



Long-term measurements of greenhouse and reactive gases, and aerosols, at Saclay/SIRTA observatory in the Ile de France Region as part of ICOS and ACTRIS

Laura BOUILLON

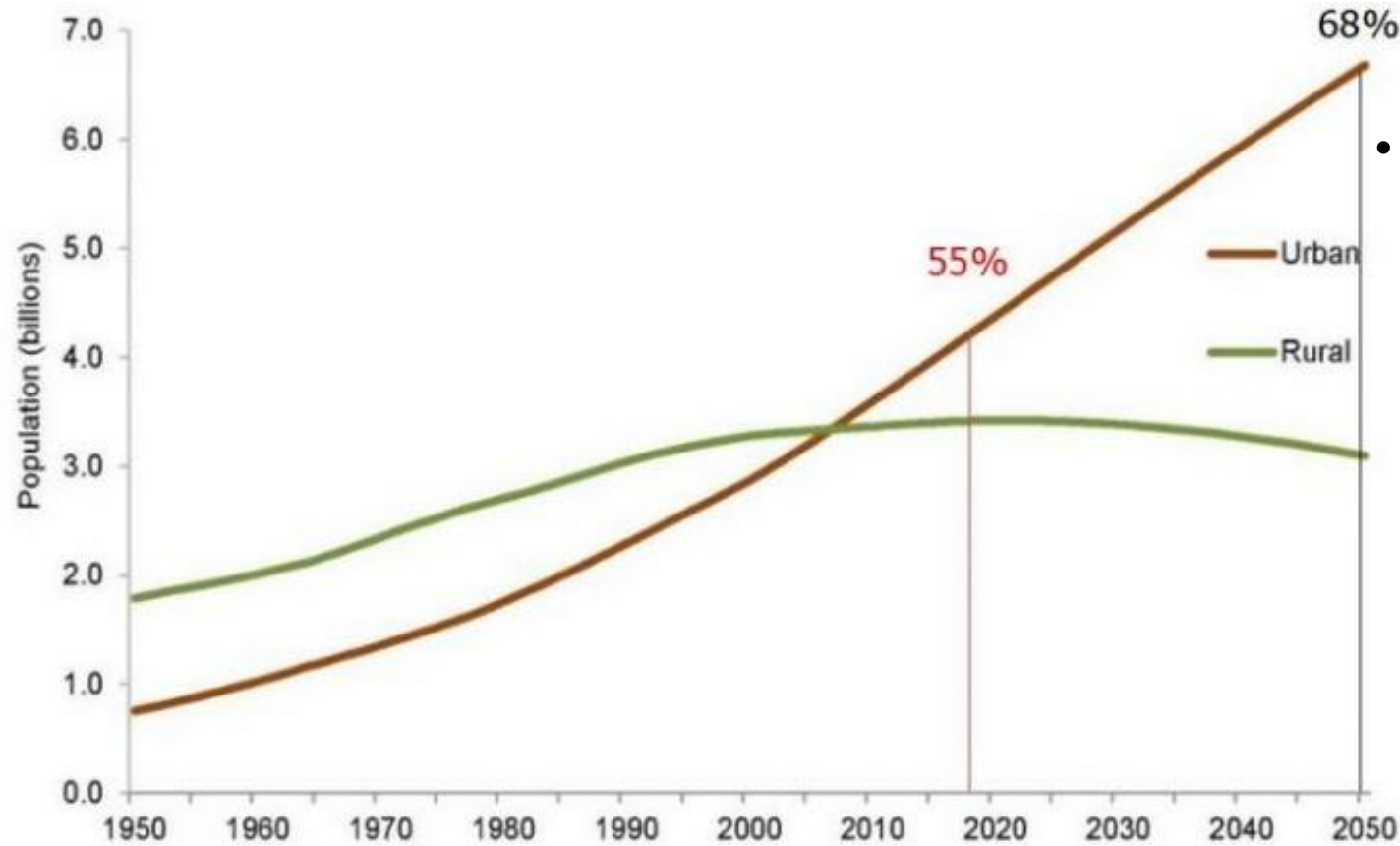
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² Airparif

