Miguel **Martin**

Postdoctoral Fellow · Building Energy and Urban Climate Specialist

About me

I am a specialist in building energy performance and urban microclimate, with over 12 years of experience conducting outdoor field experiments (utilizing large network sensors and infrared cameras) and developing coupled models (leveraging physics and machine learning). My expertise lies in building physics, computational fluid dynamics, infrared thermography, machine learning, meteorological sensing, and reduced order modelling. My upcoming research intends to evaluate the potential of novel building materials and urban designs to transform cities into carbon sinks via innovative methodologies for urban data collection and modeling.

Interests

- Building Energy Performance
- Urban Overheating
- Physics-based Modelling
- Machine Learning
- Meteorological Sensing
- Infrared Thermography

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Personal

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Education

2021 **PhD in Building Science**
National University of Singapore — Singapore
Thesis: *"Physically-based modelling of interactions between a building and its outdoor conditions at the urban microscale"*.

2011 **MSc in Computer Science**
University of Geneva — Geneva, Switzerland
Dissertation: *"Biometric authentication using human brain activity"*.

2009 **BSc in Computer Science**
University of Geneva — Geneva, Switzerland
End-year project: *"An asynchronous web application to navigate over a large set of images"*.

Professional Experience

2025 - now **Scientific Collaborator**
Rowan Williams Davies & Irwin Inc. — Toronto, Canada
- Extract social, environmental, and adaptive capability data in various regions of the world.
- Process the data using an unsupervised learning approach to assess a heat vulnerability index map.
- Validate the heat vulnerability index map using mortality and hospitalization data.

2011 - 2012 **Software Engineer**
Ecole Polytechnique Federale de Lausanne — Lausanne, Switzerland
- Developed the back-end of a web platform to study energy flows in Switzerland.
- Managed the front-end development of the web platform.
- Communicated the progress of the web development platform to superiors and future users.

2011 **Software Engineer**
Swiss Institute of Speleology and Karstology — La Chaux-de-Fonds, Switzerland
- Developed the back-end of a web platform to study caves in Switzerland.
- Developed the front-end of the web platform.
- Communicated the progress of the web development platform to superiors and future users.

Academic Experience

2022-now **Postdoctoral Fellow: Architecture and the Built Environment**
Delft University of Technology — Delft, Netherlands
- Generate CFD models using the City4CFD tool (here).
- Simulate carbon dioxide dispersion using the urbanMicroclimateFoam solver (here).
- Manage a field experiment to be conducted at the Green Village (here).
- Compare the accuracy and performance of various coupled schemes between building energy models and an urban microclimate model.

2023-2025 **Visiting Scholar: Civil and Environmental Engineering**
Carnegie Mellon University — Pittsburgh, PA, United States
- Collected meteorological data in campus using weather stations and an infrared camera.
- Developed a coupled scheme between detailed building energy models and a data driven urban canopy model.
- Studied the impact of interactions between buildings and their outdoor conditions on the calibration of urban building energy models.
- Determined how machine learning can be used to improve simulations of interactions between buildings and their outdoor conditions at different scales, for various climates, and in several applications.

2020-2022 **Senior Research Fellow: Building Efficiency and Sustainability in the Tropics**
University of California Berkeley — Singapore
- Reviewed the literature in infrared thermography for the built environment.
- Collected thermal images of the built environment on a university campus in Singapore.
- Assessed contributors and mitigators of urban overheating using thermal images.

Languages

French — Native

English — Proficient

Spanish — Fluent

Italian — Intermediate

Programming

Python

Matlab

Java

C/C++

Operating Systems

Windows

Linux

Mac

Building Simulation

EnergyPlus

Design Builder

IES

CFD

OpenFOAM

ENVI-MET

Co-simulation

BCVTB

EnergyPlus Python API

Other Skills

Critical Thinking

Scientific Communication

Adaptability

Time Management | Leadership

Active Learning | Creativity

2015 - 2016 **Research Fellow: Building Science**

National University of Singapore — Singapore

- Analyzed the importance of interactions between buildings and their outdoor environment in the assessment of their energy consumption.
- Monitored the concentration of PM2.5 during haze episodes in Singapore.

2013 - 2015 **Research Engineer: Engineering Systems and Management**

Masdar Institute of Science and Technology — Abu Dhabi, United Arab Emirates

- Developed a coupled scheme between a detailed building energy model with a single-layer urban canopy model.
- Validated the coupled scheme using measurements of the outdoor air temperature and humidity in Abu Dhabi (United Arab Emirates) and Basel (Switzerland).

