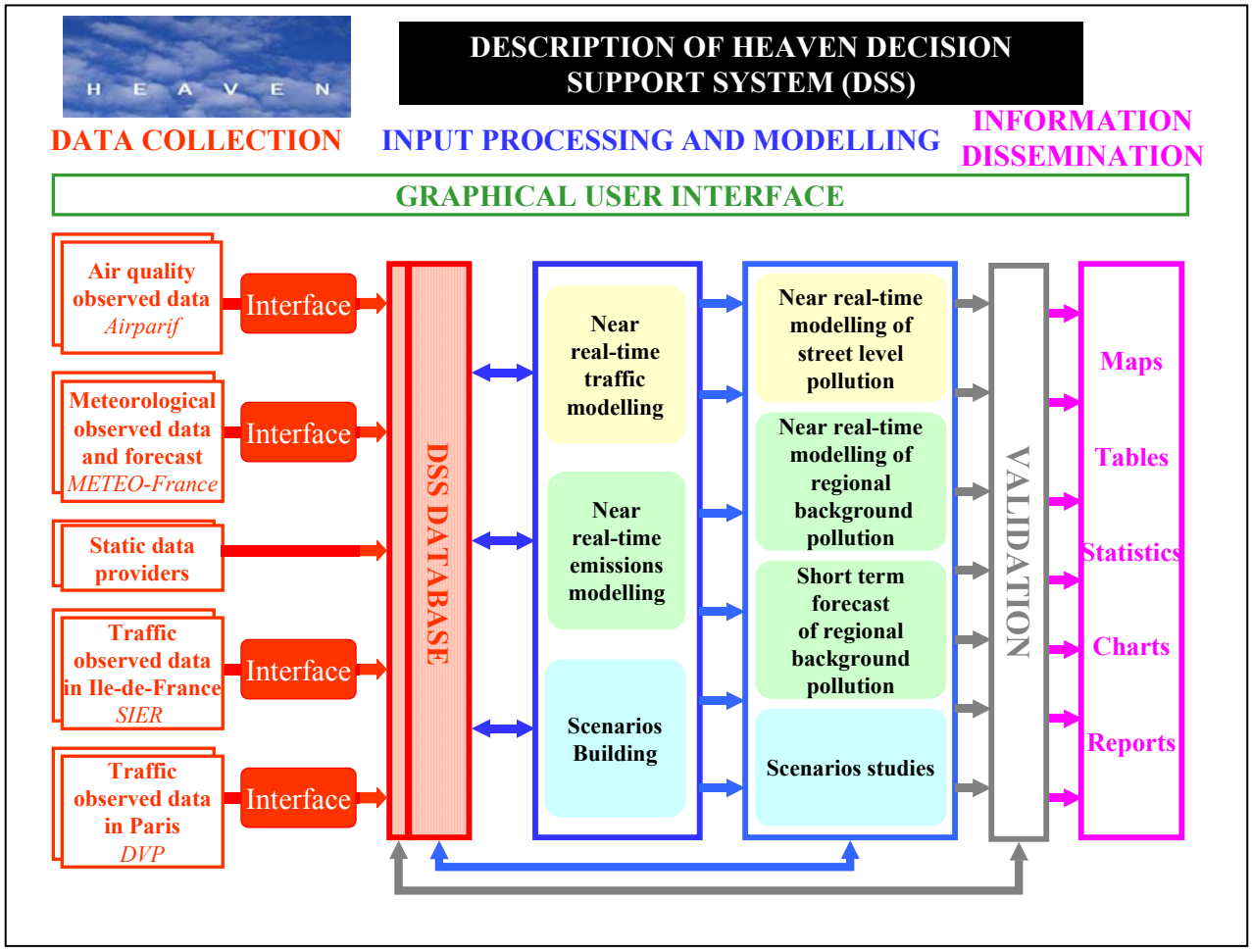

Figure 3 : Description of heaven DSS

2.1.1 Interface to air quality data sources

The HEAVEN DSS is connected to the air quality database of Airparif using the local area network by the way of SQL requests. It acquires hourly air quality observed data of NO, NO_2, O_3 corresponding to background monitoring sites and observed data of CO, NO, NO_2, PM10, C_6H_6 corresponding to traffic sites for the previous hours. The connections will be achieved six times per day.

2.1.2 Interface to meteorological data sources (Météo-France)

The HEAVEN DSS is interfacing with two different servers from the French Meteorological Office (Météo-France).
From the first server (ftp.meteo.fr), the HEAVEN DSS acquires hourly meteorological observations for the previous day coming from some twenty monitoring sites located in Ile-de-France region. This acquisition is achieved every day at 11.15 a.m. (local time) using a ftp protocol.
From the second server (SIRIUS1), the HEAVEN DSS acquires meteorological analyses and forecasts coming from the ARPEGE model. The connection is achieved once a day at 06h45 a.m. by using a ftp protocol.

2.1.3 Static data providers

The HEAVEN DSS also uses static data provided by :

- - IGN : topographical data
- - IFEN: land-use data
- - INSEE : social and economical statistics
- - IAURIF : streets typologies (“canyon”, “open”…)
- - EEA : MEET / Copert III methodology
- - INRETS/ADEME : national fleet data
- - DRIRE : annual emissions for industrial sources
- - ADP : annual emissions for aircraft traffic (below 900 m)
- - CITEPA : annual emissions for area sources.

2.1.4 Traffic observed data in Ile de France

Ile de France traffic data (SIER) originate from two different systems named SIREDO and SIRIUS. SIRIUS and SIREDO are concentrated on a different MI2 node of the Ministry of Transport, and made available to Airparif through the national traffic information access node located at CETE Bordeaux. The MI2 node provides traffic flows, occupancy rates and speeds measured by electromagnetic sensors on the highway and national road network of the Ile-de-France region (238 selected inductive loop). The sensors provide 6-minute data, which are averaged to 1-hour values before the transmission to the Heaven DSS.

2.1.5 Traffic observed data in Paris

Paris centre traffic data originate from the information SGI server. Dedicated wires were installed between Airparif and City of Paris TCC for the traffic data acquisition. On line traffic data from 421 selected inductive loops are then continuously sent to Airparif for near real-time traffic modelling. (The SGI server provides 3-minute data, which are averaged by the Heaven DSS to 1-hour values.)

2.1.6 DSS database

Air quality data, meteorological data, traffic data are stored in oracle databases.

2.1.7 The traffic modelling module

The traffic modelling module is a new and innovative development that is specifically realised in the HEAVEN project. The module simulates a traffic status on an extended network.

