Graduate Research Projects Scheme
The University of Melbourne and The Centre National de la Recherche Scientifique (CNRS)

Proposals should be prepared jointly by the CNRS PI and UoM PI and submitted by 27 November 2023. PIs should attach this title page to their proposal for submission via the CNRS website.

Proposal title
Climate benefits and tradeoffs of urban greening: evaluation and impact of management practices at parkscape and streetscape

Principal Investigator– UoM Prof. Stephen Livesley	
School/Department	School of Agriculture, Food and Ecosystem Sciences
Faculty	Faculty of Science
Laboratory/Research Institute (if applicable)	Green Infrastructure Research Group
Address	The University of Melbourne, Burnley campus, VIC 3121, Australia
Email	sjlive@unimelb.edu.au
Telephone number	+61 0439 615 772
Link to website/profile	https://findanexpert.unimelb.edu.au/profile/21449-stephen-livesley

X☐**I confirm that I am a University of Melbourne academic staff member (minimum Level B) registered to supervise as per the *Supervisor Eligibility and Registration Policy*, and contracted beyond the envisaged submission date of the PhD candidate(s) OR have provided a letter of support detailing the arrangements in place to ensure continuity of supervision.**

OR

☐**I confirm that I am an honorary employee whose primary affiliation is with the University of Melbourne, eligible to supervise as per the *Supervisor Eligibility and Registration Policy*; and my primary employer has entered into an agreement to fund the Melbourne lump sum component of the Project's collaborative activity.**

Primary employer:

OR **☐I confirm that I am an honorary employee whose primary affiliation is with the University of Melbourne, eligible to supervise as per the *Supervisor Eligibility and Registration Policy*; I am otherwise unaffiliated and participating at my own expense.**	
Career stage	**☐Within five years FTE of PhD conferral** **☐ Within ten years FTE of PhD conferral ☐X Neither**
Gender identification	**☐ Female** **X☐ Male** **☐ Other** **☐ Prefer not to say**
Do you identify as Aboriginal and/or Torres Strait Islander?	**☐ Yes** **X☐ No** **☐ Prefer not to say**
X☐I have attached evidence of approval from the Head of Department/School and the Faculty's Associate Dean (Graduate Research).	

Principal Investigator – CNRS : Pr. Pierre Emmanuel BOURNET	
Laboratory/Research Institute	Institut de Recherche en Sciences et Techniques de la Ville (FR CNRS 2488)
Address	Ecole Centrale de Nantes - 1 rue de la Noé 44300 Nantes
Email	pierre-emmanuel.bournet@institut-agro.fr
Telephone number	+33 241225504
Link to website/profile	https://pro.institut-agro-rennes-angers.fr/en/pierre-emmanuel-bournet

UoM Co-Supervisor 1 (if applicable) Dr. Kerry Nice	
School/Department	Melbourne School of Design
Faculty	Faculty of Architecture, Building and Planning
Laboratory/Research Institute (if applicable)	Transport, Health and Urban Systems Research Lab

Email	kerry.nice@unimelb.edu.au

UoM Co-Supervisor 2 (if applicable) Dr. Paul Cheung	
School/Department	School of Agriculture, Food and Ecosystem Sciences
Faculty	Faculty of Science
Laboratory/Research Institute (if applicable)	Green Infrastructure Research Group
Email	cheung.p@unimelb.edu.au

CNRS Co-Supervisor 1 (if applicable) : Pr. Patrice CANNAVO	
Laboratory/Research Institute	Institut de Recherche en Sciences et Techniques de la Ville (FR CNRS 2488)
Address	Ecole Centrale de Nantes - 1 rue de la Noé 44300 Nantes
Email	patrice.cannavo@institut-agro.fr
Telephone number	+33 241225511

CNRS Co-Supervisor 2 (if applicable) : Dr. Sophie HERPIN	
Laboratory/Research Institute	Institut de Recherche en Sciences et Techniques de la Ville (FR CNRS 2488)
Address	Ecole Centrale de Nantes - 1 rue de la Noé 44300 Nantes
Email	sophie.herpin@institut-agro.fr ; sophie.herpin@ec-nantes.fr
Telephone number	+33 (0)2 41 22 54 35

PART B: Description of the scientific projects

Project 1 : Analysis of trade-offs between soil GHG exchange and microclimate cooling under different urban green space management regimes

Supervision : Patrice Cannavo (FR) and Stephen Livesley (AU)
Co-supervision: Kerry Nice (AU) and Pierre-Emmanuel Bournet (FR)
Participants : Sophie Herpin (FR) and Paul Cheung (AU) and René Guénon (FR)

Context Cities are hotspots for GHG emissions. The EU Green Deal (2019) aims to reduce net GHG emissions by >55% by 2030 compared to 1990 levels. Australia has a 2030 target to reduce GHG emission by 43% compared to 2005 levels. Urban populations are demanding climate action in the management of their cities. Changing the management of urban green spaces (UGS) is one way to help offset urban GHG emissions, by modifying mowing, fertilizer and irrigation management.
Meanwhile, both European and Australian cities are experiencing increasingly high temperatures, driven by more frequent and more intense heat waves. Extreme urban heat has negative health impacts through heat stroke, hospitalization and mortality. Changing the management of UGS can also mitigate urban heat and cool local residents, through irrigation and tree planting.
UGS can account for >20% of urban land use cover. Lawns and wooded lawns are the dominant form of UGS type. To ensure the well-being and leisure activities of residents, these lawns are often intensively managed, which can negatively impact soil GHG emissions but positively impact the local microclimate. Soil GHG exchange is the result of soil biological activity which is sensitive to irrigation, fertilizer inputs and soil temperature. While irrigation increases lawn quality and evapotranspiration cooling, it can also stimulate soil biological activity and promote soil GHG emissions. The key factors that can impact GHG emissions include mowing (frequency, with or without restitution), fertilization (none, mineral and/or organic) and irrigation (frequency, time). The key factors that impact UGS microclimates are irrigation (frequency, time, amount) and tree canopy cover (percentage).