Teaching Experience

Spring 2025 **Modelling Wind and Dispersion in Urban Environments (GEO5015)**

Delft University of Technology — Delft, Netherlands

Teaching Assistant

Spring 2024 **Autonomous Sustainable Buildings (12-770)**

Carnegie Mellon University — Pittsburgh, PA, United States

Co-instructor with overall teaching score of 4.2 when the average at Carnegie Mellon University was 4.2

Spring 2019 **Digital construction (PF1103)**

National University of Singapore — Singapore

Teaching Assistant

Spring 2019 **Digital construction (PF1103)**

National University of Singapore — Singapore

Teaching Assistant

Spring 2010 **Project in Software Engineering (CS 13X008)**

University of Geneva — Geneva, Switzerland

Teaching Assistant

Fall 2009 **Software Engineering (CS 13X003)**

University of Geneva — Geneva, Switzerland

Teaching Assistant

Grants and Awards

2022 **Marie Curie Global Fellowship**

European Commission — Brussels, Belgium

Granted (297,000 EUR) to conduct two years of research at the Carnegie Mellon University and one year at the Delft University of Technology in contribution to the mission Climate Neutral and Smart Cities.

2019 **Best Paper Award**

Sustainable Built Environment Conference — Tokyo, Japan

Awarded for my scientific contribution to the analysis of retro-reflective facades in Tokyo and Singapore.

2019 **Best Presentation Award,**

Sustainable Built Environment Conference — Tokyo, Japan

Awarded for my presentation on the analysis of retro-reflective facades in Tokyo and Singapore.

2018 **President's Graduate Fellowship**

National University of Singapore — Singapore

Granted (72,000 EUR) for my exceptional promises and accomplishments during my Ph.D. research in physics-based modelling of interactions between a building and its outdoor conditions.

2018 **Virtual Singapore Grant**

National Research Foundation of Singapore — Singapore

Granted (670,000 EUR) for my suggestion to incorporate physics-based models of interactions between buildings and their outdoor conditions into Virtual Singapore, a city digital twin platform for Singapore.

2016 **NUS Research Scholarship**

National University of Singapore — Singapore

Granted (61,000 EUR) for accomplishing my Ph.D. research in physics-based modelling of interactions between a building and its outdoor conditions within 4 years.

Talks

2025 **Jared L. Cohen Student Seminar Series**
Scott Institute for Energy Innovation — Pittsburgh, PA, United States
Invited talk on modelling interactions between buildings and their outdoor environment.

2024 **Civil Engineering Seminar Series**
Ecole Polytechnique Federale de Lausanne — Lausanne, Switzerland
Invited talk on simulations of interactions between buildings and their outdoor conditions at multiple scales.

2024 **ClimateChange.AI Discussion Seminar Series**
ClimateChange.AI Scientific Community — Online
Webinar on machine learning applied to urban building energy modelling and climate risk assessment.

2023 **CAPS Seminar Series**
Center for American Political Studies — Pittsburgh, PA, United States
Invited talk on the project Smart City Innovations and Experiments using New Climate and Energy Simulations (SCIENCES).

2023 **AIS Seminar Series**
Carnegie Mellon University — Pittsburgh, PA, United States
Invited talk on the project Smart City Innovations and Experiments using New Climate and Energy Simulations (SCIENCES).

2020 **Cooling Singapore Seminar Series**
Singapore-ETH Center — Singapore
Invited talk on coupling EnergyPlus with urban canopy models.

Journal Publications

2024 **Martin, M.**, Ramani, V. and Miller, C.. InfraRed Investigation in Singapore (IRIS) Observatory: Urban heat island contributors and mitigators analysis using neighborhood-scale thermal imaging. *Energy and Buildings 307*, 113973 (2024).

2023 Lin, S., Ramani, V., **Martin, M.**, Arjunan, P., Chong, A., Biljecki, F., Ignatius, M., Poolla, K. and Miller, C.. District-scale surface temperatures generated from high-resolution longitudinal thermal infrared images. *Scientific Data 10*, 859 (2023).

Ramani, V., **Martin, M.**, Arjunan, P., Chong, A., Poolla, K. and Miller, C.. Longitudinal thermal imaging for scalable non-residential HVAC and occupant behaviour characterization. *Energy and Buildings 287*, 112997 (2023).

2022 **Martin, M.**, Chong, A., Biljecki, F. and Miller, C.. Infrared thermography in the built environment: A multi-scale review. *Renewable and sustainable energy reviews 165*, 112540 (2022).

2021 **Miguel, M.**, Hien, W. N., Marcel, I., Chung, H. D. J., Yueer, H., Zhonqi, Y., Ji-Yu, D., Raghavan, S. V. and Son, N. N.. A physically-based model of interactions between a building and its outdoor conditions at the urban microscale. *Energy and Buildings 237*, 110788 (2021).

Lim, T. K., Wong, N. H., Ignatius, M., **Martin, M.**, Juang, H. H., Lou, J. and Tiong, R. L. K.. Singapore: an integrated multi-scale urban microclimate model for urban planning in Singapore. *Urban Climate Science for Planning Healthy Cities* 189--217 (2021).

