A Worldwide Evaluation of Operational Air Quality Forecast System with CHIMERE

CHIMERE workshop – 14th November 2013

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Company Profile

ARIA Technologies SA
- Founded in 1990 by researchers from EDF R&D

One single focus: the atmospheric environment
- Software and systems
- Study and consults
- R&D collaboration with large universities (CNRS-IPSL) and research center (US-NCAR)

SME

Headquarter in Boulogne-Billancourt
- Offices in Grenoble, Toulouse, Brest, Mexico
- Subsidiary company in Milan (Italy) since 2000: ARIANET
- Subsidiary company in Turin (Italy) since 2010: SIMULARIA
- Subsidiary company in Rio (Brazil) since 2010: ARIA do Brazil

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Software dedicated to the atmospheric environment

Consulting & Expertise

System & Software

R&D

ARIA Impact™
ARIA Impact 3D™
ARIA Risk™
ARIA Local™
ARIA City™
ARIA Regional™
ARIA View™

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Urban and regional application

- CHIMERE is the core of the ARIA Regional system.
- It has been installed in many cities to provide air quality forecast.
- It is also used to produce emission scenarios.

ARIA Regional Air Quality Management tools are now operational in many cities

Here are various examples of operationnal systems with CHIMERE ...
The Israel project

ARIA Regional®

Regional VOC emissions

Operational forecast
Scenarios

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Emission
Reduction Scenarios

Traffic

All sources

Rio I

ARIA Regional®

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The Qatar project

TOTAL – Qatar Petroleum
Target area: Qatar
3 domains zooming: 30 → 10 → 3 km
Implementation of a **Plume in Grid**

- **Large scale**
- **Regional scale**
- **Local scale**

**NO2 Concentrations**
01/26/2006 21:00:00

**CHIMERE users workshop 2013**
**Client:** Beijing Municipality BMEMC  
**Event:** Beijing Olympic Games  
**Fundings:** FASEP project  

- **Meteo:** MM5  
- **Emissions:** REAS and local inventory  
- **Dispersion:** CHIMERE  

3 domains zooming: 45 → 15 → 5 km  

→ Operational forecast  
→ Scenarios
• aerodynamic roughness length
• granulometric distribution of the soil aggregates
• soil texture given for 13 types of soils and with a resolution of 0.25°

Marticorena and Bergametti, 1995, LISA

(Laurent et al., 2005; 2006)

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Blue sky for Beijing
May episode study (26-30th May 2008)

Dispersion of PM10
Forecast for 05/25/2008 at 20:00:00

The model simulates 2 distinct plumes passing through Beijing: the 27th and the 29th
Blue sky for Beijing

Model performance during the Olympic Games

Bad meteorological conditions:
- Elevated humidity
- Calm wind
  ➔ Particles pollution

Meteorological conditions favorable to pollutant dispersion:
- Rain on 10, 14 and 17
  ➔ Blue sky

Air Pollution Index: PM10 daily mean concentrations (µg/m³)

Model
Measure

Source: http://www.bjepb.gov.cn

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Clean Air for Delhi

**Client:** Delhi municipality CPCB  
**Event:** Commonwealth Games 2010  
**Fundings:** FASEP project

Forecast system by Aria Technologies SA

12 CPUs  
Installed at CPCB, Delhi

Mobile and stationary lidar measurements by Leosphere SA

Continuous and manual measurements by CPCB

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Clean Air for Delhi

ARIA Regional®

Meteo: WRF

Emissions: REAS and local inventory

Dispersion: CHIMERE and FARM

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Clean Air for Delhi
Dissemination during the CWG

- Air quality report sent each day to the CPCB with publication of an AQI
- Dedicated web site

Air Quality Forecast for the Delhi Commonwealth Games

Indian-French Cooperation for 2010 and Beyond

In close cooperation with the Central Pollution Control Board and with the financial support of the French Government, ARIA Technologies and Lesphere have installed an air quality forecasting system for the National Capital Region (NCR) of Delhi which is now operational and issuing daily reports to the media and the public to inform on the movement of the criteria pollutants in the city. The daily updates from the system include:

- Animations of hourly maps for the six criteria pollutants
- Air Quality Index (AQI) at 30 locations in Delhi
- Time series for each pollutant concentrations at select locations
- Vertical profiles at select locations to compare with monitoring data
- An interface with Google Maps.

