ARPHA Conference Abstracts 8: e148956
doi: 10.3897/aca.8.e148956

Conference Abstract

Simulating urban biogenic carbon sinks and their sensitivity to environmental conditions

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Received: 06 Feb 2025 | Published: 28 May 2025

Citation: Havu M, Karvonen A, Lee HS, Järvi L (2025) Simulating urban biogenic carbon sinks and their sensitivity to environmental conditions. ARPHA Conference Abstracts 8: e148956. https://doi.org/10.3897/aca.8.e148956

Abstract

As cities expand, understanding their biogenic CO_2 fluxes becomes increasingly critical for sustainable urban planning. Tailored ecosystem models are needed to capture the unique urban characteristics, including altered land surfaces, heterogeneous green spaces, and anthropogenic influences. These models enable the design of sustainable cities and nature-based solutions while also addressing urban ecosystems' sensitivity to climate stressors such as heatwaves and droughts.

The Surface Urban Energy and Water balance Scheme (SUEWS) has been developed to simulate these biogenic CO_2 fluxes. Photosynthesis is modelled using maximum photosynthesis rates, seasonally varying leaf area index (LAI), and environmental factors such as air temperature, vapour pressure deficit, soil moisture deficit, and incoming shortwave radiation. Respiration is modelled as a function of air temperature. The 2 m air temperature, LAI, and soil moisture are simulated within SUEWS, while other meteorological inputs, such as incoming shortwave radiation, precipitation, and wind speed, are provided as forcing data.

This research builds on a series of studies incorporating in-situ measurements, including eddy covariance (EC) data from urban forests, suburbs, and lawns, sap flow and shoot chamber measurements from street and park trees, and soil chamber measurements. Observations for parameterisation have been primarily gathered in Helsinki and Minneapolis, with model evaluation conducted in cities such as Beijing, Helsinki, Munich,

Paris, Swindon, Zürich, and Minneapolis. SUEWS has been applied to spatial simulations for Helsinki at 250×250 m^2 resolution, both under current and future climate scenarios. The model has also been implemented in cities like Paris, Munich, and Zürich through the ICOS Cities project. By integrating diverse observational datasets with modelling approaches, this research captures the complexity of urban carbon dynamics and examines how they respond to environmental conditions and climate change.

Keywords

Urban ecosystems, Urban vegetation, CO_2 sinks

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Presented at

POSTER

Conflicts of interest

The authors have declared that no competing interests exist.