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4 URBAN PLATFORMS DEDICATED TO AIR QUALITY SURVEY IN PACA REGION

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Abstract: The Provence Alpes Côte d'Azur (PACA) region's climate is typically Mediterranean with a dry summer season, few rainy days (less than 120 per year) and a large period of sunshine (from 500 to 2800 hours per year). The mixture of high industrial activities, dense traffic, large population, biogenic areas and sunny climate induce frequent particles and photochemical air pollution episodes. Atmo PACA has developed an Atmospheric InteREgional System AIRES: http://www.aires-mediterranee.org.
The population of the PACA's region is estimated at 4.8 million inhabitants. More than 3.5 million are living in urban areas. In this context, Atmo PACA is currently developing four urban platforms on the cities of Aix-en-Provence, Toulon, Antibes-Sophia-Antipolis and Nice. They are aimed at providing on each city:
- High resolution concentration maps for urban tracers such as NO_2, C_6H_6, PM10;
- Air quality forecast (48 hours) via maps of air quality index;
- Tools to assist decision-making for case studies and the different urban planning scenarios;
- European and national reporting on the exposed population in comparison to regular threshold.

The four cities are situated in severe geographical conditions (complex topography). Air quality modeling is performed with the collaboration of NUMTECH and the model ADMS Urban. Simulated concentrations of NO_2, O_3, C_6H_6 and PM10 are shown and discussed versus observations. Summer and winter period are analyzed. The impact of the boundary layer height is discussed with comparisons between observed and modeled distributions of pollutants.

Key words: *Urban scale, air quality, modeling, Mediterranean cities, ADMS Urban*

INTRODUCTION

Atmo PACA is in charge of monitoring air quality in most of the Provence Côte d'Azur (PACA) region, nearly 90%. It results from the merging in 2006 of two agreed organisations, Airmaraix (based in Marseille) and Qualitair (based in Nice), and thus ensures 25 years of experience. As per the French "Air and Energy Efficiency" Law (30/12/1996), Atmo PACA has been agreed as one of the French AASQA (Agreed Association for Air Quality Monitoring) by the Ministry in charge of Environment, nowadays MEEDDM. It is member of the Federation ATMO.

The main objectives of Air quality monitoring are:
- to comply with the regulatory requirements,
- to meet the expectations of the local stakeholders who are facing the issues related to air quality.

Therefore, Atmo PACA has to deliver information and to assist in decision making, including impact assessment of the compulsory Clean Air Plans (also called Regional Plan for Atmospheric Protection or for Air Quality).

As any AASQA in France, Atmo PACA gathers 4 groups of members:
- local authorities (Municipalities, "*Départements*", Region Council),
- regional administrations of the State and of the public establishments, including ADEME,
- industries,
- organisations dealing with environment & consumer protection, qualified personalities & health professionals.

Atmo PACA organisation allows for both a consistent monitoring at the scale of this large region and close local connections. For each "*département*", one engineer is dedicated as contact person of the stakeholders-partners.

Atmo PACA wishes to fully valorise its Mediterranean identity and to exchange views and experiences with the partners of the Mediterranean shores in similar context (densely urbanised coastal areas, climate...) & issues.

Atmo PACA has 5 main missions, within a large framework "air, climate, energy":
- monitoring air quality by measurements and modelling tools,
- forecasting air quality and anticipating pollution peaks,
- informing on a daily basis and in case of pollution episodes,
- understanding the pollution phenomena, by performing specific studies and participating in assessing the existing links between air and health, air and environment,
- contributing to the think tanks and working groups related to regional planning and mobility, by delivering appraisal methods, prospective tools and support to the decision making process.

