APRIL 2016

Technical and Financial Proposal

Delivery of Professional and Expert Local Services, Software Upgrades and Maintenance

IMOE Air Quality Modeling System

REFERENCES: 15.088

TYPE OF DOCUMENT: PROPOSAL

DOCUMENT STATUS: V5

ACCESS: CONFIDENTIAL

1. Proposed services

1.1 General management of the project

ARIA Technologies has been providing services including maintenance to the MOE since 2003, by bringing a **large team of scientific experts with several years of experience in air quality projects worldwide**, and most specifically of projects which involve both the National and the Urban scale. Since then, ARIA have been working for Romania, with the ROMAIR Project, in Tunisia, with the TUNAIR modelling project, coming after the successful completion of the National Emission Inventory for Tunisia, in Delhi, Beijing, Indonesia among others... For a more detailed list of references, please see the annexes.

In order to adapt our services to the evolving needs of the MOE, ARIA Technologies proposes a reorganization of the management of the project with the recruitment of **a skilled team** which would be **permanently based in Israel** and cooperate with our team in France.

1.2 Composition of the team

French team:

Expert	Status in ARIA	Role in the MOE project
Jacques MOUSSAFIR	ARIA C&O	Coordinator
Fanny VELAY	Engineer in the Regional modeling team	Project Manager and responsible of the regional modeling
Didier BUTY	Development manager	Responsible of the software
Eva-Marie ERIKSSON	Emission expert	Emission expert
Claude DEROGNAT	Manager of the regional modeling team	Regional modeling expert
Alexis BECKMANN	IT Manager	Responsible of informatics systems

ARIA will provide the services of **two local experts** to the MOE, one of them being staffed 100% and the other 50%. The required profiles of the experts are the following as expressed by the MOE. Their recruitment will also be done in agreement with the MOE.

One expert with a PhD level in geophysics, environmental engineering or environmental sciences with the following experiences:

- at least two years of experience with numerical meteorological models such as WRF, MM5 or RAMS
- at least two years of experience with photochemical numerical models such as MM5-CMAQ, ChemEx and CHIMERE
- at least two years of experience with lagrangian dispersion models for regions with complex topography

- at least two years of experience with EPA approved dispersion models such as AERMOD

A second person full time with the following experience:

- Graduate or master degree in environmental sciences, engineering, or other equivalent background
- at least one year experience with dispersion models such as AERMOD, CALPUFF

2. Company profile

2.1 General

ARIA Technologies (www.aria.fr) was established in 1990 to respond to a single concern, the atmospheric environment, through numerical simulation of the dispersion of pollutants in the atmosphere. This single-focused specialisation has enabled ARIA Technologies to build a comprehensive team of engineers, research scientists, and environment specialists who bring together the knowledge of fluid dynamics, meteorology, atmospheric chemistry, applied computing, database management, and geographic information systems (GIS).

ARIA Technologies continually strengthens its competence through collaboration with leading laboratories in the area of fluid dynamics modelling (EDF – The French National Electricity Board, CNRS – The French National Council for Research, and many others, CNR/ISAC – The Italian National Center for Research, NCAR – The National Center for Atmospheric Research, USA).

It addresses its environmental tasks through two complementary approaches: design and development of computer-based simulation systems; research studies and consulting services. By developing its own tools as well as using simulation systems developed by selected partners, ARIA can get a deeper insight in the limitations of the models and confidently guarantee the quality of its response to its clients' requirements. Although they share a single concern, our clients are very diverse: companies, engineering consultants, government administrations, local councils, air quality monitoring networks, public and private research laboratories. This is because ARIA Technologies' simulation tools cover a vast range of applications, from continental to local scale, to study all cases from indoor air pollution to accidental releases or to the impact of traffic on air pollution.

Being a company completely dedicated to Atmospheric Environment problems, ARIA Technologies is a leading supplier of computerized modelling systems for the purpose of managing Air Quality Resources, and offers a very extended range of tools. This fact allows full confidence in the capacity of ARIA Technologies to provide further developments, continuous support and potential extensions for the systems provided to the users.

ARIA Technologies employs full time a group of over 25 scientists and engineers, with a specialization in Fluid Dynamics, Meteorology, Chemistry, Air Pollution, Computer Sciences, Databases and experience in the Environmental field. The company has a sister company in Italy, ARIANET Srl, established in 2001, with a staff of 15 scientists and engineers, a subsidiary in Rio de Janeiro, Brazil, with a staff of four, and also a commercial office in Mexico City.

ARIA Technologies' ID:

Trade Mark	**ARIA Technologies**
Created	1990
Core Business	Twenty five years of expertise and continuous growth in sales for the past 10 years enabled ARIA to provide: • High-end consulting service and advice along with training for experts in the field. • Vertical Software package (Impact, Risk, Regional, Wind, View) • Integrated systems (with industrial partners) that include sensors and operation services.
Site web	www.aria.fr
Status	Société Anonyme RCS Nanterre B 379 180 474
Headquarters	Boulogne-Billancourt (92100)
ARIA group	Participation 90 % ARIA do Brasil, Rio de Janeiro, Brazil Participation 33.4 % ARIANET SrL, Milano, Itay

Headcount ARIA Technologies (France)		
	ARIA Technologies France	ARIA Do Brasil Rio de Janeiro
Top Management	2	
Sales & Marketing	3	1
R&D	11	
Scientists	9	2
Total	25	3

2.2 Presentation of ARIA software installed in MOE

2.2.1 ARIA Regional: a complete tool for air quality management

The Air Quality Modelling System, referred to as **ARIA Regional** in the present document, is a computer tool (Software) allowing the following objectives to be realized:

- Integrate on **a Cluster System** all the data relevant for managing the complexity of atmospheric pollution problems: geography, meteorology, emission data, and measurements of ambient air quality data. The system provides the user with an operating environment, which is tailor-made for the purpose of performing different air quality management activities. The AQMS has a user-friendly interface and a **flexible software** system that allows the client to add on other modules in the future.
- Manage the presentation of Monitored Air Quality Data and Meteorological Data available for the area, allowing the **Graphical display** of raw data as well as different statistical summaries. Provide an easy **Display and Animation** of all the data on a map of the city and its surroundings.
- Create and update the **Emission Inventory** integrating a complete and detailed description of various sources (industries, traffic, area, domestic, biogenics), compatible with SNAP and SCC nomenclature.
- Make use of available emission data of in order to carry out **scenarios of emissions** in 2D/3D for the study of **specific episodes** using atmospheric modeling.
- Manage **simulations of specific episodes** allowing the realization of weather scenarios **in 3D** for the study of past episodes.
- Implement a **photochemical model of dispersion** based on data in the other modules of the system.
- To **forecast the levels of pollution** of ozone and NOx up to three days ahead (D+3).

2.2.2 General architecture

The major software installed at the MOE consists of 2 main programs:

- **ARIA Toolbox** which includes the list of software presented in Figure 1. It contains:
  - IMPACT → The Gaussian model for long-term studies
  - Landuse → Module used for the extraction of landuse data on a given tile
  - Relief → Module used for the extraction of relief data on a given tile
  - SPRAY → Lagrangian particles model
  - EWB/savi3D → 3D visualization software
  - COMBAS → model/measurement validation tool

- **ARIA Regional Client** which is a GUI of the WRF/CHIMERE models allowing to browse the forecast results but also to launch the operational chain in scenario mode (see Figure 2).

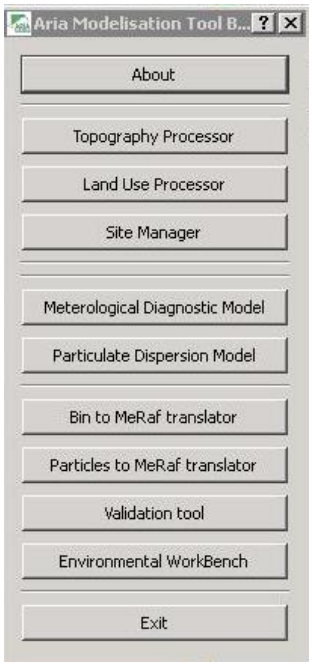


Figure 1: Aria Tool Box

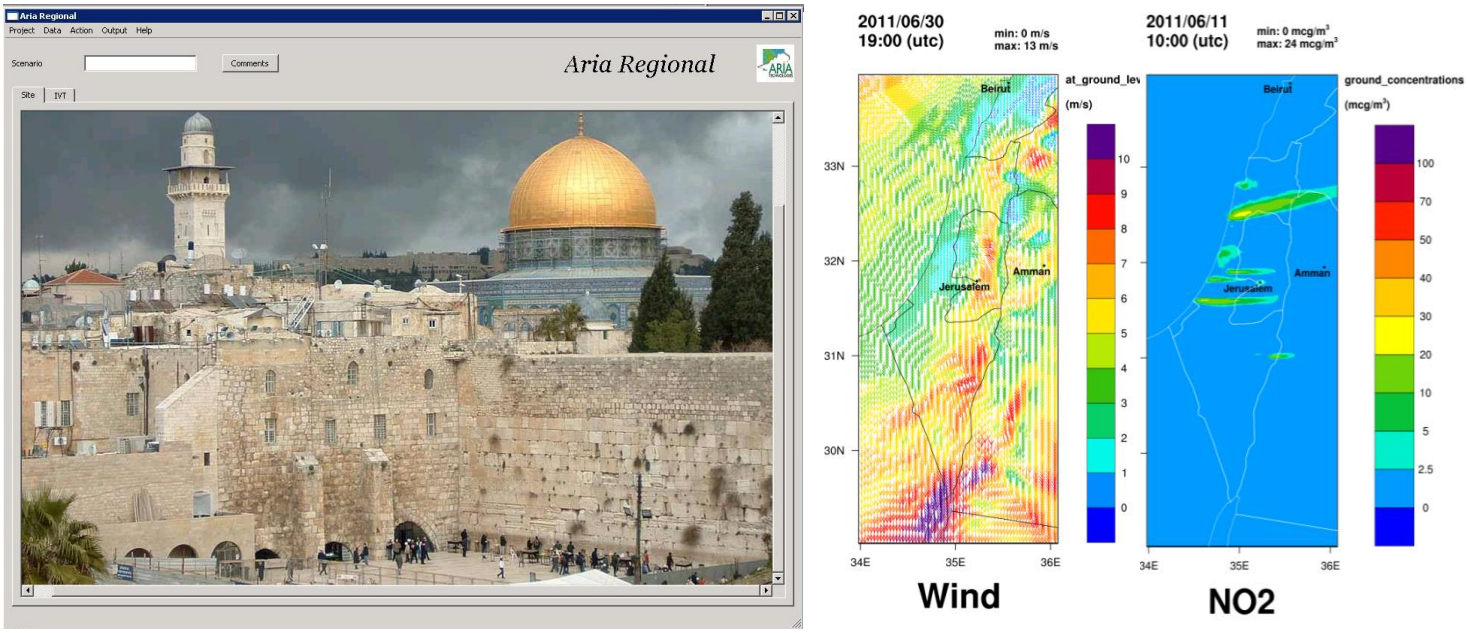


Figure 2: ARIA Regional GUI

2.2.3 The forecast system

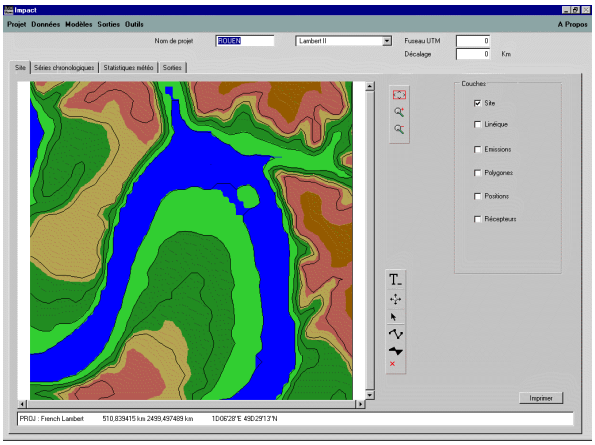
Among the software installed at the MoE, an automatic forecast system runs every day on the cluster on 8 CPU.

The air quality forecasting system main specifications are the following:

- Produce a daily (365 days a year) forecast of air quality.
- Each forecast gives results for the following two days.
- The WRF meteorological forecast runs over three nested grid at resolution of 54, 18 & 6 km with 37 vertical layers
- The photochemical model (CHIMERE) runs over three nested grid at resolutions of 46, 18 & 3 km with 8 vertical layers
- Maps and extractions at station locations are given for the following pollutants:
    - Ozone (O_3)
    - Nitrogen dioxide (NO_2)
    - Nitrogen Oxides (NO_x)
    - Particles (PM10)
    - Fine particles (PM2.5)
    - Sulfur dioxide (SO_2)
    - Volatile Organic Compounds (VOC)
    - Other pollutants can be post-treated upon request
    -
- Data archiving:
    - The daily forecasts are archived in NetCDF files on the MOE data servers. This includes both meteorological parameters (WRF model output) and pollutants (CHIMERE model output) at all vertical layers
    - A monthly file is produced with the hourly forecasts of all pollutants at the lower level of the model (near surface)
    - The vertical profile of all meteorological parameters are extracted over given locations specified by the MOE, twice a day (at 00 GMT and 12 GMT) for comparison with operational radiosondings. The parameters will include: height, barometric pressure, wind speed and direction, dry air temperature, dew point temperature, relative humidity, cloud cover.

2.2.4 Description of the main modules

ARIA Impact



ARIA IMPACT is a **local scale gaussian** model specially designed for evaluating the long-term impact of emissions from industrial sites, vehicular traffic and diffuse sources. ARIA IMPACT conforms to the norms of the Environment Protection Agency (EPA), United States.

The principle is to simulate several years of site operation by using representative meteorological time series. The software allows time-dependent modulations including daily, monthly, and annual variations and user-specified functions (deleting peak periods, downtime) for a realistic simulation of an operational site.

ARIA IMPACT outputs ground-level pollutant concentrations as isolines or colored areas superimposed on a map of the study site. The output options available with ARIA IMPACT include:

- Wind roses and time series for meteorological data
- Graphical output of a 2D cartesian calculation grid of any of the following parameters:
  - Concentration as an annual average (daily or hourly basis)
  - User-specified percentiles (e.g. P98, P100)
  - Frequency of exceedance of limits, linked to regulatory values and guidelines
- Tables:
  - Concentration calculated for the simulation period for receptor points
  - Printouts of dates corresponding to high concentration levels

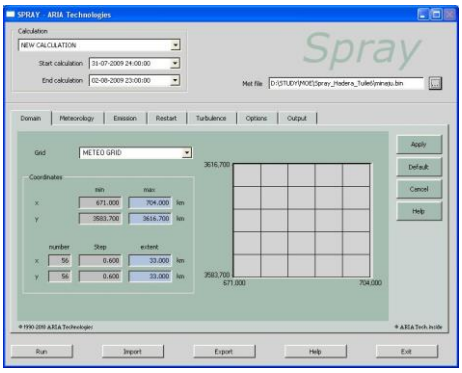
The user has a choice of several computing configurations depending on the specific objective:

- Topography computation based on simple terrain regime
- Various options for calculating the atmospheric stability class
- Several algorithm options to account for plume rise for stack emissions (Holland, Briggs, Anfossi)
- Algorithm for calculating the impact of sources in the case of calm winds
- Calculation of dry and wet deposition

Automatic calculation of deposition velocity of particles based on particle size and density

A call of the **AERMOD** model has also been included in the IMPACT GUI in 2012. This version has been upgraded at the MOE as part of the maintenance contract.

