APPEL A PROJETS LABEX/ CALL FOR PROPOSALS

2010

CaPPA

DOCUMENT SCIENTIFIQUE B / SCIENTIFIC SUBMISSION FORM B

Acronyme du projet/ Acronym of the project	**CaPPA**
Titre du projet en français	Phyique et chimie de l'environnement atmosphérique
Project title in English	**C**hemical **a**nd **P**hysical **P**roperties of the **A**tmosphere
Coordinateur du projet/Coordinator of the project	Nom / Name : Didier TANRÉ Etablissement / Institution : PRES ULNF/University of Lille 1 Laboratoire / Laboratory : Laboratoire d'Optique Atmosphérique Numéro d'unité/Unit number :UMR 8518
Aide demandée/ Requested funding	**7 732 k€**
Champs disciplinaires (SNRI) / Disciplinary field	□ Santé, bien-être, alimentation et biotechnologies / Health, well-being, nutrition and biotechnologies ☑ Urgence environnementale et écotechnologies / Environnemental urgency, ecotechnologies □ Information, communication et nanotechnologies / Information, communication and nantechnologies □ Sciences humaines et sociales / Social sciences ☑ Autre champ disciplinaire / Other disciplinary scope
Domaines scientifiques/ scientific areas	Chimie de l'Atmosphère, Physique de l'Atmosphère, Météorologie, Climatologie, Pollution/ Atmospheric Chemistry and Physics, Meteorology, Climatology, Pollution
Participation à un ou plusieurs projet(s) « Initiatives d'excellence » (IDEX) / Participation in an « Initiatives d'excellence » project	☑ oui ☐ non

Affiliation(s) du partenaire coordinateur de projet/ Organisation of the coordinating partner

Laboratoire(s)/Etablissement(s) Laboratory/Institution(s)	Numéro(s) d'unité/ Unit number	Tutelle(s) /Research Organisation reference
LOA/Université Lille 1	UMR 8518	PRES ULNF/Université Lille 1 - CNRS/INSU

Affiliations des partenaires au projet/Organization of the partner(s)

Laboratoire(s)/Etablissement(s) Laboratory/Institution(s)	Numéro(s) d'unité/ Unit number	Tutelle(s)/Research Organisation reference
PC2A/Université Lille 1	UMR 8522	PRES ULNF/Université Lille 1 – CNRS/INSIS
ICARE CGTD/Université Lille 1	UMS 2877	PRES ULNF/Université Lille 1 – CNRS/INSU - CNES .
LPCA/Université Littoral Côte d'Opale	EA 4493	PRES ULNF/Université Littoral Côte d'Opale – CNRS/INP

ANNEXE : Letters of support from EPIC (IRSN) and industriel partner (CIMEL)

1. RESUME / SUMMARY

The aerosol and gases effects on health, air quality and climate are affecting policy decisions and have direct impact on energy use and economic activities around the world. We outline in the project the need for measurements at all scales (from microscale to mesoscale and from seconds to days) and the necessity to integrate satellite observations in models in order to better understand the whole aerosol system for contributing to climate and particulate pollution studies.

CaPPA is based around research groups A+ enhanced by some research groups A presenting a high scientific potential. Currently about 60 papers are published each year in peer journals in the fields of climatology, atmospheric science, combustion, physics and chemistry of the atmosphere, etc. The project gathers laboratories that have uncommon skills : (i) sophisticated laboratory devices and experimental set up, (ii) unique satellite and ground-data bases, (iii) good experience in deploying instrumentation in the field, (iv) mathematical knowledge in inverse problems, (v) background in running operational network (vi) development of tools for easy public access to measurements. Exchanges between the CaPPA partners with their different background will be mutually beneficial and are expected to bring new ideas from one research area to an other.

The innovations and added values cover several aspects :

- The laboratory measurements with new approaches to study the joint effects of aerosols (coating by other material or not), of its reactivity, of its hygroscopic features and of its aging on the optical properties. This innovative methodology relies on the expertise of the partners on highly sensitive and selective spectroscopic techniques and for studying kinetics

of homogeneous and heterogeneous reactions occurring in atmospheric chemistry or combustion.

- The synergy between two major complementary research tools developed for studying aerosol effects: chemical transport modelling and satellite remote sensing. The key element in our approach for aerosol characterization is to use inverse modelling as an advanced tool that will help extracting new information from the observations and improving the modelling itself.
- The inverse modelling needs an accurate characterization of the aerosol type and content, which means the knowledge of a large number of aerosol parameters at global scale. The easy access to several satellite instruments, sensors of the A-Train including POLDER3/PARASOL for instance, will ensure high accuracy of the retrieved properties to allow the separation between emissions for different aerosol types.
- The capability to observe in a given location the spatial and temporal variability of aerosols in the lower layers of the troposphere and to study the exchange of aerosols according to atmospheric dynamics (stratification, stability, turbulence, weather) with innovative instruments and tools.
- The use of ground-based observations by remote sensing techniques using network observations with higher standardization of data, to improve the aerosol characterization itself as well as the consistency of the satellite observations.

Our project will contribute to the « Global Environmental Changes and Societies » program (GEC&S) of the Axe 2 «L'urgence environnementale et les écotechnologies » of SNRI (Stratégie Nationale de Recherche et d'Innovation). It is relevant to key thematic areas of two alliances of government-funded research organisations :«ANCRE » (Alliance Nationale de Coordination de la Recherche pour l'Energie) and « ALLENVI » (Alimentation, Eau, Climat, Territoires). It will provide informations that are also relevant to the European GMES program and to the FP7 program that includes as one of its key thematic areas « Environment (including climate change)». GMES (Global Monitoring for Environment and Security) is going to provide environmental information services. Project like undergoing MACC (Monitoring Atmospheric Composition and Climate) could benefit from our aerosol emission inventories. The AEROCOM-project, which is « an open international initiative of scientists interested in the advancement of the understanding of the global aerosol and its impact on climate » will also benefit since our study will lead to reduce the discrepancies between the aerosol modules of global models.

The matters of LABEX's activities facilitate direct connections with civil society. Our results will be made available to a broad user community, including decision makers, businesses and citizens. Some dedicated products will be delivered to partner decision-making systems that provide a high level of operational services (e.g. present quasi-near-real-time aerosol products made available to INERIS

PREVAIR system for quality control of their forecast). A web site for external dissemination will be constructed. A flyer and a brochure will be distributed to highlight the LABEX activities to the different types of audience, which will enhance the opportunities to promote our activities to public or private agencies and companies. In order to develop all these actions, the LABEX proposes to create a internal communication service connected to existing PRES ULNF, and CNRS services. The LABEX intends to intensify its communication to industry and companies with a newsletter specifically designed for business and local communities.

The LABEX project will strengthen the internationalization of doctoral degree courses, which should significantly raise the number of jointly supervised thesis. Rounds of conferences about international positions and "European Days of Education and Research in Atmospheric Environment" are expected to motivate the french and foreign students to international mobility. Our doctoral courses will benefit also from active collaborations with the soci-economic world for the professional integration of young PhD students. Currently, all former PhD students are either doing post-doc or found positions in academic or industrial research. A European education research project in "Reactivity, Dynamics and Impacts of Atmospheric Components" will be proposed and submitted to the Marie Curie European network. Financial support will be provided to Master's Students. The grants for Phd students will be in accordance with international standards. Post-doc fellowships will be adjusted to be attractive for young scientists.

Research activities developed in the past by several teams within the LABEX leaded to patents. The thermokinetic models for 3D simulation codes of industrial processes that will result from our project are potentially of interest for industry and private companies (TOTAL, PSA, RENAULT, GDF SUEZ...). Our expertise concerning polarized sensors and space missions can lead to a collaborative project of "POLDER follow-on" Microsatellite with Astrium EADS in the near future; preliminary discussions have already begun. Developments of future instrumental devices (photometers, lidars, pollutant sensors) will be valuable for companies such as CIMEL (letter of support in annexe) and Environnement SA. Some of our results will be relevant to (i) EPIC's (Industrial and Commercial Public Establishments), like ADEME, IFP, CNES (superving institution of the partner 3), IRSN (letter of support in annexe), (ii) to other national and international institutions (ONERA, INRETS, WMO) or (iii) private corporations. Several thesis are currently co-funded by industrial groups. The training of students in a scientific approach of pollution and climate change will benefit to industrial companies.

In order to secure the LOA, PC2A, ICARE and LPCA laboratories, the LABEX will be supported by specific funds (Universities, PRES ULNF, Région, CNRS, CNES, IRSN, industrial groups). The governance will be organized along the different

teams of the project including: (i) a steering committee, (ii) an executive board, (iii) a director and (iv) an international strategic committee.

2. CANDIDATURE AUX ACTIONS DU PROGRAMME INVESTISSEMENTS D'AVENIR/ APPLICATION TO THE ACTIONS OF THE PROGRAMME « INVESTISSEMENTS D'AVENIR »

Nom de l'action	*Acronyme du projet (préciser si le projet est déposé ou envisagé)*	*Nom du coordinateur*	*Consortium /partenariat impliqué*
EQUIPEX	SOFRA-EX	Philippe Keckhut	INSU/CNRS - Météofrance – Université Toulouse - Université Grenoble –ANDRA – Université Lille 1 – UVSQ – CEA – MEEDDM
EQUIPEX	IAOOS	Christine Provost/ Jacques Pelon	Université Pierre et Marie Curie-CNRS- CNES - IREV
EQUIPEX	META	Paul Raterron	PRES ULNF/Université Lille 1 – CNRS – Université du Littoral Côte d'Opale – Ecole des Mines Douai – INSERM - ENSCL

3. ORGANISATION DU PARTENARIAT/ MANAGEMENT OF THE PARTNERSHIP

3.1. COMPOSITION DU PARTENARIAT/ COMPOSITION OF THE PARTNERSHIP

Nom du partenaire	*Affiliation*	*Effectifs / Catégorie de personnel (chercheurs, ingénieurs, doctorant …)*
LOA	PRES ULNF /Université Lille 1 - CNRS	over 50 people : 37 are permanent positions (18 university professors, 4 CNRS researchers, 15 technical staff) and 12 PhD students.
PC2A	PRES ULNF/ Université Lille 1 - CNRS	over 60 people, of which 29 are in permanent positions (12 university associated professors and professors, 5 CNRS researchers, 5 engineers and 7 technical staff) and 22 PhD Students.
ICARE	PRES ULNF/ Université Lille 1 – CNRS - CNES	10 people including 1 Director, 8 IT engineers, and 1 Administrative Assistant.

LPCA	PRES ULNF/ Université Littoral Côte d'Opale - CNRS	2 professors, 2 associated professors, 2 engineers, 2 post-docs and 11 Ph.D students.

3.2. QUALIFICATION DU COORDINATEUR DE PROJET /RELEVANT EXPERIENCE OF THE PROJECT COORDINATOR

Dr Didier Tanré is a senior scientist appointed Directeur de Recherche de Classe Exceptionnelle at the Centre National de Recherche Scientifique (CNRS). His research experience covers both theory and applications of radiative transfer modeling through realistic atmospheres, with a focus on the aerosol effects on climate and air quality. He has an international contribution to the development of remote sensing of atmospheric properties from satellite as well as from ground-based observations like AERONET. He is a member of the MODIS Science Team, where he has primary responsibility for remote sensing of tropospheric aerosol over the ocean. He is a member of the CALIPSO (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation) science team and is also Principal Investigator (PI) of the PARASOL (Polarization and Anisotropy of Reflectances for Atmospheric Science coupled with Observations from a Lidar) mission. He has ~130 peer-reviewed papers (total number of citations : ~ 11 300 ; h-factor : 53)[1] including three papers in Nature and one in Science.

Honours

- ISIHighlyCited Researcher in Geosciences.
- 1992 & 2003 : Prize of the best paper of the year by IEEE/TGRS.
- 2003 & 2007 : NASA Group Achievement Award for Outstanding Teamwork on the Earth Observing System (EOS), MODIS/AQUA & CALIPSO Mission Teams respectively.

Activities/Management

- Director of the « Laboratoire d'Optique Atmosphérique » (UMR8518) : 2002 - 2007.
- Chair of the following National Committees. 1997-2001 : Remote Sensing National Program (PNTS). 2001- 2002 : Atmospheric Group of the « Terre, Atmosphère, Océan, Biosphère » CNES Committe (TAOB). 2004-2006 : Ocean-Atmosphere Committee (CSOA),INSU. 2004 - 2009. Co-Chair of the scientific committee of the API-AMMA (Action Programmée Inter-organismes - Analyses Multidisciplinaires de la Mousson Africaine).
- Member of the following International Committees. 1987- 1995: IGAP/IGBP (International Global Aerosol Program). 1996-1999 : IGAC/DARF. 2005-Present : IRC /IAMAS (Inter. Radiation Commission).

[1]On November 15th, 2010. From Web of Science® – with Conference Proceedings

- Topical-Editor/Atmosphere for Remote Sensing of Environment : 1996-1998.
- Chairman of the AERONET steering committee : 1996-2008.
- Guest-Editor (or co-editor) of J. Geophys. Res. Special Issues (3): 1997, 2005 and 2008.
- Organisation and co-organisation of international workshops or conferences (12).
- Reviewer for many international journals and research proposals (CNES, NASA, NERC, etc).
- Invited presentations to international conferences (20 for the last 10 years) and advanced schools (5).

Education
- Phd. adviser or co-advisor : 9.
- Master adviser : 9.

Participation to EU Framework Programme
- FP5 : DAEDALUS - Delivery of AErosol proDucts for Assimilation and environmentaL Use (1/3/2003 - 31/12/2005)
- FP6 : AMMA - African Monsoon Multidisciplinary Analysis (01/01/2005-31/12/2008)
- FP6 : GEMS - Global and regional Earth-system Monitoring using Satellite and in-situ data (01/03/2008 – 31/05/2009).

4. DESCRIPTION DE L'EXISTANT/ DESCRIPTION OF THE EXISTING

4.1. PRESENTATION DES PARTENAIRES

"Lille Nord de France University - Research and Higher Education Cluster" (later named *PRES ULNF*) was founded in January 2009 in order to increase regional academic potential, promote its visibility and enhance its international standing. With 17 higher education institutions (Universities and Grandes Ecoles), 130 000 students, 4 600 researchers and research fellows, 3 000 doctoral students in 6 doctoral schools, Lille Nord de France University focuses largely on public research in the Nord/Pas-de-Calais region. It also supports the academic community to work in close collaboration with national research organisations and business and techno clusters. All of its activities lead to development in regional research and higher education.

4.1.1 PARTENAIRE 1/ PARTNER 1 : LABORATOIRE D'OPTIQUE ATMOSPHERIQUE (LOA)

4.1.1.1 RECHERCHE ET INNOVATION / RESEARCH AND INNOVATION

The Laboratoire d'Optique Atmosphérique (LOA) is an academic research laboratory of the Lille1 University and a research unit attached to the INSU Institute of the CNRS. **At the last evaluation by AERES, the laboratory has achieved a grade A+.** The LOA consists of over 50 people, of which 37 are

permanent positions (18 university professors, 4 CNRS researchers and 15 technical staff). The laboratory is constituted by a large majority of physicists.

The research field of the LOA is the Atmospheric Physics, and the main activity of the laboratory is devoted to the **study of aerosols, clouds, gases and their interactions with atmospheric radiation**. Since the creation of LOA in the early '60s, the research lab focused on the theoretical aspects and understanding of radiative transfer in planetary atmospheres. Very soon, they have included an experimental field with the development of new concepts and achievements of original instruments. **Among the most recent instruments of the laboratory, some are now in space, as POLDER3 on the PARASOL platform which is one of six components of the Afternoon (or A-Train) international satellite constellation. Others will may be in space in the near future, such as the 3MI instrument on a Post-EPS platform of the european EUMETSAT agency**.

Beyond the conception of new instruments, the LOA has developed skills in analyzing radiation measurements, spreading from calibration of sensors for the determination of geophysical parameters through the implementation of validation means for these parameters and the development of processing tools and data visualization. Analysis of radiation measurements requires the maintenance of skills in modeling and signal interpretation. **The LOA has continued theoretical developments necessary for a better understanding of the interactions between atmospheric components and the radiation (in the UV, solar and thermal infrared).** Investment continued and strengthened recently in this field gives to the laboratory expertise that is recognized since many years both nationally and internationally.

Since the early 1990s and the launch of the first POLDER instrument in space, the laboratory know-how is widely recognized in processing and interpretation of satellite data to characterize atmospheric components.

Although the LOA is not a space laboratory from CNES it has been strongly supported by CNES for several years. Our staffs developed instrumental concepts and built airborne instruments or instruments onboard stratospheric balloons that serve as models for space experiments in past, present and probably in near future. Beyond the instrumental conception itself, the lab works with CNES to instrumental characterization, calibration, Data Processing Level and contributes greatly to the validation and scientific use of spatial measurements. **Ten researchers of the laboratory are Principal Investigator (PI) and/or are part of the Science Team of several space missions as POLDER3/PARASOL (CNES), MODIS/Terra and Aqua (NASA), CALIOP (CNES/NASA), Cloudsat (NASA), GLI (NASDA), and others**.

In recent years, this strong involvement made possible the creation of the national ICARE thematic center and the **creation of the UMS 2877, Data and**

Service Center (CGTD – ICARE in french) at Lille1 on January 1, 2006 (see description of ICARE as partner 3). The ICARE thematic center, which the LOA is a component, has been created by CNES, CNRS, Lille1 University and the Nord-Pas-de-Calais Regional Council.

Other research and service activities of the LOA are openly shared with the whole international scientific community. **The AERONET (Aerosol Robotic NETwork) network federation originated from a joint french-american initiative born around 1990.** LOA in France and GSFC/NASA in the USA designed and started development of a network of sun/sky photometer built by the french CIMEL SME. At present the global AERONET network is composed of around 200 permanent sites plus variable number of temporary sites (http://aeronet.gsfc.nasa.gov). The french historical component, PHOTONS (http://loaphotons.univ-lille1.fr/), became in 1998 a national « Service d'Observation » from CNRS/INSU. For several years, PHOTONS supported supersite approach involving both lidar and sunphotometer system for improving characterisation of aerosols particles. In 2010, PHOTONS/LOA is maintaining 25 AERONET sites operating in France and Africa and has many involvements in european projects such as GEOMON and ACTRIS in the near future. **LOA is managing two atmospheric sites in Lille and M'Bour (80km south of Dakar, Senegal).** Since mid-90's, they are part of AERONET and since 2006 they include lidar and flux (solar and thermal infrared) measurements.

The LOA has also the responsibility of the French UV network in the NDACC « Service d'Observation » from CNRS/INSU. More recently the LOA leads a SOERE project (ORAURE – Observations en Réseaux des Aérosols à Usage de Recherches Environnementales) in order to coordinate and to harmonize the aerosol observations made so far at national level by several approaches (satellite, network, instrumented sites, photometers, lidar, etc…) and different institutions. **Through the upcoming SOERE "ORAURE", the SO PHOTONS and the ground measurement supersites of the LOA are some components included in the EQUIPEX project SOFRA-EX coordinated by IPSL.**

The expertise of the LOA on theoretical and applied aspects of radiative transfer results in a strong involvement of the LOA staffs in many international collaboration studies (the exploitation of spatial measurements of the A-Train, of POAM and MSG satellites for example), **in European FP5 to FP7 projects** (GEMS (FP5, coordinator), AMMA (FP5), CIRCLE (FP5), EUCAARI (FP6), GEOMON (FP6), and in the near future ACTRIS (FP7)) or in the GIS IRENI project at regional level.

The overall effort of the laboratory results in a large number of scientific publications (more than 120 publications in refereed journals during the last four years). Furthermore, the increase of the number of invited talks talks (25 invited presentations during the 2006-2010 period compared to 18 during the 2002-

2006) is a good indication of the strong involvement of researchers of the LOA in collaborations and projects, as well as the impact of research conducted at LOA on the scientific community. **Three researchers of the LOA have received awards.** The coordinator of the present project, Didier Tanré, has been recognized among the "ISIHighlyCited" scientist in geosciences in 2006. Two of his papers were awarded in 1992 and 2003 (IEEE Geoscience and Remote Sensing Society Transactions Prize Paper Award). He received the "NASA Group Achievement Award" in 2007 as CALIPSO team member. Oleg Dubovik received the "NASA Medal for Public Service" in 2005 and has been elected an AGU Fellow in 2010. Olivier Pujol has received the Award of CNFGG (Comité National Français de Géophysique et de Géodésie) in 2007. It is also worthy to note that Jérôme Riedi is already Principal Investigor of several research proposals related to recent and future spatial missions (Glory/NASA/USA, SCLI-GCOM/NASDA/Japan and TOPASE/ESA/EU).

On another level, the recent **award of an international Marie Curie fellowship** and the large number of **foreign visitors (about 40 over 4 years)** is also significant aspects of the laboratory's visibility at the international level.

4.1.1.2 VALORISATION / EXPLOITATION OF RESULTS

The scientific activities of the LOA favour **relations and research contracts with EPIC (Industrial and Commercial Public Establishments)** and civil institutions rather than with private companies. Nevertheless it should be mentioned that the **LOA maintains close relationship with the CIMEL Electronics company (Paris)**, which has developed instruments for atmospheric measurements for many years; let us remind that the sunphotometer of AERONET was developped through a collaborative effort since 1991. Two instruments for ground and airborne measurements have recently been developed in partnership with this company. A fully digital thermal infrared radiometer has been studied in LOA and developed in partnership with CIMEL. Funding was provided by CNRS-INSU and Météo-France through an approval from their Technical Divisions. The second instrument is a version of multi-spectral and polarized sunphotometer now used by the **Observation Service PHOTONS of the LOA and by other partners in the AERONET network**. This new instrument offers the possibility to characterize the polarization of radiation scattered from 0.34 microns to 1.6 microns which will enrich aerosols monitoring and improve inversions of aerosol parameters. It is developped within a framework of a PhD thesis cofinanced by CIMEL and the Region NPdC. Through the partnership with the CIMEL company one of their research engineer works on a permanent position at the LOA. He participates (40 % equivalent full time position) to the validation and qualification of thermal-infrared instruments developed by CIMEL and LOA.

These last ten years strong involvement of the LOA in space studies has made possible the **creation of the ICARE thematic national center and the the Data and Service Center (ICARE/CGTD) in 2003 (UMS - Unité Mixte de**

Service- 2877 since 2006) (see section 4.1.3.1). Operational organization of ICARE relies on Centers of Scientific Expertise (CES) that constitute the research laboratories, as the LOA, and on a Data Management Center (ICARE/CGTD) designed specifically for the needs of the CES. The ICARE/CGTD develops science algorithms and production codes, building on the expertise from various scientific partners, among them the LOA. Its objective is to provide a set of technical services and shared services to enable the user community to exploit the data and products of dedicated space missions. Since the end of 90's the LOA has been involved in the project through its participation to the definition and dimensioning of ICARE/CGTD (2001 and 2002) and through the strong implication of a CNRS engineer who served as project manager between mid-2003 and late 2005. The establishment of the joint ICARE thematic center represents a unique opportunity to enhance the scientific results of French teams, especially those of the LOA, as the ICARE/CGTD is now a gateway to the "Clouds-Aerosols-Precipitation" satellite products for the entire international community.

Among other operations that highligh research activities of the laboratory one has to mention a **collaboration with the Centre d'Etudes Techniques de l'Equipement de Lyon**, which has enabled development and validation of infrared technology onboard road vehicles to assess the risk of occurrence of icy roads. **It is also imporant to note that three patents have been filed recently on characterization methods of precipitation using ground-based and airborne radar**. There are also contacts with **EADS/ASTRIUM for a PARASOL follow-on mission** to fill out the gap between PARASOL/POLDER-3 and Post-EPS/3MI.

