Personal information

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Scientific interests: Carlo has acquired expertise in computational fluid dynamics, with a focus on high-resolved numerical simulations of turbulent flows and heat transfer processes utilising the large-eddy simulation approach. The physical phenomena investigated include heat exchange mechanisms, turbulent convection, and water evaporation in the low atmosphere. Mathematical models are explored and subsequently implemented in an open-source numerical solver (OpenFOAM). In the last years, he approached the investigation of thermally-driven environmental flows such as the slope flows, and urban fluid dynamics focusing on pollution dispersion mechanisms through Nature-Based Solutions.

Keywords: Large-Eddy Simulations · Environmental Flows · Pollution Dispersion · Heat Transfer Processes · Turbulence Modelling · OpenFOAM

Research and Work Experience

dec 2021 – today	**Junior Assistant Professor at University of Bologna** Dept of Physics and Astronomy, via Irnerio 46, 40126 Bologna.
may 2019 – nov 2021	**Postdoctoral fellow at University of Bologna (Italy)** Dept of Physics and Astronomy, via Irnerio 46, 40126 Bologna. · Project: OPERANDUM - *OPEn-air laboRAtories for Nature-baseD solUtions to Manage hydro-meteo risks.* Horizon 2020. See also Sect. Research Projects. · Activity: numerical modelling for the assessment of nature-based solutions efficacy and reproduction. Large-eddy simulations of removal pollution from urban canyons improved by obstacles (green infrastructures) on the rooftop. Advisor Prof. Silvana Di Sabatino.
nov 2017 – feb 2019	**Research Engineer at INRIA Rennes, Bretagne Atlantique (France)** Fluminance group, Campus de Beaulieu, 35042 Rennes Cedex. · Activity: stochastic modelling of turbulent flows. The activity focused on the development of innovative stochastic turbulence models for computational fluid dynamics applications, their implementation in numerical software, and the performance assessment in reproducing selected case studies. Advisor Dr Etienne Mémin
jun 2017 – oct 2017	**Research Engineer at IEFLUIDS s.r.l. (Italy)** Spin-off of the University of Trieste, piazzale Europa 1, 34127 - Trieste. · Activity: development of numerical tools for simulations of quenching process. Particularly, implementation of a numerical solver to reproduce the quenching process and the related heat transfer mechanisms.
apr 2016 – apr 2017	**Postdoctoral fellow at University of Trieste (Italy)** Dept of Engineering and Architecture, via A. Valerio 6/1, 34127 Trieste · Project: COSMO - *CFD Open Source per opera MOrta.* Region Friuli-Venezia Giulia, Fondo per lo Sviluppo e la Coesione. See also Sect. Research Projects.

	· <u>Activity</u>: numerical investigation of flow separation around bluff bodies at high Reynolds numbers using detached-eddy simulation methodology and dispersion of pollutants from exhaust stacks. Advisor Prof. Vincenzo Armenio.
sep 2015 – dec 2015	**Visiting Ph.D. student at Chalmers University, Gothenburg (Sweden)** Collaboration with Prof. Håkan Nilsson, Dept Applied Mechanics. · <u>Activity</u>: implementation and validation of the P_1 thermal radiation model for participating media and conductive solid boundaries; see also Sect. Collaborations.
feb 2012 – apr 2016	**Ph.D. in Environmental and Industrial Fluid Mechanics (Italy)** University of Trieste, Dept of Architecture and Engineering. · <u>Thesis</u>: *Large-eddy simulations of conjugate heat transfer with evaporation-condensation and thermal radiation.* Supervisors: Prof. V. Armenio, Dr A. Petronio. · <u>Committee assessment</u>: the researches considered in the thesis are very original. The adopted methodologies are very good. The results are very interesting and analysed with an excellent critical sense. · <u>Additional label</u> *Doctor Europaeus* obtained after having fulfilled the criteria of the European University Association and the University of Trieste. · <u>Note</u>: interrupted during the 2013 to attend the TFA course and obtain the teaching licence for high school, see Sect. Didactic Activity and Certificates.
nov 2011 – jan 2012	**Internship at Enel Green Power** Company: Enel Green Power, Lungarno Colombo 54 - 50136 Firenze (Italy) · <u>Activity</u>: performance analysis of wind farms; development of new statistical software for monitoring energetic production from renewable sources. · <u>Note</u>: interrupted to start the Ph.D.

Education

feb 2012 – apr 2016	**Ph.D. in Environmental and Industrial Fluid Mechanics** University of Trieste (Italy), thesis: *Large-eddy simulations of conjugate heat transfer with evaporation-condensation and thermal radiation.* Supervisors: Prof. V. Armenio, Dr A. Petronio. Mark: graduate with distinction. See details in Sect. Research and Work Experience.
sep 2008 – apr 2011	**Master Degree (M.Sc.) in Mathematics** University of Florence, thesis: *Semiclassical expansion of quantum diffusive equations using Fermi and Bose statistics.* Supervisor: Dr Luigi Barletti, subject of mathematics-physics. Final mark 110/110 cum laude. · <u>Production</u>: [13]
sep 2009 – jun 2010	**LLP/Erasmus at UPMC Paris** Visiting undergraduate student at *Université Pierre et Marie Curie - Paris 6* (France). Duration: one academic year.
sep 2005 – oct 2008	**Bachelor Degree (B.Sc.) in Mathematics** University of Florence, thesis: *The equations of motion of the Foucault Pendulum.* Supervisor: Prof. P. Maurenzig, subject of physics and numerical simulation.

