

Report of research activities 2012

CEREA



CEREA - Centre d'Enseignement et de Recherche en Environnement Atmosphérique

Atmospheric Environment Center

École des Ponts ParisTech et EDF R&D

6-8 avenue Blaise Pascal - Champs sur Marne - 77455
Marne la Vallée cedex 02, France

Tel. +33 (0) 1 64 15 21 57

fax : +33 (0)1 64 15 21 70

<http://cerea.enpc.fr>

Director: Christian Seigneur
Deputy director: Luc Musson-Genon
Deputy director: Marc Bocquet

Staff : 62

OVERVIEW

Introduction

The Atmospheric Environment Center (CEREA) is a joint laboratory of École des Ponts ParisTech and the Research & Development Branch of the French Energy Group (EDF R&D). It also hosts a joint effort with the French National Computer Science Institute (Inria, Institut national de recherche en informatique et en automatique), the Clime project-team.

CEREA has three locations in the Paris region (École des Ponts ParisTech in Champs-sur-Marne, EDF R&D in Chatou, and Inria in Rocquencourt).

The main research activities at CEREA focus on modeling the atmospheric environment with particular emphasis on air quality and atmospheric dispersion modeling from short-range to long-range scales, atmospheric dynamics near the Earth's surface (i.e., the so-called atmospheric boundary layer, which extends from the surface to about 1 to 2 km), and the assimilation of data and images into geoscientific models. Thus, research activities cover three major areas:

- Dynamics of the atmospheric boundary layer
- Air quality modeling at local, regional and continental scales
- Data and image assimilation, inverse modeling and network design

Meteorological measurements are conducted to better understand the physical processes that govern the atmospheric flow, air pollutant dispersion and fog formation near the ground. Those measurements are used to evaluate the atmospheric dynamics model and help to improve its parameterizations of atmospheric physical processes.

For modeling atmospheric processes, CEREA uses primarily two numerical modeling platforms: an atmospheric Computational Fluid Dynamics (CFD) model, "Code_Saturne", to simulate the dynamics of the atmospheric boundary layer and an air quality modeling system, "Polyphemus", to simulate the transport processes and chemical transformations of air pollutants. The atmospheric version of "Code_Saturne" was developed at CEREA and it is used to study local pollution, wind power estimates, fog formation, and atmosphere/building energy transfer. "Polyphemus" includes different air quality chemical transport models ranging from short-range dispersion (Gaussian plume and puff models) to long-range transport at regional and continental scales (the chemical transport model Polair3D). Both modeling platforms are open source.

These models are evaluated by comparison to available measurements (included those collected by CEREA) and used for improving our understanding of the atmosphere as well as for practical applications such as impact studies, future scenarios, and air quality forecasting. The research activities devoted to data and image assimilation aim at improving the ability of models to make reliable forecasts and identifying emission sources via inverse modeling.

Applications of research-grade models to real-world case studies include the assessment of the environmental impacts of the transportation and energy production (both fossil-fuel fired and nuclear plants) sectors. These activities are related to the programs of EDF R&D and to the activities of the research and technical centers of the Ministry of Ecology, Sustainable Development, and Energy (MEDDE, ministère de l'Écologie, du Développement Durable et de l'Énergie). Long-term relationships have also been developed with the Technical Center for Transportation Studies of the Nord-Picardie Region (CETE Nord-Picardie) for the air quality impacts of roadways, the French Agency for Radioprotection and Nuclear Safety (IRSN, Institut de radioprotection et de sûreté nucléaire) for impact studies related to radioactive releases and with the French Agency for the Industrial Environment and Risk Analysis (INERIS, Institut national de l'environnement industriel et des risques) for air quality impact studies and forecasting.

Budget summary

The operating budget of CEREAs (excluding salaries of permanent staff and office space rental) was about 800 000 € in 2012. It was about 2 400 000 € if one includes salaries of permanent staff.

Key facts

Marc Bocquet of CEREAS co-organized a summer school on advanced data assimilation for geosciences in the Les Houches School of Physics, at Les Houches, France, 28 May-15 June 2012, with the participation of 53 students and 25 lecturers.

CEREAS is a founding member of the Environmental Science Observatory EFLUVE (Observatoire des sciences de l'univers, OSU), which includes three other laboratories of Université Paris-Est: LISA, LEESU and CERTES.

CEREAS is also a member of the "Labex" Urban Futures, which consists of a group of thirteen laboratories conducting research on urban planning architecture, transportation, environment, and resource economics.

The Clime project-team hosts an I-Lab, which is a joint effort between Inria and a private company (Seth). This I-Lab conducts technology transfer of research tools developed at CEREAS toward their operational use in areas such as data assimilation, ensemble forecasting and uncertainty assessment.

CEREAS participates in several projects of the French National Agency for Research (ANR), as well as the R2DS network on sustainable development in the Île-de-France region. Partnerships with IRSN (French Agency for Nuclear Safety), INERIS (French Agency for the Industrial Environment and Risk Analysis), the Technical Center for Transportation Studies of the Nord-Picardie region (CETE Nord-Picardie) and the scientific and technical network for air issues of the Ministry of Ecology (MEDDE) are very active and lead to the use for real-world case studies by these organizations of methods and models developed at CEREAS.

CEREAS is an official partner of the French national air quality forecast system Prev'air (<http://www.prevoir.org>). CEREAS developed the method used to conduct improved air quality forecasts using ensemble modeling (i.e., several models rather than a single model) and data assimilation. Furthermore, the CEREAS air quality model (Polair3D of Polyphemus) is part of this ensemble modeling system. The Polair3D/Polyphemus forecast is available on the CEREAS web site (<http://cerea.enpc.fr/fr/prevision.html>).

At SIRTA, the experimental site for atmospheric research using remote sensing (<http://sirta.ipsl.polytechnique.fr>), CEREAS is setting up a new experiment to study air pollutant dispersion under stable atmospheric conditions using propene, which is released upwind of an array of fast-response monitors. Several industrial and government organizations have expressed interest in participating in those experiments with their instruments.