- The simulated traffic status consists of a traffic assignment from an origin/destination matrix that is as close as possible to the typical O/D matrix for the type and time of day in question (see figure 11). The typical O/D matrix is extracted from a reference matrix assignments database, and that takes into account the historically observed traffic data.
- The simulated traffic status reproduces, as closely as possible, a sample of pinpoint measurements of the real traffic status.

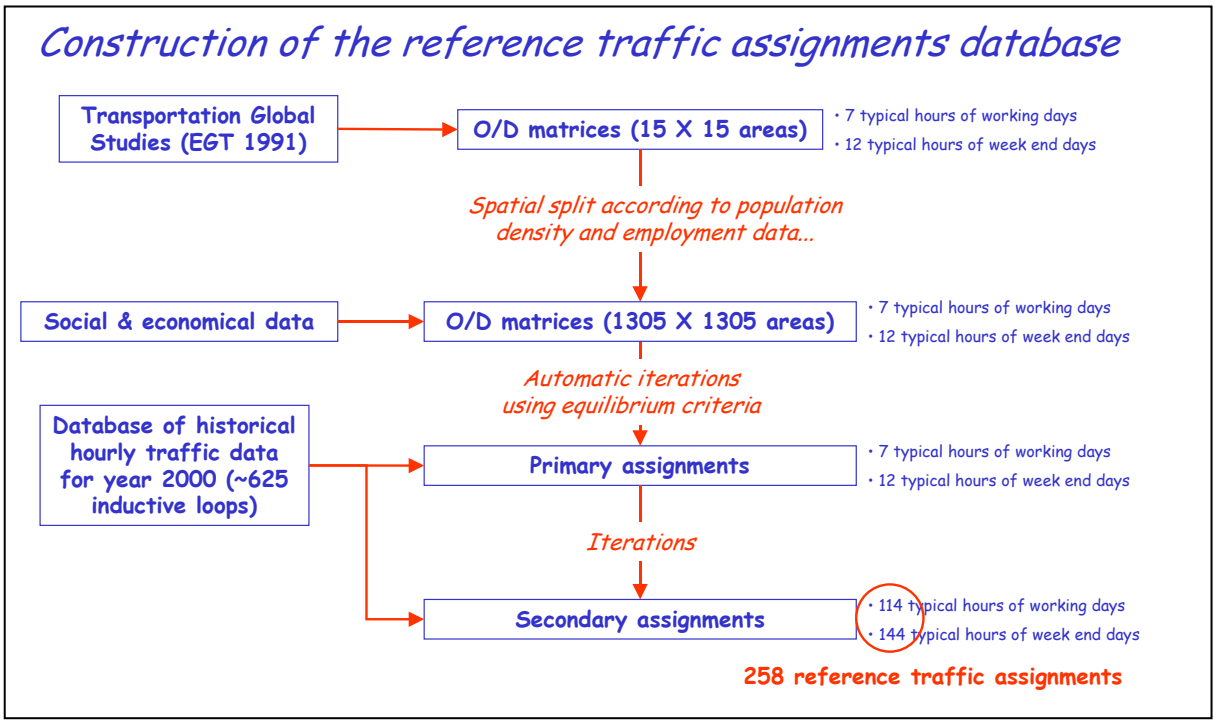

Figure 4 : Construction of traffic reference assignments database

The module takes as input :

- the traffic flows at 659 points obtained each hour through the interfaces to SIER and City of Paris
- the description of the road network (~39000 oriented links)
- 258 traffic assignment matrices.

The module produces a traffic assignment matrix that indicates traffic flow, speed and cold-vehicle percentage for 39000 oriented links of the road network of the Paris region. The simulation runs each hour, starting from the measurements taken during the recent hour and the typical O/D matrix corresponding to that hour (see figure 12). It lasts about 20 minutes.

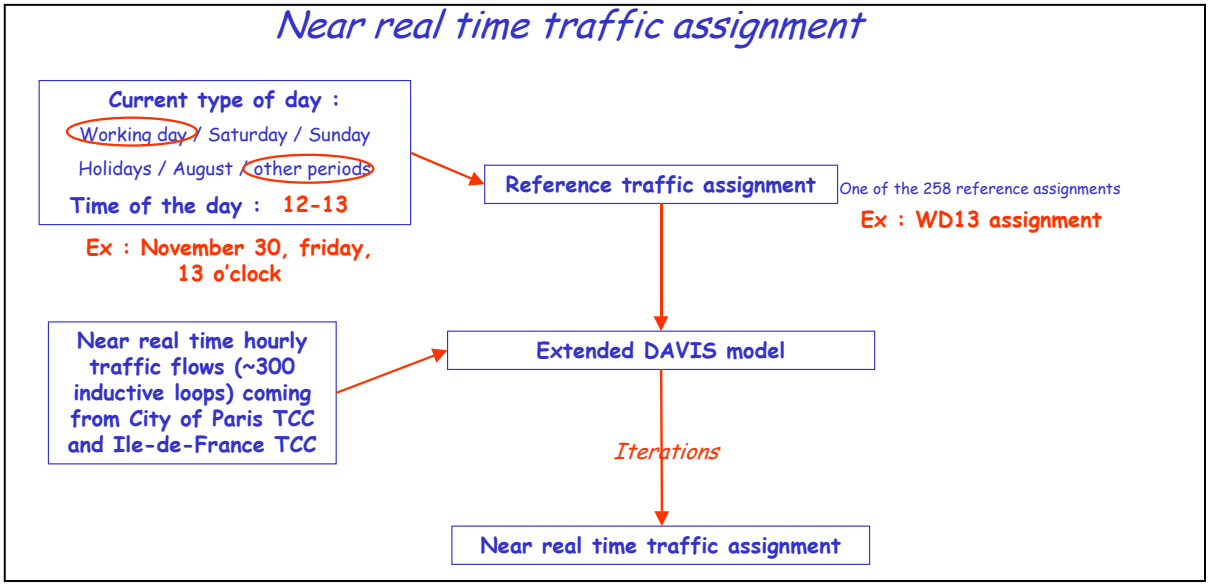

Figure 5 : Traffic modelling

2.1.8 The emissions modelling module

This module called DSS_EMI provides pollutants emissions for the Ile-de-France and surrounding area. Emissions are calculated each hour, with a linear resolution for the traffic and spatial resolution

of 1 square kilometre for total emissions. Following substances : carbon monoxide (CO), sulphur dioxide (SO_2), nitrogen oxide (NOx), non-methane volatile organic compounds (NMVOC), carbon dioxide (CO_2) and methane (CH_4) are concerned. For traffic, particulate matter emissions are as well calculated.
This module covers three main sub-modules :

- traffic related emissions modelling module: This module is devoted to the calculation of the linear then grid square traffic emissions based on the Traffic Modelling Module outputs (traffic flow and speed for example), the fleet distribution and the emission factors coming from the Copert III methodology,
- other sources emission modelling module: This module is devoted to the calculation of the grid square emissions related to other sources (industries, airports, diffuse sources like domestic heating or biogenic emissions).
- merging module: This module is devoted to assemble both emissions.

