



Semi-natural forests



Urban greening forests



Succession forests

Drought years of 2018 and 2019 affect CO₂ balance of urban forest ecosystems in the Ruhr Metropolitan Region (Germany) differently



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„Complex case studies for ecosystem responses to climate and hydrological extremes“ (BG3.17)

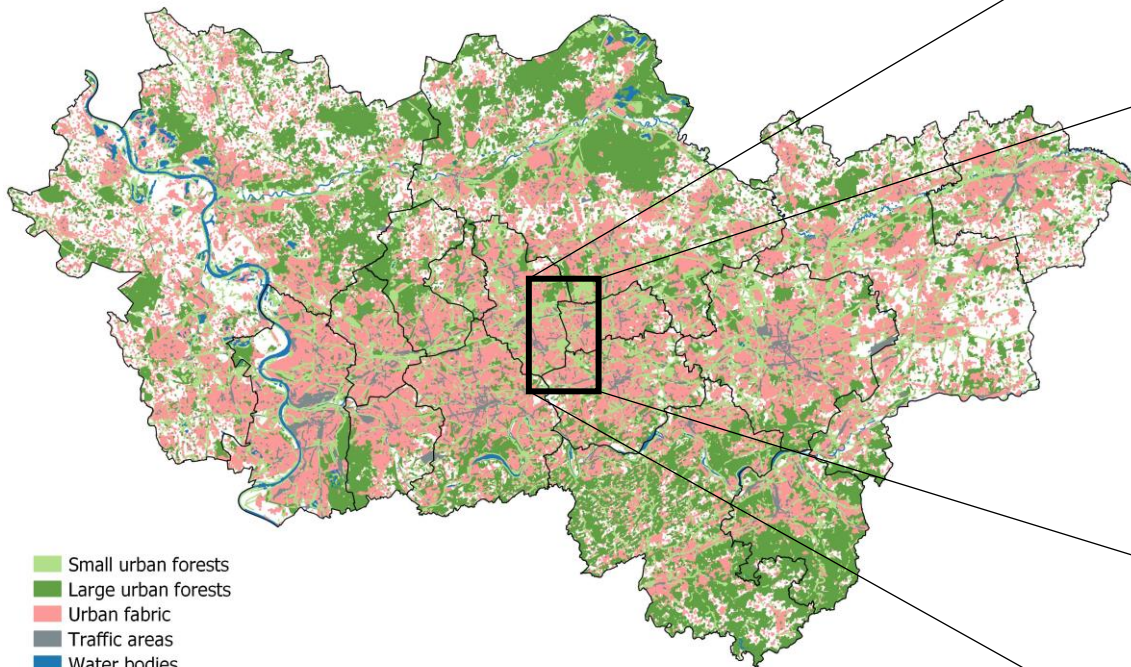
27.04.2021

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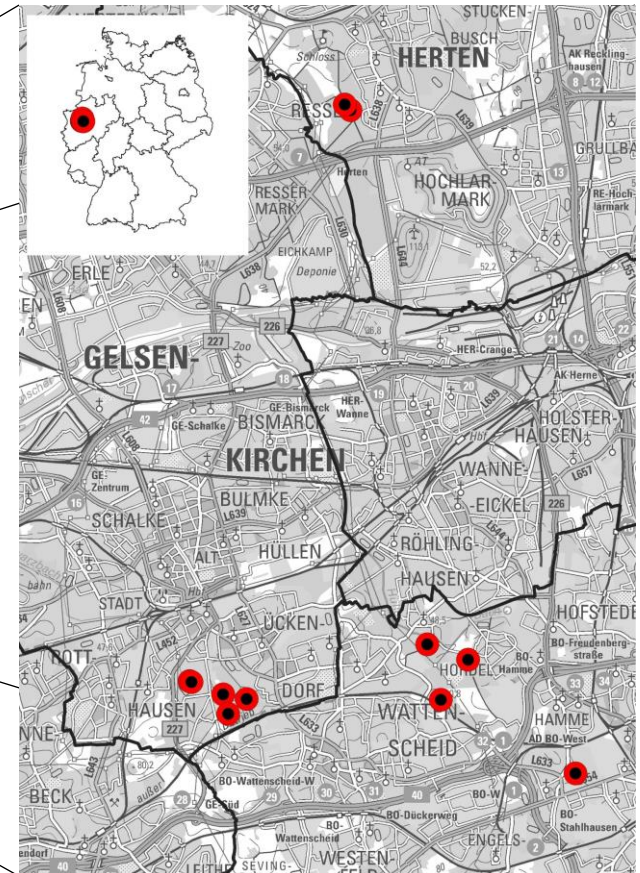


