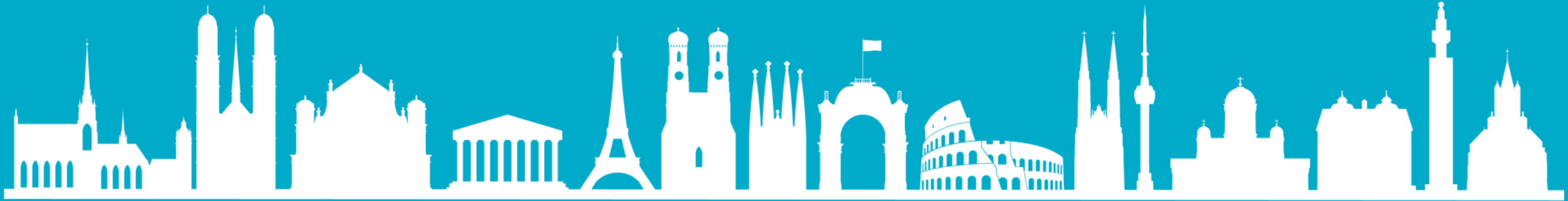
ICOS | Cities
Pilot Applications in Urban Landscapes

@ RI Urbans

1st Science Meeting 19-20 October, 2022



ICOS Cities, aka Pilot Applications in Urban Landscapes - Towards integrated city observatories for greenhouse gases (PAUL), has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101037319

ICOS Cities

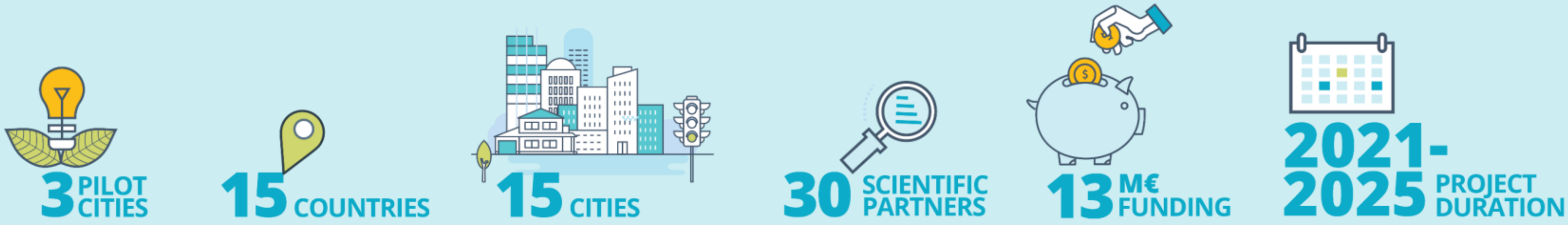
“Cities are where the climate battle will largely be won or lost.”

António Guterres, Secretary-General, United Nations
Speech at C40 World Mayors Summit (Copenhagen), 11.10.2019

Photo: A. Christen, University of Freiburg

PAUL – ICOS Cities project

- **P**ilot **A**pplication in **U**rban **L**andscapes – towards integrated city observatories for greenhouse gases
- Urban green-house gas observation
  - ICOS Cities bring together and evaluate the most innovative **measurement approaches** of **greenhouse gas emissions** in densely populated urban areas.
  - The project supports the European Green Deal and aims at **developing useful tools** and **services** for cities in support of their local climate **action plans**.
  - The project aims at creating **data services** that have societal impact.



The Consortium

ICOS Carbon Portal

cmcc Centro Euro-Mediterraneo sui Cambiamenti Climatici

Empa Materials Science and Technology

Technical University of Munich TUM

HELSINGIN YLIOPISTO

TNO innovation for life

European Social Survey

UNI FREIBURG

ICOS Integrated Carbon Observation System

ECMWF

LUNDS UNIVERSITET

UAB Universitat Autònoma de Barcelona

cnrs

Organisation météorologique mondiale

Aalto University

cea

Stadt Zürich Umwelt- und Gesundheitsschutz

UNIVERSITY OF COPENHAGEN

FINNISH METEOROLOGICAL INSTITUTE

SciencesPo

Universität Basel

Universiteit Antwerpen

Consiglio Nazionale delle Ricerche

AIRPARIF

MAX-PLANCK-GESELLSCHAFT

AGH

KIT Karlsruher Institut für Technologie

INRAE

gesis Leibniz-Institut für Sozialwissenschaften

NATIONAL OBSERVATORY ATHENS

universidade de aveiro

origins.earth

CzechGlobe Ústav výzkumu globální změny AV ČR, v. v. i.

