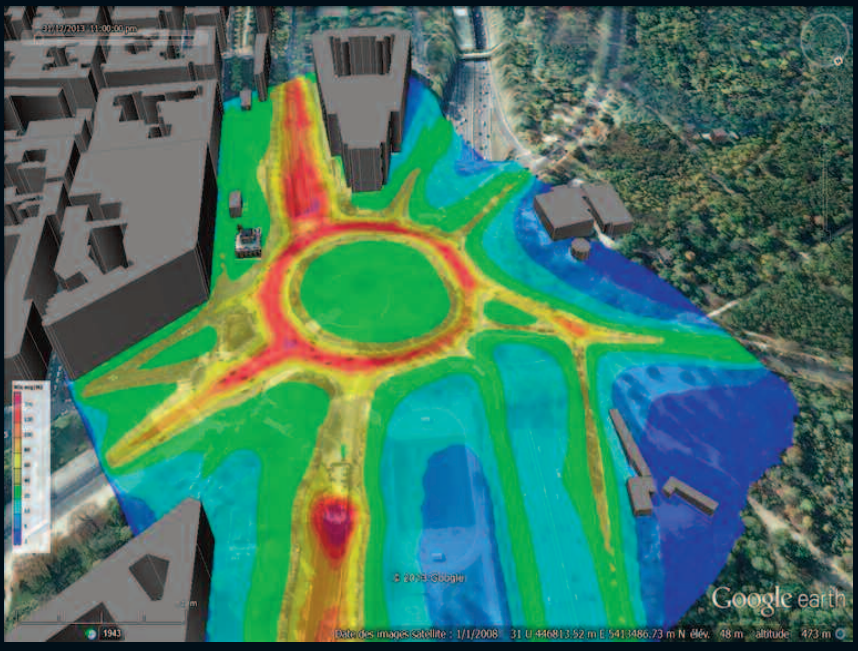


SOFTWARE & SYSTEMS CATALOGUE 2018

ARIA Technologies

A single concern: the atmospheric environment

Founded by a group of researchers from the French electricity board EDF, ARIA Technologies has played a pioneering role in the global development of atmospheric modelling.

The original group has grown into a team of 25 engineers drawn from various fields of atmospheric sciences, who have placed this knowledge-based SME at the cutting edge. ARIA Technologies' head office is located in Boulogne-Billancourt, near Paris; off-site staff are posted in Brest, Grenoble, Lyon, Marseille, Metz and Toulouse.

Its Italian subsidiaries ARIANET (founded in Milan in 2000) and SIMULARIA (Turin, 2010) together employ 20 engineers specialized in atmospheric sciences. In 2010, ARIA established its subsidiary in Rio de Janeiro, Brazil, with a team of 3 specialist engineers.

ARIA Technologies collaborates with key French organizations involved in monitoring air quality — regional air quality management bodies, CEA (atomic energy), INERIS (environmental safety), METEO-FRANCE (weather) CNRS (IPSL), KIC-Climate, — and with a large number of well-known international partners.

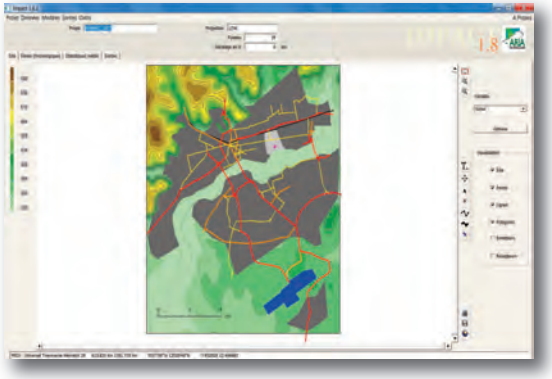
A comprehensive range of software and systems

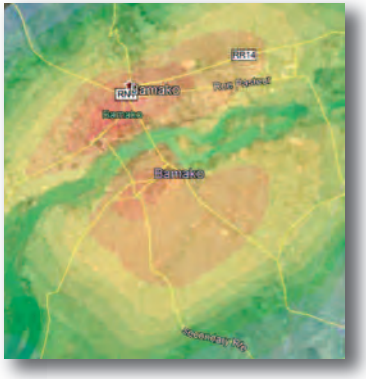
ARIA Technologies' software and systems are designed to address issues related to air pollution—industrial, urban, hazardous, and chronic. They are also suited for specific uses in applied meteorology.