Objectives This PhD program seeks to explore the trade-offs between soil GHG emissions and cooling benefits under different UGS management scenarios in France and Australia. Findings will seek to strike a balance between urban heat mitigation and urban GHG emissions reduction. The scientific objectives are to characterize the impact of:
(1) irrigation, fertilizer and mowing on lawn soil GHG fluxes,
(2) irrigation and mowing on the energy balance and thermal comfort of lawn UGS, and
(3) increasing tree canopy cover on lawn soil GHG emissions and microclimate cooling.

Methods Soil GHG exchange will be measured using Infrared spectrophotometers to quantify CO_2, CH_4 and N_2O fluxes. UGS microclimate and energy balance will be measured using soil moisture/temperature sensors and heat flux plates and climate stations measuring air temperature, relative humidity, black globe temperature, wind speed. net radiation and surface temperature. In France, measures will be made in campus lawn plots (2 x 2 m = 4 m2, 3 replicates) with different irrigation, fertilization, mowing and tree litterfall. In the city of Angers, measures will be made in contrasting UGS from the 15 studied byTom Künnemann's PhD (2019-23). In Australia, measures will be made in experimental lawn plots (6 x 6 m = 36 m2, 12 replicates) irrigated at low, medium or high rates per day, with and without the presence of small trees. In the city of Wyndham, street-scale measures will be made of UGS to complement those in the city of Angers.

Outcomes The PhD project will generate original scientific and technical knowledge on the impact of lawn management on GHG emissions and UGS microclimate, and the capacity of lawns to ensure ecosystem services with reduced inputs. The PhD will develop a decision support system for UGS managers to optimise sustainable management strategies according to their priorities and UGS context.

Project 2 : Analysis of the impact of dynamics of street vegetation on localized climate benefits
Supervision : Pierre-Emmanuel Bournet (FR) and Kerry Nice (AUS)
co-supervision: Stephen Livesley (AUS) and Sophie Herpin (FR)
Participants : Patrice Cannavo (FR), Paul Cheung (AUS)

Context Rapid urbanization and climate change have increased urban heat and health risks in cities mainly as a consequence of replacement of natural surfaces by heat-absorbing ones. Increasing urban vegetation and providing additional water support can shift energy balances and provide cooling benefits. The EU recognizes the crucial role of vegetation and is working on the Nature Restoration Law to ensure at least 10% canopy cover in European cities by planting 3 billion trees by 2030. In Australia, similar policies are implemented locally, such as Melbourne's Urban Forest Strategy targeting 40% canopy cover by 2040. Urban vegetation undergoes dynamic changes depending on seasons, weather, water availability, and maintenance, impacting the localized climate benefits it provides. Defining the most effective mitigation strategies requires a better understanding of these processes. This could be reached through modeling tools. Available models, however, still lack accuracy in predicting levels of latent energy (cooling water evaporation) as well as functions of urban hydrology (runoff, soil infiltration, evaporation, and transpiration). Additionally, modeling of vegetation is generally very static, and does not account for the dynamic nature of vegetation.

Objectives The aim of this PhD is to investigate the dynamics of street trees (time evolution of leaf area, architecture), in relation with environmental conditions (weather, water inputs), its impacts on evapotranspiration, shading, and the resulting climate benefits that can be realized through increased urban vegetation and optimized management practices. By combining experimental and modeling approaches, the project will:

1. Evaluate the skill of current urban climate models to capture the impacts of a range of urban vegetation types under varying conditions (including water inputs and maintenance operations).
2. Provide experimental observations of changes in physiological responses of structural changes to canopies and variations in water availability to support further model improvements.

Method The project with involve ***two experimental*** sites:

- A reduced-scale (⅛) vegetated canyon street located in Angers (Institut Agro) with three zones: a control zone without trees and two zones with 5 trees each, managed with independent irrigation. It is instrumented along the soil-plant-atmosphere-building continuum (matric potential/water content, radiation, air temperature and humidity, globe temperature, wind speed, stem diameter, stomatal resistance, terrestrial laser scanner).
- A network of north-south streets in the City of Wyndham (Australia) with small and large crown street trees of different species. The site is equipped with fixed micro-climate sensors. A portable six-way net radiation biometeorological platform (MaRTy-Melbourne) will also be used.

Evaluations of and modifications will be made to the ***micro-climate model*** VTUF-3D, a 3-dimensional surface energy balance model that also includes the influences of urban vegetation on human thermal comfort. Datasets from previous field surveys in Angers will first be used to evaluate the vegetation module. Complementary experiments at reduced scale (France) and real scale (Australia) will also be undertaken to improve and adapt the improved integration of urban vegetation in the model, particularly for hydric stress situations (or on contrary additional water inputs in summer) and quick variations of tree architecture (following leaf fall, trimming or pruning operations).