Prizes

Florian COUVIDAT received the 2012 Jean Bricard Prize from the French Association for Aerosol Research (ASFERA) for his thesis work on modeling atmospheric organic aerosols.

Results

Completed projects

The ANR MSDAG project, managed by CEREAs, on the assimilation of data in multi-scale geophysical models has led to innovative techniques to improve data assimilation in geophysics. Implications will be beneficial to various areas of geophysics including climate science and atmospheric pollution. We anticipate that, in addition to academic contributions in the scientific literature, operational tools will be developed and made available to the scientific community over the next few years. This project ended in September 2012.

A new method, the finite-size ensemble Kalman filter (EnKF-N), was developed that allows one not to use arbitrary inflation parameters to account for ensemble sampling errors when applying an ensemble Kalman filter (EnKF) for data assimilation. EnKF-N was further combined with the iterative ensemble Kalman filter (IEnKF) to constitute the finite-size iterative ensemble Kalman filter (IEnKF-N), which performs as well as or better than previous EnKF algorithms and much better for strongly non-linear systems without inflation.

Four Ph.D. theses on atmospheric particles were completed in 2012. They focused on nanoparticles, organic aerosols and the dynamics of multi-species aerosols. This work combines modeling and measurements in a constructive and judicious fashion. The results of these theses led to new and improved models for simulating the formation and fate of atmospheric particles in indoor and outdoor atmospheres. In particular, the importance of emissions of semi-volatile organic compounds (SVOC), which are not currently included in standard emission inventories, was demonstrated. Further work continues with three ongoing Ph.D. theses to incorporate the aerosol models into 3D air quality models and compare simulation results with observations.

Data assimilation is at the heart of many projects conducted at CEREAs. To facilitate the applications of methods developed at CEREAs and elsewhere, a generic data assimilation methods library, named "Verdandi", is under development, and already available.

A multi-scale model to simulate the impacts of roadway traffic on air quality was completed and successfully evaluated against a large observational dataset covering over 800 km of roads. The model has been incorporated into the Polyphemus air quality modeling platform and will be used operationally for air quality impact studies.

For the first time in air quality studies, a data assimilation method (4D-Var- ξ) was proposed to objectively quantify representativeness errors attached to monitoring stations within a standard data assimilation approach (4D-Var here). It was successfully validated in the inverse modelling of the carbon monoxide emissions over France.

CEREAs was the first group to publish an estimation of the Fukushima-Daiichi nuclear accident source terms of cesium-137 and iodine-131 using a mathematically rigorous inverse modeling method.

Inverse modeling of volatile organic compounds (VOC) was conducted to evaluate the European VOC emission inventory; significant uncertainties were identified for some VOC and recommendations to improve the spatial distribution and speciation of VOC emissions were made.

The final report on the influence of low-emission zones (LEZ) on air quality in cities (in particular, nitrogen dioxide – NO₂ – concentrations) was completed for the Agency for the Environment and Energy Management (ADEME). Such LEZ were shown to help improve air quality, but long-term emission control measures are necessary to reach air quality standards.

Ongoing projects

Work is ongoing on the use of the CFD model "Code_Saturne" to simulate heat exchange between buildings and the atmosphere. The development of accurate modeling tools to correctly assess energy transfer is essential for managing our energy consumption in buildings as a function of varying atmospheric conditions. A detailed comparison between model simulation results and experimental data was conducted for an area of the southern city of Toulouse and will continue with areas of Marseille and Paris under a new ANR project, in collaboration with Météo France and other laboratories.

Under several programs of ANR and the French Ministry of Ecology (MEDDE), CEREAs is developing new modeling tools to simulate atmospheric dispersion and deposition of pollutants to urban watersheds. This work is conducted in collaboration with LEESU (the water quality laboratory of École des Ponts ParisTech) and IFSTTAR. Recent results include the development of a novel method to calculate the deposition of air pollutants in urban settings (ANR INOGEV project) and the coupling of a dynamic traffic model with various air pollutant emission models ("Ville numérique" Project).

The first dynamic evaluation of the ability of an air quality model to simulate the effect of meteorology on air quality (in particular, PM_{2.5} concentrations) was conducted. Work is ongoing in collaboration with the European Center for Scientific Computing (Centre Européen de Recherche et de Formation Avancée pour le Calcul Scientifique, CERFACS) to use the air quality model simulation results in combination with future climate to estimate the effect of climate change on PM_{2.5} concentrations.

A project funded by ADEME, conducted in collaboration with the UPEC laboratory LISA, is assessing the potential impacts of the atmospheric particulate matter program ("Plan particules") on air quality and emissions of greenhouse gases. Preliminary results were provided to ADEME in 2012.

CEREAs is involved in the development and validation of methodologies for onshore and offshore wind resource assessment including the modelling of wake effect. This work is especially important in the short term for EDF-Énergies Nouvelles, which is in charge of the development of 3 offshore wind farms in France in the framework of a consortium including Dong and Alstom. New methodologies based on CFD models should allow one to reduce the uncertainty on the estimation of the annual energy production compared to the current operational tools.

Models for gas and aerosol transformation processes have been incorporated in the CFD model Code_Saturne. Different levels of complexity of the chemical scheme have been compared for different background concentrations, different emission rates, and different meteorological conditions. Thus it is now possible to take into account the chemical transformations in the simulations with Code_Saturne of the impact of traffic or industrial releases on air quality.

