SIRTA: a French national observatory dedicated to cloud and aerosol research

M. Haeffelin [1], C. Boitel[2], J.C. Dupont[1], F. Lapouge[2], Y. Morille[2], C. Pietras[2], B. Romand[2]

[1] Institut Pierre-Simon Laplace, CNRS/Ecole Polytechnique, France
[2]Laboratoire de Météorologie Dynamique, CNRS/Ecole Polytechnique, France

ABSTRACT

SIRTA is a French national atmospheric observatory dedicated to cloud and aerosol research. SIRTA is located 25 km south of the city of Paris (48.7N, 2.2E). The SIRTA observatory gathers an ensemble of state-of-the-art active and passive remote sensing instruments, including cloud and precipitation Doppler radars, cloud and aerosol backscatter and depolarization lidars, radiometers, and in-situ measurements. SIRTA provides access (1) to three platforms in an environment with routine monitoring based on a core ensemble of instruments: a radiation platform with 360-deg unobstructed view, a platform for active remote sensing instruments, and two 30-m masts located 1km apart to study local scale dynamics; (2) to long time series of data, and data analysis software.

SIRTA is ideally located to study both local/regional-scale processes typical to the urban-rural transition under high-pressure situations and larger-scale cloud processes associated with baroclinic fronts. It is predominantly exposed to westerly winds that advect clean maritime air, alternating regularly with north-easterly winds that advect more polluted continental air.

This poster will present the SIRTA infrastructure, the remote sensing instruments currently deployed, and the available database.

1. INTRODUCTION

SIRTA is the atmospheric observatory of IPSL for cloud and aerosol research. It is a National Experimental Site. IPSL is a French research institute in environmental sciences that federates six national research laboratories of the Paris metropolitan area, involved in both Earth observation from space and from the ground and in atmospheric modelling.

At laboratories involved in SIRTA, (e.g. CEREA, LATMOS, LMD, LSCE) scientists are involved in process study research, atmospheric modelling (climate, weather, chemistry and transport), satellite observation programs, and atmospheric remote sensing from the ground (active and passive techniques). Development of remote sensing instruments has been an active area of research at IPSL laboratories for many years. Instruments such as radars, lidars and radiometers for ground-based and airborne applications were developed to observe atmospheric processes such as boundary layer dynamics, cloud formation and microphysics, precipitation, aerosols and ozone in the urban environment.

SIRTA is supported by CNRS/INSU the National Center for Scientific Research, Ecole Polytechnique, and CNES, the French Space Agency.

This extended abstract present current research interests, the SIRTA facility, and a few examples of recent field campaigns and instrument development activities.

2. RESEARCH INTERESTS

SIRTA research focuses on studying macro and micro-physical properties of cloud and aerosols (vertical distributions, occurrences, particle shapes and sizes), the dynamics of the atmosphere (boundary layer and free troposphere) associated with their life cycle, and their impact on the radiation budget and photochemistry, exploiting both active and passive remote sensing and multi-spectral synergies. Retrieval methods developed at IPSL from SIRTA observations will be used as official algorithms of the upcoming Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) and Cloud Radar Pathfinder satellite mission (CloudSat).

Extensive partnerships have been setup between SIRTA and the modelling research community, involving researchers that are trained at the model-observation interface. We develop new methods of exploiting observations to evaluate the ability of parametric representations to simulate physical processes. A specific web-based platform was developed as a working tool to confront model output to observation on a daily basis. Comparisons are based on (1) atmospheric parameters derived from retrievals and (2) instrument observables simulated from model output. This platform operates the MM5 community meso-scale model, the IPSL climate model (LMDZ), and the IPSL chemistry-transport model (CHIMERE).

3. DESCRIPTION OF THE FACILITY

SIRTA is composed of an ensemble of state-of-the-art active and passive remote sensing instruments, including radars, lidars, and radiometers. The measurement system was developed with sensor synergy in mind. Active remote sensing instruments provide information on the vertical distribution of particles in the atmospheric column (hydrometeors, aerosols) and their properties. Cloud radar and lidar emit waves at millimetre and micrometer wavelength, respectively. Their sensitivities with respect to the size distribution of particles are hence quite complementary. Passive remote sensing instruments measure the cumulative radiance contribution of the whole column. Spectral

© Proceedings of the 8th International Symposium on Tropospheric Profiling, ISBN 978-90-6960-233-2
Delft, The Netherlands, October 2009. Editors, A. Apituley, H.W.J. Russchenberg, W.A.A. Monna

selection allows contributions from different constituents to be separated.

