

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

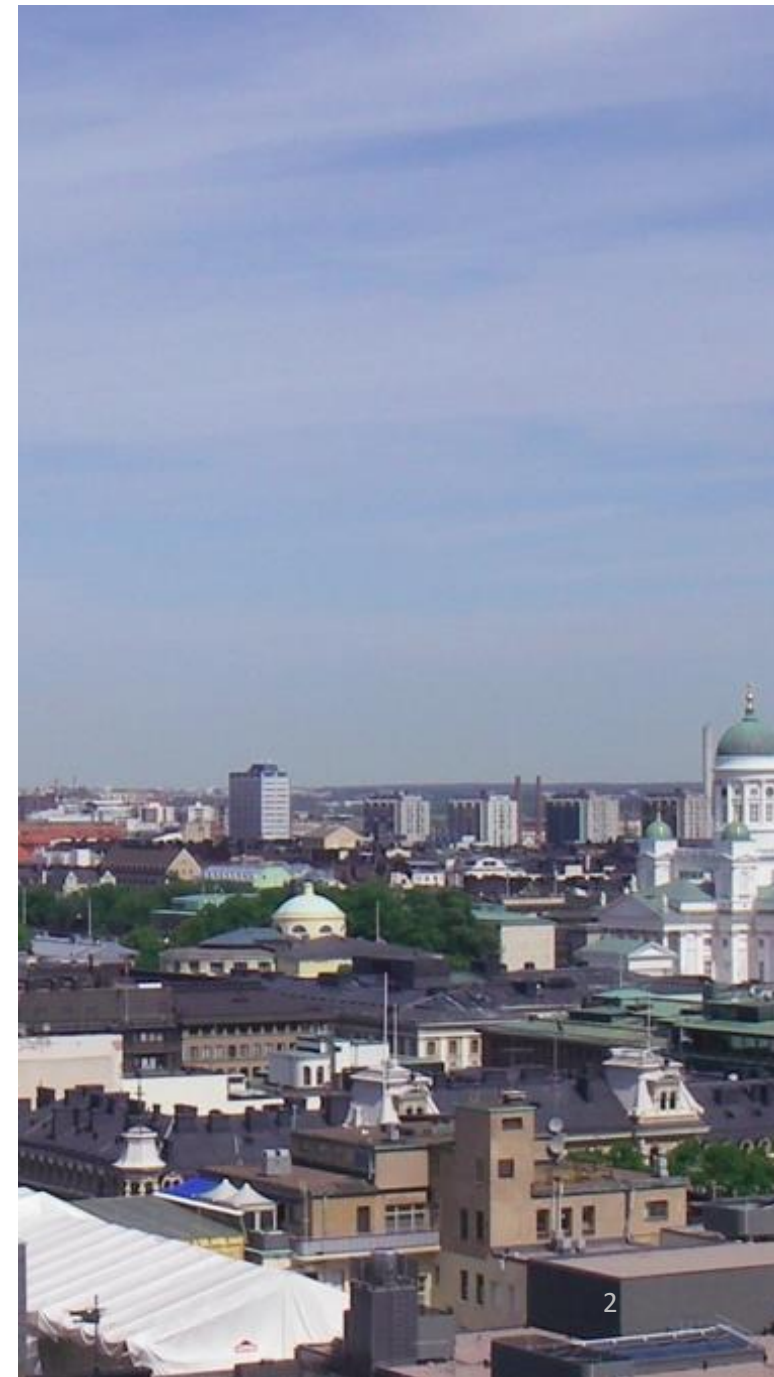
# **Insights from CO<sub>2</sub> Uptake Modelling and Case Studies**