2.1.9 The street level pollution modelling module

Evaluation of air quality for each link of the whole reference network (~ 39000 links) is made at AIRPARIF by using the “Street” V.4 software. The objectives in framework of the Heaven project is to be able to go down from an annual evaluation to a hourly evaluation based on the near real-time traffic, meteorological and background concentration data.
For this point, different approaches are under investigations (see section on 'Actions to be taken after verification').

2.1.10 The background pollution modelling module

The system called POLLUX_HEAVEN is the system that provides the regional background dispersion modelling and forecast (figure 13). It is based on a deterministic chemistry-transport model called Chimere.

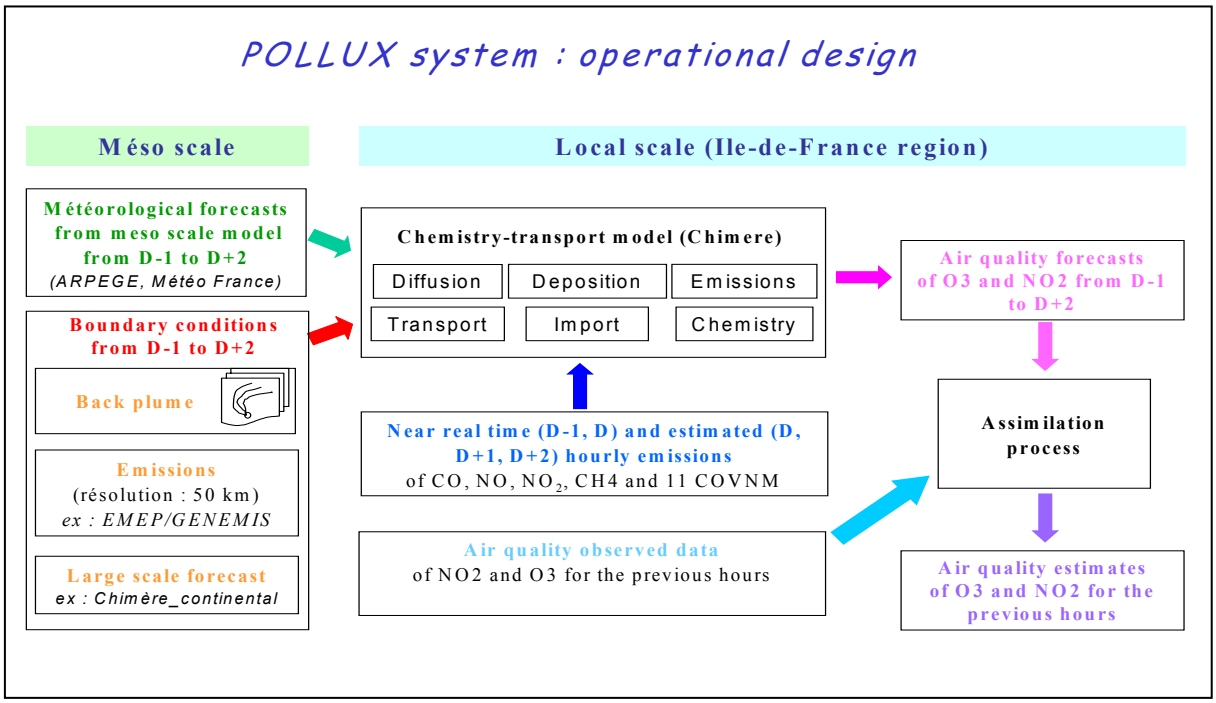

Figure 6 : Pollux_Heaven system

The system is designed to be as simple as possible in order to fit the real-time constraints, i.e. it delivers O_3 and NO_2 quasi real-time evaluations and O_3 and NO_2 forecasts in the early morning up to two days ahead. In order to satisfy this constraint, a major simplification is made. This simplification is based on the geographical character of the Paris area that allows us to assume that the meteorological variables can reasonably be represented by a large-scale meteorological model. This enables the use of operational forecasts issued in the main weather forecasting centres. We use here the ARPEGE weather forecasts from Météo-France.

The background pollution imported into the model domain can be modelled using either a set of back trajectories (called the back plume) or output from a large-scale forecast. The system uses estimated emissions generated by the emissions module for the hours of the previous days and estimated emissions for days D, D+1 and D+2.

Using the emissions, meteorological variables and lateral boundary conditions, the chemistry-transport model CHIMERE calculates the concentrations fields of O_3 and NO_2 on a 6km x 6km grid over a domain of 180km x 180km that will cover the Ile de France area or on a 3km x 3km grid over a 90km x 90km domain that constitutes a zoom on the dense urban area of the Ile-de-France region.
Chemical mechanism describes the chemical behaviour of about 80 gaseous species, through almost 200 reactions. The hydrocarbon degradation scheme is very similar to the EMEP gas phase chemical mechanism.
The execution time of the complete simulation process is about two hours on an IBM RS6000 platform. The assimilation process takes only few minutes. The outputs will be delivered in the form of graphics and tables to the DSS information platform, every 3 hours.

2.1.11 Scenarios building and studies

Some tests of Transport Demand Management Strategies (TDMS) have already be done such as :

- a test of air pollution sensitivity to traffic density in Paris related to the experiment of the “22 September 1999”.
- a study of the impact of a traffic ban enforcement.

2.1.12 Validation

Validation of each module will be done comparing modelled results to measured one’s. Examples of validation are represented in figure 14.