4.1.1.3 ENSEIGNEMENT SUPERIEUR / HIGHER EDUCATION

The LOA depends on the DSTP3 of the Ministry for Higher Education and Research. It is a unit of the Department of Physics of Lille1. Consequently, lessons conducted by members of the laboratory are mainly delivered in Physics (but also in computer sciences) at Bachelor or Master degree as well as in Atmospheric Physics at Bachelor to Ph-D degree. Specialized lessons focus on Atmospheric Physics, Radiative Tranfer, Climate and climate change, Meteorology, Physics and Chemistry of the atmosphere, Remote Sensing. They are mainly delivered in a new **course of the Master of Physics of Lille1, untitled "Atmospheric and Ocean Physics".** Note also that training on the basic Atmospheric Physics is also taught at Geology Bachelor degree. Moreover, **courses on "Greenhouse effect and climate change"** are taught for 4 years in two professional masters, one in Lille1 (specialty: Strategic Intelligence and Industrial Intelligence) and one in Lille3 (specialty: management and Environmental Protection). For this year, several members of the LOA are involved in a new professional bachelor on green energy and sustainable development.

LOA members are responsible for eight courses in Bachelors and seven in Masters of Physics and Ph.D, allowing them to play a leading role in the development of scientific teaching in Lille1. Others also play this role in accepting duties of administration and management of education that are often time consuming. For instance, one professor is a member of the Council of Graduate School.

Eight Ph.D dissertations have been defended these last 4 years. Eleven Ph.D are in progress with 5 foreign students.

4.1.1.4 ORGANISATION / ORGANISATION

The organization of the LOA is based on a Governing board (the Director + the heads of the two scientific teams) assisted by a Council of laboratory. An internal regulations define the main principles of operation of the laboratory. A General Assembly of all the members of the LOA takes place once a year.
The Council of laboratory is composed of 14 people, including 10 researchers, 3 engineers and 1 Ph.D. This Council meets regularly (every 6-8 weeks) to review funding or equipment needs, to advise on priorities for recruitment of researchers and technical staff, to discuss all issues concerning the laboratory.
Research activity of the laboratory is mainly organized by two research teams of roughly similar size, the "Radiation-Clouds-Interactions" team (IRN) and the "Aerosol-Radiation-Interactions" team (IAR). Team heads are primarily responsible for scientific leadership.
The Director relies primarily on the heads of scientific teams and the coordinator of the SO PHOTONS to manage laboratory activities and relationships with institutions.
In order to better adapt the activities of engineers to the needs and the projects, the work plan of technical staff is discussed in a meeting open to all the members of the laboratory one or two times a year depending on the progress of projects and time constraints. These meetings promote the animation and technical exchanges between the scientific and technical teams.

4.1.2 PARTENAIRE 2/ PARTNER 2 : PHYSICOCHIMIE DES PROCÉSSUS DE COMBUSTION ET DE L'ATMOSPHÈRE (PC2A)

4.1.2.1 RECHERCHE ET INNOVATION / RESEARCH AND INNOVATION

The Laboratory "PhysicoChimie des Processus de Combustion et de l'Atmosphère (PC2A)" is an academic research laboratory of Lille1 University and a research unit attached to the INSIS (Institut des Sciences de l'Ingénierie et des Systèmes) Institute of the CNRS. Head of PC2A is Pr. J.F. Pauwels. At the last evaluation by AERES, the laboratory achieved a grade A and **the two research groups involved in the LABEX project have been evaluated A+**. The PC2A consists of over 60 people, of which 29 are in permanent positions (12 university associated professors and professors, 5 CNRS researchers, 5 engineers and 7 technical staff). The laboratory is constituted by a large majority of physical-chemists. At University Lille1, the PC2A is associated with LOA and other

laboratories to develop their research programs in an Institut of Pluridisciplinary Research on Environmental Sciences (IRePSE) directed by Pr. JF. Pauwels.

The main activities of the laboratory pertain to Physical Chemistry and Engineering Sciences. **The covered topics are connected with Energetics (combustion) and Environment (atmospheric chemistry). Emphasis is placed upon physical chemistry investigations of fundamental processes as well as on specific applications by using both experimental and modelling approaches.** Basic studies include the characterization and the reactivity of chemical species, the measurement of reaction kinetic parameters, the theoretical determination of thermokinetics data and the development of detailed and reduced chemical mechanisms by modelling. Experimental studies are conducted in specific laboratories or semi-pilot reactors like flat flame burners, diffusion flame burners, rapid compression machine, flow-tube reactor, photolysis cell, simulation chambers, etc.
Applied studies are devoted to flame structure, combustion in engines, aeronautic, clean processes, nuclear safety, pollutant metrology and modelling of air pollution and also impact of pollution on climate and health.

The laboratory project is tightened around 3 research teams (RT)

RT1: Physical Chemistry of Combustion (A+) (Head: P. Desgroux)
RT2: Homogeneous and Heterogeneous Reactivity of Atmosphere (A+) (Head: C. Fittschen)
RT3: Associated laboratory CNRS/IRSN/Lille1 "Chemical kinetics, Combustion, Reactivity: nuclear security (not noted) (Head: L. Cantrel / IRSN)

Since the early 1990s, the laboratory know-how is widely recognized in developing metrology of chemical species by laser diagnostics to characterize complex processes like combustion and atmospheric pollutants. **Our staff developed and built powerful and sophisticated instrumental equipments to study the complex systems that are combustion and atmosphere.** They are based mainly on optical methods like Laser Induced Fluorescence, Cavity Ring-Down Spectroscopy, Laser Photolysis, Tunable Diode Laser Absorption Spectroscopy, Quantum Cascade Laser Absorption Spectroscopy, Laser Induced Incandescence, Fluorescence Assay after Gas Expansion… associated with others analytical techniques like molecular beam, mass spectrometry (QMS, PTRMS), gas and liquid chromatography, Infrared Fourier Transformer spectroscopy, thermal desorption, Differential Thermal Analysis, Scanning Mobility Particule Sizer... Some of these equipments are designed to be transportable and have already participated in national and international field campaigns related to indoor (hospitals, industry, laboratories, houses…) and outdoor (Aircraft Engines, European Simulation Chambers, Atmosphere…) air quality. Regulated and non regulated pollutants, Volatile Organic Compounds, Aldehydes, Aromatics, Polycyclic Aromatic Hydrocarbons, NOx, Greenhouse gas, Soot, Aerosols, Reactive species (atoms, radicals)… emissions are usually studied.

To characterize solid surfaces of soot and aerosols, the PC2A benefits of complementary analytical techniques (Aerosol Mass Spectrometer, XPS, TOF-SIMS, μRaman, Transmission Electronic Microscopy) shared with other laboratories. **The PC2A is involved in the EQUIPEX project "Microscopie Electronique à Transmission Analytique (META)" (Analytical Transmission Electron Microscope).** All these equipments are at a very high international level and beyond classical systems.

The PC2A maintains specific collaborations on pollutant metrology and air quality with the "Department of Environmental Chemistry (DCE)" of the engineer school of Douai (http://www.ensm-douai.fr/) mainly by way of several joint phDs. The DCE has been associated with the PC2A for 4 years by way of a research agreement contract with the CNRS/INSIS.

In recent years, the strong involvement of the **PC2A in laser diagnostics development made possible the recognition by the CNRS of the laboratory as a national platform of optical metrology** (MeOL, http://www.meol.cnrs.fr/). MeOL, which is a component of PC2A, associated with the Laboratoire de Mécanique de Lille, has been created by CNRS, Lille1 University and the Nord-Pas-de-Calais Regional Council. The laboratory is also involved in the activities of the CERLA (Centre d'Etudes et de Recherches Lasers et Applications, http://cerla.univ-lille1.fr/).

The **other research activities of the PC2A are shared with the french institut of nuclear safety (Institut de Radioprotection et de Sûreté Nucléaire, IRSN**, Cadarache, www.irsn.fr). They develop experimental and theoretical research on the reactivity of radioelements in the case of an hypothetic accident in a nuclear center. Since 2009 and for 4 years, the PC2A, IRSN, CNRS and Lille1 University are in contract to share research in a labelled Associated Research Laboratory "Chemical kinetics, combustion, reactivity : nuclear security (C3R)".

The expertise of the PC2A on theoretical and applied aspects of physical chemitry of combustion and atmosphere results in a strong involvement of the PC2A staffs in many collaboration studies at regional (GIS "Institut de Recherche en Environnement Industriel" (http://www.ireni.fr/), Phytair, Environment and Health programs…) and national levels (coordination of ANR programs SOOT and NO-Mecha; CNRS Energy, ADEME Phytener, PRIMEQUAL SURFIN, CNRS CHARMEX, LEFE-CHAT programs…) and international collaboration studies in European FP5 to FP7 projects (INTERREG III Energy Source and Air Pollutants, INTERREG III A AQMASI Air quality Modeling Actors and Skill Inventory), FP6 STREP AEROTEST "Remote sensing technique for Aeroengine emission certification and monitoring", ECONET, coordination of FP6 Marie-Curie Early Stage Training Site TOTECAT "TOols and TEchniques for a Changing

Atmosphere", FP7 AFDAR "Advanced Experimental Technologies for Innovations in Aeronautics", PICS CNRS with Karlsruhe Germany).

The PC2A develops strong **international joint academic research collaborations with Germany (Karlsruhe, Duisburg), Great Britain (Cambridge), Italy (Milano, Florence), Hungary (Szeged), Czech Republic (Prague), Slovakia (Bratislava), Korea (Pohang), Japan (Tokyo), Canada (NRC), USA (Lawrence Livermore National Laboratories, Advanced Light Source Berkeley, California Institute of Technology)**. Several French-German PROCOPE projects have been awarded between PC2A and University of Karlsruhe (group Prof. Hippler), initiating high pressure gas kinetic experiments in Lille. French-Hungarian BALATON projects (group Prof. Viskolcz, University Szeged) are based on the complementarity experiment (Lille1) - ab-initio calculations (Szeged). A collaboration with Tokyo Metropolitan University (group Prof. Y. Kajii) has been started through a SAKURA project and has developed into a formal agreement between both universities and 2 PhD thesis under co-tutelle agreement are actually underway. A collaboration with South Korea (program STAR) has recently been initiated by PC2A on the subject of photocatatlysis with the group of Prof. W. Choi (Pohang University): one PhD thesis under co-tutelle agreement is underway. A France Berkeley project has been awarded in 2010 between Lawrence Berkeley laboratory, PC2A and the French accelerator SOLEIL, designated to install kinetic measurements at SOLEIL. Several collaborations have been developed in the field of laser diagnostics development for sooting flames and soot monitoring within French-British ALLIANCE projects (C. Kaminski, I. Burns, University of Cambridge and Strathclyde) and the European projects FP6/AEROTEST and more recently FP7/AFDAR. PC2A is also involved in the COST *(European* Cooperation in Science and Technology) CM0901 project devoted to the detailed chemical models for cleaner combustion.

The PC2A always developed strong contractual collaborations with private companies (see section 4.1.2.2) to develop alternative fuels, new ways of combustion in engines and kinetics model to improve engines working and to reduce atmospheric pollution. A joint research program is in progress with GDF SUEZ on combustion of natural gas mixtures with hydrogen or endgas in gas turbins and engines.

The overall effort of the laboratory results in a large number of scientific publications (more than 75 publications in refereed journals during the last four years). Furthermore, the recent increase of the number of invited talks (10 in 2010) is a clear indication of the strong involvement of researchers of the PC2A in collaborations and projects, as well as the impact of research conducted at PC2A on the scientific community. **JF. Pauwels has been President of the French section of the Combustion Institute (2003-2006). Three CNRS researchers of the PC2A (P. Desgroux, C. Schoemacker, X. Mercier) obtained Paul Lafitte national award for the best french thesis in**

combustion. C. Fittschen has been awarded a Fulbright fellowship in 2004 and a JSPS fellowship in 2010. Several researchers have been or are members of scientific board of International Symposiums. P. Desgroux is a member of Editorial board of Combustion and Flame and has been Colloquium co-chairing at the International symposium on combustion (2004: laminar flames and 2010: diagnostics). C. Fittschen is member of the Gas Kinetic Discussion group of the Royal Society of Chemistry, organizing the biannual International Symposium on Gas Kinetics.

The **large number (6-7 per year) of foreign visitors is also a significant aspect of the laboratory's visibility at the international level**.

4.1.2.2 VALORISATION / EXPLOITATION OF RESULTS

The scientific activities of the PC2A favour relations and **research contracts with the EPIC (IRSN) and civil institutions (ONERA, INRETS, IFP) but also with private companies (TOTAL, PSA, RENAULT, GDF SUEZ, RECORD, EDF)**. The PC2A maintains close relationship with the GDF SUEZ group by developing since 20 years a specific detailed chemical mechanism GDF-Kin® for natural gas applications. Several versions of the mechanism have been developed to predict natural gas combustion, thermal degradation of oxygenated volatile organic compounds, aromatics, NOx formation and reduction, minor pollutants formation, combustion of natural mixed with end gas and hydrogen in order to predict gas-cleaning plant, turbine and engine working and to reduce pollution. The PC2A has been involved in several contracts during the recent years: Technology Research Team with GDF SUEZ (2006-2009) and collaborative research programs with industries like TOTAL and PSA (SYNGAZ 2003-2007, BIOKIN 2005-2008, HCCI 2005-2008), RENAULT (UHCDiesel 2007-2009, PROBCAR 2007-2009), AUXITROL (LIISOOT 2003-2007), GDF SUEZ (OZONE 2005, MARIN 2005-2006, PARTICLES 2008, NatGasH2 2005-2008 and 2009-2012), AFSSET (CH2ORisk 2006), etc.

4.1.2.3 ENSEIGNEMENT SUPERIEUR / HIGHER EDUCATION

The PC2A depends on the Engineering Sciences Scientific Direction (DSTP8) of the Ministry for Higher Education and Research. It is a unit of the Department of Chemistry of Lille1. Consequently, lessons conducted by members of the laboratory are mainly delivered in Chemistry, thermochemistry, reactivity, chemical Engineering and spectroscopy at Bachelor (eurobachelord of chemistry) or **Master degree (Masters "Chemistry", "Engineering of Industrial Systems (GSI)", "Hygiene, Security and Environnemental Quality (HSQE)", Master Erasmus Mundus "Advanced Spectroscopy in Chemistry (ASC)"**) as well as in Atmospheric Chemistry and Combustion at Bachelor to Ph-D degree. Specialized lessons focus on Atmospheric Chemistry, Advanced Combustion, Theoretical chemistry, Laser Diagnostics and applications, Physics and Chemistry of the atmosphere (in collaboration with the LOA). Several

members of the PC2A are also involved in a new professional bachelor on analytical methods.

Pr. JF. Pauwels has been the coordinator of the Master of Chemistry for 6 years. Members of PC2A are responsible of several courses in Bachelors (General chemistry, Physical chemistry, Kinetics, Chemical kinetics and reactivity) and **ten in the International Masters ASC** (M1 : Methodology in physical chemistry, Optical spectroscopy) and Chemistry (M1 : Chemical kinetics and catalysis; Chemical engineering; Atmospheric environment; Energetics, concepts and applications; Photonic and molecular spectroscopy; M2: Advanced analytical methods; Energetics cycles; Photonic spectroscopical techniques; Homogeneous and heterogeneous reactivity) and three in Ph.D (Advanced Combustion : metrology and modelling; Theoretical chemistry; Physical chemistry of Atmosphere), allowing them to play a leading role in the development of scientific teaching in Lille1. Others also play this role in accepting duties of administration and management of education that are often time consuming.
The **PC2A also organizes national (Combustion School) and international (Marie Curie Early Training Site in atmospheric chemistry) summer schools**. Every two years the PC2A organize a specific workshop "Laser diagnostics of reactive species" labelled "atelier national" by the CNRS/INSIS.
18 Ph.D dissertations have been defended these last 4 years. 22 Ph.D are in progress.

4.1.2.4 ORGANISATION / ORGANISATION

The organization of the PC2A is based on a Governing board (the Director and the heads of the research teams) assisted by a Council of laboratory. An internal regulation defines the main principles of operation of the laboratory. A General Assembly of all the members of the PC2A takes place once or twice a year.
The Council of laboratory is composed of 14 members (mainly elected), including 8 researchers, 4 engineers/technicians and 2 Ph.D. This Council meets regularly (approximately every 3 months) to review funding or equipment needs, to advise on priorities for recruitment of researchers and technical staff, to discuss all issues concerning the laboratory.
Research activity of the laboratory is mainly organized by three research teams (RT1: Physical Chemistry of Combustion, RT2: Homogeneous and Heterogeneous Reactivity of Atmosphere, RT3: Chemical Kinetics, Combustion, Reactivity: Nuclear Security (C3R)) of roughly similar size. Team heads are primarily responsible for scientific leadership.
The Director relies primarily on the heads of scientific teams and the director of the associated laboratory with IRSN (RT3) to manage laboratory activities and relationships with institutions (Lille1 University, CNRS, IRSN).
In order to better adapt the activities of engineers to the needs and the projects, the work plan of technical staff is discussed in meeting opened to all the members of the laboratory several times a year depending on the progress of

projects and time constraints. These meetings promote the animation and technical exchanges between the scientific and technical teams.

4.1.3 PARTENAIRE 3/ PARTNER 3 : ICARE CGTD / ICARE DATA AND SERVICES CENTER

4.1.3.1 RECHERCHE ET INNOVATION / RESEARCH AND INNOVATION

The ICARE Thematic Center was created in 2003 by CNES, CNRS, the Nord-Pas-De-Calais Regional Council, and the University of Lille1, to provide various services to support the research community in fields related to aerosols, clouds, water cycle, and their interactions with radiation in the atmosphere. **ICARE's main objective is to help the science community access and exploit the huge data volumes derived from Earth observation missions** such as the ones within the A-Train, combine them with products derived from other satellites, including meteorological satellites, or compare them to ground-based measurements to support validation activities.

ICARE's main strength is to articulate several key players within one well-organized structure to generate science products in a short loop with high quality standards and good users support. One of ICARE's main components is the **Data and Services Center (ICARE/CGTD), located at the University of Lille1**, which develops science algorithms and production codes, building on the expertise from various scientific partners, and distributes products to the users community. **Unlike the other partners, the ICARE Data and Services Center does not carry out research directly, it only provides services in support of research activities**.

Over the years, the ICARE/CGTD has already developed a large computing facility (27 servers, 450 Tbytes online storage), collected a **large number of remote sensing data sets (e.g., PARASOL, MODIS, CALIPSO, CLOUDSAT, SEVIRI, OMI, MERIS, AMSU, SSMI ...)** from various data providers (CNES, NASA, EUMETSAT, NOAA, ESA), developed various browse and data access tools, and already offers numerous development and computing services to the users. Although ICARE activities are not limited to spaceborne observations, a specific effort is put on the development of satellite scientific products with a near-real-time processing capability and the development of tools to help data use and data analysis. While ICARE activities are mostly driven by the French research community, all products and services are openly shared with the whole users community. **ICARE currently counts over 600 registered users worldwide**.

4.1.3.2 VALORISATION / EXPLOITATION OF RESULTS

While the ICARE Data and Services Center primarily serves the research community, it also develops services that aim at making aerosol and cloud

products available to a broader user community, including decision makers, businesses and citizens. Although ICARE directly distributes products from its web site and ftp sites, a number of products are also delivered to partner decision making systems that provide a higher level of operational services and integrate ICARE products into application-specific services. For example, **ICARE provides near-real-time aerosol products to ECMWF to assimilate into the MACC aerosol forecast model** (http://www.gmes-atmosphere.eu), a precursor of a future GMES atmospheric service. **ICARE also provides quasi-near-real-time aerosol products to INERIS PREVAIR system** (http://www.prevair.org) for quality control of their aerosol forecast. Finally, **ICARE delivers quasi-near-real-time aerosol imagery to WMO's Sand and Dust Storm Warning Advisory and Assessment System** (http://www.bsc.es/sds-was).
ICARE also has direct connections with society. For example, in the framework of **the school program "Meteo des Ecoles", teachers and students access ICARE resources** (http://meteodesecoles.org/chasseursdenuages_lang.php) to support near-daily cloud observations .

4.1.3.3 ENSEIGNEMENT SUPERIEUR / HIGHER EDUCATION

Not applicable

4.1.3.4 ORGANISATION / ORGANISATION

The ICARE Data and Services Center has a staff of 10 people (as of 01/11/2010), including 1 Director, 8 IT engineers, and 1 Administrative Assistant.
ICARE's governance consists of a Steering Committee (CNES, CNRS/INSU, University of Lille1 and Nord Pas de Calais Regional Council), which defines ICARE's overall strategy and allocates resources. The Data and Services Center responds to specific demands expressed by ICARE partners and the broader users community within the scope defined by the Steering Committee. A coordination structure composed of an Executive Bureau, a Chief Scientist, and a Users Committee, proposes scientific objectives, reviews and prioritizes all users demands.

4.1.4 PARTENAIRE 4/ PARTNER 4 : LABORATORY FOR PHYSICO-CHEMISTRY OF THE ATMOSPHÈRE (LPCA)

4.1.4.1 RECHERCHE ET INNOVATION / RESEARCH AND INNOVATION

The LPCA is an academic unit from Littoral University in Dunkerque. The human potential of this lab consists of 32 University researchers and engineers, including 6 Professors, 13 Associate Professors, 4 engineers, one technician, 2 post-docs and 11 PhD students. The LPCA consists of 3 teams described below. **The team 1 only will be involved in this LABEX project. This team was evaluated, in February 2009, at the A level by the national agency (AERES).** More precisely, the project will be achieved by 2 Professors, 4

Associate Professors and 2 Engineers. The following scientific program is consistent with the lab project as proposed to the AERES committee and extends it up to a ten-years duration.

From many examples like photochemical pollution, accidental pollution releases in the air or unusual weather events, it is now clear that any occurrence of pollution in the atmosphere cannot be isolated from its environment. Each pollution event may be considered as a complex system involving many reacting chemical compounds and meteorological phenomena with various space-time scales. To address this complexity, a wide range of theoretical, experimental and numerical tools are needed to understand the state of the system, and predict its evolution. **The Laboratory for Physico-Chemistry of the Atmosphere (LPCA - EA 4493 - CNRS convention) has the expertise in optics, materials chemistry, chemistry of the atmosphere, meteorology and modelling, allowing it to address experimentally and theoretically such complex systems, to study their mechanisms and develop appropriate diagnostic tools**. These themes are based on both fundamental and applied research in physics and chemistry, to capture, with various viewpoints, the disturbance made to the environment, mainly in the field of air quality.