- **ARIA Impact™** and **ARIA Impact 3D™**: software for studies on the impact of industries and vehicular traffic on air quality
- **ARIA City™**: GIS-embedded software for modelling air quality in cities
- **ARIA Risk™**: 3D software for assessing air dispersion of accidental releases
- **ARIA Indoor™**: software for the assessment of indoor air quality
- **ARIA Local™**: software for calculating air flow and dispersion at micro-scale
- **ARIA Wind™**: system for mapping, calculation, and optimization for wind farm sites
- **ARIA View™**: system for continuous surveillance of air quality at industrial sites
- **ARIA Regional™**: system for air quality analysis and forecasting at urban and regional levels

ARIA Impact

Software for studies on the impact of industries and vehicular traffic on air quality





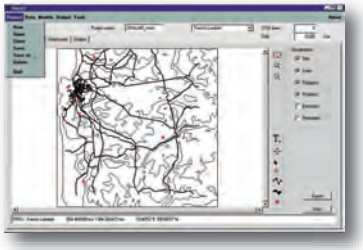
ARIA Impact™ is a user-friendly software customized to meet the requirements of consultancy firms, enterprises, local authorities, and air quality monitoring associations. It ensures compliance with air quality regulations and is used for complete assessments of, for example, health risks, olfactory pollution from an industrial site, the impact on air quality and health of a road project. With ARIA Impact™, users can simulate the long-term dispersion of air pollutants (gaseous or particulate) released from any type of emission source. They can calculate concentrations and deposition (dry and wet) expressed as an annual average or as percentiles. ARIA Impact™ now incorporates both the AIM Gaussian model (already available in the previous versions) and the AERMOD model from US-EPA (integrated through a partnership with CAIRN Développement).

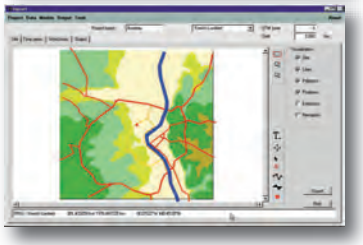
Selected references:

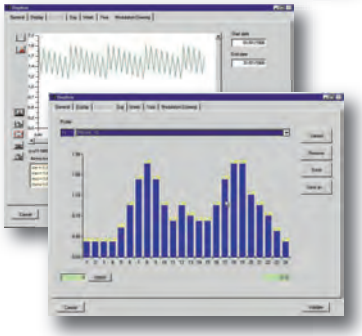
ABH Environnement, AENA, AFIRM, Air Breizh, ANDRA, ARKEMA, ASEZA, AXE, BDS Forage, Beture Environnement, Bureau Veritas, BURGEAP, Cabinet GREUZAT, Cabinet MERLIN, CEA DAM, CETIM , CTP, EDS, ENTIME, EOG, EVOLUTYS, GDF, GEOSAN, GES, GINGER Environnement, INGEROP, INGEVALORIS CONSEIL, IRSN, ISPE, ISSEP, JMB, KALIES, Mininstries of. Environment of Malta and Morocco, NEODYME, NOVALLIA, OLENTICA, Ouest Performance, ORAMIP, OTE Ingénierie, Pitesti, RATP, SAIPEM, SANOFI AVENTIS, SETIS Environnement, SOCOTEC, THERIUS, TOTAL Pétrochimie, Universities of Paris VII et XII - DESS QCBA, WLI Algeria, SGS MULTILAB, Ecole des Mines d'Alès, Mediaterre, Ecole des Mines de Rabat (ENIM), Europe Environnement, INSA Rouen, THEMA Environnement, AGMS, TEREA France, Environnement Air, SOLYME, TESCO (Tunisia), MECRO System (Romania), CIA-Acoustique

