

Dr. Elliott Lumet

PhD in Applied Mathematics and Atmospheric Sciences

27 years old

(he/him)

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Summary

After obtaining a prestigious general engineering degree from the École Centrale de Nantes, France, Dr. Elliott Lumet turned to atmospheric science scientific research, with a strong focus on the quantification of uncertainty of microscale atmospheric processes.

Dr. Lumet has just recently defended his PhD thesis, entitled “*Assessing and reducing uncertainty in large-eddy simulation for microscale atmospheric dispersion*”, at the Université Toulouse III, France, on January 12, 2024. During his PhD, he wrote several articles for peer-reviewed scientific journals, and developed his skills in handling HPC systems and managing large simulation datasets, in compliance with open science standards.

He is now a post-doctoral fellow at Cerfacs in Toulouse, France, and his research works focus on surrogate modelling for atmospheric flow and air quality in urban environments.

1. Research interests

- Microscale meteorological and pollutant dispersion modelling
- Environmental risk assessment for urban environments
- Model emulation and acceleration using machine learning techniques
- Uncertainty characterisation, quantification and reduction through data assimilation

2. Key skills

Building and managing complex modelling chains that combines:

- High-fidelity and expensive numerical models
- Model reduction based on a large ensemble of simulations,
- Real field measurements,

Atmospheric modelling

- Setting up and running CFD models (AVBP, FEniCS, NEK5000, OpenFOAM) to perform large-eddy simulations of new case study on microscale atmospheric flows/pollutant dispersion
 - o Spatial discretisation (meshing) generation
 - o Boundary condition calibration
 - o HPC scaling optimisation
- Handling of datasets of observations from an experimental campaign (MUST)

Applied mathematics

- Quantifying internal variability in simulations using bootstrap techniques
- Implementing data assimilation algorithms (EnKF), and using them with synthetic and real measurements
- Analysing the sensitivity of a model to its main input parameters (Sobol’ indices, Saltelli algorithm)
- Implementing and tuning machine learning and deep-learning methods (PCA, Gaussian processes, Convolutional Autoencoder) for model reduction

Carbon accounting, i.e. quantifying the greenhouse gas emissions associated with research activities

3. Education

- 12/01/2024

Doctoral Degree in Atmospheric Sciences, Université Paul Sabatier Toulouse III, *Toulouse, France.*

- 15/12/2020
Engineering diploma (equivalent to MSc) in Applied Mathematics, École Centrale de Nantes (a highly-selective engineering school), *Nantes, France*.

4. Professional experience

Research experience

- 15/01/2024 – present
Postdoctoral research fellow, European Centre for Research and Advanced Training in Scientific Computation (CERFACS), *Toulouse, France*. “ASSIM4LES – Data assimilation for large-eddy simulations of accidental atmospheric pollutant dispersion”. Supervisor: Dr. Mélanie Rochoux
- 01/10/2020 – 12/01/2024
PhD, Université Paul Sabatier Toulouse III, *Toulouse, France*. “Assessing and reducing uncertainty in large-eddy simulation for microscale atmospheric dispersion”. Supervisors: Dr. Mélanie Rochoux and Dr. Simon Lacroix
- 01/04/2020 – 30/09/2020
Master 2, Research Internship, von Karman Institute for Fluid Dynamics (VKI), *Sint-Genesius-Rode, Belgium*. “Dispersion of pollutants in built environment”. Supervisors: Dr. Delphine Laboureur and Dr. Sophia Buckingham

Other experience

- 01/04/2019 – 31/08/2019
Engineer internship, Safran Aircraft Engines, *Villaroche, France*. “Impact of uncertainties in thermodynamic cycle predictions”. Supervisor: Nathan Eckert
- 01/07/2013 – 31/08/2013 to 01/07/2018 – 31/08/2018
Summer jobs at Le Rustick (restaurant), *La Tranche-sur-Mer, France*, and Laboratoire de l’Environnement et de l’Alimentation de la Vendée (as a sampling agent), *La Roche-sur-Yon, France*.

