Quantification of carbon storage, fluxes and sequestration in urban green infrastructure

Insights from CO_2 Uptake Modelling and Case Studies

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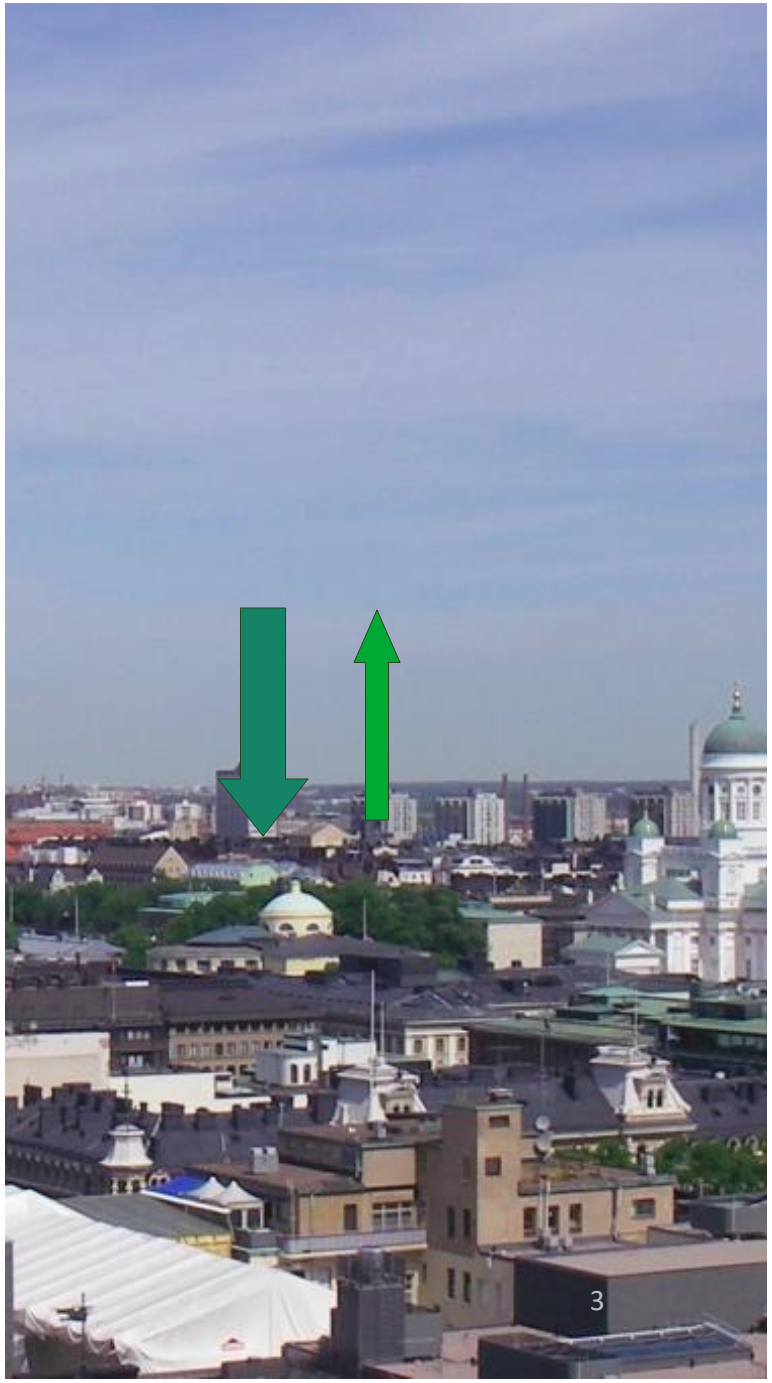
Introduction

- Several cities are actively striving for **carbon neutrality** in the coming decades
- Urban vegetation plays a role in **mitigating** emissions
- High **spatial variability** in urban microclimate and vegetation coverage
- Accurate estimations of CO_2 exchange between atmosphere and urban surface require suitable **modelling tools**

