

# Simone Silvestri

## Personal information

**Last name:** Silvestri

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## Short biography

Simone Silvestri is a computational fluid dynamicist with experience in fluid dynamics, turbulence, and ocean modeling. He is currently working as a senior postdoctoral scientist at the Massachusetts Institute of Technology, funded by the Climate Modeling Alliance (CliMA). In this project, he is developing a new generation ocean and sea ice model (Oceananigans.jl and ClimaOcean.jl) to become a CliMA Earth system model component.

## Education

**Ph.D.** Computational fluid dynamics, 06/2021

Delft University of Technology, Delft, The Netherlands.

Dissertation: High-temperature turbulence; coupling of radiative and convective heat transfer in turbulent flows.

This dissertation was awarded “cum laude”. It was selected as one of the five finalists of the 2021 “ERCOFTAC da Vinci” prize in recognition of an excellent PhD thesis in theoretical and applied fluid dynamics.

**M.S.** Mechanical engineering, fluid dynamics track 09/2016

Delft University of Technology, Delft, The Netherlands.

Thesis: Turbulence - radiation interactions in high-temperature turbulent flows.

This thesis was awarded “cum laude” and obtained a grade of 10/10. The TUDelft Best Graduate program selected it as the best thesis in Mechanical, Maritime, and Materials Engineering in 2016.

**B.S.** Energy Engineering, 09/2013

Politecnico di Milano, Milano, Italy.

Graduated “cum laude” with a final GPA of 110/110.

## Employment

**Dates:** 02/2024 - present

**Employer:** Massachusetts Institute of Technology

**Location:** Cambridge, MA, USA

**Job title:** Senior postdoctoral research scientist

**Project:** Developing an ocean model to couple with the CliMA atmospheric model developed at Caltech. Improving numerical methods and representation of turbulent dynamics in ocean models.

**Dates:** 10/2021 - 02/2024

**Employer:** Massachusetts Institute of Technology

**Location:** Cambridge, MA, USA

**Job title:** Postdoctoral fellow

**Project:** Developing an ocean model to couple with the CliMA atmospheric model developed at Caltech. Improving numerical methods and representation of turbulent dynamics in ocean models.

## Awards

Name	Year
Finalist of the “ERCOFTAC Da Vinci” competition in recognition of excellent PhD Thesis in theoretical and applied fluid dynamics, Rome, Italy	2021
Ph.D. in computational fluid dynamics awarded “cum laude”, TUDelft, The Netherlands	2021
Best graduate of the Mechanical, Maritime, and Material Engineering department, TUDelft, The Netherlands	2016
Master thesis awarded “cum laude”, TUDelft, The Netherlands	2016
Excellence Scholarship, Bsc. Politecnico di Milano	2011-2013
Le migliori matricole dell’A.A. 2010/2011, Prize (Best freshmen of academic year 2010/2011)	2011

## Proposals

Name	Role	Year	Awarded
NSF proposal, title: “Quantifying mixing and restratification in the upper ocean: a unified approach”	co-PI	2024	No
NESAP Pathfinding project, title: “Oceananigans: a new generation ocean model”, salient features: Julia an LLVM, toolchain at scale, multi-gpu	PI	2024	yes
NERSC computational proposal, title: “High-fidelity large eddy simulations of coupled mesoscale and microscale turbulence in the Upper Ocean”.	PI	2023-2024	yes
PRACE proposal, 20th call, title: “Unveiling Turbulence-Radiation Interactions (TRI) in Participating Non-gray Media”.	co-PI	2020-2021	yes

## Teaching and mentoring experience

Type	Description	University	Years
Teaching	Climate modeling in “Introduction to Computational Thinking (in Julia)” graduate course. Main Lecturer: Prof. Alan Edelman	MIT	2022-2023
Teaching	Computational ocean modeling in “Modeling Ocean Transport in Julia”, COESSING summer school	UNILAG	2022
Mentoring	Four master thesis projects including “Direct numerical simulation of high temperature supersonic flows” and “DNS of particle aggregation in turbulent flows” that were awarded “cum laude”.	TUD	2016 - 2021
Teaching assistant	for the “Turbulence” post graduate course. Lecturers: Prof. Rene Pecnik and Prof. Wim-Paul Breugem	TUD	2018-2021
Teaching assistant	for the “Modeling of thermodynamics systems and fluid flows” undergraduate course. Lecturer: Prof. Rene Pecnik	TUD	2017-2021

## Publications

1. **S. Silvestri**, G.L. Wagner, J.-M. Campin, N.C. Constantinou, C.N. Hill, A.N. Souza, and R. Ferrari. “A New WENO-Based Momentum Advection Scheme for Simulations of Ocean Mesoscale Turbulence”. In: Journal of Advances in Modeling Earth Systems 16.7 (2024), e2023MS004130