Key features

- Easy import of meteorological, terrain, and emission data (constant, cyclic, occasional) from Excel files
- Statistical processing of meteorological data (time series, wind roses)
- Simultaneous processing of different types of pollutants: gases, particles, odours, radioactive matter, as well as odour mixes (in odorimetric units)
- Unlimited number of point, area, volume, and line sources
- Conversion of NOx to NO/NO2 for vehicular traffic
- Consideration of constant or fluctuating background pollution
- Extensive range of outputs: concentration and deposition maps (annual average, percentiles, daily and hourly maximum, exceedance frequency)
- Results for specific points (schools, hospitals, sensors, etc.) at ground level or at a given altitude
- The AIM model developed by ARIA Technologies is based on stability classes and can account for calm winds; pollutant dispersion can be modelled from a simple wind rose or a 1- or 3-hourly meteorological database
- The US-EPA AERMOD model, often described as a second generation model, is based on the computation of turbulence; pollutant dispersion can be modelled from a 1-hourly meteorological database. It accounts for the effect of buildings located near the emission sources
- Visualization of concentrations at any point by using the cursor
- Export of results to Google Earth and to GIS-enabled Mapinfo and ArcGIS
- Validated against measured or computed data; validation report available
- Software, detailed technical documentation, and tutorial in English and French







Project management

All project components are automatically stored in corresponding folders: geographical context, terrain, mapping objects, land cover data, station coordinates, meteorological data, and emissions. Variants are created by loading a previous project.

Maps: import from/export to GIS

Geographical data can be imported directly from major GIS (Mapinfo, ArcInfo/ArcView), in DXF or shapefile formats. The dispersion calculations actually use terrain and land cover data.

Emissions management

For each source, time variation profiles (monthly, weekly, hourly) help define a realistic emission scenario that provides an accurate assessment of the long-term impact. The model can also account for technical breaks in industrial emissions. Existing emission data can be easily imported from Excel sheets into ARIA Impact™.

ARIA Impact3D

3D software for studies on the impact of industries and vehicular traffic on air quality

ARIA Impact3D ARIA Impact3D software is designed to assess the chronic impact of industrial plants or vehicular traffic on air quality through the simulation of actual or virtual emission scenarios. It simulates in 3D the air dispersion of pollutants (gaseous or particulate) from stacks and outlets, and fugitive sources based on a detailed account of terrain, building effects, and meteorological data measured or forecast simultaneously at multiple heights.

ARIA Impact3D is intended for enterprises, consulting firms, and local authorities of industrial zones that need a detailed assessment of chronic risks. It integrates a 3D Lagrangian dispersion module.

CAIRN DÉVELOPPEMENT

** CALMET-CALPUFF has been integrated into ARIA Impact3D through a partnership with CAIRN Développement*

Objectives

- Model air pollution around industrial sites
- Conduct studies (diagnostics, preparation, surveillance) for air quality improvement campaigns
- Plan and develop pollution monitoring strategies
- Model and map air pollutant emissions in a city district, city, or region
- Simulate air dispersion of all pollutants measured by air quality monitoring networks in the study area
- Determine the contribution of each emission source
- Analyse existing regulation strategies
- Simulate the meteorological conditions in 3D environment to study past episodes or forecast future episodes

Key features

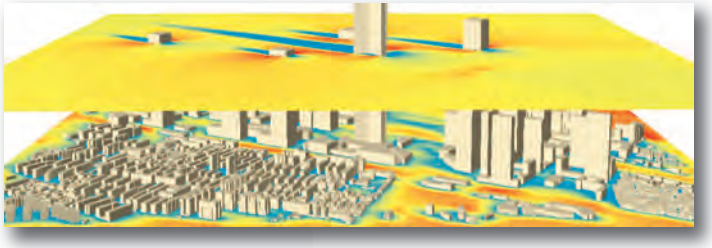
- Fully compatible with ARIA Impact™ (provided): allows to study significant episodes with 2D and 3D emission scenarios.
- Provided with MSS (Micro SWIFT SPRAY), the state-of-the-art lagrangian particle dispersion model developped by ARIA Technologies and its partners ARIANET and Mokili.
- Includes CALPUFF, a lagrangian puff dispersion model which uses CALMET meteorological fields or station data; CALMET and CALPUFF are US-EPA approved*.
- Simulation time period ranging from one hour to several years
- Can be inserted as an engine in the ARIA View™ system for producing a detailed real-time map of the impact of an industrial site.