2.1 Geographical and meteorological information

Measurement site, in operation since 1999, is located in Palaiseau (20 km south of Paris, semi-urban environment with agricultural fields, wooded areas, housing and industrial developments). Geographical coordinates are 48° 42' 47''N, 2° 12' 29''E. Altitude ASL is 156 m. Main wind direction: Westerly (advects clean maritime air) and North-Easterly (advects polluted continental air)

Figure 1. *Main instruments deployed at SIRTA for routine monitoring of physical processes in the atmosphere.*

2.2 Instrumentation available and monitoring activities

Routine measurements of physical processes in the atmosphere are carried out based on a suite of supported instruments since 2002. Data are made available to the science community through the SIRTA database available from http://www.sirta.fr

Table 1. List of instruments operated routinely or continuously at (or near) SIRTA

4. FIELD CAMPAIGNS

Scientific field campaigns are carried out regularly at SIRTA.

PARISFOG: a national project dedicated to monitor and study the key processes that drive the life cycle of fog. An experimental setup by CEREA (EDF R&D/ENPC), CNRM (Météo-France/CNRS), and IPSL (CNRS/Ecole Polytechnique) was deployed at SIRTA from Oct 2006 to March 2007 (Figure 2). It captured 37 fog and 109 haze events. This project allowed us to improve our understanding of the role of aerosols in radiation fog formation and to study physico-chemical processes in two different numerical models.

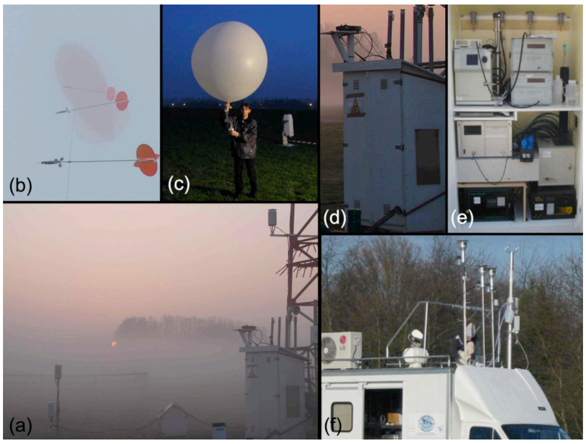

Figure 2. *In-situ measurements deployed at SIRTA during PARISFOG.*

MEGAPOLI: an international (FP7) program focused on the study and quantification of sources of particle pollution in large urban areas, from primary (direct

Instrument	Range	Area of use	Instrument PI (Institute)
Backscattering lidar (532, 1064 nm)	0.1 –15 km	Cloud and aerosol properties	M. Haeffelin (IPSL)
95 GHz doppler radar	0.1 – 15 km	Clouds properties	A. Protat (LATMOS)
BSRN radiometric station	Surface	Surface radiation budget	M. Haeffelin (IPSL)
GPS receiver	Column integrated	Water vapor	Y. Morille (LMD)
Microwave radiometer (20+30GHz)	Column integrated	Vapor + liquid water	H. Brogniez (CETP)
Aeronet/Photon s sun-photometer	Column integrated	Aerosols, water vapor	P. Goloub (LOA)
Meteorological station	Standard 2 and 10 m	Surface thermodynamics	C. Pietras (LMD)
Radiosondes (Météo-France, Trappes, 15 km west)	0 – 30 km	Vertical wind+PTU profiles	M. Ruchon (Météo-France)
Near-surface Turbulence	10-30 m	Surface layer dynamics	P. Drobinski (LMD), E. Dupont (CEREA)

emission) or secondary formation (through oxidation or condensation of volatile organic compound). A one-month field experiment was carried out in July 2009, deploying instruments from ten different institutes in Europe at 4 sites in and around Paris, on mobile platforms and on an ATR-42. A second observation period is planned for January-February 2010 to study winter pollution events.

Figure 3. *Instruments deployed at SIRTA during the MEGAPOLI campaign.*

5. INSTRUMENT EVALUATION AND DEVELOPMENTS

The SIRTA facility is suited to evaluate new instruments by testing against existing instruments.

ALS450 cloud-aerosol lidar. A 355-nm backscatter and depolarization lidar operating in a continuous mode was tested over the past 18 months. The lidar signal has full overlap starting at 200m, which is adequate for boundary layer study. The combined analogue and photon counting detection signals were tested to give a signal-to-noise ratio greater than 3 in molecular (particle free) atmospheres up to 8 km during daytime and 12 km during nighttime. For continuous operations, the system requires flash lamps to be changes every 3-4 weeks, but annual operating cost remain reasonable (<10k€). The compact laser head, which is not as rugged as in larger systems, required several repairs, inducing significant downtime in the first six month of the test period.

BASTA Doppler Cloud Radar. A low-cost cloud radar has been developed by LATMOS (CNRS) during the past 3 years. The idea is to emit significantly less power than traditional pulsed radar using a frequency modulation and continuous wave radar. The BASTA radar was deployed at SIRTA in April 2009 and has since worked in three operational modes – precipitation, clouds, and thin clouds. Sensitivity is not yet up to required specifications (-55 dBZ @ 1 km), but the following developments are under way: larger antennas, and larger integrating time.