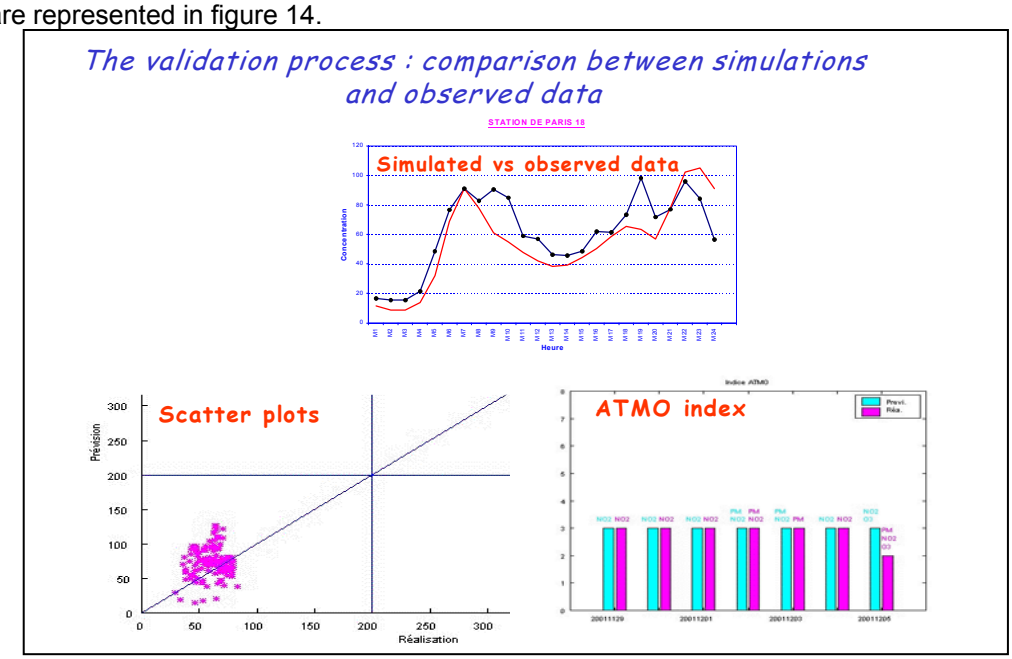

Figure 7 : Examples of comparison between simulations and observed data

2.1.13 Information platform

Information on meteorological data, traffic flow, proximity and background air pollution will bespread on AIRPARIF internet web site (figure 15).

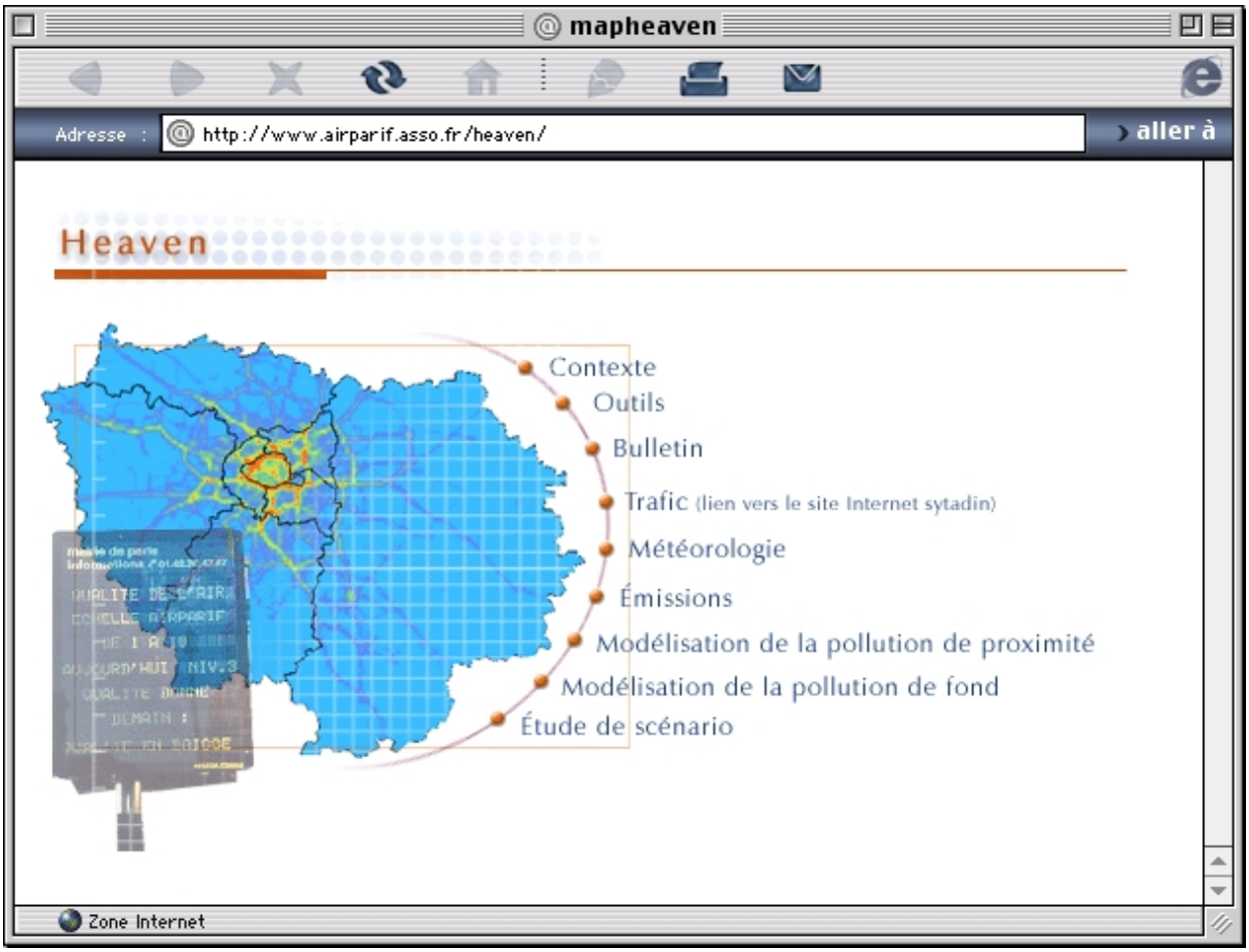

Figure 8 : Design of the information platform front page (status April 2002)

2.2 Main actors and appraisal groups

The appraisal groups refer to those people that are affected by the impacts of the Heaven project applications. The advantages and disadvantages of the project will be evaluated by the opinions of the most relevant appraisal groups, who should reflect the main future market of the application.

In Paris, the principal appraisals groups are constituted by

- the operators of the application (AIRPARIF)
- public authorities and decision makers
- the general public and interest groups.