Selected references:

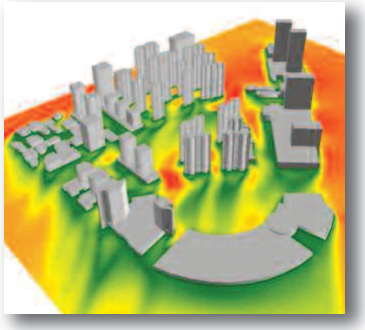
BV Lyon, Andra, Air Rhône-Alpes, Olentica

ARIA City

GIS-embedded software for modelling air quality in cities



Environment authorities of cities encounter particularly complex air dispersion problems arising from the diversity of the urban landscape and vehicular emissions. They need a 3D digital representation of the urban ecosystem (roads, terrain, 3D images of buildings) to visualize the confinement effects of different obstacles. Urban data are generally stored by city authorities in geographic information systems (GIS), the most common being ESRI's ArcGis Desktop.



A direct and simplified link makes **ARIA City™** fully compatible with the data storage standards and graphic tools of ArcGIS 9 and ArcGIS 10.

Selected references:

AIRPARIF, Ville de Paris, Lille Métropole, INERIS, INGEROP, SYCTOM, Tsinghua University (China), CMM (Mexico), SONATRACH (Algeria), ENWARE

esri Partner Network Silver

Objectives

- Studies for city development, planning of high-traffic roads (new or modified), location of tunnel exits and ventilation system openings (car parks, metro), traffic reduction strategies

Key features

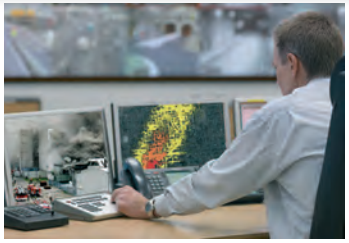
Single input and selection of:

- site-related geographical site data: terrain, land cover, buildings, location of the meteorological stations
- project basics: study domain, development or intervention option, traffic flow (light vehicles, light utility vehicles, two wheelers, heavy vehicles), other emission sources (industrial, household)
- calculation of emissions based on vehicle flow and fleet data, using the TREFIC model
- computation: Gaussian model (ARIA Impact Model — AIM), Lagrangian particle model (Micro SWIFT SPRAY — MSS), complete CFD model (Code_SATURNE).
- expected results and maps: annual mean, regulatory percentile, simulation of a daytime period, scenario comparisons, worst case studies (2F meteorological situation).

ARIA Risk

3D software for assessing dispersion of accidental releases

Michelstadt (projet COST ES1006)



Selected references:

APSYS, AXE, CAEPE, CEA-DAM, DGA-CEB, CNES, EOG, Tunisian chemical group, GSN, INERIS, KNMI (The Netherlands), METEO FRANCE, MGPI, THALES, TOTAL, Enware, University of Tsinghua, DSO Singapour

ARIA Risk™ is a 3D software for assessing risks arising from the dispersion of toxic industrial gases (storage accident, pipe failure, fire). It can be incorporated in an alert system, outputs maps of instantaneous or integrated concentration and deposition and enables the determination of safety limits, zones of threshold exposure and IDLH.

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 winds.

Options and variants

- **ARIA Risk CBRN™** for chemical, biological, radiological, and nuclear accidents or threats.
- **Rescube3D,** a product offered jointly by Leosphere and ARIA Technologies for real-time monitoring of dispersion of hazardous plumes

Objectives

- Evaluate source term (accident)
- Locate risk zones based on 3D fields (terrain, meteorological stations).

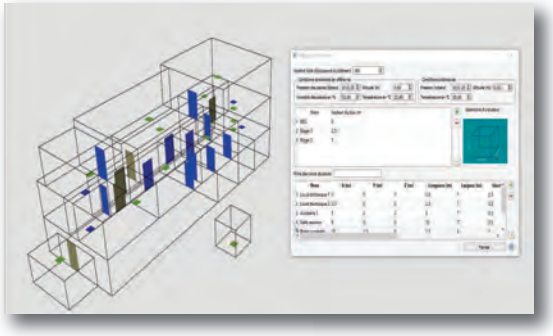
Key features

- Use of real-time meteorological data for multiple sources
- Modules with relatively short calculation time depending on the problem
- Simple, academic, or very complex meteorological situations considered, depending on the modules used
- Accounts for calm winds
- Accounts for wind shear effects
- Accounts for terrain and surface roughness
- Accounts for obstacles (based on the model used)
- Considers variable emissions
- 4D calculation with a 4D grid and time scale
- Multi species emissions
- Leakage model
- Calculation of depositions