2. **S. Silvestri**, G.L. Wagner, N.C. Constantinou, C.N. Hill, J.-M. Campin, A.N. Souza, S. Bishnu, V. Churavy, J.C. Marshall, and R. Ferrari. “A GPU-based ocean dynamical core for routine mesoscale-resolving climate simulations”. In: ESS Open Archive (2024)
3. M. Klöwer, M. Gelbrecht, D. Hotta, J. Willmert, **S. Silvestri**, G.L. Wagner, A. White, S. Hatfield, T. Kimpson, N.C. Constantinou, and C. Hill. “SpeedyWeather.jl: Reinventing atmospheric general circulation models towards interactivity and extensibility”. In: Journal of Open Source Software 9.98 (2024), p. 6323
4. G.L. Wagner, A. Hillier, N. Constantinou, **S. Silvestri**, A.N. Souza, K. Burns, A. Ramadhan, C. Hill, J.-M. Campin, J. Marshall, and R. Ferrari. “CATKE: a turbulent-kinetic-energy-based parameterization for ocean microturbulence with dynamic convective adjustment”. In: ESS Open Archive (2023)
5. **S. Silvestri**, G.L. Wagner, C.N. Hill, M.R. Ardakani, J. Blaschke, J.-M. Campin, V. Churavy, N.C. Constantinou, A. Edelman, J. Marshall, A. Ramadhan, A.N. Souza, and R. Ferrari. “Oceananigans.jl: A model that achieves breakthrough resolution, memory and energy efficiency in global ocean simulations”. In: arXiv physics.ao-ph (2023), p. 2309.06662
6. J. Strong-Wright, S. Chen, N.C. Constantinou, **S. Silvestri**, G.L. Wagner, and J.R. Taylor. “OceanBioME.jl: A flexible environment for modelling the coupled interactions between ocean biogeochemistry and physics”. In: Journal of Open Source Software 8.90 (2023), p. 5669
7. **S. Silvestri** and D.J.E.M. Roekaerts. “Mixed convection and radiation heat transfer in porous media for solar thermal applications”. In: Convective heat transfer in porous media. CRC Press, 2020. Chap. 12, pp. 227–262
8. **S. Silvestri** and Rene Pecnik. “Turbulence modulation in thermally expanding and contracting flows”. In: Journal of Fluid Mechanics 926 (2021), A30
9. **S. Silvestri**, Dirk J.E.M. Roekaerts, and Rene Pecnik. “Modelling turbulent heat flux accounting for Turbulence-Radiation Interactions”. In: International Journal of Heat and Fluid Flow 89 (2021), p. 108728
10. **S. Silvestri**, Dirk J.E.M. Roekaerts, and Rene Pecnik. “Assessing turbulence-radiation interactions in turbulent flows of non-gray media”. In: Journal of Quantitative Spectroscopy and Radiative Transfer 233 (2019), pp. 134–148
11. **S. Silvestri** and Rene Pecnik. “A fast GPU Monte Carlo radiative heat transfer implementation for coupling with direct numerical simulation”. In: Journal of Computational Physics 3 (2019), p. 100032
12. **S. Silvestri**, A. Patel, D.J.E.M. Roekaerts, and R. Pecnik. “Turbulence-radiation interaction in channel flow with various optical depths”. In: Journal of Fluid Mechanics 834 (2018), pp. 359–384

## Presentations

- Oral:** “Global ocean simulations with ClimaOcean.jl: numerical implementation, performance, and results”, COMMODORE Ocean Modeling Workshop, Boulder, United States of America, Invited.
- Oral:** “Oceananigans: a fast trainable ocean model accelerated by GPUs”, OGS, Trieste, Italy, Invited.
- Oral:** “A new momentum advection scheme for eddy-permitting ocean simulations”, COSIMA, Australia, Invited.
- Oral:** “Oceananigans: A trainable ocean model on GPUs”, Courant, New York, United States of America, Invited.
- Oral:** “A novel momentum advection scheme for mesoscale ocean large-eddy simulations with no explicit dissipation”, In Ocean Sciences Meeting, New Orleans, United States of America, (2024).

- Poster:** “A WENO-based Vector Invariant advection scheme for Implicit Ocean LES”, AGU fall meeting, Chicago, United States of America (2022).
- Oral:** “High-temperature turbulence, coupling of radiative and convective heat transfer in turbulence flow”, ERCOFTAC, Rome, Italy, (2021), *Invited*.
- Oral:** “Heterogenous computing for coupled turbulence and radiative heat transfer”, Opening of the DHPC Center, TU Delft, The Netherlands, (2021), *Invited*.
- Oral:** “Coupled Convective and Radiative heat transfer in turbulent flows”, Physics at Veldhoven, Veldhoven, (2020), the Netherlands.
- Oral:** “Coupled Turbulence and Radiation calculations on Heterogeneous computing architectures”, APS, Division of Fluid Dynamics, Seattle, United States of America, (2019).
- Oral:** “Coupling of convection and radiation in turbulent flows”, APS, Division of Fluid Dynamics, Atlanta, United States of America (2018).
- Oral:** “DNS of Turbulence-Radiation Interaction in non-grey media: Influence of variable absorption coefficient and real spectra”, Computational Thermal Radiation in Participating Media VI, Cascais, Portugal (2018).
- Oral:** “Turbulence radiation interactions in channel flows with various optical depths”, European Turbulence Conference, Stockholm, Sweden, (2017).
- Oral:** “Particle size influence in high-temperature volumetric absorption of sunlight”, CHAINS, Veldhoven, the Netherlands, (2017).