1. PROJECT

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Title: InfruTreeCity: Understanding Infrared radiative performance of urban trees for better future city

Dates: 01 January 2018 to 31 December 2020

Funding organisation: The UK Engineering and Physical Sciences Research Council (EPSRC) and the National Environment Research Council (NERC)

Grant no.: [EPSRC Grant No. EP/P023819/1]

2. DATASET

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Title: Data for 'Infrared radiative performance of urban trees: spatial distribution and interspecific comparison among ten species in the UK by in-situ spectroscopy'

Description: The datasets include 1) Leaf reflectance spectra of 9 common tree species (carpinus betulus, acer campestre, quercus robur, platanus x acerifolia, tilia platyphyllos, acer x freemanii, betula pendula, acer platanoides, aesculus hippocastanum) in the UK over the full wavelength range of 400 - 2500 nm. The leaf reflectance spectrum of each species was sampled from 5 to 10 individual trees with 10 leaves randomly collected from each tree. The collected leaves were measured promptly in the laboratory. Statistical mean leaf reflectance spectra and the spectral standard errors of the 9 tree species were estimated by the measuring samples within species. 2) Tree crown transflectance spectra samples of 10 tree species (sequoiadendron giganteum, carpinus betulus, acer campestre, quercus robur, platanus x acerifolia, tilia platyphyllos, acer x freemanii, betula pendula, acer platanoides, aesculus hippocastanum) in the frontal sunlit area of the trees, with a wavelength range of 350 - 1000 nm. The tree crown transflectance spectra were sampled in the sunlit side of trees by in-situ spectroscopy measurements using a vertical reference plane perpendicular to the transient solar azimuth direction. For each tree species, at least 5 trees were sampled at the crown level with visibly dense foliage (no obvious gaps in foliage and no concave crown contours). Statistical mean transflectance spectra of multiple tree species were determined in terms of intraspecific transflectance spectra in the frontal sunlit area, by converting transflectance spectra samples to the equivalent spectra at a solar altitude of 45° (benchmark condition). 3) Interspecific comparison of radiative performance levels across 10 species on sunny days determined in the benchmark conditions of 45° solar altitude. The statistical mean transflectance spectra and the standard mean errors of the 10 tree species implied interspecific difference of the radiative performance levels.

Publication Year: 2019

Creator(s): Jie Deng

Organisation(s): University of Reading

Rights-holder(s): University of Reading

3. TERMS OF USE

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Copyright University of Reading 2019. This dataset is licensed under a Creative Commons Attribution 4.0 International Licence: https://creativecommons.org/licenses/by/4.0/.

4. CONTENTS

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File listing

Leaf\_reflectance\_nine\_species.xlsx This file recorded leaf reflectance spectra of 9 common tree species (carpinus betulus, acer campestre, quercus robur, platanus x acerifolia, tilia platyphyllos, acer x freemanii, betula pendula, acer platanoides, aesculus hippocastanum) in the UK over the full wavelength range of 400 - 2500 nm, as well as the standard mean errors of the spectra.

Tree\_crown\_transflectance\_samples\_of\_10\_species.zip This file recorded tree crown transflectance spectra samples and spectral standard mean errors of 10 tree species (sequoiadendron giganteum, carpinus betulus, acer campestre, quercus robur, platanus x acerifolia, tilia platyphyllos, acer x freemanii, betula pendula, acer platanoides, aesculus hippocastanum) in the frontal sunlit area of the trees (wavelength range: 350 - 1000 nm) in the benchmark condition of 45° solar altitude.

TR\_ten\_tree\_species\_comparison.xlsx This file summarised the statistical mean transflectance spectra and the spectral standard mean errors of the 10 tree species in the benchmark condition.

5. METHOD and PROCESSING

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Leaf reflectance spectra of tree species were measured in the laboratory using a model SM2500 spectrometer (Spectral Evolution, Haverhill, Massachusetts, USA) with spectral resolution of 3.5–22 nm in the full range of ultraviolet, visible, near infrared (wavelength range: 350–2500 nm and wavelength reproducibility of 0.1 nm at an accuracy of 0.5 bandwidth). The leaf reflectance spectrum of each species was sampled from 5 to 10 individual trees with 10 leaves randomly collected from each tree. The collected leaves were measured promptly in the laboratory. Statistical mean leaf reflectance spectra and the spectral standard errors of the 9 tree species were estimated by the measuring samples.

Tree crown transflectance spectra in the frontal sunlit area of trees were measured by in-situ spectroscopy measurements using a Black-Comet-SR model CXR-SR (StellarNET Inc., Tampa, Florida, USA) concave grating miniature spectrometer with a wavelength range of 350–1000 nm. A vertical reference plane perpendicular to the transient solar azimuth direction was adopted in the field tests and for each tree species, at least 5 trees were sampled at the crown level with visibly dense foliage (no obvious gaps in foliage and no concave crown contours). Statistical mean transflectance spectra of multiple tree species were determined in terms of intraspecific transflectance spectra in the frontal sunlit area, by converting transflectance spectra samples to the equivalent spectra at the solar altitude of 45° (benchmark condition).

More information in relation to the measurement method and concept is available in an earlier publication by us: J. Deng, B.J. Pickles, A. Kavakopoulos, T. Blanusa, C.H. Halios, S.T. Smith, L. Shao, Concept and methodology of characterising infrared radiative performance of urban trees using tree crown spectroscopy, *Building and Environment*. 157 (2019) 380–390. https://doi.org/10.1016/j.buildenv.2019.04.056.

In addition, the data is the supplementary material of a journal paper submitted to *Building and Environment* (see below). More explanatory information can be found in the article once it is accepted and published.

[1] Jie Deng, Brian J. Pickles, Stefan T. Smith, Li Shao. Infrared radiative performance of urban trees: spatial distribution and interspecific comparison among ten species in the UK by in-situ spectroscopy. submitted to *Building and Environment* (Ms. BAE-D-19-02763, under review).