Wong, N. H., He, Y., Nguyen, N. S., Raghavan, S. V., **Martin, M.**, Hii, D. J. C., Yu, Z. and Deng, J.. An integrated multiscale urban microclimate model for the urban thermal environment. *Urban Climate 35*, 100730 (2021).

2019 Ignatius, M., Wong, N. H., **Martin, M.** and Chen, S. C.. Virtual Singapore integration with energy simulation and canopy modelling for climate assessment. in *IOP Conference Series Earth and Environmental Science 294*, 012018 (2019).

Martin, M., Wong, N. H. and Ichinose, M.. Impact of retro-reflective glass façades on the surface temperature of street pavements in business areas of Singapore and Tokyo. in *IOP Conference Series Earth and Environmental Science 294*, 012020 (2019).

2017 Lim, T. K., Ignatius, M., **Miguel, M.**, Wong, N. H. and Juang, H. H.. Multi-scale urban system modeling for sustainable planning and design. *Energy and Buildings 157*, 78--91 (2017).

Martin, M., Wong, N. H., Hii, D. J. C. and Ignatius, M.. Comparison between simplified and detailed EnergyPlus models coupled with an urban canopy model. *Energy and Buildings 157*, 116--125 (2017).

2016 **Martin, M.**, Afshari, A., Armstrong, P. R. and Norford, L. K.. A new validation protocol for an urban microclimate model based on temperature measurements in a Central European city. *Energy and Buildings 114*, 38--53 (2016).

Wei, R., Song, D., Wong, N. H. and **Martin, M.**. Impact of urban morphology parameters on microclimate. *Procedia Engineering 169*, 142--149 (2016).

2015 **Martin, M.**, Afshari, A., Armstrong, P. R. and Norford, L. K.. Estimation of urban temperature and humidity using a lumped parameter model coupled with an EnergyPlus model. *Energy and Buildings* 221--235 (2015).

2014 Afshari, A., Nikolopoulou, C. and **Martin, M.**. Life-cycle analysis of building retrofits at the urban scale—A case study in United Arab Emirates. *Sustainability 6*, 453--473 (2014).

Conference Papers

2024 **Martin, M.**, Berges, M., Stoter, J. and Sanchez, C. G.. Impact of interactions between buildings and their outdoor conditions on the calibration of an urban building energy model. in *eSim 2024: 13th Conference of IBPSA-Canada* 151 (2024).

Martin, M., Ignatius, M., Berges, M., Lim, J., Lu, Y., Xu, R., Stoter, J., Garcia Sanchez, C. and Wong, N. H.. Towards a Full Data Driven Coupled Scheme to Simulate Interactions Between Buildings and Their Outdoor Conditions at the City-Scale. in *ASim2024, The 5th Asia Conference of the IBPSA* (2024).

Martin, M., Berges, M., Stoter, J. and Garcia Sanchez, C.. Coupling between detailed building energy models and a data driven urban canopy model. in *PLEA 2024: (Re)Thinking Resilience* (2024).

2016 **Martin, M.**, Hii, D. J. C., Ignatius, M. and Wong, N. H.. Comparison between a simplified and detailed building energy model coupled with an urban canopy model. in *4th International Conference on Countermeasures to Urban Heat Island* 1--16 (2016).

Martin, M., Hii, D. J. C., Ignatius, M. and Wong, N. H.. Predictability of urban air temperature changes from variations of PM2. 5 concentration during the 2015 Southeast Asian transboundary haze episode. in *Proceedings of the 4th International Conference on Countermeasures to Urban Heat Island* (2016).

2015 **Martin, M.**, Afshari, A., Norford, L. K., Parlow, E. and Vogt, R.. Validation of a lumped thermal parameter model coupled with an EnergyPlus model using BUBBLE data. in *9th International Conference on Urban Climate* (2015).

Martin, M., Afshari, A., Armstrong, P. and Marpu, P.. MOBO--An experimental network for urban heat island analysis in a green district of the Middle-East. in *9th International Conference on Urban Climate* (2015).

2014 **Martin, M.**, Afshari, A., Armstrong, P. R. and Norford, L. K.. Validation of a Coupled-Scheme Urban Canopy Model and Building Simulator. in *3rd International Conference on Countermeasures to Urban Heat Island* (2014).

References

Nyuk Hien Wong
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Advisor during my Ph.D. at the NUS
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Clayton Miller
National University of Singapore — Singapore
Advisor during my at the Berkeley Education Alliance for Research in Singapore.
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Carnegie Mellon University — Pittsburgh, PA, United States
Advisor during my visit at CMU.
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Delft University of Technology — Delft, Netherlands
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