The laboratory pursues its general approach towards environmental issues, initiated over the past fifteen years, and fits into the research pattern in Environment of Littoral University. **The privileged geographical position, in a heavily industrialized and urbanized area, has been an opportunity to develop an original research in an industrial environment.** In this way, the LPCA is the leader of the creation of an Institute in Environmental and Industrial Research (GIS IRENI CNRS) with our regional partners (16 M€ for the period of 2007-2013). The IRENI program focuses on the complexity of air pollution and its effects on human health and the environment. It puts emphasis on improvements in monitoring technologies, atmospheric modelling, pollution reduction, as well as on the effects of pollution on the value of a territory, the legal and regulatory responsibilities. The LPCA teams are mostly involved in GIS IRENI and take benefit of the means obtained for the term of this state-region project (CPER), thanks to collaborations with other regional labs like LOA and PC2A. The laboratory also maintains close relations with local communities to which air pollution is a major issue.
Finally, the **border position with Belgium and the UK supports the implementation of European projects** (INTERREG II « Impact des poussières atmosphériques sur la pollution de l'environnement marin : cas du Détroit du Pas de Calais » and " Centre régional de compétences de mesure de l'émission et du transport de polluants "**;** Interreg IIIa (2002-2005) " Centre Interrégional d'Etudes de Suivi des Flux de Polluants et de leur Réactivité ", INTERREG IVA 2-Seas Programme franco-anglais « 2-Seas Technology Centre for Clean Environment: CleanTech » (2009-2012). But its scope of action goes well beyond this "heart of business" with a growing investment of teams in national and international research programs. **The teams are involved in research groups**

in molecular spectroscopy (GDR SPECMO, GDRI France-Russie-Chine), in THz radiation generation (European GDR THz) and in chemical kinetics (Groupe de Cinétique et Photochimie). They also develop collaborations with other labs within numerous national and **international field campaigns (AMMA-Multidisciplinary analysis of African monsoon, HYMEX-hydrological cycle in the Mediterranean experiment, CHARMEX-chemistry aerosol Mediterranean experiment, EUSAAR-european supersites for atmospheric aerosol research etc.)** and are involved in national research programs (LEFE etc.). The teams are also beam users of particle accelerators for spectroscopic analysis (THz region) and materials structure studies (synchrotron SOLEIL (Saclay), CEA (Saclay), Instu-itut Laue Langevin (Grenoble), Synchrotron ESRF (Grenoble), ISIS (Oxford), synchrotron Spring-8 (Osaka), synchrotron APS (Chicago)).

At the end of the previous contract, the laboratory has also undergone a significant transformation in hosting the staff from another lab (UMR ELICO), working in the fields of aerosols, modeling and atmospheric chemistry. It has then structured its research project taking into account these new skills and is now developing research activities to strengthen the integration of these topics.

4.1.4.2 VALORISATION / EXPLOITATION OF RESULTS

The LPCA is located in urban and industrialized Dunkerque's area and naturally develops relationships with locally implemented industries. **Previous research contracts with Arcelor-Mittal Dunkerque company led us to file a patent on a lead sensor for analysing the aerosols emissions and a second one is under preparation.** Moreover, recent studies conducted as part of the Interreg IIIA program and also in collaboration with Arcelor Mittal Dunkerque, have shown that new combustion additives are able to reduce the emission of NOx by a factor of two. This issue is under study in the INTERREG IVA "2 Seas" programme, with Arcelor-Mittal, Kent and Delft Universities, within the Cleantech program (LPCA is the program leader). Besides, a collaboration with Vale Manganese company (a subsidiary of Vale, the world leader of mining) began in 2009, in the framework of a **doctoral thesis funded by ADEME,** on emissions of metal nanoparticles whose impact on human health is now the subject of many studies. The LPCA is also involved in the INNOCOLD project dedicated to the creation of a research institute for low temperature technologies by associating EPIC institutions and industry.
Focusing on this project, **LPCA is now working on a new generation of ultracompact optical detectors of gas and aerosols,** within collaboration with the French group "Composants à nanostructures pour moyen infra-rouge" (evaluated A+ by AERES) of "Institut électronique du Sud" at Montpellier University. The present project aims to develop the applications of such detectors combined with lidar systems in fields experiments and meets **the needs of industrials and national agencies involved in air quality.**

4.1.4.3 ENSEIGNEMENT SUPERIEUR / HIGHER EDUCATION

Actually, nine students are trained in research for the preparation of a doctoral thesis. Various financial supports were obtained for these phD students (MENRT, NPDC region, SMCO, DGA…). Furthermore, the laboratory welcomes a large panel of students in physical chemistry for trainings of several months duration (Bachelor's and Master's degree of the ULCO, Master's degree of fundamental Physics of the University of Paris-Sud, second year technical degree of optical engineering of the high school Gustave Eiffel (Armentière)…).

Professors and assistant professors of the LPCA belong to the departments of chemistry, physics and physics of the atmosphere. Arnaud Cuisset is actually director of the department of physics and physics of the atmosphere. Other lecturers manage different courses in Bachelor's and Master's degree in ULCO: **Agnès Noyer and David Lecoq are responsible of the Physical Chemistry Bachelor's degree in Dunkirk and Calais, Gaël Mouret manages the Masters degrees in Physics Teacher Education** and Hervé Delbarre sparked off high-level competitive examination for recruitment of teachers in physics and chemistry in ULCO.

Several members of the laboratory have created a new master's degree focus on Expertise and Treatment in Environment (E.T.E) in ULCO. Karine Debout is responsible of the first year of the E.T.E Master, which proposes a multidisciplinary approach where the different compartments of the natural environment are presented. Various topics such as ecology, biogeochemistry, meteorology are also addressed in the different courses. Finally the expertise of the laboratory members and their industrial partners allows training the students in a scientific approach of the industrial pollution. During the second year, three specializations in physics, chemistry and toxicology are purposed. Except for the last specialization, professors and assistant professors of the LPCA deliver courses closely related to fundamental and applied researchs in physical chemistry of the atmosphere. The specialization physics of the E.T.E Master's degree is integrated in the regional Physics Master's degree of Lille. In this context of a regional master of Physics, members of LPCA are involved in the courses delivered at the Lille1 university for the "light-matter" speciality.

The **LPCA has hosted two PhD students in the framework international programs.** The first one has been co-supervised by LPCA and Anhui Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, in the framework of "Bourse Eiffel" program. The second one has been co-supervised by LPCA and LOA thanks to the Marie Curie European programs.

4.1.4.4 ORGANISATION / ORGANISATION

A governing board (the director and the head of each team) manages the LPCA and a laboratory council helps in decisions. Laboratory members meet, at least once a year, in a general assembly.

The laboratory project is tightened around 3 teams that have a thematic focus to the asserted Physico-Chemistry in Environment, without forgetting the fundamentals inherent in each discipline:

Team 1: Dynamics, Modelling and Atmospheric Chemistry
Team 2: Materials and Emissions
Team 3: Complex Dynamics and Modelling: analysis of molecular systems

The first team aims to characterize the properties of gaseous compounds and aerosols, and to address various issues of the dynamical phenomena of pollution in the troposphere. This theme benefits from the synergy of complementary skills in the areas of physico-chemistry of gases and aerosols, the reactivity of these compounds, the optical detection of trace gases, remote sensing and numerical modelling. These skills are exploited within the framework of field campaigns, numerical modelling and experimental developments in the laboratory.
The second team develops fundamental and applied research in order to understand new phenomena in the field of amorphous materials to obtain new sensors, to develop innovative and clean industrial processes and study the chemical transformations of aerosols from their release point.
The third team concerns "dynamics and modelling of complex systems". It has acquired a theoretical competence in the field of atomic and molecular modelling, and specifically on the qualitative theory of quantum excited systems. This approach is used to interpret qualitatively molecular rotational and vibrational spectra.

4.2. COLLABORATIONS EXISTANTES / EXISTING COLLABORATIONS

Since 2006, the **LPCA, LOA and PC2A laboratories are collaborating within the research axis "Air Quality" of the Institute IRENI** regional program. **LOA, PC2A ICARE/CGTD and LPCA also aim to collaborate within the Mediterranean HYMEX and CHARMEX components** of the MISTRALS (Mediterranean Integrated Studies aT Regional And Local Scales) program by working on radar observations, on field campaigns relative to outdoor air quality, long-term aerosol monitoring (lidar and sun-photometers) and on the use of satellite data as well as airborne observations. ICARE/CGTD is also involved in the definition of the data base of the program.

Concerning bilateral collaborations,

- PC2A and LOA are associated with other laboratories to develop their research programs in the axis "Physics and Chemistry of Atmosphere" within the Institute IRePSE.
- LPCA and LOA work together on aerosol issues in the troposphere, by means of lidar remote sensing and photometric measurements. In this framework, they have acquired and are using mutual instruments like an aerosol lidar and AERONET photometers. This collaboration led them to

supervise together a PhD student supported by a Marie Curie European project.

- PC2A and LPCA (as project leader) have developed research in the field of "Energy sources and air pollutants" within an INTERREG III program (associating Sussex and Kent universities (UK) and "Bioenergy Technology Ltd" private society. They collaborate also on the development of detection of OH free radical using Faraday rotation spectroscopy.
- In addition to the collaborative involvement in the context of the A-train space constellation (mainly for PARASOL), LOA and ICARE/CGTD have several collaborations in the framework of European projects such as FP6/GEOMON, and FP7/ACTRIS in the near future. Concerning measurements from ground network and supersites, both LOA and CGTD are part of the SOERE ORAURE and the EQUIPEX SOFRA-EX projects.

5. DESCRIPTION SCIENTIFIQUE ET TECHNIQUE DU PROJET / TECHNICAL AND SCIENTIFIC DESCRIPTION OF THE PROJECT

5.1. ETAT DE L'ART / STATE OF THE ART

Our objective is to study ***the aerosol cycle and to monitor the modifications of the aerosol properties along its transport by mixing, reactivity and in-cloud processes****. Our project is* ***expected to contribute to the estimate of the aerosol effects on the climate system*** *and on the hydrological cycle as well as to quantify changes in* ***air quality*** *on global, regional and urban scales.*

In the troposphere, chemical reactions proceed at the surface and in the bulk of solid and liquid aerosol particles and can influence atmospheric gas-phase chemistry as well as chemical and physical properties of the atmospheric particles (chemical composition, optical and hygroscopic properties, cloud condensation activity, see Fig. 1).

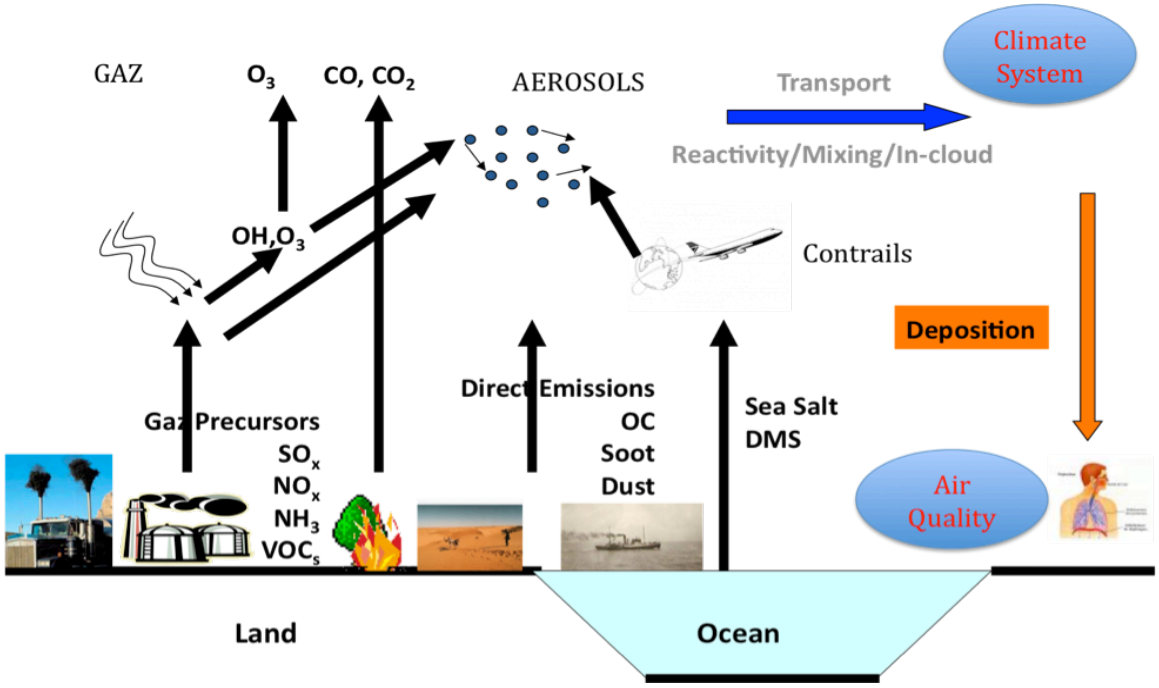

Figure 1 : Schematic view of the aerosol cycle

Because of their high surface-to-volume ratio, fine aerosol particles can be very efficiently transformed upon interaction with solar radiation by photolysis and reactive trace gases (oxidation by HOx radicals, nitration, hydrolysis, radical-initiated oligomerization, etc) [George et al 2010, Rudich 2003]. Chemical analysis of sampled atmospheric particles highlight that the core of aerosol particles (Black Carbon, dust, sea salt) are covered by a coating of mainly organics compounds [Zhang et al (2007), De Gouw and Jimenez (2009)]. During the transport in the atmosphere, oxidative reactions of this organics compounds lead to the formation of multifunctional hydrocarbon derivatives on the surface of the particle. All these fundamental processes are named as the generic term 'aging'.

Sorting out the gases and aerosol effects is difficult because of the high spatial and temporal variability of the sources, complex interaction of aerosol with atmospheric trace gases and clouds and the short lifetime of these atmospheric components. For instance, a single aerosol particle can include anthropogenic sulfate and carbonaceous material, coating natural dust particle and may encounter a cloud several times. So we need to apprehend the aerosol in the atmosphere as a multicomponent system; its chemical composition and structure needs to be characterized for deriving the aerosol refractive index and single scattering albedo as well as its hygroscopicity. All theses parameters need to be understood in order to evaluate the aerosol effects on clouds and radiation and to improve remote sensing approaches that will be used to reach our objectives.

Concerning the climate system and the hydrologic cycle (see for example Ramanathan et al., 2001; Kaufman et al., 2002; Anderson et al., 2003; Hansen et al., 2005; IPCC, 2007; Remer et al., 2009) the first role of atmospheric aerosols is interaction with solar and thermal radiation: by scattering sunlight and reflecting a fraction of it back to space aerosols cool the climate system, which counteracts the warming of greenhouse gas (GHG); by absorbing sunlight in the atmosphere aerosols further cool the surface but warm the atmosphere, changing the temperature and humidity profiles and the conditions for cloud development and formation. Hygroscopic aerosol particles play a second role by impacting the hydrologic cycle: serving as cloud condensation nuclei aerosols control the cloud droplet concentration and size. These processes may cause changes in precipitation patterns, changes in cloud cover, and possible changes in the severity of severe storms.

The aerosols effect on radiation balance at the top, bottom and inside the atmosphere is commonly referred to as the aerosol direct radiative forcing. We still have a much poorer knowledge in quantifying aerosol forcing than the greenhouse effect (Penner et al., 2001), due to the complex aerosol composition, resulting uncertainty in the aerosol optical properties, and variability in the aerosol spatial distribution. Better understanding has been gained for conservative scattering aerosols (e.g. pure sulfate) than absorbing aerosols (e.g. more realistic mixture with black carbon) (Hansen et al., 1997). In the conservative case, aerosol forcing at the top of the atmosphere (TOA) is identical to that at the surface (Ramaswamy et al., 2001). Increasing attention is recently paid to absorbing aerosols whose effects are far more complex and poorly understood (Russell et al., 1999; Ramanathan et al, 2001; Kaufman et al., 2002a). Pending on the combination of aerosol properties, surface reflectance and cloud distribution, aerosol forcing at the TOA may be positive, negative or zero, while it is always negative and large at the surface. Aerosols can then modify the atmospheric stability and circulation, cloud presence/disappearance, etc. This effect has been demonstrated in the pollution plume off India (Ackerman et al., 2000) and during the biomass burning season over the Amazonia (Koren et al., 2004; Davidi et al., 2009). Aerosols may change the number, size (Coakley et al 1987; Bréon et al., 2002; Costantino and Bréon, 2009) and lifetime of cloud droplets in the Earth's atmosphere, the so-called aerosol "indirect effects" (Twomey, 1984; Albrecht, 1989) and thereby change the reflectivity of the planet, i.e., the amount of solar radiation it absorbs. These changes also perturb the mechanisms by which precipitation is produced, modifying the intensity and distribution of rainfall (Rosenfeld, 2000; Lau et al., 2009). As the evaporation and condensation of water plays a central role in the planetary energy household, modification of rainfall dynamics may even change global circulation.

The direct effect is still not very accuratly estimated over land where the single scattering albedo (the ratio between absorption and extinction properties of aerosol) is a key parameter (Loeb and Su, 2010) difficult to apprehend at a global scale. For instance, the heating effect of absorbing aerosol is increased

(Haywood and Shine, 1995) if the aerosol is located over a bright surface like a cloud (Waquet et al., 2009) when, over ocean, aerosols cool the atmosphere-ocean system by increasin the reflected solar flux. Furthermore, the presence of an aerosol layer over clouds is difficult to detect, which can lead to wrong interpretation of cloud properties for indirect effects that are extremely complex and very difficult to predict. Just as accurate modeling of the indirect effects is very difficult, the observation of these effects is also a great challenge.

Concerning the Tropospheric composition and its impact on human health, atmospheric pollution due to airborne fine particles is an environmental issue of a worldwide increasing concern. Particulate mass concentration measured at the ground level (PM_x means the mass of particles with an aerodynamic diameter lower than x µm) is a common way to quantify the amount of particles in the atmosphere and is used as a standard to evaluate air quality. The small aerosol component, $PM_{2.5}$ in $\mu g.m^{-3}$, is of most concern to human health because the exposure to suspended particles can contribute in some lung and respiratory diseases and even premature death. In terms of aerosol pollution monitoring, particulate mass concentration is measured by air quality agencies (handled in France by the Environment and Energy Management Agency, ADEME).
In urban areas, aerosol concentration is strongly dependent on the daily evolution of the boundary layer and turbulent processes play a crucial role on vertical aerosol mixing. If diurnal conditions are generally featured by well mixed aerosols in the boundary layer, these situations only represent a few hours in a full day and for the rest of the day, the ground measurements may be disconnected from columnar aerosols (Boselli et al., 2009). A particular attention must be paid to these stable meteorological conditions leading for instance to a stratification, and also to the transition periods between unstable and stable atmosphere. Aerosols behavior also depends on geographical singularities (relief, sea etc.). In coastal areas for instance where half of the world population is living, the sea breeze represents a critical meteorological phenomenon, which acts on the transport and dispersion aerosols, and leads to high pollution levels at ground level and to a lift effect carrying pollutants into elevated layers (Rimetz-Planchon et al, 2008). It is actually a complex phenomenon whose dynamics radically change the structure of the lower troposphere, and which relies heavily on the meteorological synoptic conditions and the local topography. The Thermal internal Boundary Layer (TIBL) generated by the sea breeze, traps and mixes the aerosols emitted from the ground, while the gravity current carries this air mass inland above the ground (Talbot et al., 2007). Moreover, it leads to the formation of an elevated reservoir of pollutants relating to a regional scale larger than the sea-breeze dimensions. This reservoir may be recycled the next day either in a new sea-breeze system or in the atmospheric boundary layer outside the sea-breeze system, and will thus add to the fresh pollutants and participate in the next day's photochemistry. By keeping the pollutants close to their emission point at a regional scale, a succession of breeze days can then lead to an amplification of the background regional air pollution. In the lower layers of the troposphere, the distribution of aerosols needs to be spatially

resolved in order to understand the impact on pollution of local sources (urban and industrial) and long-range transport.
Most of the air quality-monitoring stations are located close to major urban areas leaving large areas without operational observations. Satellite remote sensing is well suited for a daily monitoring of the aerosol load [*Kaufman et al.*, 2002; *King et al.*, 1999] but primary aerosol quantity derived from space borne remote sensors is the aerosol optical thickness. However, ground-level particle mass concentration are not representative of the concentration profile most of the time. The relationship between column aerosol optical thickness (AOT) derived from satellite imagery and fine particulate mass ground measurements has already been explored (Engel-Cox et al., 2004; Wang and Christopher, 2003) using a simple linear relationship but its accuracy is strongly dependent on the aerosol scale height. The uncertainties in such a relationship come from the constraints that deposition, condensation, and coagulation put on suspended particle sizes in the atmosphere. It is important to take into consideration the vertical distribution of aerosols in the elaboration of a satellite air quality product. The information on the vertical distribution of aerosols can be either simulated by the chemistry-transport model or measured by Lidar. In recent years, single-wavelength lidar technology has developed very quickly and now allows to set up lidar networks (EARLINET; Mathias et al., 2004) for long-term monitoring. However, the calibration of lidar signals in mass concentration of aerosols still remains an important issue. There are indeed some limitations on the extraction of aerosol optical properties (extinction and backscatter). The lidar ratio is generally assumed to be constant over the entire column for extracting extinction and backscatter from lidar data. The inversion of lidar signals may be done only for vertical measurements since it needs a clean reference in the upper troposphere. The lidar observation is finally limited by the blind distance (typically 250 m) below which it is hard to measure. Photometric techniques assume an horizontally homogeneous atmosphere and cannot account for the variability at small scale. It is so difficult to get the evolution of the spatial distribution of aerosol at micro-scale, especially in the boundary layer.
As reported in Hoff and Christopher (2009), ground-based and in-situ measurements, models, and satellite observations should be viewed as a system, each component of which is necessary to better understand air quality.

The scientific issues arised above, i.e.

- **To estimate the PM2.5 and the contribution of long-range transport to the regional budget,**
- **To reduce the uncertainties of the aerosol radiative budget and forcing,**

requires collaborations at a national and/or international levels to be fully apprehended, which is out the scope of the present project. We do not intend to cover all the aspects, within this proposal, we will contribute to the following key issues :

- **To monitor and model the evolution of the physical and optical aerosol properties along the transport by chemical transformation, reactivity, mixing or in-cloud processes.**
- **To identify the sources and sinks of gases precursors and aerosols,**
- **To quantify their strength and their variability,**

Our strategy relies upon the integration of measurements in laboratory, of observations from satellites and ground-based networks, of data acquired during field experiments with aerosol model simulations. Based on its experience, PC2A has the capability to link the aerosol surface properties and their reactivity to the optical and hygroscopicity properties. It is also possible to generate aerosols, to coat them by particular material (for instance silicates « covered » by soot) and to measure the resulting optical properties as well as their hygroscopicity. The study can be done for different classes of the size distribution. LPCA has been participating to campaigns devoted to urban pollution with ozone as principal issue (Delbarre et al., 2006; Augustin et al., 2007). They successfully led to develop operational tools in order to predict ozone concentration in a regular way but there are still needs to progress in atmospheric dynamics and chemistry to get the same possibilities in predicting aerosols. From a experimental viewpoint, LPCA made many progresses in developping or using remote sensing techniques. Research activities at LOA is based on an expertise in theoretical and applied aspects of radiative transfer within planetary atmospheres. Analysis of the PARASOL/POLDER measurements are performed from inversion algorithms developped internally, which means that the findings of the laboratory measurements can be easily considered in the retrieval. The AERONET network of sun/sky photometer provides an historical data set (more than 15 years in some parts of the world) of aerosol properties. Again, LOA has the capability to retreat the data for considering new processes like internal mixing or aging of the aerosol components. The ICARE/CGTD Data and Services Center archives, processes and distributes satellite data and products for aerosol, cloud and water cycle research. In particular, ICARE is the main processing center for the CNES PARASOL mission and a mirror site with specific applications for the NASA/CNES CALIPSO mission. It also archives a large number of other datasets like MODIS/AQUA, MERIS or MSG. Several aerosol and cloud products are generated daily at CGTD/ICARE.

