

# INAR

INSTITUTE FOR ATMOSPHERIC AND  
EARTH SYSTEM RESEARCH



UNIVERSITY OF HELSINKI

## ICOS Cities – Monitoring urban carbon emissions in Europe

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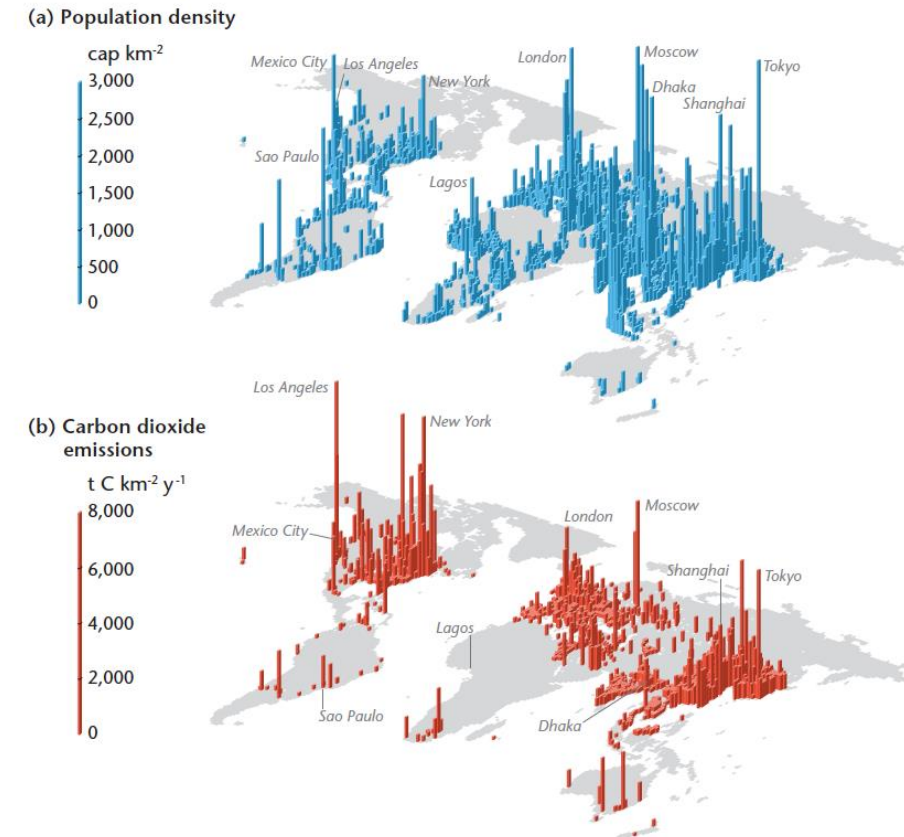
**ICOS** |   
Cities

# ICOS Cities - to develop a systematic greenhouse gas monitoring system for European cities

EU funded H2020 project PAUL – Pilot Applications in Urban Landscapes

Supports the European Green Deal and Climate Action

- validate implementation of Paris Agreement
- raise awareness
- develop tools and services for cities
- showcase services



Oke et al. 2017. *Urban Climates*.  
Cambridge University Press.

