Co-ordinated by ECMWF

CoCO2
Prototype system for a Copernicus CO_2 service

WP 7: OBSERVATIONS

1st General Assembly
16-18 November 2021

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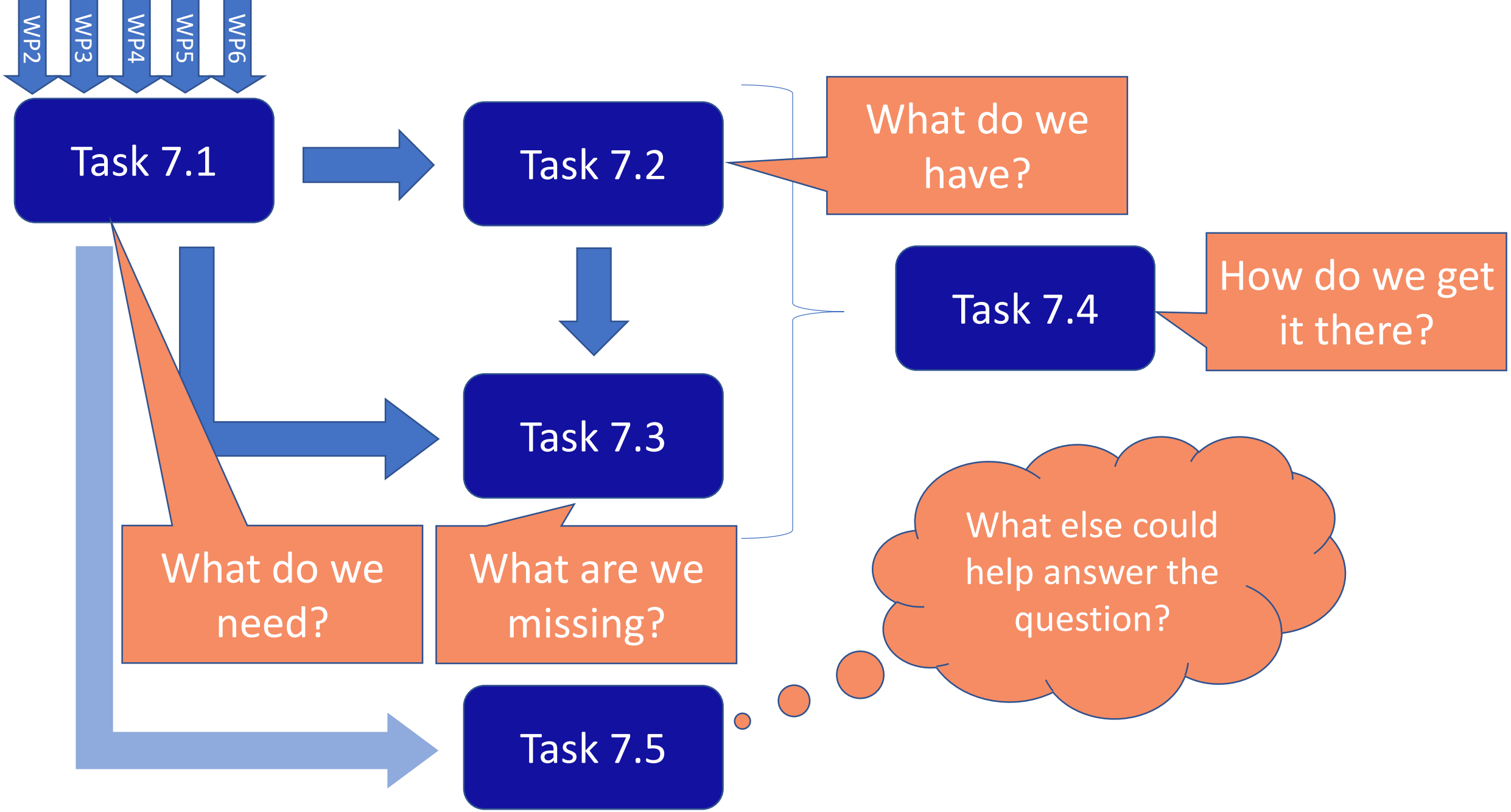
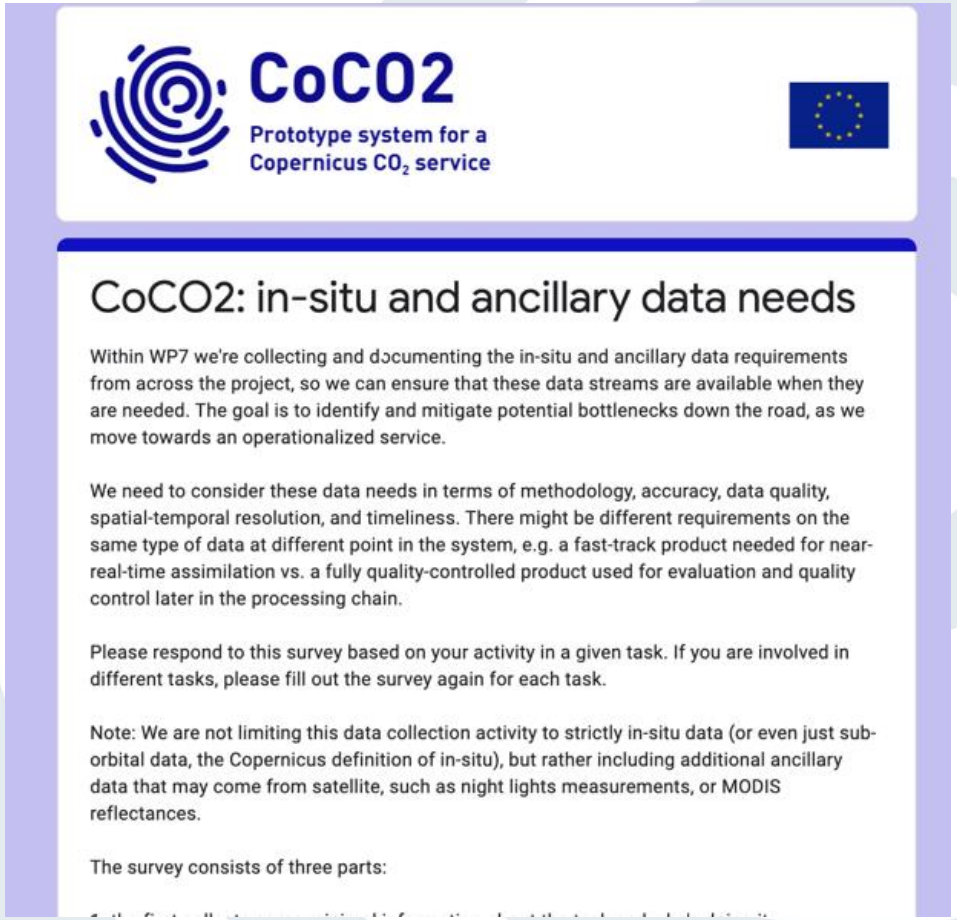
16/11/2021

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 958927.