ARIA Indoor

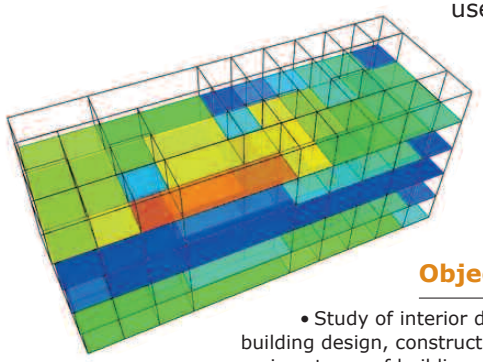
Software for the assessment of indoor air quality

Increased public awareness of air pollution issues and the significant time we spend inside buildings (schools, offices, industrial buildings,...), have highlighted the importance of identifying not only air quality in outdoor ambient air, but also inside confined environments.



To meet this need, ARIA Technologies has developed a new software: **ARIA Indoor™**, based on the CFAST model (developed by NIST), which is a multizone model (or box model) that allows to evaluate the concentrations of various pollutants in different rooms of a building.

The software is simple to use in order to allow non-specialists to quickly take control of the software (engineering firms in building design, construction, administration, etc.).



Objectives

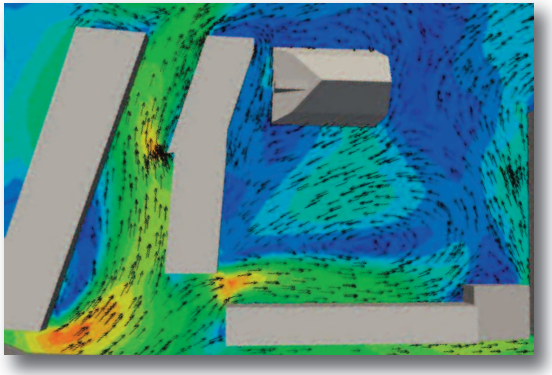
- Study of interior design, building design, construction of various types of buildings (office buildings, housing, shopping centers, etc.)
- Study of air quality in confined areas

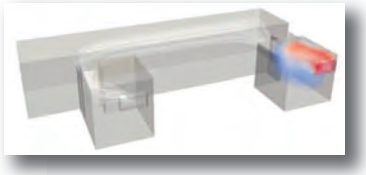
Key features

- User-friendly interface allowing to define the geometry of the buildings, the air flow between the rooms and the emission of pollutants
- Extremely fast calculation time; allowing to model a particular episode (1 minute to several days) or estimate the long-term impact on persons using the building (one to several years)
- Graphical user interface for visualization of results from the dispersion modeling (specific situations and time series) as well as the possibility to save animated 3D sequences
- Description of several source and sinks terms
- Ability to deal with accidental releases and fires
- Possibility of coupling with CFD models or with atmospheric dispersion models (for example PMSS) to study pollutant transfer between outdoor and indoor environment

ARIA Local

Software for calculating air flow and dispersion at micro scale





ARIA Local™ is designed to model air pollution problems down to a very small scale in urban and industrial environments (continuous or accidental releases); it accounts in detail for obstacles (buildings, slopes). ARIA Local™ can also be used for micro-meteorological applications such as wind power plants, construction works or indoor air quality assessments.

Objectives

- Flow mode precisely for different applications such as the study of wind effects on structures, micrositing for evaluating wind power potential (outdoor), profiling of airflows in closed spaces (indoor)
- Simulate most physical atmospheric phenomena that occur at the local scale, taking into account, for example, the atmospheric boundary layer, specific turbulence model, water microphysics
- Calculate the dispersion of heavy or light gas pollutants for different types of sources (instantaneous or continuous; point, area, or volume) of different origins (vehicular traffic, industrial, accident).