SPRAY



SPRAY is a **three-dimensional lagrangian particle dispersion model** developed by Arianet S.r.l. in collaboration with Aria Technologies SA. This code reproduces the transport, dispersion, dry and wet deposition and radioactive decay of airborne chemically inert species released in meteorological complex conditions (low windspeed, flow over complex topography), often marked by spatial and temporal inhomogeneities of the meteo-diffusive variables (e.g. vertical wind-shear, breeze due to the presence of terrain discontinuities). In addition, it is also possible to reproduce the dispersion of particulate emissions, taking into account the gravitational vertical settling phenomenon. SPRAY can simulate emissions from point, area or line sources, continuous and discontinuous, as well as to exploit the available wind and turbulence measurements provided by advanced meteorological instruments (such as SODAR Doppler and RASS). In a Lagrangian particle dispersion model the airborne pollutant is simulated by means of certain number of 'virtual' or 'pseudo' particles, each of them representing a determined pollutant mass; such particles are supposed to follow the turbulent motion of the air particles in which they are introduced, so that their spatial distribution at a certain time reveals the concentration of the emitted substance

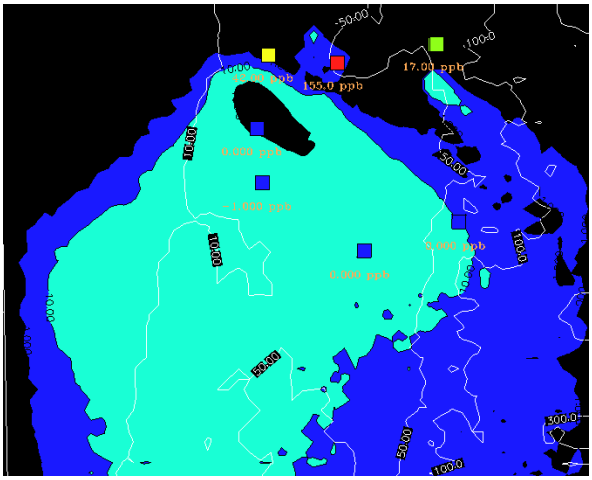


Figure 3: Example of a test case over Hadera

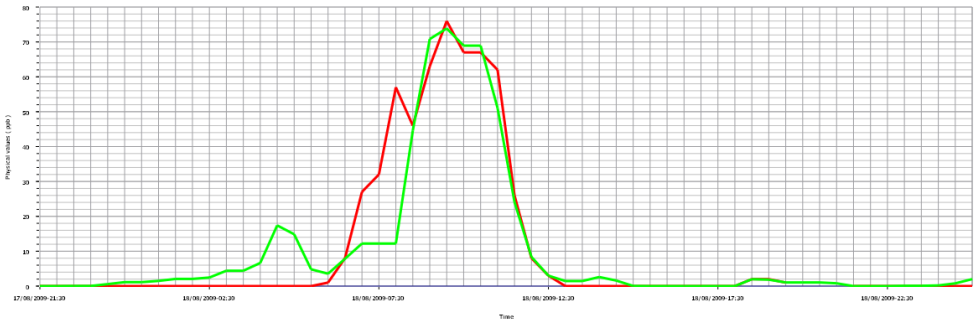


Figure 4: Example of validation case in the Hadera area (model in green, measure in red)

FARM

FARM (Flexible Air quality Regional Model) is a three-dimensional Eulerian model that accounts for the transport, chemical conversion and deposition of atmospheric pollutants. The code has been derived from STEM (G.R. Carmichael, Centre for Global and Regional Environmental Research, Univ. of Iowa), a model extensively used and tested during the past two decades (Kitada et al., 1984; Carmichael et al., 1986; Hong and Carmichael, 1986; Chang et al., 1990; Carmichael et al., 1991; Shim and Carmichael, 1991; Mathur et al., 1992; Carmichael et al., 1998).

FARM major features include:

- emission of pollutants from area and point sources, with plume rise calculation and mass assignment to vertical grid cells;
- three-dimensional transport by advection and turbulent diffusion;
- simple or detailed cloud module;
- transformation of chemical species by gas-phase chemistry, with flexible mechanism configuration;
- dry removal of pollutants dependent on local meteorology and land-use;
- wet removal through precipitation scavenging processes;
- possibility of one- or two-way nesting with an arbitrary number of computational grids
- interface with a complete modeling system for multiscale air quality simulations.

The code can be configured to be used in a variety of applications, according to specific problem features, computational resources and data availability.

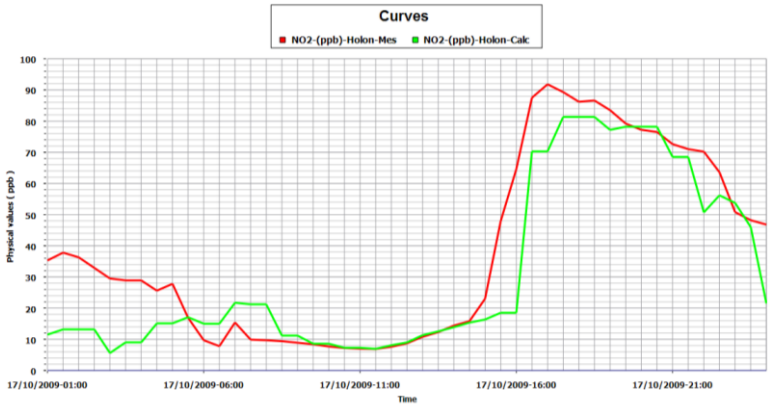


Figure 5: Example of validation in the Tel Aviv area

CHIMERE

CHIMERE (http://www.lmd.polytechnique.fr/chimere/) is one of the models included in ARIA Regional. The CHIMERE multi-scale model is primarily designed to produce daily forecasts of ozone, aerosols and other pollutants and make long-term simulations for emission control scenarios. CHIMERE runs over a range of spatial scales from the regional scale (several thousand kilometers) to the urban scale (100-200 Km) with resolutions from 1-2 Km to 100 Km.

CHIMERE proposes many different options for simulations which make it also a powerful research tool for testing parameterizations, hypotheses. Its use is relatively simple so long as input data is correctly provided. It can run with several vertical resolutions, and with a wide range of complexity. It can run with several chemical mechanisms, simplified or more complete, with or without aerosols.

CHIMERE is also used daily in operational systems in order to provide forecast of air pollution:

- French air quality forecast PREV'AIR
- for french regions with:
    1. AIRPARIF
    2. AIRMARAIX
    3. ASPA
    4. Air Normand
    5. ESMERALDA
- In Europe, with:
    1. ARPA-sim (Italy)
    2. University of L'Aquila - CETEMPS (Italy)
    3. IRCELINE (Belgium)
    4. KNMI (Netherlands) etc.

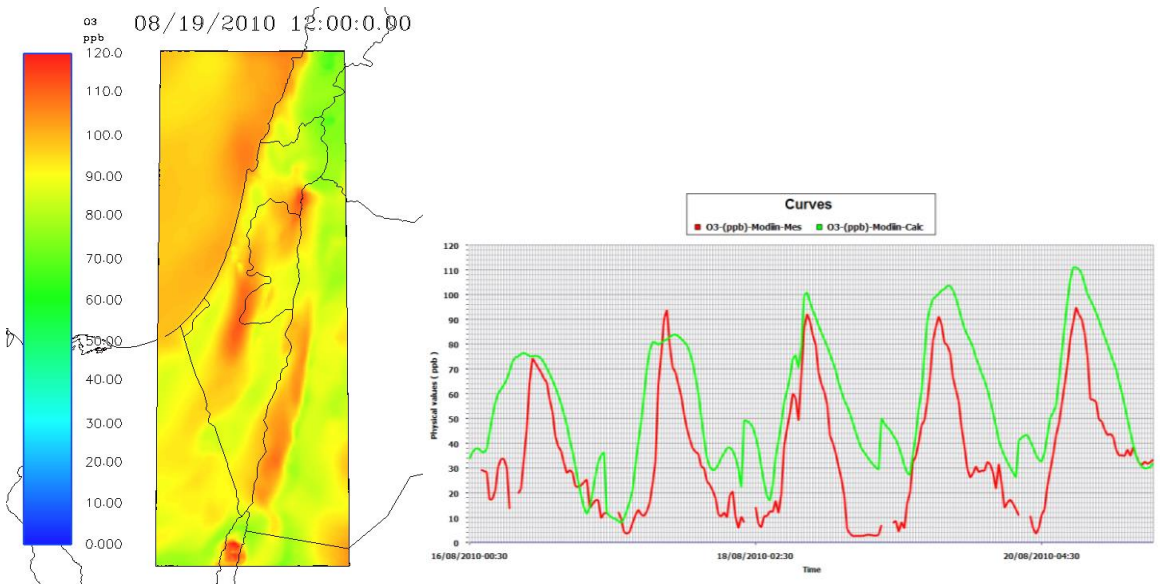


Figure 6: Ozone concentration map and validation example for CHIMERE

WRF

The meteorological forecast is performed using the **WRF** (Weather Research & Forecast) model (http://wrf-model.org/index.php), a next-generation meso-scale numerical weather prediction system designed to serve both operational forecasting and atmospheric research needs. The model features multiple dynamical cores, a 3-dimensional data assimilation system, and a software architecture allowing for parallel computing. The model has a broad spectrum of applications across scales ranging from meters to thousands of kilometers**.**

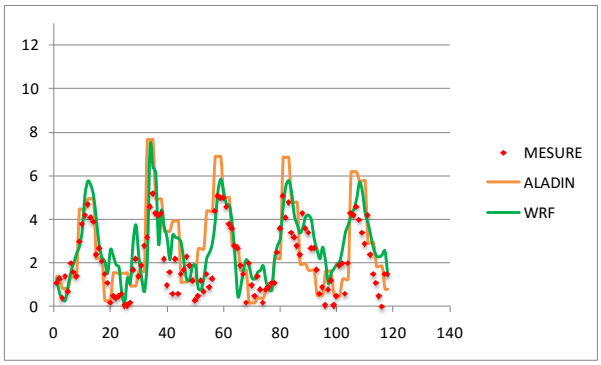


Figure 7: Example of validation case for WRF

SWIFT

SWIFT is a 3D wind field model for complex terrain. It produces a mass-consistent wind field using data from a dispersed meteorological network. Temperature and humidity fields can also be interpolated with SWIFT.

Reconstruction of a wind field with SWIFT requires two types of data:

- site topography data
- meteorological data, including:
    - data on wind and, if possible, on temperature and relative humidity near ground level (surface layer) as well as location of measuring sites;
    - data on wind and, if possible, on temperature and relative humidity in the upper air, in the form of vertical profiles at a single point.

3D reconstitution of the wind field requires data from at least one measuring site and one vertical structure.

Several interpolation procedures can be used, depending on the number of available data.

Variations in the stability coefficient can be taken into account by entering one or more temperature profiles.

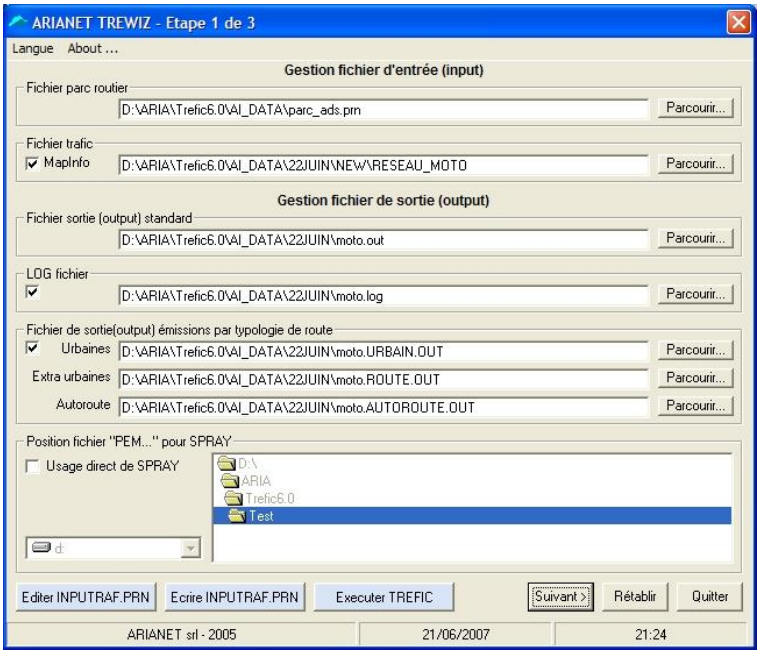
TREFIC ("TRaffic Emission Factor Improved Calculation")
has been conceived to answer to the many specific requests which arise when calculating the atmospheric pollutant emissions from road sources. Such requirements, actually, can be concerned both with emissions estimates in a project/planning framework (emission inventory) and with specific emissions calculation in order to use modeling methodologies with diagnosis/forecast objectives (air quality standard agreement of scenarios).
The program is based on COPERT VI methodology for the calculation of road vehicles EF, taking into account specific features, as:

- vehicle type;
- fuel consumption;
- average traveling speed;
- road type.

The EF calculation methodology includes all necessary information to determine road vehicles emissions, in terms of pollutant mass per trip unit. This methodology, implemented in a computing module which is the core of TREFIC software, is the base of a system built in order to :

- pre-process the input to make it compliant with CORINAIR specifications;
- determine, from emission factors, total emissions for each link of the road network;
- produce synthetic and GIS output of these emissions;
- produce input files for dispersion models.

Moreover, software is provided with a simple GUI to help the execution.



***EWB** (Environmental Workbench)* is the new name of **SAVI3D** a commercial 3D Graphics software package designed by SESSCO (Minneapolis, USA) completely interfaced with the "ARIA REGIONAL" system. All model outputs may be displayed in a uniform way through this 3D package. It is invoked from the standard **ARIA Regional** user interface, and presents the user with an ensemble of specific control windows, which allow any manipulation of the model outputs.

This module includes all the classical graphical data display functions, which we shall not describe in full detail here. We like to insist on its most striking features:

- **Full 3D capabilities**: the user manipulates the 3D simulation domain with control knobs, allowing to move into every view point of the domain in a natural way. The 2D map, like upper views, is simply obtained by letting the horizontal plane in its default position, but any perspective view of the plumes may be obtained.

- **Object orientation**: there is no predefined plot or view of the data. All data and model output may be converted into graphical objects and displayed simultaneously or separately into the 3D domain. The user is free to choose his favorite colors, legends and presentation features with extremely simple commands.

- **Time animation of network data**: the stations may be displayed on a vector map in the form of color icons, whose size and color are controlled by the displayed value.

- **Time animation of color contours**: when looking at a time-dependent simulation, the animation of contours deduced from 3D model output or data interpolation is a natural function, controlled by a VCR-like button.

- **Time animation of wind vector plots**: a set of widgets is used to control the presentation of 3D vector fields, allowing to understand the circulation of the wind flow really better than with 2D projections only, especially when small scale simulations are performed.

- **Iso-surfaces with transparency** : the concentration distribution may be viewed as nested iso-value surfaces, with varying transparency. The inner part of a highway plume may be then be colored with one color corresponding to a high concentration value, while the outer part may be colored with a lighter color, and transparency.