WP2
WP3
WP4
WP5
WP6
Task 7.1
Task 7.2
What do we have?
Task 7.4
How do we get it there?
Task 7.3
What do we need?
What are we missing?
What else could help answer the question?
Task 7.5

Finding out what is needed

- First survey was circulated throughout the project, to determine current data needs: “What we are using now”, with a deliverable due in December
- The feedback was somewhat underwhelming... But this is important!
- And we have to do it again: Second and third iterations will follow in the next years of the project



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CoCO2: in-situ and ancillary data needs

Within WP7 we're collecting and documenting the in-situ and ancillary data requirements from across the project, so we can ensure that these data streams are available when they are needed. The goal is to identify and mitigate potential bottlenecks down the road, as we move towards an operationalized service.

We need to consider these data needs in terms of methodology, accuracy, data quality, spatial-temporal resolution, and timeliness. There might be different requirements on the same type of data at different point in the system, e.g. a fast-track product needed for near-real-time assimilation vs. a fully quality-controlled product used for evaluation and quality control later in the processing chain.

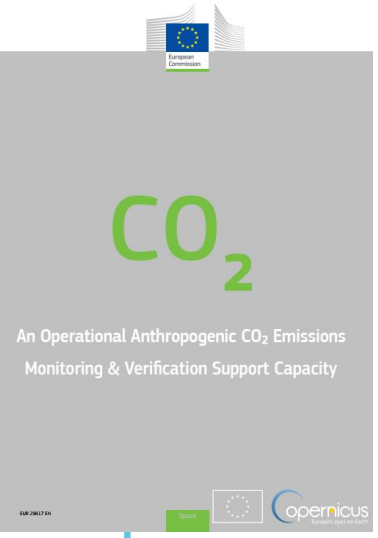
Please respond to this survey based on your activity in a given task. If you are involved in different tasks, please fill out the survey again for each task.

Note: We are not limiting this data collection activity to strictly in-situ data (or even just sub-orbital data, the Copernicus definition of in-situ), but rather including additional ancillary data that may come from satellite, such as night lights measurements, or MODIS reflectances.

The survey consists of three parts:

Finding out what is needed

What task you're working on and what you're doing



In-situ data

Q1: eddy covariance flux data
Q2: in-situ CO2 measurements
Q3: in-situ CH4 measurements
Q4: in-situ measurements of co-emitted species
Q5: measurements from urban networks
Q6: ocean fluxes/partial pressures
Q7: radiocarbon
Q8: other tracers (e.g. radon, OCS)
Q9: ground-based remote sensing (e.g. TCCON)
Q10: site-level ecosystem parameters
Q11: site-level information on management and/or lateral fluxes
Q12: in-situ soil moisture
Q13: in-situ meteorological measurements
Q14: anything else?

Ancillary data

Q1: meteorological fields
Q2: nightlights
Q3: activity data
Q4: satellite-based indices
Q5: satellite measurements of SIF
Q6: other satellite-based measurements
Q7: landcover maps
Q8: concentration fields from a global model
Q9: anything else?

- Timeliness needs
- Pre-processing level
- Use of uncertainty
- Spatial coverage/resolution
- Temporal coverage/resolution
- Where you access data now
- Limiting factors

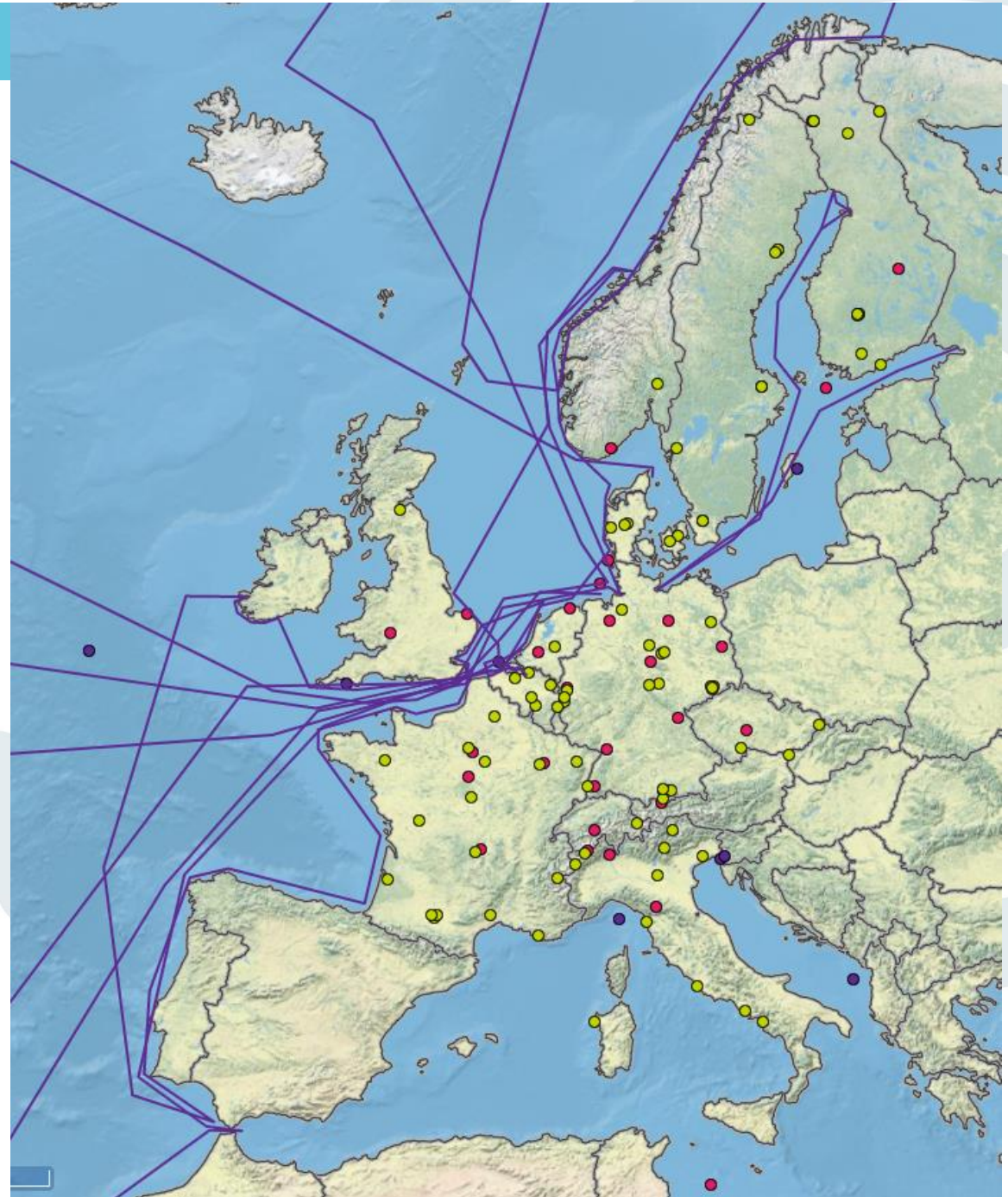
Finding out what is needed to find out what is needed…