Key features

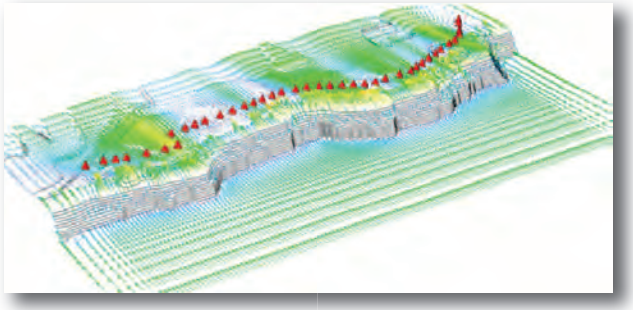
- Complete CFD applied to atmospheric physics (tested, validated, conforming to Quality Assurance norms). It is particularly suitable for processing small-scale atmospheric releases; it also has several types of turbulence closures
- Several pre and post processors
- Cartesian or terrain-following coordinates on structured or unstructured grids
- Stationary and transient calculations at small scale (from a few metres to a few kilometres) that integrate terrain and buildings on the site
- Microphysical parametrization of water based on the Kessler scheme (condensation, re-evaporation, autoconversion, collection)
- Designed for a wide range of studies such as an analysis of the impact on air quality of new structures or new urban projects (e.g., ring roads, stadiums, streets), studies for the defence sector (missile launches, delimitation of protected areas), indoor air studies (ventilation in buildings)

Selected references

Airparif, Areva, SGN Areva, CEA Cadarache, CEREA (ENPC), City of Paris, CNES CSG, CNRS (Aeronomy Laboratory, Jussieu), DGA–CEB, Ecole Centrale de Lyon (Fluid Mechanics Laboratory), ENEA (Italy), GDF, GIVAUDAN (Switzerland), IRSN (Fontenay), Italeco (Italy), JANUS, LMD, Queensland University of Technology–ILAQH (Australia), RATP, SAIC, SGN (COGEMA), Total

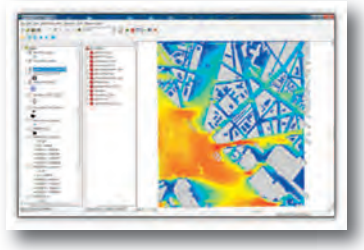
ARIA Wind

System for calculating and optimising wind potential



ARIA Wind™ is a tool for planning wind farms based on an evaluation of the available energy resource. It is used for assessing wind potential, optimizing the wind farm design, and determining the variability of energy generation. ARIA Wind™, which is linked to meteorological forecasts in real time, provides reliable estimates of turbine output.

ARIA Wind™ is a 3D model that reconstitutes wind fields according to the situation at the wind farm; it can simultaneously integrate different types of meteorological data and account for complex terrain.



Input data

Spatial scale:

- Wind turbine scale: < 1 km (ARIA Local™)
- Wind farm scale: 10 km x 10 km
- Regional scale: 100 km x 100 km

Meteorological data: All data measured at ground or elevated level, output of large-scale models (ECMWF, ARPEGE, NMC)

Site data: Digital terrain model, land cover, obstacles.

Objectives

- Regional scale:
  Map wind potential and specify the best sites for wind energy production
- Local scale:
  Determine the optimum configuration of the turbines and their location.
  Accurately calculate the output per turbine (kWh/year)

Key features

- Accurate 3D wind fields over complex terrain
- Arbitrary number and type of input meteorological data (several surface stations or none, wind profiles…)
- Reliable results (several validations)
- Linked to ARIA Local™ for micrositing applications

Selected references

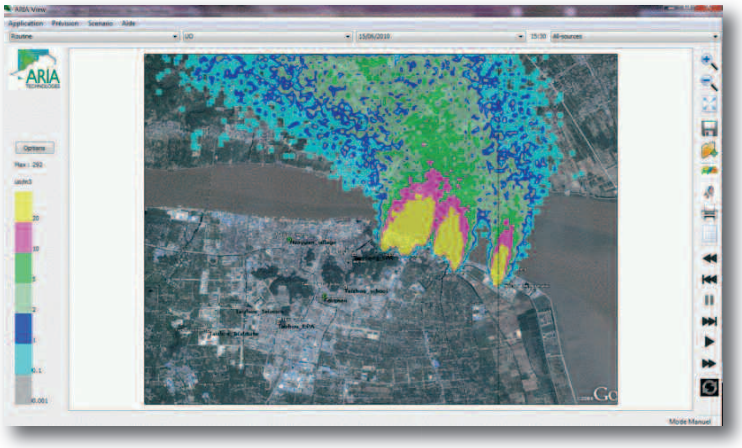
ADEME, Desarollos Eolicos (Spain), EDF, IMGW, JANUS, University of Moncton (Canada), Windlogics

