

List of research activities

2020

CEREA



Atmospheric Environment Center

École des Ponts ParisTech & EDF R&D

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Deputy director: Marc Bocquet

Deputy director: Martin Ferrand

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FERRAND Martin, EDF R&D, Research engineer
CARISSIMO Bertrand, EDF R&D, Senior Researcher and Associate Professor, HDR
DEFOSSEZ Arièle EDF R&D, Research engineer
DUPONT Éric, EDF R&D, Research engineer
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KIM Youngseob, École des Ponts ParisTech, Research engineer
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MINIER Jean Pierre, EDF R&D, Engineer
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QUEMENER Aurélie, École des Ponts ParisTech Engineer
ROZBORSKI Sébastien EDF R&D, Engineer
WALL RIBOT Bénédicte, EDF R&D, Engineer
WENDUM Denis, EDF R&D, Engineer

Technicians

FAUCHEUX Aurélien, École des Ponts ParisTech

Post-doctoral scientists

DIALLO Mouhamet, École des Ponts ParisTech
KUZNETSOV Konstantin, École des Ponts ParisTech
LANNUQUE Victor, École des Ponts ParisTech
VANDERBECKEN Pierre, École des Ponts ParisTech

Ph.D. students

ASMAR Léa, EDF R&D, ED SIE
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GALANTE-AMINO Hector, EDF R&D, ED SIE
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MAISON Alice, École des Ponts ParisTech ED SIE
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SARICA Thibaud, École des Ponts ParisTech ED SIE
WANG Yunyi, École des Ponts ParisTech EDF R&D, ED SIE
WANG Zhizhao, École des Ponts ParisTech ED SIE

Interns

NORDDINE Thomas, École des Ponts ParisTech
JACQUOT Oscar, École des Ponts ParisTech

Articles in peer-reviewed international journals

1. **A. Fillion, M. Bocquet**, S. Gratton, S. Gürol. and P. Sakov. *An iterative ensemble Kalman smoother in presence of additive model error*. SIAM/ASA J. Uncertainty Quantification, 8, 198-228, 2020.
2. C. Grudzien, **M. Bocquet**, and A. Carrassi. *On the numerical integration of the Lorenz-96 model, with scalar additive noise, for benchmark twin experiments*. Geosci. Model Dev., 13, 1903-1924, 2020.
3. **M. Bocquet**, J. Brajard, A. Carrassi, and L. Bertino. *Bayesian inference of chaotic dynamics by merging data assimilation, machine learning and expectation-maximization*. Foundations of Data Science, 2, 55-80, 2020.
4. P. Tandéo, P. Aillot, **M. Bocquet**, A. Carrassi, T. Miyoshi, M. Pulido, and Y. Zhen. *A Review of Innovation-Based Approaches to Jointly Estimate Model and Observation Error Covariance Matrices in Ensemble Data Assimilation*. Mon. Wea. Rev., 148, 3973–3994, 2020.
5. J. Brajard, **M. Bocquet**, A. Carrassi, and L. Bertino. *Combining data assimilation and machine learning to emulate a dynamical model from sparse and noisy observations: A case study with the Lorenz 96 model*. J. Comput. Sci., 44, 101171, 2020.
6. M. Tondeur, A. Carrassi, S. Vannitsem, and **M. Bocquet**. *On Temporal Scale Separation in Coupled Data Assimilation with the Ensemble Kalman Filter*. J. Stat. Phys., 179, 1161–1185, 2020.
7. **J. Dumont Le Brazidec, M. Bocquet**, O. Saunier, **Y. Roustan**. *MCMC methods applied to the reconstruction of the autumn 2017 Ruthenium-106 atmospheric contamination source*. Atmospheric Environment: X, 6, 100071, 2020.
8. M. André, **K. Sartelet**, S. Moukhtar, JM. André, M. Redaelli. *Diesel, petrol or electric vehicles: what choices to improve urban air quality in the Ile-de-France region? A simulation platform and case study*. Atmos. Environ., 241, 117752, 2020.
9. **L. Lugon, K. Sartelet, Y. Kim**, J. Vigneron, O. Chrétien. *Nonstationary modeling of NO₂, NO and NO_x in Paris using the Street-in-Grid model: coupling local and regional scales with a two-way dynamic approach*. Atmos. Chem. Phys., 20, 7717-7740, 2020.
10. **C. Abdallah**, C. Afif, S. Sauvage, A. Borbon, T. Salameh, A. Kfoury, T. Leonardis, C. Karam, P. Formenti, JF. Doussin., N. Locoge, **K. Sartelet**. *Determination of Gaseous and Particulate Emission Factors from Road Transport in a Middle Eastern capital*. Transp. Res. Part D: Transport and Environment, 83, 2020.
11. **K. Sartelet**, F. Couvidat, Z. Wang, **C. Flageul, Y. Kim**. *SSH-Aerosol v1.1: A Modular Box Model to Simulate the Evolution of Primary and Secondary Aerosols*. Atmosphere, 11, 525, 2020.
12. **M. Majdi, Y. Kim**, S. Turquety, **K. Sartelet**. *Impact of mixing state on aerosol optical properties during severe wildfires over the Euro-Mediterranean region*, Atmos. Environ., 220, 117042, 2020.