5.2. OBJECTIFS DU PROJET PAR RAPPORT À L'ÉTAT DE L'ART ET LIENS AVEC LA SNRI/ OBJECTIVES OF THE PROJECT COMPARED TO THE STATE OF THE ART AND IN RELATION TO THE SNRI

5.2.1 PRESENTATION SCIENTIFIQUE DU PROJET DE RECHERCHE/ SCIENTIFIC PROGRAMME

To map and characterize chemically, physically and optically the relevant atmospheric components, to retrieve the aerosol size distribution and chemical composition, to discriminate the anthropogenic component, and to estimate the impacts on radiation and particulate matter, we need **orchestrated**

observations of aerosols, precursor trace gases and clouds, which requires a multidisciplinary approach. The present project gathers the necessary skills. The four laboratories or teams are associated to three different CNRS institutes (INP/LPCA, INSIS/PC2A, INSU/LOA/ICARE-CGTD) and have expertise in complementary fields as reported in sections 4.1.1 to 4.1.4.

We have to bridge the gaps between the different scales, from microscale in laboratory to mesoscale for satellite, from seconds to days depending on the chemical and physical process. From our understanding of the evolution of the chemical, physical and optical properties of aerosols through mixing process or reactivity at small scales, simple parametrizations will be derived and their validity checked by comparison with satellite and in-situ observations. The development of the parametrizations will require to select actual situations where a given process prevails, which requires long series of observations and global coverage. The methodology is challenging but with past and future observations, we will have the capability to sample very different meteorological conditions, usual as well as extreme aerosol situations over a wide area.

We envision an array of measurements at several temporal and spatial scales:

- Laboratory-generated model particles for relating the composition, the aging, the hygroscopicity to the optical properties.
- Surface networks and devoted ground stations that continuously measure in situ and remotely the aerosol physical and chemical properties, the vertical distribution and concentration, the distribution of solar radiation and clouds.
- Dedicated field campaigns that concentrate the measurement capability in a given region for a limited period of time, and help to understand the aerosol and gaz sources and the aerosol and cloud processes.
- Global and daily satellite observations of aerosol and clouds for deriving a 3D description of their chemical, physical and optical properties.
- The use of models, from local to regional scale, with detailed aerosol and cloud chemistry and physics. The development of transport or climate models is out of our fields of expertise and is not relevant for our project. Nevertheless, modelling activities developed elsewhere will benefit from a better understanding of the aerosol-gas-cloud interaction processes, the estimate of the strengths and localization of aerosol sources and a better knowledge of the radiative parameters.

Hereinafter, we have identified several issues and reported them into WP's. **The two first WP's are very detailed and are considered as the first priorities. Although several methodologies** (experimental setup, mathematical tools, modelling) **will be specifically developped for the project, we believe that the objectives can be achieved in the four first years.** We have a clear view of the procedures that we will have to put in place and we do not anticipate

breakdowns that cannot be overcame. **Parts of the WP-3 can be considered as an on-going activity (networking, data processing, etc) but are essential to the success of the project.** In addition to these operational aspects, we will apply **improved procedures for satellite (and AERONET) inversions** and will **deploy innovative instrumentation for a 3-D description of the atmosphere in a given area**. Ultimately, we have also **two longer-term (5-10 years) objectives (WP-4 and 5) that are foreseen as more "risky"**. They concern the aerosol indirect effects and hazard of chemical substances like iodine-based aerosols.

WP-1: Aerosol physical, chemical and optical properties
Leader: Christa Fittschen/PC2A. Co-leader: Yevgeny Derimian/LOA
Laboratory measurements are the only means to fully characterize the aerosol chemical composition and structure, used to derive the aerosol refractive index, single scattering albedo, radiative properties and hygroscopicity. Laboratory measurements will be conducted to generate a database, from which the optical properties of different aerosol types (considering mixing, reactivity, coating, aging) and in varying meteorological conditions will be derived. Then, the relationship between remotely sensed optical properties and the physiochemistry of various aerosol components will be established.

From laboratory studies:
The optical properties of aerosols that influence the direct radiative forcing depend on their chemical composition, their hygroscopic feature and on physical characteristics such as their morphology. In addition chemical composition of aerosols can result from a complex mixture leading for example to a core coated by adsorbed material, which can be organic, inorganic or both (Abo Riziq et al., 2008). The way the mixture of aerosols has been formed is also important. Indeed solid black carbon (BC) which is less soluble than most aerosol components and relatively inert has been found to be a stronger absorber when it is internally mixed (Chung, S. H., et al., 2002).
Depending on their size, airborne particles can be transported over large distance (from 10 kms to 10^3 kms) and cross different air masses. Size, morphology, chemical composition and optical properties of the particles can be strongly different along this aging phenomenon.
In this project three research teams well recognized for the quality of their research for developing highly sensitive and selective spectroscopic techniques, and for studying kinetics of homogeneous and heterogeneous reactions occurring in atmospheric chemistry or combustion gather their competences to improve the knowledge of aerosol impact on radiative forcing in conjunction with the LOA team. The new approach, proposed in this project, aims to study the joint effects of the nature of the particle (covered or not by a coating), of its reactivity, of its hygroscopic feature and of its aging on the aerosol optical properties. **A three step process will be applied.**

- First different kinds of aerosol will be prepared, namely laboratory generated quasi-spherical aerosols, synthesized black carbon aerosol and

more representative atmospheric aerosols like sea salt and soot particles issued from combustion processes available at the laboratory PC2A (Delhay et al., 2009, Desgroux et al., 2008, Lemaire et al., 2009, Mercier et al., 2008). Particularly soot particles consist of fractal-like aggregates for which interaction with electromagnetic wave is very complex and difficult to implement in the codes. Due to their surface composition and complex morphology, the reactivity and hygroscopic characteristics of soot particles are quite different from BC synthesized particles (Salgado et al., 2002). This raw material will be possibly covered or mixed with different compounds representative of atmospheric components and which might alter their properties (Abo Riziq et al. 2008). Monodispersed aerosol of various size ranging from a few nm to a few mm will be selected from the obtained polydispersed aerosol using a differential mobility analyser (DMA).

- The monodispersed aerosol will undergo a panel of reactions occurring in the troposphere with representative atmospheric oxidant like OH and HO_2 radicals, halogens radicals (X, or OX avec X = Cl, Br or I) and VOC with strong dipolar moment (like H_2CO, HCOOH…). Special care will be focussed on water uptake by aging particles in various relative humidity (RH) conditions (George et al., 2010, Vesna et al., 2008). Particularly hygroscopic growth factor will be measured by HTDMA (hygroscopic tandem differential mobility analyser). The kinetics of the heterogeneous reaction aerosol+gaz will be studied in an aerosol flow tube (AFT) equipped with highly sensitive techniques to determine both the composition of the gas phase and the characteristics of the aerosol (see below). At this stage the project will benefit from the unique expertise of PC2A laboratory to measure HOx radicals by cavity ring down spectroscopy (CRDS) absorption, and particularly using Fluorescence Assay by Gas Expansion (FAGE) technique (Parker et al., 2010, Thiebaud et al., 2006) and from the potentiality of THz spectroscopy available at LPCA (Bigourd et al. 2007). Data on the aerosol reactivity will serve for further implementation in the codes. Furthermore variations of the aerosol morphology will be also explored by microscopy (TEM) taking advantage of the available platform available at University of Lille1 and whose capacity and performances should be increased through the EQUIPEX project META.
- The optical properties of aerosol particles will be determined using the simultaneous combination of CRDS and light scattering detection in a devoted analysis chamber coupled at the exit of the AFT. The chamber might be inspired from the one developed by Dial et al. (Dial et al., 2010). These techniques will provide the total cross section for extinction of light by scattering and absorption (s_{ext} = s_{scat} + s_{abs}) from which the single scattering albedo (ω= s_{sca} /s_{ext}) will be derived. Mie scattering theory will be used for validation. Expertise of PC2A in laser diagnostics for soot detection by Laser Induced Incandescence (LII) and CRDS in flames (Desgroux et al., 2008) will serve the project. In addition laser induced incandescence (LII) will be originally applied on aggregate soot particles to

determine the size of the primary soot particle from time-resolved LII measurements (Eremin et al., 2006) and the relative spectral absorption of the particle (Therssen et al., 2007). Combination of these techniques offers a unique opportunity to scan the optical properties of a large panel of aerosols. Radiation sources covering a wide spectral range (like optical parameter oscillator (OPO)) will be selected.

Also, **a great challenge in this third step is to use THz radiation**, well suited to probe media with a large concentration of aerosols in order to bring a relevant characterization spectroscopic in the Far Infrared. Up to now, such project have been realised in the IR and give access to the extinction properties of different kinds of aerosols by probing localized vibrational modes (Sigurbjornsson et al., 2009). No similar approach has been proposed in the THz domain despite its great potential. Indeed, the aerosol may be studied as a complex molecular systems containing clear signatures in the THz range such as intermolecular large amplitude vibrations, characteristic of the structure and the dynamics of the molecular system. THz Time Domain Spectroscopy developed at the LPCA will be used jointly with Far Infrared Fourier Transform Spectrometer in the AILES beamline of the SOLEIL synchrotron.

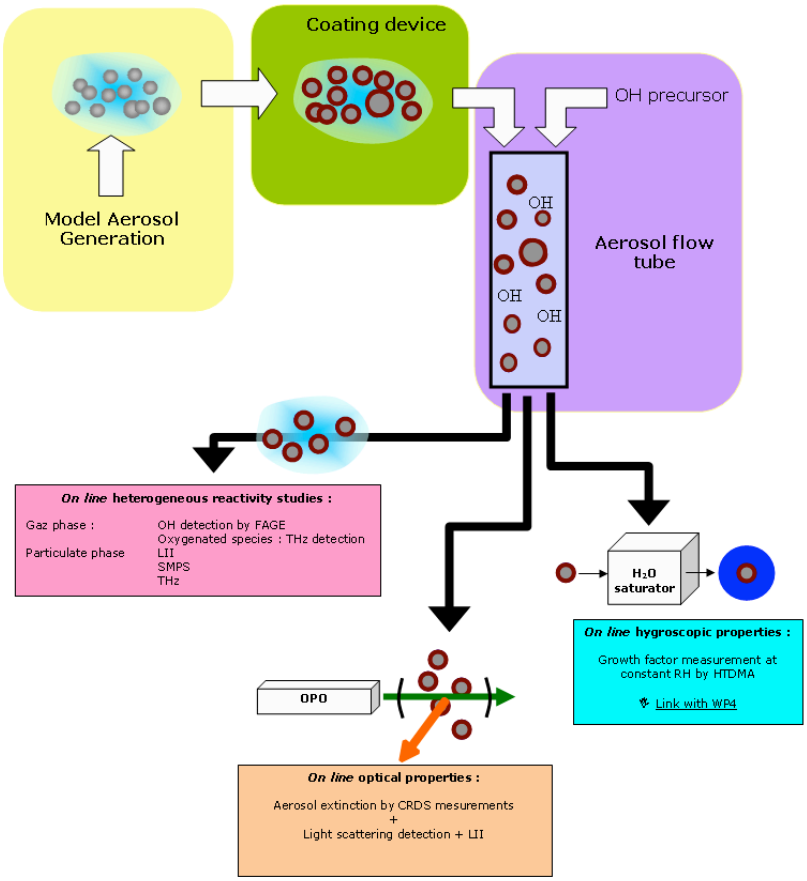

Figure 2 : Experimental set-up dedicated aerosol physical/chemical/optical properties

Finally the complete methodology will allow to provide optical properties of aerosol particles (single scattering albedo, refractive index) as function of crucial physical and chemical parameters : incident radiation wavelength covering partly the range of observation instruments used in WP-2, size, chemical composition of the coating, hygroscopic feature and aerosol aging. Such a detailed knowledge will also be determinant to understand the links between these parameters and their induced effects on aerosols. The experimental methodology developed in this WP-1 will be in strong interaction with that one of WP-4 (aerosol and cloud interaction). Finally we can anticipate that representative global models of aerosols incorporating pertinent parameters could be formulated.

From remotely sensed data

The AERONET network (see WP-3) of sun-photometers and sky radiance radiometers (Holben et al., 2001) is very suited to reliably and continuously derive the aerosol optical properties in multiple locations (Dubovik et al., 2002) but requires sophisticated inversion methods to derive the physical (refractive index, size and shape) properties and composition of the aerosols.

Specifically we will use the rigorous physical model suggested by Shuster et al. [2005]. It allows **calculation of spectrally dependent complex refractive index considering aerosol particle as a mixture of several chemical components.** It computes the complex refractive index based on the assumption that aerosol particles are homogeneous particles composed by internally mixed components (see illustration in Fig. 3). **The optical properties of the aerosol particles are calculated using Maxwell-Garnett approximation**. The model is driven by only few parameters describing BC (Black Carbon) content, liquid water content and ratio soluble to non-soluble components.

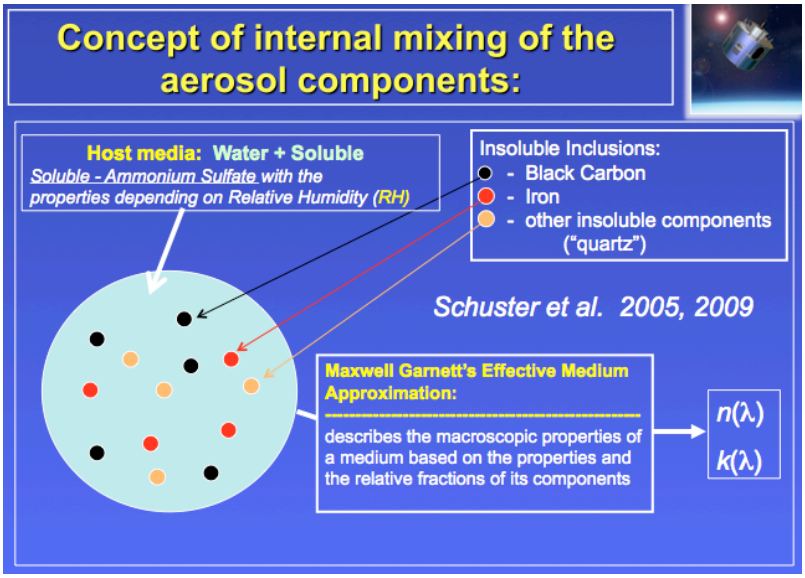

Figure 3 The illustration of the approach for modeling complex refractive index using the rigorous model describing the optical properties of the mixture of the actual chemical components of the aerosol.

Using such model one can derive valuable information about aerosol chemical composition using complex refractive index retrieved from AERONET observations. Thus, the aerosol single scattering model is driven by the following parameters:

- $dV(r_i)/d\ln r$ – aerosol size distribution in the atmospheric column given in N_i size bins;
- $n(\lambda_i)$ and $k(\lambda_i)$ - real and complex parts of the refractive index given at a wavelength λ_i;

and by combining the different components of the aerosol mixture (internal or external mixing, coated, hygroscopicity). Let us mention that the method allows accounting for aerosol particle non-sphericity.

Different categories of aerosol types associated to different sources and emission mechanisms will be sampled. The selection will be based on significant differences observed on the optical properties. We plan to first focus on (i) urban/industrial aerosol from fossil fuel combustion in populated industrial regions, (ii) desert dust blown into the atmosphere by wind and (iii) aerosol of marine origin by using the full data sets (see WP-3) measured in our ground-based stations (Dunkerque and Lille, France ; M'Bour, Sénégal). Then, in a second step, we will study biomass burning aerosol produced by forest and grassland fires but it will require to enhance the measurements performed in a suitable AERONET station.

The outcome of the WP will be:

- ***to generate a database of optical properties for different types of aerosols in varying conditions,***
- ***to deliver a chemistry driven module derived and validated by laboratory measurements and compared to the properties derived from remotly sensed data.***
- ***to provide important additional physical constants on the spectral dependence of aerosol complex refractive index and the resulting single scattering albedo,***
- ***to link the chemical composition of the aerosol to its radiative properties for several aerosol components.***

WP-2: Inverse modeling from satellite observations for improving aerosol sources and evolution along transport.

Leader: Oleg Dubovik/LOA

The influence of aerosol pollution on regional and global distribution of tropospheric aerosols and associated effects on air quality, atmospheric radiation balance and climate requires detailed knowledge of spatial distributions of aerosol and their dynamics. When the use of chemical transport models is required, their accuracy is limited due to the uncertainties in location and strength of aerosol emission sources.

The development of new inverse modeling algorithm intends to tune chemical transport models by the global satellite aerosol data and to derive/correct the global sources of atmospheric aerosols. This approach compares the model outcome with the real observations at large space and time scales and corrects the least known model parameters (e.g. aerosol or gas sources and sinks) relying on better-known model components (e.g. meteorological fields, advection and diffusion processes, deposition) (Fig.4). Inverse modelling may correct the source magnitudes and location by providing the best agreement between used satellite observations and available a priori and ancillary information about aerosol sources. Thus, inverse modelling ties the model to the actual observations and therefore is one of most promising ways of improving model performance. However, the inverse modelling is a research domain that is still under development, especially its applications to atmospheric aerosol (e.g. see conclusions of WMO Technical Report by Tegen and Dentener [2006]). Indeed, while the inverse modeling of atmospheric trace gases has been established and rather commonly used, the atmospheric aerosol has generally higher temporal and spatial variability than gases and its properties are characterized by a larger number of parameters (including particle size, shape, composition, etc.), which explains the fact that there are only few studies discussing application of an inverse modelling approach for atmospheric aerosol [e.g. Hakami et al. 2005; Henze and Seinfeld, 2006; Huneeus et al.; Dubovik et al. 2008;]. In addition, if the satellite data do not display enough sensitivity to separate aerosol type, that lack of the information do not allow the separation between emissions for different types of aerosols.

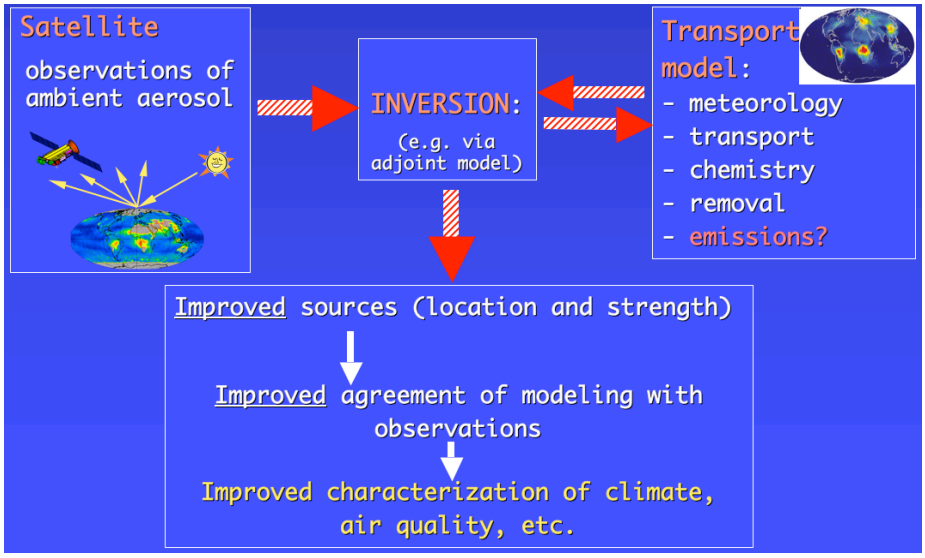

Figure 4: Illustration of the approach of using inverse modelling for improved characterization of climate and air quality.

Our objective is to **apply the adjoint to global aerosol transport model (GOCART) already available (Dubovik et al., 2008) to the PARASOL satellite data**. The polarimetric observations (as those by POLDER) provide sensitivity to aerosol parameters such as composition (via sensitivity to refractive index), shape (spherical particles or not like dust), size (Herman et al., 2005; Dubovik et al., 2010), which allows to identify the aerosol type. **The study will here benefit from the results of WP-1.** In addition, PARASOL can simultaneously derive the surface reflectance (that is a problem in the visible) and have higher sensitivity to aerosol absorption. Our project will gain from other satellite sensors available at ICARE/CGTD (see WP-3) such as CALIPSO and its lidar for vertical aerosol distribution or SEVIRI observations for the diurnal cycle (data acquisition every 15mns) at regional scale. We will verify consistency of the satellite observations with ground-based AERONET data and devoted field experiment. In a second step, the inverse modeling algorithm could be developped for the MESO-NH or LMDzT-INCA models that are used by the french modelling community.
Thanks to its involvement in several satellite missions, A-train (http://aqua.nasa.gov/doc/pubs/A-Train_Fact_sheet.pdf), Metop (Clerbaux et al., 2007 and 2009), ACE (Coheur et al., 2007), GOSAT, LOA has also the **capability to provide « operationnal » and « research » products related to gaz aerosol precursors**. Sensors, like IASI or ACE-FTS, have been efficient for detecting several atmopheric components such as (SO_2, NOx, COVs…) that play an important role in atmopheric chemistry and, as a result, in the aerosol cycle. We intend to merge the satellite data of IASI into chemical reactivity models and laboratory measurements to apprehend the atmospheric response to

pollution events or specific meteorological situations. For instance, the global distribution of Ethylene (C_2H_4) within the upper troposphere/lower stratosphere has been obtained from ACE-FTS spectra (Herbin et al., 2009). Through the analysis of the seasonnal variations, biomass burning activities have been identified as the main contributor but its presence around the North pole in winter time is inconsistent with the expected life time (hours to few days) of this gas species. **Comparison between model outputs and observations is a powerful tool to point out the shortcomings of the processes involved in the aerosol generation by precursors**. The water vapor amounts can be also retrieved ; we will study if the transport patterns of aerosol optical thickness and precipitable water vapor are consistent and if the increased aerosol extinction is associated with hygroscopic growth of aerosol particles.

The outcome of the WP will be:

- ***deriving improved global aerosol emissions sources,***
- ***estimating aerosol effects on climate,***
- ***identifying aerosol emissions hotspot dominating aerosol pollution of Europe (when SEVIRI/MSG is considered),***
- ***utilizing aerosol satellite observations as a tool for improving accuracy of aerosol modelling,***
- ***providing the results on the derived aerosol emission to the modelling community.***

WP-3: Aerosol observations: Instrumentation and intensive field campaigns – Monitoring from networks and satellites.
Leader: Hervé Delbarre/LPCA. Co-Leaders: Jacques Descloitres/ICARE and Philippe Goloub/LOA

The WP will be devoted to the *in-situ* (in its broadest sense, including remotely data) observations:

- to build a data base of categories of key aerosol types associated to different sources and emission mechanisms from AERONET,
- to establish from field campaigns the relationship between remotely sensed optical properties (needed to quantify the regional forcing) and the physiochemistry of various aerosol components and the atmospheric dynamics,
- to analyse the present aerosol-cloud satellite imagers including mainly PARASOL/POLDER, CALIPSO/CALIOP, AQUA/TERRA in reference to aerosol parameters. The SEVIRI/MSG geostationary satellite will be also considered since it provides images of Europe and Africa with a high temporal sampling which permits the monitoring of aerosol transport. Observations from IASI or ACE-FTS for the gas component will be included.

We also intend to develop new measurement capabilities such as compact instrumentation on-board drones or multi-wavelength Raman lidar.