Motivation & Objective

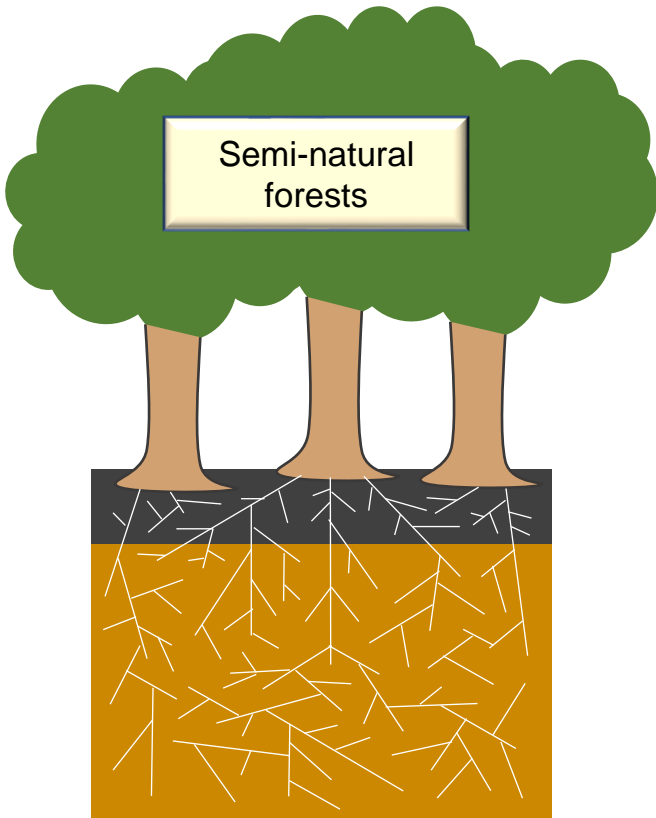
- Investigation on CO₂ balance of different **urban forest types** in the Ruhr Metropolitan Region in West-Germany for the **years 2018 and 2019**
- Eleven **monitoring sites** located in the center of the agglomeration
- CO₂ balance considering CO₂ uptake by forest growth, CO₂ translocation by litterfall, and CO₂ release by soil respiration



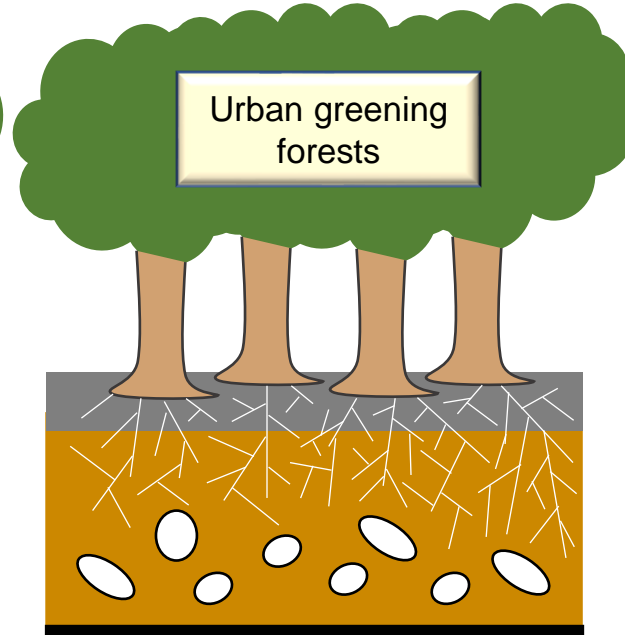
- Small urban forests
- Large urban forests
- Urban fabric
- Traffic areas
- Water bodies
- Other land use and boundaries