ICOS Cities

KEY OBJECTIVES

1 RELIABLE DATA

Develop and test comprehensive greenhouse gas measurement observatories and technologies in urban environments, to produce reliable data for cities

2 PILOT STUDIES

Conduct pilot studies in large, medium and small cities, and later implement the same methods in multiple European cities

3 SERVICES & TOOLS

Develop services and tools based on the needs of cities, for processing and analysing the observation data, while raising awareness and engaging citizens

4 SUPPORTING THE EUROPEAN AMBITION

Provide the future backbone of an urban GHG monitoring system in Europe and contribute to the European ambitious climate strategy to meet the targets of the Paris Agreement.

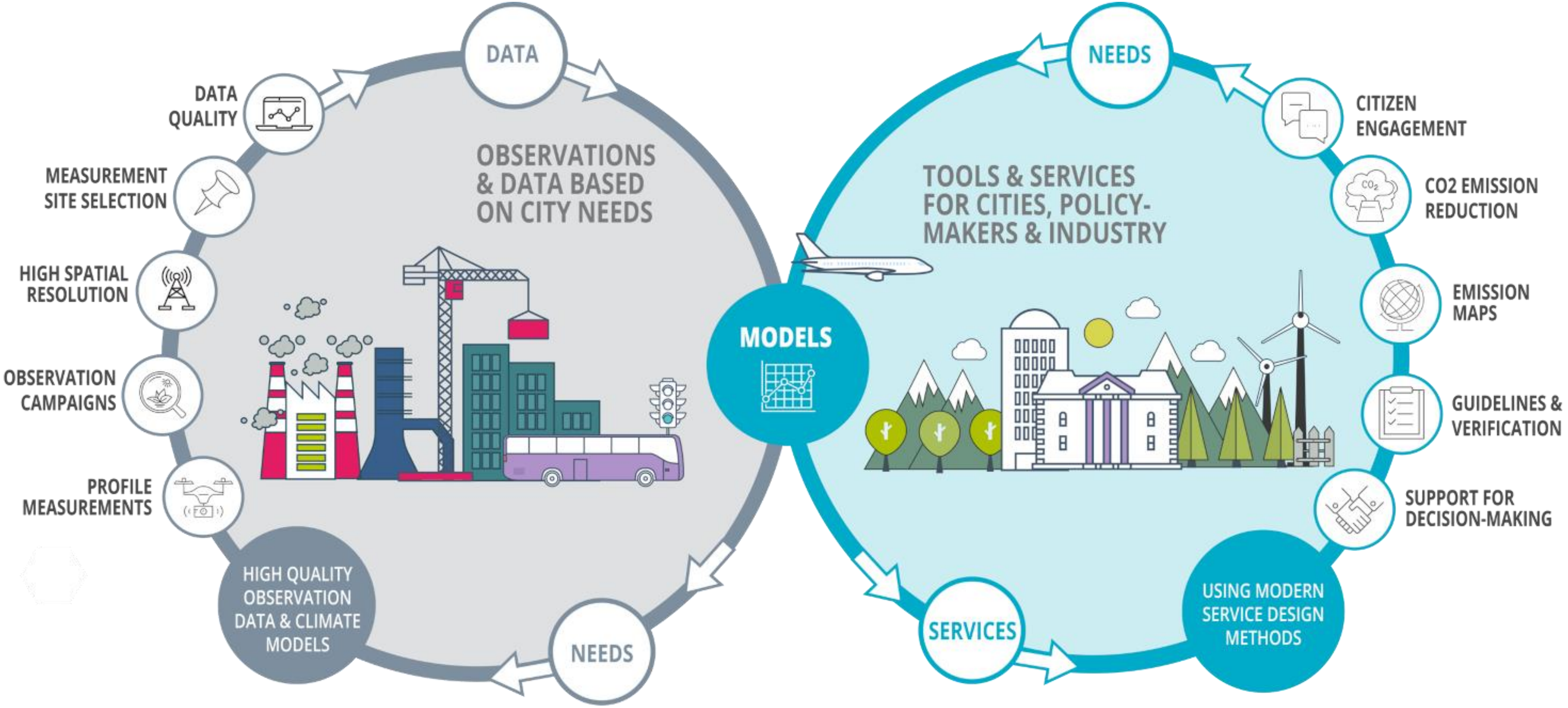
5 RESEARCH IN SUPPORT OF CITIES

Design a concept for an upgraded Research Infrastructure able to support cities in implementing their climate action plans

ICOS Cities

ICOS Cities brings together European citizens, policy makers and top scientiststo co-design pioneer greenhouse gas measurement methodologies and services for cities in support of climate action.