AIR QUALITY IN THE PACA REGION

The pollutants monitored by Atmo PACA are determined on knowledge about their sources, their effects on health & environment, and the techniques available for their evaluation. WHO recommendations, EU directives, French laws and regulations are considered together. PACA region is ranking n° 1 to 3 in France for emissions of NO_x, SO_2, VOCs and CO_2. Combustion (vehicles, heating and industry) and industrial processes are the main sources of emissions in the region. The breakdown is estimated as below:

SO_2: 90% from industry & power generation

Particulates: 30% from Industry, 40% from Transport sector

NO_x: 60% from Transport (road, sea, air…)

Industry and transport also produce emissions of benzene, heavy metals, VOCs.
Ambient air concentrations of some pollutants, including ozone, may rise above the levels set for health protection, in certain situations, especially close to the main traffic ways, in urban centres or in the vicinity or plume of few heavy industries. New issues are emerging: pollutants from agriculture, emissions from some land cover (Mediterranean forest, landfills…), odours, interior air quality…

EMISSIONS INVENTORY, MONITORING NETWORK, AND MODELLING: COMPLEMENTARY APPROACHES

The **inventory of emissions** deals with about a hundred pollutants, from various sources (human activities and nature). It is an essential step for feeding models and preparing balances per geographic area or per pollutant, and maps of emissions with high spatial (1km) and temporal (hourly) resolutions. N_2O, CH_4 and CO_2 also are included.

The **measuring network** includes about 50 sites spread from the Rhône River to Italy, plus a few mobile units and means for passive diffusion tubes campaign. Data are transferred to the computing centre, where they are validated, analysed and disseminated.

Under the name of AIRES Méditerranée, the **modelling system**, including Chemistry & Transport Model, has been developed within an interregional cooperation with Languedoc Roussillon. It is based over years on several national, EU & international scientific teams & field projects, such as AIRPROCHE, ELFE, ESCOMPTE and PRIMEQUAL (Cros *et al.*., 2004) (www.aires-mediterranee.org)

AtmoPACA's team, a mix of measurement specialists, statisticians, chemists, database & modelling scientists, has networked with several partners at various levels (research, monitoring networks, national agencies), and is involved in several EU projects.

AIR POLLUTION, A PUBLIC HEALTH ISSUE

There is a growing concern about the health impacts of air pollution. AtmoPACA is involved with the professionals and scientists on those issues, providing data and participating in research activities (mapping, exposure studies, high risk areas…). The social demand for relevant information needs to be answered.

AWARENESS, PUBLIC INFORMATION AND WARNING, THE PLANS FOR ATMOSPHERIC PROTECTION

As the present regulations require it, AtmoPACA disseminates processed data and information, on behalf of the regional administrative authority, to more than 2000 stakeholders. Public information is provided through the ATMO index and maps on the website and through the media, for "today and tomorrow". In case of expected alerts, the Authority is prepared to take adequate measures to prevent pollution. At the scale of the "départements" and of the region, Clean Air Plans are prepared and enforced as agreed legal tools. Atmo PACA is involved in their preparation, follow-up and their appraisal.

RESULTS

In this context, ADMS Urban (Mc Hugh *et al*., 1997) has been implemented over 4 cities and their suburbs in the PACA region. The dispersion code has been tested and the results have been compared to measurements performed by Atmo PACA (passive devices and automatic stations) (AtmoPACA, 2005, 2006, 2007 and 2009). The validation of the model includes both comparisons with long term measurements (yearly average concentrations) and hourly data.

Figures 1, 2 and 3 show some examples of these different results. They illustrate the sharp PM10, C_6H_6 and NO_2 gradients existing between urban and rural environment or even inside each city center. Methodology and results will be discussed.
Table 1 shows a synthesis of long term correlations and biases obtained for these 4 cities. Correlations are distributed between 0.7 and 0.9. Biases are distributed -3 and +8 $\mu g/m^3$ according to the pollutants and the periods.

Improvements have been tested in considering the link between mesoscale resolution and urban resolution. Since the last four years, Atmo PACA has been working in close cooperation with NUMTECH in order to test and improve the URBAN AIR System (Pradelle *et al*., 2010).