Academic Teaching Activity

> University Teaching Experience

2022-2024	**Physics and Statistics**. Statistics and Computer Laboratory. B.Sc. in Biotechnology, (University of Bologna).

2022-2024	**Planetary boundary layer and turbulent dispersion**. Numerical Simulations Laboratory. M.Sc. in Physics of the Earth System, (University of Bologna).
2020-2021	**Teaching Assistant M.Sc. Course**. Lecturer and numerical laboratory in *Planetary boundary layer and turbulent diffusion*, prof. S. Di Sabatino (University of Bologna).
2015	**Teaching Assistant M.Sc. Course**. Lecturer in *Applied Hydraulics*, Civil Engineering, prof. V. Armenio (University of Trieste).
2012, 2014	**Teaching Assistant B.Sc. Course**. Lecturer in *Geometria I*, Mathematics and Physics, prof. B. Zimmermann (University of Trieste).

Research Project Activities and Collaborations

> Participation in Research Projects

- (20230) PI of project GREEN-POLIS (Italian National Project PRIN). The project GREEN-POLIS - Multi-scale investiGation of natuRe-basEd solutions for thE mitigatioN of urban heat and POLlution ISland - aims at studying the efficacy of selected Nature-Based Solutions in mitigating the negative effects caused by the Urban Heat Island and the Urban Pollution Island. The investigation will be conducted from a multiscale perspective, ranging from the street and building scale to the city neighbourhood. Collaboration with the University of Roma La Sapienza, and the University of Trento.

- (2023) Project RISKADAPT (Horizon Europe). The project RISKADPAT - Asset Level Modelling of RISKs in the Face of Climate-Induced Extreme Events and ADAPtation - aims to investigate and estimate the impact of high-intensity low-probability weather events on key buildings and infrastructures for the economy and civil society. Through a downscaling procedure, the climatic inputs will be incorporated into the mesoscale simulation and then in high-resolved simulations at building scale. Numerical modelling complemented with experimental measurements will allow the estimation of climate forcing on buildings and infrastructures.

- (2021) Project I-CHANGE (European Project H2020). The project I-CHANGE - Individual Change of HAbits Needed for Green European transition - aims to raise awareness of climate issues through the direct collection of environmental and socio-economic data with novel and user-friendly tools (sensors, monitoring devices, simplified models and data resources). Within the coordination team that writes the proposal. Involved in the citizen science monitoring activities and the simulation campaign conducted as part of WP3 - 'Enhancing monitoring opportunities through citizen science'.

- (2019-2021) Project OPERANDUM (European Project H2020). The project OPERANDUM - OPEn-air laboRAtories for Nature baseD solUtions to Manage hydro-meteo risks - will deliver the tools and methods for the validation of Nature-Based Solutions (NBS) to enhance resilience in European territories by reducing hydro-meteorological risks. Involvement in the WP5 - 'Multiple impact modelling for assessment and replication' coordinated by Helmholtz-Zentrum Hereon GmbH. Linked to [4, 6].

- (2017) Project COSMO (Italian Regional project). The project COSMO - Cfd OpenSource per opera MOrta - develops an open-source computational fluid dynamics numerical model for the analysis of flows on the upper works of ships, civil and military, considering also the fallout of smoke and particulate matter. Contribution: numerical investigation of flow separation around bluff bodies at high Reynolds numbers using detached-eddy simulation methodology. Subsequently, a study on the dispersion of polluted smoke from chimneys, see [8].

> Collaborations

- (2021) University of Bath (UK), Centre for Energy and the Design of Environments. Collaboration with the Ph.D. candidate P. Ampatzidis, supervised by T. Kershaw, for developing a numerical solver to reproduce and analyse the evaporation from a water body in an urban settlement. The aim of the study is to quantify the effects of evaporation from blue nature-based solutions (water bodies) for increasing the city's thermal comfort and livability. Expertise linked to [11, 11, 9].

- (2019) Università Cattolica del Sacro Cuore (Italy), Dept Mathematics and Physics. Collaboration with Prof. G. Gerosa and Dr A. Finco on the experimental and numerical study of forest ventilation. In this framework, it was conducted the experimental campaign at "Bosco Fontana", Marmirolo (MN) - Italy. Four one-day missions between October and December 2019 to assemble experimental equipment to measure atmospheric variables within and without the forest (e.g. wind, temperature, humidity).