Outcomes The ambition of the PhD is to adapt an existing model to predict the impact of irrigation strategy and tree architecture and leaf density variations on the evapotranspiration, shading and climate benefits provided by trees. The improved tool will be used to perform a wider range of scenarios to test the most effective ways to use vegetation and vegetation maintenance to deliver urban cooling strategies.

PART C: added value of international collaboration

The main aim of this project is to develop new scientific knowledge on heat, water and greenhouse gas transfers in urban green spaces, with a focus on the interactions between these processes. The collaboration makes it possible to apply data to many more aspects of the benefits of vegetation in urban areas than would otherwise be possible as isolated projects or research groups. PhD projects 1 and 2, while being distinct PhD projects in terms of scientific questions, urban greening typology, and methodologies, both contribute to this overall objective.

The strength of this proposal lies in the cross-disciplinary experience of both teams in urban environments, bioclimatology, fluid mechanics, agronomy and soil science, with complementary experimental systems or numerical models that have been tried and tested in previous research projects. Sharing the existing experimental observations from both sides, as well as the microclimate model know-how, creates a rapid starting point to quickly ramp up both projects. New experimental and numerical data will also be co-developed in the framework of this project to meet the specific objectives of the proposal. For project 1, the research infrastructure of 18 irrigated turf plots in the Burnley campus, Australia provides an excellent opportunity to concurrently study GHG exchange and microclimate conditions under contrasting and controlled irrigation, fertilizer and tree shade regimes. For project 2, the reduced-scale experiment in Angers, France, with controlled conditions (irrigation, canonical environment) is especially well suited for the validation and improvement of the model developed in Australia (VTUF-3D).

The two teams have previously been in contact and discussed possible collaboration during a face-to-face seminar on Urban Cooling organized by UoM in Melbourne in August, 2023 with the participation of K. Nice (AU), S. Livesley (AU), P. Cheung (AU) and S. Herpin (FR). Following that, regular video meetings have been organized with all participants from both teams to create this proposal. From a cultural point of view, there is a broad mix of international backgrounds (with UK, Hong-Kong, Chile, USA, Australia). More specifically, S. Herpin (FR) obtained her PhD in 2009 from an Australian University (Monash University). During her recent stay in Melbourne in 2023, she also met the CNRS regional director for Oceania, Thierry Correge, to discuss collaborative schemes between the two countries. A strong foundation for a fruitful and efficient international collaboration has been built between the two teams.

The proposal will also involve the contribution of other partners to strengthen the project: IRHS research unit (FR, S. Demotes Mainard) with expertise in ecophysiology and tree architecture, and the City of Wyndham (AU) will provide in-situ experimental sites. In addition, the results of the project will be shared with Plante et Cité (FR association on urban horticulture and landscape), and the cities of Angers, Nantes, Paris and Melbourne, which are regular partners of the two research units.

Part D : Planned activities

Project 1

Home institution - CNRS, France

Période	**Activity**
M1-M15 (France)	**Bibliographical work:** analysis of processes related to GHG emissions from urban soils and water transfer and energy balance in the soil-plant-atmosphere continuum. **Development of an experimental protocol and data processing chain aimed at :** o measure GHG emissions under different urban lawn management methods o characterize the water and energy balance (soil water stock, plant evapotranspiration demand, soil heat storage) **Implementation of the experimental protocol** - Measurement campaign during the spring-summer 2025 period. -> M2 internship associated with this task

	Data analysis, comparison of GHG fluxes, microclimate and inputs as a function of lawn management methods. **Presentation of work at a conference and writing of a scientific article:** "Impact of urban lawn management on GHG fluxes and human thermal comfort".
M15-M26 (Australia)	**Measurement campaign** using the existing experimental facility at Burnley Campus to examine the impacts of irrigation inputs on microclimate during the spring-summer 2026 period **Journal article writing #2:** Impacts of irrigation amount on microclimate in turfed and treed urban green space
M27-M36 (France)	**Data analysis** **article writing** **Drafting of PhD manuscript.** **Presentation of work** at a conference and writing of a scientific article: "The trade-offs between GHG footprint and green space cooling when sustainably managing our urban parks for multiple ecosystem service benefits".

Project 2

Home institution - University of Melbourne, Australia

Période	Activity
M1-M15 (Australia)	**Bibliographical work** : Influence of trimming and irrigation on street tree microclimate benefits ; Review on Soil-Vegetation-Atmosphere (SVAT) schemes in microclimate models. **Evaluation of VTUF-3D model** using French datasets at reduced scale. **Design and implementation of an experimental protocol for the measurement in a canyon street at scale 1 in Wyndham, Australia .** **Data analysis** of measurement campaign at scale 1. **Scientific conference #1** (12th International conference on Urban Climate) : Evaluation of VTUF-3D model using French datasets at reduced scale. **Journal article writing #1** : evaluation of Soil-vegetation-Atmosphere (SVAT) schemes in microclimate models using experimental datasets. **Design of an experimental protocol for the new measurement campaign at reduced-scale in Angers, France.**
M16-M26 (France)	**Implementation of the new experimental protocol at reduced-scale in Angers, France** **Data analysis** of experiment at reduced-scale, Angers, France ; Comparaison of the experimental results at reduced-scale and scale 1. **Journal article writing #2 :** influence of irrigation on tree climate benefits : comparison of reduced-scale experiment with full-scale experiment. **Presentation of work at a international conference**
M27-M36 (Australia)	**Development of new vegetation models in VTUF-3D** **Journal article writing #3** influence of management (irrigation and trimming) on street tree benefits : a sensitivity analysis using improved microclimate models