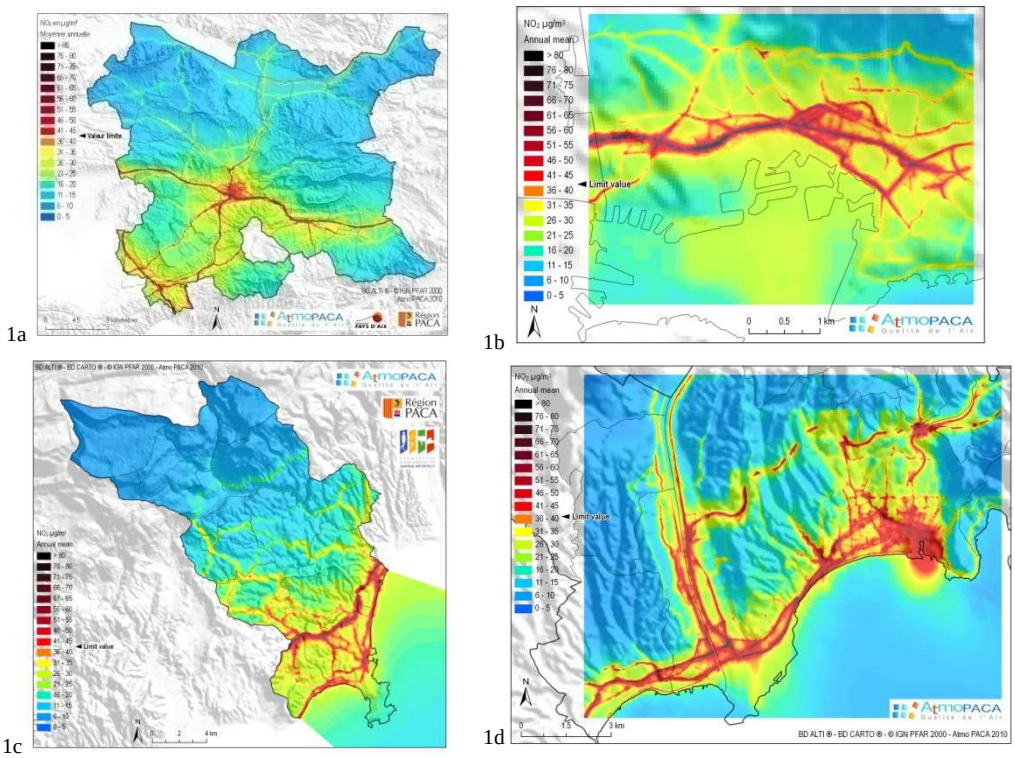

Figure 1. NO_2 annual mean simulated concentrations over Aix en Provence and its suburb (1a), Toulon (1b), Antibes and its suburb (1c) and Nice and its suburb (1d) - Concentrations in $\mu g/m^3$.

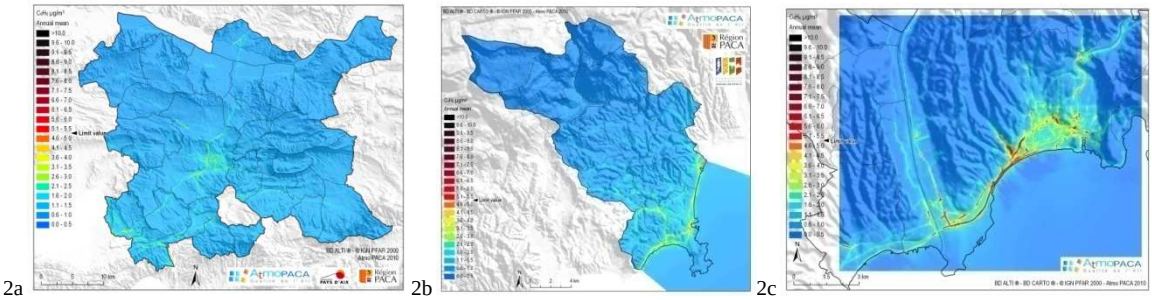

Figure 2. C_6H_6 annual mean simulated concentrations over Aix en Provence and its suburb (2a), Antibes and its suburb (2b) and Nice and its suburb (2c) - Concentrations in $\mu g/m^3$.