- Perhaps not all modellers felt it applied to them (e.g. I'm the only respondent from WP2…)
- Conflict between *which data I think could be useful* vs. *which data I'm actually using right now* proved difficult for some respondents
- This uncertainty made answering complicated: video walk-throughs of me filling out the video took 10-15 minutes – colleagues have reported taking over an hour!
- Working with what we have for now, but:

Moving to interviews for information collection in year 2 of the project.

What we have now

- ICOS produces 25-30 TB of sensor data per year, mostly time-series of observed variables, for example atmospheric carbon dioxide concentrations, given for every 30-minute interval.
- There 150 stations measuring the atmosphere (tall towers), ecosystems (flux measurements) and oceans (pCO2 and more), with 50-100 variables each.



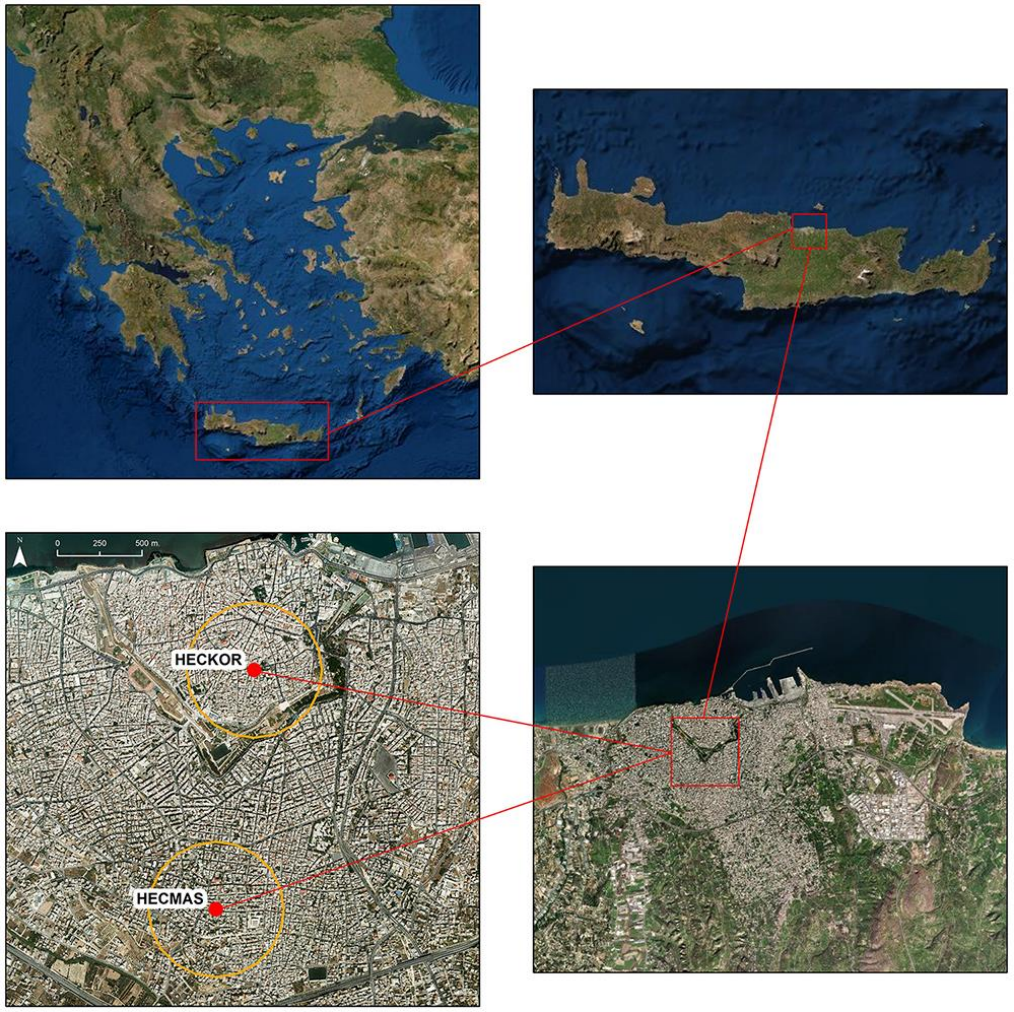
What we have now

- Contacts have been made to map available data outside ICOS domain, to find campaign datasets that can be used, as well as operational data streams from other continents

R/V Polarstern photo from MOSAIC expedition website

What we have now

- ✓ Flux footprint model parameterization and source area estimation for the tower sites in Heraklion are regularly updated.



FORTH
FOUNDATION FOR RESEARCH AND TECHNOLOGY - HELLAS

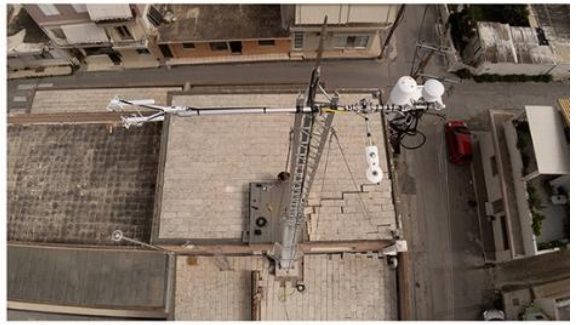
What we have now

- ✓ Instrument maintenance, data quality control, data processing and CO_2 flux estimation have been ongoing for the 2 urban Eddy Covariance sites.