Part E : budget

CNRS budget (in €)	year 1	year 2	year 3	Total
PhD scholarship (project 1)	**40 000 €**	**40 000 €**	**40 000 €**	**120 000 €**
PhD Travel cost (project 1)				**4800 €**
-return flight ticket		**1800 €**		
-initial accommodation (2 weeks)		**1200 €**		
-travel cost for scientific conference			**1800 €**	
PIs Travel cost (project 1 and project 2)				**9158 €**
- 3 return flight ticket for CNRS PI/supervisors	**3600 €**	**1800 €**		
-accomodation support (18 days in total for 3 years)	**2505 €**	**1253 €**		
Workshop organization				**1042 €**
Workshop on the impact of greenspace management on GHG and local cooling benefits : with local research group (IRSTV, EPHor, and IRHS research units), UoM PIs, partner cities (Angers Loire Métropole, Nantes Métropole, Paris) and Plante et Cité.			**1042 €**	
Subtotal : PhD travel + PI travel + workshop	**6105 €**	**6053 €**	**2842 €**	**15000 €**
Total CNRS	**46105 €**	**46053 €**	**42842 €**	**135 000 €**
UoM Budget (in $AU)				
PhD scholarship (project 2)	**$37000**	**$38000**	**$39000**	**$113000**
PhD travel cost (project 2)				
return flight ticket		**$3000**		
initial accommodation (2 weeks)		**$1000**		
PhD travel for conference (project 2)			**$3000**	
PI travel cost (project 1 and project 2)				
Return flights for PIs from Melbourne		**$3000**	**$6000**	
Accommodation support for Melbourne PIs		**$1000**	**$2000**	
Total UoM	**$37000**	**$46400**	**$50600**	**$133 000**

Part F : Perspectives and external funding

French project ADEME SAGES (2022-25; Call topic: Graine 2019; grant number 2203D0002; total budget : 170k€. Amount that can be mutualized with this project : 2k€ for the experimental site : turfgrass experiment)
ARC Discovery Early Career Research Award (DECRA 2025): Paul Cheung, UoM. (Submission Nov 2024)
ARC Discovery Project (DP 2026) Stephen Livesley, UoM (Submission 2025).

Part G : scientific quality of the teams

Cheung, P. K. (**AU**), & Jim, C. Y. (2018). Comparing the cooling effects of a tree and a concrete shelter using PET and UTCI. Building and Environment, 130, 49–61. https://doi.org/10.1016/j.buildenv.2017.12.013
Cheung, P. K. (**AU**), Jim, C. Y., Tapper, N., **Nice, K. A**. (**AU**), & **Livesley, S. J**. (**AU**) (2022). Daytime irrigation leads to significantly cooler private backyards in summer. Urban Climate, 46(October), 101310. doi: 10.1016/j.uclim.2022.101310
Cheung, P. K. (**AU**), **Nice, K. A.** (**AU**), & **Livesley, S. J.** (**AU**) (2022). Irrigating urban green space for cooling benefits: the mechanisms and management considerations. *Environmental Research: Climate*, 1(1), 015001. doi: 10.1088/2752-5295/ac6e7c
Cheung, P. K. (AU), **Livesley, S. J. (AU)**, **& Nice, K. A. (AU)** (2021). Estimating the cooling potential of irrigating green spaces in 100 global cities with arid, temperate or continental climates. Sustainable Cities and Society, 71(April), 102974. https://doi.org/10.1016/j.scs.2021.102974
Nice, K. A. (**AU**), Coutts, A. M., & Tapper, N. J. (2018). Development of the VTUF-3D v1.0 urban micro-climate model to support assessment of urban vegetation influences on human thermal comfort. *Urban Climate*, 24(December 2017), 1052–1076. doi: 10.1016/j.uclim.2017.12.008
Sanusi, R., Johnstone, D., May, P., & **Livesley, S. J.** (**AU**) (2017). Microclimate benefits that different street tree species provide to sidewalk pedestrians relate to differences in Plant Area Index. *Landscape and Urban Planning*, 157, 502–511. doi: 10.1016/j.landurbplan.2016.08.010
Livesley, S. J. (**AU**), Dougherty, B. J., Smith, A. J., Navaud, D., Wylie, L. J., & Arndt, S. K. (2010). Soil-atmosphere exchange of carbon dioxide , methane and nitrous oxide in urban garden systems : impact of irrigation, Fertiliser and Mulch. *Urban Ecosystems* 273–293. doi: 10.1007/s11252-009-0119-6