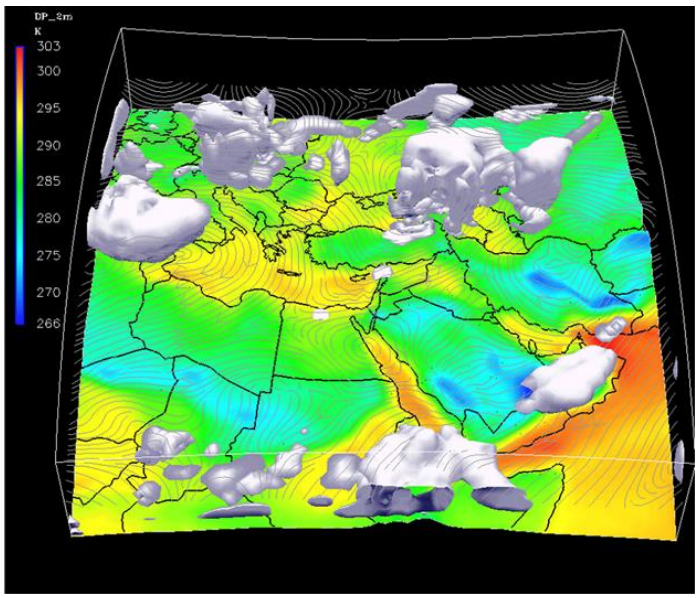


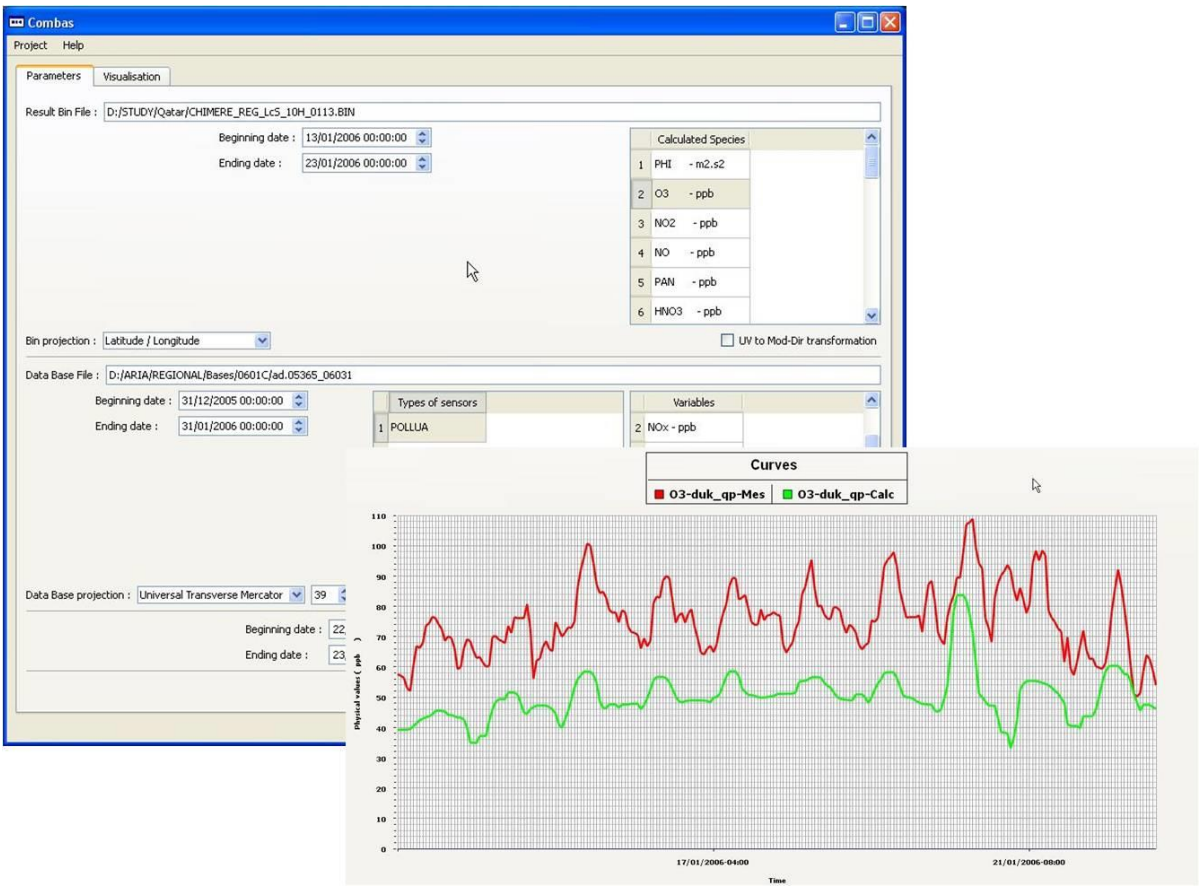
Figure 8: Example of Savi3D figure

COMBAS

The COMBAS tool has been developed in order to plot model/measurement comparison.

It is based on the methodology of “best neighbors”. The COMBAS executable is delivered with a client GUI which allows easily:

a. display the result of the comparison, allowing to print and export graphic files.
b. calculate values well-established validation procedure fallowing the The ‘Model Validation Kit’ (MVK) of Hanna et al. (1991), used by many code developers to illustrate how well their model does.



3. Services proposed to the MoE: base proposal

3.1 French team

3.1.1 Application maintenance – hotline, support and assistance

The yearly maintenance includes the following the hotline, one week training session, one joint work session, as well as the licenses costs. The benzene development in CHIMERE is offered in the maintenance package. The services are detailed below:

ARIA will respond to MOE requests through hotline and e-mail. These questions will cover the assistance in running the models installed at the MOE.

The assistance won't cover major modifications which are not described in the following sections. These have to be identified and agreed upon through separate contracts.

In more details, duties attributed to the French team of experts are listed here:

- the expert(s) will be responsible for the modeling system maintenance, which will include:
  - Solving forecast system errors and bugs (i.e., software errors).
  - Update new versions of the models when available.
- Provide advice to the MOE regarding the modeling system and its components.
- Provide advice to the MOE regarding the hardware requirements for the modeling system.
- Responsible for the data archiving of the forecast system as described above.
- Update regional and global emissions data from global repositories (e.g., The Emissions Database for Global Atmospheric Research (EDGAR)) when such updates are available.
- Improve the model predictions and solve errors in the forecast due to inappropriate / incorrect global emissions (e.g., high PM due to dust storms).

Training 1 week/2experts

The trainings should allow the MOE engineers to become more and more autonomous in using the software. Trainings must include test cases defined in collaboration with the MOE. The detailed content of the training must be adapted according to the MOE engineer needs. Documentations and tutorials will be provided.

As a starting point, we propose 2 possibilities for which the MOE has expressed a need:

1. **IMPACT 3D software training**

   This training is adapted to expert users of IMPACT. It includes

   - Installation of last version of Relief – Landuse – Impact – Impact3D
   - ARIA Impact3D presentation (Short Theory about MSS – Software structure – GUI description)
   - Application of Impact3D (MSS) : Aria Standard practical training
   - Application of Impact3D (MSS) : Training on MOE test case
   -

2. **TREFIC software training.** It includes:
   - TREFIC installation and presentation (Theory – Software structure – GUI description)
   - Application on MOE current traffic modelling data

One joint work session (1 week/1 expert) in Israël

This joint work session will take place during the first quarter of every year. It has mainly the objective to improve the forecast system scores through a validation methodology proposed below:

- Provide a deliverable at the end of the week on the yearly validation of the system with indications on what to improve. The deliverable will be given to the MOE and to the contractor
- It's the role of the contractor to centralize the questions and requests formulated in the deliverable and to obtain answers/results from the different parties (emissions / modeling for ARIA).
- The improvements that could be made concern an optimization of the system. It doesn't concern any supplementary modules not included in the maintenance proposition. Improvements may be the following:
    - Double-check/correction of the inventory: missing LPS source, wrong hypothesis for traffic emission calculation
    - Choice of an appropriate parameterization for meteorology or dispersion model if the evaluation deliverable shows it's necessary.

Software licenses & upgrades, including ARIA Regional and added licences (50%off) :

A. ARIA Regional modules maintenance including WRF
B. B. AIRCITY + Web Maps Display + "Green Path" + EMEX (Licenses + Maintenance)

Introduction of benzene in CHIMERE:

- **Benzene** emissions need to be provided in the inventory. Then ARIA Technologies will introduce the oxidation mechanism in CHIMERE.

For benzene, this has already been done in France by other lab or institute. However the quality of inventories is still too weak to be sure of the quality of the results.

3.2 Products and time tables

- The daily forecast will be available every day by 6:00AM local time. The penalty for each day without a forecast due to an error in ARIA module will be 100€. Are excluded any problem linked to:
    - the hardware or to the network connections
    - the non-availability of NCEP files provided on the NOAA servers.
- The validation report will be submitted to the MOE once per year within a month after the validation session. The penalty for each week delay in the report will be 100 €. All improvements to the modeling system that result from this session will be implemented during the second and third quarters of the calendar year.

- The performance of the model for each pollutant will be assessed through several statistic indexes. As an example, the table below provides levels of satisfaction for several pollutants. This type of methodology will be followed. However it will have to be defined clearly, i.e. to set the cutoff levels for each pollutant and each statistical parameter. The final methodology for the validation will be determined after the first validation session and will be reviewed every year together with the MOE.

Species	stat	Bad	Not good enough	Good	Very good
Ozone	Bias	10<[in ppb]	5<[in ppb] [in ppb]<10	2<[in ppb] [in ppb]<5	[in ppb]<2
	RMSE	14<[in ppb]	14<[in ppb] [in ppb]<12	10<[in ppb] [in ppb]<12	[in ppb]<10
NO2	Bias	65<[in %]	65<[in %] [in %]<50	50<[in %] [in %]<35	[in %]<35
	RMSE	80<[in %]	80<[in %] [in %]<65	65<[in %] [in %]<50	[in %]<50
SO2	Bias	65<[in %]	65<[in %] [in %]<50	50<[in %] [in %]<35	[in %]<35
	RMSE	80<[in %]	80<[in %] [in %]<65	65<[in %] [in %]<50	[in %]<50

- Scenario report:
  - For a complex scenario the report will be submitted within a month from the request time.
  - For a simple scenario the report submitted within two weeks from the request time.
  - The penalty for each week delay in a report will be 100€.
- Errors and bugs in the forecasting system will be addressed within 4 hours during working hours from the report of the error and will continue until the problem is solved. The penalty for each hour delay in starting to address the errors will be 50 Euros.
- Requests for support / advice about the modeling will be addressed within 24 hours (still during working days). The penalty for a delay of each day in addressing a request will be 100€.
- Critical cases of emergency (as defined by the MOE) will be addressed immediately (within one hour), and the case will start being treated during working days. The penalty for each hour delay in starting to address a critical request will be 50 €.

4. Services proposed to the MoE: options

4.1.1 Additional recurrent services

Simulation of an Air Quality scenario

As it has already been asked by the MOE in the past, we propose our services for the realization of specific scenarios that require non-usual usage of the models, and consequently the work of a developer expert.

It includes

- the preparation of emission files,
- the specific settings of the model,
- running the model
- writing a short note with the methodology and the results

The possibility of running the required scenario will be previously studied. The cost for one scenario will be 7k€. If several similar scenarios are ordered the cost for a package of 4 similar scenarios (same methodology) will be 5k€.

Upon request, supplementary **training session** or **joint work session** will be provided.

4.1.2 Existing applications operational upgrades

Zoom with FARM model over 3 cities (Tel Aviv, Jerusalem, Haïfa)

The current system covers Israel at a resolution of 6 km for the dynamical model (WRF) and 3 km for the chemistry-dispersion model (CHIMERE). The MOE would like to improve the scores for the restitution of primary pollutants nearby of the main sources of emissions: it concerns industrial sites as well as agglomerations.

The current facts are the following:

1. Although the CHIMERE model is operational on the Territory of Israel, CHIMERE is running at a resolution of 3 km over Tel Aviv which doesn't allow to correctly represent the NO_2 peaks linked to the traffic in an agglomeration.
2. Tests have shown that the FARM model applied with a high resolution grid over a relatively small domain over the Tel Aviv agglomeration was able to represent correctly these NO_2 episodes.

In order to remedy this, we propose the implementation process of FARM over Tel Aviv, nested with the CHIMERE model, thus improving very much the quality of the primary pollutants forecast.

In this purpose, **ARIA will implement in the operational ARIA Regional system the models SWIFT and a parallel version of FARM over 3 agglomerations**. This chain will be installed on the MOE cluster. The CPU capacity of the cluster should be in adequacy with the constraint of running a supplementary model in order to provide a forecast on time.

The following **refinement of the resolution** is proposed:

1. Refine the meteorological resolution of the WRF calculation (currently 6 km) with the implementation of the SWIFT code in order to reach a 500 m resolution. In routine, SWIFT will run from WRF meteorological profiles.
2. Refine the dispersion calculation using FARM at 500 m resolution on a 30 * 50 grid cells domain covering an area of 15*25 km (which is the size of the current Tel Aviv tile).

The model FARM will be implemented in reactive mode, including:

1. The transformation of chemical species by gas-phase chemistry;
2. aqueous-phase sulphur oxidation;
3. aerosol module treating particles dynamic and their interaction with gas-phase species.

An automatic production of pictures on the model of CHIMERE outputs will be developed. Maps, time series and profiles from model results will be visualized through the CHIMERE GUI. An updated version of the GUI will be provided.

Production of the FARM result maps compatible with the Website will be done for the following pollutants:

- NO
- NO_2
- O_3
- SO_2
- CO
- PM10

Validation over 2 episodes with a report will be included. The validation will be done for each city for which FARM is implemented.

We propose to start the first case study over Tel Aviv as FARM already proved good results. However, the choice of the first case study belongs to the MOE.

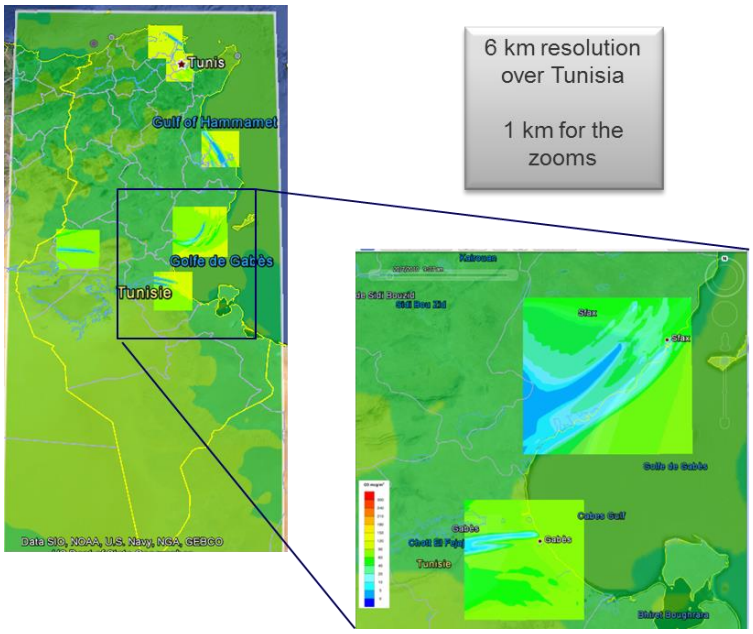


Figure 9: Visualisation of FARM zooms nested from CHIMERE simulation over 6 cities in Tunisia

Zoom with SPRAY model over Hadera

Although the CHIMERE model is operational on the Territory of Israel the resolution of the CHIMERE model does not allow to correctly represent SO2 maximum values in the vicinity of very large stacks like the HADERA Power Plant. Tests have shown that the SPRAY model applied with a high resolution grid over a relatively small domain surrounding the plant was able to represent correctly these SO2 episodes.

Hence, we propose a solution to develop an automated chain to forecast daily SO2 maximum concentrations with a lagrangian model in the vicinity of the Hadera plant. This chain will be set in operation in the same sequence as the WRF/CHIMERE sequence and will be installed on the MOE cluster. The CPU capacity of the cluster should be in adequacy with the requirement of the lagrangian model in order to provide a forecast on time.