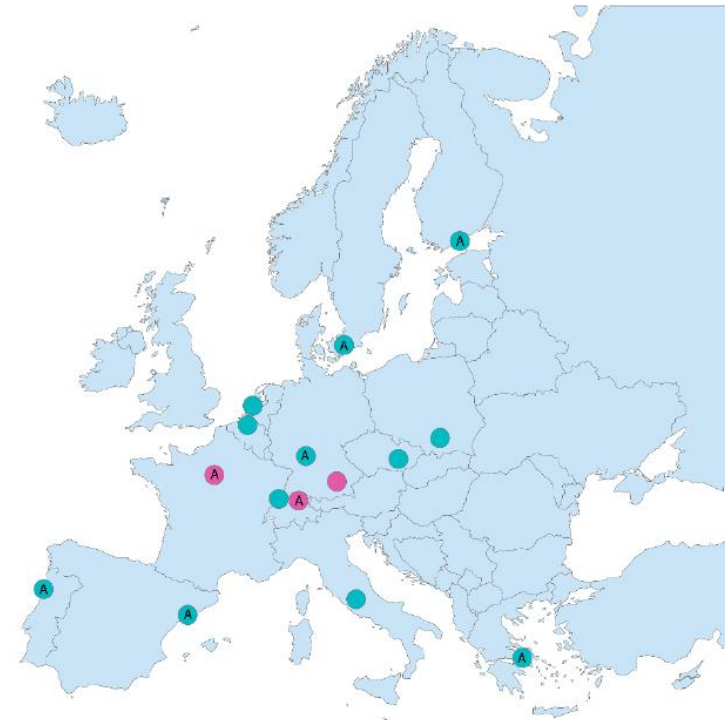
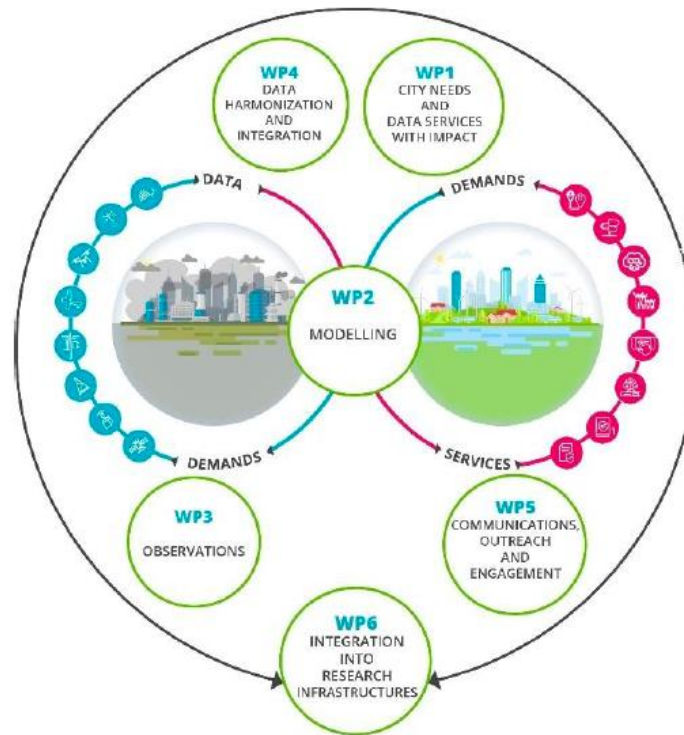