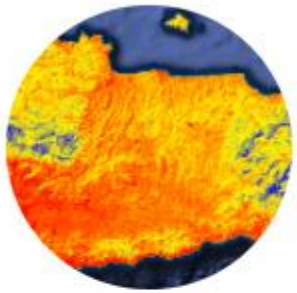



What we have now

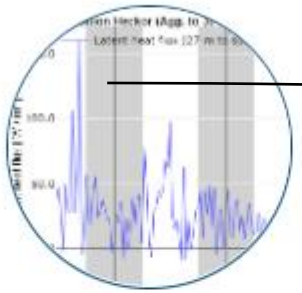
- ✓ A near real-time data processing, storage and online visualization interface (http://rslab.gr/heraklion_eddy.html) has been established on the FORTH servers.

RSLab

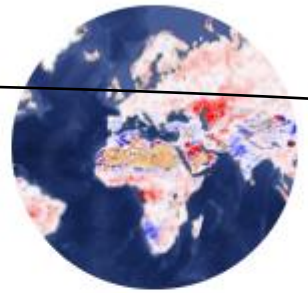
HOME PEOPLE PROJECTS PUBLICATIONS PRODUCTS EQUIPMENT CONTACT



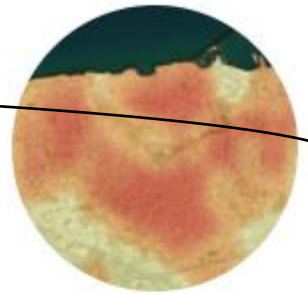
Landsat Land Surface Temperature



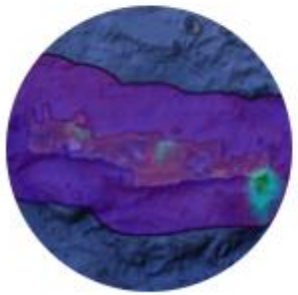
Urban Heat and CO_2 Fluxes



True Land Surface Albedo

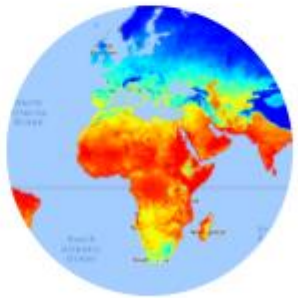


Air-Temperature and Surface Fluxes



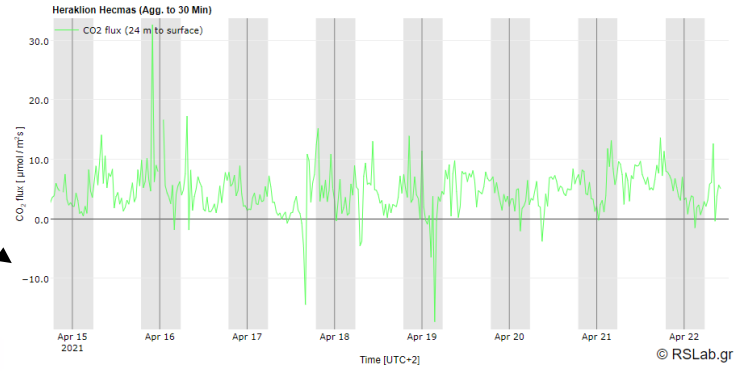
Sentinel-5P Atmospheric Viewer

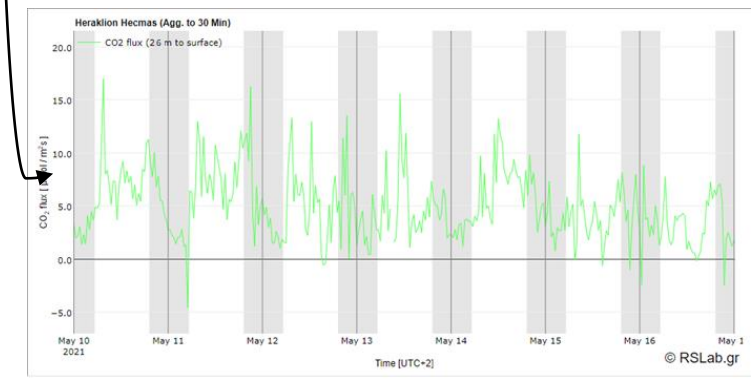
Meteorological Observations