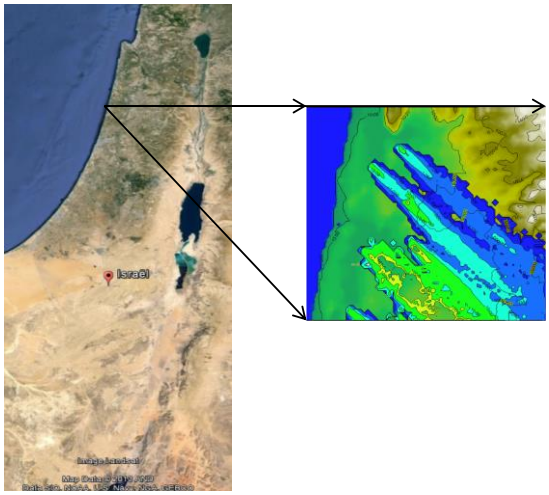


Figure 10: Visualisation of a SPRAY simulation in the Hadera area

Profiles in COMBAS

ARIA will integrate vertical profiles model/measure comparison in COMBAS. It will be possible to plot profile comparisons for each AQM station. It will include:

a. The possibility to use the best neighbour methods
b. The visualization through the GUI of profiles comparison for each time step
c. The export of CSV files (Excel compatible) including the model and measure values at each altitude.
d. The export of a statistic file. Statistics will be given at each layer of the model (as measure and model levels usually don't coincide, measurements will be interpolated on the model vertical grid). A mean value on all the layers will also be computed.

The ADSO database format, currently used by the MOE for the ground stations comparisons, allows the integration of profiles. A support for the integration of profiles data in the ADSO base is proposed to the customer.

The possibility to extract automatically each day WRF profiles for a list of stations. The result will be saved in a CSV format. The parameters saved are: Temperature, Relative Humidity, Pressure, Wind Direction, Wind Speed, Geopotential height.

ECMWF/GFS forcing WRF comparison

Presently, the WRF meteorological model uses the GFS global scale fields as boundary and initial conditions. The Global Forecast System (GFS) is a weather forecast model produced by the National Centers for Environmental Prediction (NCEP).

The Israel Meteorological Service uses the ECMWF model to force their WRF forecast. These files can be provided it in the framework of the Air Quality forecast system to the MOE.

We propose to compare the results of WRF simulations with a GFS and an ECMWF forcing. This comparison will be conducted on 4 selected episodes of 4-7 days representative of the different seasonal situations.

Introduction of new VOCs in CHIMERE:

As it has already been requested by the MOE:

- **1-3 butadiene and trichloroethylene:** These pollutants need to be provided in the inventory. Then ARIA will introduce the oxidation mechanism in CHIMERE.

- **Formaldehyde**: It is already treated as a single real specie in CHIMERE. So the chemical reactions are already in CHIMERE. Also the inventory must be provided for this specie.

4.1.3 Introduction of new functions

Web services

Display of forecast simulations on the web as well as on smartphone can now be provided by ARIA. It includes the visualization of the results on Google Earth which means that the maps can be in Hebrew.

It is also possible to extract time series at virtual sensor by simply clicking on the map.

An example can be seen on the ROMAIR website: www.romair.eu

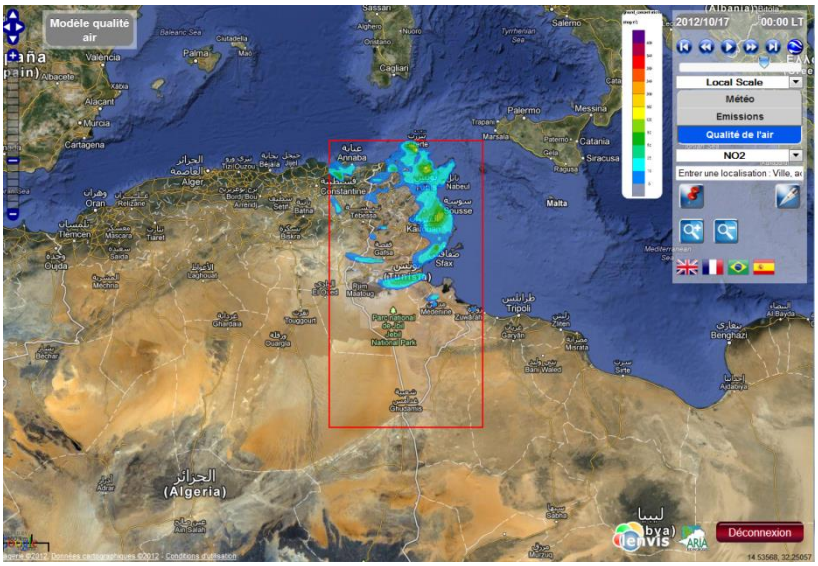


Figure 11: Web application over Tunisia

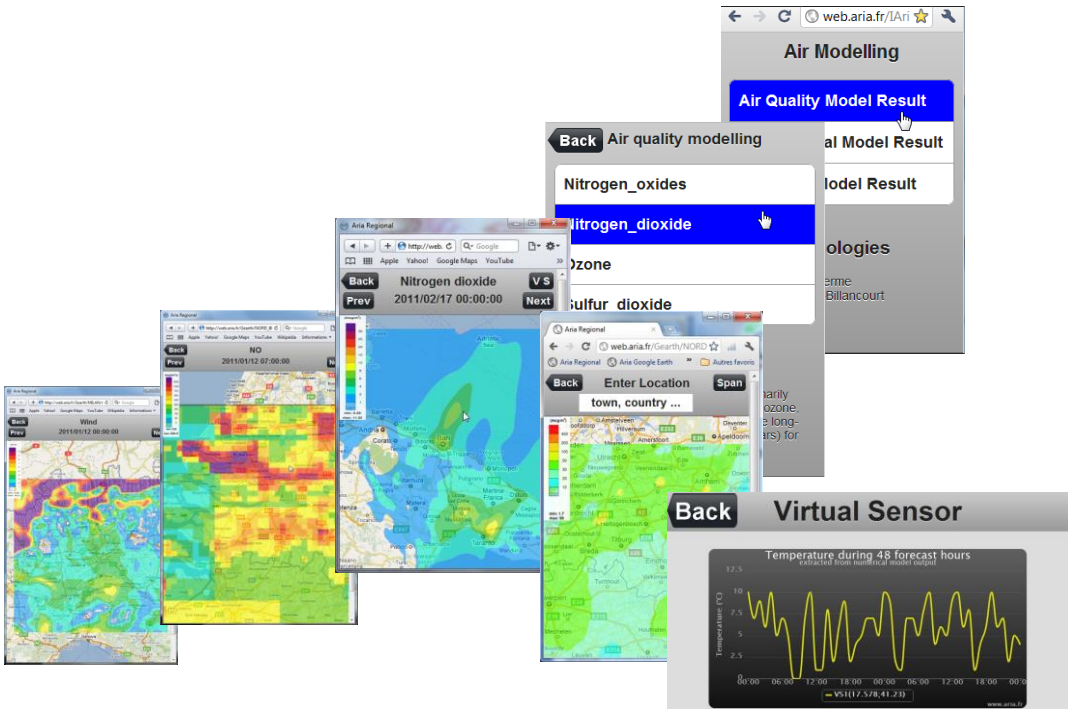


Figure 12: Smartphone application

ARIA View web

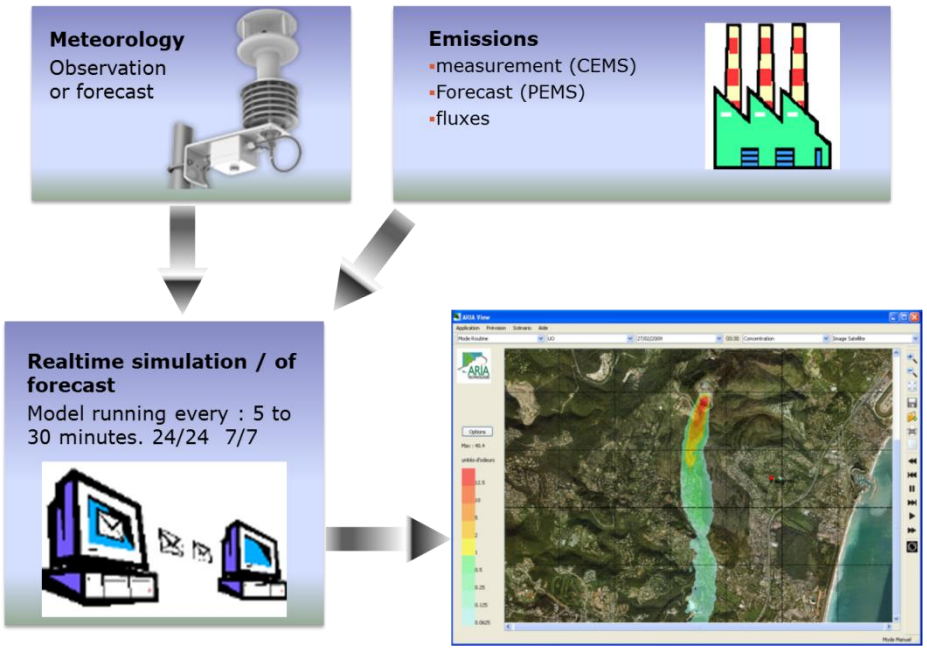
ARIA View Is an Air quality on-line supervision system for industrial sites. It enables to follow the air quality around the site continuously, in order to get a complete and accurate understanding of the impact of industrial activity on its atmospheric environment. Industrial managers can also use ARIA View to prepare and produce the air quality reporting required by the administration. **ARIA View** can deal with conventional pollutants, such as SO2, NOx, PM, CO2, Dioxin, as well as new parameters (odours, legionella, hot air plumes, etc).

ARIA View can be set over a whole industrial area including several chimneys. It can also take into account road and area emissions if included in the domain. However for calculation time reasons it is not recommended to run **ARIA View** over a whole city.

Managers can predict the future air quality on site, depending on meteorological conditions and forecast emissions. Thus **ARIA View** can be considered as a true on-line air quality management system. **ARIA View** has a specific module for air quality monitoring on the site itself, with a detailed 3D representation of the plant. It can be critical for the safety of the operators, and for productions requiring good air quality. Indeed, some industrial processes, such as cosmetics, biotechnologies or microelectronics are highly dependent on the quality of this resource.

Main Characteristics :

- Automatic, as it works without intervention
- On line and real-time: calculations are quick,
- Flexible and powerful: from simple (gaussian) to very precise (3D lagrangian)
- Multi-purpose: automatic monitoring, simulation, prediction, data consolidation.
- Reliable: designed for 7/24 ,remote maintenance through internet
- Communicative: real time visualization, automatic reporting including exported images



AIRCITY over Tel Aviv

http://www.aria.fr/projets/aircity

The AIRCITY project's goal is to develop a new modeling and decision helping system allowing representing and providing the **atmospheric pollution at any points for a very big city, with a 3 meter resolution**, and this for the whole city extent**.**

The AIRCITY tool was designed to be implemented on both small or medium computer, typically containing between 5 computing cores (laptop) and 50 computing cores (a department's cluster) and massively parallel architectures (HPC) counting de several thousand of processors.

The common objective is to achieve 3D computation of road traffic released substances on a urban area with a fast response time. AIRCITY was test on the « Paris Hypercenter » on small computers and « Over all Paris » on HPC computers.

AIRCITY solution includes meteorological models as well as a dispersion model:

In order to downscale meteorological data until high resolution needed in AIRCITY project

- Mesoscale atmospheric flow WRF are used: using to adapt synoptic fields to Ile-de-France scale
- Microscale urban flow SWIFT: simplified CFD taking into account 3D buildings and 3D canyon flows.

For the dispersion modeling, the lagrangian model SPRAY is used. It takes into account the traffic sources (38 000 segments for the « Over all Paris » domain and a total length of 1 070 kilometers).
The CHIMERE model was also used in order to provide boundary conditions.

AIRCITY chain validation was carried out comparing hourly NOx concentrations calculated and concentrations measured by Airparif stations. The intensive validation campaign shows very good scores.

ARIA Technologies proposes to set up the same system over Tel Aviv.

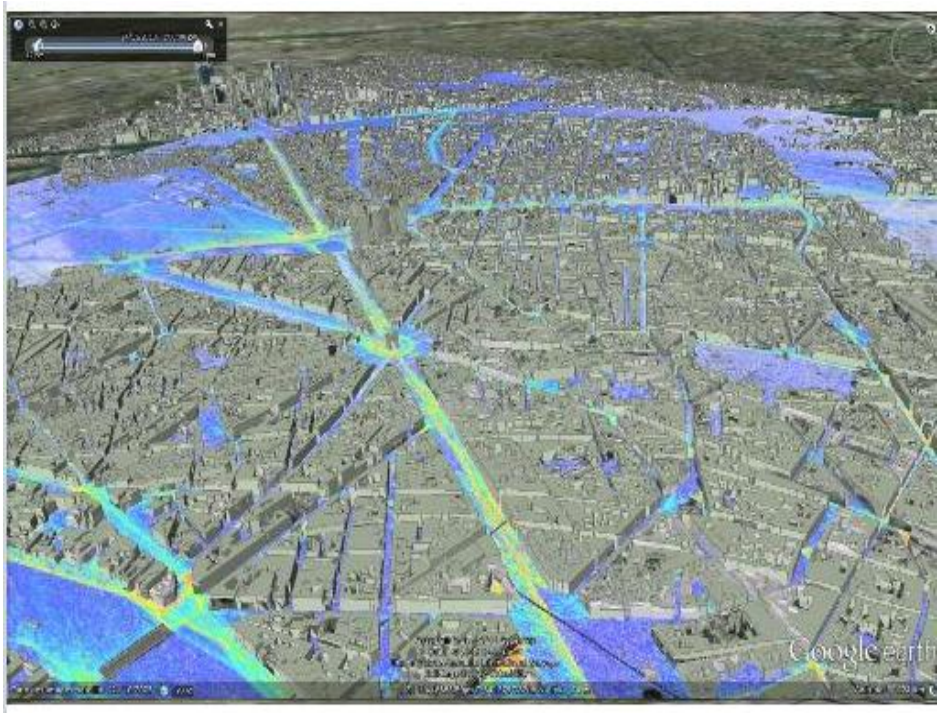


Figure 13: NO_2 concentration fields over Paris at 3m resolution

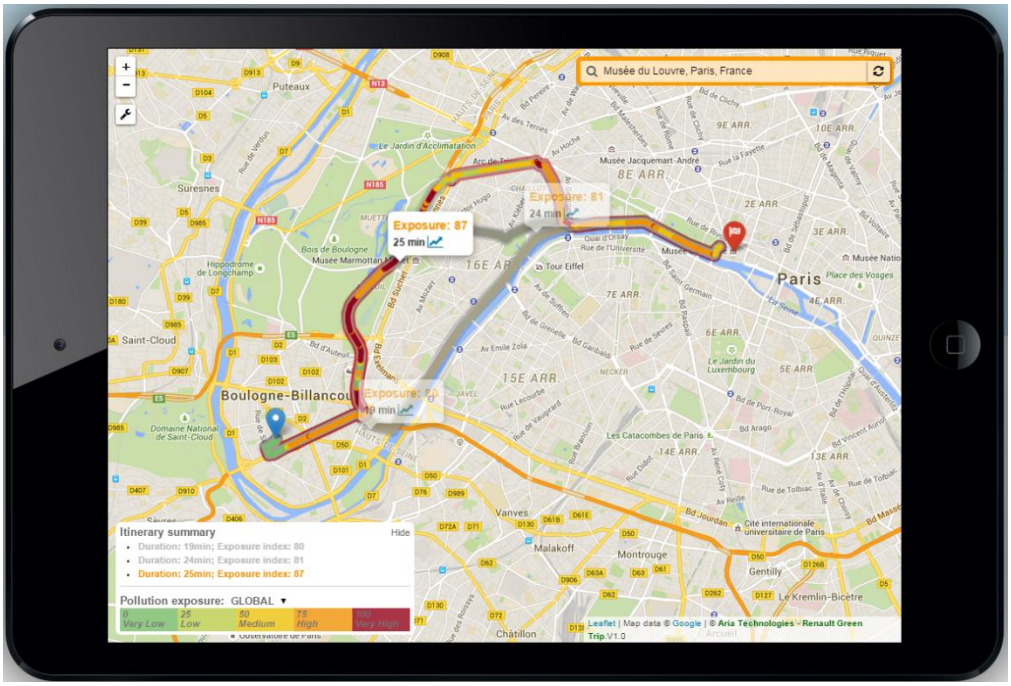
Configuration of "Green Path" Web application on Tel-Aviv area

The purpose of such a system is to provide to the conductor a service assistance depending on the quality of the external air along paths:

- route choices,
- optimization paths
- car ventilation

The “Green Path” service provides the following information:

- Statistics on many trips in order to quantify the gains attributable to the use of the web application in term of conductors exposure;
- A web application available on a tablet computer or smartphone and that provides, from a departure and arrival places, the exposure along the route and on a set of alternative routes.