Künnemann T., **Cannavo P**. (**FR**), Guérin, V., **Guénon, R**.(**FR**) (2023) Soil CO2, CH4 and N2O fluxes in open lawns, treed lawns and urban woodlands in Angers, France. *Urban Ecosystems*, doi: 10.1007/s11252-023-01407-y
Mballo, S., **Herpin, S**.(**FR**), Manteau, M., Demotes-Mainard, S., & **Bournet, P. E**.(**FR**) (2021). Impact of well-watered trees on the microclimate inside a canyon street scale model in outdoor environment. *Urban Climate*, 37, 100844. doi: 10.1016/j.uclim.2021.100844
Bouzouidja R., **Cannavo P**.(**FR**), Bodénan, P., Gulyas A., Kiss, M., Kovacs A., Béchet B., Chancibault K., Chantoiseau, E., **Bournet P.E**.(**FR**), Bouzidi, R., **Guénon R**.(**FR**), Lebeau T., Musy M., Rodriguez F. (2021). How to evaluate nature-based solutions performance for microclimate, water and soil management issues – Available tools and methods from Nature4Cities European project results. *Ecological Indicators,* 125, doi: 10.1016/j.ecolind.2021.107556
Cambou A., Saby N.P.A., Hunault, G., Nold F., **Cannavo, P**.(**FR**), Schwartz, C., Vidal-Beaudet, L. (2021) Impact of city historical management on soil organic carbon stocks in Paris (France). *Journal of Soils and Sediments*, doi: 10.1007/s11368-020-02869-9
Bouzouidja, R., Béchet, B., Hanzlikova J., Sněhota, M., Le Guern, C., Capiaux, H., Jean-Soro, L., Claverie, R., Joimel, S., Schwartz, C., Guénon, R., Szkordilisz, F., Körmöndi, B., Musy, M., **Cannavo, P**.(**FR**), Lebeau, T. (2020) Simplified performance assessment methodology for addressing soil quality of nature based-solutions. J. *Soil and Sediments*, doi: 10.1007/s11368-020-02731-y
Herpin, S. (FR), Perret, L., Mathis, R., Tanguy, C., & Lasserre, J.-J. (2018). Investigation of the flow inside an urban canopy immersed into an atmospheric boundary layer using laser Doppler anemometry. Experiments in Fluids, 59(5). https://doi.org/10.1007/s00348-018-2532-1

Part H : CV of PIs

Pierre-Emmanuel BOURNET
Full Professor (PR1) in Transfer Physics, Institut Agro Rennes-Angers
52 years old
Contact email: pierre-emmanuel.bournet@institut-agro.fr

EDUCATION

- 2008 Accreditation to supervise research (Habilitation à Diriger des Recherches), University of Angers, specialty Physics: « Contribution to the modeling of flows and transfers in fluid mechanics: analysis of several coupling mechanisms.»
- 1996 PhD thesis at ENGREF (Ecole Nationale du Génie Rural, des Eaux et des Forêts / National School of Rural Engineering, Water Resources and Forestry, Paris, France) in environmental sciences: « Contribution to the hydrodynamic and thermal study of lake Bourget: density currents and internal waves », with first class honors.
- 1993 Engineer diploma at ENSEEIHT (École Nationale Supérieure d'Électrotechnique, d'Électronique d'Informatique et d'Hydraulique de Toulouse / Engineering school in Energy, Environment, Computer Science and Telecommunications, Toulouse, France) in hydraulics and fluid mechanics.
- 1993 Master degree at UPS (Université Paul Sabatier/ Paul Sabatier University, Toulouse, France) in environmental physics and chemistry.

EMPLOYMENT

- From December 2023 to July 2024 : Fulbright scholar at the Climate Urban Research center in Tempe, Arizona.
- Since 2022 Deputy director of the Institute of research in urban science and technology IRSTV (FR CNRS 2488), 170 people (https://irstv.ec-nantes.fr/english-version).
- Since 2021 Head of the Department of Physical Environment, Landscape Architecture and Territorial Development (MilPPaT Milieu Physique, Paysage, Territoire) at l'Institut Agro Rennes-Angers (https://international.institut-agro-rennes-angers.fr/), 60 people.
- Since 2021 Full Professor (PR1) in Transfer Physics, Institut Agro Rennes-Angers.
- 2012-2021 Head of EPHor (Environmental Physics and Horticulture) research unit, ministry of agriculture.
- 2011-2020 Full Professor (PR2) in Transfer Physics, Agrocampus Ouest, Institut National d'Horticulture et de Paysage, Angers, France.
- 2001-2011 Associate Professor, Agrocampus Ouest, Angers, France.
- 1999-2000 Assistant Professor, Institut National Agronomique Paris-Grignon (INA P-G), Paris, France.
- 1999 Research Engineer, French National Institute for Research in Digital Science and Technology (INRIA, Institut National de Recherche en Informatique et Automatique), Sophia Antipolis, France.
- 1998-1999 Engineer, Numeca Int. S.A.-Université Libre Flamande, Brussels, Belgium.
- 1997-1998 Delegate at the European institutions for IFREMER (French National Institute for Ocean Science / Institut Français de Recherche pour l'Exploitation de la Mer), Club of associated research institutes (Club des Organismes de Recherche Associés CLORA), Brussels, Belgium.

ACADEMIC TIMETABLE

Since 2001: Courses in hydraulics, water resources, landscape engineering (approximately 200 hours/year, Bachelor (50%) and Graduate (50%) levels, Agrocampus Ouest/Institut Agro, Angers)

SCIENTIFIC FOCUS AREAS

- greenhouse climate (opening management, energy balance, plant-climate interaction, impact of water restriction, condensation),

- urban climate: plant interaction with local climate taking account of shading, water inputs, soil compaction. Another point of interest is climate ecosystem services provided by trees in urban environments.