# Concept of ICOS Cities project

To implement and showcase  
pilot city observatory in 3 cities

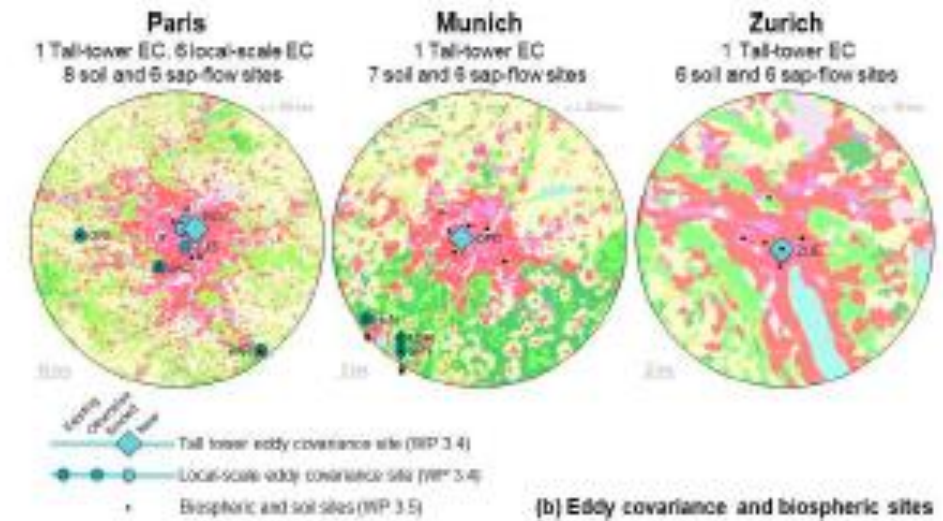
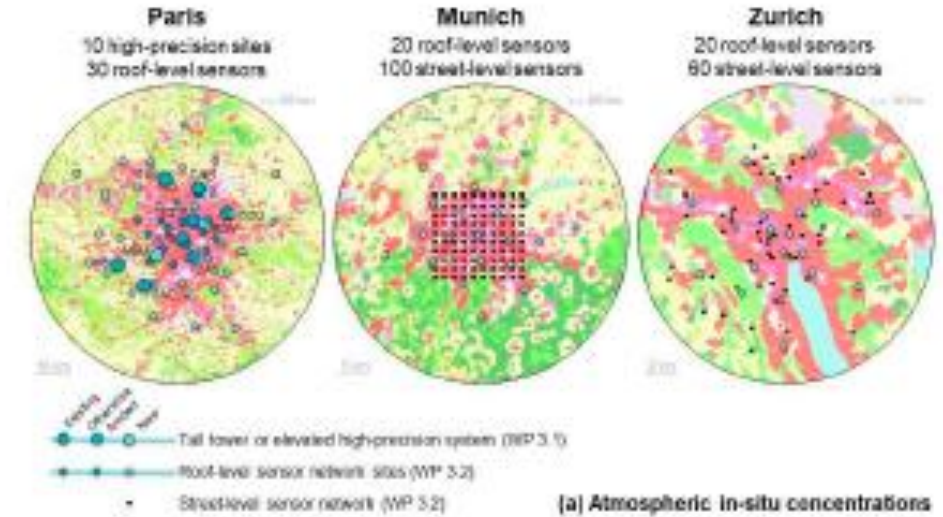
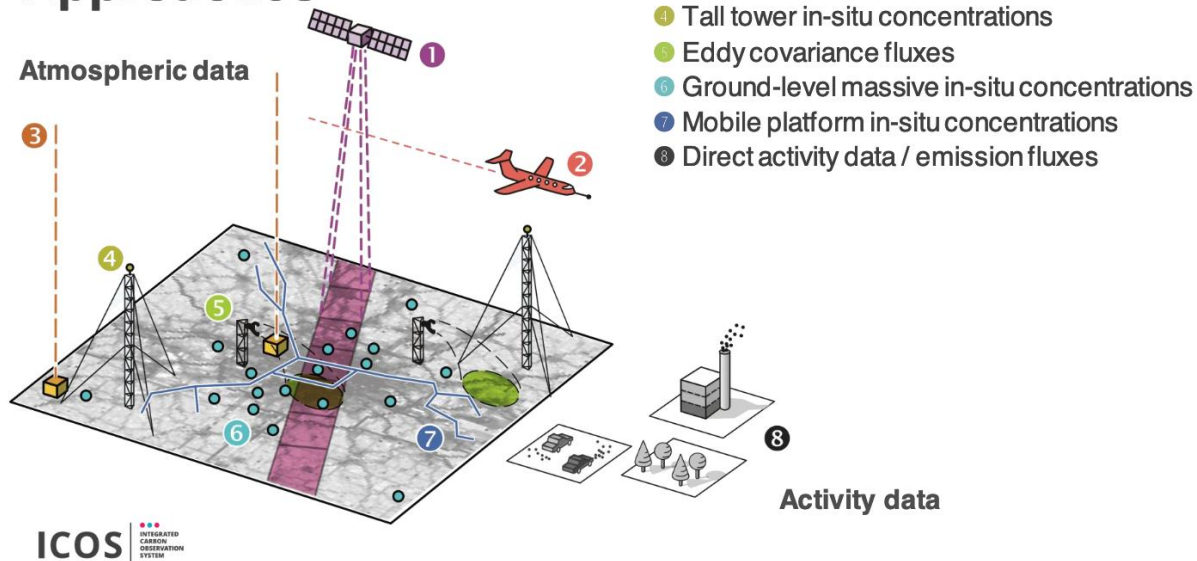
Supported by ICOS Cities  
network

Develop research  
infrastructure concept that  
can provide needs-based  
services for cities