MODIS Land Surface Temperature

SEN4RUS Information System



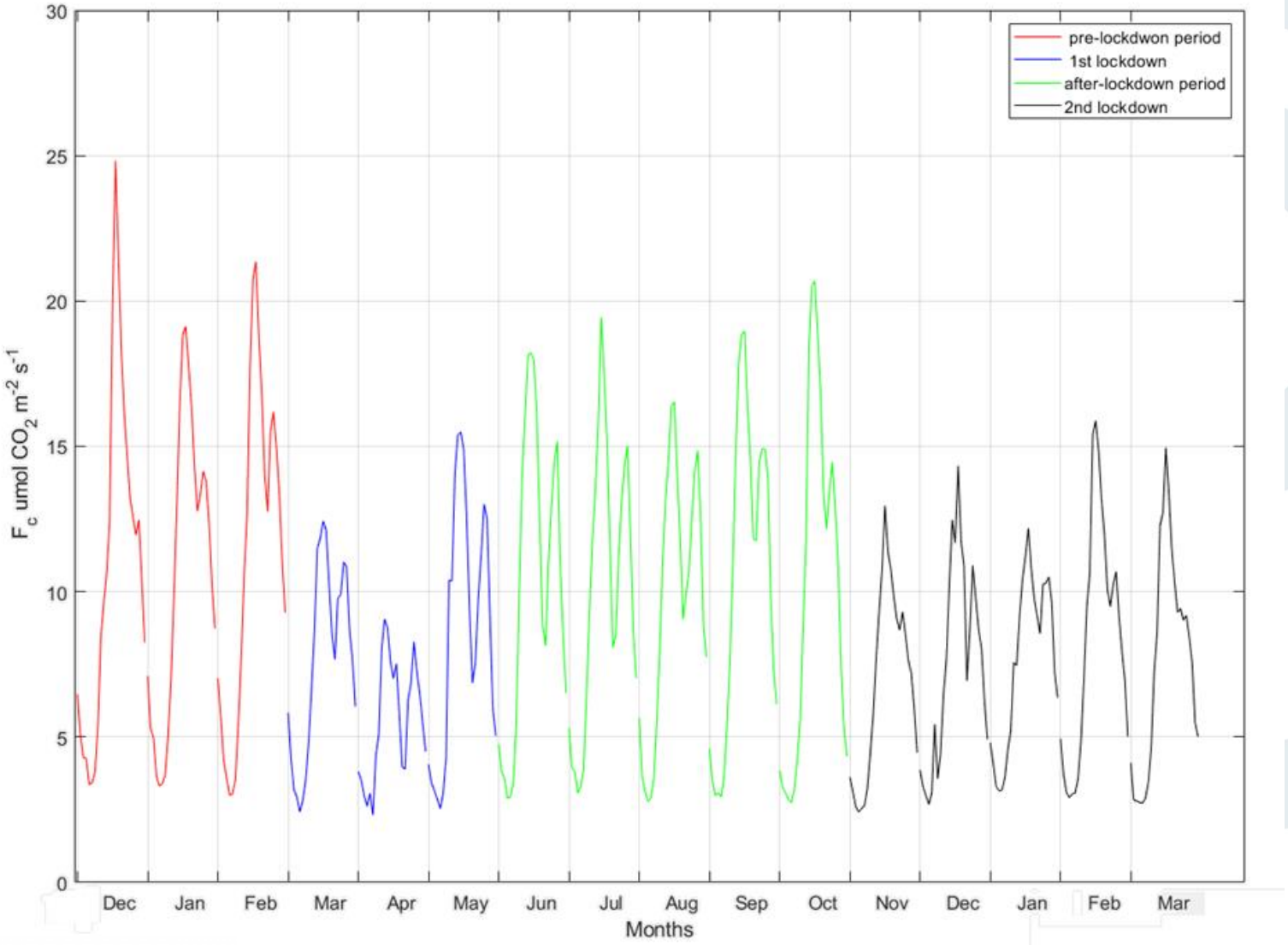


Scientific results from the Heraklion urban station

Monthly Diurnal F_c patterns Dec 2019 to Mar 2021.

Observation of different flux patterns for the period of mobility restrictions (March 2020 – April 2020 & November 2020-March 2021)

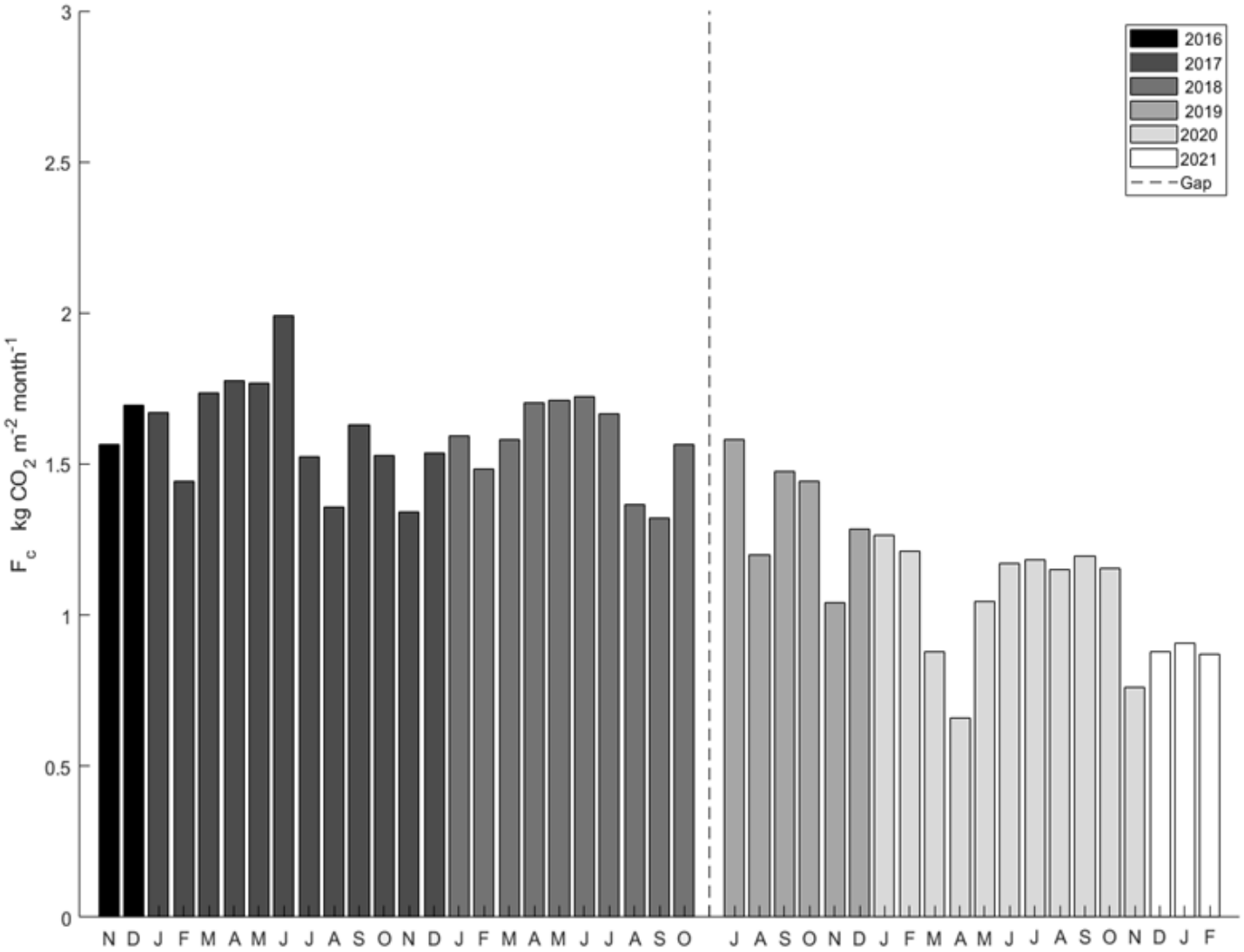
In non-lockdown periods, traffic and commuter patterns in Heraklion follow the commercial and working hours for shops and offices: 09:00-14:00 and 18:00-21:00 (local time) during weekdays.



Scientific results from the Heraklion urban station

Monthly CO_2 emissions ($kg\ m^{-2}month^{-1}$) from Heraklion city center eddy covariance flux tower (HECKOR) since November 2016.