Laboratory Staff

Permanent research staff and faculty

- **BOCQUET Marc**, École des Ponts ParisTech, Senior research scientist and Professor (ICPEF), HDR
- **CARISSIMO Bertrand**, EDF R&D, Senior research engineer, HDR
- **DUPONT Éric**, EDF R&D, Research engineer
- **HERLIN Isabelle**, Inria, Senior research scientist (DR2)
- **HUOT Étienne**, Inria, Université de Versailles Saint-Quentin-en-Yvelines, Associate professor (MdC)
- **MALLET Vivien**, Inria, Research scientist (CR1)
- **MILLIEZ Maya**, EDF R&D, Research engineer
- **MUSSON-GENON Luc**, EDF R&D, Research engineer (IGPEF)
- **ROUSTAN Yelva**, École des Ponts ParisTech, Research scientist (CR2)
- **SARTELET Karine**, École des Ponts ParisTech, Research scientist (CR1)
- **SEIGNEUR Christian**, École des Ponts ParisTech, Director and Professor, HDR

External collaborators

- **BÉRÉZIAT Dominique**, Université Pierre-et-Marie-Curie, Associate professor (MdC), HDR
- **ZHUK Sergey**, IBM Research Dublin, Ireland, Research scientist

Post-doctoral scientists

- **BECERRA-BARAUD Giuliana**, École des Ponts ParisTech
- **CHAHINE ALI**, École des Ponts ParisTech
- **DREVET Jérôme**, École des Ponts ParisTech
- **DUHANYAN Nora**, École des Ponts ParisTech
- **GIRAULT Laetitia**, École des Ponts ParisTech
- **HERGAULT Virginie**, École des Ponts ParisTech
- **KIM Youngseob**, École des Ponts ParisTech
- **PAPARI Guisepepe**, Inria
- **QU Yongfeng**, École des Ponts ParisTech
- **WU Lin**, École des Ponts ParisTech
- **YAN Nicolas**, École des Ponts ParisTech
- **ZAÏDI Hanane**, École des Ponts ParisTech

Ph.D. students

- **ABDALLAH Charbel**, École des Ponts ParisTech, ED SIE
- **BAUDIN Paul**, Inria, ED Sciences Mathématiques Paris Centre
- **BRIANT Régis**, École des Ponts ParisTech, ED SIE
- **CHERIN Nicolas**, École des Ponts ParisTech, ED SIE
- **COUVIDAT Florian**, ADEME, ED SIE
- **DALL'OZZO Cédric**, EDF R&D, ED SIE
- **DAVIAU-PELLEGRIN Noëlie**, EDF R&D, ED SIE
- **DERGAOUI Hilel**, INERIS, ED SIE
- **DESCHAMPS Stéphanie**, École des Ponts ParisTech, ED SIE
- **DEVILLIERS Marion**, INERIS, ED SIE
- **DRIFI Karim**, Inria, ED Sciences Mathématiques Paris Centre
- **DURASAMY Venkatesh**, EDF R&D, ED SIE
- **FALLAH SHORSHANI Masoud**, IFSTTAR, ED SIE
- **KOOHKAN Mohammad Reza**, École des Ponts ParisTech, ED SIE
- **LECOEUR Ève**, École des Ponts ParisTech, ED SIE
- **LEPOITTEVIN Yann**, Inria, ED Sciences Mathématiques Paris Centre
- **LOIZEAU Vincent**, EDF R&D, ED SIE
- **MAKKÉ Laurent**, École des Ponts ParisTech, ED SIE
- **WAKED Antoine**, École des Ponts ParisTech, ED SIE
- **WANG Yiguo**, CEA, ED École Polytechnique
- **WEI Xiao**, EDF R&D, ED SIE
- **WINIAREK Victor**, École des Ponts ParisTech, ED SIE
- **ZHU Shupeng**, École des Ponts ParisTech, ED SIE
- **ZYSK Janusz**, École des Ponts ParisTech, ED SIE

Interns

- **BAUDIN Paul**, Inria
- **DAVIAU-PELLEGRIN Noëlie**, EDF R&D
- **LEPOITTEVIN Yann**, Inria
- **MEZDOUR Ali**, École des Ponts ParisTech
- **TARDIEU Guillaume**, EDF R&D
- **WEI Xiao**, EDF R&D

Engineers, administrative staff and technicians

Engineers

- **BRESSON Raphaël**, EDF R&D, Engineer
- **CHARPENTIER Kévin**, Inria, Associate engineer
- **DEMENGEL Dominique**, EDF R&D, Engineer
- **DORÉ Sylvain**, École des Ponts ParisTech, Engineer
- **GILBERT Éric**, EDF R&D, Engineer
- **LEFRANC Yannick**, EDF R&D, Engineer
- **PÉRILLAT Raphaël**, Inria, Associate engineer
- **TILLOY Anne**, Inria, Engineer
- **WENDUM Denis**, EDF R&D, Engineer

Administrative staff

- **DEHLINGER Véronique**, École des Ponts ParisTech
- **GAUDECHOUX Nathalie**, Inria

Technicians

- **FAUCHEUX Aurélien**, École des Ponts ParisTech
- **ROZBORSKI Sébastien**, EDF R&D