Context

- 7 million deaths worldwide linked to air pollution, mainly in urban areas



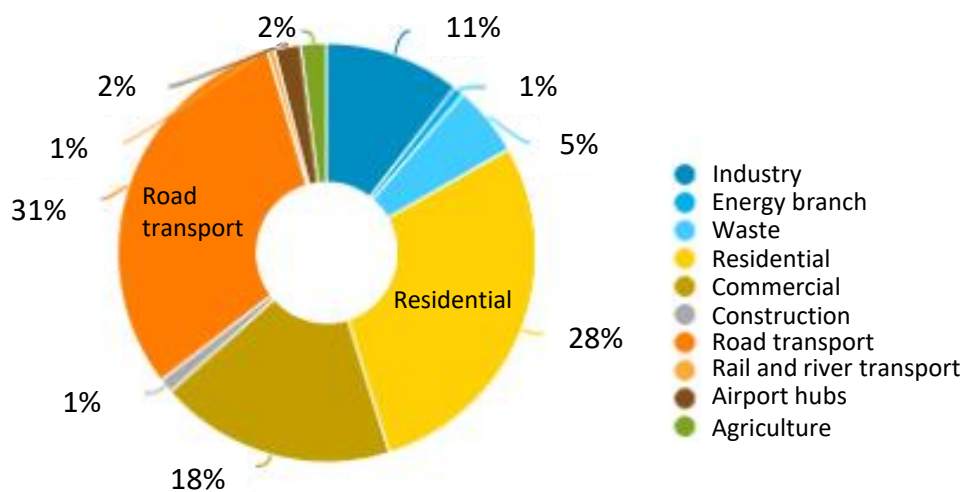
- Urban planning projections: the growth of cities will increase → 2.5 billion more people by 2050
 - More health problems linked to deteriorating air quality
 - If no restriction → ↗ CO₂ emission

Source : World Urbanization Prospects 2018, ONU, 2018

Context

- $\frac{3}{4}$ of anthropogenic CO₂ emissions linked to cities
- Main emission sectors in the Ile-De-France (IDF) → road and residential

Breakdown by sector of direct and indirect GHGs in the IDF



Adapt from Bilan des Emissions Atmosphériques en Ile-de-France, Airparif, 2021



<https://www.regions-departements-france.fr/region-ile-de-france.html>

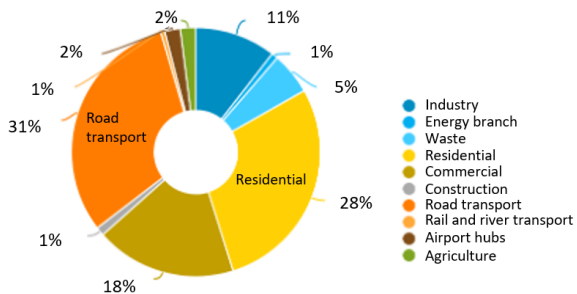
Context

- ¾ of anthropogenic CO₂ emissions linked to cities
- Main emission sectors in the Ile-De-France (IDF) → road and residential

• **Challenge** : Finding joint solutions to reduce CO₂ and improve air quality

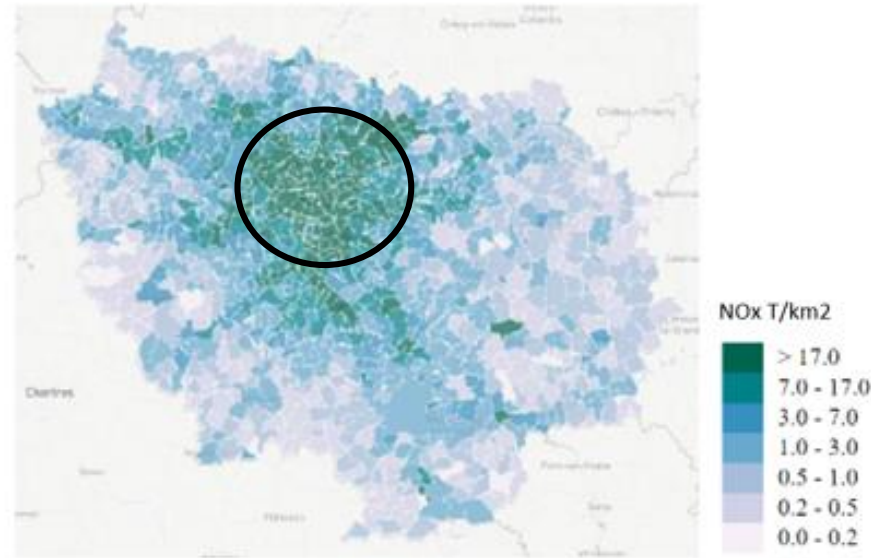
- Co-emission of atmospheric pollutants and greenhouse gases (GHG)