The forecasting system is supported by the meteorological modeling using WRF model, chemical transport modeling using 3D CHIMERE/FARM models, utilizing a geo-referenced and time-profiled emissions inventory (segregated into multiple sectors) at 1km x 1km resolution over the NCR region.

More details at forecasting modeling system for Delhi.
Mixing height from the lidar

Forecast results from October 9th

Particle backscatter lidar observations on October 10th

Mix with dust
**Client:** National Environment Protection Agency (NEPA)

**Fundings:** Life project

**Partners:** RSI, Euroquality

**Meteo:** WRF

**Emissions:** EMEP and local inventory

**Dispersion:** CHIMERE

Animation of ozone concentrations over Romania (ROMAIR project)
ROMAIR
The graphic user interface

Visualisation of forecast outputs:
- Maps
- Time series
- Profiles

Exports:
- Savi3D
- Google Earth

Realization of scenarios and exploitation of results

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1. Import emission files through the GUI

2. Possibility to modulate emissions by SNAP and by pollutant in scenario mode
Impact on air quality for 5 scenarios linked to major emission modifications (Target year 2015):

S1 Business as usual
   Traffic: expected fleet renewal and annual traffic increase

S2 Public transport demand
   New bus lines along the most saturated paths

S3 Partial fleet renewal
   Replacement of old buses (Euro2 and older) with new buses of Euro standard.
   Restriction of Heavy Duty > 5 tons in central Bucharest

S4 National Scenarios for CO2 emissions
   National Scenarios for CO2 emissions and related reduction for other pollutants

S5 Industrial emission reduction scenario
   National Program for reducing emissions for large combustion plants

Differences computed / 2015 “business as usual” evolution base case

S1-S0
Difference between the scenario “Business as usual” (year 2015) and the Scenario “0” (year 2009) for CO
ROMAIR
Dissemination: web site, newsletters.

www.romair.eu

Romanian air quality forecasting system

The ROMAIR Project

Through a French-Romanian cooperation and with the financial support of the European Union (ROMAIR LIFE-Project), ARIA Technologies has installed an air quality forecasting system at the National Environmental Protection Agency (NEPA) in Romania which is now operational and issuing daily reports to inform on the dispersion of criteria pollutants. Summary of the project.

Forecast visualized on Google Earth (2 domains available):

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Client: Agence Nationale de Protection de l’Environnement, ANPE
Fundings: AFD (Agence Française de Développement
Partners: INERIS, I2E

6 km resolution over Tunisia

Models
WRF
CHIMERE

Emissions
EDGAR at 10km resolution
6 zooms over the main agglomerations at 1 km resolution:
- Bizerte
- Tunis
- Sousse
- Sfax
- Gafsa
- Gabès

Models
- SWIFT
- FARM

Local inventory
TUNAIR
New web application

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Specificity of the project

Modeling Indonesian continental pollution including **haze pollution**

**Client:** BMKG  
**Partners:** MFI

- Fire satellite observations
- Landuse vegetation classes
- Vegetation humidity indexes

**Fire Emissions**
- New episode reanalysis: choice of 1 most recent date = historical record in Singapour

- Smoke plume heights compatible with Zender et al (2012): below 800m
- PSI = 401 (about PM10 = 400-500 ug/m3) not yet reproduced by IAQM – ongoing analysis of results...
Example of FORECAST of the radioactive plume of Fukushima (Japan) and dissemination on smartphone
Safety and emergency response

Simulation of the Icelandic volcano pollutants dispersion

Daily emissions: 100kt (Météosat-SEVIRI observation for the 10th of May)