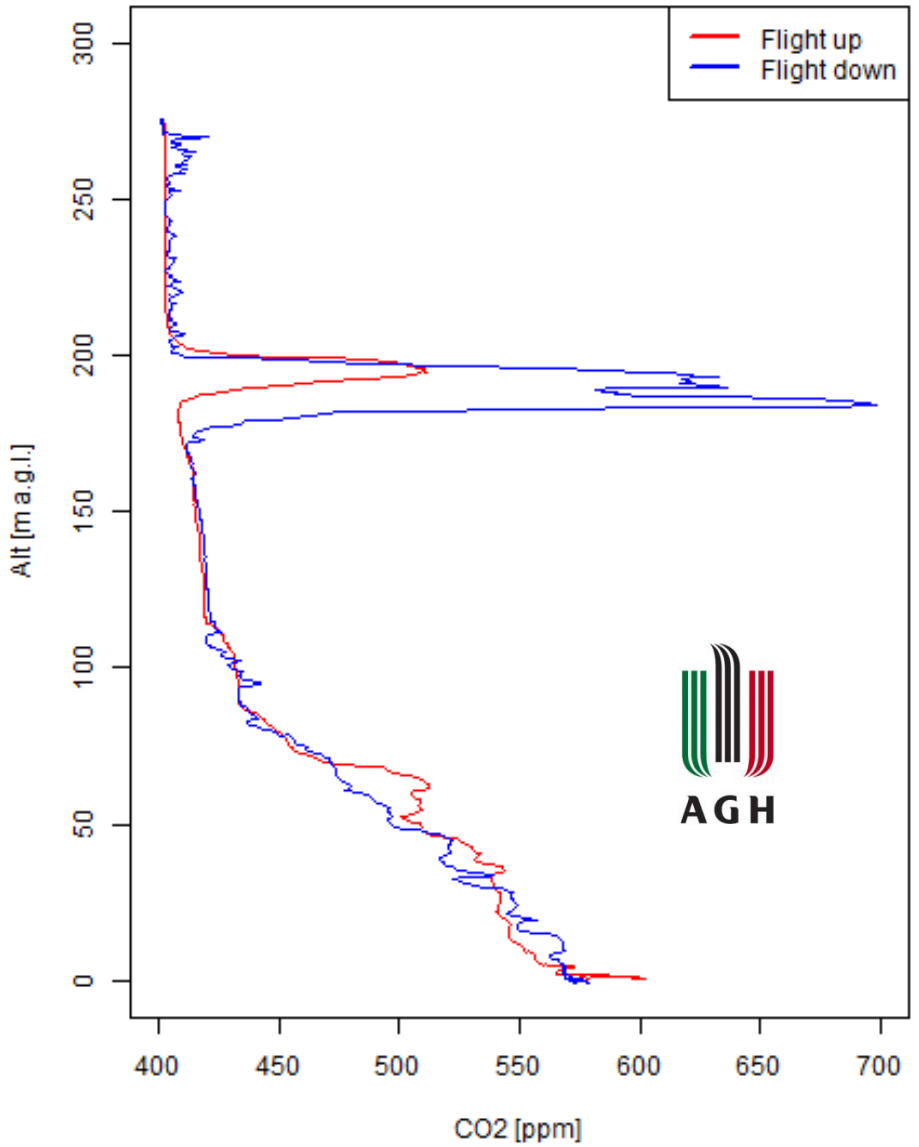
Reduced fluxes due to changes in traffic regulations applied by the municipality of Heraklion have been observed over the course of this 3-year study period.



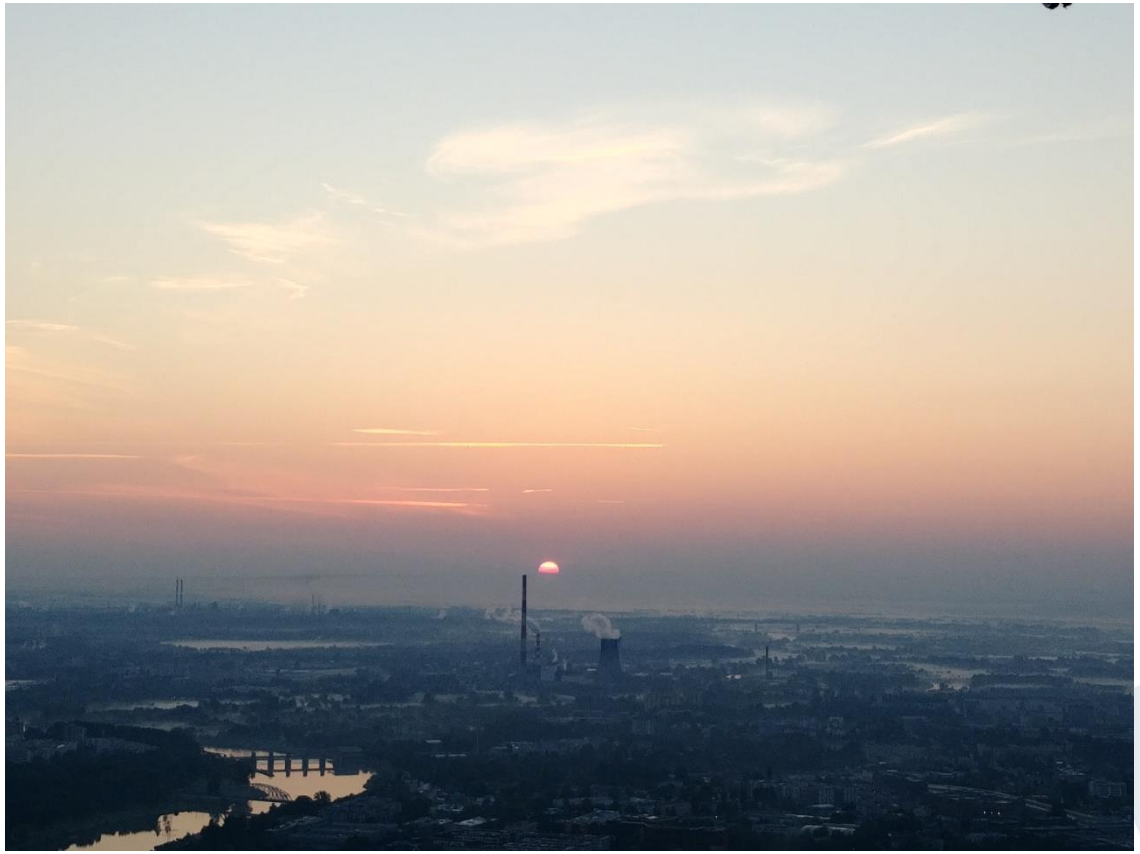
New things being developed

- Observations from urban areas, within this project as well as via the Urban Stations network and the the ICOS Cities project
- Regular profile measurements of GHGs with drones and balloons in Krakow from AGH:

Nighttime CO_2 profile from balloon measurements. There is a pronounced inversion at around 90 m agl with a significant drop in CO_2 concentrations relative to the surface values. Above at ca. 200 m agl a large CO_2 plume is visible: wind direction analysis indicates that the source may be a power plant located around 15 km from the measurement site.