RESEARCH

Publications

Articles in peer-reviewed international journals

- **Bocquet M.** Parameter field estimation for atmospheric dispersion: Application to the Chernobyl accident using 4D-Var, *Q. J. R. Meteor. Soc.*, **138**, 664-681, doi:10.1002/qj.961, (2012).
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- **Briant R., C. Seigneur.** Development of a new plume-in-grid model for roadways combining an Eulerian model with a Gaussian line-source model, 92nd American Meteorological Society Annual Meeting, 22-26 January 2012, New Orleans, Louisiana, USA
- **Fallahshorshani M., M. André, C. Bonhomme, C. Seigneur.** Coupling traffic, pollutant emission, air and water quality models: Technical review and perspectives, Transport Research Arena Europe 2012, 23-26 April 2012, Athens, Greece, *in Proc. Social Behavioral Sci.*, **48**, 1794-1804 (2012)
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- **Béréziat D., I. Herlin.** Nonlinear observation equation for motion estimation, International conference Inverse Problems: Identification, Design and Control (ICIP), October 2012, Orlando, Florida, USA
- **Herlin I., D. Béréziat, É. Huot.** Image assimilation and motion estimation of geophysical fluids, International Environmental Modeling and Software Society (iEMSs), July 2012, Leipzig, Germany
- **Herlin I., D. Béréziat, N. Mercier.** Improvement of motion estimation by assessing the errors on the evolution equation, VISAPP 2012 : International Conference on Computer Vision Theory and Applications, Vol. 2, pp. 235-240, February 2012, Rome, Italy
- **Herlin I., D. Béréziat, N. Mercier. S. Zhuk.** Divergence-free motion estimations, ECCV 2012 : European conference on Computer Vision, vol. 7575, pp. 15-27, doi :10.1007/978-3-642-33765-9_2, A. Fitzgibbon, S. Lazebnik, P. Perona, Y. Sato, eds, October 2012, Florence, Italy
- **Herlin I., K. Drifi.** Learning reduced models for motion estimation on long temporal image sequences, IEEE International Geoscience and Remote Sensing Symposium (IGARSS), 2012, Munich, Germany
- **Herlin I., É. Huot.** Monitoring surface currents from uncertain image observations, International conference on Problems of Decision Making under Uncertainty (PDMU), September 2012, Brno, Czech Republic
- **Herlin I., O. Nakonechnyi, S. Zhuk.** Minimax optimal flow estimation from a sequence of 2D images, International conference on Problems of Decision Making under Uncertainty (PDMU), September 2012, Brno, Czech Republic
- **Wang Y., K. Sartelet, M. Bocquet, P. Chazette.** Assimilation of ground versus lidar observations for PM10 forecasting, European Geosciences Union General Assembly 2012, 23-27 April 2012, Vienna, Austria
- **Qu Y., M. Milliez, L. Musson-Genon, B. Carissimo.** 3D radiative and convective modelling of urban environment: an example for the city center of Toulouse, 32rd NATO/SPS International Technical Meeting on Air Pollution Modelling and its Application (ITM), 7-11 May, 2012, Utrecht, The Netherlands
- **Dupont E., Y. Lefranc, L. Soulier, D. Koulibaly.** Detailed analysis of uncertainty reduction on power curve determination using lidar measurements, European Wind Energy Association Conference, 16-19 April 2012, Copenhagen, Denmark
- **Duraisamy Jothiprakasam V., E. Dupont, B. Carissimo.** Towards a new methodology for wind resource downscaling with CFD in complex terrain. European Wind Energy Association Conference, 16-19 April 2012, Copenhagen, Denmark
- **Duraisamy Jothiprakasam V., E. Dupont, B. Carissimo.** Downscaling wind energy resource from mesoscale to microscale model and data assimilating field measurements. The science of making torque from wind, 9-11 October 2012, Oldenburg, Germany
- **Zaidi H., E. Dupont, M. Milliez, B. Carissimo, L. Musson Genon.** Long term local simulation of atmospheric dispersion conditions over a complex terrain using a clustering method. 32st NATO/SPS International Technical Meeting on Air Pollution Modelling and its Application 7-11 May, 2012, Utrecht, The Netherlands

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- **Couvidat F., K. Sartelet, C. Seigneur.** Modélisation des aérosols organiques secondaires en zone urbaine : application à l'Île-de-France, 27^{ème} congrès français sur les aérosols, CFA 2011, 25-26 January 2012, Paris, France
- **Keirsbulck M., G. Boulanger, M. André, C. Bugajny, G. Plassat, E. Rivière, J. Sciare, C. Seigneur.** Étude d'impact d'infrastructures routières et les effets de la pollution de l'air sur la santé : la prise en compte des particules, Ateliers scientifiques « Pollution par les particules : impacts sur la santé, l'air et le climat », 13-14 November 2012, Paris, France; in *Pollution Atmosphérique, Numéro spécial, Ateliers scientifiques : « Pollution par les particules, impacts sur la santé, l'air et le climat »*, 45-48 (2012)
- **Seigneur, C.** Penser le futur urbain pour une meilleure qualité de l'air, Ateliers scientifiques « Pollution par les particules : impacts sur la santé, l'air et le climat », 13-14 November 2012, Paris, France; in *Pollution Atmosphérique, Numéro spécial, Ateliers scientifiques : « Pollution par les particules, impacts sur la santé, l'air et le climat »*. 144-146 (2012)
- **Wang Y., K. Sartelet, M. Bocquet, P. Chazette.** Assimilation of ground versus lidar observations for PM10 forecasting, Colloque National sur l'Assimilation des Données, 17-19 December 2012, Nice, France
- **Qu Y., M. Milliez, L. Musson-Genon, B. Carissimo.** 3D radiative and convective modeling in the urban atmosphere with CAPITOUL field experiment, Colloque « La modélisation des flux au service de l'aménagement urbain », 13 et 14 juin 2012, Lille, France

International conference oral and poster presentations

- **Cherin N., Y. Roustan, C. Seigneur, L. Musson-Genon.** Dry deposition of air pollutants over urban areas, European Geosciences Union General Assembly 2012, 23-27 April 2012, Vienna, Austria
- **Couvidat F., C. Seigneur.** Influence of humidity on SOA formation from isoprene oxidation: Effect of NO_x level, European Geosciences Union General Assembly 2012, 23-27 April 2012, Vienna, Austria
- **Dall'Ozzo C., B. Carissimo, L. Musson-Genon, E. Dupont, and M. Milliez.** Intercomparison of different subgrid-scale models for the Large Eddy Simulation of the diurnal evolution of the atmospheric boundary layer during the Wangara experiment, European Geosciences Union General Assembly 2012, 23-27 April 2012, Vienna, Austria
- **Lecoeur Ève, C. Seigneur, L. Terray, C. Pagé.** Influence of climate on PM_{2.5} concentrations over Europe: a meteorological analysis using a 9-year model simulation, European Geosciences Union General Assembly 2012, 23-27 April 2012, Vienna, Austria
- **Girault L., Y. Roustan, C. Seigneur.** Air quality modelling: effects of emission reductions on concentrations of particulate matter, European Geosciences Union General Assembly 2012, 23-27 April 2012, Vienna, Austria
- **Waked A., N., C. Afif, C. Seigneur.** A modelling study of air pollution in Beirut city for the summer of 2011, European Geosciences Union General Assembly 2012, 23-27 April 2012, Vienna, Austria
- **Waked A., C. Afif, C. Seigneur.** An atmospheric emission inventory of anthropogenic and biogenic sources for Lebanon, 2012 ACCENT-IGAC-GEIA Conference – Emissions to Address Science and Policy Needs, 11-13 June 2012, Toulouse, France
- **Girault L., Y. Roustan, C. Seigneur.** Air quality modelling: Effect of emission reductions on concentrations of particulate matter, Urban Environmental Pollution Conference, 17-20 June 2012, Amsterdam, The Netherlands
- **Cherin N., Y. Roustan, C. Seigneur, L. Musson-Genon.** Dry deposition modelling of air pollutants over urban areas, Urban Environmental Pollution Conference, 17-20 June 2012, Amsterdam, The Netherlands
- **Couvidat F., K. Sartelet, C. Seigneur.** Development of an aqueous-phase mechanism for secondary organic aerosol formation, European Aerosol Conference EAC-2012, 2-7 September 2012, Granada, Spain
- **Lecoeur È, C. Seigneur, C. Pagé, L. Terray.** Relationships between present/future climate and PM_{2.5} concentrations over Europe, American Geophysical Union Fall Meeting 2012, 3-7 December 2012, San Francisco, California, USA
- **Mallet V., G. Stoltz, S. Zhuk, A. Nakonechniy.** Ensemble Forecast of Analyses With Uncertainty Estimation, International Conference on Ensemble Methods in Geophysical Sciences, 12-16 November 2012, Toulouse, France