**Minttu Havu and Michael Lee**

INAR/Physics, University of Helsinki

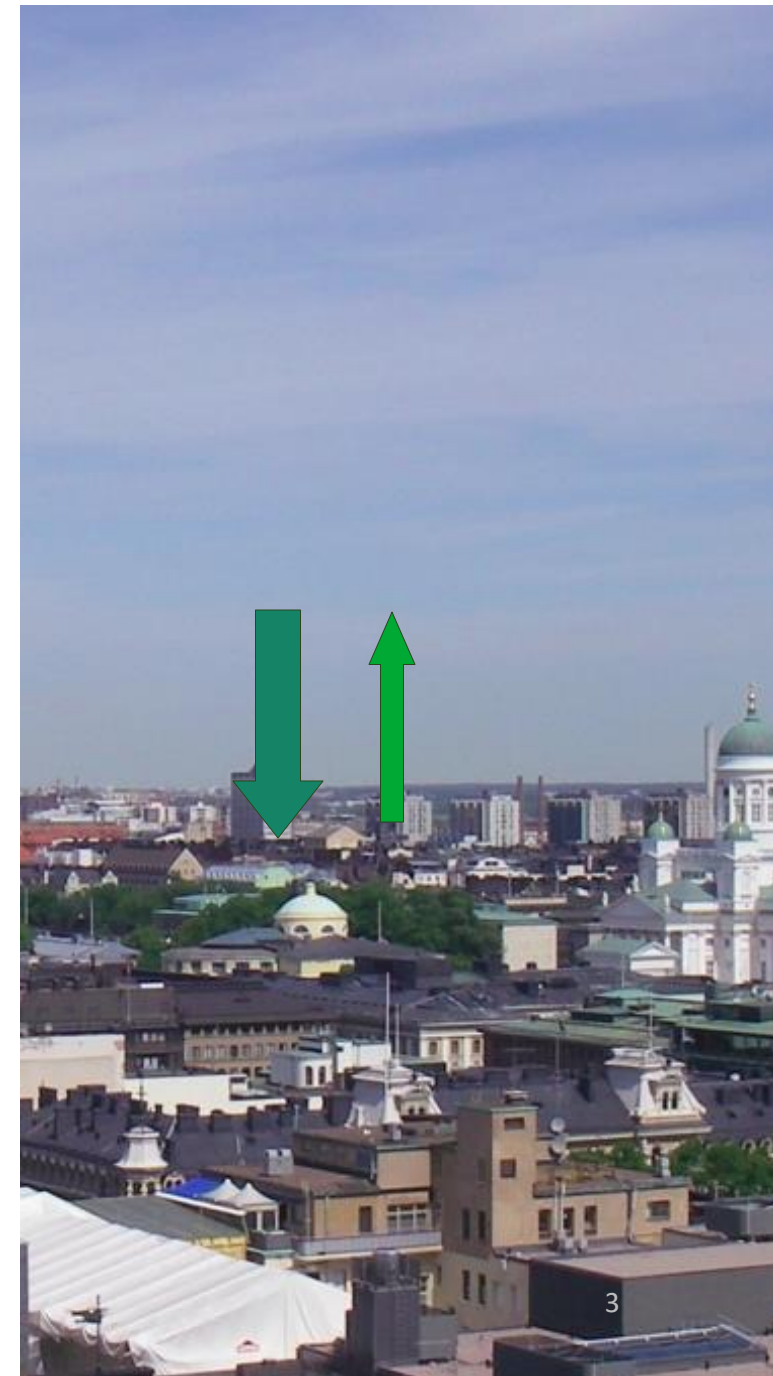
# Introduction

- ▶ 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<sub>2</sub> exchange between atmosphere and urban surface require suitable **modelling tools**



# Urban land surface model SUEWS

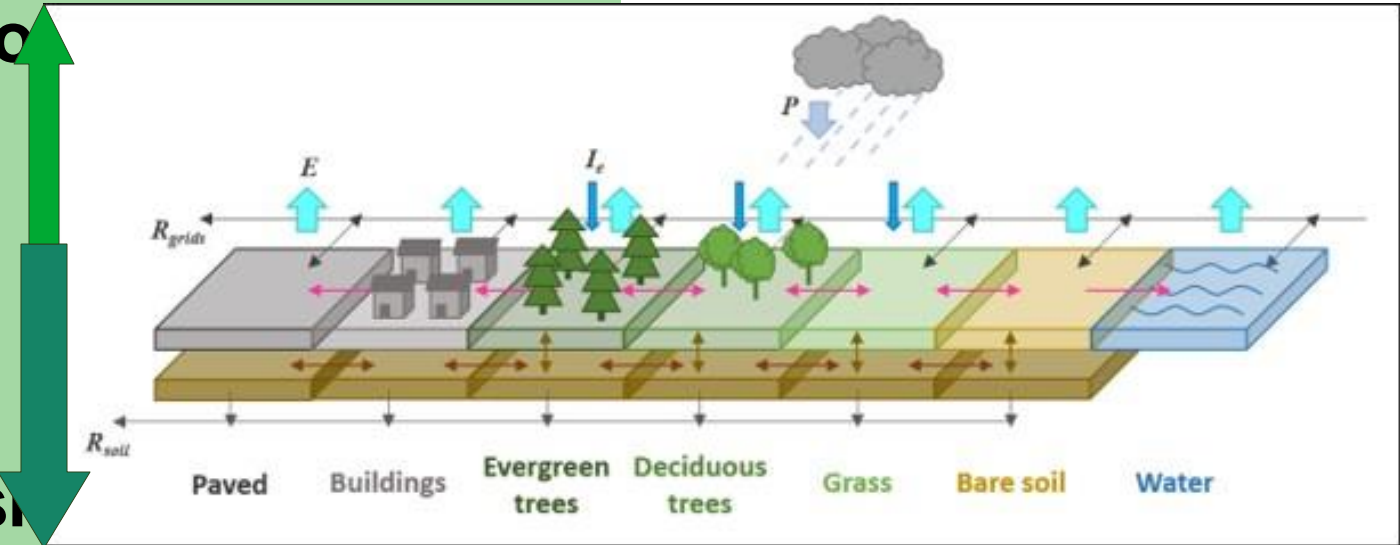
- ▶ Surface Urban Energy and Water Balance Scheme (Järvi et al., 2019)
- ▶ SUEWS simulates energy, water, and CO<sub>2</sub> balances with meteorological variables and surface information
- ▶ The biogenic net CO<sub>2</sub> exchange results from the balance between photosynthetic CO<sub>2</sub> uptake and soil/vegetation respiration