Network: Long-term, time-series data sets of aerosol chemical, physical and optical properties are of great value to modelers and experimentalists to understand the effects of aerosols on climate and air quality. For example, the AERONET network of sun-photometers and sky radiance radiometers (Holben et al., 2001) is very suited to reliably and continuously derive the aerosol optical properties in multiple locations. **General categories of aerosol types with distinctly different optical properties have been derived from AERONET (Dubovik et al., 2002). They are associated to different sources and emission mechanisms:** (i) urban/industrial aerosol from fossil fuel combustion in populated industrial regions; (ii) biomass burning aerosol produced by forest and grassland fires; (iii) desert dust blown into the atmosphere by wind; and (iv) aerosol of marine origin. They clearly exhibit significant differences in optical properties that drive the aerosol radiative forcing. **In addition to column integrated aerosol optical properties, vertical distribution of aerosol is necessary** for understanding long range transport as well as cloud-aerosol interaction. Strategically placed network sites are able to provide observations with time-continuity. For instance **LOA has two lidars acquiring data operationnally in M'Bour (Sénégal) and in Lille.** Inversion of simultaneous AERONET and Lidar will provide information on the vertical distribution at relevant scales.

Satellite: **Various satellite data sets are acquired to support characterization and monitoring of aerosols and their precursor gases**. Data are archived at the ICARE Data and Services Center. Some of the required data sets are part of ICARE existing operations already, namely aerosol products from various sensors (PARASOL, MODIS, OMI, MERIS, SEVIRI), while some others will be specifically acquired in the framework of this project, such as concentrations of selected gases and atmospheric components (OMI, IASI, GOSAT). Building on ICARE's experience, various tools will be developed to facilitate comparison and combined use of airborne and ground-based measurements with satellite observations.
Separately, we expect to achieve the **development of new algorithm for enhanced retrieval of aerosol properties from POLDER/PARASOL observations that will derive reliable information about detailed aerosol properties including aerosol sizes, absorption, and, possibly, shape, elevation and composition (refractive index) as required by the project**. The retrieval will take into account time and space correlation of aerosol and surface properties. For using it operationnally, it will require new computer capabilities that are presently not available at the ICARE/CGTD.

Field campaign: We intend to observe the spatial and temporal variability of aerosols in the lower layers of the troposphere and to study the exchange of aerosols according to atmospheric dynamics (stratification, stability, turbulence, weather ...). We will develop an **optical instrument for extinction measurement, by using a photoacoustic spectrophone (Lack et al., 2006; Havey et al., 2010; Rossi et al., 2005) compact enough to be mounted on**

a drone (Kosterev et al., 2002; Liu et al., 2009). **In field campaigns, this instrument will be deployed for getting extinction in the boundary layer, and coupled with lidar observation to extract extinction and backscatter profiles without any previous assumption.** The field campaigns will be selected in order to explore various pollution schemes (likely urban and industrial) and meteorological conditions with a focus on transitional periods where atmospheric features change significantly. **The experimental approach will be strengthened by a modelling of atmospheric dynamics**. Numerical modelling is a powerful and complementary tool for studying the aerosol distribution, which is related with the hydrodynamic parameters such as temperature, humidity and wind speed simulated by the model. We are going to use non-hydrostatic MESO-NH nested numerical models, to simulate the atmospheric dynamics at ranges from tens of kilometers (synoptic scale) up to hundreds of meters (large eddy simulation). Moreover, the **model version including chemistry coupling (MESO-NH-C) with the integrated aerosol module can consider the microphysical processes of aerosols formation and transformation.** For proper aerosol description, the local atmospheric phenomena, which contributes a lot to the atmospheric dynamics and stratification, should be taken into account, such as night jets, sea, land, mountain and valley breezes and others.
Concerning vertical aerosol distribution, **multiwavelength (Polarized & Raman) lidars have demonstrated their potential to profile particle parameters**. With this information, microphysical properties of aerosols can be retrieved like the particle size distributions or aerosol shape at different altitudes (Veselovskii et al., 2010). The instrument will be built through existing collaborations.

The outcome of the WP will be:

- ***to compile a data base of categories of key aerosol types with distinctly different optical properties***
- ***to pursue and complement long-term operational ground-observations,***
- ***to study forcing and atmospheric chemistry at regional scale,***
- ***to develop tools for easy comparison of satellite, model and in-situ data***

<u>WP-4: Aerosol and cloud interaction - Hydrologic cycle</u>
Leader: Pascale Desgroux/PC2A. Co-leader: Frédéric Parol/LOA
Cloud formation and its liquid water content are determined predominantly by large scale processes; however, the cloud droplet or ice crystal concentration is driven primarily by the concentration and properties of aerosol particles that act as cloud condensation (CCN) and ice nuclei.
A larger concentration of nuclei produces a larger concentration of droplets, which for a given liquid water content requires smaller droplet size. This aerosol effect on cloud microphysics usually results in more reflective clouds and is called the *first aerosol indirect effect*. The smaller droplets slow the coalescence

process, requiring stronger convection to reach the precipitable droplet size, thus delaying or preventing the development of precipitation, which is called the *second aerosol indirect effect*.
The effect on the microphysics and radiative properties of a cloud due to polluted air is poorly characterized and the effect of aerosols on precipitation is even less well understood. WP-4 will be devoted to the study of the first indirect effect for specific ice-phase clouds and of the second indirect effect for liquid-phase clouds. **The outcome of that WP will not be summarized by deliverables, we underline in the last paragraph of each section the difficulties we have to first overcome to succeed.**

Cirrus, contrails and aircraft emissions
Aircraft engines emit CO_2 , water vapour, NOx, sulfur compounds, and soot in the atmosphere. At present, the impacts of trace-gases on the atmosphere and thus on climate are very weak due mainly to the young age of commercial aviation in the history of the industrial world. **Aerosols, for their part, are emitted in such small quantities that their direct effect on the solar and infrared radiation is negligible. However their indirect effect on clouds may be more important.** Thus jet aircraft flying at high altitudes often produce a cirrus-like trail of condensed vapour called a condensation trail or *contrail* that represents the most visible and perhaps most important effect of aircraft engine emissions on the atmosphere. The condensation may come directly from the water vapour added to the air from engine exhaust. In this case, there must be sufficient mixing of the warm gases with the cold ambient air to produce saturation. However, the release of aerosols in the exhaust is strongly suspected to provide nuclei on which ice crystals form. Contrails evaporate rapidly when the relative humidity of the surrounding air is low. If the relative humidity is high, contrails may persist for many hours and can evolve towards persistent cirrus-like clouds. Aircraft contrails can coexist with older trails that evolve over hours to cirrus clouds, until they become indistinguishable. **Consequently aircraft traffic may modify the global and regional cloud amounts and contribute to radiative forcing**. Contrails may also form by a cooling process. The reduce pressure produced by air flowing over the wings causes the air to cool. This cooling may supersaturated the air, producing an aerodynamic contrail. Nevertheless, this type of trail usually disappears quickly in the turbulent wake of the aircraft. If the thermodynamic conditions necessary for the appearence of these condensation trails are relatively well understood, their microphysical properties and finally their impact on radiation budget and on climate are currently under investigation.

In France, the « Réseau Thématique Aéronautique et Environnement » (RTAE) du COnseil stratégique pour la Recherche Aéronautique Civile française (CORAC) has been asked to encourage research related to contrails induced by aeronautic traffic. **PC2A is one of the leading groups of the RTAE because of its experience in soot monitoring at the exit of aircraft engines by laser induced incandescence (Delhay et al., 2009). In 2010 it has coordinated**

a working group elaborating tasks aiming to study the influence of soot characteristics on the nucleation rate of ice. From this experience it is proposed here to associate PC2A, LOA, and CGTD in a long-term project devoted to the determination of optical properties of ice crystals of various geometries and composition by combining experimental, observational, and modelling approaches. **One part of the project will involve a complex experimental part consisting in a reactor, maintained at very low temperature, and in which a selected aerosol will be injected.** The atmosphere inside the reactor will be of variable humidity and possibly reaching supersaturated water conditions. The reactor will be designed in such a way that ice crystals will be formed dynamically thanks to the aerosol presence. The reactor will be equipped with optical access allowing the optical techniques developed in WP-1 to be applied. It is expected that scattering/extinction data from different types of crystals will be obtained.

In the 1990's the LOA has developed a remote sensing bispectral technique in order to identify thin cirrus clouds from space and to derive some of their optical and microphysical properties (optical thickness, infrared emissivity, range of particle size). The method is based on the differences that exist between the spectral extinctions at two wavelengths in the thermal infrared window (8-14 µm) (Parol et al., 1991 ; Giraud et al, 1997). **Further analysis of infrared satellite data has highlighted the important difference between natural thin cirrus and jet contrail microphysics.** In their study, Brogniez et al. (1995) show that **contrails are revealed to be composed of much smaller equivalent spherical particles than natural cirrus**. These results had been obtained using simple microphysical models (spheres, cylinders) but the LOA has recently developed more sophisticated **models of ice particle built from randomly oriented hexagonal ice crystals containing air bubbles or soot (IHM model).** Analysis of ADEOS-POLDER measurements over cirrus clouds have shown a rather good agreement between measurements and calculations using this new approach (C.-Labonnote et al, 2000 ; C.-Labonnote et al, 2001). Now, such a crystal model is used to derive optical and radiative properties of cirrus clouds in the operational "Earth Radiation Budget, Water Vapour and Clouds" processing line for PARASOL-POLDER (Parol et al, 2004).

On one hand, this part of the project will involve the **development of operational method for detecting thin cirrus and contrails** from thermal infrared meteorological and research satellite measurements. The physical basis of the method will be developed and analyzed at the LOA but the operational version of the algorithm will be developed and implemented at ICARE-CGTD. On the other hand **free parameters of the IHM model will be adjusted in order to match the optical parameters of different types of crystals determined by the experiments undertaken at the same time at PC2A.** Thus adapted IHM models or more sophisticated derived models will be used to quantify the radiative forcing of contrails at regional and global scales from large satellite database collected by ICARE-CGTD. In addition, **influence of structural parameters of contrails and cirrus clouds will be evaluated and compared by using dedicated 3D radiative transfer codes** (see Cornet et

al, 2009 for example). Finally, radiative transfer codes developed at the LOA (Dubuisson et al, 2006) will be adapted to make as fast as possible the calculation of additional radiative forcing induced by contrails in the shortwave and the longwave spectral domains for large satellite database.

This is a challenging part of the project that aims to make the link between the formation of ice crystals from aircraft engine exhaust, the measurement and the modelling of optical properties of induced ice crystals, and finally the calculation of additional radiative cloud forcing in the shortwave and in the longwave by accounting for microphysical and macrophysical properties of observed contrails and cirrus at large scale.

Aerosols and precipitation

As already underlined, by acting as heterogenous nucleus, aerosols control the formation of cloud droplets at low and mid-altitudes and of ice crystals at higher altitudes, by water vapour condensation. Subsequently, precipitations initiated by droplet coalescence and snow by ice crystals collection, can be affected by the presence of aerosols. Indeed, one can expect that if cloud droplets present a small-variance in their size distribution spectrum (SDS), fall velocities would be quite similar and coalescence not favored; on the contrary, with a spread SDS, fall velocities are very different and then raindrop initiation by coalescence should be more efficient (Pruppacher and Klett 1997).

There are several questions to first answer before relating changes in precipitation patterns to the presence of aerosols and to **establish the mechanisms by which precipitation can be inhibited or enhanced**:

- What **kind of aerosols contributes to significantly modify the physical characteristics of clouds**?
- **Do maritime particles impact precipitation differently than continental aerosols?** Some studies (e.g. Zipser et al. 2006) tend to show that continental convective and maritime systems differ for dynamic and topographical reasons. Lightning, which is most frequent over continents than over ocean (Orville and Henderson 1986, Christian et al. 2003), is a clear indication of such differences, can the different aerosol types explain these differences?
- Correlatively, **precipitations are essential for the aerosol evolution since they are an efficient way to "wash" the atmosphere and decrease aerosol concentrations.** At the present, it is assumed that the aerosols are totally dissolved in hydrometeors, so the concentration is equal to zero after a precipitation event. This question needs to be adressed more deeply: for instance, do aerosols dissolve completely inside a raindrop ? What are the aerosol types that are not well dissolved because of low electromagnetic interaction with water molecules? **What is the aerosol concentration along the atmospheric column after a precipitating event?**

Studies of cloud-precipitation-aerosols "interactions" are difficult to carry on

since many parameters and processes are involved : seasons, latitudes, topography (sea, mountain, plains, ...). They require large data set in order to make meaningful statistics.
In the context of the LABEX project, we plan to **investigate possible correlations between SDS of cloud droplets and the presence of aerosols surrounding the cloud**. Specifically, our study will first focus on the methodology that needs to be elaborated to succeed. In particular, the **availability as well as the accuracy of the present measurements will be investigated**. Precipitation are studied by radars since microwaves penetrate inside the meteorological target. Lots of data are available, as for instance the US-Nexrad radar network which provides freely S-band radar data of ground-based observations of high quality and the TRMM data center for spatial observations. Microwave radiometric measurements are also of prime importance for cloud property retrievals, in association with infrared radiometer for temperature data.

Observations, sources and quality of data will be our first concern as well as the numerical simulations that are relevant to our analysis. In a second step, consequences on precipitation (nature, extent, etc) will be investigated but we do not expect conclusive results in a short time period.

WP-5: Hazard and Aerosols- Dispersion and deposition of radionuclides in the atmosphere.
Leader: Jean-François Pauwels/PC2A
The "source term" describes the quantity of **radionuclides that can be accidently released to the environment** in case of severe accident in a nuclear power plant. Extensive R&D programmes have been operated worldwide to analyze all possible accidental sequences and corresponding type, amount, release kinetics but also **chemical and physical forms of released radionuclides**. The release duration can be long (up to several days) and the characteristics of the release will strongly vary during those days. **Once released to the environment the evolution of all those radionuclides characteristics has to be determined to evaluate their impact on both human health and ecosystem**. Radioactive material accidentally released from a nuclear power plant will be either under gaseous form or aerosol form and also under various chemical form with clearly different impact. As an example, organic iodine which is released under volatile form will majorly contribute to the human dose at short term due to its short-lived ^{131}I isotope. At contrary long-lived isotopes of cesium that is mainly released under aerosol form will lead to a long term contamination of the environment and will contribute to the human dose by different pathways for years. As a sum-up, to predict the contaminating impact on both ecosystem and human metabolism of an accident on a nuclear power plant, one has to be able to determine the evolution in time of the characteristics of the released radionuclides, not only their decay rate and energy but also their physical and chemical behavior. On this last and essential issue,

the nuclear problematic clearly join the "classical" atmospheric pollutant problematic of this proposal. For emergency preparedness and management, nuclear technical safety organizations have developed monitoring systems and predicting tools and on both those issues they will found clear interest in what will be developed to analyze the aerosol cycle from the time is has been emitted to the time it will be deposited including the determination of the evolution of its characteristics. The French TSO, the "Institut de Radioprotection et de Sûreté Nucléaire", already collaborates with the PC2A laboratory in what concerns the experimental and theoretical modeling of radionuclide chemical behavior inside the nuclear power plant during a severe accident. IRSN has developed a numerical simulation platform able to simulate the transport of radionuclides in the atmosphere and their deposit from the short distance of the plant to the continental scale. All the physical processes of interest are modeled for the aerosols in this platform (including the decay rate) but it lacks for model for the coupled physical and chemical processes that will change the radionuclide characteristics. **Modeling of the chemical transformations of radionuclides by interaction with the other atmospheric species (dust, pollutants, photolysis products) is a very interesting extension for this proposal.** A key issue for this item is the reactivity between a gaseous radionuclide and an airborne particle; indeed gaseous species can be captured and transported by particles and chemical species can also react at the particle surface leading to possible release of another gas of different characteristic. Considering again the iodine example, molecular gaseous iodine will certainly react with the carbonaceous aerosols and the behavior of the iodine oxide aerosols must also be determined. A question to resolve is the possible atmospheric formation of organic iodine species of higher health impact than the ones that are directly released from the plant.

A second issue if the **assessment of experimental techniques to characterize the radionuclides and their evolution in the atmosphere at different scales, from the local scale near the release to much larger distances**. Those experimental techniques are also the subject of important developments by the main TSO and are used to validate the simulation tools and to propose and improve emergency monitoring systems. IRSN has an important experience in experimental characterization of atmospheric dispersion, dry and wet deposition of gases and aerosols in the environment including the measurement of pollutants released in the atmosphere (sea-atmosphere transfers, size distribution of aerosols, chemical speciation of gases…), the experimental quantification of aerosol dispersion versus meteorological parameters, particle size, topography in rural and urban environments; the experimental quantification of gas, aerosol dry and wet deposition as a function of turbulent parameters, aerosol size, substrate in rural and urban environments. **Clearly on this second issue both communities will benefit from additional exchanges and as a TSO, the IRSN is interested in the techniques that will developed and assessed as mentioned in this proposal**.

5.2.2 VALORISATION, TRANSFERT ET EXPERTISE/ EXPLOITATION OF RESULTS, TRANSFER AND EXPERTISE

This component of our project will be declined through the implementation and monitoring of various types of actions around: (i) the scientific communication and dessimination, (ii) the valuation of expected results, (iii) the scientific, technical, industrial, and economic impacts of the LABEX activities, (iv) the potential impact in term of expertise, support to the public policy and participation in public debate.

5.2.2.1 - Scientific communication and dissemination

Today, laboratories and teams that support the LABEX CaPPA already participate actively to numerous actions of dissemination of scientific information, at several levels ranging from broadcasting to the general public to education for students through science communication (publications in peer reviews and papers at conferences and workshops). The CaPPA partners intend to diversify this action also by orienting towards industry and business.

We propose to set up regularly **(once every two years) an "Atmosphere week" event dedicated to the atmospheric environment which will present laboratory activities to the general public during a devoted "open laboratories" short period.** These events will be organized with our academic institutes and the Regional council. However, at the request of colleges or schools, visits of laboratories, technical platforms and observations of the LABEX, as proposed in Section 5.2.3, will be also an opportunity to present the activities of LABEX to the pupils and students. In our project, communication and dissemination of scientific knowledge to students is clearly based on courses and our contribution to the training of PhD students (see Section 5.2.3) but also on the reception of foreign students for co-supervised PhD thesis. Our laboratories are currently already hosting students from Biellorussie, Romania, China, Japan, Korea, Spain and Ukraine.

The main results and milestones from LABEX activities will be disseminated through the popular science journals and websites of our academic partners (CNRS, INSU, INSIS, ...) and national or regional agencies (ADEME, APPA, AFSSET, ...) working in the field of environment. Several members of the LABEX regularly lead lectures and debates in the field of climate change, air quality and pollution, the contribution of satellite remote sensing to study climate, aerosols, in secondary schools, or for various associations such as the "University of Free Time", or in scientific forums such as the "Forum of Science" in Villeneuve d'Ascq. In this project, the LABEX hopes to encourage this type of communication to general public which is part of the missions of researchers of academic institute and university.

Communication of scientific results to the academic world in european and international level will mostly go through publications in peer journals and international conferences. Currently about 60 papers are published each year in peer journals in the fields of climatology, atmospheric science, combustion, physics and chemistry of the atmosphere, etc. (see section 7.2).

The LABEX intends to intensify its communication to industry and companies by writing a newsletter specifically designed for business and local communities (once per year for instance).
A flyer, a brochure and a website for the LABEX will be quickly built to highlight the LABEX activities to the different types of audience mentioned here-above. In order to develop all these actions, the LABEX proposes to create a small internal communication service that will be supported by and connected to existing communication services from the universities, PRES ULNF, and CNRS.

5.2.2.2- Valuation of expected results

Different types of activities developed within the LABEX may lead to patents, as it has sometimes been the case for the partners of the LABEX (see section 4). The filing and management of possible patents will build on the skills implemented within existing structures and in particular those of the PRES ULNF and CNRS. Indeed, the PRES ULNF has decided to group together the existing development structures in a "SATT" (Acceleration of Technology Transfer Company) named "Nord de France Valo". This new structure is being set up in association with the University of Picardie Jules Vernes (UPJV, Amiens) and the University Reims Champagne Ardennes (URCA, Reims).
The development activities and procedures have been organized at regional level, which is the right scale for high level skills to be mobilized and optimized. The organization of the Lille Nord de France Valo Centre provides every researcher in the Nord-Pas de Calais Region with quality service in terms of project engineering, help in drafting projects, the handling on intellectual property, mediation with addressing economic conditions, undertaking market research, and also with contracts or negotiating, confidentiality agreements, licensing, agreements for the provision of equipment, letters of intent, performed for or in collaboration with a private partner.
The SATT, as a unique service centre for researchers and companies, will become a privileged interlocutor for the competitiveness clusters of the Region in terms of the identification of innovative projects and collaborative partnerships.

5.2.2.3 - Scientific, technical, industrial, and economic impacts.

As illustrated in Section 4 of this document the different LABEX's partners are already working in conjunction with several industrial partners. Thus expected research results of the LABEX concerning development of thermokinetics models for 3D simulation codes of industrial processes will be used by industry and private companies (TOTAL, PSA, RENAULT, GDF SUEZ...). The well-known expertise of the LABEX concerning polarized radiometer and space missions could lead to a collaborative project of Microsatellite POLDER follow-on with Astrium EADS in the near future. Preliminary discussions have already begun.
Future developments of instrumental devices (photometers, lidars, radiometers, pollutant sensors) and innovative retrieval methods of optical, radiative, and microphysical properties of atmospherics components will be valuable for companies such as CIMEL and Environnement SA. Our project involves important technical and scientific developments, as well as management of huge

atmospheric and satellite databases that should be for a part operated in close collaboration with engineering companies such as Noveltis (in Toulouse) and Hygeos (in Lille), which already work with the LABEX's partners. Some of our research results will be relevant for EPIC (Industrial and Commercial Public Establishments), like CNES and IRSN, or civil institutions (ONERA, INRETS, IFP, Aviation Companies). Spatial activities supported by CNES will be highly valuated in the framework of the ICARE thematic centre of which two LABEX's partners are components. The project will reinforce the development of collaborations with public and private partners. It will participate to the social and economic development at the regional as well as national scale since it will result in increasing of employments both directly in the LABEX and indirectly through technology transfers towards industries and private companies.

5.2.2.4 - Potential impact in term of expertise, suport to the public policy and participation in public debate

The LABEX proposes to maintain and enhance a variety of actions directed towards monitoring and survey of air quality, pollution, and climate, through its work in partnership with national and regional agencies (APPA, AFSSET) and its strong involvement in national and international observation network (eg PHOTONS and AERONET) and in upcoming national structurations as the SOERE "ORAURE" and the EQUIPEX project SOFRA-EX.

The LABEX will also develop services that aim at making aerosol and cloud products available to a broader user community, including decision makers, businesses and citizens. Some dedicated products will be also delivered to partner decision-making systems that provide a higher level of operational services and integrate products into application-specific services (eg the future European GMES atmospheric service). The nature of LABEX's activities will facilitate direct connections with society. For example, in the framework of the school program "Meteo des Ecoles", teachers and students access ICARE resources (http://meteodesecoles.org/chasseursdenuages_lang.php) to support near-daily cloud observations.

In order to implement actions 2 to 4 of our development project we propose to create a dedicated internal valuation service (See section 6.1.1) that will work in narrow connection with the PRES ULNF and CNRS technology Tranfer services ("Nord de France Valo" mentionned here-above).

5.2.3 ENSEIGNEMENT SUPÉRIEUR, INSERTION / HIGHER EDUCATION, INTEGRATION INTO THE WORKPLACE

The LABEX project will be backed by the commitment of the university teams with five targets: (i) Raising students awareness of the issue of Environment-Atmosphere and their interest in research, (ii) Getting strongly involved in the masters programme, (iii) Internationalization of PhD programmes, (iv) Professional guidance, (v) Self assessment as source of innovation.