- **Debry É., V. Mallet, F. Meleux, B. Bessagnet, L. Rouil.** Ensemble forecasting coupled with data assimilation, and threshold exceedance detection on Prev'Air, ITM, 7-11 May 2012, Utrecht, The Netherlands
- **Mallet V., D. Garaud.** Data-Constrained Uncertainty Estimation In Air Quality Simulation, NUMDIFF-13, 10-14 September 2012, Halle, Germany
- **Qu Y., M. Milliez, L. Musson-Genon, B. Carissimo.** Impact of urban radiativetransfers and complex canopy geometry on pollutant dispersion in a real urban environment, 16th Annual George Mason University Conference on Atmospheric Transport and Dispersion Modeling (GMU), July 17-18, 2012, Virginia, USA
- **Bocquet M., P. Sakov.** Finite-size ensemble Kalman filters (EnKF-N). EnKF workshop, 22-24 May 2012, Albany, NY, USA
- **Saunier O., A. Mathieu, D. Didier, M. Tombette, D. Quélo, V. Winiarek, M. Bocquet.** Using Gamma Dose Rate Observations with Inverse Modelling Techniques to Estimate the Atmospheric Release of a Nuclear Power Plant Accident: Application to the Fukushima Case, ANS Winter meeting & Nuclear Technology Expo, 11-15 November 2012, San Diego, California, USA
- **Wu L., M. Bocquet, F. Chevallier.** On Uncertainty Quantification in CO₂ Flux Inversion, TransCom Meeting 2012, 4-8 June 2012, Nanjing, China
- **Gray M., J.-M. Conan, T. Fusco, C. Petit, L. Bertino, M. Bocquet, S. Rdionov, B. Le Roux.** Ensemble Transform Kalman Filter, A non stationary control law for complex AO systems on VLTs & ELTs : Theoretical aspects and first simulation results. SPIE, Adaptive Optics Systems III, 5 July 2012, Amsterdam, The Netherlands
- **Bocquet M.** Optimal monitoring network design for air quality, Symposium on air quality observing systems, 9-12 January 2012, Santiago, Chile
- **Bocquet M., V. Winiarek.** Estimation of Errors in the Inverse Modeling of Accidental Release of Atmospheric Pollutant: Application to the Reconstruction of the Cesium-137 and Iodine-131 Source Terms from the Fukushima Daiichi Power Plant, Fukushima Daiichi workshop, 22-23 February 2012, NCAR, Boulder, Colorado, USA
- **Bocquet M.** An introduction to inverse modelling and parameter estimation for atmospheric and oceanic sciences. Summer school Advanced Data Assimilation, 28 May-15 June 2012, Les Houches, France
- **Bocquet M., L. Wu, F. Chevallier, M.R. Koohkan.** Selected topics in multiscale data assimilation, part II. Summer school Advanced Data Assimilation, 28 May-15 June 2012, Les Houches, France
- **Bocquet M.** About finite-size and iterative ensemble Kalman filters. 7th EnKF workshop, 18-20 June 2012, Bergen, Norway
- **Bocquet M.** Theoretical developments in data assimilation with relevance to land data assimilation. ISSI Hydrological Cycle International Team meeting, 28th June 2012, Bern, Switzerland
- **Bocquet M.** Reconstruction of tropospheric emissions: A brief tour of DA parameter estimation with (not too) complex models. DADA exploratory workshop, 15-18 October 2012, Buenos Aires, Argentina
- **Bocquet M.** Finite-size ensemble Kalman filters (EnKF-N) – Iterative ensemble Kalman smoothers (IEnKS), International Conference on Ensemble Methods in Geophysical Sciences. 12-16 November 2012, Toulouse, France
- **Bocquet M., A. Groth, M. Ghil, P. Dumas.** Towards using data assimilation in macro-economic dynamical models. Climate Economics Workshop, 22-23 November 2012, Ecole Normale Supérieure, Paris, France
- **Koohkan M.R., M. Bocquet.** Inversion of atmospheric tracers and the representativeness error: Coupling 4D-Var with a simple subgrid statistical model, European Geosciences Union General Assembly 2012, 23-27 April 2012, Vienna, Austria

National conference oral and poster presentations

- **Girault L., Y. Roustan, C. Seigneur.** Modélisation de la pollution atmosphérique : Effets des réductions d'émissions sur les concentrations en particules fines (PM_{2.5}), Journées Interdisciplinaires de la Qualité de l'Air (JIQA 2012), 2-3 February 2012, Villeneuve d'Ascq, France
- **Mallet V.** Estimation des incertitudes et assimilation de données en simulation de la qualité de l'air, Rencontres doctorales IMREDD, 8-10 October 2012, Nice, France