5. Publication in peer-reviewed scientific journals

1. **Lumet, E.**, Jaravel, T., Rochoux, M. C., Vermorel, O., and Lacroix, S. (2024). Assessing the internal variability of Large-Eddy Simulations for microscale pollutant dispersion prediction in an idealized urban environment. *Boundary-Layer Meteorology*[†], 190(2):9. DOI: [10.1007/s10546-023-00853-7](https://doi.org/10.1007/s10546-023-00853-7)
[†]*Boundary-Layer Meteorology is the reference international journal for fundamental research on the physical, chemical and biological processes occurring in the atmospheric boundary layer*

Under review

2. **Lumet, E.**, Rochoux, M. C., Jaravel, T., and Lacroix, S. (2024). Uncertainty-Aware Surrogate Modeling for Urban Air Pollutant Dispersion Prediction. *Building and Environment*[‡]. Preprint: <https://ssrn.com/abstract=4920879>
[‡]*Building and Environment is a high-impact journal that publishes articles related to the environmental performance of the built environment*

6. Other research outputs

Data repository

1. **Lumet, E.**, Jaravel, T., and Rochoux, M. C. (2024). PPMLES – Perturbed-Parameter ensemble of MUST Large-Eddy Simulations. Dataset at Zenodo. DOI: [10.5281/zenodo.11394347](https://doi.org/10.5281/zenodo.11394347)

Open-access code

2. **Lumet, E.** (2024). POD–GPR surrogate modeling for microscale pollutant dispersion. Tutorial notebook. URL: https://github.com/eliott-lumet/pod_gpr_ppmles

Technical report

3. Rochoux, M., **Lumet, E.**, Thouron, L., Rea, G., Auguste, F., Jaravel, T. and Vermorel, O. (2021). Large-eddy simulation multi-model comparison of the MUST trial 2681829. URL: <https://cerfacs.fr/wp->

7. Conferences

International conference

1. **Lumet, E.**, Rochoux, M. C., Jaravel, T., and Lacroix, S. (2024). Reduced-cost EnKF for parameter estimation of microscale atmospheric pollutant dispersion models. International EnKF workshop, *Bergen, Norway*. Oral presentation
2. **Lumet, E.**, Rochoux, M. C., Jaravel, T., and Lacroix, S. (2024). Surrogate-based data assimilation for microscale atmospheric pollutant dispersion. European Geophysical Union (EGU) General Meeting, *Vienna, Austria*. Poster presentation, Abstract EGU24-17987.
3. **Lumet, E.**, Rochoux, M. C., Jaravel, T., Lacroix, S., and Vermorel, O. (2022). Sensitivity analysis of microscale pollutant dispersion large-eddy simulations for observation network design. HARMO conference, *Aveiro, Portugal*. Oral presentation

Invited presentation

4. Rochoux, M.C., Lumet, E., Jaravel, T., and Lacroix, S. (2024) Prendre en compte les incertitudes dans les prévisions de dispersion atmosphérique de polluants en milieu urbain, Atelier TERATEC “Risques naturels et technologiques”, *Paris, France*. Invited talk (*in French*)

8. Funding received

- 07/03/2024
LEARN4LES – Learning for large-scale atmospheric dispersion simulations. An ENV’IA funding from the Observatoire Midi-Pyrénées (OMP), for the supervision of a Master student. Report URL: https://cerfacs.fr/wp-content/uploads/2024/09/Rapport_de_stage_Emmarius_Delar.pdf (*in French*)
- 01/01/2024
ASSIM4LES – Data assimilation for large-eddy simulations of accidental atmospheric pollutant dispersion. An Initiative at CERFACS 2023 internal project, for the funding of my postdoc position
- 01/05/2022
LES2EMULATE – From high-fidelity simulations to reduced-order modelling to analyse environmental risk. Project funded by DARI-GENCI 2022, a French national program, that provided access to the HPC resources for Dr. Lumet’s PhD project (grant agreement no. A0062A10822).

9. Supervising, teaching, and mentoring activities

Supervising

- 02/05/2024 – 30/08/2024
Co-supervision of Master Student. “Learning-based dimension reduction methods for statistical emulation of an atmospheric dispersion model”. Université Paul Sabatier Toulouse III, *Toulouse, France*

Teaching

- 01/09/2021 – 08/10/2021; 24/10/2022 – 30/12/2022
Tutorials for bachelor students. La Prépa des INP, *Toulouse, France*. Mechanical wave propagation (45 hours)
- 09/11/2021; 14/06/2022; 13/06/2023; 25/06/2024
Tutorials and practical works for PhD students and scientists. CERFACS, *Toulouse, France*. Data Assimilation (7.5 hours)

Mentoring

- 27/07/2023 – present
Organisation of bi-monthly meetings to improve the well-being and supervision of trainees, PhD students and young researchers. CERFACS, *Toulouse, France*
- 09/11/2017 – 22/06/2018
Mentoring of undergraduate students. CPGE Lycée Clémenceau, Nantes, *France*. Mathematics and Physics (56 hours)