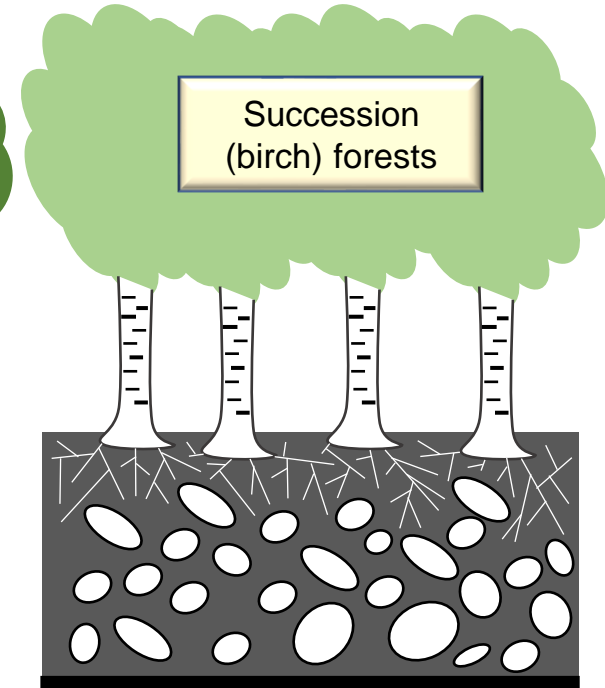
Investigated urban forest types



- Old-grown beech, maple, and oak forests (> 100 a)
- Deep native soils
- Large soil carbon content
- No limitation in rooting

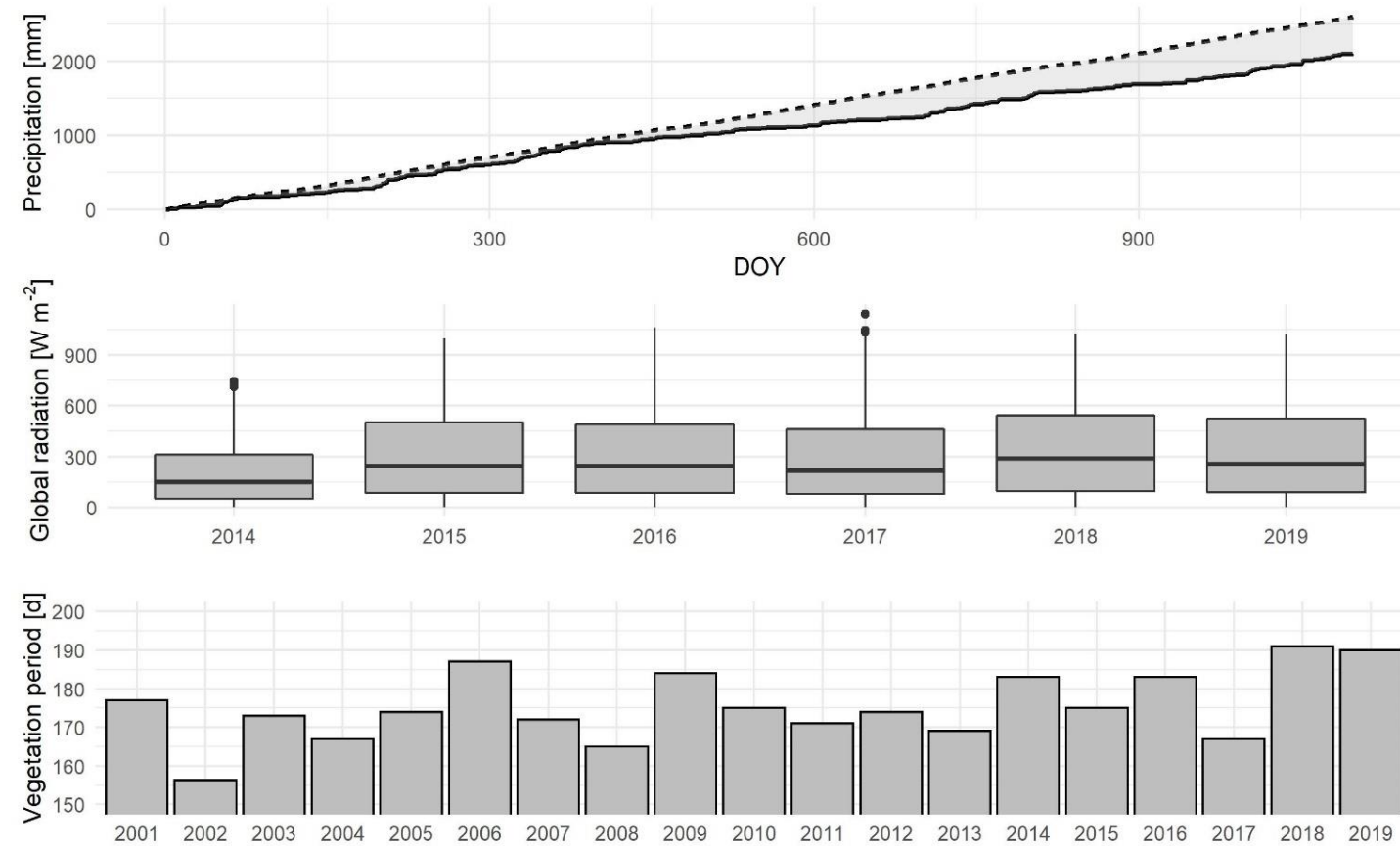


- Planted forests in parks and on heaps
- Before planting, a topsoil was added
- Low soil carbon content
- Rooting limitation due to sealed soil layers