# In pilot cities multiple innovative observational approaches tested

## Observational Approaches



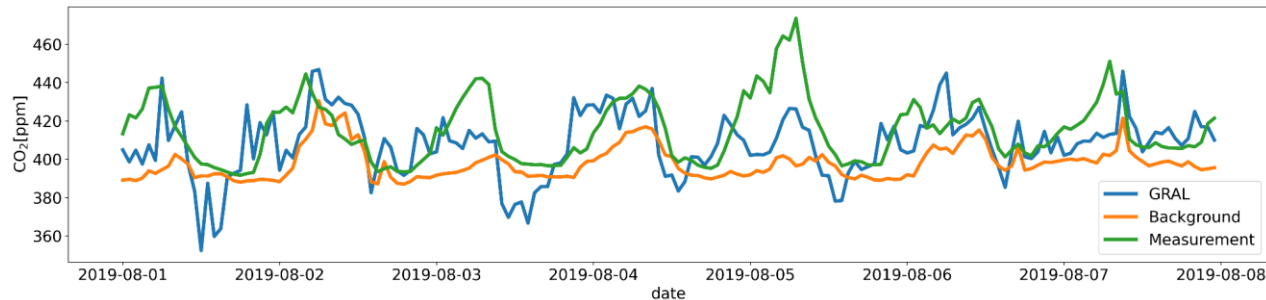
# Modelling integral part of the observatory

Example from Zurich with GRAMM/GRAL model system

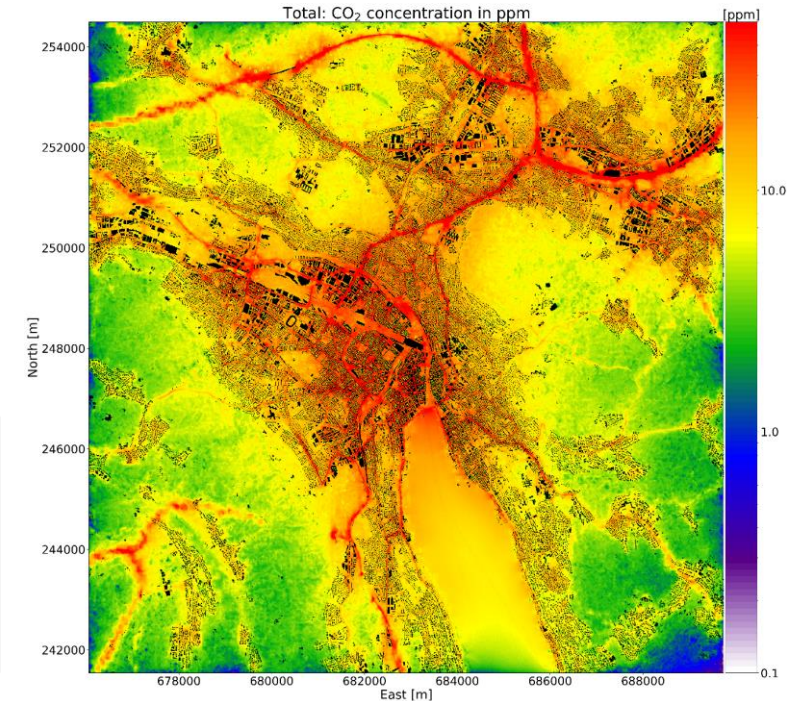
Interpretation of atmospheric concentration measurements