Data assimilation

Four-dimensional data assimilation techniques may be useful to produce an atmospheric state as close as possible to the reality, dynamically consistent and taking into account all the available information: observations, model results, emission patterns and physical-chemical constraints. This can be effectively used to provide a more realistic initial state of a forecast system, in “near real time” systems (nowcasting) or when producing air quality analyses.

To meet these goals FARM model includes data assimilation capabilities. The measured concentration of a given pollutant is used for the assimilation.

The methodology uses in a first step a Kalman filter in order to correct the model at the station point. Then it is possible to apply the ARPMEAS module that uses this corrected value in order to obtain a corrected map.

The determination of the ratios for the Kalman filter induces a work on the stations, meaning a classification according to their type (industrial, urban, peri-urban) in order to give them an appropriate weight. This is the most complicated task. Once the Kalman filter is correctly set, the ARPMEAS module can be run on netcdf model output files in order to obtain maps mixing model and measures.

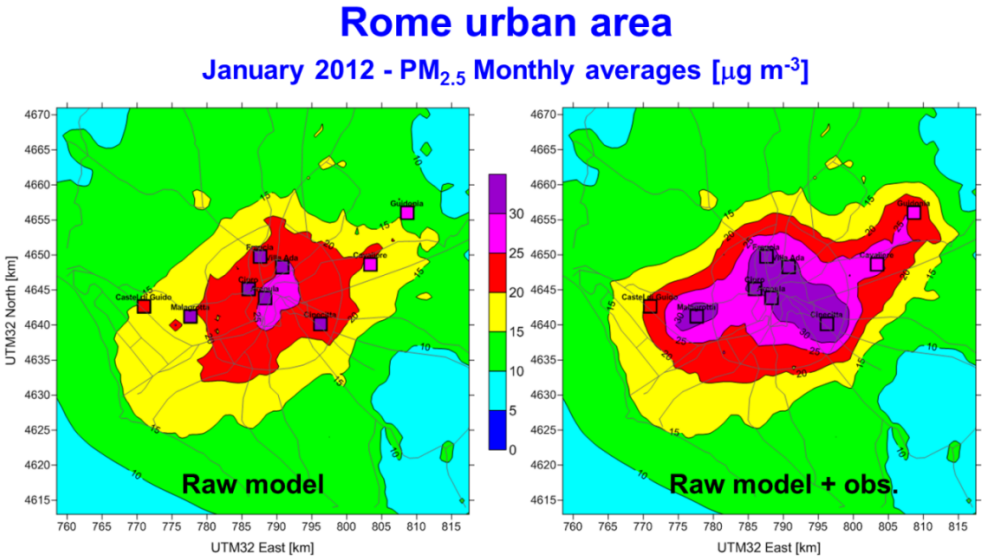


Figure 14 : Effect of data assimilation on Rome Air Quality fields

4.1.4 Case studies

Introduction of Electric Vehicles in Tel Aviv

ARIA Technologies has realized studies for RENAULT and NISSAN over Roma and Hong Kong respectively in order to evaluate urban co-health benefits associated with widespread introduction of EV's. These studies were based on the following methodology:

- Calculation of changes in the emissions inventory, taking into account changes in fleet composition (EV / Thermal)
- Impact on thermal power stations of the additional power supply needed
- Numerical simulation of air pollutants
- Benefits related to population exposure

Such study would be very interesting to realize over Tel Aviv in order to promote the use of Electric Vehicle in Israel.

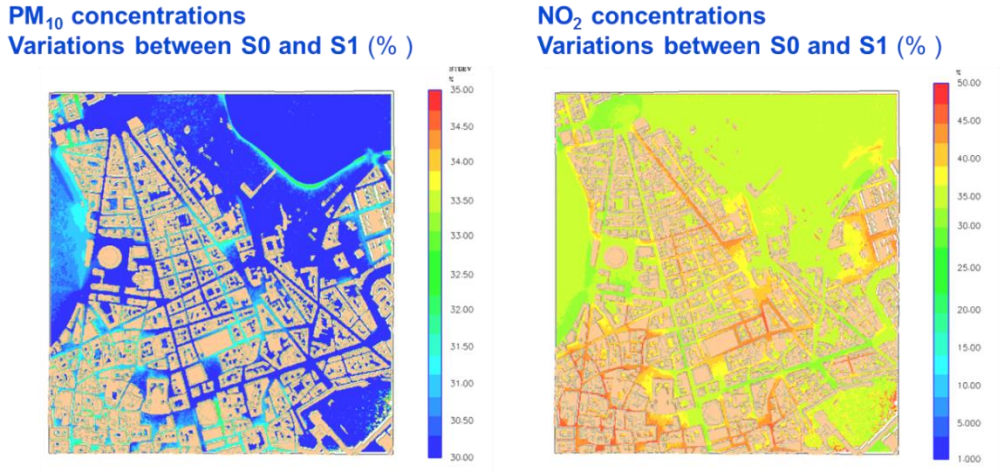


Figure 15: Results of comparison of 2 scenarios (with and without EV) on concentrations of pollutants over Roma

Sensitivity study to emission inventory

It has been shown from model/measure comparison exercises that the model tends to underestimate the ozone production inland and more specifically during the summer period. Concentrations of ozone at the coastline stations are correctly reproduced by the model. This means that the boundary conditions of ozone and emissions of NOx at these stations are correctly reproduced. However, when going downwind the pollution plume, the model produces only 20 ppb of O_3 whereas it should be about the double in order to simulate 100 ppb O_3 peaks. The lack of productivity of the model has been noticed several cases going from April to October. As the NOx concentrations are correct, we can suspect the VOC emissions to be underestimated. Indeed, if the VOC/NOx ratio increases, the system should be more ozone productive.

Several options have to be tested in order to improve the ozone forecast. Here is a non-exhaustive list that the contractor should test:

- **Testing the Israeli inventory upgrades**: Several updates of the inventory have been done since the last validation tests conducted in 2010. Hence, the contractor should propose an evaluation of the updates doing an inter-comparison with the 2010 validation. This validation

exercise had consisted in model/measure comparisons for 4 weeks representative of 4 different seasons.

- **Role of surrounding countries emissions**: Since the 2010 validation exercise, a new global inventory has also been implemented in order to provide emissions for the large scale domains. Indeed, the current system runs with 3 nested domains, the first domain covering a part of Europe, North Africa and Middle East countries, and the smaller domain being focused on Israel. These embedded domains provide boundary conditions to the Israel domain. A good restitution of the levels of pollutants in the surrounding countries implies good boundary conditions for the domain of interest. Hence, it is important to care about the quality of the global inventory used. In the 2010 validation exercise, the GEIA (1995, 1° resolution) inventory was used for the Middle East North African countries and the EMEP inventory (2007, 50 km resolution) over Europe. Recently, these inventories have been replaced by a more resolved and new inventory: EDGAR (0.1° resolution, 2011, http://edgar.jrc.ec.europa.eu/index.php). The contractor will have to test the improvement brought by this inventory by simulating a summer episode and comparing it with the validation done in 2010.

- **Role of biogenic VOC**: Currently, biogenic VOC are provided by the Israeli national inventory. However, knowing that incertitude on BVOC emissions are quite important and that BVOC such as isoprene are very reactive, it highly participates in ozone production. Thus, an underestimation of BVOC emissions could lead to a non-negligible underestimation of ozone production. The contractor should propose tests and solution to assess the role of BVOC in the formation of ozone in Israel. An interesting test could be to use the MEGAN model (included in CHIMERE) in order to compute the BVOC emissions.

5. Financial table

Costs

The items developed previously are summarized in the following table. The maintenance services costs as explained in section 3 “Services proposed to the MoE: base proposal” correspond to the item 1. All other tasks presented in section 4 “Services proposed to the MoE: options” correspond to the items 2 to 5.

In case the MOE express other needs, or if other developments are available in the coming year, ARIA Technologies will give a proposition in term of number of days. The cost will be calculated on the base of our Man x day expert sales price (780 €) as given in the Excel budget table.

These costs do not include any hardware costs, but they do include all travel expenses for ARIA personnel.

TASK	#	Men x Day	External costs (€)	COST elts. (€)	COST(€)
1. Application maintenance - hotline support & assistance (yearly fee)	1			91000	91 000 €
Estimated support and assistance service of 75 men x day / year, including :					
A. Estimated Hotline / assistance		55	0 €	42 900 €	
B. One training session (1 week/2 experts) in Israël / year (travel included)		14	3 000 €	13 920 €	
C. One joint work session (1 week/1 expert) in Israël / year (travel included)		6	1 500 €	6 180 €	
Software licenses & upgrades, including ARIA Regional and added licences (50%off) :					
A. ARIA Regional modules maintenance including WRF				10 000 €	
B. AIRCITY + Web Maps Display + "Green Path" + EMEX (Licenses + Maintenance)				18 000 €	
Inclusion of Benzene in CHIMERE					
BASELINE cost of 5 years project including all licenses					**455 000 €**
2. Optional recurrent services (upon request)					
2.1 Simulation of an Air Quality scenario (unit cost = 1 week)	1	7	0 €	5 460 €	**5 000 €**
2.2 Training session (1 week/2 experts) in Israël (travel included)	1	14	3 000 €	13 920 €	**13 500 €**
2.3 Joint work session (1 week/1 expert) in Israël (travel included)	1	6	1 500 €	6 180 €	**6 000 €**
3. Existing applications operational upgrades					
3.1 Vertical profiles in COMBAS	1	20	0 €	15 600 €	**15 600 €**
3.2 Comparison of ECMWF and GFS forcing for WRF (4 one-week episodes)	1	20	0 €	15 600 €	**15 600 €**
3.3 Sensitivity tests for specific COVs in EMMA/CHIMERE	1	20	0 €	15 600 €	**15 600 €**
3.4 Zoom with FARM model over one large city (Tel-Aviv or Jerusalem or Haïfa)	3	50	2 500 €	41 500 €	**124 500 €**
3.5 Zoom with SPRAY model over Hadera area (SO2/NO2/PM maxima)	1	50	0 €	39 000 €	**39 000 €**
4. Introduction of new functions					
4.1 Web+ I-Phone/Androïd Google Maps + Google Earth configuration (CHIMERE)	1	60	5 000 €	51 800 €	**51 800 €**
4.2 ARIA View Web (per large industrial site)	1	40	0 €	31 200 €	**31 200 €**
4.3 Data assimilation and FARM	1	100	0 €	78 000 €	**78 000 €**
4.4 ARIA City configuration on Tel-Aviv	1	120	5 000 €	98 600 €	**98 600 €**
4.5 Configuration of "Green Path" Web application on Tel-Aviv area	1	60	0 €	46 800 €	**46 800 €**
4.6 UMOS Development for CHIMERE or FARM	1	100	0 €	78 000 €	**78 000 €**
5. Case studies					
5.1 Sensitivity study to emission inventories (domestic and foreign)	1	50	0 €	39 000 €	**39 000 €**
5.2 Introduction of electric vehicles in Tel-Aviv	1	96	0 €	74 880 €	**74 880 €**
Total cost of selected options					**733 080 €**

Prices do not include VAT or taxes.

Planning

A detailed planning will be proposed for validation during the kick-off meeting.

Validity

This proposal is valid for 6 months. Beyond that, content, costs and timing are liable to be changed.

Exclusions

Any task not explicitly described in this proposal is considered as outside the scope of this project and would be charged as a separate task.

Payment schedule

We propose that the contract foresees **for each year** a **25% upfront payment**, followed by **three 25% quarterly payments.**

The payment conditions are, **for each year**:

- 25 % with the purchase order form (PO),
- Three 25% invoices quarterly

ARIA's invoices have to be paid within a maximum period of 30 days.

The Bank address of ARIA Technologies is

HSBC

29 Rue Paul Vaillant Couturier

92300 LEVALLOIS-PERRET

Bank code	: 30056
Counter code	: 00077
Account number	: 00772005957
Key	04

Responsibility

ARIA Technologies guarantees the supply of the services such as described in the technical proposal supplied and accepted by the Customer.

ARIA Technologies will incur no responsibility connected to the consequences of the use of the results of this study by the Customer.

Confidentiality

ARIA Technologies undertakes to protect the confidentiality of all the information communicated by the Customer within the framework of this project, as well as that of the obtained results.

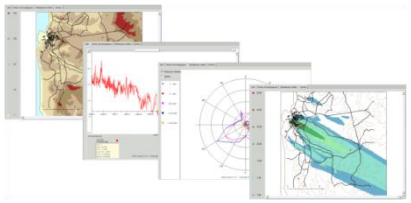
The Customer also undertakes to quote ARIA Technologies for any exploitation of the results of the calculations supplied by ARIA Technologies.

Annexes

1. ARIA Software

ARIA Impact

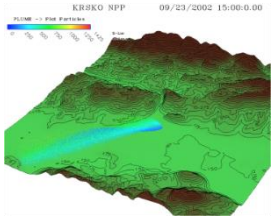
ARIA Impact is an user friendly software explicitly designed for evaluating the long-term impact of emissions (gas and particulate) from industrial sites, vehicular traffic and diffuse sources. The system is designed for decision-making purposes providing results that can be compared with regulatory norms of air quality as well as being used for complete evaluation of health risks or odor evaluations. **ARIA Impact** is a second generation local scale gaussian model that takes into account industrial plume rise, deposition, topography, calm wind situations, NO/NO2 conversion and canyon effects in urban conditions**.**



Applications

- Impact of industrial & traffic emissions on air quality
- Statistical assessment of long-term impact of industrial and traffic emissions on air quality
- Comparison of concentration levels with regulatory norms (annual averages, percentiles)
- Statistical analysis of meteorological data (time series, wind roses

ARIA Risk

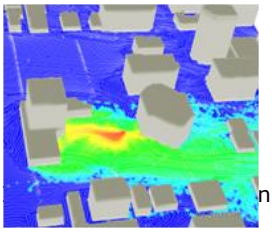


ARIA Risk is a 3D software for the evaluation of industrial risks linked to the airborne dispersion of toxic releases (storage accidents, pipe failure, fire clouds). The software outputs maps of instantaneous or integrated concentration and deposition, it also enables the determination of safety limits and zones of threshold exposure and IDLH. **ARIA Risk** can be incorporated in an alert system. **ARIA Risk** is built with modules using 3D calculation of meteorology and dispersion (puff or particle model) and takes into account arbitrarily complex topography, the effect of buildings on the flow, and very low wind conditions.