Urban land surface model SUEWS

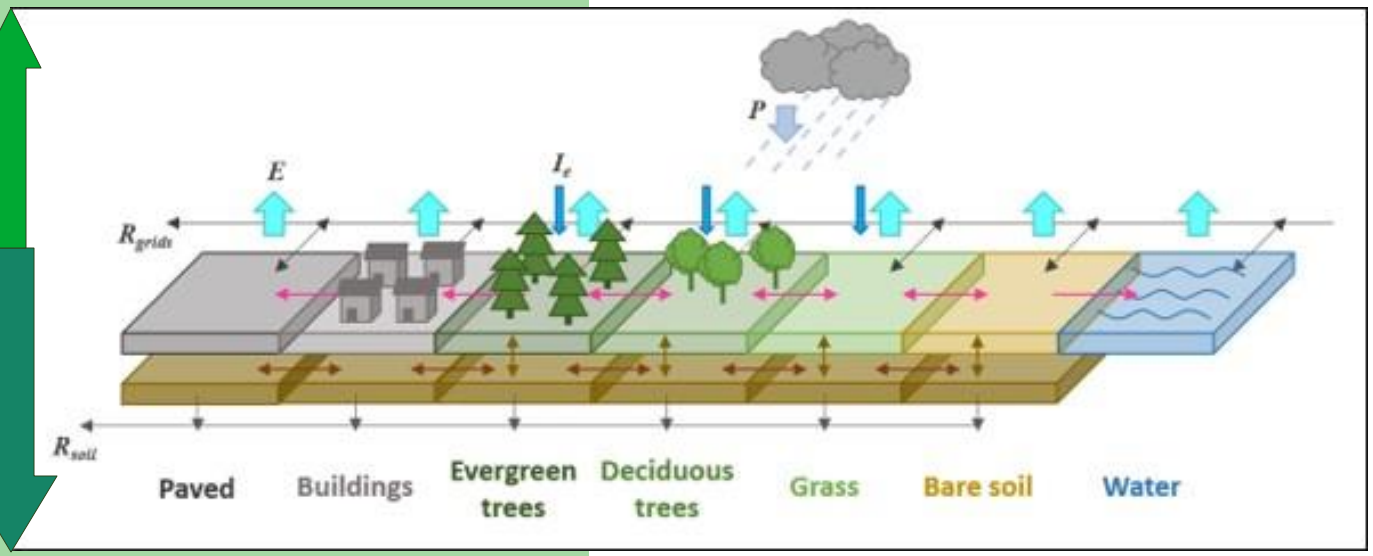
- Surface Urban Energy and Water Balance Scheme (Järvi et al., 2019)
- SUEWS simulates energy, water, and CO_2 balances with meteorological variables and surface information
- The biogenic net CO_2 exchange results from the balance between photosynthetic CO_2 uptake and soil/vegetation respiration