Keywords: greenhouse, livestock building, fluid mechanics, thermics, radiation, coupling, turbulence, CFD, numerical methods, sensible and latent heat, porous medium, metrology

CURRENT PROJECT WORK

- Urbinat (2018-2024): European H2020 project (13000 k€). URBINAT aims at using “health corridors” as an innovative and flexible solution to integrate a large number of renaturation solutions resulting from citizen design..
- CoolTrHyd (2021-2024): Funded by the city of Paris, the ANRT & the RFI (Recherche-Formation-Innovation) Objectif Végétal (126 k€). The project aims at quantifying and modeling the impact of water restriction and extreme weather conditions (heat wave) on the climatic benefits (shading / cooling) provided by alignment trees in the city.
- SpecHyUrb (2021-2024): PhD thesis with the financial support of Pays de la Loire Region and the French government (118 k€). How to choose tree species adapted to drought and heat episodes in the city to ensure their sustainability and mitigate the urban heat island effect?

INSTITUTIONAL RESPONSIBILITIES

- Since 2022 Member (deputy director) of the steering committee of the IRSTV Research Institute.
- Since 2021 Member of the national working group on Urban Climate.
- Since 2020 Member of the scientific council of ASTREDHOR (professional ornamental plant technical center).
- Since 2018 Elected Vice-chair of the Precision Horticulture & Engineering Division of ISHS.
- Since 2004 Member of the International Society for Horticultural Science (ISHS).

PhD SUPERVISION

Since 2003 : Supervision of 7 PhD thesis on topics related to greenhouse climate assessment and modeling or to urban climate: 1 at University of Angers, 2 at University of Batna (Algeria), 5 at Agrocampus Ouest, funded by a private company, Pays de la Loire Region, Algerian government, ADEME, city of Paris.

SELECTED PUBLICATIONS (last 5 years)

Fatnassi H., **Bournet P.E**., Boulard T., Roy J.C., Molina-Aiz F.D., Zaaboul R. (2023) Use of Computational Fluid Dynamic tools to model the coupling of plant canopy activity and climate in greenhouses and closed plant growth systems: a review, Biosystems Engineering, 230: 388-408. https://doi.org/10.1016/j.biosystemseng.2023.04.016

Bournet P.E., Rojano F. (2022) Advances of Computational Fluid Dynamics (CFD) applications in agricultural building modelling: research, applications and challenges, Computers and Electronics in Agriculture, 201(5):107277. DOI:10.1016/j.compag.2022.107277.

Bouzouidja R., Cannavo P., Bodenan P., Gulyás A., Kiss M., Kovács A., Béchet B., Chancibault K., Chantoiseau E., **Bournet P.E.**, Bouzidi R., Guénon R., Lebeau T., Musy M., Rodriguez F. (2021), How to evaluate nature-based solutions performance for microclimate, water and soil management issues – available tools and methods from Nature4Cities European project results, Ecological indicators, Vol 125, 16p.

Mballo S., Herpin S., Demotes-Mainard S., **Bournet P.E.** (2021) Impact of well-watered trees on the microclimate inside a canyon street scale model in outdoor environment, Urban Climate, Vol 37, 27p., DOI:10.1016/j.uclim.2021.100844.

Bouhoun Ali H., **Bournet P.E.**, Cannavo P., Chantoiseau E. (2019). Using CFD to improve the irrigation strategy for growing ornamental plants inside a greenhouse. *Biosystems Engineering*, 186:130-145.

Rojano F., **Bournet P.E.**, Hassouna M., Robin P., Kacira M., Choi C.Y. (2019) Assessment of gas dispersion inside and outside of a poultry house by means of a 3D CFD model, Biosystems Engineering, 180:168-181. DOI:10.1016 /j.biosystemseng.2019.02.001.

Bouhoun Ali H., **Bournet P.E.**, Cannavo P., Chantoiseau E. (2018). Development of a CFD crop submodel for simulating microclimate and transpiration of ornamental plants grown in a greenhouse under water restriction. Computers and Electronics in Agriculture, 149, 26-40, DOI:10.1016/j.compag.2017.06.021.

Rojano F., **Bournet P.E**, Hassouna M., Robin P. Kacira M. Choi C. (2018) Assessment using CFD of the wind direction on the air discharges caused by natural ventilation of a poultry house, *Environmental Monitoring and Assessment*, 190(12):724. https://doi.org/10.1007/s10661-018-7105-5.

Stephen LIVESLEY

Curriculum Vitae - Professor Stephen Livesley

I am an urban researcher studying the urban forest, urban microclimate and green space ecosystem services. I have worked on numerous national collaborative projects involving Local governments, State and Federal Governments and key industry partners (VicRoads, Melbourne Water). I have represented Australia at Asia-Pacific and International urban forest forums. I am a co-leader of the Green Infrastructure Research Group, a multi-disciplinary research team exploring socio-ecological functions of urban vegetation and urban greening and the benefits for urban environment, climate and public health.