From needs to data to services



ICOS Cities network

3 PILOT CITIES:

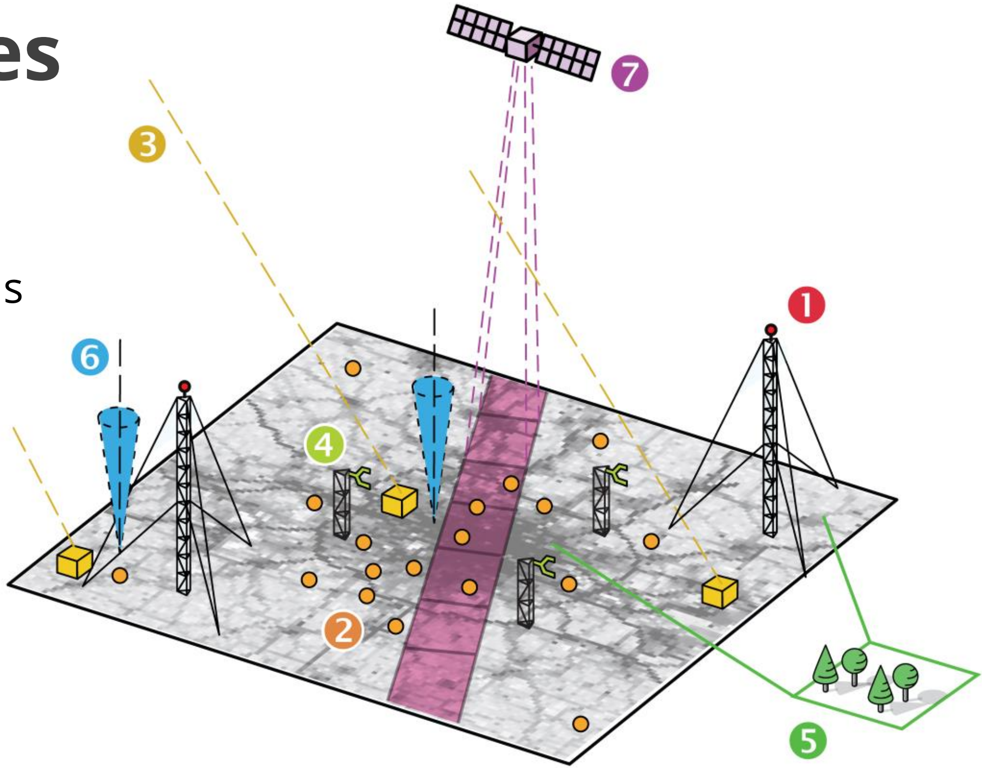
Paris, Munich and Zurich

12 NETWORK CITIES:

Antwerp, Barcelona, Basel, Brno, Athens, Copenhagen, Heidelberg, Helsinki, Krakow, Rome, Rotterdam and Porto

Observation strategies in the 3 pilot cities

1. High-precision tall tower concentrations
2. Roof- and street-level networks
3. Ground-based total column network
4. Tall eddy covariance towers
5. Biogenic process observations
6. Ground-based wind and meteorology
7. Satellite total column observations



- Comparing techniques
- Identify synergies between approaches and scales
- In three cities (metropolitan, large, mid-size)

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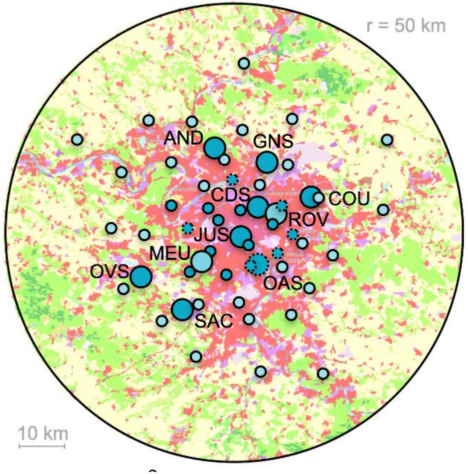
Concentration measurements

High-precision **atmospheric concentration networks** on **tall towers**, **roof-level** and at street-**level** will allow exploring options for urban- and local-scale inverse modelling.