ARIA View

Air quality surveillance system for industrial sites

Selected references

OMIFCO, Rompetrol, SITA Dectra, SITA Environnement, Taizhou – EPA, Véolia, Degrémont, Syded 87, BSC, Suez NOSE, ENWARE, Fibria (Brasil)

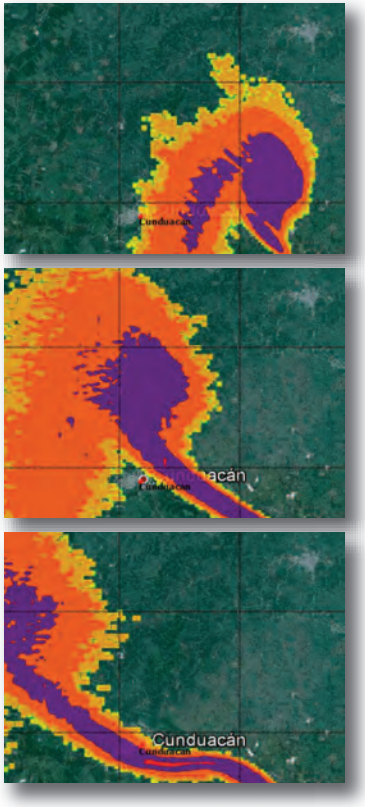


Key features

- Automatic: functions autonomously
- Continuous operation in real time: speedy calculations, typically 30 minutes of real time can be simulated in less than 5 minutes
- Flexible and powerful: Micro SWIFT SPRAY (MSS), the internal calculation engine of the system, is a 3D Lagrangian model that accounts better than a Gussian model for obstacles and local parameters such as weather, terrain, buildings, etc. .
- Multi-function: automatic monitoring, simulation of past events, forecasting, consolidation (average concentration, deposition, or centiles over a period)
- Reliable: designed to function 24 x 7, remote maintenance and telephone assistance
- Connected: real-time visualization of the plume, image export for reports or internet, export of virtual sensor data, automatic generation of easily configurable environment reports sent by email.

ARIA View™ is an operational system for air quality management. It provides users with a complete and precise picture of the impact of industrial activity on air quality around the site, which they can monitor continuously. ARIA View™ can generate the reports required by the authorities and present an accurate image of industrial activity to stakeholders (civil society and local committees). It is the best tool for a responsible corporate citizen.

ARIA View™ tracks conventional pollutants (SO2, NOx, PM, CO2, dioxin) as well as odours, *Legionella*, hot air plumes.



Routine monitoring

Modelling the atmospheric impact of an industrial plant using:

- measured emission data (link with emission data acquisition system) or most recent available data (nominal values or values deduced from the most recent regulatory measurements)
- real-time meteorological data, either measured on site or forecast by a predictive model
- a continuous dispersion model configured for the site and using an accurate description of the terrain, with an option to include buildings
- background pollution.

Output

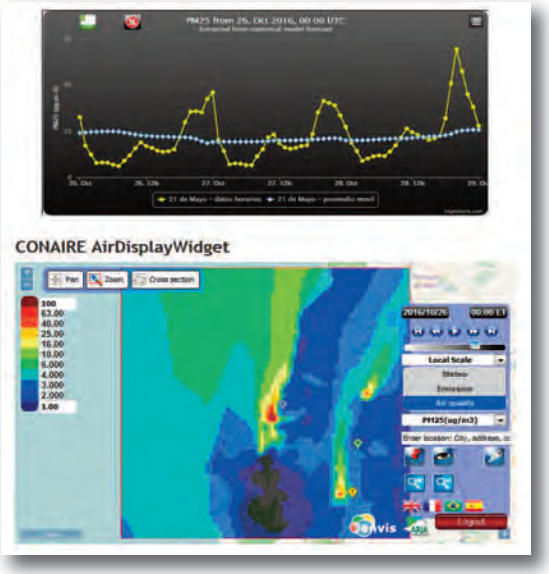
- Tables of maximum concentrations in the area and at any receptor point (montitoring stations and critical points)
- Concentration and deposition maps
- Automatic calculation of selected statistical values (e.g., monthly or annual averages, or centiles)
- *A posteriori* simulation of specific events
- Data storage
- Automatic integration of the results on intranet or extranet sites
  - Contribution from each source