Academic qualifications

1999 PhD, The University of Reading, UK
1995 BSc (Hons) Natural Environmental Science, The University of Sheffield, UK

Employment history

2016 – now Professor, School of Agriculture, Food and Ecosystem Sciences, University of Melbourne
2011 – 2015 Associate Prof, Urban Forestry, School of Ecosystem and Forest Science, University of Melbourne
2010 – 2011 Research Fellow, Monash Sustainability Institute, Monash University
2006 – 2010 Research Fellow, Department of Forest Science, The University of Melbourne
2003 – 2006 Senior Scientist, Department of Sustainability and Environment, State of Victoria.
2000 – 2003 Research Associate, Department of Botany, The University of Western Australia

Competitively won grants in past 6 years

2023-2025 $1.28M Horticulture Innovations Australia (HIA) Demonstrating the benefits of increasing available green infrastructure in residential homes. S J Livesley lead CI – team of nine researchers.
2022-2024 $394k ARC LP190100089 ‘Walk-quality: A multi-criteria design platform to facilitate active travel’ M White, N Frantzeskaki, R Schofield, S J Livesley, M Stevenson
2019-2020 $128k Horticulture Innovations Australia (HIA) Global review of incentive schemes for retention and establishment of trees on private urban land. S J Livesley, C Ordonez, J Bush, J Hurley and M Amati.
2019-2021 $128K City of Melton, ‘Passive irrigation for street trees trial at City Vista’ Szota C, Livesley S J and Fletcher T.
2018-2020 $425k ARC LP160100780 ‘Managing urban trees for people and wildlife’ S J Livesley, R Fuller, M Davern, D Kendal, R van der Ree, D Hochuli, C Threlfall.
2015-2017 $275k ARC DP150103135 ‘Seeing the good from the trees - using LiDAR to measure the urban forest. M Amati, S J Livesley and C L Brack.
2014-2016 $540k ARC LP140100885 ‘Species traits, substrates and stormwater grates: improving urban tree health using polluted stormwater. S J Livesley, T Fletcher, S Arndt.

Journal Associate Editor roles

Landscape and Urban Planning (Elsevier), Landscape Research (Taylor & Francis), Urban Ecosystems (Springer)

Committees

2021 -present - Standards Australia, Committee member for Urban Green Infrastructure Guide Handbook.
2017 -present - Standards Australia, Committee member for review of AS-2302:2018 Tree stock for Landscape Use, ongoing review of AS-4970 2009 Protection of Trees on Development Sites

2015 – 2017 Board member of LOCI Environment and Place, a not-for-profit organisation supporting practitioners involved in shaping our cities for healthy environments and people

Relevant and recent (6 years) journal publications

Ordóñez, C., Threlfall, C. G., Kendal, D., Baumann, J., Sonkkila, C., Hochuli, D. F., van der Ree, R., Fuller, R. A., Davern, M., Herzog, K., English, A., & Livesley, S. J. (2023). Quantifying the importance of urban trees to people and nature through tree removal experiments. People and Nature, 5, 1316–1335. pan3.10509

Cheung P K, Nice K, Tapper N, Jim C Y and Livesley S J (2022) Daytime irrigation leads to significantly cooler private backyards in summer. Urban Climate 46, 101310.

Kendal, D., Ordóñez, C., Davern, M., Fuller, R.A., Hochuli, D.F., van der Ree, R., Livesley, S.J., Threlfall, C.G. (2022) Public satisfaction with urban trees and their management in Australia: The roles of values, beliefs, knowledge, and trust. Urban Forestry & Urban Greening 73, 127623.

Cheung P. K., Nice, K. and Livesley, S. J. (2022) Irrigating urban greenspace for cooling: the mechanisms and management considerations. Environmental Research: Climate 10.1088/2752-5295/ac6e7c

Thom, J.K., Fletcher, T.D., Livesley, S.J., Grey, V., Szota, C., 2022a. Supporting Growth and Transpiration of Newly Planted Street Trees With Passive Irrigation Systems. Water Resources Research 58 (1), e2020WR029526

Thom, J.K., Livesley, S.J., Fletcher, T.D., Farrell, C., Arndt, S.K., Konarska, J. and Szota, C. (2022) Selecting tree species with high transpiration and drought avoidance to optimise runoff reduction in passive irrigation systems. Science of the Total Environment 812, Article 151466.

Livesley, S.J., Daly, E., Marchioni, V., Cheung, P.K. and Pataki, D. (2021) Water Smart Cities Increase Irrigation to Provide Cool Refuge in a Climate Crisis. Earth's Future 9 (1), Article e2020EF001806.

Hanley, P.A., Arndt, S.K., Livesley, S.J., Szota, C., (2021) Relating the climate envelopes of urban tree species to their drought and thermal tolerance. Science of the Total Environment 753, Article 142012.

Thom, J.K., Szota, C., Coutts, A.M., Fletcher, T.D., Livesley, S.J., (2020) Transpiration by established trees could increase the efficiency of stormwater control measures. Water Research 173, Article 115597.

Clark, C., Ordóñez, C., Livesley, S.J., (2020) Private tree removal, public loss: Valuing and enforcing existing tree protection mechanisms is the key to retaining urban trees on private land. Landscape and Urban Planning 203, Article 103899.

Croeser, T., Ordóñez, C., Threlfall, C., Kendal, D., van der Ree, R., Callow, D., Livesley, S.J., (2020) Patterns of tree removal and canopy change on public and private land in the City of Melbourne. Sustainable Cities and Society 56, Article 103899.