13. **M. Bahlali**, C. Henry, **B. Carissimo**. *On the Well-Mixed Condition and Consistency Issues in Hybrid Eulerian/Lagrangian Stochastic Models of Dispersion*. *Boundary-Layer Meteorol* 174, 275–296, 2020.
14. T Fonty, **M Ferrand**, A Leroy, D Violeau. *Air Entrainment Modeling in the SPH Method: A Two-Phase Mixture Formulation with Open Boundaries*. *Flow, Turbulence and Combustion* 105, 1149–1195, 2020.

International conference oral presentations

1. **M. Bocquet**, J. Brajard, A. Carrassi, and L. Bertino: *Data-driven reconstruction of chaotic dynamics using data assimilation and machine learning*. Seminar at the SFB 1292 Center, University of Postdam, January 31, 2020, Postdam, Germany. [Invited]
2. **A. Farchi** and **M. Bocquet**: *On the localisation of ensemble data assimilation methods*. DARC seminar series, University of Reading, UK, March 4, 2020. [Invited]
3. J. Brajard, A. Carrassi, **M. Bocquet**, and L. Bertino: *Data-driven parametrizations in numerical models using data assimilation and machine learning*. European Geosciences Union General Assembly 2020, May 4, 2020, online conference. [Invited]
4. **Marc Bocquet**, J. Brajard, A. Carrassi, and L. Bertino: *Bayesian inference of dynamics from partial and noisy observations using data assimilation and machine learning*. European Geosciences Union General Assembly 2020, May 5, 2020.
5. **J. Dumont Le Brazidec**, **M. Bocquet**, O. Saunier, and **Y. Roustan**: *Bayesian inference and uncertainty quantification for source reconstruction of radionuclides release: application to recent European radionuclide detection events*. European Geosciences Union General Assembly 2020, May 8, 2020.
6. **M. Bocquet**, J. Brajard, A. Carrassi, and L. Bertino: *Bayesian inference of chaotic dynamics by merging data assimilation, machine learning and expectation-maximization*. ICCS 2020, MLDADS 2020, June 15, 2020.
7. **A. Farchi**, M. Bonavita, P. Laloyaux, **M. Bocquet**: *Exploring machine learning for data assimilation*. Seminar at ECMWF, Machine Learning seminar series, May 7, 2020. [Invited]
8. **M. Bocquet**, J. Brajard, A. Carrassi, L. Bertino, **A. Farchi**, **Q. Malartic**, M. Bonavita, and P. Laloyaux: *Using machine learning and data assimilation to learn both dynamics and state*. ECMWF-ESA Workshop on Machine Learning for Earth System Observation and Prediction, October 5-8, 2020. [Invited]
9. M. Bonavita, P. Laloyaux, **A. Farchi**, and **M. Bocquet**. *Data Assimilation and Machine Learning Science at ECMWF*. ECMWF-ESA Workshop on Machine Learning for Earth System Observation and Prediction, October 5-8, 2020.
10. A. Carrassi, J. Brajard, **M. Bocquet**, and L. Bertino. *Combining data assimilation and machine learning to emulate hidden dynamics and to infer unresolved scale parametrisation*. ECMWF-ESA Workshop on Machine Learning for Earth System Observation and Prediction, October 2020, 5-8. [Invited]