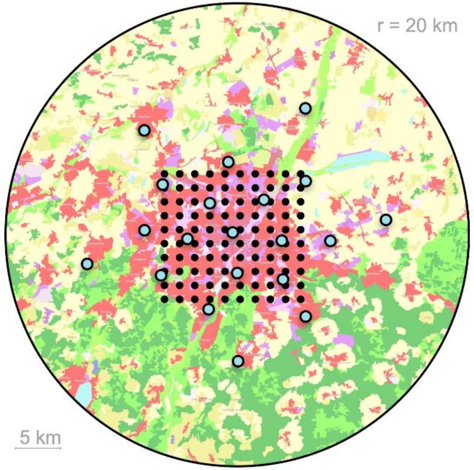
Paris

10 high-precision sites
30 roof-level sensors



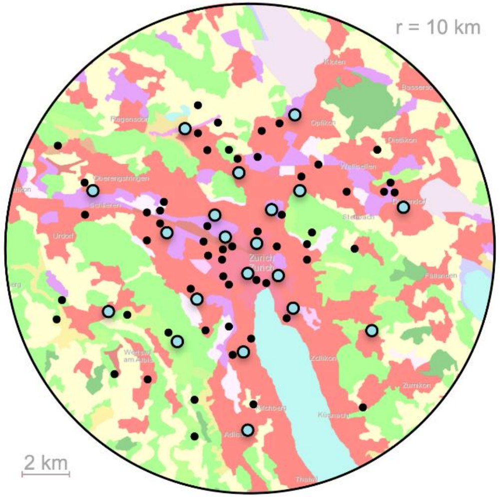
Munich

20 roof-level sensors
100 street-level sensors



Zurich

20 roof-level sensors
60 street-level sensors



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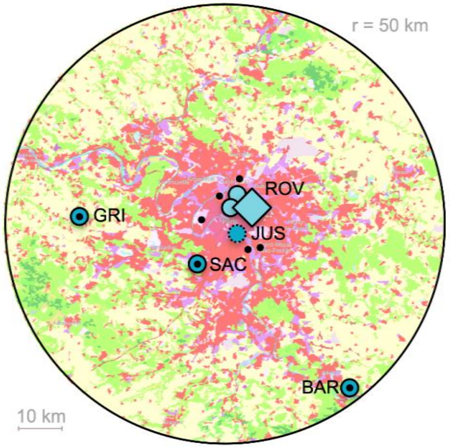
Eddy covariance and biogenic fluxes

Tall-tower **eddy-covariance** systems in urban and rural areas, including co-emitted species, enable the **separation of fossil-fuel and biogenic CO_2**. The modelling of urban biogenic fluxes is supported by process monitoring of **urban vegetation and soils.**