Applications –

- Industrial risk assessment
- Source term evaluation (accident)
- Localization of risk zones based on 3D fields (topography, several meteorological stations)

ARIA IMPACT 3D



ARIA Impact 3D is a software package that enables industries to know the impact of their plant on air quality in the surrounding area, through the simulation of actual or virtual emission scenarios. **ARIA Impact 3D** simulates the 3D atmospheric dispersion of pollutants (gaseous or particulate) from

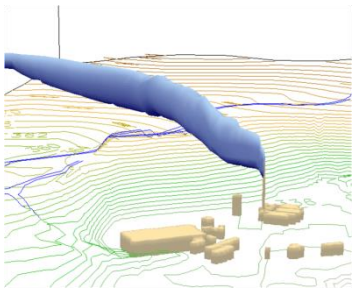
stacks and diffusers or fugitive sources by taking into account detailed data on topography, the effect of buildings on the flow, as well as different types of simultaneous meteorological data (both ground level and upper air, measured or forecast).

Used by industries, consulting companies and air quality management boards overseeing industrial areas, **ARIA Impact 3D** is software for detailed evaluation of chronic risks, equipped with a state of the art 3D Lagrangian model. When used as the computational engine of the ARIA View system, with an on-line connection to monitored stack emissions and meteorological data, it provides maps of the real time impact of an industrial site.

Applications

- Modeling pollution at industrial or Urban sites
- Simulation of industrial emission dispersion for specific meteorological conditions and time series,
- Assessment of statistical impact industrial emissions in complex terrain (annual average, percentile),
- Conducting studies (diagnostics, preparation and supervision) for air quality improvement campaigns,
- Planning and development of pollution control strategies, calculating emissions and preparing atmospheric pollutant emission maps for a street, a city or a region,
- Simulating atmospheric dispersions of all pollutants measured by air quality monitoring networks in the
- area under study,
- Determining the contribution of each emission source,
- Analyzing existing regulation strategies.

ARIA Local



Fully solving Navier-Stokes Equations, **ARIA Local** models air pollution conditions down to a very small scale in industrial and urban environments for continuous or accidental emissions by taking into account detailed data on obstacles (buildings, topography…). The software can also be used for micro-meteorological applications such as wind power plants, construction works or indoor air quality assessments.

ARIA Local is based on a CFD (Computational Fluid Dynamics) model dedicated to the atmospheric environment, including a 3D non-stationary modeling of multiphase flows, turbulence and atmospheric dispersion.

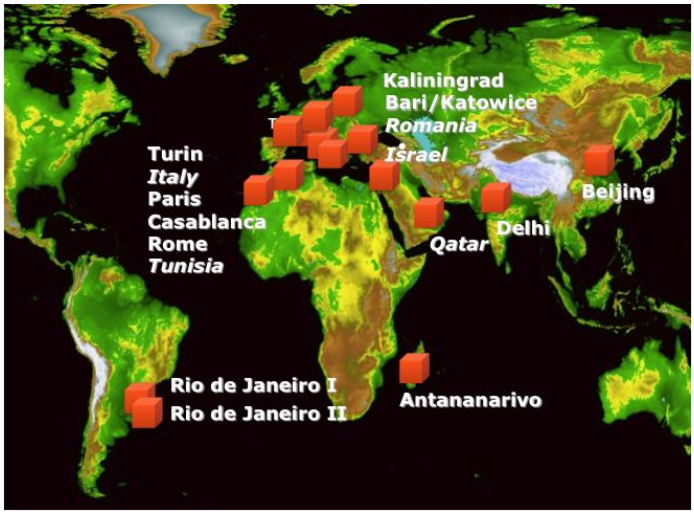
Applications

- Small scale dispersion with obstacles.
- Flow modeling including obstacles and topography (wind effect on built-up sites…),
- Small scale dispersion modeling, including obstacles, heavy or buoyant release, high momentum jet,
- Accurate modeling of fluid flow for different applications: study of wind effects on structures, micrositting for evaluating the windborne potential ("OUTDOOR"), profiling of airflows in closed spaces("INDOOR"),
- Simulating most physical atmospheric phenomena that occur at the local scale (atmospheric boundary
- layer, turbulence model, water microphysics, …),
- Calculating, for different types of sources, the dispersion of heavy or light gas pollutants, from various sources (vehicular traffic, industrial, hazard, etc.)..

2. SOME REFERENCES

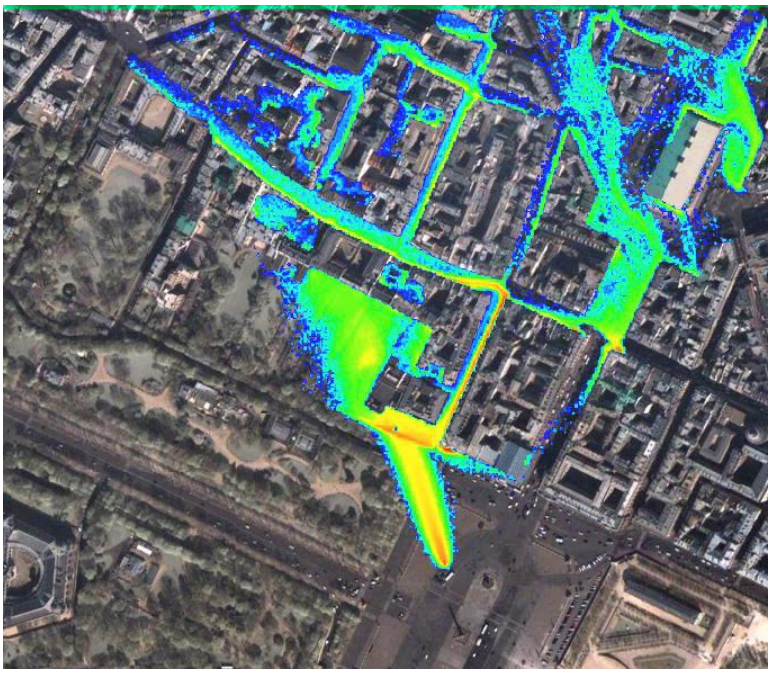
2.1.1 PLUBLIC SECTOR AND LOCAL AUTHORITIES

	° ARIA Regional : Air quality forecast system (AIRPARIF)
	° Urban Air quality modeling tools (city of paris)
	° ARIA Regional : Air quality forecast system (Beijing Olympic games) ° ARIA Regional : contribution from province to province (SEPA/CNEMC)
	° ARIA Regional : Air quality forecast system (Commonwealth Games 2010)
	° ARIA Regional : Air quality forecast system (Winter Olympic Games 2006)
	° ARIA Regional : Air quality Policies studies improvement ° ARIA Regional : Air quality forecast system for 2014 World cup
	° ARIA Regional : Air quality Policies studies improvement on Kaliningrad (UE Project)
	° ARIA Regional : AIR quality forecast system and Air quality Policies studies improvement on Romania (UE project)
	° ARIA Regional : Air quality forecast system and Air quality Policies studies improvement on Romania (UE project Eten E2SP)
	° ARIA Regional : Air quality improvement studies on QATAR (Total and Qatar Petroleum Project)
	° ARIA Regional : National emission inventory and Air quality improvement studies on TUNISIA
	° ARIA Impact for the Malta Island
	° Air quality study and air quality improvement studies on Antanarivo (World bank project)



2.1.2 HOMELAND SECURITY AND SPACE

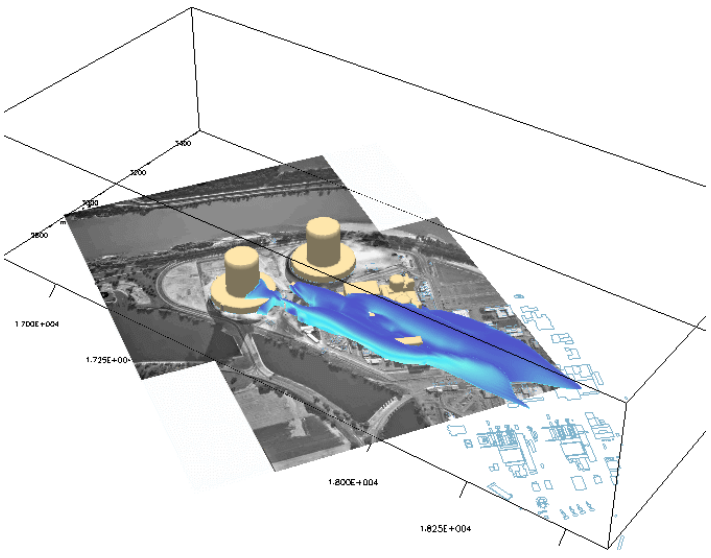
	° CBRN ARIA Risk ° Urban emergency response
DGA	° Meteore Program : ° CBRN ARIA RISK ° Missile exhaust impact (test on workbench)
IAEA	° CTBTO ° Internationnal Chernobyl Benchmark
SAIC	° 3D Wind field builder in HPAC ° Urban release module (MSS)
THALES	° 47 licenses of ARIA RISK for the French Army ° Emergency prepardeness for an airbase
cnes	° Operationnal realtime system in Kourou (French Guyana) : impact of ARIANE 5 booster exhaust assessment
EADS APSYS	° ARIA Risk software
MBDA	° 3D missile exhaust impact assessment



Accidental release at Place de la Concorde Paris (Courtasy of CEA-DAM).

2.1.3 INDUSTRY

TOTAL	° ARIA Industy systems : Plume trakers for raffinerys ° Offshore safety studies
EDF	° ARIA Risk systems on Nuclear power plant ° ARIA Impact for environmental impact assessment ° ARIA wind : wind power assessment
AIR LIQUIDE	° 3D Impact assessment and safety analysis
GDF SUEZ	° ARIA view odors systems (waste water plant) ° ARIA Impact for environmental impact assessment ° ARIA wind : wind power assessment
LAFARGE	° ARIA Impact for environmental impact assessment
Italcementi Group	° Impact Denox assessment of photocatalytic cement (TiO3) ° ARIA Impact for environmental impact assessment
PEUGEOT	° ARIA Impact for environmental impact assessment ° Indoor pollution / Health risk for the workers
RENAULT	° ARIA Impact for environmental impact assessment ° Indoor pollution / Health risk for the workers
PÖYRY	° ARIA Impact for environmental impact assessment (Papermill)
Technip	° Design studies : hot plumes GPL liquefaction trains ° Flame design and Offshore safety studies



dispersion at the Nuclear power plant of Sant-Laurent des Eaux (Courtasy of EDF).

3. Curriculum Vitae

Proposed Position: Team Leader

Name of Firm: ARIA Technologies

Name of Staff: **Jacques MOUSSAFIR**

Profession: Senior expert

Date of Birth: 1956, Milano, Italy

Nationality: French

Years with Firm/Entity: 21 Nationality: French

Education:

Institution [Date from - Date to]	Degree(s) or Diploma(s) obtained:
Université de Paris 6 - Pierre et Marie Curie [1979-1981 Laboratoire de Météorologie Dynamique.	**Doctor-Engineer Thesis (Ph.D)**
Université de Paris 6 - Pierre et Marie Curie [1979]. Laboratoi de Météorologie Dynamique.	**Advanced Degree in Oceanography and Meteorology**
Ecole Nationale Supérieure des Mines de Paris (E.N.S.M.P.) [1976-1978]	**Ingénieur Civil des Mines (Civil Engineer)**

Language skills: competence on a scale of 1 to 5 (1 - excellent; 5 - basic)

Language	Reading	Speaking	Writing
French	Mother Tongue		
Italian	1	1	1
English	1	1	1
Spanish	2	2	2

Membership of professional bodies:

Member of the French Conseil Supérieur de la Météorologie (CSP), Environmental Group at METEO-FRANCE

Other skills: Extended computer literacy, both in classical scientific languages (F95) and modern data handling tools.

Personal Computing	*OS systems:* Win 2000, XP, Linux. *Software packages:* MS Office; Adobe, Surfer, EWB, Mapinfo, ArcGIS. *Programming languages*: Fortran, C++, Shell-script
Mathematical models	Expertise in the application of a wide range of air pollution and meteorological models
Legislation	Knowledge of the main European Environmental Laws.

Employment record:

From 1990	*ARIA Technologies France, President and CEO*.
1983-1990	*EDF (French Electricity Board), France, R&D Engineer*

1981-1982 *IHFR (Institut Hydrométéo de Formation et de Recherche), Algeria*
Volunteer for foreign training programs
1979-1981 *Bertin Co Fluid Mechanics Division, France, Fluid Mechanics Engineer*

Present position: President and Chief Executive Officer of ARIA Technologies SA

Years within this position: 21

Key qualifications:

During his 28 years of professional experience in the field of **atmospheric environment**, Jacques MOUSSAFIR. has acquired a sound experience in the different aspects involved in **air pollution modelling** , especially when applied to the definition of abatement strategies.

As the head of ARIA Technologies since 20 years, with a company fully dedicated to air pollution modeling in all its aspects (local scale, urban scale, regional scale, continental scale), he has started applying modern modeling technology to several cities in France (Paris, Toulouse, Rouen,..). He participated in the foundation in Italy of ARIANET SrL, a sister company to ARIA Technologies, and ARIANET is managing the air pollution modeling tools for various cities in Italy (Torino, Milano,...) . He has undertaken diverse assignments in foreign countries for the construction of air pollution simulation tools, used to define abatement scenarios as well as for forecasting current air pollution (China, Kaliningrad, Rio de Janeiro City, Sao Paulo innerbelt study).

He participated in several EU funded Projects, such as ISHTAR, applying modeling tools to the Cities of Bologna, Athens, Paris, Grenoble, and Graz. He was also involved in the E2SP Project, where remote air pollution modelling systems are applied to the Cities of Katowice and Bari and in the LENVIS Project which will extend these concepts to Lisbona, Milano, and Noord Brabant region.

He is also managing the activities of ARIA Technologies in South America, through ARIA do Brasil, a fully owned subsidiary of ARIA Technologies, based in Rio de Janeiro, and through a one-person joint venture with GDF-SUEZ in Mexico City, focused on on-line atmospheric dispersion systems for water treatment plants.

He keeps an area of scientific involvement in the development of Urban micro-scale modeling in the presence of obstacles, with the MSS model (Micro SWIFT SPRAY) used by CEA and the US-DOD for emergency response inside their operational systems.

Date	Location	Company	Position	Description
2011-2012	BRAZIL	State of Rio Environmental Protection Board	**Project Manager**	AR DO RIO : Providing an operational meteorological and air quality forecast for the City of Rio de Janeiro, in view of the Copa 2014 and the 2016 Olympics.