- (2015) Chalmers University (Sweden), Dept Applied Mechanics. Collaboration with Prof. H. Nilsson to develop a new numerical solver within the OpenFOAM framework to simulate the heat transfer by conduction, convection and thermal radiation among different media. Focus on the implementation and use of the P_1 thermal radiation model. Linked to [10]

Publications

> Journal Papers

[1] C. CINTOLESI, F. BARBANO, P. L. TRUDU, A. FINCO, G. GEROSA, S. DI SABATINO (2023), Characterisation of flow dynamics within and around an isolated forest, through measurements and numerical simulations, Agricultural and Forest Meteorology, 109557. DOI: 10.1016/j.agrformet.2023.109557

[2] P. AMPATZIDIS, C. CINTOLESI, T. KERSHAW (2023). Impact of Blue Space Geometry on Urban Heat Island Mitigation. Climate, 11(2):28. DOI: 10.3390/cli11020028

[3] P. AMPATZIDIS, C. CINTOLESI, A. PETRONIO, S. DI SABATINO, T. KERSHAW (2022), Evaporating waterbody effects in a simplified urban neighbourhood: A RANS analysis, Journal of Wind Engineering and Industrial Aerodynamics, 1-20. DOI:10.1016/j.jweia.2022.105078

[4] C. CINTOLESI, B. PULVIRENTI, S. DI SABATINO (2021), Large-Eddy Simulations of Pollutant Removal Enhancement from Urban Canyons, Boundary-Layer Meteorology, 1-26. DOI: 10.1007/s10546-021-00610-8

[5] C. CINTOLESI, D. DI SANTO, F. BARBANO, S. DI SABATINO (2021), Anabatic Flow Along a Uniformly Heated Slope Studied Through Large-Eddy Simulation, Atmosphere 12(7), 850. DOI: 10.3390/atmos12070850

[6] C. CINTOLESI, F. BARBANO, S. DI SABATINO (2021), Large-Eddy Simulation Analyses of Heated Urban Canyon Facades, Energies 14 (11), 3078. DOI: 10.3390/en14113078

[7] C. CINTOLESI AND E. MÉMIN (2020), Stochastic modelling of turbulent flows for numerical simulations, Fluids. DOI: 10.3390/fluids5030108

[8] C. CINTOLESI, A. PETRONIO, V. ARMENIO (2019), Turbulent structures of buoyant jet in cross-flow studied through large-eddy simulation, Environmental Fluid Mechanics 19:401–433. DOI: 10.1007/s10652-018-9629-1

[9] C. Cintolesi, A. Petronio, V. Armenio (2017), *Large-eddy simulation of thin film evaporation and condensation from a hot plate in enclosure: Second order statistics*, Int. J. of Heat and Mass Transfer, 115, 410–423. DOI: 10.1016/j.ijheatmasstransfer.2017.08.043

[10] C. Cintolesi, H. Nilsson, A. Petronio, V. Armenio (2017), *Numerical simulation of conjugate heat transfer and surface radiative heat transfer using the P_1 thermal radiation model: parametric study in benchmark cases*, Int. J. of Heat and Mass Transfer, 107, 956–971. DOI: 10.1016/j.ijheatmasstransfer.2016.11.006

[11] C. Cintolesi, A. Petronio, V. Armenio (2016), *Large-eddy simulation of thin film evaporation and condensation from a hot plate in enclosure: First order statistics*, Int. J. of Heat and Mass Transfer, 101, 1123–1137. DOI: 10.1016/j.ijheatmasstransfer.2016.06.006

[12] C. Cintolesi, A. Petronio, V. Armenio (2015), *Large eddy simulation of turbulent buoyant flow in a confined cavity with conjugate heat transfer*, Physics of Fluids, 27. DOI: 10.1063/1.4930815

[13] L. Barletti, C. Cintolesi (2012), *Derivation of isothermal quantum fluid equations with Fermi-Dirac and Bose-Einstein statistics*, Journal of Statistical Physics, 27. DOI: 10.1007/s10955-012-0535-5

> Ph.D. Thesis

[11] C. Cintolesi (2016), *Large-eddy simulations of conjugate heat transfer with evaporation-condensation and thermal radiation*, Ph.D. Thesis. Supervisors V. Armenio and A. Petronio, School of Environmental and Industrial Fluid Mechanics, University of Trieste.

Additional activities and skills

> Scientific community and review activities

- Member of AISAM (Associazione Italiana di Scienze dell'Atmosfera e Meteorologia), 2019-2021.
- Reviewer for: Journal of Fluid Mechanics (2), Environmental Fluid Mechanics (2), Journal of Heat and Mass Transfer (3), MDPI Journals (Fluids, Energies, Atmosphere - 5).

> Computer skills

- Experience with both Windows (Office Suite) and Linux Ubuntu operating systems
- On-line writing tools (Google Suite, One Drive, LaTeX): shared writing documents, on-line workspace, data and document repository for effective collaborative writing.
- OpenFOAM: Open-source CFD software (C++), source code knowledge and programming skills
- Bash, Fortran: Development of customised post-processing tools for CFD simulations
- Matlab, Octave: Data analysis and programming skills

> Languages

Italian	Mother tongue
English	Professional working proficiency
French	Intermediate working proficiency (DELF B2)

Bologna, 25th July 2023 *Carlo Cintolesi*