11. A. Carrassi, J. Brajard, **M. Bocquet**, and L. Bertino. *Combining data assimilation and machine learning to emulate hidden dynamics and to infer unresolved scale parametrisation*. EPSRC Excalibur WS on Data Assimilation and Uncertainty Quantification, September 24-25, 2020. [Invited]
12. **J. Dumont Le Brazidec**, **M. Bocquet**, O. Saunier, and **Y. Roustan**. *Bayesian inference and uncertainty quantification for source reconstruction of radionuclides release*. DARC seminar series, University of Reading, UK, November 11, 2020. [Invited]
13. **K. Kusnetsov**, **M. Ferrand**, **B. Carissimo**, and **M. Bocquet**. *Inverse Modeling for the Reconstruction of Accidental Sources of Pollutants*. Twenty-fourth Annual George Mason University Conference on Atmospheric Transport and Dispersion Modeling, December 8-11, 2020.
14. J. Brajard, A. Carrassi, **M. Bocquet**, and L. Bertino. *Combining data assimilation and machine learning to infer unresolved scale parametrisation*. AI Chair Oceanix and AI4OAC webinar, December 16, 2020, online seminar. [Invited]
15. **V. Lannuque**, B. D'Anna, F. Couvidat, R. Valorso and **K. Sartelet**. *Mechanical study of toluene oxidation: development of a simplified chemical scheme for SOA formation*, Atmospheric Chemical Mechanisms Conference, Virtual Conference, Nov. 2020, UC Davis, United States.
16. EA. Fiorentino, H. Wortham, and **K. Sartelet**. An Indoor Air Quality Model to Test the Depollution Efficiency of Indoor Surfaces Containing *Nanoparticles*, Paper Id 1098, 7th International Conference NANOSAFE 2020, Nov. 2020, Grenoble, France.
17. **L. Lugon**, **K. Sartelet**, **Y. Kim**, J. Vigneron, and O. Chrétien. *Simulation of primary and secondary particles in the streets of Paris using MUNICH*. Faraday Discuss., Online, Nov. 2020, London, UK.
18. J. Jose, A. Gires, D. Schertzer, **Y. Roustan**, A. Ruas. and I. Tchiguirinskaia. Variability in Rainfall and Kinetic Energy across scales of measurement: evaluation using disdrometers in Paris region, EGU General Assembly 2020, Online, 4–8 May 2020, EGU2020-994, <https://doi.org/10.5194/egusphere-egu2020-994>.
19. **B. Carissimo**, S. Trini Castelli, G. Tinarelli. A comparison of building wakes measurements with numerical modelling approaches with four different levels of complexity during the JRII Special sonic anemometer study. Twenty-fourth Annual George Mason University Conference on Atmospheric Transport and Dispersion Modeling, December 8-11, 2020.
20. **B. Carissimo**, S. Trini Castelli, G. Tinarelli. A comparison of building wakes measurements with numerical modelling approaches with four different levels of complexity during the JRII Special sonic anemometer study. Twenty-fourth Annual George Mason University Conference on Atmospheric Transport and Dispersion Modeling, December 8-11, 2020.

International conference poster presentations

1. **A. Farchi**, M. Bonavita, P. Laloyaux, and **M. Bocquet**. *Using machine learning to correct model error and application to data assimilation with a quasi-geostrophic model*. ECMWF-ESA Workshop on Machine Learning for Earth System Observation and Prediction, October

5-8, 2020.