- **Mallet V.** Simulation numérique et assimilation de données pour la qualité de l'air à l'échelle urbaine, Rencontre In'Tech, 27 September 2012, Grenoble, France
- **Mallet V., S. Zhuk, A. Nakonechniy, G. Stoltz.** Prédiction d'ensemble de l'analyse avec estimation d'incertitude, Journée LEFE, 21 March 2012, Paris, France
- **Roustan Y, V. Winiarek, N. Duhanyan, M. Bocquet, N. Talerko, O. Saunier, A. Mathieu.** Modélisation inverse du terme source de l'accident de Tchernobyl à l'aide des mesures de flux de dépôt de radionucléides, 4th Colloque national d'assimilation de données, 17-19 December 2012, Nice, France
- **Bocquet M., M.R. Koohkan.** Inverse modeling of carbon monoxide fluxes, ADOMOCA-2, 10-12 September 2012, Les Lecques, France
- **Winiarek V., M. Bocquet, O. Saunier, A. Mathieu.** Estimation des erreurs et modélisation inverse de rejets accidentels de polluants atmosphériques : application au cas de l'accident de Fukushima Daiichi, ADOMOCA-2, 10-12 September 2012, Les Lecques, France
- **Bocquet M.** Projet MSDAG: Assimilation de données multi-échelles en géosciences, ANR - Grand colloque STIC 2012, 4-6 January 2012, Lyon, France
- **Bocquet M.** Assimilation de données et optimisation de réseaux de mesure pour la surveillance environnementale. Atelier GéoStic, CRAN, Université de Lorraine, 14 December 2012, Nancy, France
- **Winiarek V., M. Bocquet, O. Saunier, A. Mathieu.** Estimation des erreurs et incertitudes dans la modélisation inverse de rejets accidentels de polluants atmosphériques : Application à la reconstruction des termes sources de Césium-137 et Iode-131 émis par la centrale nucléaire de Fukushima Daiichi, INSU/LEFE-MANU workshop "Assimilation et incertitudes", 21 March 2012, ENS, Paris, France
- **Wu L., F. Chevallier, M. Bocquet, T. Lauvaux, T. Wang.** Uncertainty Quantification in CO2 Flux Inversion, Journée thématique LEFE Assimilation et incertitudes, 21 March 2012, ENS, Paris, France

Committee activities

Editorial boards

- **Bocquet M.**, Associate Editor, "Quartely Journal of the Royal Meteorological Society"
- **Musson-Genon L.**, Scientific Committee, « Pollution Atmosphérique »

International conference committees

- **Bocquet M.**, Co-organizer, Les Houches international summer school, "Advanced data assimilation for geosciences", 28 May – 15 June 2012, Les Houches, France
- **Bocquet M.**, Member of the scientific committee of the conference: "International Conference on Ensemble Methods in Geophysical Sciences". 12-16 November 2012, Toulouse, France

National conference committees

- **Bocquet M.**, Co-organizer, 4th Colloque national d'assimilation de données, 17-19 December 2012, Nice, France
- **Bocquet M.**, Co-organizer, INSU/LEFE-MANU workshop "Assimilation et incertitudes", 21 March 2012, Paris, France

Conference session chairs

- **Herlin I.**, "Analysis of data of different scales and sources for mesoscale environmental models" sessions, International congress on Environmental Modeling and Software (IEMSs2012), 1-5 July 2012, Leipzig, Germany

- **Seigneur C.**, "Aérosols et Environnement" session, 27th Congrès Français sur les Aérosols, 25-26 January 2012, Paris, France
- **Bocquet M.**, Session : "Identification and Representation of Model Errors", International Conference on Ensemble Methods in Geophysical Sciences. 12-16 November 2012, Toulouse, France
- **Bocquet M.**, 4th Session, Colloque National d'Assimilation de Données, 17-19 December 2012, Nice, France

Scientific committees

- **Bocquet M.** Scientific committee, European Center for Scientific Computing (CERFACS).
- **Bocquet M.** Co-chair: Scientific Committee of the "Mathematical and numerical methods" (MANU) activity of the research program, "Les enveloppes fluides et l'environnement" (LEFE) of the National Institute of Earth and Space Science (INSU)
- **Demengel D., E. Dupont, I. Herlin, Y. Roustan, C. Seigneur.** Council, EFLUVE Observatory (Observatoire des sciences de l'univers ; Enveloppes fluides : de la ville à l'exobiologie).
- **Herlin I.**, Scientific Council of the High Council for Strategic Education and Research in France (CSFRS)
- **Milliez M.** Management Committee of the Earth System Science and Environmental Management Domain, COST Action ES-10-06, "Evaluation, improvement and guidance for the use of local-scale emergency prediction and response tools for airborne hazards in built environment".
- **Musson-Genon L.** Chair: Scientific Committee, "Site instrumental de recherche par télédétection atmosphérique" (SIRTA)
- **Sartelet K.** Scientific committee, SIRTA
- **Sartelet K.** Scientific Committee of the "Atmospheric Chemistry" (CHAT) activity of the research program "Les enveloppes fluides et l'environnement" (LEFE) of the National Institute of Earth and Space Science (INSU)
- **Seigneur C.** Chair: Working Group on the selection of air pollutants for risk assessment of roadway projects, French Agency for Food, Environmental and Occupational Health & Safety (ANSES)
- **Seigneur C.** Expert Committee (CES) for the risk assessment of air pollutants, French Agency for Food, Environmental and Occupational Health & Safety (ANSES)
- **Seigneur C.** General Assembly of the Air Quality Agency for the Paris Region (AIRPARIF)
- **Seigneur C.** Management Committee of the Earth System Science and Environmental Management Domain, COST Action ES-10-04, "European framework for online integrated air quality and meteorological modelling"
- **Seigneur C.** National Funding Commission (CNA) for climate, air and energy of the Agency for Environment and Energy Management (ADEME)
- **Seigneur C.** Scientific Advisory Committee of Interagency Research Program for Improved Local Air Quality (PRIMEQUAL)
- **Seigneur C.**, Scientific Committee of the Chronic Risk Division (DRC) of the National Institute of Industrial Environment and Risk (INERIS)
- **Seigneur C.**, Operational Group N°1 "Energy-Environment", Program for Research and Innovation in Transportation (PREDIT 4)
- **Seigneur C.** Scientific Committee of the Global Monitoring for Environment and Security (GMES) program of the Ministry of Ecology, Sustainable Development, and Energy (GMES-MDD)
- **Seigneur C.** Scientific and Steering Committee of the Excellence Laboratory (Labex) "Urban Futures"

Thesis committees

- **Seigneur C.** Ph.D. thesis, Qije Zhang, « Simulation de la matière particulaire dans la région parisienne, en particulier de l'aérosol organique », Université Paris Diderot, 28 March 2012.
- **Seigneur C.** Ph.D. thesis, Maxence Mendez, « Étude expérimentale de la réactivité hétérogène de particules ultrafines d'acides gras et modélisation de la composition chimique des aérosols à l'échelle régionale », Université Lille 1, 27 November 2012.