5.2.3.1- Awareness of the issue of "Environment Atmosphere" and research

Lecturers and researchers from the teams involved in the project, regularly participate in junior high school events (chemistry ambassadors, animated virtual sciences, "Do Science", Science festival …). They also set up actions for senior high school students (conferences, visits of labs, open doors, placements) and provide tutoring to undergraduate students (transition high school - university, additional classes in some courses) which facilitate the interactions with high school teachers and enable high school students to upgrade their scientific and multidisciplinary cultures and hence to get a better approach of the university system. Those higher education staff are also strongly involved in the organisation of courses in science, technology and health bachelor's programmes in Chemistry (Euro-bachelor label with an A+ evaluation by the AERES) and Physics (A). One of the major strengths of these new programmes are the new courses in introduction to research in the 3rd year, the "research label" to raise students awareness to research and train them to its specific working methods and thought process.

The LABEX partners wish to strengthen this introductory approach to research by creating a thematic workshop "Atmospheric Environment" and a mobile workshop to enable young people to get formation with the techniques of observation, remote sensing, measure of pollutants, reactivity and dynamics of atmospheric components and their impact on the environment, climate and health. Open door days will also be part of the scheme supported by the MeOL platform and the observation services of the LABEX.

5.2.3.2- Strong involvement in the Masters Programmes

The LABEX lecturers and researchers are very strongly involved in the Masters in Physics (A) master-physique@univ-lille1.fr, Chemistry (A) master-chimie@univ-lille1.fr and the Erasmus Mundus. Master in "Advanced Spectroscopy in Chemistry" (ASC) (www.master-asc.com). They are in charge of the "Master of Chemistry" and other courses such as "Chemical Kinetics and Catalysis", "Chemical Engineering", "Atmospheric Environment", "Energetics, concepts and applications", "Molecular spectroscopy" (Master of chemistry), "Physical processes in the atmosphere", "Light and Matter", "Applications of atmospheric and Quantic Optics" (Master of Physics) and "Optical Spectroscopy", "Methodology in Physical Chemistry" (ASC Master). We also coordinate courses in the 2nd year of Masters programmes where we organise the curricula. It concerns the speciality "Chemistry, Energy, Environment" from the chemistry course with responsabilities for the units "Advanced Analytical Methods: case study", "Photonics Spectrocopic techniques", "Life Cycle of Materials", "Light and Matter" in a specific course based on "Radiative Transfers in the Atmosphere", "Physical Oceanography", "Physical Chemistry of the Atmosphere" and "Optical and Laser Metrologies in Physical Chemistry", the teaching of the last two units being common in the 2nd year of Masters programmes to the Physics and Chemistry courses.

In its education project, the LABEX proposes the creation of an international masters programme in "Physics and Chemistry of Atmospheric Environment"

which will be based on the first year of existing Physics and Chemistry masters programmes on the one hand, with common Physics and Chemistry courses, and on the other hand on the LABEX and GIS IRENI teams. The Master international dimension will be emphasized by the participation of foreign professors, the opening to international recruitment, the provision of scholarships based on academic record review and interview, teaching classes in English, encouraging mobility to get double degrees. This project will be reinforced by an international chair (supported by the Region). The classes will be divided into two semesters. The 1st semester will be devoted to common courses ("Physics and Chemistry of the Atmosphere", "Spectroscopic and Optical Methods", "Observation Systems", "Reactivity and Dynamics of the Atmosphere", "Professional Personalized Project", "International Project Management") and the second will include a research placement abroad in a laboratory or a company, with the joint supervision of a foreign partner, under, for example, the current bilateral Hubert Curien programmes with Britain, Germany, Japan, Korea, Ireland, China, USA, etc or the International Erasmus Mundus Masters programme (ASC). Rounds of conferences about international positions and "European Days of Education and Research in Atmospheric Environment" will be regularly organised to motivate students to international mobility and improve their professional integration.

5.2.3.3- Internationalization of doctoral courses

The LABEX teams are already strongly committed to the doctoral courses, in terms of thesis supervision and participation in international education research networks, as well as in the sitting up of national and international courses and thematic workshops.

The teams are indeed part of the same regional doctoral school in Sciences of Matter, Radiation and Environment (EDSMRE) where they also have administrative and teaching missions (members of the school board, experts in several courses: "Advanced Combustion", "Physical Chemistry of the Atmosphere", "Modelling and Climate Change", "Remote Sensing Applications for Ocean-Atmosphere Observations", "Theoretical Chemistry for Environment".

Fourty-Four thesis are currently in progress within the teams. They are generally co-funded by local governments (Region, Communauté Urbaine de Dunkerque), big industrial groups (GDF Suez, Arcelor-Mittal, Total, PSA, RECORD, etc), by research bodies (CNRS, ADEME) and EPIC (CNES, IRSN). Several theses are currently under joint supervision with foreign labs (Belarus, China, Japan, Korea, Ukraine, USA …). Our teams organise or regularly participate in national or international thematic schools in the fields of atmospheric chemistry (2007, 2008), combustion (2006, 2008, 2010, 2012) and metrology of reactive species (2007, 2009) which welcome several PhD students and academic and industry researchers. On the european level, the whole team took part in the European programme TOTECAT (Tools and Technique for a Changing Atmosphere), Marie Curie Early Stage Training Site (2006-2010) which gathered around jointly supervised theses, a number of regional (among which PC2A, LOA, LPCA) and european labs (Hungary, Czech Republic, Romania) specialized in atmospheric chemistry and physics. The programme was coordinated by the PC2A lab.

Additionally, in the field of education through research, the PC2A coordinated (along with the PhLAM from Lille 1) a Regional Action programme in university science cooperation with the Ministry of Foreign Affairs on the atmospheric physical chemistry (PhyCAFOR 2006-2010).
In order to develop all these programmes, the teams get the backing of the University Lille 1, one of the few universities benefiting from the "European label for Students and Faculty mobility" delivered by the European Union.
The LABEX project in that field is to strengthen the internationalization of doctoral degree courses by significantly raising the number of jointly supervised theses, which enable students to spend one year at the partner lab, in order to conduct a joint research project. This scheme is already operational in our teams. It will be strengthened by increasing and supporting the international mobility projects of our french and foreign students. International day events for PhD students in atmospheric environment will be organised.
Our teams also welcome several foreign researchers (Invited professors, Post Docs) for short (1 month) and long (1 year) stays with a variety of financial helps (Region, Universities, CNRS, CNES, IRSN). These stays often lead to the joint publication of papers and the setting up of new research programmes. In that respect, our aim is to raise our researchers and lecturers awareness of the need to increase their international mobility, notably within the EU.
Regarding the need for a stronger internationalization of doctoral courses and a higher mobility of researchers, the LABEX will be supported by the European Doctoral School (www.pres-ulnf.fr), of which the EDSMRE is a member, in order to encourage the mobility of PhD students in Europe, the cooperation between our doctoral school and those of our partner labs, and the setting up of courses and summer schools on the european scale. Our doctoral courses benefit also from active collaborations with the soci-economic world for the professional integration of young PhD students. Currently, all our former PhD students are either doing post-doc internships or have found many positions in academic or industrial research. A European education research project in "Reactivity, Dynamics and Impacts of Atmospheric Components" will be proposed and submitted to the Marie Curie European network with our french (Lille 1, Lille 2, ULCO, EM Douai), european (Germany, Hungary, Czech Republic, Ukraine, Belarus) and international partners (Brazil, Japan, Korea, China …). Teams from the CNES and IRSN as well as industrial groups, such as GDFSUEZ, CIMEL, Hygeos, will also participate and bring in their expertise in terms of development.

5.2.3.4- Professional guidance

The LABEX will follow the policy of Lille 1 university and the PRES ULNF in that matter. The aim is to set up a reference group regarding masters programmes, offering courses consistent with the research activity and its applications. It will support the professionalization and professional integration related to the socio-economic world. Some university departments such as the SUAIO Professional Integration Department (Lille 1) and the "House of Entrepreneurship" and the Professional Integration platform (www.pres-ulnf.fr) will also be involved.

In order to value at best his or her doctoral experience on the job market, any LABEX PhD student will be able to prepare and write his or her "New Thesis Chapter (NCT)". The NCT is a course designed by the ABG (www.abg.asso.fr) to facilitate the professional integration of PhD students who, in their last year, benefit from personal tutoring by a "mentor", a professional from outside the academic sphere, a consultant specialized in recruitment. This outside look is of great help to the student who can then identify and value the scientific and no scientific knowledge acquired during the thesis. This process leads to the NCT which even though it has no academic value, is still subject to a specific presentation. It is already implemented within the PC2A. Moreover, in the last year of Ph Degree course, the students participate in the european "Doctoriales" which are a preparation to the integration into the professional world.
Regarding continuing education, the University Lille 1 has always been pilot, well-known both on the national and european levels for its policy of long time learning courses engineering, and V.A.E. (Degree Equivalence Scheme). The long life learning scheme, implemented within the PRES, ULNF, will be operational at masters and doctorate levels. This approach is carried out in full-time education with the "Professional Personalized Project (PPP)", thanks to the setting up of a self access "Career Management Resource Centre". In an economic context characterized by the necessity to react rapidly to organisational technological and managerial changes, a whole set of specialized courses is offered aiming at acquiring new skills rapidly. This approach courses along with major guidance support in skill acquisition (knowledge of professional environment, self-knowledge, knowledge of course relate outlets), PPP portfolio, course work, professional guidance …

5.2.3.5- Self assessment as source of innovation

The University Lille 1 hosts a valuable efficient and recognized course assessment departments the OFIP "Monitoring centre of degree courses and professional integration" (www.univ-lille1.fr/ofip). All aspects related to our offer of degree courses will be benchmarked: assessment of teaching, of professional outlets and of professional integration conditions, assessment of living conditions. These benchmarking results will be systematically used as indicators teaching practices and for the improvement of inter-university collaboration.

5.2.4 GOUVERNANCE DU LABEX/ GOVERNANCE

The LABEX hosts research teams from 4 different partners, working on scientific projects in relation with research bodies, local governments and socio-economic world. CaPPA will initiate new research projects and give to the involved teams a premium international visibility. Its missions are (i) to favour and support the development of pluridisciplinary research teams, (ii) to lead a strategic reflexion on the development of scientific activity and on the use of financial human and material means, (iii) to run the technological platforms and improve their visibility in terms of expertise and services, (iv) to organise the support to innovation and valuation of research, in relation with the various valuation schemes (Universities - PRES - Region local authority, the City of Lille, etc) and

(v) to collaborate with the various departments and doctoral schools on the offer of research training and research degree courses.
In order to secure the LOA, PC2A, ICARE and LPCA laboratories, a governance will be organised along project teams with an organisation like the Research Federation including: (i) a steering committee, (ii) an executive board, (iii) a director, (iv) an international strategic committee.
The LABEX will be supported on one hand by specific funds allocated by the Ministry, the institutions (Universities, PRES ULNF, Région, CNRS, CNES, IRSN …) and the industrial groups, and on the other hand, by shared funds allocated by the research units of the teams involved in the project. This allows the LABEX to carry out its mission mainly the implementation of its research programmes, the scientific coordination, the education of students, the joint management, the running and development of the platforms and common facilities.

5.2.4.1- The Steering committee
It sets the strategic orientations and the objectives of LABEX. It defines the strategic choices in terms of scientific policy. It provides the LABEX with the resources necessary to the conduct of its scientific project (staff, credits and infrastructure) and its monitoring. It sets under the proposal of the executive committee, the priorities among the various needs expressed by the LABEX. It is composed of the representatives from Lille 1 University, University of Littoral, PRES ULNF, of the director and leads of the LABEX WP's, of the directors of the research Units involved and of invited members (Région, DRRT, CNRS, CNES, IRSN, GDFSUEZ, Arcelor-Mittal, CIMEL …).

5.2.4.2-The executive board
The Director leads the LABEX mission with the executive board. The executive board has an executive role: it defines the needs and priorities which will be submitted to the steering committee. It is in charge of the coordination of the LABEX activities. It facilitates the implementation and the monitoring of the projects (resources pooling and pluridisciplinary projects linked to research teams). The executive board meets along with the heads of the departments and doctoral schools involved to deal with common issues (recruitment policy, education-research interface, use of promises, management of technological platforms …). On the issues of general and scientific policies, it also calls all members of the LABEX for a general board meeting. It is composed of the director, the scientific coordinators of the LABEX and of the directors of the four research units.

5.2.4.3- The Director
The director along with the executive board carries out the LABEX mission. The director is appointed by the steering committee following a position announcement after proposal from the executive board.

5.2.3.4- The strategic committee

The LABEX will set up a strategic committee composed of national and international high-level scientists. This committee will examine the scientific strategy and the LABEX results every two years. It will make recommendations to the institutions on the scientific orientations of the LABEX.

5.2.5 ATTRACTIVITE/ATTRACTION

"*Euraxess* Services" offers personalized services to researchers within Europe and from third countries: http://ec.europa.eu/euraxess. Within the PRES ULNF, the **Euraxess** Service and Mobility centre assists Professors and Researchers, and their families that have specific needs such as: housing, administrative papers, on-hand assistance with integrating the family (locating appropriate maternity needs, day-nurseries and schools), organising day-to-day life, practical information, etc.

Nevertheless, there is no standardized welcome procedure for first-class researchers between the members of the PRES ULNF. The PRES ULNF intends to provide the following coordinated services through a regional centre for ressources and networking (pooling experience and skills, on-line regional guide, etc):

- accommodation offers,
- customized services,
- information on French learning programs (prior to and after arrival),
- overview of regional cultural and economic assets,
- supplying of social activities to the international community,
- intercultural training for local administrative.

The center will also provide assistance and practical informations about administrative and legal issues when moving from one country to another (Prefecture for visas, CAF : family allowance Office, CPAM : Social Security Centre, etc).

Financial support will be provided to Master's Students. The grants for Phd students will be in accordance with international standards. Post-doc fellowships will be adjusted to be attractive for young scientists (see section 6.1).

5.3. STRATEGIE DES ETABLISSEMENTS TUTELLES/ STRATEGY OF THE SUPERVISING INSTITUTION

5.3.1 - The scientific strategy of the PRES "Université Lille Nord de France"

The Establishments of Research and Higher Education supporting the LABEX project have a common research strategy within the PRES University Lille Nord de France (PRES – ULNF)». Through this strategy, the PRES-ULNF aims to be an international leader in research/training in certain scientific fields of high socio-economic impact with a domino effect to other fields with high research

potential. It also aims to drive the territorial and socio-economic development through innovation. The roadmap includes the following priorities:

- Organization of research around excellent scientific clusters
- Increasing the international attractiveness of research and training programs.
- Enhancing the education and lifelong training programs.
- Reinforcement of the research impact on the territorial and socio-economic development through innovation

5.3.1.1. Organization of the research around excellent scientific clusters

The scientific strategy of the University Lille Nord de France consists in the structuring of the research around excellent clusters having already a strong international recognition with a domino effect for sectors with high research potential. The scientific programs of these clusters correspond to the priorities of the 7th Framework Program for Research and Technological Development (FP7) in particular, Health, Information and Communication Technologies; Nanosciences, Nanotechnologies; Materials and new Production Technologies, Environment (including climate change), Transport and Socio-economic Sciences and Humanities. They also correspond to the three priorities of the National Strategy of Research and Innovation (SNRI):

- Health, food and Biotechnologies;
- **Environment urgency and Ecotechnology (relevant for our project**).
- Information, communication and nanotechnologies.

For each cluster, the partners' strategy is based on the creation of seven LABEX around the research groups A+ enhanced by some research groups A presenting a high scientific potential. Within the framework of the PIA, the research perimeter of excellence is based on the following projects:

- A Labex in the field of Science and Technology of Communication and Information "Information COmmunications and Nanotechnologies"
- Three LABEX in the field of Biology/Health:
  - (GID – European Genomic Institute for Diabetes ;
  - Oncochannelopathies, high-technology interdisciplinary approach for innovative medicine ;
  - RespInfEX – « Infections respiratoires : pathogenèse, prévention »
- **The present LABEX CaPPA** in the field of the **Environment: "Physico-Chemistry of the Atmosphere"**
- A LABEX in the field of Materials Science "Materials under complex Environment"
- A LABEX in the field of the Human Social Sciences "Argumentation"

Each LABEX is created on the basis of a scientific project with a flexible structure in charge of supporting management by project, multidisciplinary research and emergence of new projects on challenging issues. A particular attention is paid to the emergence of scientific leaders recognized by international, European and national evaluation. A logistic support will be devoted for the preparation and

management of both ANR and European projects. Clusters have to intensify the international partnership through various forms of research association (LEA, LIA GDRI,…). In addition to the European space, they should reinforce their partnership with countries with high scientific capacity, such as North America, China, India, South Korea, Brazil and Russia.

Cluster are expected to develop multidisciplinary research within each cluster (hard /soft in ICT; physics and chemistry in Materials Science and Environment; biology, chemistry and imaging in Biology and Health, ...) and between clusters such as SHS with ICT; physics with all sectors; biology with chemistry, ICT, computer science and mathematics.

The scientific equipment constitutes also a priority. It concerns the reinforcement of the capacity of scientific facilities through an ambitious investment policy and the allocation of human resources. The objective is the positioning of the scientific facilities at the international standards. Particular interest is given to the access of these facilities to the scientific community by encouraging various forms of hosting and the establishment of "Project Hotel". PRES ULNF provided a support for EQUIPEX projects related to excellent clusters. The management of these projects will be conducted in synergy with LABEX through an integrated management.

5.3.1.2. Enhancing the internal attractiveness

The attractiveness is a fundamental part of the scientific policy of the University Lille Nord de France. The development of clusters of excellence is subjected to the ability of these clusters to attract both highly talented researchers and students to the master and PhD degrees. A proactive policy of attractiveness will be implemented with the support of Local Authorities. This policy will be based on the allocation of specific resources to attract and keep talented researchers. These means include both the scientific environment (scientific equipment, logistic support, scientific position, research grants post-doc, high-level training for masters and doctoral programs,..), and the establishment of attractive careers. Attractiveness will be developed through tracking actions and the implementation of various procedures such the PRES international Chair and an extensive use of the local, national and European opportunities such as the chairs of excellence of the Region, the ANR program (Chair of Excellence program and post-return, ..) and the PEOPLE / Marie Curie FP7 program.

5.3.1.3. Enhancing the education and life-long training programs

Clusters already rely on a large base of training programs (masters, engineering schools and doctoral schools). The objective of the PRES -ULNF is to emerge international training programs to attract talent candidates and to train students in an open international environment. This action aims to establishing a recruitment pool of doctoral students and to train executive graduates to creative and scientific approach. Specific resources will be devoted to these training programs to reinforce their national and international attractiveness.

The life-long raining constitutes also a priority for the clusters policy. This training beneficiates of the great achievement and expertise in this field of the PRES-ULNF members. The doctoral program will be re-organized by the creation of a doctoral school for each cluster. Doctoral Schools will focus on providing doctoral students with an additional high-level scientific training, interdisciplinary openness and an awareness of intellectual property and societal and international issues. They should also widely implement the international mobility and the doctoral attractiveness program.

5.3.1.4. Enhancing the research impact on the territorial and socio-economic development through innovation

Innovation is a key element for both the promotion of research and for the economic and social development. Both the innovation and technology transfer activity constitute a high priority of the PRES-ULNF. Substantial support will be given to the establishment of an innovation ecosystem in partnership with the support of the Local Authorities, the State and economic partners. Priority is given to establishing strategic relation with leading companies, to support small and medium companies and to reinforce the partnership with the competitiveness clusters. A particular attention is paid to the territorial development through the involvement in the competitiveness clusters in the Region (I-Trans, NSL, PICOM, MAUD, UPTEX, AQUIMER, TEAM2), the Economic Excellence Clusters created within the framework "Regional Scheme for Economic Development (SRDE) and the park of technology: EURASANTE (Health/Biology), Haute Borne (Technology), Euratechnologies (IT) and Plain Image (image creation).

The development of the innovation/transfer activity will be enhanced by the establishment of a SATT (Society for the acceleration of the transfer and technology) comprising members of the PRES ULNF and the Universities of Amiens and Reims. The SATT will be in charge of the maturation of innovative projects, management of intellectual property and technology transfer. It will also provide a high level of expertise in legal, financial and management of partnership projects with the industry.

5.3.2 - The strategy of the University Lille 1 Sciences et Technologies

Université Lille1 Sciences et Technologies | DIRVED Direction de la Recherche, de la Valorisation et des Etudes Doctorales

Commitment of the Université Lille1 – Sciences et Technologies for the LABEX

Chemistry and Physical Properties of the Atmosphere (CaPPA)

Through the LABEX CaPPA "Chemistry and Physical Properties of the Atmosphere", the University Lille1 aims to become an international leader in the field of 'Atmospheric Environment" and to actively contribute to the challenging researches concerning the climatic changes and the environment protection.

This LABEX is highly supported by the partners because of the excellent scientific potential and activity of the research groups of this LABEX. It emanates from a major multidisciplinary scientific field in the region with more than 400 scientists, PhD students and administrative and technology staff. It also relies on the excellent platforms of LOA, PC2A, LPCA laboratories and UMS/ICARE-CGTD and on strong national and international partnership with the major actors in this field. Research groups of this LABEX are very active in the training programs, innovation activity, and collaborative research with research centers and the industry.

We believe that the excellent potential of this LABEX together with the high quality management and the strong support of partners through additional human resources and scientific facilities will present an attractive environment for talent scientists and students and for the development of promoting innovative research. This environment will be also conducive for student training, innovation and the development of research for the challenging issue concerning the climatic changes and the environment protection.

The University Lille1 largely supports this project. In addition to the actual human resources, scientific equipment and building infrastructure, the university is committed to providing subnational additional support for this LABEX, in particular in Human resources support (4 faculty members, doctorate and post doc grants, positions for inviting talent international researchers for long period,..), building and scientific infrastructure as well as in administrative and logistic support and current expenses.

Friday, November 19, 2010

Professor Philippe Rollet

President of the Université Lille1 – Sciences et Technologies

Cité Scientifique - Bâtiment A3 - 59655 Villeneuve d'Ascq Cedex
Tél. +33 (0)3 20 43 44 37 | www.univ-lille1.fr

5.3.3 - The strategy of the University of Littoral Côte d'Opale (ULCO)

The University of Littoral Côte d'Opale (ULCO) is pursuing a 10-years strategy centred on the environment, through two basic axes:

- Coastal and marine environment
- Industrial environment and energy

These axes are supported by three structural projects carried undertaken by ULCO within the University of Lille Northern France (ULNF), Regional Centre for Research and Higher Education (PRES):

- Sea Campus. The project brings together the PRES–ULNF teams within a Scientific Interest Group (SIG) to work on (i) aquatic product promotion/development, (ii) coastal and marine environment, and (iii) integrated management of coastal zones.
- Institute for Industrial Environment Research (IRENI). The project within the 2007-2013 State Region Contract Programme is a SIG gathering together research groups from the Douai Mining School, Artois, Lille 1 and Lille 2 universities, as well as from the ULCO and the CNRS to work on (i) air quality in industrial and port environment, and (ii) air quality-induced sanitation and social economic consequences.
- Innocold. Project submitted to 'Institut de Recherche Technologique' in 2010. Creation of a Research Institute for Low Temperature Technologies that will promote intensive partnerships between public institutions, industrialists and other stakeholder organisations.

