OU STEM EEES Project Proposal Form – 2025 entry

Project Title	Urban tree function in a warming and drying world
Key words	Sustainable cities, green infrastructure, environmental physiology, carbon-water relations, soil biogeochemistry
Supervisory team (including email address	**PI: Dr. Kadmiel Maseyk (kadmiel.maseyk@open.ac.uk)** **Co-I: Dr. Philip Wheeler (philip.wheeler@open.ac.uk), Dr. Yoseph Araya (yospeh.araya@open.ac.uk)**
Is the PhD suitable for part time study?	Yes ☒ No ☐

Project Highlights:

- Environmental physiology research in an area of increasing societal importance.
- Experimental work and field data collection.
- Cross-sector collaboration opportunities.

Overview:

The importance of urban vegetation, or 'green infrastructure', is now well recognised for the multitude of ecological, societal, health and climate benefits it brings to the urban environment and residents. Trees are a key component of green infrastructure, and therefore understanding the ecological and physiological characteristics of urban trees in a changing environment is essential, particularly because urban environments differ from the non-urban environments where most of our knowledge on tree ecophysiology has been derived. Urban soil properties differ in terms of their composition, structure and biogeochemistry; water infiltration varies with surface cover and planting approach; species composition is influenced by cultural and economic factors, and it it's not clear whether the species that have been planted historically are appropriate for a warming and drying future.

Urban trees are at the nexus of climate change drivers, impacts and feedbacks. Urban environments are ahead of non-urban environments with respect to aspects of global change: temperatures tend to be higher in urban environments due to the urban heat island (UHI) effect, and atmospheric CO_2 concentrations tend to be higher in urban environments, with implications for stomatal responses, carbon gain and water use efficiency. In this way, urban trees can therefore also provide insight into how non-urban trees might respond to future climate conditions. Urban trees also have an important role in mitigating climate change impacts of urban environments through carbon sequestration and cooling through shading and transpiration.

This project will investigate urban tree environmental physiology, joining an expanding group working on urban trees and urban ecology at the Open University. Research will focus on tree water use and water-use efficiency, soil-tree interactions, and/or carbon and nutrient dynamics. It will take advantage of infrastructure at the Open University for controlled experiments on trees and tree monitoring on campus, unique aspects of the urban treescape of the city of Milton Keynes and paired urban/non-urban woodland study sites. Depending on the interests of the student, specific research questions can include, but are not limited to, a comparison of native and non-native

species and their suitability to future climate; the contribution of urban trees to urban carbon and water fluxes and associated ecosystem service provision; or interactions with soil type and soil health and the implications for climate resilience.

Figure 1: A majestic London plane tree in an urban park providing shade, habitat and amenity value.

Alt text: A large London plane tree in an urban park as an example of an urban tree that provides environmental benefits for users of the park.

Methodology:

Depending on the research focus, a range of approaches are available. Controlled outdoor experiments on large potted trees can be conducted using a mesocosm system, which can involve the manipulation of soil water availability, soil type, and tree species. Physiological responses can be investigated using leaf gas exchange and fluorescence, tree water use, tissue nutrient, pigment and stable isotope analysis, hyperspectral reflectance and solar induced fluorescence. In situ urban woodland measurements on campus include sapflow, microclimate conditions and canopy light transmittance. Students with an interest in remote sensing will be able to scale their results through access to airborne datasets of hyperspectral reflectance across Milton Keynes and other UK cities. Species distribution datasets are available through the OU-run Treezilla citizen science platform (the largest UK dataset of urban trees).

Training and skills:

You will have opportunities to receive training in tree ecophysiology, plant and soil biogeochemistry, field spectroscopy, and geospatial data analysis. You will also be supported in the development of your skills in experimental planning and project management, including liaising with external organisations where applicable (such as local authorities). Those with an interest in citizen science will have the chance to develop this through Treezilla and other platforms at the OU. A rich and varied training programme is available to OU PG students which includes sessions on academic writing, research design and data management, career development communicating your research, as well as opportunities to get involved in public engagement, media and remote digital teaching.

Partners and collaboration:

External collaboration is expected in this project through our existing relationships with the Milton Keynes Parks Trust and the Urban Tree group at Forest Research, and you will be supported in establishing these. Collaboration with practitioners we work with can also be explored as part of the project.

Possible timeline:

Year 1: Literature review, familiarisation with instrumentation and techniques, system set-up, and first season of data collection. Complete Upgrade.

Year 2: Ongoing data collection and analysis. National conference presentation (e.g. British Ecological Society annual meeting).

Year 3: Final data collection and analysis and writing up. International conference presentation (e.g. European Ecological Federation).

The student will be encouraged to join national and international network programmes such as COST Actions and develop their own networks through the course the PhD.

Further reading:

Kagotani, Y., Fujino, K., Kazama, T. *et al.* (2013) Leaf carbon isotope ratio and water use efficiency of urban roadside trees in summer in Kyoto city. *Ecological Research* 28, pp. 725–734. doi: 10.1007/s11284-013-1056-7.

Rahman, M.A., Armson, D., Ennos, A.R. (2015) A comparison of the growth and cooling effectiveness of five commonly planted urban tree species. *Urban Ecosystems* 18, pp. 371–389. doi: 10.1007/s11252-014-0407-7.

Roy S., Byrne J., Pickering C. (2012) A systematic quantitative review of urban tree benefits, costs, and assessment methods across cities in different climatic zones. *Urban Forestry & Urban Greening* 11(4), pp. 351-363. doi: 10.1016/j.ufug.2012.06.006.

Further details:

We invite applications from students with a background in plant or ecosystem ecology or physiology, an interest in urban ecosystems and global change processes and an enthusiasm for field work and independent research. A clean driving licence for accessing field sites is desirable.

If you are interested in this project and would like more information, including discussion about alternative project directions or project suitability, please contact Kadmiel Maseyk (kadmiel.maseyk@open.ac.uk). We'd be happy to hear from you.

The successful student will join well-established teams researching environmental and ecosystem processes and a vibrant postgraduate community at the Open University.