CO_2 MODULE

Vegetation and soil respiratio

depend exponentially on local air temperature



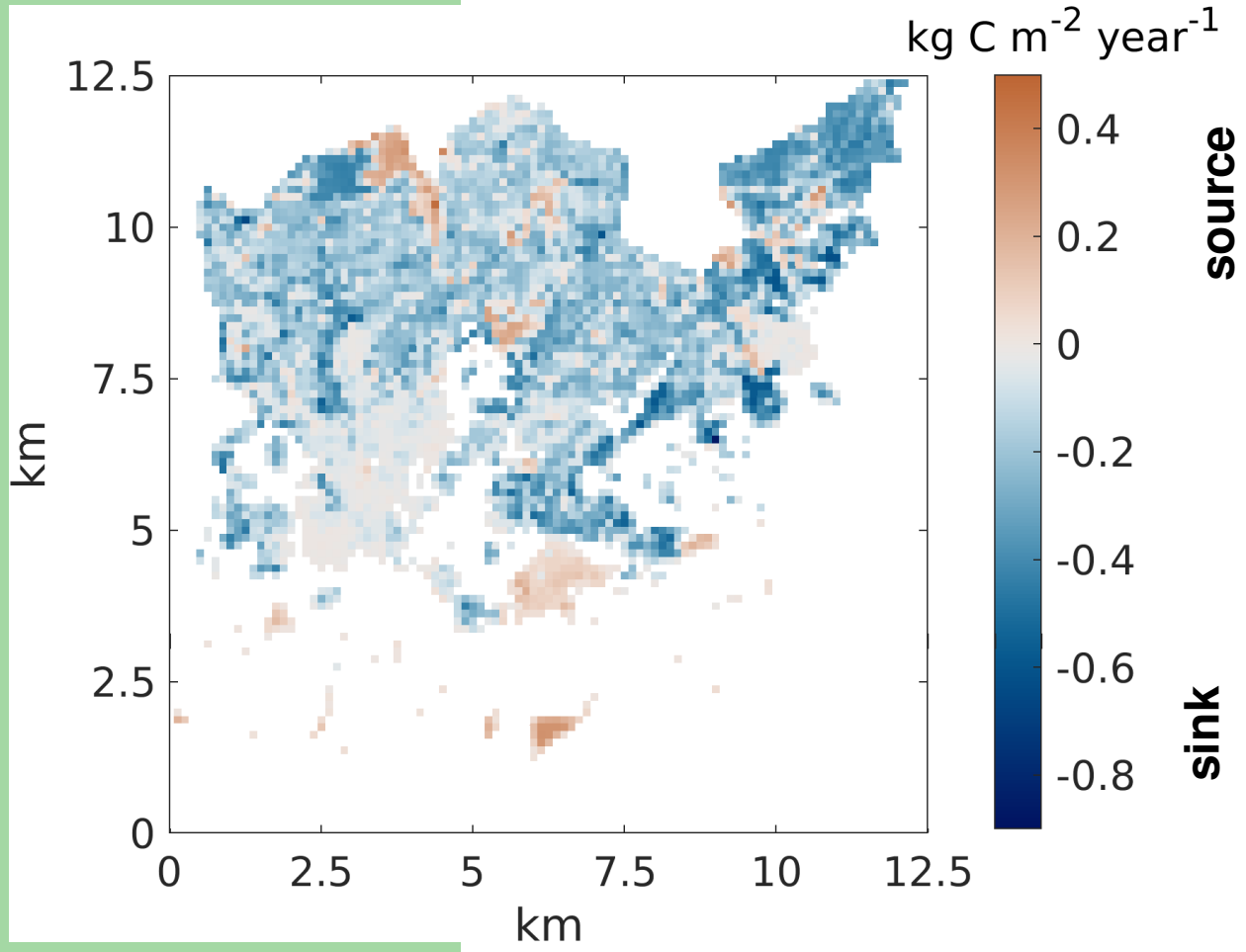
CO_2 uptake by photosynthesi

depends on LAI, solar radiation, air temperature, humidity and soil moisture

Case study

The city of Helsinki

- Net CO_2 exchange simulation for 2019
- Urban forests are the strongest sinks (averaging 0.3 kg C m^{-2} $year^{-1}$), contributing 44% to the city's net uptake
- Vegetation within urban neighbourhoods contribute significantly, accounting for 47% of the city's net uptake
- Overall net uptake: -36.3 kt C $year^{-1}$



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Case study

New neighbourhood

- Assessment of net CO_2 exchange using SUEWS in the planned “Hiedanranta” neighbourhood in Tampere
- Estimation includes urban forests, parks, street trees and courtyards
- Total net uptake: -1.25 kt C $year^{-1}$

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Conclusion

- The CO_2 module within SUEWS enables a comprehensive understanding of photosynthetic uptake and respiration processes
- The case study in Helsinki demonstrates the vital role of urban forests and neighborhoods in CO_2 uptake
- Expansion to new neighborhoods, such as "Hiedanranta", showcases how modelling can aid in proactive urban planning for sustainable CO_2 management
- The presented research provides a foundation for policymakers, city planners, and researchers to align urban development with carbon neutrality goals

Thank you!