- Autochthonous birch forests
- Coarse and loosy soils from coal mining activity
- Low soil carbon content
- Rooting limitation due to sealed soil layers

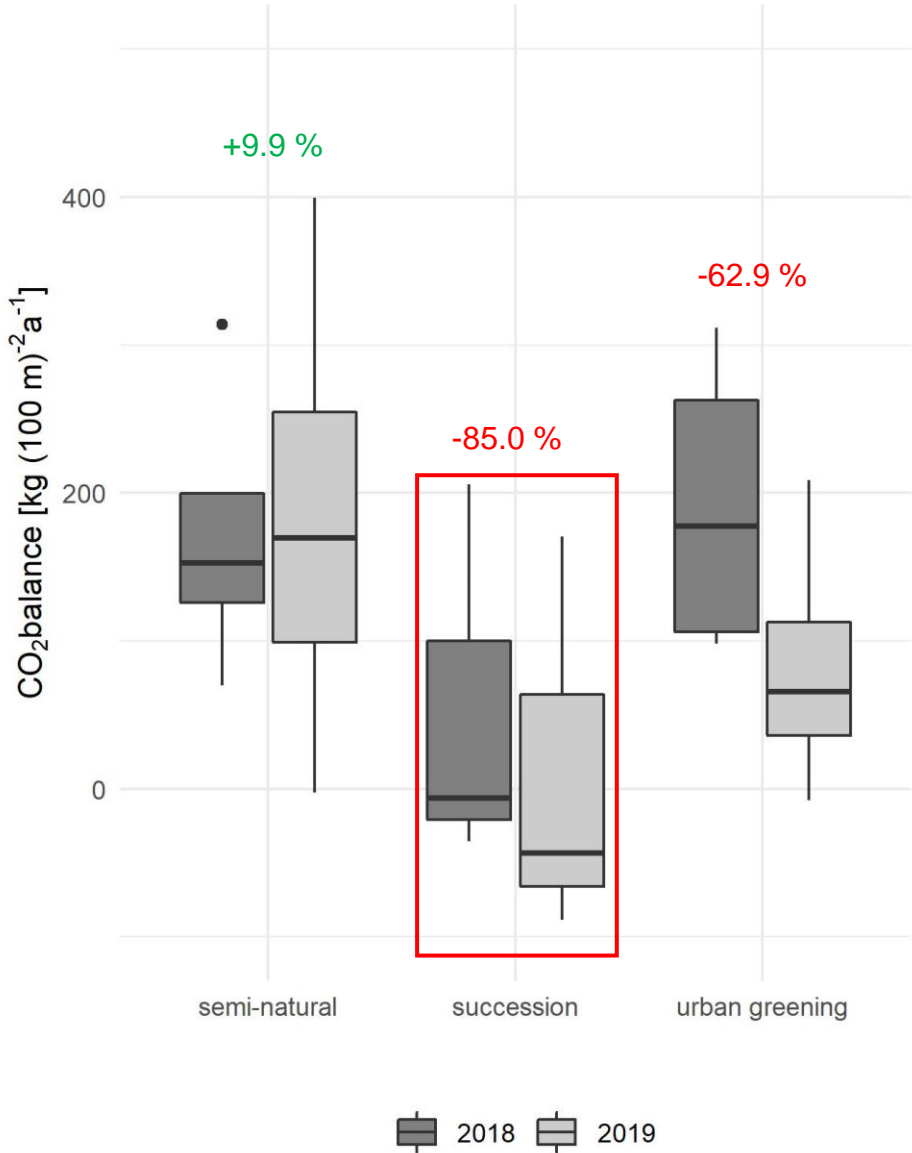
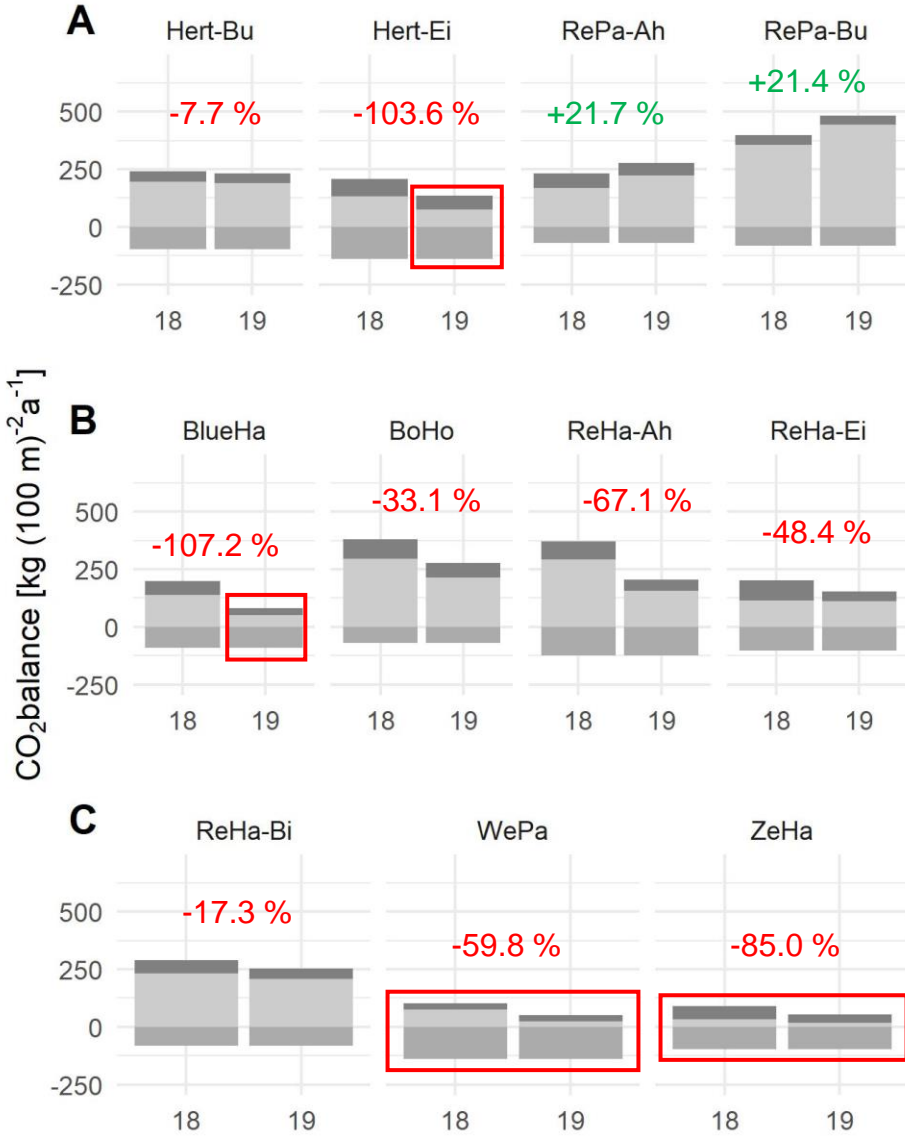
Characteristics of the drought years 2018/2019