2. C Colas, **M Ferrand**, JM Hérard, O Hurisse, E Le Coupanec, L Quibel. A Numerical Convergence Study of some Open Boundary Conditions for Euler equations. International Conference on Finite Volumes for Complex Applications, 655-663, 2020.
3. C Demay, **M Ferrand**, S Belouah, V Robin. Modelling and simulation of ingot solidification with the open-source software Code_Saturne IOP Conference Series: Materials Science and Engineering 861 (1), 012033, 2020.

National conference oral presentation

1. **M. Bocquet**: *Inférence bayésienne et quantification d'incertitude pour la reconstruction de sources de radionucléides : application à des événements accidentels récents*. Colloque : Comprendre, prédire et maîtriser les risques à l'aide de la statistique, Société Française de Statistiques, November 20, 2020. [Invited]

Committee activities

Editorial boards

- **Bocquet M.**, Associate Editor, “Quartely Journal of the Royal Meteorological Society”.
- **Bocquet M.**, Associate Editor, “Foundations of Data Science”, journal of the AIMS.
- **Bocquet M.**, Guest Editor, for the topic *Data Assimilation of Nonlocal Observations in Complex systems* of “Frontiers in Applied Mathematics and Statistics”.
- **Bocquet M.**, Associate Editor for the topic *Dynamical Systems in* “Frontiers in Applied Mathematics and Statistics”.
- **K. Sartelet**, Guest Editor, for the topic *Air quality at street levels* of the journal “Atmospheric Chemistry and Physics”.
- **K. Sartelet**, Member of the editorial board of the section *Aerosols* of the journal “Atmosphere”.

Conference organisation

- **M. Bocquet**, Member of the organisation committee of the ECMWF-ESA Workshop on Machine Learning for Earth System Observation and Prediction, October 5-8, 2020.

Conference session chairs

Scientific committees

- **M. Bocquet**, Member of the Scientific committee, European Center for Scientific Computing (CERFACS).

- **P. Bernardara, M. Bocquet**, Members of the Management Committee, Pierre-Simon Laplace Institute (IPSL).
- **M. Bocquet**, Member of the Prix André Prud'Homme Committee of the Meteorology and Climate Society.
- **M. Bocquet**, Co-leader of SAMA (Statistiques pour l'Analyse, la Modélisation et l'Assimilation) of Pierre-Simon Laplace Institute (IPSL).
- **K. Sartelet**, Scientific committee, DIM QI² (Air quality research network in Île-de-France)
- **K. Sartelet**, Elected member of the Management Committee, OSU-EFLUVE (observatory of the sciences of the universe)
- **K. Sartelet**, Co-leader of COMPOSAIR (Atmospheric composition and air quality) of Pierre-Simon Laplace Institute (IPSL).
- **Y. Roustan**, Elected member of the Management Committee, OSU-EFLUVE (observatory of the sciences of the universe)
- **É. Dupont**, Scientific Committee, "Site instrumental de recherche par télédétection atmosphérique" (SIRTA).
- **Y. Roustan**, Elected member of the Scientific Committee, OSU-EFLUVE (observatory of the sciences of the universe)
- **É. Dupont**, Member of the Scientific Committee, "Site instrumental de recherche par télédétection atmosphérique" (SIRTA).

Thesis committees

- **M. Bocquet**, Committee member and Reviewer, PhD, Pierre Vanderbecken, "Apport des infrasons pour l'assimilation de données dans un modèle global de prévision numérique du temps", University of Toulouse, June 22, 2020.
- **M. Bocquet**, Committee member, PhD, Mayeul Destouches, "Prise en compte des hydrométéores dans un schéma d'assimilation variationnel ensembliste appliqué au modèle de prévision AROME", University of Toulouse, December 17, 2020.
- **K. Sartelet**, Committee member and Reviewer, PhD, Simon Martinet, "Estimation in-situ des facteurs d'émission des polluants du trafic routier", IFSTTAR, June 2020.
- **Y. Kim**, Committee member, PhD, Mario Eduardo Gavidia Calderón, "From global to local: A multi-scale air quality modeling study over the Metropolitan Area of São Paulo", University of São Paulo, November 25, 2020.