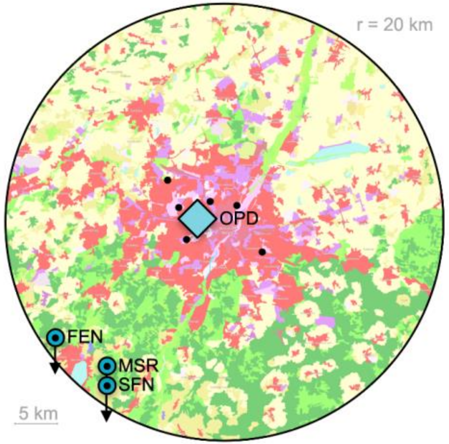
Paris

1 Tall-tower EC, 6 local-scale EC
8 soil and 6 sap-flow sites



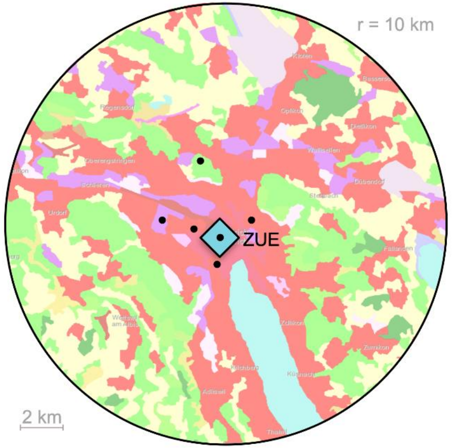
Munich

1 Tall-tower EC
7 soil and 6 sap-flow sites



Zurich

1 Tall-tower EC
6 soil and 6 sap-flow sites



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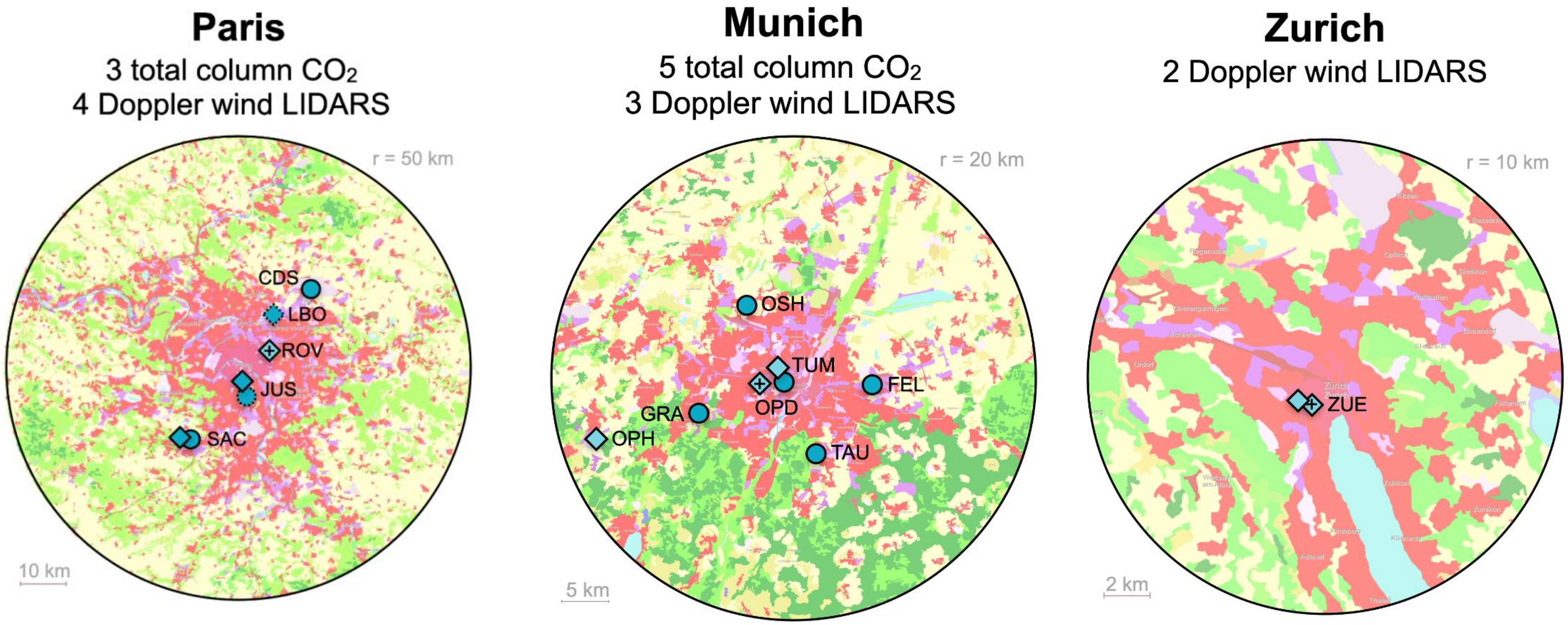
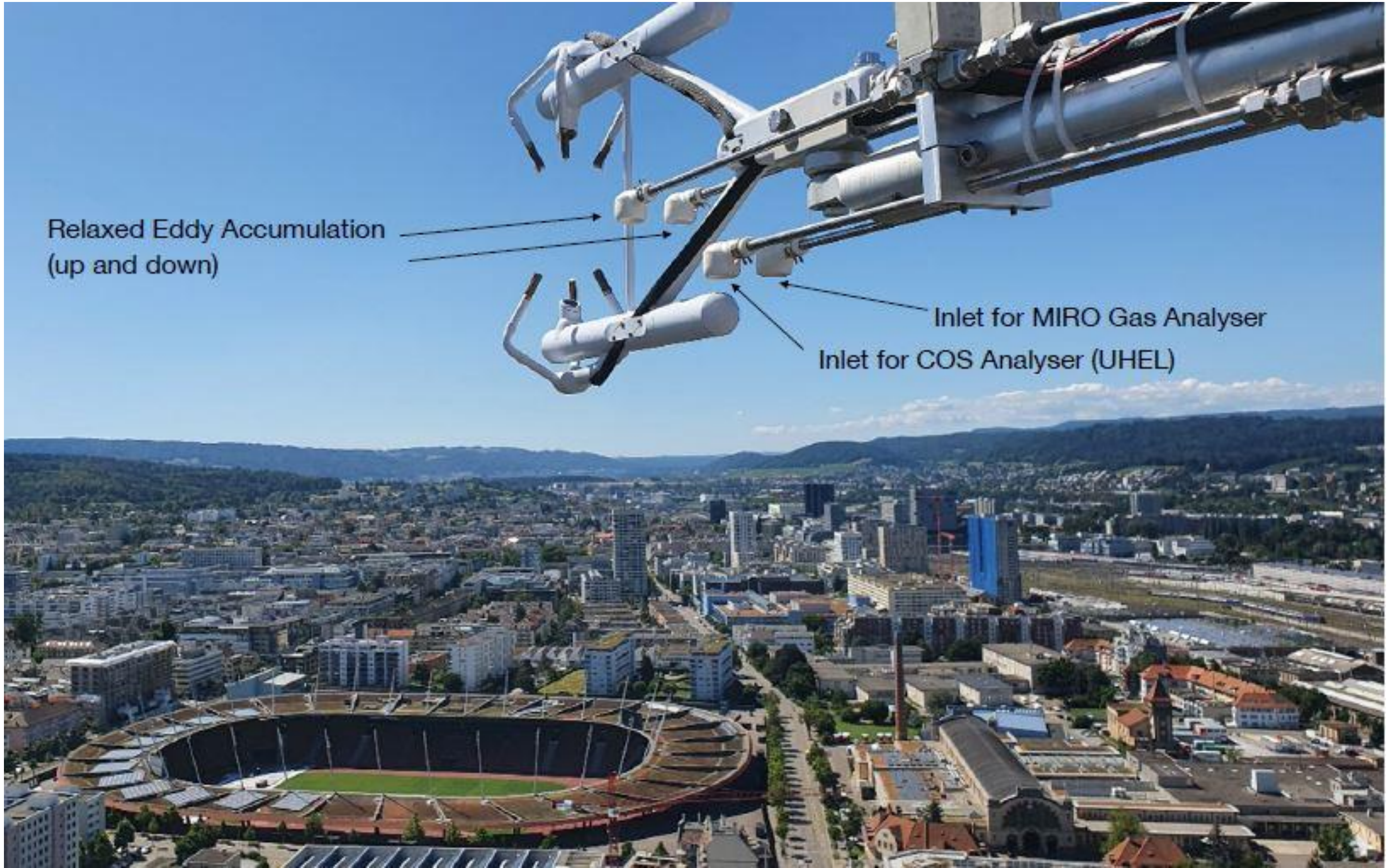
Remote sensing and transport