Linking observations to emissions

First comparison with observations at Zürich Kaserne



Annual mean near surface CO<sub>2</sub> from anthropogenic sources



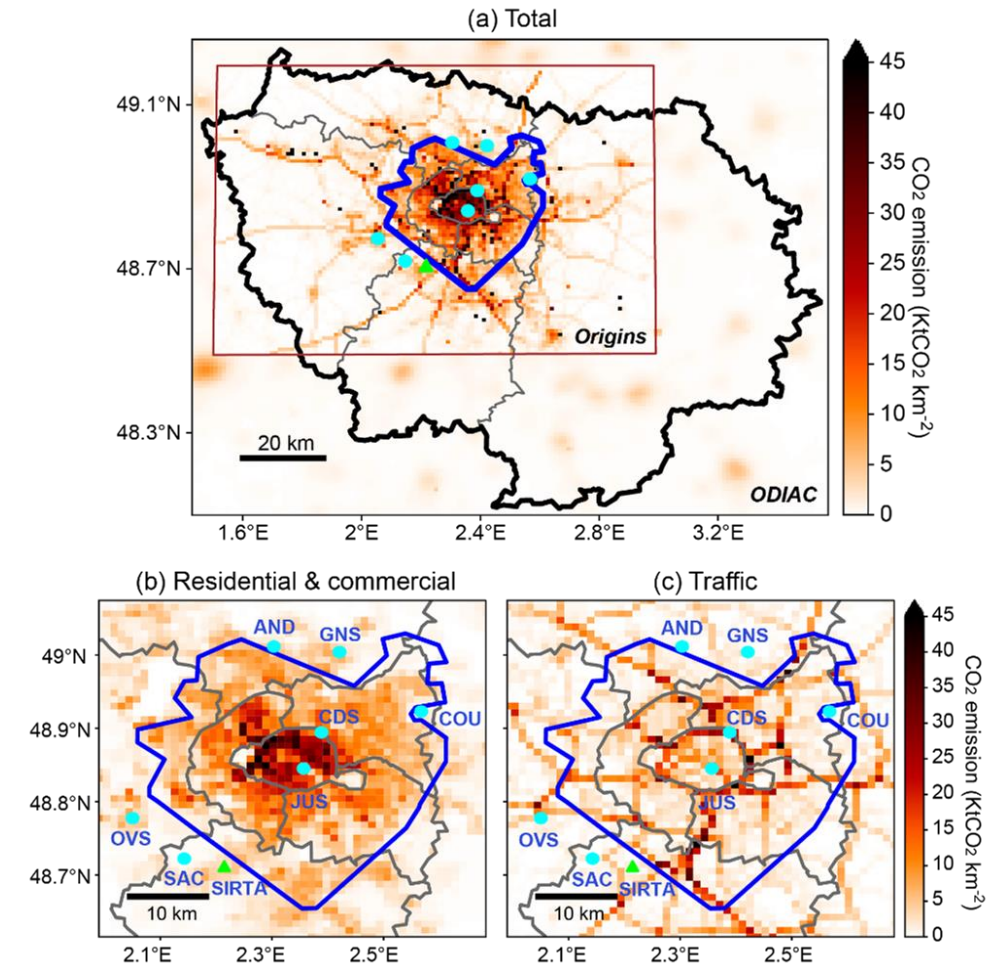
Courtesy of Dominik Brunner/Empa team



# Modelling example from Paris

Example from Paris using WRF-Chem model with 1 km x 1 km resolution

Inversion modelling approach using high-accuracy sensor network and sectoral emissions from Origins.Earth inventory