Profiles



Sun rising above the inversion. In the middle the top of two power plant stacks are below the inversion: emissions are being trapped in the PBL.
Photo taken during balloon measurement campaign on 8 September 2021.

Sun rising above a very low inversion. Far away in the top right corner the same stacks are visible – the emissions from the lower one are trapped below the inversion but the higher one reaches above this time, allowing smoke to disperse vertically.
The photo was taken during balloon measurement campaign on 26th October 2021.

Profiles

Drone profile measurements. Attached to the drone is a tube leading to the analyzer and taking live measurements during the ascent and descent. In the background an EC tower is visible on top of the university building.

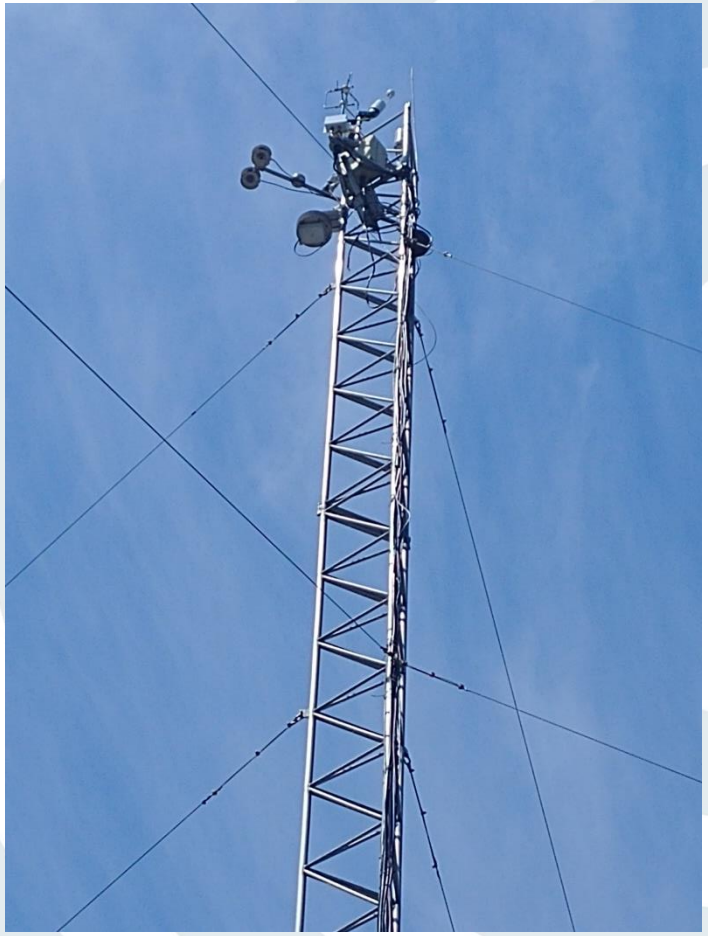
AGH

June balloon measurement campaign from below.

These data from these measurement campaigns, including radiocarbon measurements, form the basis of the Krakow city-level simulations in WP4.

EC

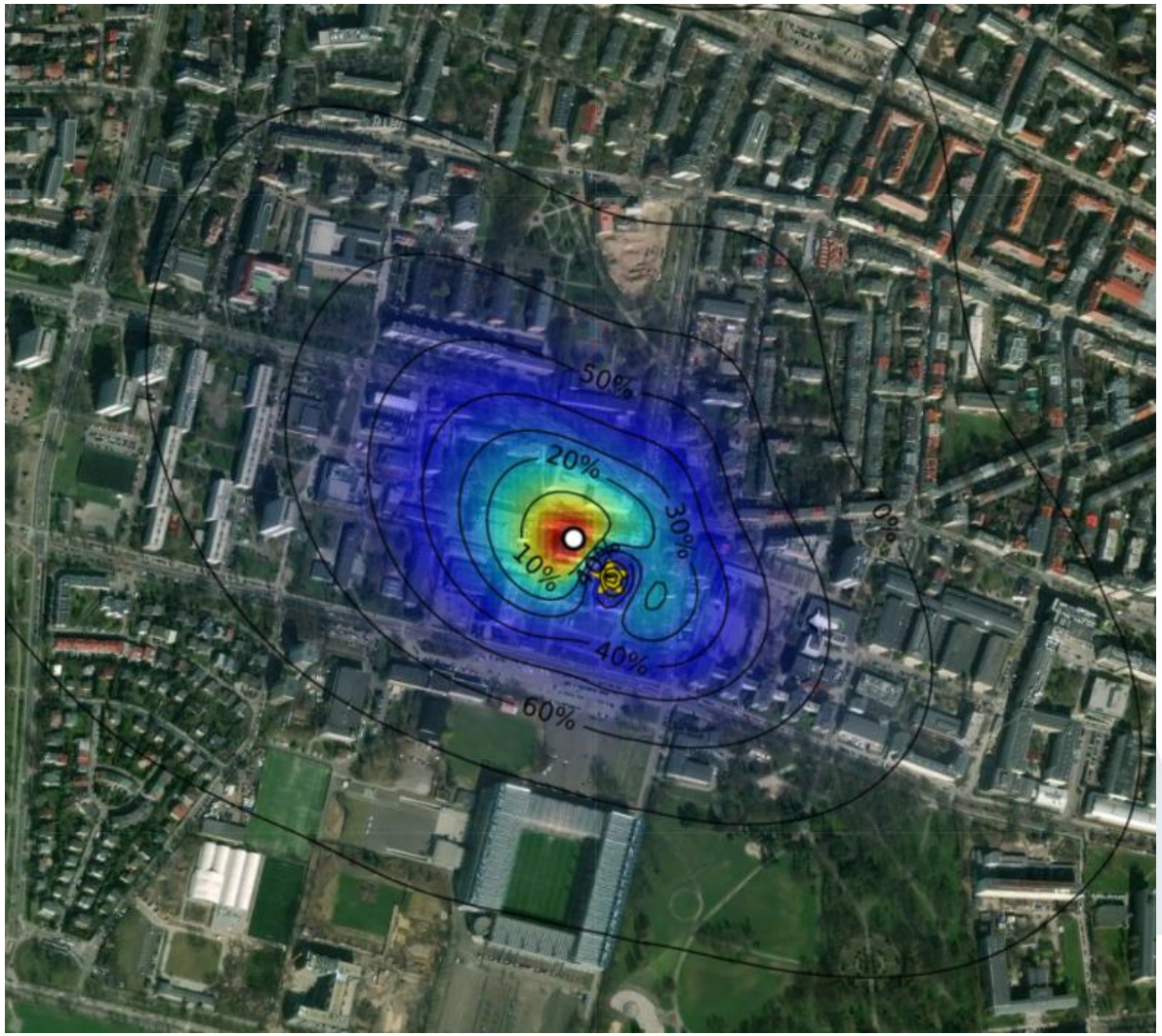
Drone photo of the flux tower and its surroundings. Measurement height is 40 m. Different CO_2 sources or sinks are nearby: residential and university campus buidings (both high- and low-rise), streets with traffic, and green spaces.