The most important single actors in these appraisal groups are listed in the following table:

HEAVEN User Category	**Names of User Organisations**	**Role with respect to Heaven DSS**
Operators of DSS	AIRPARIF	Air quality monitoring and evaluation of TDMS impacts
Public administration	SIER	Provider of traffic data, operator of main urban highways
	City of Paris, Road and transport department	Provider of traffic data, operator of urban road network
	DREIF	Advisor to decision makers for transport policy
	DRIRE LHVP	Advisors to decision makers for environmental policy
General public	Citizens	
	NGOs	
	Research institutions	

3 Demonstration site

3.1 Areas and Maps

3.1.1 Physical characteristics and socio-economic structure

The demonstration area will comprise the whole Ile-de-France region. The Ile-de-France region lies in the centre of the so-called Paris basin. It is a flat region with isolated hills. Paris, the capital of France, lies on the river Seine at an average of 62m above sea level. The geographical location of central Paris (Longitude: 2° 20' E ; Latitude: 48° 51' N)

The administrative Region of "Ile-de-France" covers an area of 12,073 km^2 and has a population of about 11.07 million inhabitants (source : INSEE 1997). It contains about one fourth of the total population of France and represents about 29 % of the Gross Domestic Product and 22.5 % of the employment with about 5 millions employees. The city of Paris occupies 105 km^2 and has a population of about 2.13 million inhabitants.
The demonstration area for the NO2 and O3 background pollution modelling is a domain of 180 x 180 km2 containing the whole Ile-de-France region (shown in Figure 17), with a grid resolution of 6 km. More detailed information (zoom) is also available on a domain of 90 x 90 km2 with a grid resolution of 3 km containing the dense urban area (“agglomeration parisienne”), with a grid resolution of 3 km (shown in Figure 17 below).

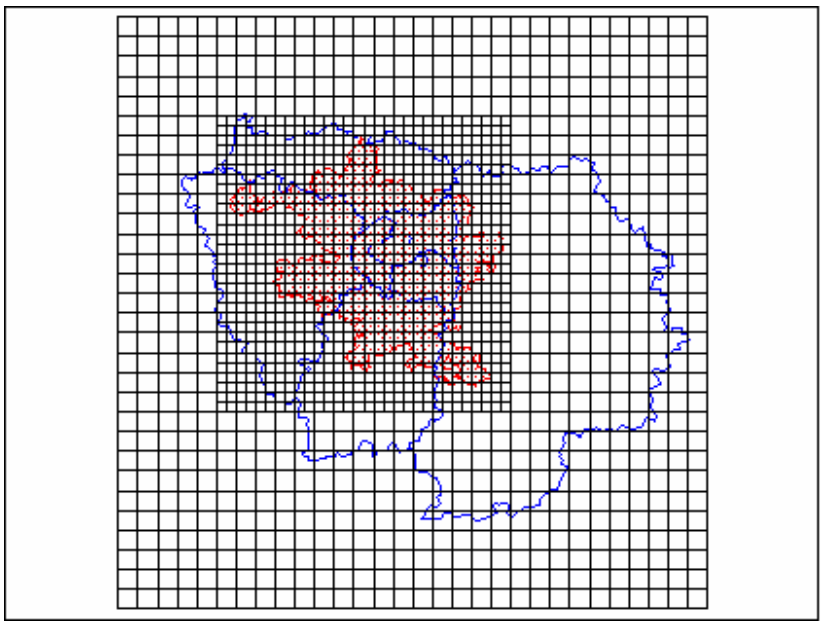

Figure 9 : Demonstration areas for background pollution modelling

The demonstration area for the CO, NOx, C6H6, Particulate Matter street level pollution modelling is the whole Ile-de-France main road network for the annual evaluation and the road network of the dense urban area (limited by the motorway A86) (see the red circle) for the hourly evaluation (as shown in figure 18 on the next page).

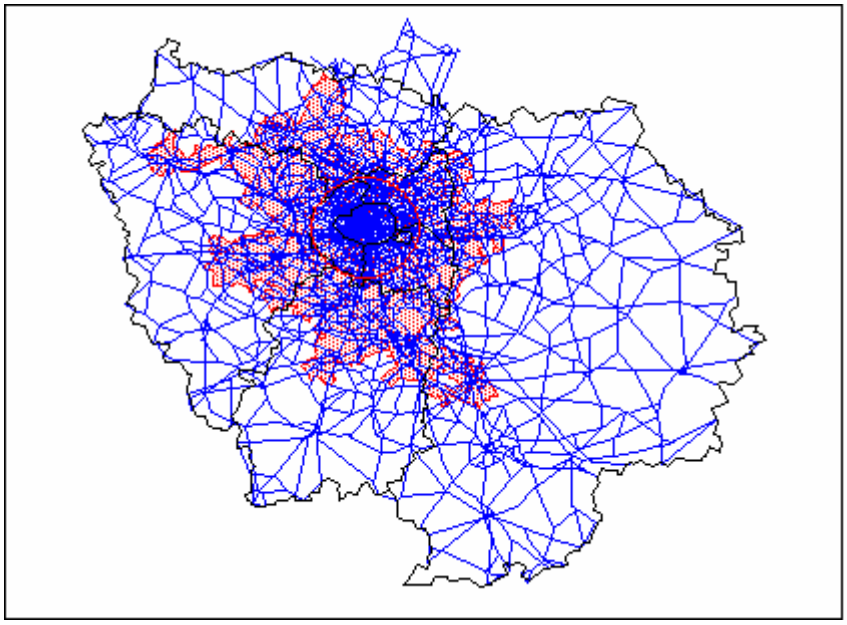

Figure 10 : Demonstration areas for street level pollution modelling

3.1.2 Current transport situation

The shift of population towards the outer suburbs is accompanied by an increase of 2% per year of road traffic and by a modal shift from public transport and pedestrian trips to car trips (presently 45 % of trips are made by car). An extrapolation of current trends to 2015 results in an increase of 55 % of the volume of traveller * km, 2/3 of them made by car. The main reasons for these trends include the ability to use the public transport network for trips from suburb to suburb, and the increasing number of trips other than between work and home. Also, the development of transport infrastructures and traffic management has led to an increase in the average speeds of motorised trips, and hence of their scope. Concerning public transport, frequently named problems are insufficient quality of service, multiple institutional responsibilities, and pricing systems adverse to inter modality. Goods transport is increasing and mostly performed by road.
From 1999 statistics, while there is only 0.79 million registered vehicles in the city of Paris, the entire Region of Ile-de-France contains 5.43 million registered vehicles. The total traffic volume is about 85.4 million vehicle x km/day in Ile-de-France region. The traffic trend in Paris is stable from 1990 but the highways around Paris and the main roads support the grows of the traffic evolution.