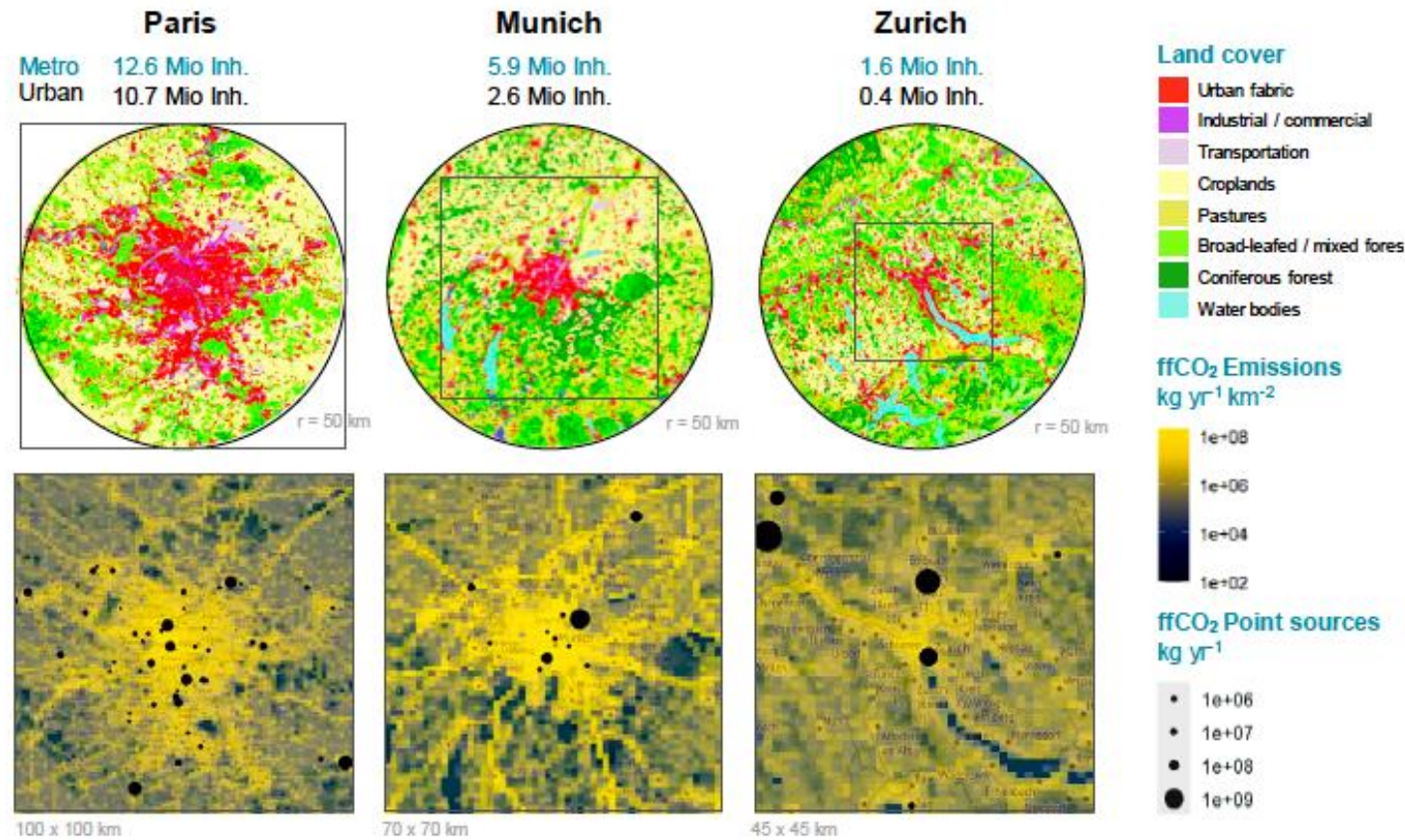


# Detailed emission inventories from different sectors in pilot cities needed

Emission inventory with 100 m x 100 m resolution

Observations used to improve them further

Scalability to other cities as similar emission datasets not necessarily available for all cities in Europe and beyond?