Options and variants

- **Forecast option** to predict future air quality at the site according to meteorological conditions and emissions
- **ARIA View Risk™** for leakage prediction
- **ARIA View™ Server** for remote monitoring of the impact of a whole industrial site, or of an individual industry.
- **AS3** couples ARIA View a XRF analyzer in order to monitor heavy metals in the atmosphere
- **Inverse modelling option** to redefine the source emissions from an industrial site

ARIA Regional

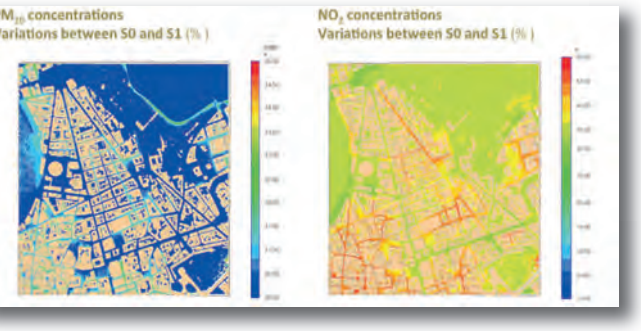
System to analyse and forecast air quality at urban and regional levels

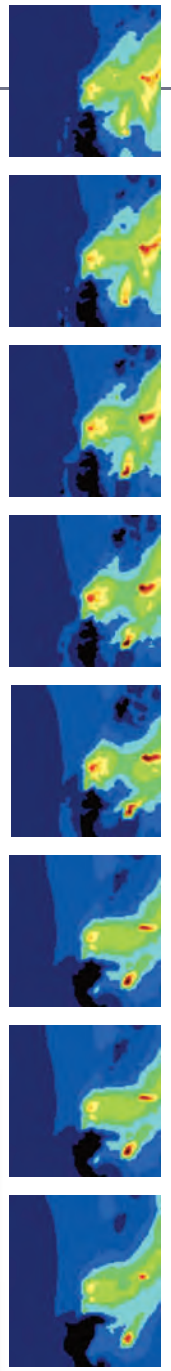


ARIA Regional™ is a complete system for analysing and forecasting air pollution at regional and urban scales from gaseous and particulate pollutants (primary and secondary). ARIA Regional™ integrates a suite of modules for evaluating and managing pollutant emissions from diverse sources: industry, traffic, natural sources, domestic sources. In diagnostic mode, the system enables the evaluation of incidents of pollution. In prospective mode, it tests the impact of measures taken to improve air quality (e.g., city transport plan, emission reduction, changes in vehicular fleet, fuel composition). In forecasting mode, through the use of a 3D medium-scale meteorological forecast model, ARIA Regional™ provides information on air quality (ozone, NO2, PM) up to 48 hours in advance and displays it on a wide range of public awareness tools: websites, smartphones, etc.

Key features

- Air quality forecast module
- Centralized information on air quality and site characteristics
- Link to databases of air quality monitoring networks
- 3D module for visualization of data and results
- Management and update of emission maps with detailed description of the sources
- Module for 3D reconstitution of wind fields, turbulence and temperature, apart from air quality
- Choice between different 3D dispersion modules, with or without chemical reaction
- Data export in various formats: NetCDF, KML, etc.
- Dissemination through Web HCI: Web services (WMS maps), extraction of time series (REST API)





Input data

- Spatial scale: domains ranging from 30 km x 30 km to 2000 km x 2000 km
- Meteorological data: all available data measured at ground or elevated level, output from large-scale models (ECMWF, ARPEGE, GFS [NCEP])
- Emissions data: emissions of all norm species (CO, NOx, SO2, VOCs, PM, NH3) from large point sources, linear sources (e.g, road segments), area sources (e.g., domestic heating, biogenic)
- Management of SNAP categories and VOC speciation
- Temporal modulation (monthly, weekly, and hourly) for each category

Modelling

- Meteorological models: SWIFT meteorological assimilation model for the diagnostic mode; WRF model, with or without assimilation, for the forecasting mode
- Dispersion models: Eulerian model (CHIMERE and FARM in reactive or non-reactive, gaseous or particulate mode) and Lagrangian model (SPRAY)
- Forecast model: reactive model CHIMERE, Eulerian model FARM, and Lagrangian model SPRAY

Selected references

A single concern, the atmospheric environment

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