2009-2010	ROMANIA	National Environmental Protection Agency (NEPA)	**Project Manager**	ROMAIR : Implementation of an air quality modeling and forecast system in Romania
2007-2008	RUSSIA	Ministry of Environment	**Consultant**	KALAIR : Regional Scale Air Pollution Modeling Project for Kaliningrad, Russia
2007-2008	CHINA	BMEPB	**Consultant**	CLEAN AIR FOR BEIJING : Regional Scale Air Pollution Modeling Project for Beijing, China, in view of the preparation of the Olympics 2008
2005_2010	QATAR	TOTAL / QP	**Project Director**	QAQM : Qatar Air Quality Model. Regional scale Air Pollution Modeling Project for the State of Qatar, involving a complete emission inventory of the Gulf Area.
2002-2004	BRAZIL	RENAULT & French Foreign Affairs Ministry	**Project Director**	Air Pollution Modeling Project for Rio de Janeiro "Clean Air for Latin American Cities World Bank Program"
1990-2010	France	ARIA Technologies	**CEO**	- **LENVIS** : Joint EU Funded 7th Framework Peer to Peer Environmental Modeling Project (2007-2010) - **E2SP** : Joint EU Funded IT Environmental Project (2005-2006) - **ANEMOS** : Joint EU Funded Wind Energy Project (www.anemos.com) (2002) - **ISHTAR** : Joint EU Funded 5th Framework Project, Integrated Assessment (2001-2004) - **US-DOD / SAIC** : Urban Small scale simulations for the HPAC System (2002-2011) - **ADEME** : Emission Inventories for the ESCOMPTE area (2002-2003) - ORAMIP, Modeling System for the TOULOUSE Air Quality Board (2002) - COPARLY, Modeling System for LYONS Air Quality Board (2002) - WORLD BANK : Study of the Sao Paulo Innerbelt (2000) - ASPA, Modeling System for the STRASBOURG Air Quality Board (2000-2002) - AIRPARIF, Modeling System for the PARIS Air Quality Board (1997-2003) - SAIC (USA) : Cooperation in the US-DOD DNA/MEDOC project (1992-1995) - ENEA (Italy) : Modeling of the City of TORINO. - VILLE DE PARIS : Modeling of various small-scale Air Pollution Episodes - AIRFOBEP : Air Pollution monitoring network at Fos-Berre (France). - KANAZAWA INSTITUTE OF TECHNOLOGY (Japan) . Application of the MIRAGE code to intercontinental transfer of aerosols. - ENEL (Italian National Electricity Board) : atmospheric

				transport/diffusion modeling system. - REDAT, air pollution monitoring network for the Abruzzese region in central Italy. - FIAT CORPORATION, Assistance in development of mathematical models to be used for the Naples Air Pollution Monitoring Network. - FRENCH MINISTRY OF THE ENVIRONMENT, Air Quality Modeling Systems (AQMS). - AIR NORMAND, Air pollution monitoring network at Le Havre (France).
1983-1990	France	EDF (French Electricity Board)	**R&D Engineer**	Research and Development Department - EDF (French Electricity Board) Electricity and Environment Applied Services **Department of Atmospheric and Aquatic Environment (Meteorology and Climate Group)** The main task at EDF was to develop software to better manage on-site measurements for environmental-impact simulations of accidental gaseous emissions. The final product would result in rapid and efficient simulations for real-time application on a local workstation. **1989 Development of the first version of GEEE** (Pollutant and Environment Survey) at the Chinon nuclear power plant (France). **1987 - 1988 ECRAN PROJECT** (Evaluation of Radiological Consequences from a Nuclear Accident) Installation of a demo system at the CRUAS (Rhône Valley, France) nuclear power plant in order to analyze system limitations as well as to receive user feedback. **1987 French representative at the "Expert Committee on the Probabilistic Estimation of Accident Consequences"** .(I.AE.A., Vienna) **1986 - 1987 Impact studies** of the CREYS, CHOOZ, and PENLY nuclear power plants (France) **1985 - 1986 Intensive field measurements** at CREYS, CHOOZ, and PENLY. **1985 Definition of specifications for the ADSO software program**, to be used to centralize measured data collected for field studies. Impact study for LARDERELLO geothermal site (Italy). **1983 - 1985 Development of HERMES model** : mesoscale atmospheric flow and pollutant transport.
1981-1982	Algeria	IHFR (Institut Hydrométéo de Formation et de	**Volunteer for Foreign Training**	▪ HYDROMETEOROLOGICAL RESEARCH INSTITUTE (Oran, Algeria) ▪ VSNA - United Nations Institute ▪ Responsible for instructing Level II and III Meteorology courses

		Recherche)	**Programs (VSNA)**	
1979-1981	France	Bertin Co Fluid Mechanics Division	Fluid Mechanics Engineer	**Research and development** in atmospheric physics and air pollution, applications to industry, engineering and agriculture. **First Developments of the French Doppler Acoustic Sounder (SODAR)**, now developed and sold by REMTECH Inc. Participation in several intercomparison experiments (Boulder, Colorado)

Specific experience in the Middle East / Africa region:

Country	Date from - Date to
QATAR Air Quality Model	2005-2009 (Doha)
TUNISIA National Inventory	2008-2010 (Tunis)

Other relevant information:

More than 25 years of experience in the application of air pollution modeling to environmental policy issues, and R&D in air pollution modeling.. Author of peer-reviewed journal papers and presentations at numerous national and international conferences.

"Lagrangian Particle Simulation of Tracer Dispersion in the Lee of a schematic Two-Dimensional Hill". Journal of Applied Meteorology, 33, 744-756 - 1994 -.

"Environmental Modeling For Emergency Preparedness". Chapter 10 of the book : ENVIRONMENTAL MODELING. Paolo Zannetti, Editor. Comp. Mechanics Publications & Elsevier - 1992 -.

1990 IBM Award of Excellence for Intensive Numerical Computations.

In charge of the “Applied Air Pollution” module for the Master in Environmental Engineering of ISIGE (Ecole des Mines de Paris) (1993 – 1996)

Detailed Tasks Assigned:

Leadership - Planning - Choice of methodologies – Report outlines and review

Animation of workshops and presentations.

Languages:

English

- Speaking: excellent
- Reading: excellent
- Writing: good

French

- Speaking: excellent
- Reading: excellent
- Writing: excellent

Italian

- Speaking: excellent
- Reading: excellent
- Writing: excellent

Spanish

- Speaking: good
- Reading: good

- Writing: good

Certification:

I, the undersigned, certify that to the best of my knowledge and belief, these data correctly describe me, my qualifications, and my experience.

Date: 16/3/2012

Full name of staff member: **Jacques MOUSSAFIR**

Full name of authorized representative: **Jacques MOUSSAFIR**

Fanny VELAY-LASRY, 35 Years old

fvelay@aria.fr

Engineer at ARIA Technologies since February 2007

Skills

• Scientific: Three-dimensional modeling, transport and dispersion of pollutants, physico-chemistry of the atmosphere, impact studies, emission scenarios, emissions inventories

• Data processing: Work environments Windows and Linux, knowledge of Word, Excel, Power Point and Access software, programming in FORTRAN

• Communication: English and French oral presentations to public and scientific articles published in international scientific journals, secondary and university level education

• Languages: Fluent in English, Spanish fair, Hebrew fair

Projects

• **Jordan Ministry of Environment,** *Elaboration of a National Emission Inventory over Jordan*

• **SINOP project,** *Establishment of a forecast of transboundary air pollution (haze) system on Indonesia on behalf of Meteo France International and final destination of BMKG (Indonesian Meteorological, Climatological and Geophysical Agency) (2013)*

• **E3P KIC-climate,** *European project about extreme climate phenomena and their impacts in the energetic sector*

• **FASEP-INDIA project,** *Establishment of an operational air quality modeling system for the CPCB in New Delhi. Weather platform (WRF) and photochemical model (CHIMERE). Consideration of desert dust and biomass burning.*

• **ROMAIR european project,** *Establishment of an operational air quality modeling system in Romania. Weather platform (WRF) and photochemical model (CHIMERE).*

• **Agence Nationale de Protection de l'Environnement (Tunisia),** *Elaboration of a National Emission Inventory over Tunisia.*

• **Agence Nationale de Protection de l'Environnement (Tunisia),** *Establishment of an operational air quality modeling system for the ANPE in Tunisia. Weather platform (WRF) and photochemical model (CHIMERE). Consideration of desert dusts*

• **FASEP-China project,** *Establishment of an operational air quality modeling system for Beijing. Weather platform (WRF) and photochemical model (CHIMERE). Consideration of desert dust*

• **Israeli Ministry of Environment,** *Establishment of an operational air quality modeling system for Israel. Weather platform (WRF and Meteo France) and photochemical model (CHIMERE). Consideration of desert dust*

• **KIT-Japan project,** *Establishment of a desertic dust transport modeling system for Japan. Weather platform (MM5) and photochemical model (CHIMERE).*

• **Ministère de l'Ecologie et du Développement Durable (France),** *Development of a National Inventory for France at the 1km2 scale and for biogenic sources (Agriculture, Forestry, Volcanoes, Erosion, fire ...).*

• **ORAMIP Network monitoring air quality (Toulouse, France),** *Establishment of an operational air quality modeling system for Toulouse. Weather platform (MM5) and photochemical model (CHIMERE).*

Professional experience

• 12/06- 03/07 **Research Fellow,** *Centre d'Enseignement et de Recherche en Environnement Atmosphérique (CEREA), Laboratory ENPC and EDF R&D*

• 2005-2006 **ATER for Education and Research**, *University Paris12-Val de Marne, Laboratoire Interuniversitaire des Systèmes Atmosphériques (LISA)*

• 2002-2005 **PhD** « Analyse par modélisation des processus physico-chimiques déterminant la production d'ozone – Evaluation de l'impact de scénarios d'émissions prospectifs – Application au site ESCOMPTE», *LISA*, *Modeling group, supervision : Isabelle Coll, Université Paris12-Val de Marne.*

Awarded by the PREDIT (programme national de recherche d'expérimentation et d'innovation dans les transports terrestres) in 2008

• 2002-2005 **Office and lessons in physics** *(fluid mechanics, optics, mechanics point), Université Paris12-Val de Marne*

• 2000-2002 **Teacher in Physics and Chemistry** (5th and 4th classes), *Collège-Lycée privé Georges Leven*

Formation

• Février 2006 **PhD in Sciences - Specialty Chemicals Air Pollution and Environmental Physics,** *University Paris 12-Val de Marne*, very honorable mention

• 2001-2002 **DEA in Chemicals Air Pollution and Environmental Physics**, *Université Paris 7*, mention B

Training: « Eulerian three-dimensional modeling of a pollution episode in the area of Fos-Berre-Marseille », *LISA, University Paris12-Val de Marne*

• 2000-2001 **Physics Master,** options Fluid Mechanics, Dynamics of the atmosphere and ocean, Atmospheric Environment, *Université Paris 7*, mention AB

Training: « Simulation of oxygen 18 in ocean general circulation model for modern and glacial periods», *Laboratoire des Sciences du Climat et de l'Environnement (LSCE)*

Papers and international conferences

• *F. Lasry, E. Buisson, I. Coll "An insight into the formation of severe ozone episodes: Modeling the 21/03/01 event in the ESCOMPTE region", Atmos. Res., ESCOMPTE special issue, 2005*

• *F. Lasry, I. Coll, S. Fayet, M. Havre, R. Vautard "Emergency measures: An expertise via the elaboration of emission scenarios", Journal of Atmos. Chem.,*

• *Zhang, Q. J., Laurent, B., Velay-Lasry, F., Ngo, R., Derognat, C., Marticorena, B., Albergel, A., (2012) : An Air Quality Forecasting System in Beijing – Application to the Study of Dust Storm Events in China in May 2008, J. Environ. Sci., 10.1016/S1001-0742(11)60733-X*

- **Air Quality Conference** English oral presentation March 2009, *Istanbul, Turkey*
- **Journées de l'Oh** French oral presentation May 2006, *Créteil*
- **Air Pollution 2005** English oral presentation May 2005, *Cordova*
- **European Geosciences Union** English oral presentation April 2005, April 2006, *Vienna*
- **ESCOMPTE workshops** English and French oral presentation May 03, février 05, *Toulouse, Marseilles*

Didier BUTY

email : dbuty@aria.fr

Software development Manager - ARIA Technologies since 1991

ARIA View software product manager, software dedicated to online tracking of atmospheric impact of industrial plants

Skills

- Sciences: Three-dimensional modeling of meteorology at different scales (regional and local) transport and dispersion of pollutants. Atmospheric boundary layer Physics.

- Project Manager: Project management and software development, development of specifications. Development team Supervision. Management of technical relationships with partners in France (AlphaMos, Cairpol, Environnement SA), in the USA and Italy

- Computer: Computer environments Unix and Windows. Development Fortran, C, C + +. User interface generators ILOG Views C + + and Qt Nokia. System Databases Oracle and SQLite.

- Languages: Spoken and written English, Italian and Polish notions.

Projects within Aria Technologies

- Computer development projects:

Development of atmospheric modeling software. Implementation of the provision of packaged software (complete management of three software products). Creation of systems incorporating a package including software, sensors and computer. Developments related to specific issues (CNES, CEA). Training on the software provided in France and abroad. Pre-sales support in conjunction with the sales teams.

Installation of software monitoring and decision support on networks of pollution monitoring, Air Normand (Le Havre, Rouen), AIRPARIF (Paris), ASPA (Strasbourg).

Installation of online tracking software on industrial plants. Maintenance and development of the real-time calculation for estimating the impact of a facility. On-site installation and training provision of ARIA View software. OMIFCO (Sultanate of Oman). Rompetrol (Romania). EGZIA (industrial area of Arzew - Algeria), BSC (Brazil), Degrémont (Mexico)

Installation of online tracking software related to the problem of odors: In cooperation with the company AlphaMos, establishment of monitoring systems related to electronic nose on landfill sites and composting facilities (Veolia, Sita, Barisien Group). In cooperation with the company Cairpol, establishment of monitoring systems relied on a network of micro sensors (emission sources estimates) on landfill sites and composting facilities (Syded87, Degrémont Mexico ODEMS project) .

Participation in the provision of software for the United States Department of Defense (U.S. DOD): In collaboration with the American company SAIC, insertion of the SWIFT meteorology fast calculation code, developed by ARIA, inside the computer modeling system HPAC (Hazard Prediction Advisory Capability) for the U.S. Army.

Participation in projects validation software release:

Siesta Experiment (Paul Sherrer Institute).

Life Project 1995 "Intégration de mesures optiques de type DOAS dans les procédures d'alerte du réseau Normand de la surveillance de la qualité de l'air" in collaboration with Air Normand, Environnement SA and INERIS.

Simulation of pollution episodes in the Paris region in collaboration with Airparif (1998)

Study of numerical modeling of weather and pollutant dispersion for the DRIRE Normandy. Simulation of 31 pollution peaks observed in 2007 on the site of Le Havre and Notre Dame de Gravenchon

• *Regional scale projects :*

- Implementation of the modeling system « SIMPAR » AIRPARIF (1997). First operational modeling tool for a large city in France, including in particular the calculation of emissions from road traffic.
- Simulations of photochemical episodes LYON (1998) in partnership with the IFP, Peugeot, Renault, Elf, Total. Implementation of software. Installation and training with partners.
- Participation in the project to provide "turnkey" system for the Ministry of environment In Israel (2003). Implementation of " Israeli PREV'AIR " national spatial emission (3km and 1km inventory resolution) computing system with scenarios, operational forecasting system of pollution processing the CHIMERE code and weather forecasts ARPEGE / ALADIN provided by METEO-FRANCE.
- Establishment of the national modeling air pollution system in QATAR (2005): On behalf of TOTAL Production Operations, to be used by Qatar Petroleum. Taking into account all the issues around the Arabian Gulf. Commissioning of a system of scenarios calculations relied on the MM5 meteorological code. System updated and expanded in the field of forecasting in 2009.
- Participation in the project of setting up a modeling system nationwide in Tunisia (2012) computing system with scenarios, operational forecasting system of pollution relied on CHIMERE and FARM codes and weather forecasts WRF . Module development of chemical accident calculation.