The composition of the running fleet has been estimated for the year 1998: 71.1 % private cars, 17.7 % light utilities, 7.7 % heavy duty vehicles (including buses) and 4.5% two wheelers. The large private car fleet can be broken up as follows:
-50.4% diesel
-26.6% non catalysed gasoline
-23% catalysed gasoline.

3.1.3 Meteorological conditions

The Ile-de-France region benefits from a mild climate that is favourable to the dispersion of pollutants with the relatively flat topography making the climatic conditions over the entire Ile-de-France Region quite homogeneous. Nevertheless, sunny periods with anticyclones and low wind speed combined with important thermal inversion conditions limit the dispersion process and lead to pollution episode (around 20 days per year in average). Some climatic indicators of Paris calculated over 30 years are given below:
-Temperature range: 2.5°C (av. Winter min.) to 23.7°C (av. Summer max.)
-Average yearly rainfall: 642 mm with 112 rain days / year
METEO-France handles around 20 meteorological stations in the Ile-de-France region

3.1.4 Current air quality situation

To monitor air quality, AIRPARIF handles around 52 air quality measurement stations. This network comprises a total of 137 automatic analysers and 18 sensors for laboratory analysis.

Over the last 10 years in Ile-de-France region, levels for SO2, lead and black smoke have declined to levels that are consistent with European guidelines. The same cannot be said for ozone and for the ozone precursors like NOx and Benzene whose levels have not decreased significantly and remain the subject of particularly intense monitoring. In the past years, NO_2 has been the pollutant which has provoked the entry of temporary emission reduction measures. Besides the concentration maximum, the annual average concentrations of NO_2 is superior to the legal quality objective in some parts of the agglomeration.
The ozone concentrations have repeatedly exceeded their threshold in the past years. The highest ozone peaks are recorded in the rural zones of the region. The ozone pollution peaks are accompanied by relatively high average concentrations.
Two further points of concern are the benzene concentration, which are more than twice as high as the legal quality objective, and the particles. The legal limits relying on black-smoke measures are respected, but high concentrations of fine particles (PM10 and PM2.5) are observed in the vicinity of road traffic.
Traffic is the main responsible for non-attainment of legal quality objectives.
The emissions are mainly concentrated in the dense urban area of the Ile-de-France region.

3.2 Monitoring and modelling

3.2.1 Air quality monitoring

To monitor air quality, Airparif handles 52 air quality measurement stations.

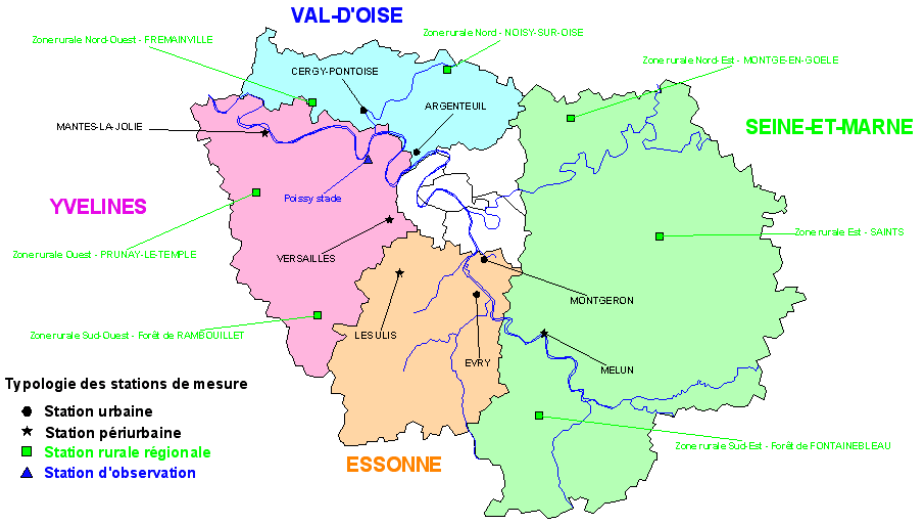

Figure 11: Location of measurement stations for air quality monitoring (Ile-de-France region)

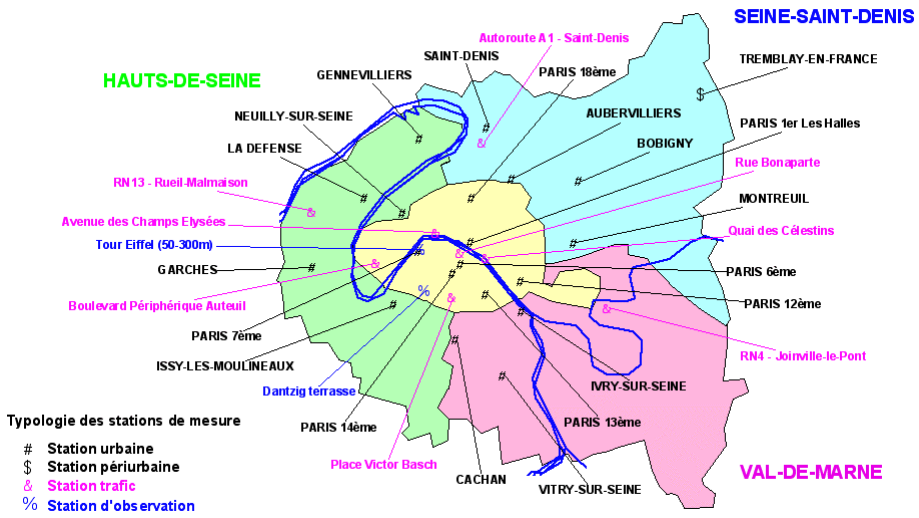

Figure 12: Location of measurement stations for air quality monitoring (Inner area of Ile-de-France region)

This network comprises a total of 137 automatic analysers and 18 sensors for laboratory analysis.

Automatic measures								Laboratory measures					
NOx	O3	SO2	Black Smoke	PM10	PM2,5	BTX	CO	As, Cd, Ni	Pb	PAH	MAH	Alde-hydes	VOC
40	26	30	19	8	2	3	9	2	2	4	8	1	1
Total analysers:					137			Total sensors:			18		

3.2.2 Emission inventories

The emission inventory presently used has been constituted for the year 1998. Diffuse sources (domestic heating and biogenic emissions) have been provided by the industry-related agency CITEPA. The government agencies DRIRE and ADEME have provided the inventory of point sources. Data on industrial point sources have been provided by the industry. Aéroports de Paris has provided data on air traffic emissions. Road traffic emissions are based on COPERT emission factors, on fleet data provided by ADEME and INRETS, and on fuel data from the EPEFE program.