Precipitation	
Long-term	865 mm
2018	544 mm
2019	739 mm
Temperature	
Long-term	11.0 °C
2018	11.6 °C
2019	11.2 °C

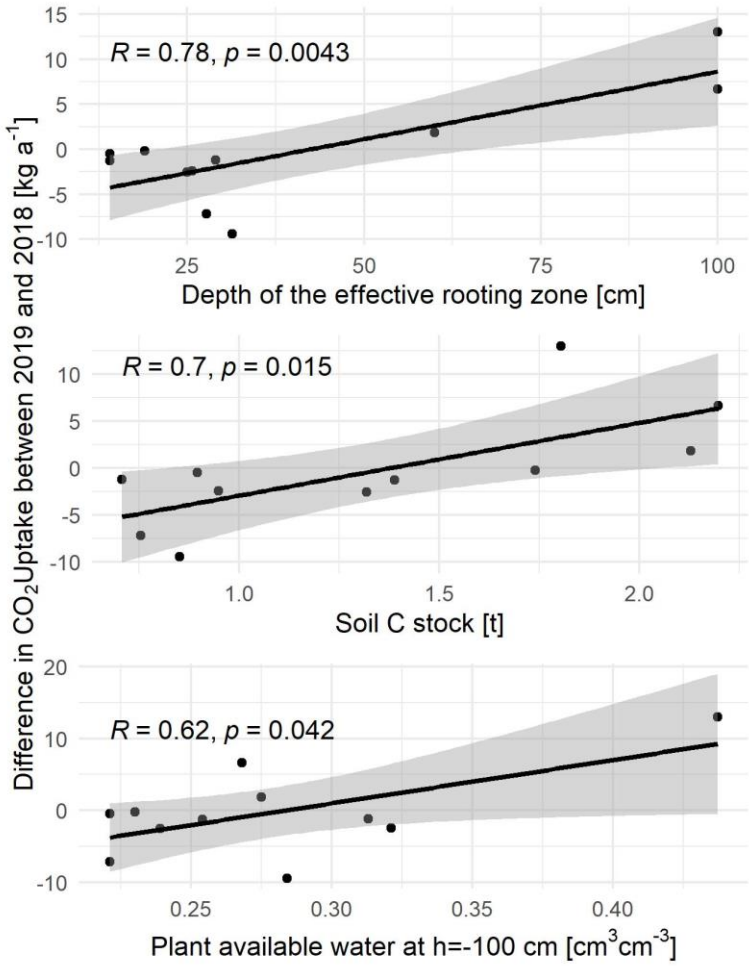
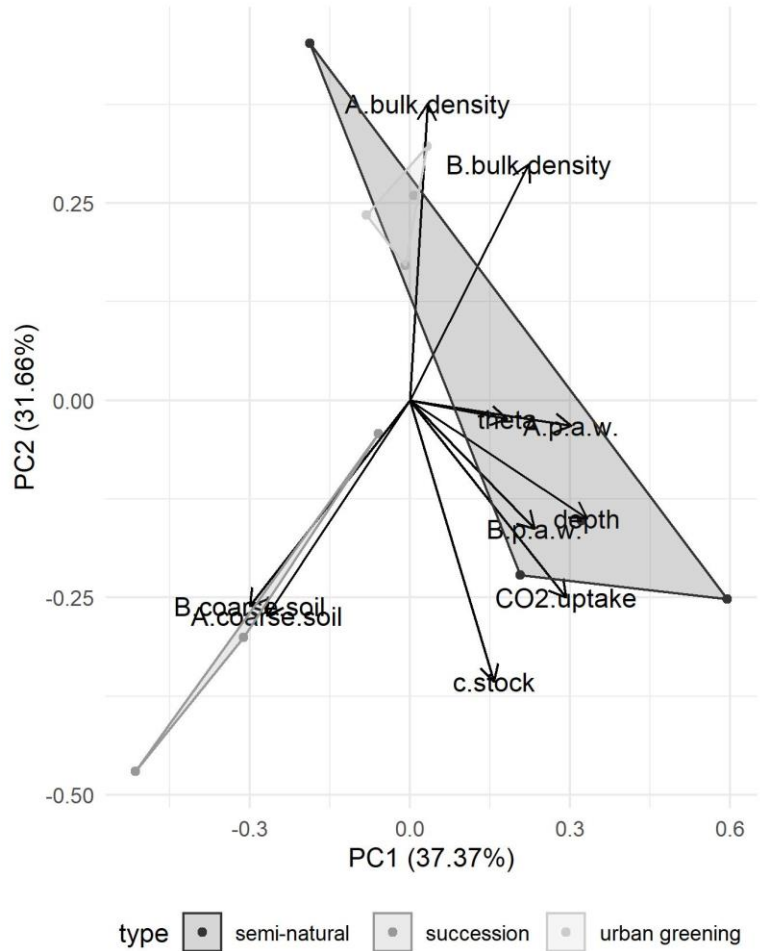
- Experimental period (2018/2019) was much warmer and drier than typical.
- Precipitation deficit of 321 mm (-37%) in 2018 and 126 mm (-15%) in 2019.

CO₂ balance



A = semi-natural forests; B = succession forests; C = urban greening forests

PCA & Correlation analysis



Annual changes in CO₂ uptake are highly correlated with rooting depth, soil carbon content, and amount of plant available water

➔ CO₂ sequestration decreased stronger on sites with limited rooting zone, low soil carbon content, and low plant available water.

Conclusion

- Good soil conditions are crucial for forest growth in urban areas.
- Urban forest ecosystems with unfavorable growth conditions can turn from carbon sinks into sources during droughts.