# CO<sub>2</sub> MODULE

**Vegetation and soil respiration**  
depend exponentially on  
local air temperature

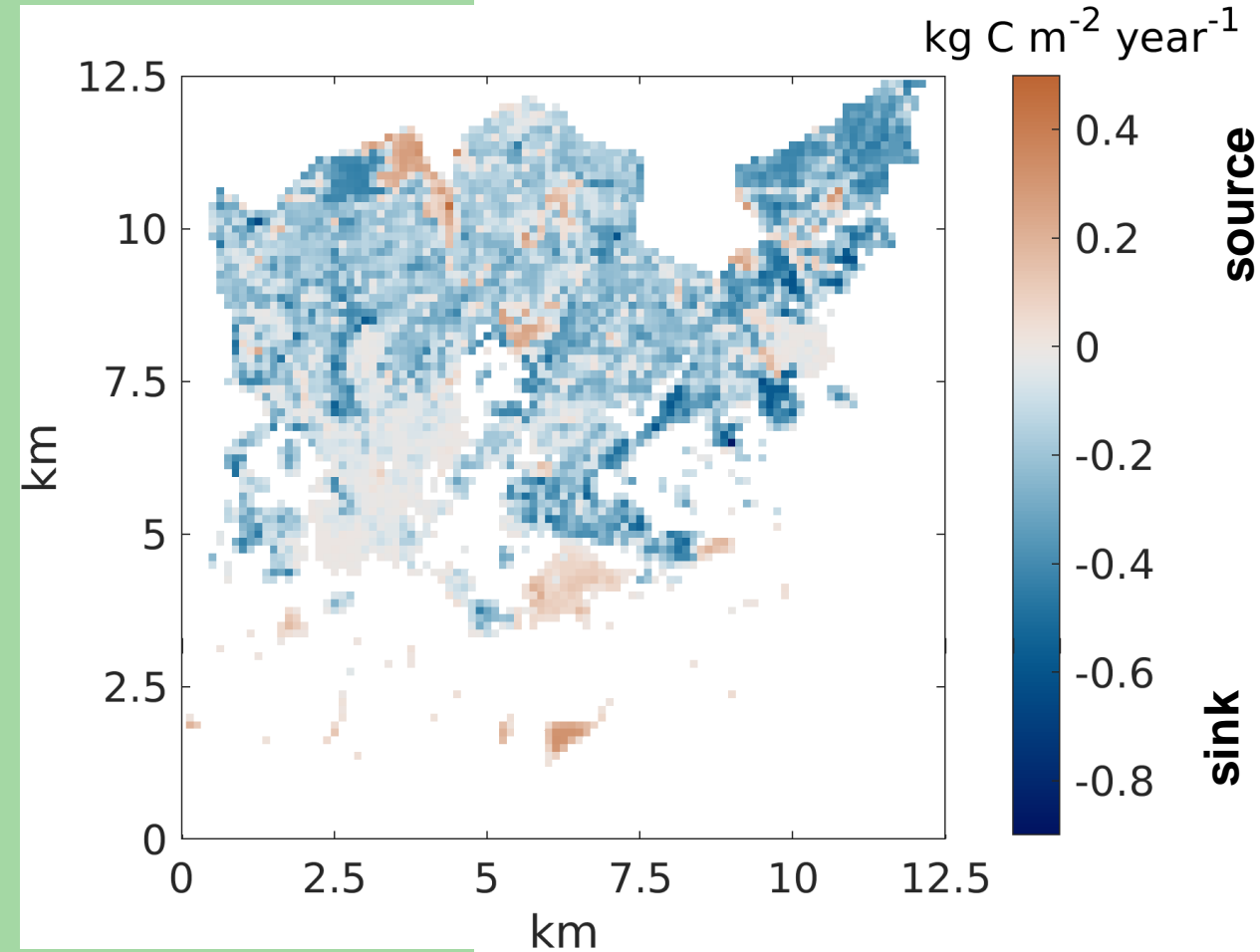
**CO<sub>2</sub> uptake by photosynthesis**  
depends on LAI, solar radiation,  
air temperature,  
humidity and soil moisture



## Case study

### The city of Helsinki

- ▶ Net CO<sub>2</sub> exchange simulation for 2019
- ▶ Urban forests are the strongest sinks (averaging 0.3 kg C m<sup>-2</sup> year<sup>-1</sup>), 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<sup>-1</sup>





## Case study

### New neighbourhood

- ▶ Assessment of net CO<sub>2</sub> 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<sup>-1</sup>



©Michael Lee

# Conclusion

- ▶ The CO<sub>2</sub> 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<sub>2</sub> uptake
- ▶ Expansion to new neighborhoods, such as "Hiedanranta", showcases how modelling can aid in proactive urban planning for sustainable CO<sub>2</sub> management
- ▶ The presented research provides a foundation for policymakers, city planners, and researchers to align urban development with carbon neutrality goals

**Thank you!**