The emission inventory is currently updated to the status of year 2000.

Emissions related to road traffic are identified by SNAP category 07. They can be isolated from other emissions.

3.2.3 Traffic Monitoring

The Ile-de-France Region counts 45 000 km of primary roads in which 630 km are motorways. For comparison, underground represents 200 km and express trains network 487 km.
The existing traffic monitoring covers a large part of the main road network. It relies on inductive loops.

Network	*Operator*	*Coverage*	*Inductive loops*
Urban road network	City of Paris	200 km	2000
Regional main roads and highways	DREIF/SIER	650 km	2500

The data are centralised in real-time by the respective traffic control centres. They are used for traffic management, for driver information by VMS, and for travel information services by the operators themselves (SIER) or by other travel and traffic information service providers.

4 Outcomes from WP7

4.1 Actions to be taken after verification, Paris

Further investigate roadside concentration modelling for hourly estimates

Concerning the hourly roadside concentration modelling, different approaches were or are still under investigations.

The first approach concerned the adaptation of the street version 4 model in order to deliver hourly estimates instead of annual estimates.

This approach has been the subject of a feasibility study and has given insufficient results, as reported in deliverable D7.

The second approach under investigations is the use of statistical filters that will be specifically developed within the Heaven framework.

The idea is to make use of the annual estimates given by the street model version 4 for every street and to go from annual estimates to hourly levels of pollution using statistical filters based on the hourly estimated traffic status and on the background estimates of pollution and meteorological conditions. The investigations related to this approach started at the beginning of April and should be achieved and tested for next September.

The third and last approach investigated is the direct use of a 3D model called Sirane which has been developed by the Ecole Centrale de Lyon.

A one year collaboration between Airparif and the laboratory in charge of the development of the Sirane model has been set up at the beginning of the year 2002 in order to adapt the Sirane model to Paris site and to test it on a 3 x 3 km^2 domain located in the east of Paris (see figure on the next page). During October 2002, an intensive air quality measurement campaign will be set up in this domain in order to be able to assess the accuracy of the modelling tool. The results of these investigations should be available at the end of the year 2002, before the end of the Heaven project.

Figure 13: 3 x 3 km^2 domain in the east of Paris for assessment of the Sirane model

Conclude development of information platform

The verification of preliminary user acceptance has given the following hints for this task:

- Try to create a compact "bulletin" page on the Website or some other function for quick synthetic information in real-time, in order to avoid that users get overwhelmed by the quantity of information.
- Add some geographical details to maps, and more explicative legends at some points.

Be aware that Heaven information is modelled
The local partners have got aware of the necessity to insist, when promoting and presenting the Heaven DSS to non-specialists, on the fact that the validity of the Heaven information is subject to the natural limitations of a modelling approach.

Evaluate user acceptance by general public
The evaluation will be done by WP3, whose activities are planned to start as soon as the information platform is finished.

4.2 Contingency/Backup arrangements for supporting DSS output

While hourly values for roadside pollutant concentrations are not available, the DSS will deliver annual mean values. The annual means have been verified positively by WP7.

5 Implementation of RTD/demonstrations on the site

5.1 Implementation in Paris

The operational goals programmed for the demonstration phase on each site are listed in the following table.

	Demonstration site (code)					
Research/demonstration tasks	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**
D.1 Demonstrate new monitoring technologies		x				
D.2 Validate the improvements in forecasting quality of new air and noise quality models	x	x	x	**x**	x	x
D.3 Provide content, operate and demonstrate the benefits of a comprehensive decision support system	x	x	x	**x**	x	x
D4 Implement an information platform on air and noise pollution		x	x	**x**	x	x
D5 Involve citizens in consultation processes and to raise their awareness on the effects of mobility decisions		x	x	**x**	x	x
D6 Provide valid data for health authorities		x			x	
D7 Evaluate the environmental effects of the demonstrations in the project	x	x	x	**x**	x	x
D8 Analyse the socio-economic benefits and user impacts of the demonstration work in the project.	x	x	x	**x**	x	x

Site Key:
S1= ROME, S2=ROTTERDAM, S3=BERLIN, S4=PARIS, S5=LEICESTER, S6=PRAGUE

In Paris the achievements of these goals relies on the following activities:

D2 The new air quality models improve the description of the current air quality situation, bringing a near-real-time description:

- Hourly update of the air quality description based on real-time supply of traffic data, meteorological data, and air quality monitoring data; before Heaven, the air quality description did not take into account the day-to-day traffic situation, and was updated once per day (three times for short term forecast).
- Hourly estimates of roadside pollution: before Heaven, only annual means were computed.

The validation of these improvements is the object of the evaluation indicators belonging to impacts 1 and 3. They include, among others, a monitoring campaign for validating the improvement in street level air quality modelling.

D3 During the entire demonstration phase, the DSS will be in continuous operation. Through its information platform (Web site), the local project partners will be able to demonstrate the systems operation in numerous occasions and in many circumstances.
The interviews which will be conducted for the evaluation of the indicators related to user acceptance, usefulness, and support for urban planning, will equally rely on a practical demonstration of the DSS. It is through the feedback of these demonstrations, and through its formalisation by the related evaluation indicators, that the benefits of the DSS will be demonstrated.

D4 The local Heaven Web site represents the information platform of the DSS. It will be in continuous operation (with hourly update) during the demonstration phase.

D5 Citizens will have free access to the current status of the air quality description through the information platform (Web site). In particular, the *bulletin*, which gives a synthetic view of the situation of meteorology, traffic, emissions, and pollutant concentrations, is an element of the information platform which can make visible the link between traffic and air quality, and thus contribute to raise awareness for the impact of mobility decisions on air quality. The presentation of selected scenario modelling results on the web site has the same objective.

D7 The environmental effects of the demonstration will not be direct since the DSS will not motivate directly, during the demonstration phase of Heaven, the implementation of TDMS measures.

The effects will be indirect, and their evaluation will namely be the object of impact 5: Increased support for urban planning on an environmental basis.

D8 The user impact and socio-economic benefit will be investigated through the demonstrations of the DSS to general and professional users, as they are planned in the framework of evaluation interviews, and foreseeable in many other circumstances.
The evaluation interviews and the formalisation of the feedback through the related evaluation indicators will be the privileged means for the analysis of impacts and benefits.

5.2 TDMS/Scenario Modelling

5.2.1 Sensitivity tests

30 scenarios will be tested for the assessment of evaluation indicator 2.3.