In addition to these two basic axes, ULCO also participates the European Institute of Social Sciences Humanities (MESHS), a CNRS unit regrouping the research activities in Human and Social Sciences of the PRES-ULNF. Finally, ULCO with the PRES-ULNF partners is starting a research axis on entrepreneurship and is developing trainings of engineers (Computer Science and Information Technology, Industrial Engineering) supported by the laboratories of mathematics, computer sciences and electronics.
Within the framework of this global strategy, ULCO is going to participate in the following future initiatives:

- An EquipEx project carried by the Laboratory of Oceanology and Geosciences (LOG) is related to the research activities within the SIG Sea Campus. In addition, the LOG is a partner in two other EquipEx projects.
- A LabEx project 'Atmospheric Physical Chemistry' includes as a partner one team of the Laboratory of Physical Chemistry of the Atmosphere (LPCA). The research activity of the project is related to the SIG IRENI.
- A LabEx project 'Argumentation' involves the teams from the following laboratories: Territories Cities Environment Society (TVES) and History Languages Literature and Intercultural (HLLI)
- A project of the Research Institute for Environment within the Excellence Initiative of the PRES-LNF will regroup all regional research teams working on this subject.

ULCO will actively promote these strategic axes, it will make available 2/3 of the funds 'Research Quality Bonus' for environment and will target the lecturer-researcher positions for the excellence initiatives as a priority.
However, beyond the 4-years commitment of a single institutional quadrennial contract, it is essential to establish the perennial obligations that will allow the excellence initiatives to be planned on a 10-years scale. This point should be discussed by the PRES-ULNF and to be a force of IdEx proposals of the PRES-ULNF.

5.3.4 - The strategy of National Center for Scientific Research (CNRS)

Université Lille Nord de France
Monsieur le Président,
SERGHERAERT Christian
1bis rue Georges Lefèvre
F- 59044 LILLE CEDEX

Paris, le 27 octobre 2010

www.cnrs.fr
Campus Gérard Mégie
3 rue Michel Ange
75794 Paris cedex 16
01 44 96 40 00
01 44 96 49 13

Objet : Lettre de soutien pour les dossiers LABEX des investissements d'avenir

Monsieur le Président,

Le Comité de Direction du CNRS a examiné avec beaucoup d'intérêt les projets de LABEX qui lui ont été adressés. Il apporte son soutien aux projets qui remplissent les trois critères suivants :

- L'excellence scientifique, le caractère innovant et la plus-value par rapport à l'existant, ainsi que la cohérence avec les orientations stratégiques du CNRS sur le site;
- La pertinence du projet dans la politique du site ;
- L'assurance d'une gouvernance en « mode projet », respectant la structuration des unités de recherche.

Le projet «Physique et chimie de l'environnement atmosphérique» remplit ces trois conditions et reçoit ainsi le soutien complet du CNRS. En cas de succès de ce projet, le CNRS s'engage à maintenir ses ressources sur le périmètre du projet de LABEX et à entamer des discussions avec ses partenaires pour envisager la façon de mettre en place une programmation pluri-annuelle concertée des ressources futures.

Nous vous remercions d'avance de bien vouloir nous adresser dès que possible une copie de l'intégralité du dossier final que vous déposerez.

Nous vous prions de croire, Monsieur le Président, en notre parfaite considération.

Le Directeur scientifique référent
Jacques MARTINO

Le directeur de l'INSU
Jean-François STEPHAN

Advancing the frontiers

5.3.5 - The strategy of the Centre National d'Études Spatiales (CNES)[2]

cnes
CENTRE NATIONAL D'ÉTUDES SPATIALES

**Direction de la Stratégie, des Programmes,
de la Valorisation et des Relations Internationales**

M. Didier Tanré
LOA
Bat. P5
Université Lille 1
59655 Villeneuve d'Ascq Cedex

Paris, le 18 novembre 2010

**Objet : Soutien du CNES au projet LABEX
« Physique et Chimie de l'Environnement Atmosphérique »**

Cher Monsieur,

Le Cnes soutient depuis de nombreuses années les activités du LOA, notamment dans le cadre des missions spatiales Polder-1, Polder-2 et Parasol et du réseau de photomètres au sol Aeronet, qui sont devenus, au niveau mondial, des moyens d'observation de référence des aérosols atmosphériques. Le travail en commun du Cnes et du LOA se poursuit actuellement autour des projets de missions spatiales 3MI/EPS-SG (Europe) et PACE (Etats-Unis), également dédiés à l'observation et au ssuivi des aérosols atmosphériques.

Le Cnes est par ailleurs à l'origine de la création du pôle thématique Icare et de son Centre de données (CGTD), dont il est cotutelle et cofinanceur depuis 2003, avec l'Université Lille 1, le CNRS et la Région Nord-Pas-de-Calais. Le CGTD Icare est devenu un Centre de données et de services de niveau européen pour le traitement et la distribution des données spatiales dans la thématique « Aérosols, nuages, rayonnement, cycle de l'eau ».

La mise en place d'un laboratoire d'excellence regroupant ces deux entités avec le PC2A et le LPCA sur le thème du cycle des aérosols atmosphériques serait pour le Cnes une opération très profitable, en fédérant des moyens et des expertises complémentaires de ceux de l'observation spatiale pour l'étude approfondie de l'aérosol atmosphérique et de son comportement physico-chimique. On sait aujourd'hui que l'aérosol atmosphérique constitue l'une des espèces clés en matière

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Direction des lanceurs : Rond Point de l'Espace – Courcouronnes – 91023 Evry cedex – Tél. : 33 (0)1 60 87 71 11
Centre spatial de Toulouse : 18 avenue Edouard Belin – 31401 Toulouse cedex 9 – Tél. : 33 (0)5 61 27 31 31
Centre spatial guyanais : BP 726 – 97387 Kourou cedex – Tél. : 594 (0)5 94 33 51 11

RCS Paris B 775 665 912 Siret 775 665 912 000 82 code APE 731 Z N°d'identification TVA FR 49 775 6 65 912

[2] The letter with the signature is available from the project coordinator.

de changement climatique et de qualité de l'air, deux préoccupations environnementales majeures de nos sociétés.

Pour ces raisons, le Cnes apporte son entier soutien au projet de laboratoire d'excellence « Physique et Chimie de l'Environnement Atmosphérique ».

Je vous prie d'agréer, cher Monsieur, l'expression de mes cordiales salutations.

Le Directeur Adjoint

Richard BONNEVILLE

Copies :
P. Ultré-Guérard, D. Renaut (DSP/OT)
G. Campan (DCT/ME)

5.4. RELATION AVEC LE MONDE SOCIO-ECONOMIQUE/ CONNECTIONS TO THE SOCIO-ECONOMIC WORLD

Research activities developed in the past by several teams within the LABEX leaded to patents as reported in Section 4. The thermokinetic models for 3D simulation codes of industrial processes that will result from our project are potentially of interest for industry and private companies (TOTAL, PSA, RENAULT, GDF SUEZ...). Our expertise concerning polarized sensors and space missions can lead to a collaborative project of "POLDER follow-on" Microsatellite with Astrium EADS in the near future; preliminary discussions have already begun. Developments of future instrumental devices (photometers, lidars, pollutant sensors) will be valuable for companies such as CIMEL (letter of support in annexe) and Environnement SA. Some of our results will be relevant to (i) EPIC's (Industrial and Commercial Public Establishments), like ADEME, IFP, CNES (superving institution of the partner 3), IRSN (letter of support in annexe), (ii) to other national and international institutions (ONERA, INRETS, WMO) or (iii) private corporations. Several thesis are currently co-funded by industrial groups. The training of students in a scientific approach of pollution and climate change will benefit to industrial companies.
The matters of LABEX's activities facilitate direct connections with civil society. Our results will be made available to a broad user community, including decision makers, businesses and citizens. Some dedicated products will be delivered to partner decision-making systems that provide a high level of operational services (e.g. present quasi-near-real-time aerosol products made available to INERIS PREVAIR system for quality control of their forecast).

5.5. EFFET D'ENTRAINEMENT POTENTIEL/ PULL EFFECT

Exchanges between the CaPPA partners with their different background will be mutually beneficial and are expected to bring new ideas from one research area to an other.
The LABEX concerns different types of audience, which will enhance the opportunities to promote our activities to public or private agencies and companies. As already mentionned (section 5.2.2.1) a flyer, a brochure and a website will be created to highlight the CaPPA project.
The LABEX project will strengthen the internationalization of doctoral degree courses, which should significantly raise the number of jointly supervised thesis. Rounds of conferences about international positions and "European Days of Education and Research in Atmospheric Environment" are expected to motivate the french and foreign students to international mobility.

6. JUSTIFICATION SCIENTIFIQUE ET FINANCIERE DES MOYENS DEMANDES / FINANCIAL AND SCIENTIFIC JUSTIFICATION FOR THE MOBILISATION OF THE RESOURCES

6.1. JUSTIFICATION DES MOYENS DEMANDES (SUR 10 ANS) / JUSTIFICATION FOR THE MOBILISATION OF THE RESOURCES

6.1.1 PROJET DE RECHERCHE/ RESEARCH PROJECT

- *Équipement / Equipement (coût unitaire supérieur à 4000 euros HT)*

Estimates are attached (7.3) : the total is larger than the requested budget reported below. Priorities have not been made yet. For computers, costs are evoluting rapidly and estimates have to be requested few weeks before purchase.

Lidar (Multiwavelenght, Polarized)	332k€
Mainframe computer for developping new inversion algorithms	93k€
ICCD IMAX camera	86k€
Scanning Mobility Particle sizer	95k€
Aerosol Neutralizer Kr-85	10k€
Lasers Nd-YAG + Lasers accordables Dye + OPO	124k€
Infrared Interferometer ARIES	220k€
Mainframe computer for processing and archiving satellite data	500k€
Total (resquested):	**1 200 K€** .

- *Personnel / Personnel cost*

Research engineers : 3.1 ETP (372 person.month)	**1 697 k€**
PhD Grants (4 per year, no cumulative), (480 person.month)	**1 392 K€**
Post Doc fellowships (1,5 per year), (180 person.month)	**738 K€**

- *Missions/ Travel*

Presentations at dedicated policy-oriented conferences.
Presentations at international conferences and workshops.
Participation to Field experiments
Meeting with industrial companies
Participation in public debate
Estimated cost for one ETP per year: 1.5 k€
(20 ETP x 10 years) **300 k€**

- *Autres dépenses de fonctionnement/ Other working costs*

Implementation and participation to Field Experiment (maintenance, electronic and optical components, transport, etc)
Support to laboratory activities (fluid, electronic components, running cost)
Data acquisition and storage
Publications in peer-viewed journals
Estimated cost per year: 67 k€ **670 k€**

- *Dépenses justifiées sur une procédure de facturation interne/ Expenses for inward billing (Costs justified by internal procedures of invoicing)*

Morphology analysis (aerosols, soot, etc) MET/MEB et TOF/SIMS
Estimated cost per year : 5k€ **50 k€**

6.1.2 PROJET PEDAGOGIQUE/ EDUCATIONAL PROJECT

- *Personnel / Personnel cost*

Technical and administrative staff 0,5 ETP (60 person.month) **180 k€**
½ Chair Professor (60 person.month)
(½ from Nord-Pas-de-Calais Regional Council) **498 k€**

- *Missions/ Travel*

Summer schools (student travel expenses, invitation of experts/lectures and associated cost) **100 k€**

- *Autres dépenses de fonctionnement/ Other working costs*

Administrative management Education – Selection of students – French lessons not covered by PRES ULNF (late arrival, etc) **50 k€**
«Master-2» Grants : (10 fellowships /year) **70 k€**

6.1.3 VALORISATION/ EXPLOITATION OF RESULTS

- *Personnel / Personnel cost*

Research engineers : 0.2 ETP (24 person.month) **110 k€**

- *Prestation de service externe / Subcontracting*

Web site design, Flyer, etc **20 K€**

- *Missions/ Travel*

Meetings with providers **10 K€**

- *Autres dépenses de fonctionnement/ Other working costs*

Events (Chemistry Ambassador, Science Festivals, Do Science, Animated virtual Sciences, Open Doors, Job Fair, Posters) : **20 k€**

6.1.4 GOUVERNANCE/ GOVERNANCE

- *Personnel / Personnel cost*

Technical and administrative staff 0,5 ETP (60 person.month) **180 k€**

- *Missions/ Travel*

International Advisory Board : **100 k€**

- *Autres dépenses de fonctionnement/ Other working costs*

Seminar (Lecturer travel expenses), Lap Top, Beamer/Projector, Reception costs, hiring of meeting room): **50 k€**

6.2. AUTRES RESSOURCES / OTHERS RESOURCES

Equipex SOFRA-EX : **1 509 k€**
Equipex META : **600 k€**
Equipex IAOOS : **/**

Personnel has been evaluated to 20 ETP for the 4 years and to 25 ETP for the 6 following years. The precise cost will be reported in the « LABEX–2010–Document–A ».

7. ANNEXES / APPENDICES

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7.3. DEVIS/ESTIMATE

N°1 : Multiwavelength polarized LIDAR

Development of MW lidar system in LOA

PIC prepares

1. Telescope with laser beam collimator and steering optics — **40,000€.**

2. Spectrum analyzer with 7 channels: — **60,000€**
   - dichroic mirrors, polarizers, lenses
   - PMT Hamamatsu R1924 with housings 5 pc
   - 6 interference filters (4 from Barr and 2 from CVI)
   - Mechanics

   Custom expenses and shipping ~2 KE

Total 102,000€

LOA prepares

1. Laser Quantel "Brilliant B" (France) — **~40,000€**

2. Receiving electronics Licel, 7 channels (ADC 40 MHz +PC) +rack (Germany) — **7*8.6kE+3k=63,000€**

3. Detector at 1.06 μm (Licel) (Germany) — **7,000€**

4. Detector Hamamatsu 7422P-40 for 608 nm (USA) — **6,000€**

5. Power supplies for 5 channels (USA) — **7,000€**

Total 123,000€

Additional equipment:

Radar for aircrafts monitoring — **~6,000€**

electronics and shutter for blocking laser beam — **~2,000€**

Maintenance

Flash lamp for laser (4,500€/year x 10 years) — **~45,000€**

Total 53,000€

Total budget HT	278 k€
Taxe (19,6%)	54.5 k€
Total budget TTC	**332.5 k€**

There is no such lidar available on the market; it will be realized through a collaboration with scientist (Igor Veselovskii) who already built 3 similar instruments.

Affiliation :
Physics Instrumentation Center of General Physics Institutute
Moscow region, Troitsk, 142190 Russia
http://www.optosystems.ru/

N°2 : Mainframe Computer

Windows®. La vie sans limites. Dell recommande Windows 7.

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Description

Dell PowerVault™ MD3000

Date et heure : lundi 26 juillet 2010 21:49

COMPOSANTS SYSTÈME

Dell PowerVault™ MD3000 Qté 7

PowerVault MD3000 external RAID array with two single-port controllers Prix à l'unité 6 111,00 €

Référence catalogue : 909 PV MD30001

Module	Description	Vue détaillée
Base	PowerVault MD3000 external RAID array with two single-port controllers	
Câbles	Four SAS cables, 1 meter, connects MD3000 - 10000 to SAS HBAs	
Contrôleur Raid	Four SAS 5/E HBAs, PCI-Express, 2X4 Connectors (requires 4 SAS cables)	
Garantie de base	3Yr Basic Warranty - Next Business Day - Minimum Warranty	
Services de support technique	3Yr Basic Warranty - NBD Included - No Upgrade Selected	
Installation professionnelle	Pas d'installation	
Rails de montage de rack	Rapid Rails for Dell, or other Square Hole Racks, MDxx00	
Informations sur la commande	Power Vault Order - France	
Remplissage de disque dur	(14) MD1000 blank hard drive filler	
Cadre avant	PV MD3000 Bezel Assembly	
Licence entreprise	Snapshot (8 per LUN) Software feature License key	
1er disque dur	500GB Near Line SAS 6Gbps 7.2k 3.5" HD	

TOTAL ( ) :42 777,00 €

DELL™ PowerEdge™ M905

Date et heure : lundi 26 juillet 2010 21:42

COMPOSANTS SYSTÈME

http://ecomm.euro.dell.com/dellstore/PopUps/popup_print_cart.aspx?itemtype=CFG&s=bsd&l=fr&cs=frbsdt1&c=fr&marketable=true Page 1 sur 3

N°2 : Mainframe Computer (cont'd)

Trouvez des ordinateurs portables ou de bureau, des serveurs, des imprimantes, des logiciels, des services ou des écrans chez Dell. 26/07/10 21:50

DELL™ PowerEdge™ M905 Qté 1

4x Six Core AMD Opteron™ 8439SE; 2.8GHz, 55W ACP, HT-3 Prix à l'unité 34 853,00 €

Référence catalogue : 909 PEM9051

Module	Description	Vue détaillée
Base	4x Six Core AMD Opteron™ 8439SE; 2.8GHz, 55W ACP, HT-3	
Mémoire	96GB Memory, DDR2, 800MHz (24x4GB Dual Ranked DIMMs) Clocked down to 533MHz	
Documents de livraison	M805/M905 Shipping Documentation	
Garantie de base	3Yr Basic Warranty - Next Business Day - Minimum Warranty	
Services de support technique	5Yr ProSupport for IT and 4hr Mission Critical	
Installation professionnelle	Dell Proactive Systems Management - Remote Installation Advisory	
Gestion des systèmes	OpenManage Software loaded and DVD Kit	
Services de conseil à distance	3Yr 5 Cases - Remote Advisory - Secure Exchange	
Informations sur la commande	PowerEdge Order - France	
2e disque dur	No Additional Hard Drive	
2e disque dur	100GB, Solid State Disk SATA, 2.5-in Additional Hard Drive (Hot Plug)	
Système d'exploitation installé en usine	Red Hat Enterprise Linux 5AP, x32&x64, 3yr Sub, FI x64, Auto-Entitle, License Only	
Offres de virtualisation en option	VMware 4.0 U1, 2 CPU, Not Factory Install, Advanced Edition, 3 Years Subscription	
Carte E/S pour structure B	Emulex OCm10102-F-M 10Gbps FCoE I/O Card, Redundant	
Type de carte réseau intégrée (Structure A)	Onboard Broadcom 5709 Quad Port GbE NIC with TCP/IP Offload and iSCSI	
1er disque dur	No First Hard Drive	
Support Dell	M905 System Information Label - French	
Connectivité Raid	C1 - No RAID configuration, 1 or 2 Hard Drives attached to SAS6/iR Controller Daughtercard	
1er disque dur	No Hard Drive	
1er disque dur	100GB, Solid State Disk SATA, 2.5-in Hard Drive (Hot Plug)	

TOTAL ( ) :34 853,00 €

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Montant total	78 120,00 €		93 431,52 €

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snCM03

N°3 : PIMAX Camera

ROPER SCIENTIFIC™

Z.I. Petite Montagne Sud - Lisses - 8 rue du Forez - C.E. 1702 - 91017 EVRY CEDEX - FRANCE
Tel : 33 (0) 1 60 86 03 65 - Fax : 33 (0) 1 60 86 07 09 - E-mail : info@roperscientific.fr

Monsieur Xavier MERCIER
Université des Sciences et Technologies de Lille
PC2A - bat C11
59655 Villeneuve d'Ascq Cedex

N/REF. : DEV14664
V/REF :

Évry, le 8 septembre 2010

Monsieur,
Suite à votre demande, j'ai le plaisir de vous faire parvenir notre meilleure offre de prix pour le système **Roper Scientific** qui a retenu votre attention.
Je reste à votre disposition pour tous renseignements complémentaires que vous pourriez souhaiter et vous prie d'agréer, Monsieur, mes sincères salutations.

Système d'imagerie – Roper Scientific

1 – Système **PIMAX3-1024i-RB-FG-P43**

- Détecteur CCD	: Kodak, grade 1, MPP
- Taille CCD	: 1024 lignes x 1024 pixels x 2 (interligne)
- Taille pixel	: 12,8 x 12,8 µm
- Intensificateur	: GEN 2, Rouge-Bleu, fast gate, 18 mm, >45 lp/mm, couplé fibres optiques 1:1
- Gamme spectrale	: 195 nm à 900 nm
- Ouverture de porte sur l'intensificateur	: de 3 ns au continu, phosphore P43
- Dynamique réelle	: 16 bits
- Puits de potentiel	: 150 ke-
- Gain	: 2 – 200 ADU/photoélectron
- Refroidissement	: thermoélectrique, régulé par 3 étages peltiers
- Température	: jusqu'à -30°C forcé par air et -40°C forcé par eau
- Courant d'obscurité	: 1 électrons/pixel/seconde à -30°C
- Largeur de pulse réglable	: de 3 ns à 20 secondes
- Délai de pulse réglable	: de 25 ns à 20 secondes
- Vitesses d'acquisition	: 2x **2 MHz / 16 bits + 8 MHz / 16 bits + 16 MHz / 16 bits**
- Interface	: Gigabit Ethernet
- Montures	: C, F, spectro

Logiciel WINVIEW32
- Logiciel d'acquisition et de gestion du détecteur + PC DELL

Prix du système toute remise déduite : **...38 800 € HT**

Conditions de vente :
Notre prix est établi en EUROS, hors T.V.A. (T.V.A. 19,60% en sus), franco destination.
Il est ferme et non révisable.

Délai de livraison :	3 mois
Conditions de règlement :	30 jours net date de facture.
Garantie :	1 an, pièces et main d'œuvre en nos laboratoires
Validité de l'offre :	30 septembre 2010

ROPER SCIENTIFIC
Philippe BERNHARD

N°3 : PIMAX Camera (Cont'd)

ROPER SCIENTIFIC™

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Évry, le 8 septembre 2010

Monsieur,
Suite à votre demande, j'ai le plaisir de vous faire parvenir notre meilleure offre de prix pour le système **Roper Scientific** qui a retenu votre attention.
Je reste à votre disposition pour tous renseignements complémentaires que vous pourriez souhaiter et vous prie d'agréer, Monsieur, mes sincères salutations.