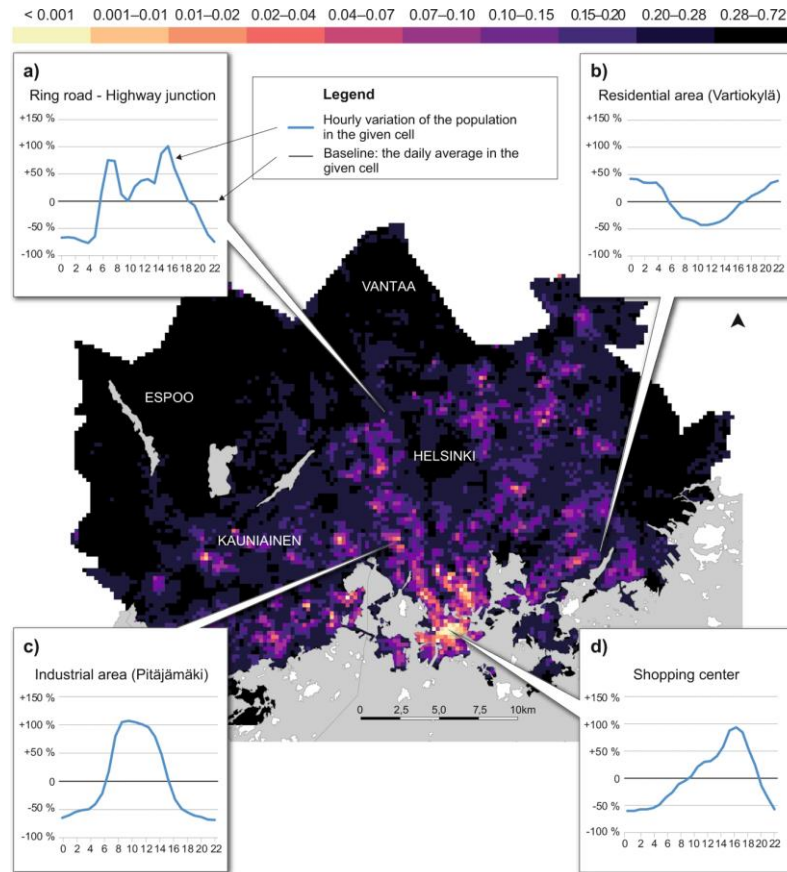


Courtesy of TNO team

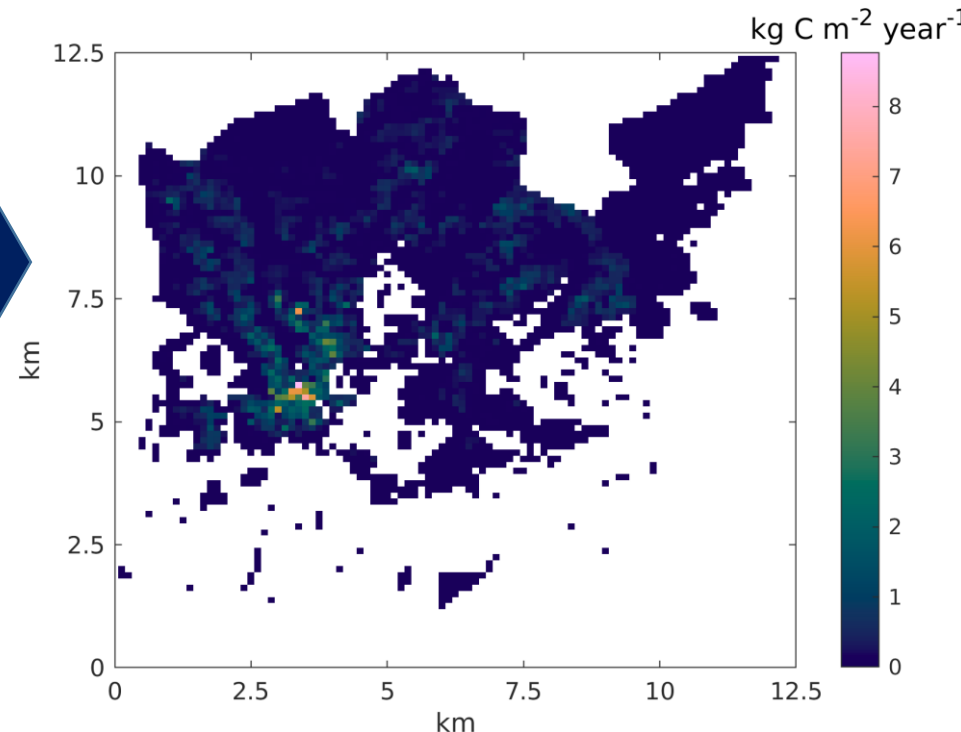
# New emerging datasets to provide information on urban activities

Mobile phone data from Helsinki to provide information on urban function

Bergroth et al. 2022. A 24-hour population distribution dataset based on mobile phone data from Helsinki metropolitan area. *Scientific data* 9, 39