Ground-based remote sensing systems allow for total column observations of CO_2 and wind, turbulence all upwind, and downwind of cities.



Eddy covariance tall tower in Zurich Hardau

Head of the IRGASON EC and inlets for the REA system, MIRO and COS analyzer installed in Zurich. Picture by Roland Vogt, University of Basel



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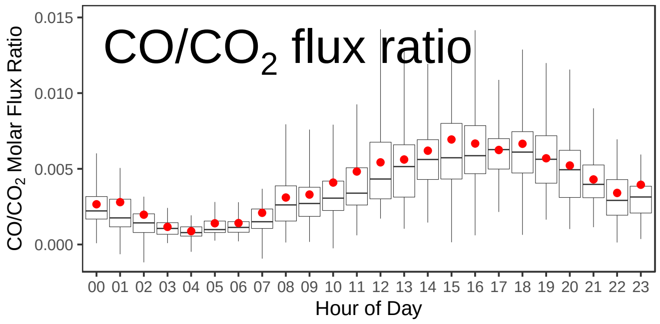
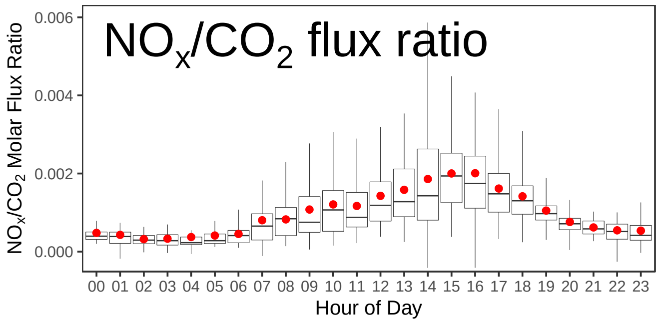
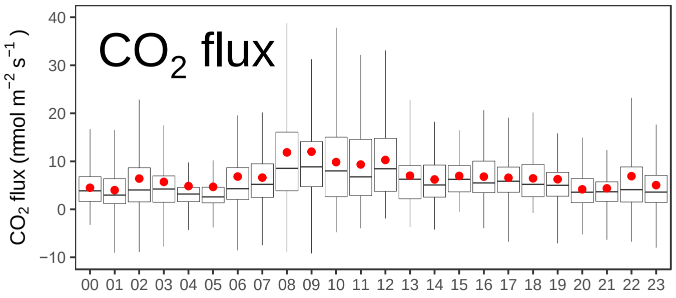
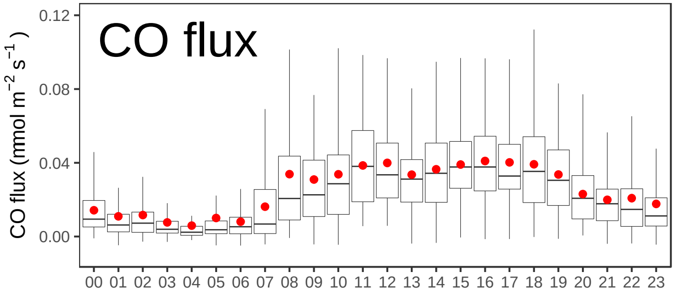
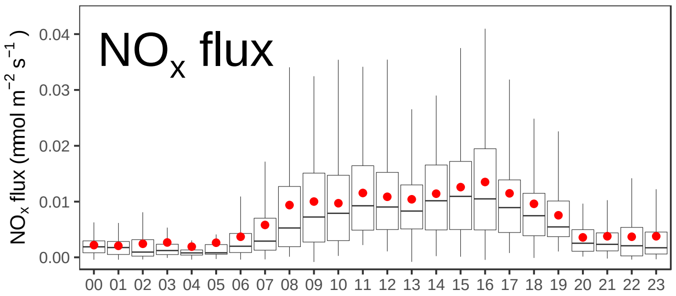
Eddy covariance Zurich
First results