Système d'imagerie – Roper Scientific

1 – Système **PIMAX3-1024i-UNIGEN2-P43**

- Détecteur CCD	: Kodak, grade 1, MPP
- Taille CCD	: 1024 lignes x 1024 pixels x 2 (interligne)
- Taille pixel	: 12,8 x 12,8 µm
- Intensificateur	: GEN 3, UNIGEN-II, fast gate, 18 mm, >55 lp/mm, couplé fibres optiques 1:1
- Gamme spectrale	: 195 nm à 900 nm
- Ouverture de porte sur l'intensificateur	: de 2 ns au continu, phosphore P43
- Dynamique réelle	: 16 bits
- Puits de potentiel	: 150 ke-
- Gain	: 2 – 200 ADU/photoélectron
- Refroidissement	: thermoélectrique, régulé par 3 étages peltiers
- Température	: jusqu'à -30°C forcé par air et -40°C forcé par eau
- Courant d'obscurité	: 1 électrons/pixel/seconde à -30°C
- Largeur de pulse réglable	: de 2 ns à 20 secondes
- Délai de pulse réglable	: de 25 ns à 20 secondes
- Taux de répétition sur l'intensificateur	: 1 MHz
- Vitesses d'acquisition	: 2x **2 MHz / 16 bits + 8 MHz / 16 bits + 16 MHz / 16 bits**
- Interface	: Gigabit Ethernet
- Montures	: C, F, spectro

Logiciel WINVIEW32
- Logiciel d'acquisition et de gestion du détecteur + PC DELL

Prix du système toute remise déduite : **...47 300 € HT**

Conditions de vente :
Notre prix est établi en EUROS, hors T.V.A. (T.V.A. 19,60% en sus), franco destination.
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N°4 : Scanning Mobility Particle Sizer

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Votre numéro client	518311
Référence client	email D. Petitprez
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Conditions de paiement	net 30 jours
Valable jusqu'au	31.12.2010
Devise	EUR
Votre n° de TVA	FR95195935598

Pos.	Modèle/description	Quantité	Montant H.T	Montant H.T
1	3936NL76-N Scanning Mobility Particle Sizer	1,00	75.895,00	75.895,00
2	3076 Constant Output Atomizer	1,00	2.380,00	2.380,00
3	4140 Flowmeter (20 L/min) 1/4" Tube	2,00	725,00	1.450,00
4	3001788 Cond TU 50' Rol .190 ID x .375 OD	1,00	315,00	315,00

Sous total H.T	80.040,00
Frais de Transport H.T	150,00
T.V.A 19,6 %	15.717,24
Montant Total	95.907,24

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13382 Marseille cedex 13

Tel: *+33 (0)4 91 11 87 64*
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Email: *tsifrance@tsi.com*
Web: *http://www.tsiinc.fr*

Fabricant de produits TSI®, Alnor® et Airflow Instruments

Devis

Adresse

Universite de Lille 1
PC2A - USTL hors SACD
Batiment A3 Cité Scientifique

59655 Villeneuve d'Ascq
FRANCE

Numéro de l'offre	20024555
Date de l'offre	15.11.2010
Votre numéro client	518311
Référence client	Mr Petitprez
Incoterms	FCA: Voir Ci-Dessous TSI High Wycombe (UK)
Conditions de paiement	net 30 jours
Valable jusqu'au	31.12.2010
Devise	EUR
Votre n° de TVA	FR95195935598

Pos.	Modèle/description	Quantité	Montant H.T	Montant H.T
1	3077A Aerosol Neutralizer, Kr-85 (370 MBq)	1,00	6.790,00	6.790,00
2	6600PT-EC Installation et formation Installation et formation	1,00	750,00	750,00
			Sous total H.T	7.540,00
			Frais de Transport H.T	1.350,00
			T.V.A 19,6 %	1.742,44
			Montant Total	10.632,44

Siret n° 317 327 252 000 68
APE 4669C
TVA/VAT: FR 03317327252
IBAN: FR76 3062 8000 0100 6091 0790 117
RIB: 30628 00001 06090107901 17

GBP Account: 32719702
sort code 60-92-42.
IBAN: GB81 CHAS 6092 4232 719702
EUR Account: 32719703
IBAN: GB54 CHAS 6092 4232 719703

RCS Marseille 05 B 1794
Siège Social:
500 Cardigan Road
St. Paul, MN 55112 USA
Capital 10.000 $

N°6 : Laser Nd-YAG + tunable laser Dye + OPO

EXCEL TECHNOLOGY FRANCE

tel : 01.69.74.13.80
fax : 01.69.07.56.12

Excel Technology France
22 Av de la Baltique
Zac de Courtaboeuf
91 140 Villebon sur Yvette

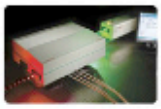
Mme Lamoureux & Mme Desgroux
UMR 8522
Université de Lille 1
Bat C11
59 655 Villeneuve d'Ascq Cedex

DEVIS

Référence	AS10-1001-4
Date	01/10/2010
Validité	2 mois
Votre référence	

Affaire suivie par : Aurélia SHIRTLIFFE - a.shirtliffe@excel-france.com
01 69 74 13 82 – 06 07 17 17 93

Lasers accordables et son laser de pompe - CONTINUUM

It Nb	Références	Descriptions	Qté	Prix € HT Total
1	**PL DLS 8000** **DS** **WSP1-A**	Laser Nd : YAG modèle **Powerlite DLS 8000** (Digital Laser System) nouvelle génération permettant d'obtenir **1.2 J @ 1064 nm @10 Hz@ 5-7 ns.** **Option incluse** : doubleur (type II) de fréquence : 532 nm **Option séparation en longueur d'onde** modèle WSP 1 A pour obtenir le 532 nm avec possibilité de récupérer le résiduel 1064 nm. Spécifications techniques: - E = 1.2 J@ 1064 nm - E= 600 mJ@ 532 nm - Cadence : 10 Hz possibilité de diviser la fréquence par 1/ 1….n (n = nombre entier =10) - Pulse : 6 ns - Jitter : +/- 0,5 ns *Autres paramètres voir fiche technique*	1	49103
3	Source Accordable	**Laser accordable comprenant ND 6000 – Colorants et OPO Panther EX Plus** **ND 6000,** de marque CONTINUUM permettant d'obtenir une accordabilité de : 420 nm à 740 nm avec le réseau standard pour une finesse de raie de 0.08 cm-1 @ 560 nm. • Réseaux : 2400 traits/mm • ASE : < 0.2% au pic de la rhodamine 6G • Stabilisation en fréquence : 0.05 cm-1 / °C/ hr • Répétabilité : +/-0.5A • Reproductibilité : +/- 0.5A • Divergence : < 0.5 mrad • Mode Scan et Burst disponible • Logiciel inclus • Options disponibles • Option **FSO** de stabilisation en fréquence : 0.05 cm-1/5°C/7hrs  **OPO modèle Panther EX Plus,** modèle moyenne bande pompé par le PL8000 DLS permettant une accordabilité de 410- 2550 nm • Pompage @ 355 nm • Ordinateur et logiciel inclus • Finesse avec pompe non injectée : < 6 cm-1 • Finesse avec pompe injectée : < 5 cm-1 • Option **Doubleur Plus** : Doubleur de fréquence pour l'OPO Panther EX Plus : **215 nm – 420 nm** • **Sorties accessibles** : 532 nm et 1064 nm résiduelles et 355 nm en direct.	1	75349

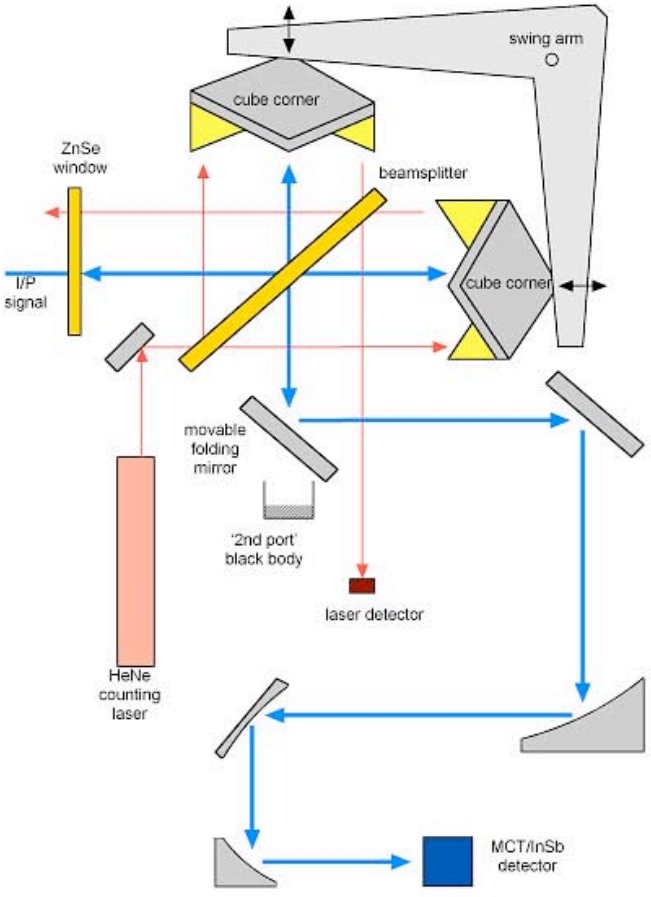
N°7 : : Infrared Interferometer ARIES

Project of acquisition of an Infrared Interferometer as ARIES
(Airborne Research Interferometer Evaluation System)

Approximate price of such an instrument + maintenance/10 year : 220k€.

ARIES is a Fourier transform spectrometer based on the Bomem MB100 interferometer, modified by ABB Bomem (Canada) for airborne use, with Met Office designed pointing optics, external black bodies and control electronics. Although designed, and primarily used, for airborne measurements ARIES can also be used for ground based work away from the aircraft. **In the framework of the LABEX research activities, an ARIES-like interferometer will allow to characterize dust optical properties but will be mainly operated from ground or aircraft in order to characterize cirrus and contrails optical and radiative properties.**

The existing ARIES instrument flew for the first time in March 1996 on the Lockheed C-130, XV208 and was installed on the English BAe 146-301 in April 2004.
The schematics of the instrument is shown in Figure 1 below and the specifications are listed in Table 1.



N°7 : : Infrared Interferometer ARIES (Cont'd)

Figure 1: schematic diagram of ARIES internal optics

Specifications	
Range	550 – 3000 cm^{-1}
Resolution	1 cm^{-1} max OPD
Beamsplitter	potassium bromide
Detectors	MCT/InSb sandwich with Sterling cycle cooler
Views	zenith, nadir-5° to nadir +55° (8 angles), hot and cold targets, selectable in flight
Scan rate	4 double-sided igms/sec. at 1 cm^{-1} resolution up to 64 igms/sec. at 16 cm^{-1}
Field of view	2.5° full angle
Calibration	2 external, heated, stabilised, black body targets
Noise	NE δ T 0.2 K for 1-minute averaged spectra

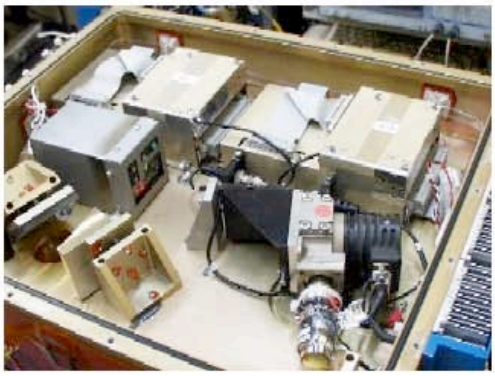


Figure 2: ARIES with starboard side removed showing electronics modules (top), detector/cooler unit (bottom right), heater controller (mid left) and folding/focusing optics (bottom left).

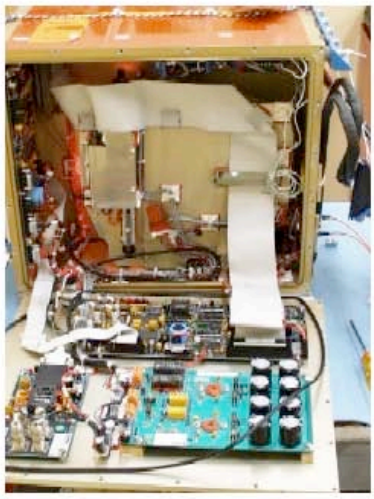


Figure 3: ARIES with port side open showing electronics modules attached to side panel (bottom). The interferometer optics are hidden behind the gold coloured panel (top centre) but the orange glow of the HeNe counting laser can be seen past the forward end (left) of the panel.

N°7 : : Infrared Interferometer ARIES (Cont'd)

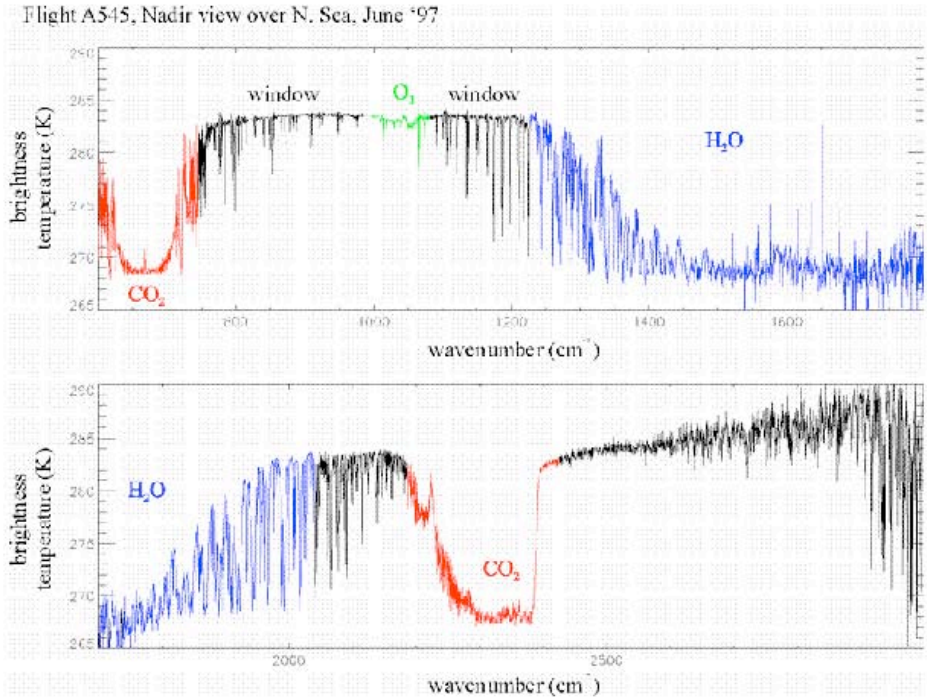


Figure 4: The above plot is of a spectra recorded by ARIES during flight A545 over the North Sea in June 1997. The spectrum was measured looking down at the sea surface from an altitude of 8 km. The spectrum covers the full range of ARIES and has been coloured and labelled to show the radiometrically dominant species in various regions and those 'window' regions where the atmosphere is sufficiently transparent to permit measurement of surface properties from space.

Recent ARIES publications

Fiedler & Newman, 2005: Correction of detector nonlinearity in Fourier transform spectroscopy with a low temperature blackbody, in press, Applied Optics.

Newman et al., 2005: Temperature and salinity dependence of sea surface emissivity in the thermal infrared. In press, QJR Meteorol Soc.

Baran & Francis, 2004: On the radiative properties of cirrus cloud at solar and thermal wavelengths: A test of model consistency using high-resolution airborne radiance measurements. QJR Meteorol Soc, 130 (598): 763-778 Part A.

Smith & Taylor, 2004: Initial cloud detection using the EOF components of high-spectral-resolution infrared sounder data. J Appl Meteorol, 43 (1), 196-210.

Taylor et al., 2003: Water vapour line and continuum absorption in the thermal infrared – Reconciling models and observations. QJR Meteorol Soc, 129, 2949-2969,.

N°8 : Mainframe computer for processing and archiving satellite data.

Université Lille1 Sciences et Technologies

Universite des Sciences et Technologies de Lille 1
Projet ICARE

DELL

Vincent HEUSCHLING

Version N° 1 (cf Devis N° 22890155/2)

Description	Qté	Prix Unitaire	Prix Total
Controlleurs de baie de disques Dell EMC² CX4-240 Logiciel Navishere et Flare Installation 5Yr ProSupport for your Enterprise and 4hr Mission Critical	1	24 000,00 €	24 000,00 €
Tiroir Disques DAE-OS 6 disques de 146 Go à 15000 tr/minutes Installation 5Yr ProSupport for your Enterprise and 4hr Mission Critical	1	8 600,00 €	8 600,00 €
Tiroir Disques DAE-4P 10 disques de 1 To à 7200 tr/minutes Installation 5Yr ProSupport for your Enterprise and 4hr Mission Critical	1	11 500,00 €	11 500,00 €
Tiroir Disques DAE-4P 15 disques de 1 To à 7200 tr/minutes Installation 5Yr ProSupport for your Enterprise and 4hr Mission Critical	14	14 000,00 €	196 000,00 €
Switchs Brocade 5100 FC8 32 ports activés sur un maximun de 40 ports Installation Cables LCLC 5Yr ProSupport for your Enterprise and 4hr Mission Critical	2	11 000,00 €	22 000,00 €
Chassis Blades Dell M1000e Controlleur de gestion redondant Lecteur de DVDROM 8x Alimentations en mode 6x2360W Cordons d'alimentation KVM Analogique Logiciel OpenManage Pass-Thru Ethernet redondants (2x16 ports) Pass-Thru FC8 redondants (2x16 ports) Installation 5Yr ProSupport for your Enterprise and 4hr Mission Critical	1	6 900,00 €	6 900,00 €
Serveur Lame Dell M610 2 Processeurs Intel Xeon X5560 (2,8 Ghz, 8 Mo Cache, 6,40 GT/s QPI, Turbo, HT) 16 Go de Mémoire (8x2Go UDIMM dual rank) 1066 Mhz 2 x 73 Go SAS 10ktpm 2,5" Hotplug en Raid 1 sur contrôleur SAS 6iR Carte Réseau Broadcom intégrée 5709 TOE Gbit Ethernet Carte FC Emulex LPE 1205-M 8 Gbit/s Redhat Enterprise Linux 5.2 x64 installée en usine avec support Installation 5Yr ProSupport for your Enterprise and 4hr Mission Critical	4	4 200,00 €	16 800,00 €
		Total HT :	285 800,00 €
		Tva 19,6% :	56 016,80 €
		Total TTC :	341 816,80 €

N°8 : Mainframe computer for processing and archiving satellite data. (Cont'd)

Université Lille1 Sciences et Technologies

Universite des Sciences et Technologies de Lille 1
Projet ICARE

DELL

Description	Qté	Prix Unitaire	Prix Total HT
Rack Dell 42 U 2 rack Nécessaire pour abriter l'ensemble de l'infrastructure Installation	2	900,00 €	1 800,00 €
Complément de 5 disques de 1To Pour porter la volumétrie à 225 To Bruts	1	4 200,00 €	4 200,00 €
Serveur Dell M610 comme défini dans l'offre de base	4	4 200,00 €	16 800,00 €
Switch Ethernet M6220 pour chassis Blades En remplacement des pass-Thru fournis dans l'offre de Base	2	1 600,00 €	3 200,00 €

Total Base + Options HT :	311 800,00 €
Tva 19,6% :	61 112,80 €
Total TTC :	372 912,80 €

DELL S.A.
www.dell.com
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34938 MONTPELLIER Cedex 9
Tél. 0825 004 700 - Fax 0825 004 701
S.A. au capital de 1.676.939 €uros
RCS Montpellier 351 528 229 - APE 4651 Z

JEAN-LOUIS GARD
DIRECTEUR DES VENTES
SECTEUR PUBLIC

TIG

ANNEXE : Letters of support

IRSN
INSTITUT
DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE

Direction Scientifique

Le Directeur

DS/DIR/2010-237

Saint Paul-lez-Durance, le 28 octobre 2010

Monsieur Didier TANRE
DRE-CNRS
Laboratoire LOA
Université des Sciences et Technologies de Lille
F-59655 Villeneuve d'Ascq CEDEX

Objet : Soutien au projet LABEX « Physique et Chimie de l'Environnement Atmosphérique »

Monsieur,

Dans le cadre de nos relations régulières avec le laboratoire Physico-Chimie des Processus de Combustion et de l'Atmosphère de l'Université Lille 1 Sciences et Technologies, nous sommes engagés dans une recherche continue d'une description fine du comportement des produits de fission depuis le combustible du cœur du réacteur jusqu'à leur possible relâchement dans l'environnement en cas d'accident. Cette recherche expérimentale et théorique vise au développement d'outils de simulation opérationnels et prédictifs d'analyse de sûreté des réacteurs, d'aide au dimensionnement des plans d'urgence et de gestion de crise et post-accidentelle. La collaboration avec le PC2A est formalisée dans un laboratoire de recherche commun IRSN/CNRS/Université de Lille 1 appelé C3R pour Combustion, Cinétique Chimique et Réactivité.

La mise en place d'un laboratoire d'excellence autour de la problématique du devenir des aérosols dans l'atmosphère depuis leur émission jusqu'à leur dépôt et l'analyse de leur impact sur la qualité de l'air offrirait de nouvelles possibilités de collaboration entre l'IRSN et l'université de Lille 1. En effet, les connaissances développées actuellement avec le PC2A sur la modélisation du comportement physico-chimique des produits de fission en réacteur pourront grâce aux travaux de ce LABEX s'étendre au comportement dans l'atmosphère en tenant compte notamment de l'interaction des produits de fission avec les aérosols atmosphériques (chimie hétérogène) mais surtout avec les produits de la photolyse de l'air. L'IRSN est aussi engagé dans des actions de recherche en métrologie des produits de fission dans l'atmosphère et, à ce titre, est intéressé par les techniques qui seront développées par le LABEX.

Pour ces raisons, nous soutenons pleinement le projet de laboratoire d'excellence «Physique et Chimie de l'Environnement Atmosphérique».

Je vous prie d'agréer, Monsieur, l'expression de ma considération distinguée.

Michel SCHWARZ

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Cedex France

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Fax: +33 (0) 58 35 81 39

michel.schwarz@irsn.fr

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Tel. (+33).1.43.48.79.33 – Fax. (+33).1.43.48.62.61
www.cimel.fr
S.A.S.au capital de 37.000 €
N°SIRET : 662 017 201 00036
R.C. PARIS 66 B1720 Code APE 2651B
Identification CEE : FR89662017201

To the attention of :

Mr. Frédéric PAROL
LOA Manager

Mr Didier TANRE
CaPPA Project coordinator

Paris, November 19, 2010

Object: Cimel's expression of interest for the CaPPA project

Dear Sir,

Cimel is pleased to confirm its strong interest in participating in the CaPPA (LABEX) project.

As you know well, Cimel's mission is to design and manufacture field instruments to the highest technological standards for meteorology, environmental control and atmosphere sciences.
With more than 40 years of innovation, Cimel is widely known for the quality of its products, in terms of precision, adaptation for field usage and life time. More than 3000 Automatic Weather Stations and 700 sun and sky photometers, constantly operating on all continents and under all climatic conditions, testify of this quality.

Cimel is particularly specialized in the monitoring of atmosphere parameters related to aerosols and clouds, with a range of complementary instruments: Sun and sky photometers, aerosol LIDAR for troposphere and stratosphere, infrared radiometers, radiance camera, CO2 photometer...

In our opinion, the challenges addressed by the CaPPA project are at the heart of all future challenges to better understand the behaviour of aerosols and clouds, and their impact on climate and air quality. This topic represents an enormous field for research that requires transdisciplinary approach between specialists from the chemical, physical, ground based and satellite borne remote sensing fields.

Cimel's current developments address the improvement of ground based (and some airborne) remote sensing instrument for a more complete characterisation of aerosols and cloud particles through their optical properties.

We have grown long term collaborations with numerous research laboratories in this field (CNRS LOA, NASA, CNES, CNRS LATMOS, CNRS LOV…).

In particular, our partnership with LOA (since 20 years) already covers several projects :

- Constant improvement of Cimel Sun Photometers for the AERONET /PHOTON network
- Laboratory and field qualification of Cimel's InfraRed multispectral radiometers especially for characterisation of large aerosols and cloud ice particles (1 Cimel engineer is permanently detached at LOA/Lille)
- Development of innovative retrieval methods of chemical/shape particle properties, from data measured with the newly developed Polarized Sun Photometer (Cimel finances 50% of a thesis)
- Collaboration on the development of a range of complementary instruments
  - Micro-Lidars for troposphere and stratosphere monitoring, PBL detection, 3D scanning
  - Multispectral hemispherical radiance camera
  - CO2 radiometer …

It is obvious that the solution of the project's important and difficult challenges will necessitate the combination of several complementary instruments and will result in the future development of worldwide networks of standardised monitoring platforms.

This is why we believe that the CaPPA project is a unique opportunity for Cimel that perfectly fits with its development strategy. We are also pleased to see that this initiative involves several French laboratories of worldwide renown in the field.

In conclusion, Cimel wishes to express its strong interest actively participating in the CaPPA project. While contributing our worldwide recognised expertise, innovation capacity and operational experience, we are convinced that we will also strongly benefit from this transdisciplinary project through a better understanding of the needs of the scientific community, through the scientific exposure of our new instruments and, finally, through the global outreach of the CaPPA project.

Best Regards

Didier CROZEL
CEO
Cimel Electronique