ONE Planet
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Doctoral Training Partnership

UKRI

Natural
Environment
Research Council

Project title: Machine Learning for Urban Climate: How to Cool Down Your City with Trees

Ref: OP2416

Keywords: AI, urban climate, machine learning, computer vision

One Planet Research Theme:

Climate & Climate Change ☒ | Earth System Processes ☒ | Anthropocene ☒ | Environmental Informatics ☒

Lead Supervisor:

Dr Bing Zhai, Northumbria University

Key Research Gaps and Questions:

How to use machine learning techniques and environmental informatics to generate tree inventory map (size, location, types and conditions) in UK Northeast cities?

Can we use data-driven approach to strategically organise urban forest and land use to mitigate urban heat islands?
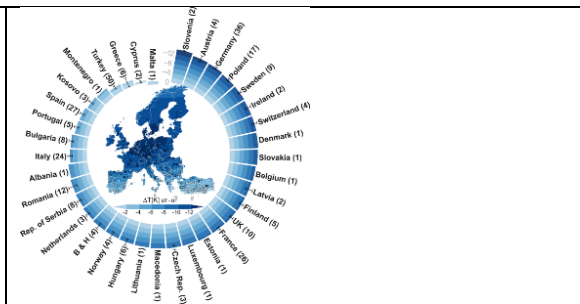
Project Description:

Urban heat islands (UHIs) are areas of higher temperature in cities due to global warming and urbanization, which can affect human health, energy use, and climate. Urban forests (UFs) are natural solutions to mitigate UHI by providing cooling effects through shading, evapotranspiration, and carbon sequestration (see image; https://doi.org/10.1038/s41467-021-26768-w). The amount of transpiration and its effect on temperatures depends on the characteristics of trees/tree species and environmental conditions. By strategically organizing tree planting, the impact of the UHI effect may be mitigated. <u>Gap</u>: A comprehensive inventory of UK's urban tree resource is not currently available and its impact on UHI mitigation is limited. This project aims to accurately derive tree inventory using data-driven approaches by strategically incorporating the land use and land cover to understand the effects of urban forests on mitigating UHI intensity. The <u>objective</u> of this research consists of 1) To curate a dataset for tree census research from UK Northeast cities using existing remote sensing data (e.g., aerial and ground-level images). 2) to develop machine learning (ML) models to recognize tree species, size, and condition using transfer learning that can leverage annotated data (e.g., Auto-Arborist and London regional data) and adapt it to the curated dataset. 3) To create a generative model that can provide guidance on where to plant more trees in urban areas to mitigate UHI effects. This model should be capable of generating suggestions for tree placement while considering urban climate knowledge (e.g., UrbClim) and constraints in optimisation. <u>Collaborations</u>: Dr Jiayi Jin who has experience on urban environment and planning. Prof. Wai Lok Woo and Dr Shidong Wang who are experienced in ML for geohazards prediction and climate change. The student will be trained on programming, data science, computer vision, time series analysis, machine learning and urban climate modelling.

Prerequisites:

A degree in Computer Science, Geophysics, Engineering, or a related field with numerical skills. For more information, please contact Dr Bing Zhai (Bing.Zhai@northumbria.ac.uk).