This indicator aims primarily at measuring the person time spent to produce environmental description on scenario analysis with the DSS and at comparing it to the average time spent to produce the same environmental description prior to the HEAVEN DSS.

But furthermore, the same scenarios will be used as sensitivity tests to demonstrate the potential impact of simple strategies of reduction of air pollution.

In addition, these scenarios will be used for evaluation indicator 5.2, for a qualitative assessment related to the utility of the Heaven DSS for urban planning.

Five parameters can be tested:

- a homogeneous speed reduction of 20% for the whole running fleet (passenger cars, Light duty Vehicles, Heavy Duty Vehicles, Buses, Mopeds, Motorcycles);
- a vehicle fleet without Heavy Duty Vehicles (>3,5 t) (Heavy Duty Vehicles will not be reallocated among the other vehicle categories),
- a vehicle fleet without two wheelers (mopeds and motorcycles) (two wheelers will not be reallocated among the other vehicle categories),
- a scenario without traffic related emissions (i.e. emissions without snap 07),
- a scenario anticipating for each type of vehicle fleet (passenger cars, Light Duty Vehicles, Heavy Duty Vehicles, Buses, Mopeds, Motorcycles) the implementation of the most advanced legislation (Euro IV or Euro V) related to the emission factors.

At Paris site level, the indicator 2.3 will be evaluated for roadside (PM10, NO2, CO and C6H6 at the morning rush hour) and for background (NO2, O3 on one day) air quality. Each scenario will be described for three different sets of meteorological conditions. One set will be related to the average meteorological conditions observed in the demonstration area for the month of October, the two others will be related to more acute conditions, leading to higher levels of air pollution (the first one corresponds to a severe winter episode, the other one to a severe photochemical episode of July).

Together, 30 runs will be performed: 5 parameters x 3 meteorological conditions x 2 modelling tools (background and roadside).

The Airparif modelling team will run the scenarios concerning the background pollution between June and October 2002. The results will be reported by WP3. The scenarios concerning the roadside pollution will start once the roadside modelling module is validated and set up.

5.2.2 Site Specific Scenarios

No specific tests are planned at present stage (i.e. only the 30 test runs described in the preceding paragraph will be executed).

Also, it is not planned at present stage to use the scenario modelling function "in real-time", i.e. for running different scenarios during a particular actual air pollution peak before deciding on the TDMS measure applicable to this particular air pollution peak.

5.3 Timetable

5.3.1 Progress to date

Paris has progressed well during the project timetable.

The system implementation is nearly complete. The interfaces to traffic control centres and to meteorological and air quality data sources are operational. The DSS modelling will be operational at the end of September with the exception of near real-time street level modelling (see section on Outcomes of WP7). Scenario and system management is implemented. The information platform has to be completed.

Verification has been concluded in May 2002. Evaluation activities are ongoing.

5.3.2 Future progress

During WP8, progress has to be achieved in system upgrade:

- Completion of information platform
- Implementation of near real-time street level modelling.

In parallel, evaluation activities are ongoing. Several evaluation indicators depend on the conclusion of the system upgrade.

The planned timetable of activities is indicated in the Gantt chart below.

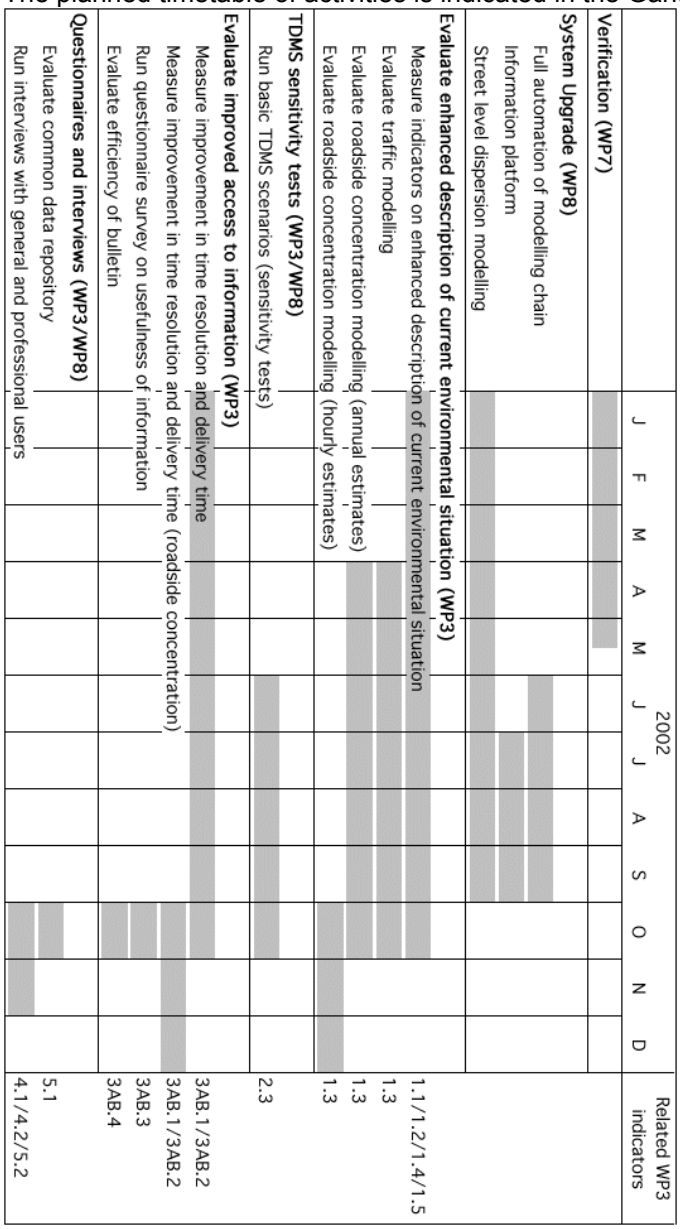

Figure 14: Planning for Demonstration phase.

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ANNEX A

The following table provides a list of the tools used in Paris:

Type of modelling	Type of model
Meteorological modelling	Météo-France ARPEGE weather forecast
Traffic modelling	• Specific development for HEAVEN based on extended DAVIS model
Emissions modelling	Specific development for HEAVEN based on: • Extended genco3_EMITRA model as a pre-processor • DSS_EMI chain specifically developed
Street level concentrations modelling	• "Street" V.4 for annual evaluation • Specific development ongoing for real-time evaluation
Background pollution modelling	• Specific adaptation for HEAVEN of the POLLUX system based on chemistry-transport model CHIMERE