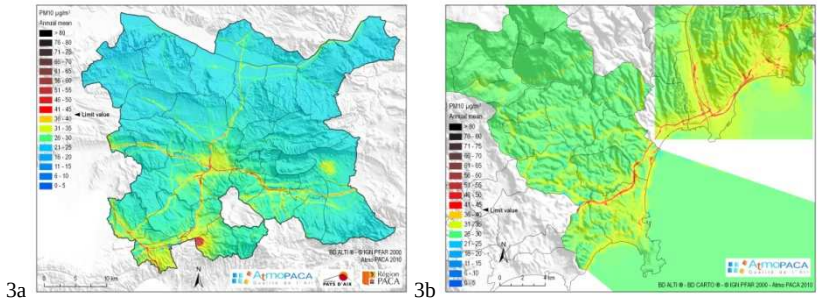

Figure 3. PM10 annual mean simulated concentrations over Aix en Provence and its suburb (3a), Antibes and Nice and its suburb (3b) - Concentrations in $\mu g/m^3$

Figure 4. Example of correlation and bias for NO_2 over Antibes and Sophia Antipolis area. Mars-April (right) June-July (left). Year 2008.

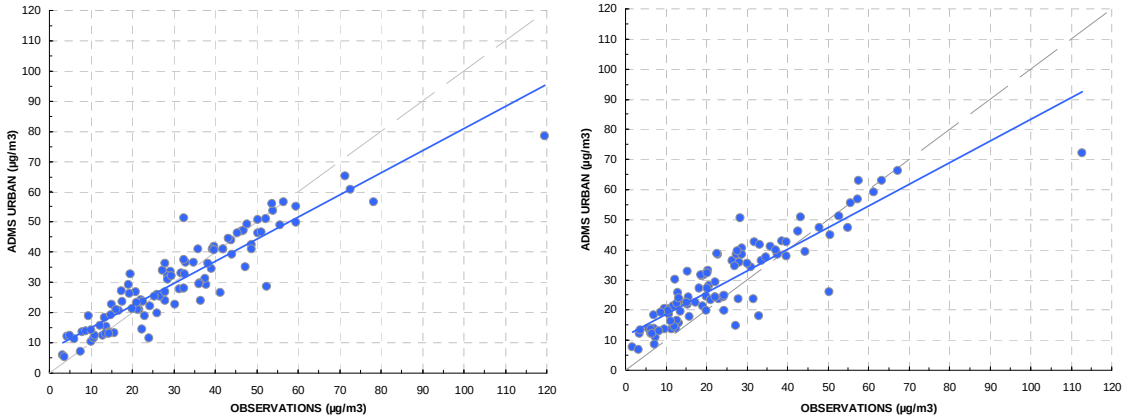

Table 1. Synthesis of comparisons for observations versus modeling

Year	Period	City	Pollutant	Nb. observations	Correlation	Bias	Background concentrations
2001	Annual	Toulon	NO_2	103	0.8	-3	0 (cadastre approach)
2001	Annual	Toulon	C_6H_6	28	0.7	-1	0 (cadastre approach)
2007	Annual	CPA	NO_2	200	0.8	1.7	0 (cadastre approach)
2007	Annual	CPA	C_6H_6	80	0.7	0	0.46
2008	Summer	NCA	NO_2	160	0.7	-3.1	0 (cadastre approach)
2008	Winter	NCA	NO_2	160	0.7	+8	0 (cadastre approach)
2008	Summer	NCA	C_6H_6	80	0.8	-0.9	0
2008	Winter	NCA	C_6H_6	80	0.8	0	1
2008	Summer	CASA	NO_2	102	0.9	4.6	0 (cadastre approach)
2008	Winter	CASA	NO_2	102	0.9	-0.8	0 (cadastre approach)
2008	Summer	CASA	C_6H_6	50	0.7	0	0 (cadastre approach)
2008	Winter	CASA	C_6H_6	50	0.7	-0.4	0 (cadastre approach)

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