HDR committees

- **Bocquet M.** HDR, Thibaut Montmerle, « Assimilation des données à moyenne échelle pour l'étude des systèmes précipitants », Université Paul Sabatier Toulouse III, 27 January 2012.
- **Seigneur C.** HDR, Jeroen Sonke, « Exploring the isotopic dimension of the global mercury cycle », Université Paul Sabatier Toulouse III, 25 May 2012.
- **Seigneur C.** HDR, Aurélien Dommergue, « Cycle biogéochimique du mercure en régions polaires », Université Joseph Fourier Grenoble, 22 June 2012.
- **Bocquet M.** HDR, Olivier Pannekoucke, « Dynamique et modélisation de l'information dans les modèles météorologiques », Université Paul Sabatier Toulouse III, 15 November 2012.
- **Seigneur C.** HDR, Isabelle Coll, « Analyse par modélisation des processus gouvernant la pollution photochimique multi-échelles – Aide à la décision environnementale », Université Paris-Est, 3 December 2012.

EDUCATIONAL ACTIVITIES

Ph.D. theses

Completed Ph.D. theses

- **BRIANT Régis.** Multi-scale mathematical modeling of the air quality impacts of roadway traffic (Modélisation multi-échelles de l'impact du trafic routier sur la qualité de l'air). Advisor: Christian Seigneur. ED SIE.
- **COUVIDAT Florian.** Mathematical modeling of atmospheric organic aerosols (Modélisation des aérosols organiques dans l'atmosphère). Advisor: Christian Seigneur; Co-advisor: Karine Sartelet. ED SIE.
- **DERGAOUI Hilel.** Coagulation of an externally mixed aerosol population: mathematical modeling and experiments (Coagulation d'une population d'aérosols en mélange externe : modélisation et expériences). Advisor: Christian Seigneur; co-advisors: Édouard Debry and Karine Sartelet. ED SIE.
- **DEVILLIERS Marion.** Mathematical modeling and numerical simulation of the dynamics of nanoparticles (Modélisation et simulation numérique de la dynamique des nanoparticules). Advisor: Christian Seigneur; co-advisor: Édouard Debry. ED SIE.
- **KOOHKAN Reza.** Inverse modeling and data assimilation in air quality (Modélisation inverse et assimilation de données en qualité de l'air). Advisor: Marc Bocquet. ED SIE.
- **WAKED Antoine.** Characterization of organic aerosols in Beirut, Lebanon (Caractérisation des aérosols organiques à Beyrouth, Liban). Advisor: Christian Seigneur; co-advisor: Charbel Afif. ED SIE.

Ongoing Ph.D. theses

- **ABDALLAH Charbel.** Characterization of aerosol mass and number concentrations in Beirut, Lebanon (Caractérisation des aérosols (masse et nombre) à Beyrouth, Liban). Advisor: Bertrand Carissimo; co-advisor: Karine Sartelet. ED SIE.
- **BAUDIN Paul.** Sequential aggregation of predictors applied to air quality forecasting (Agrégation séquentielle de prédicteurs appliquée à la prévision de la qualité de l'air). Advisor: Isabelle Herlin; co-advisors: Vivien Mallet, Gilles Stoltz. ED Sciences Mathématiques Paris Centre.
- **CHERIN Nicolas.** Characterization of air pollution sources and pollutant deposition onto urban watersheds (Caractérisation des sources de polluants atmosphériques et de leurs dépôts sur les bassins versants urbains). Advisor: Christian Seigneur; co-advisor: Yelva Roustan. ED SIE.
- **DALL'OZZO Cédric.** Mathematical modeling of complex atmospheric flows with large eddy simulation (Modélisation d'écoulements atmosphériques complexes par la simulation des grandes échelles). Advisor: Bertrand Carissimo; co-advisor: Luc Musson-Genon. ED SIE.
- **DAVIAU-PELLEGRIN Noëlie.** Fine-scale modeling of heat transfer between buildings and the atmosphere (Étude fine des échanges énergétiques entre les bâtiments et l'atmosphère). Advisor: Bertrand Carissimo; co-advisor: Maya Milliez. ED SIE