Mean dirunal courses August to October 2022 (Data by J. Hashemi, Uni Freiburg)

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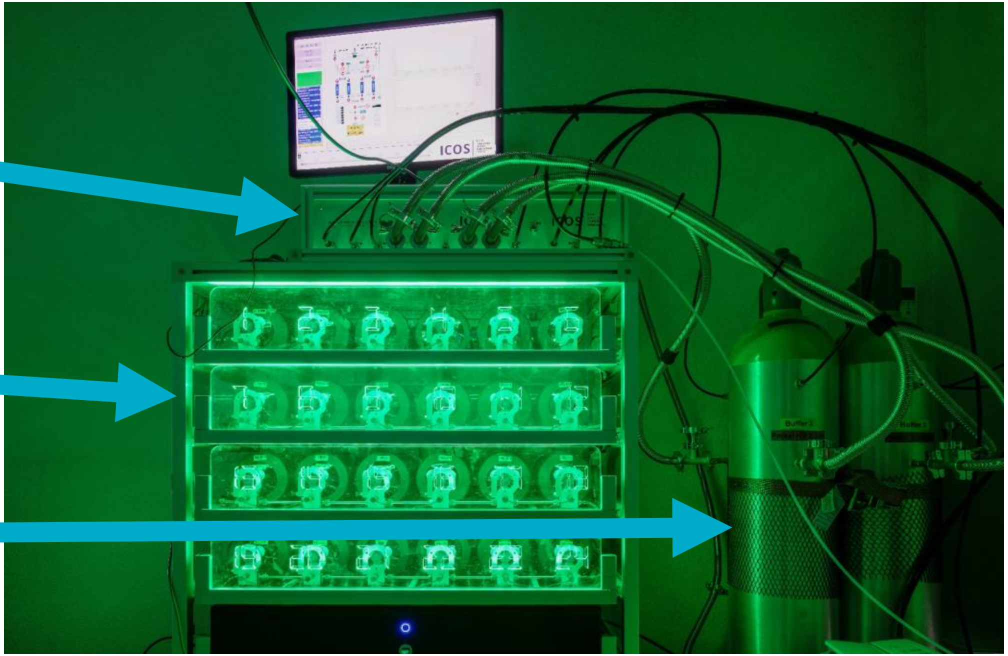
ICOS flask sampler extension: Relaxed Eddy Accumulation (REA)

REA module

ICOS flask sampler

50L buffers



Zurich low & mid cost concentration network

https://drive.google.com/file/d/1-Xs0hwXBphmvClwAoCAH9g3xFtzvBIxT/view

Photos of a low-cost CO_2 sensor (left) and mid-cost CO_2 sensor with its two reference gas cylinders (right).