Top of the tower close-up.

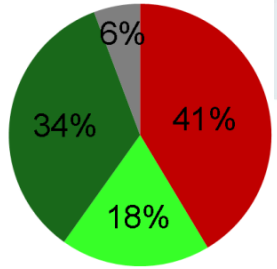
AGH

EC



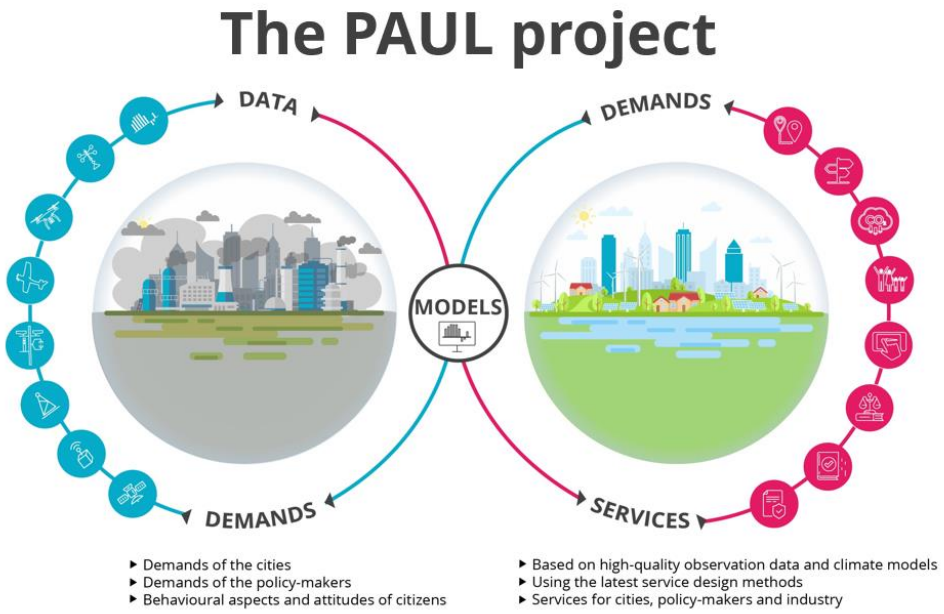
Landuse distribution:

- Built/invested
- Lowrise green
- Highrise green
- Road



Satellite image of the tower surroundings along with averaged CO_2 flux footprint. The star-shaped marker indicates the tower location.
Depending on the wind directon, flux source area may be located in the regions with prevailing green space, traffic, or invested land use type.

Synergy with ICOS Cities (PAUL) project



Project started October 2021

Goals of ICOS Cities:

To implement incremental elements of a pilot city observatory in large (Paris), medium (Munich) and small (Zurich) city.

To design the observatory with requirements of GHG monitoring in multiple European cities for validation of Paris Agreement and raise awareness

To increase our understanding of specific needs of GHG assessment in urban environment.

Expected impact

- Support inventories by direct reference observations
- Contribute to good practises of urban observations (WMO/IG^{3}IS)
- Scientific and technical progress
- Services to the cities

https://www.icos-cp.eu/projects/icos-cities-project/icos-cities-talks

Progress on milestones and deliverables

- MS19: „organization of a workshop (Milestone 19) to discuss the metadata, data quality, and timeliness requirements of additional observations with the broader community”
- Originally planned for around M18, in the context of WMO/I3GIS
- Instead it has been proposed as a dedicated session at the 2022 ICOS Science Conference: *Requirements and provision of in-situ and auxiliary observations for GHG modelling,* co-convened by Elena Saltikoff (ICOS-ERIC), Ute Karstens (Lund/ICOS-CP) and Julia Marshall (DLR)
- Plan is to follow up post-meeting with dedicated discussions of relevant topics that arise

Save the date: **13-15th September, 2022**
Live at TivoliVredenburg (Utrecht, the Netherlands), and virtually worldwide
Overarching theme: “*Tracking progress to carbon neutrality*”
https://www.icos-cp.eu/event/1078

Overview of WP7 deliverables (1/1)

Title	Due	Status
D7.1: Book of in-situ requirements V1	M12	Drafted, but will only reflect the requirements that have been reported…
D7.2: Book of in-situ requirements V2	M24	Not yet begun
D7.3 Book of in-situ requirements V3	M36	Not yet begun
D7.4 Report on data providers and long-term data availability V1	M15	Started collecting information about non-ICOS data providers e.g. from Africa and the Arctic; in communication with progress of D7.1, on which it relies heavily
D7.5 Report on data providers and long-term data availability V2	M33	Not yet begun
D7.6 Gap analysis report of the current in situ measurement capacity	M30	Relies upon mismatch between the needs defined in D7.1 and the availability described in D7.4 – not yet concretely started. Link to modelling assessments in Task 5.5 is in place.

Overview of WP7 deliverables (1/2)

Title	Due	Status
D7.7 Requirements for data streams from additional tracers and new instrumentation	M24	Not started in earnest, the documentation of the workshop (Milestone 19) will feed into this, as well as the previous reports on in-situ data needs and availability
D7.8 Demonstrator of the updated data pipeline	M36	Will be based on the specifications of D7.7, following the input from the reports on in-situ data needs
D7.9 Dataset of atmospheric observations from Krakow, Poland	M33	In progress: 7 of the 12 planned campaigns have been carried out, analysis is ongoing
D7.10 New measurement and modelling methodologies for high resolution monitoring of urban anthropogenic and biogenic CO2 fluxes	M33	Measurements are ongoing, discussion of metadata needs and interpretation is also linked to discussions with and organization of (European) network of urban eddy flux towers, coordinated by Dario Papale (CMCC)

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THANK YOU

This presentation reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

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