HdR committees

- **M. Bocquet**, Committee member and Reviewer, HdR, Laure Raynaud, "Représentation des incertitudes en prévision numérique du temps : de l'état initial aux applications", University of Toulouse, November 10, 2020.

- **K. Sartelet**, Committee member and Reviewer, HdR, Yao Liu, “Les particules et leurs précurseurs dans l’atmosphère – émission et devenir”, IFSTTAR, 2020.

Teaching

École des Ponts ParisTech

- **M. Bocquet, A. Farchi**, Coordinator and lecturers of “Introduction to Data Assimilation”, Master MOCIS and WAPE Num 2.2 and ADOMO (École des Ponts ParisTech), 30 hours.
- **K. Sartelet**, Coordinator of “Atmospheric Environment and air quality”, 2nd year École des Ponts ParisTech (30 hours).
- **K. Sartelet**, Lecturer of Urban air pollution, Master 2 « Cities and urban environments - Atmosphere, water and environment » (École Centrale de Nantes, 8 hours)
- **Y. Roustan**, Coordinator and lecturer of «Externalities of Transports», master TraDD - École des Ponts ParisTech (6 hours).
- **Y. Roustan**, “Pollution de fond et impacts écologiques des activités humaines”, Conference EGEDD (3 hours).
- **M. Ferrand**, “Mécanique des fluides incompressibles – 1”, 2^{sd} year École des Ponts ParisTech, (6x3 hours).
- **M. Ferrand**, “Mécanique des fluides incompressibles – 2”, 2^{sd} year École des Ponts ParisTech, (6x3 hours).
- **M. Ferrand**, “Simulation numérique de l'aérodynamique et de la qualité de l'air en milieu urbain”, 2^{sd} year École des Ponts ParisTech (6x2.5 hours).

École Nationale des Travaux Publics de l'État

- **Y. Roustan**, Coordinator and lecturer of “Air Quality and Health”, 3rd year École Nationale des Travaux Publics de l'État (6 hours).

University of Paris

- **Y. Roustan**, Coordinator and lecturer of “Numerical modeling”, Master 2 Risk and environment – Air (8 hours).
- **K. Sartelet**, Lecturer of Aerosol modelling, Master 2 “Risk and environment – Air” (3 hours).

Outreach

- P. Dandin, **M. Bocquet**, et al. : Participation in the French application to welcome in Toulouse

several of the ECMWF services ; interview in support of the application about the interaction between the French scientific community and the ECMWF, October 1, 2020.

- I. Korsakissok, M. Merad, S. Girard, M. O. Hernandez O., R. Périllat. and **A. Farchi** : "Pollutions atmosphériques : faire face aux aléas avec la science des données et la simulation", workshop "Incertitudes et industries" organised by the Institut de maîtrise des risques (IMdR), November 5, 2020.
- Appel KW, Baklanov A, Ching J, Freitas E, C. Perez Garcia-Pan, DK Henze, O. Jorba, CA. Keller, JC Knierel, p ; Lee, p ; Makar, M. Masson, L. Delle Monach, P. Said, JL. Santiago Del Rio, **K. Sartelet**, M. Sofiev, W. Stockwell, D. Tong, S. Yu, Y. Zhang, C. Zhou and S. Zilitinkevich. **M. Bocquet** et al. Training Materials and Best Practices for Chemical Weather/Air Quality Forecasting. World Meteorological Organisation Report, 2020, ed. Yang Zhang and Alexander Baklanov, https://library.wmo.int/index.php?lvl=notice_display&id=21801#.X8TuZR1CdTY, 2020.
- G. Broquet, **Y. Roustan.**, Alphabet Modeling Talk Series, Towards a street scale quantification of atmospheric pollutant emissions based on dense atmospheric measurement networks, June 16 2020.