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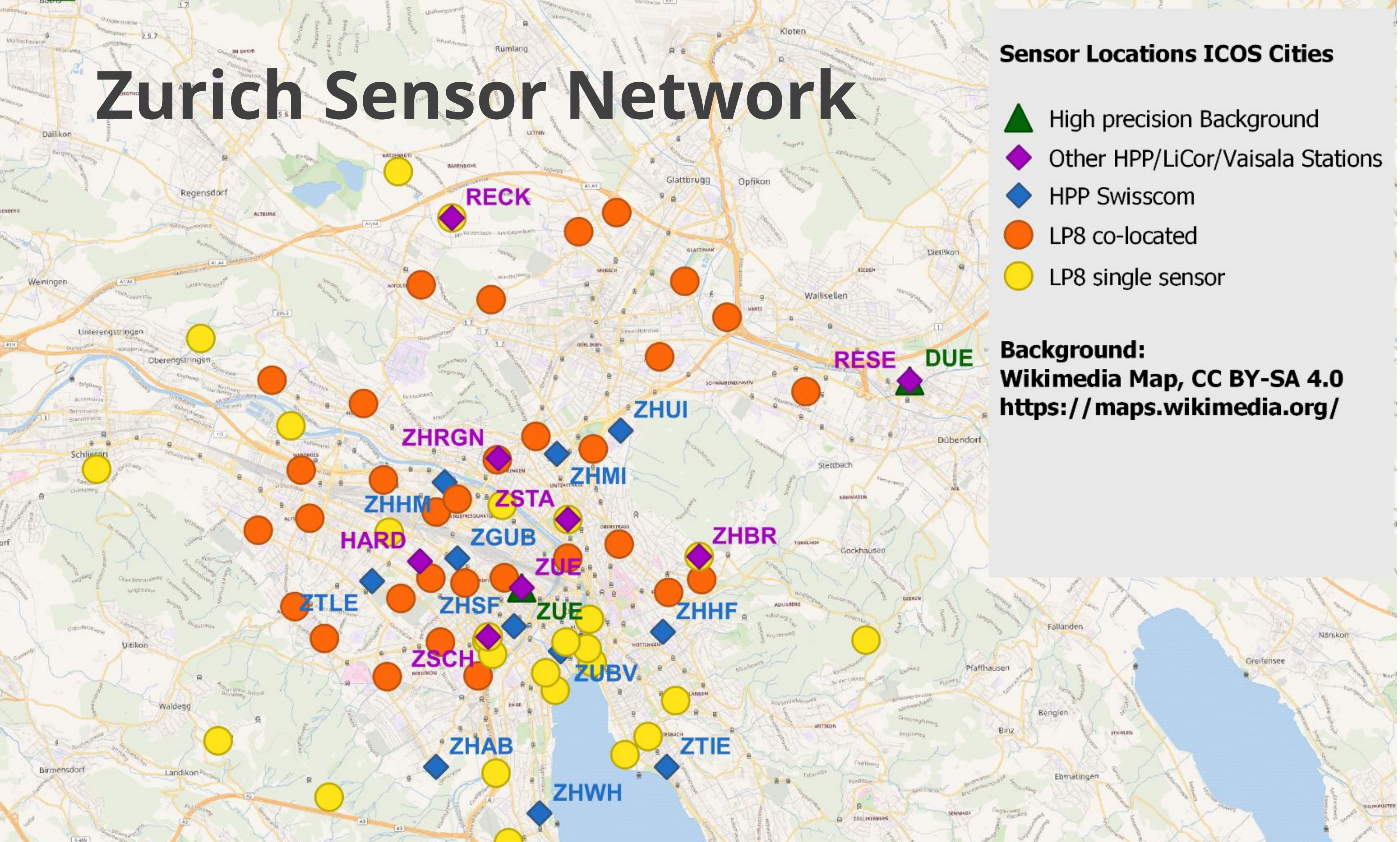
Grange et al., 2022. Operation of the ICOS-Cities urban CO2 sensor network in Z¨urich, Switzerland

Zurich Sensor Network



Mid-cost sensor @ Montmartre - Paris

Inlet and Analyser

Remote Sensing in Paris

EM27, Saclay
south west of Paris

Wind Lidar
Doppler Jussieu
(90m asl)

EM27, Gonesse,
northern Paris

ICOS Cities

Ensuring solutions fit the need

- Co-designing the services based on users' needs: user involvement e.g. through interviews of city officials and policy-makers, co-design workshops etc.
- Results of attitude surveys of the pilot city citizens feed into the solutions and concepts created
- Policy briefs and guidelines for cities and national policy-makers
- Creation of educational materials for schools

ICOS Cities
Pilot Applications in Urban Landscapes

Message to take home

- Create a blueprint for independent **urban monitoring of GHG** emission reduction efforts
- Provide the knowledge to create **tools and services** for cities, citizens, policy makers, and education

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http://www.icos-cities.eu ICOS_RI #ICOSCities