Papers

• 1994 **Modélisation numérique 3D de la pollution automobile à l'échelle du quartier et evaluation de l'impact d'un passage souterrain en milieu urbain.** Armand ALBERGEL, Didier BUTY, Philippe CAUVIN. **INRETS : 3ème colloque International : Transports et pollution de l'air.** Avignon

• 1998 **Use of dispersion modeling and a differential optical absorption spectroscopy (DOAS) monitor for improving pollution prevention procedures around an industrial site.** Dominique Thomas, Veronique Delmas, Michel Bobbia, Veronique Tatry, Jacques Moussafir, Jacques Piquard, Didier Buty, Alexis Coppalle, Tamara Menard. **Environmental Monitoring and Remediation Technologies.** Boston

• 2004 **Simulation of the plume gamma exposure rate with3D Lagrangian particle model SPRAY and post-processor Cloud Shine.** Patrick ARMAND, Pascal ACHIM, Marguerite MONFORT, Philippe GUETAT, Armand ALBERGEL, Olivier OLDRINI, Didier BUTY, Julien COMMANAY. **The 10th International Conference on Harmonisation within Atmospheric Dispersion Modelling for Regulatory Purposes** – Malia (Crète)

• 2005 **Design and Implementation of an Air Quality Forecast System for the Ministry of Environment (MOE) of the State of Israel**. Uri Stein, Claude Derognat, Alexandra Fresneau ,Eva-Marie Eriksson Jacques Moussafir, Armand Albergel, Didier Buty. **Chimere Users Club** – Ecole Polytechnique

• 2007 **SWIFT and MSS Current Developments.** Dr. Jacques Moussafir, Dr. Didier Buty, Christophe Olry, Maxime Nibart, Dr. Armand Albergel, Dr. Gianni Tinarelli, Pr. Domenico Anfossi Olivier Oldrini, Dr. Thomas Harris, Catherine Dougherty. **11th Annual GMU Transport and Dispersion Modeling Conference.** Georges Mason University

• 2010 **Système de modélisation en ligne de la dispersion des odeurs en temps reel. Présentation de réalisations en fonctionnement.** Jacques Moussafir, Didier Buty, Christophe Olry, Louis Vivola. **Atmos'fair conference 2010**

• 2013 **Odorant dispersion ans Emissions Monitoring System (ODEMS).** Olivier Zaouak, Bruno Aubert, Thierry Tonnelier, Youssef Stitou, Christian Marchionini Didier Buty, Christophe Olry, Jacques Moussafir, Julien Baroni, Jean-Louis Fanlo. **AWMA 2013 Annual Conference & Exhibition, Chicago.**

Previous professional experience

- 1989-1991 **Centre Scientifique et Technique du Bâtiment (France).** Research engineer in the field of ventilation and the study of air movement inside buildings. Use of CFD codes and development of specific models. Participation in the work of the International Energy Agency.

- 1988-1989 **CEP Systèmes (France).** Software Engineer. Development of codes of atmospheric dispersion achieved through impact assessments and hazard studies.

Formation

- 1984-1988 Department of Studies and Research - Electricité de France. Thesis on turbulence modeling applied to the simulation of atmospheric flows. Integration and validation of several models of turbulent diffusion in a three-dimensional non-hydrostatic code

CURRICULUM VITAE (CV) OF PROPOSED PROFESSIONAL STAFF

Name of Firm: ARIA Technologies

Name of Staff: **Eva Marie ERIKSSON**

Profession: Engineer

Date of Birth: 1966

Years with Firm/Entity: 13 Nationality: Swedish

Key Qualifications:

During her 20 years of professional experience in the field of atmospheric environment, Ms Eriksson has acquired a sound knowledge in the different aspects involved in air pollution modeling.

She has a wide experience in air pollution assessment studies, a field in which she has served as consultant and project manager for a great number of individual projects in Sweden and France as well as in different international projects. She has undertaken diverse assignments in foreign countries for the design, installation and application of air pollution simulation tools, used for evaluating abatement scenarios as well as for forecasting current air pollution (Rio de Janeiro City, Qatar, St. Petersburg, Barcelona, Rabat, Oman, Romania, Kaliningrad, Stockholm, Jordan, Chile…).

Ms Eriksson is experienced with traditional Gaussian models as well as three-dimensional meteorological and dispersion models, used in the framework of environmental impact studies related to industrial emissions and urban planning. Furthermore, she has undertaken several assignments related to the supervision and on-the-job guidance of the establishment of emission inventories and preprocessing of data for emission modeling.

She was recently in charge of the ROMAIR project, funded by the EU, with the objective to provide the Romanian National Environmental Protection agency with a complete air quality monitoring and forecasting system. The modeling tool was validated through on-site experiments, involving comparisons with observations at ambient air quality stations, as well as specific field experiments using LIDAR technology. The modeling system implemented provides the authorities with tools for air quality management enabling operational air quality forecasting as well as strategic planning for the study of future emission reduction scenarios.

Education:

1989-1993 M. Sc. Physics, option Meteorology Stockholm University.

1989-1990 Certificate of the Department of Environmental Science, Washington

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Employment Record:

From 2001 ARIA Technologies, France, Senior Consultant and Project Manager

1993-2000 SMHI Swedish Meteorological Hydrological Institute, Sweden, Project Manager

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Languages:

English: Speaking: excellent, Reading: excellent,Writing: good

French: Speaking: good, Reading: excellent, Writing: good

German: Speaking: fair, Reading: good, Writing: fair

Swedish: Speaking: excellent, Reading: excellent, Writing: excellent

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Recent Projects:

Date	Location	Client	Description
2014 - 2015	Chile	MMA Chile	The CONAIRE project is an ongoing project financed by the French government with the aim to provide the Chilean Environmental Protection agency (Ministerio de Medio Ambiente) with a complete air quality monitoring and forecasting system for the Concepción area.
2013 - 2014	Jordan	Ministry of Environment	The project consisted of carrying out an emission inventory of pollutants released into the atmosphere over the Jordan territory, including their spatial and a temporal distribution. The ultimate goal was to develop and provide the Jordan authorities with a tool which can be used for monitoring atmospheric pollutants and developing action plans to reduce air pollution.
2013 - 2015	FuME	EU (Climate-KIC)	Quantification of Fugitive Methane Emissions from hard-to-tackle sites and sources. On-going EU project aiming to create a Methane Measurement Service targeted at municipal waste water treatment plants, shale gas extraction and gas distribution industries. Calculation of methane emissions based on inverse modeling technique.
2010 - 2013	Bucharest, Romania	EU & ANPM	The ROMAIR project was financed by the European Union with the aim to provide the Romanian Environmental Protection agency with a complete air quality monitoring and forecasting system. The project involves an exhaustive emission inventory carried out over Romania with special focus on the Bucharest region, the implementation and configuration of a meteorological model and an air quality model for both primary and secondary pollutants as well as the organization of field experiments for model validation. The system is operated on a daily basis, and in forecast mode, with Web display of results made available to the public on internet.
2007 - 2009	Kaliningrad, Russia	EU & ECAT	KALAIR, KALiningrad AIR Pollution induced by traffic: emission inventory, modeling system design and installation. Comparison of model output with measurement data. Evaluation of emission scenarios.
2006 - 2009	Qatar	TOTAL & QP	Emission inventory for the development of an Air Quality Modeling System for Qatar. Consulting services, assistance, software and training of TOTAL and QP staff in Doha.
2005	Katowice, Poland	EU	E-TEN: European Community Program designed to help the deployment of telecommunication network based services (e-services) with a trans-European dimension. Emission inventory and preparation of data for dispersion forecast modeling for the Katowice region (Poland).
2003 - 2005	Israel	Ministry of Environment	National Scale Air Pollution Modeling Project for the Ministry of Environment in Israel.
2003 - 2004	Rio de Janeiro, Brazil	RENAULT & French Ministry for Foreign	Air Pollution Modeling Project for Rio de Janeiro “Clean Air for Latin American Cities World Bank Program”. Modeling system design, installation and training of staff at the city of Rio de Janeiro. Comparison of meteorological and

		Trade	dispersion model output with measurement data. Evaluation of emission abatement scenarios.

Further Experience:

Date	Location	Company	Description
2001 - 2009	France	ARIA Technologies	• Air Quality Impact studies of traffic emissions (ARCADIS, BCEOM, Ville de Paris, Ville de Plaisir, SEMAPHORE, Thales, IRIS Conseil ...) • Environmental Impact studies and Health Risk Assessments for several incinerators in France (PROCYRDHIM (Douai), Rennes, SMETOM (Pontarlier), SIOM (Villejust))... • Long-term impact study of atmospheric releases from industrial facilities (SPONTEX, IPEDEX Oman, Technip MOBIN project IRAN, CIMENT CALCIA, Provence Power Station Gardanne, GDF Power Stations...) • Study of odor impact due to atmospheric releases (Liège, Monbéliard…)
1998 - 2000	St Petersburg, Kaunas, Stockholm	SMHI, Swedish Meteorological and Hydrological Institute	• Air Quality Management System for the Environmental Protection Department of St Petersburg City (SP-EPD). Supervision and on-the-job guidance of the emission inventory and air quality assessment for St Petersburg city. • Supply of Computers and Air Quality Management System for Kaunas City Administration, Lithuania (EU project). • HEAVEN: Healthier Environment through Abatement of Vehicle Emission and Noise (EU project). Development and delivery of air quality management systems for Prague and Leicester. • Integration of the MATCH regional scale dispersion model and PAH calculations with the Airviro system for the Environmental Protection Department of Stockholm City. • Organization of a yearly 5-week-long Advanced International Training Programme: “Air Pollution Management and Technology” at SMHI including lectures, practical exercises, group work and study tours.

Claude
DEROGNAT
Nationality: French
Degree: Phd Science, DEA Meteorology, Oceanography and Environment, DEA Modelling and structural mechanics, Master of fundamental physics (Meteorology Sciences Option)
Professional experience: 10 YEARS

- **Team Leader of Regional and Climate Modelling (since January 2011 in ARIA Technologies since October 2003)**

- **October 1999 - March 2002** Thesis entitled "Photochemical Pollution on urban scale and the interaction with the regional scale " Aeronomy Service, National Center for Scientific Research, Paris / Paris VI University. Mr. G. and coaching Beekmann Ancelet)
- **July 2002-July 2003** Postdoctoral: Coordination of "modeling and intercomparison exercise of dynamics and chemistry on the Basis of the international field campaign DISCOUNT" CNRM, National Center for Scientific Research, Toulouse / Météo-France, Toulouse

REFERENCES

Project	Location	Client	Achievement year
FORSQUALL - Establishment of a deterministic and probabilistic forecasting chain, based on the coupling of variational assimilation and sets of techniques.(WRF / WRF-DA(3DVAR) / WRF-DA(EVIL)	West Africa	CITEPH	2011-2014
SINOP - Establishment of a forecast of trans boundary air pollution system (**haze**) on Indonesia on behalf of International MeteoFrance and final destination of BMKG (Indonesian Meteorological, Climatological and Geophysical Agency). This system takes into account the risk of fire and fire observation by satellite remote sensing. The operating system is coupled to the	Indonesia	MeteoFrance International	2012-2013

weather patterns and systems of information dissemination MFI.			
AIRCITY – SP3: Web deployment on laptop, smartphone and tablet viewing (OpenLayers / Google Earth) concentrations and meteorological fields in high-resolution computed on the city of Paris. Aircity project - SP4: graphics processing and export (OpenLayers and Google Earth) LIDAR data.	France	FEDER(EU)	2011-2013
TUNAIR - National Agency for Environmental Protection, Establishment of an operational modeling system of air quality for ANPE. Weather Platform (WRF + SWIFT) and photochemical models (CHIMERE / FARM / SPRAY)	Tunisia	ANPE	2011-2013
ARIAVIEW WEB - Web deployment on laptop, smartphone and tablet system monitored real-time dispersion plume of industrial	Mexico	Degremont	2011-2012
ROMAIR - The EU-funded project which aims to provide the Romanian Agency for Environmental Protection via a comprehensive system for air quality monitoring. The project is based on a comprehensive inventory of emissions across the country, particularly in the area of Bucharest. The system operates on a daily basis in preparation mode with online viewing. Meteorological platform (WRF) photochemical / aerosol (CHIMERE)	Bucharest Romania	EU & ANPM	2010-2012
LENVIS - Establishment of an operational modeling system of air quality and coupling with the water quality (inland	Portugal (Lisbon) / Italy (Milan/Bari) /	FP7 (European Union)	2008-2011

waterways and coastal zone)). Integration of a forecasting System, final tool for the decision based on a collaborative exchange of services related to environment and health network. Meteorological platform (WRF) photochemical / aerosol (CHIMERE)	Netherlands (Noord Brabant)		
FASEP India - Establishment of an operational modeling system of air quality for the CPCB in New Delhi. Photochemical weather platform (WRF) model and (Chimera). Consideration of desert dust and biomass burning.	India	FASEP	2011
FASEP China - Establishment of an operational modeling system for air quality in Beijing (China): Meteorological platform (MM5 model) and photochemical / aerosol (CHIMERE). Lidar coupling.	China	FASEP	2007-2009
E2SP : Establishment of an operational modeling system for air quality in Bari (Italy) and Katowice (Poland): Meteorological platform (MM5 model) and Lagrangian modeling (Spray model) and photochemical (CHIMERE and FARM). Web application (ASP)	Italy and Poland	FP7 (European Union)	2005-2007
Monitoring network of air quality in Toulouse: establishment of an operational modeling system for air quality. Photochemical weather platform (MM5 model) and modeling (CHIMERE)	France	ORAMIP Monitoring Agency and air quality in the Midi-Pyrenees region)	2006-2007
Establishment of an advanced operational modeling system forecasting SO2. Meteorological platform (MM5	France	TOTAL R&D	2005

model) and modeling (IMPACT Gaussian model and Lagrangian SPRAY)			
Team participation with the CNRS (Matthias Beekmann) to study the contribution of different Chinese provinces to Asian pollution by acid rain	Chine / France	CNEMC /SEPA CHINE	2002

PUBLICATION

Belegante, L., Nicolae, D., Nemuc, A., Talianu, C., and **Derognat, C**.: Retrieval of the boundary layer height from active and passive remote sensors, Comparison with a NWP model accepted for publication in Acta Geophysica, Springer Link, online, March 2013.

Zhang Q, Laurent B, Velay-Lasry F, Ngo R, **Derognat C**, Marticorena B, Albergel A: An air quality forecasting system in Beijing--application to the study of dust storm events in China in May 2008. J Environ Sci (China); 2012;24(1):102-11 PMID: 22783620

Beekmann, M., and **C. Derognat**, Monte Carlo uncertainty analysis of a regional scale transport chemistry model constrained by measurements from the Esquif campaign, J. Geophys. Res., Vol. 108, No. D17, 8559

Derognat, C., M. Beekmann, H. Schmidt, B. Neiniger and D. Martin, Effect of biogenic VOCs Emissions on the tropospheric chemistry during elevated ozone periods in Ile-de-France, J. Geophys. Res., ESQUIF special section, 2003

Schmidt, H. , **C. Derognat**, R. Vautard and M. Beekmann, A comparison of simulation and observed ozone mixing ratios for the summer of 1998 in western Europe, Atmos. Env., 35, 6277-6298, 2001.

TRAINING

1998-2002	National Centre for Scientific Research (CNRS) PhD Science (Thesis: The photochemical pollution in the urban scale and interaction with the regional scale)
1997-1998	DEA Meteorology, Oceanography and Environment
1996-1997	DEA Modeling and structural mechanics
1992-1996	Master of fundamental physics (Option Meteorology Sciences)

LANGUAGES

French	Talk: excellent, Read: excellent, Write: excellent
English	Speaking: good read: excellent, Write: good

Signature of the expert Date: 7/08/2013

Signature of the Office