- **DESCHAMPS Stéphanie.** Air quality modeling: particles number concentrations (Modélisation de la qualité de l'air : nombre de particules). Advisor: Marc Bocquet; co-advisor: Karine Sartelet. ED SIE.
- **DRIFI Karim.** Motion estimation using Data Assimilation in reduced order models (Estimation du mouvement par assimilation de données dans des modèles dynamiques d'ordre réduit). Advisor: Isabelle Herlin. ED Sciences Mathématiques Paris-Centre.
- **DURAIAMY JOTHIPRAKASAM Venkatesh.** Downscaling the wind energy resource in complex terrain using a coupled mesoscale microscale CDF modeling system including wake effect (Descente d'échelle de l'énergie éolienne en terrain complexe avec un code de mécanique des fluides avec effet de sillage). Advisor: Bertrand Carissimo; co-advisor: Éric Dupont. ED SIE.
- **FALLAH SHORSHANI Masoud.** Modeling air pollution from road traffic in urban areas (Modélisation de la pollution atmosphérique liée à la circulation automobile en zone urbaine). Advisor: Christian Seigneur; co-advisors: Michel André, IFSTTAR, Céline Bonhomme, LEESU. ED SIE.
- **LECOEUR Ève.** Effect of climate change on air quality in Europe (Influence de l'évolution climatique sur la qualité de l'air en Europe). Advisor: Christian Seigneur; co-advisor: Laurent Terray, CERFACS. ED SIE.
- **LEPOITTEVIN Yann.** Tracking of images structures (Suivi des structures d'images). Advisor: Isabelle Herlin. ED Sciences Mathématiques Paris Centre.
- **LOIZEAU Vincent.** Modeling of soil atmosphere exchange for POPs and mercury (Modélisation des échanges sol-atmosphère pour les polluants organiques et le mercure). Advisor: Marc Bocquet; co-advisors: Philippe Ciffroy, LNHE, EDF R&D, Luc Musson-Genon, Yelva Roustan. ED SIE.
- **MAKKÉ Laurent.** 3D Fog modeling (Modélisation 3D des rétroactions microphysique de l'eau, turbulence, rayonnement dans les nuages bas). Advisor: Bertrand Carissimo; co-advisors: Maya Milliez, Luc Musson-Genon. ED SIE.
- **WANG Yiguo.** A new approach for air quality modeling at the regional scale with lidar data assimilation (Une nouvelle approche de modélisation de la qualité de l'air à l'échelle régionale par assimilation de mesures lidar). Advisor: Marc Bocquet; co-advisors: Patrick Chazette, LSCE, CEA, Karine Sartelet. ED École Polytechnique.
- **WEI Xiao.** Experimental and numerical study of atmospheric turbulence and dispersion under stable conditions in near-field (étude expérimentale et numérique de la turbulence et de la dispersion atmosphériques en conditions stables en champ proche). Advisor: Bertrand Carissimo; co-advisor: Éric Dupont. ED SIE.
- **WINIAREK Victor.** Dispersion en milieu urbain et modélisation inverse de sources. Atmospheric dispersion in an urban area and inverse modeling of sources. Advisor: Marc Bocquet; co-advisor: Bertrand Carissimo. ED SIE.
- **ZHU Shupeng.** Modeling externally-mixed aerosols (Modélisation du mélange externe des aerosols). Advisor: Christian Seigneur; co-advisor: Karine Sartelet. ED SIE.
- **ZYSK Janusz.** Mathematical modeling of air pollution in Poland (Modélisation de la pollution pour la Pologne). Advisor: Christian Seigneur; co-advisor: Yelva Roustan. ED SIE.

Teaching

École des Ponts ParisTech

- **CARISSIMO Bertrand, MILLIEZ Maya,** MECA 1 & 2, Mécanique des fluides (Fluid mechanics)
- **SEIGNEUR Christian, MUSSON-GENON Luc,** POLU, Environnement atmosphérique et qualité de l'air (Atmospheric environment and air quality)
- **SARTELET Karine, COUVIDAT Florian,** Pollution atmosphérique (Air pollution), Master Transports et développement durable (TRADD)
- **BOCQUET Marc, MALLET Vivien,** Introduction à l'assimilation de données (Introduction to data assimilation), Master Océan, atmosphère, climat et observations spatiales (OACOS)
- **BOCQUET Marc, MUSSON-GENON Luc, CARISSIMO Bertrand, WENDUM Denis, MILLIEZ Maya, MALLET Vivien, ROUSTAN Yelva, WINIAREK Victor, QU Yongfen,** Environment and Society, Master Nuclear Energy
- **MALLET Vivien, SEIGNEUR Christian,** Modélisation de la pollution atmosphérique (Mathematical modeling of air pollution) Master Science et génie de l'environnement (SGE)
- **SEIGNEUR Christian,** Pollution atmosphérique et aérocontamination (Air pollution and contamination), Master Science et génie de l'environnement (SGE)

Other Masters

- **SEIGNEUR Christian.** “Chemistry of air pollution”, Master : Sciences et Techniques de l'Environnement Urbain (STEU), École Centrale de Nantes

DISSEMINATION ACTIVITIES AND PARTNERSHIPS

Public communications

- **MALLET Vivien.** Introduction to mathematical models and numerical simulation for environmental sciences, Paris Mathematical Olympiads, May 2012, Paris, France.
- **TILLOY Anne.** Fête de la Science, October 2012, Paris, France.
- **SEIGNEUR Christian.** Expert Panel, Reducing air pollution in cities (Réduire la pollution de l'air dans les villes : des actions pour aujourd'hui et pour demain ?), Ateliers scientifiques « Pollution par les particules : impacts sur la santé, l'air et le climat », 14 November 2012, Paris, France.

Research partnerships

Research activities at CEREAs are supported by a myriad of funding sources including several contracts from the National Agency for Research (ANR), the French Agency for Environment and Energy Management (ADEME), the French Ministry for Ecology (MEDDE), the Île-de-France Region program on sustainable development (R2DS), industry (EDF, Total), the Center for Tunnel Studies (CETU), the Interagency Program for Air Quality Research (Primequal), and the National Center for Scientific Research (CNRS). Most of these activities are conducted in partnership with other research laboratories.

New research contracts awarded in 2012 include the following:

- **SAF-MED ANR contract:** Formation of secondary aerosols in the Mediterranean region (Formation des aérosols secondaires en Méditerranée), project managed by CEREAs (Karine Sartelet) with LCE, LISA, LAMP and LSCE as partners, 658 000 euros.
- **EUREQUA ANR contract:** Multidisciplinary evaluation and environmental categorization of neighborhoods (Évaluation multidisciplinaire et requalification environnementale des quartiers), project managed by LISST with CEREAs (Maya Milliez) as partner, 127 000 euros.
- **TRAFIPOLLU ANR contract:** Multiscale modeling of pollution due to traffic in an urban area (Modélisation multi-échelles de la pollution due au trafic dans un environnement urbain), project managed by IFSTTAR with CEREAs (Christian Seigneur and Yelva Roustan) as partner, 132 000 euros.
- **NATORGA GMES-DD contract:** project managed by CEREAs (Karine Sartelet) with LMD as partner, cosponsored by the Ministry of Ecology (MEDDE) and ADEME, 135 000 euros.
- **EDF contract:** Long-range air pollution modeling, project managed by CEREAs (Luc Musson-Genon), funded by the Nuclear Engineering Center (CIDEN), 19 000 euros.