Langenheim, N., White, M., Tapper, N., Livesley, S.J. and Ramirez-Lovering, D. (2020) Right tree, right place, right time: A visual-functional design approach to select and place trees for optimal shade benefit to commuting pedestrians. Sustainable Cities and Society

Ordóñez, C., Threlfall, C.G., Kendal, D., Hochuli, D.F., Davern, M., Fuller, R.A., van der Ree, R., Livesley, S.J. (2019) Urban forest governance and decision-making: A systematic review and synthesis of the perspectives of municipal managers. Landscape and Urban Planning, 189, pp. 166-180.

Szota, C., Coutts, A.M., Thom, J.K., Virahsawmy, H.K., Fletcher, T.D., Livesley, S.J. (2019) Street tree stormwater control measures can reduce runoff but not benefit established trees. Landscape and Urban Planning, 182, pp. 144-155.

Grey, V., Livesley, S.J., Fletcher, T.D., Szota, C. (2018) Establishing street trees in stormwater control measures can double tree growth when extended waterlogging is avoided. Landscape and Urban Planning, 178, pp. 122-129.

Nitschke, C.R., Nichols, S., Allen, K., Dobbs, C., Livesley, S.J., Baker, P.J., Lynch, Y. (2017) The influence of climate and drought on urban tree growth in southeast Australia and the implications for future growth under climate change. Landscape and Urban Planning, 167, pp. 275-287.

Sanusi, R., Johnstone, D., May, P., Livesley, S.J. (2017) Microclimate benefits that different street tree species provide to sidewalk pedestrians relate to differences in Plant Area Index. Landscape and Urban Planning, 157, pp. 502-511.

Part I : Ethics

The project does not raise any requirement to apply for human or animal ethics approval.

Part J : evidence of approval

THE UNIVERSITY OF MELBOURNE

Researcher Development Schemes
Joint PhD Proposal Approval Form

Scheme title	UoM – CNRS Graduate Research Projects Scheme
Applicant name	Stephen Livesley
Academic division	Science
Collaborating PI	Pierre-Emmanuel Bournet
Project title	Climate benefits and tradeoffs of urban greening: evaluation and impact of management practices at parkscape and streetscape

AUTHORISATION FROM HEAD OF SCHOOL/DEPARTMENT AND FACULTY ASSOCIATE DEAN (GRADUATE RESEARCH)

✓	**In signing below, I confirm that:**
	I support this applicant and their capacity to deliver the expectations outlined in their joint PhD project proposal as a supervisor.
	The applicant is a University of Melbourne academic staff member, minimum Level B ***AND*** • *Is contracted beyond the envisaged submission date of the PhD candidate (s)* ***OR*** • *Has provided a letter of support detailing the arrangements in place to ensure continuity of supervision for the candidate(s)*
	The applicant is appropriately registered to supervise PhD candidates as per the Supervisor Eligibility and Registration Policy and has the capacity to supervise the PhD candidate/s.
	The Faculty or School/Department is willing to provide the required number of scholarships for this scheme, in line with the Faculty or School's internal matching processes and 1:1 scholarship matching for top-down IRTGs.
	The PI, School/Department and Faculty will provide appropriate resources for the PhD candidate(s), in line with the graduate research principles for infrastructure support.

HoS/HoD Name	Giovanni Turchini		
School/Department	Agriculture, Food and Ecosystem Sciences		
Signature		**Date**	24 / 11 / 2023
ADGR Name	Craig Nitschke		
Academic Division	Faculty of Science		
Signature		**Date**	24 / 11 / 2023

Please forward any queries to res-devschemes@unimelb.edu.au

IRSTV CNRS FR2488

ECOLE CENTRALE DE NANTES

1 RUE DE LA NOË BP 92101

44321 NANTES CEDEX 3

Nantes, November 24, 2023

Object : **Opinion of IRSTV Direction (FR CNRS 2488, Director : Béatrice Bechet) –** Project "Climate benefits and tradeoffs of urban greening: evaluation and impact of management practices at parkscape and streetscape"

IRSTV is a CNRS research federation set up in 2006 with the aim of developing multidisciplinary research on the physical urban environment and developing methods and tools to help meet the challenges of climate change.

The proposed project fits in perfectly with the federation's research themes, and more specifically with the programme on the water-soil-vegetation-microclimate continuum and adaptation strategies. The IRSTV's work on vegetation in urban environments is recognised at national level, and the collaboration between the 2 teams initiated by Dr Sophie Herpin is a real opportunity to open up these activities internationally, in order to support and strengthen them. The researchers submitting the thesis proposal are strongly involved in the coordination of IRSTV research activities: Pr. P.E. Bournet is deputy director of the federation, Dr. S. Herpin is the coordinator of the Urban Microclimate department, and Prof. P. Cannavo is former coordinator of the Urban Soil departement. With the support of other IRSTV colleagues, they will also be able to contribute their experience of Nature-Based Solutions gained through their participation in two European projects on this theme (Nature4Cities https://www.nature4cities.eu/ and Urbinat https://urbinat.eu/).

The systemic approach of the Melbourne team echoes that of the IRSTV and there are already prospects for developing collaboration on stormwater management and multifunctionality of urban soils.

As a result, the IRSTV direction has given a very favourable opinion of these thesis proposals in collaboration with the University of Melbourne.

Béatrice Béchet

Director of IRSTV