CO<sub>2</sub> emissions from human metabolism in Helsinki in 2019



Courtesy of Minttu Havu

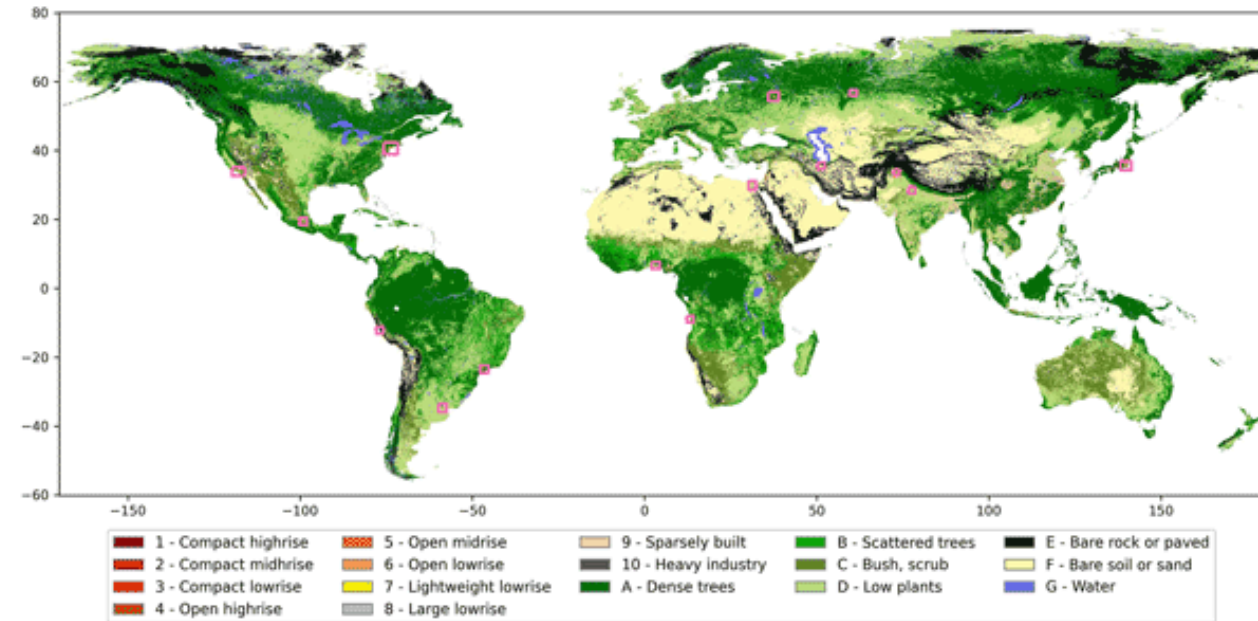
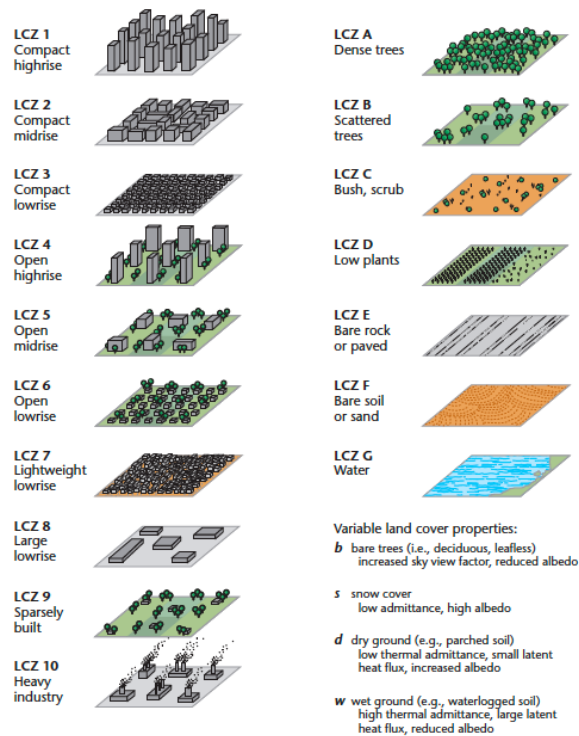


# Local climate zones provide detailed information on urban surface globally

100 m x 100 m resolution

Designed for Earth System Models (ESMs)

Potential for CO<sub>2</sub> observatory?



Demuzere et al 2022. A global map of local climate zones to support earth system modelling and urban-scale environmental science. *Earth Syst Sci Data* 14, 3835

# Key points

ICOS Cities project designs **GHG observatory for European cities** to validate implementation of climate actions, and showcase tools and services

Aims to develop **research infrastructure** concept to answer needs of cities

Three pilot cities with support from **ICOS Cities network**

**Novel observations** are combined with **modelling approaches**

For scalability to other European cities and beyond, alternative and **innovative data sources** needed





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