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| **City-scale moisture and energy flux due to transpiration from trees: effects on urban heat island and flood resilience** |
| **Project Outline** |
| The concept of ‘Urban Metabolism’ provides a framework for modelling complex urban system flows – water, energy, food, people, et cetera – as if the city were an ecosystem. An important component of these resource flows is the role of vegetation in determining the energy and moisture flux between the ground and atmosphere. This flux is crucial to understanding and mitigating the urban heat island effect.  Trees play an important role in the urban water balance, transferring significant quantities of moisture (and latent heat) from the ground back to the atmosphere via the process of transpiration. Trees may be present as part of the natural urban landscape or may be deliberately introduced as part of Sustainable Drainage System (SuDS) components such as tree pits or bioretention swales. For SuDS devices, the transpiration rate determines the SuDS’ capacity to retain runoff from a storm event. However, very little information exists to characterise this moisture loss for typical urban trees in representative urban SuDS and landscape settings.  The objectives of the PhD will be to: characterise transpiration for commonly-occurring tree species in the field; relate observations to climatic and soil moisture data; and develop models to estimate the impact of changes in tree species, distribution and cover to energy and moisture transfer between the ground and atmosphere and storm water management at the city scale.  The work will be undertaken by combining sample porometer data (measurements of stomatal leaf conductance) with time series data for soil and environmental conditions to create a model of energy and moisture transfer across the city as a function of vegetation characteristics and to seek to establish how the configuration and design of green spaces should be designed to best support the reduction of the urban heat island effect and improve resilience to increased rainfall levels. |
| **Primary supervisor** |
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| **Other members of the supervisory team** |
| *Co-supervisor: Martin Mayfield, Civil and Structural Engineering, Theme 2 & 8* |
| **The proposed project adds value to TWENTY65** **by:** |
| Added value by linking knowledge gained from Twenty65, to knowledge that can be gained from the Urban Flows Observatory (a UKCRIC facility) which will fund equipment requirements. Links into theme 4, as SuDS models require data on moisture loss due to transpiration from vegetation, including trees. |
| **Suggest titles and journals for two 4\* papers that you expect to arise from the project** |
| *Paper 1:* A novel allometric model to predict the systemic value of urban vegetation for climate change adaptation. *Nature Sustainability.*  *Paper 2:* Transpiration rates from urban trees. *Journal of Hydrolgy.* |