Breakdown by sector of direct and indirect GHGs in the IDF

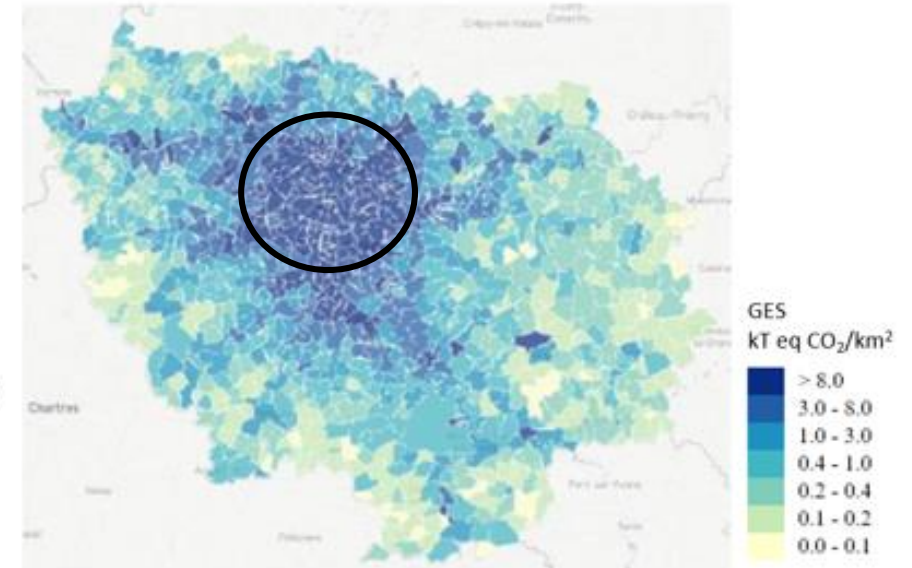


Adapt from Bilan des Emissions Atmosphériques en Ile-de-France, Airparif, 2021

Spatial distribution of NO_x in the IDF

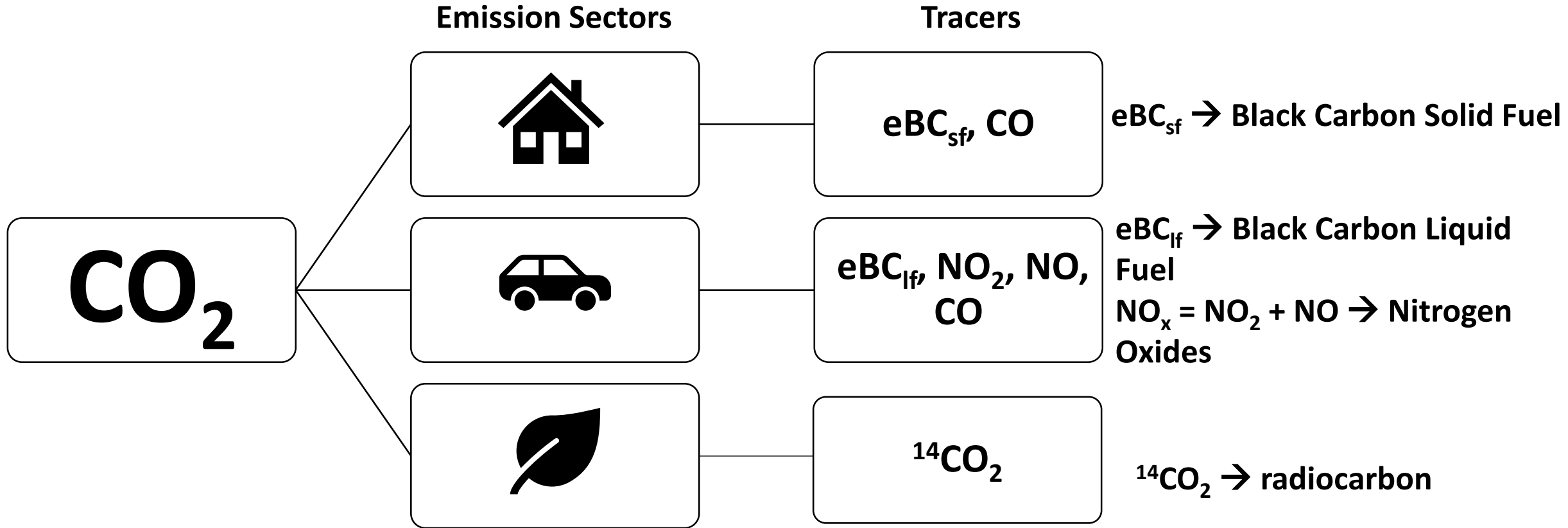


Spatial distribution of GHGs in the IDF



Source : Bilan des Emissions Atmosphérique en Ile-de-France, Airparif, 2021

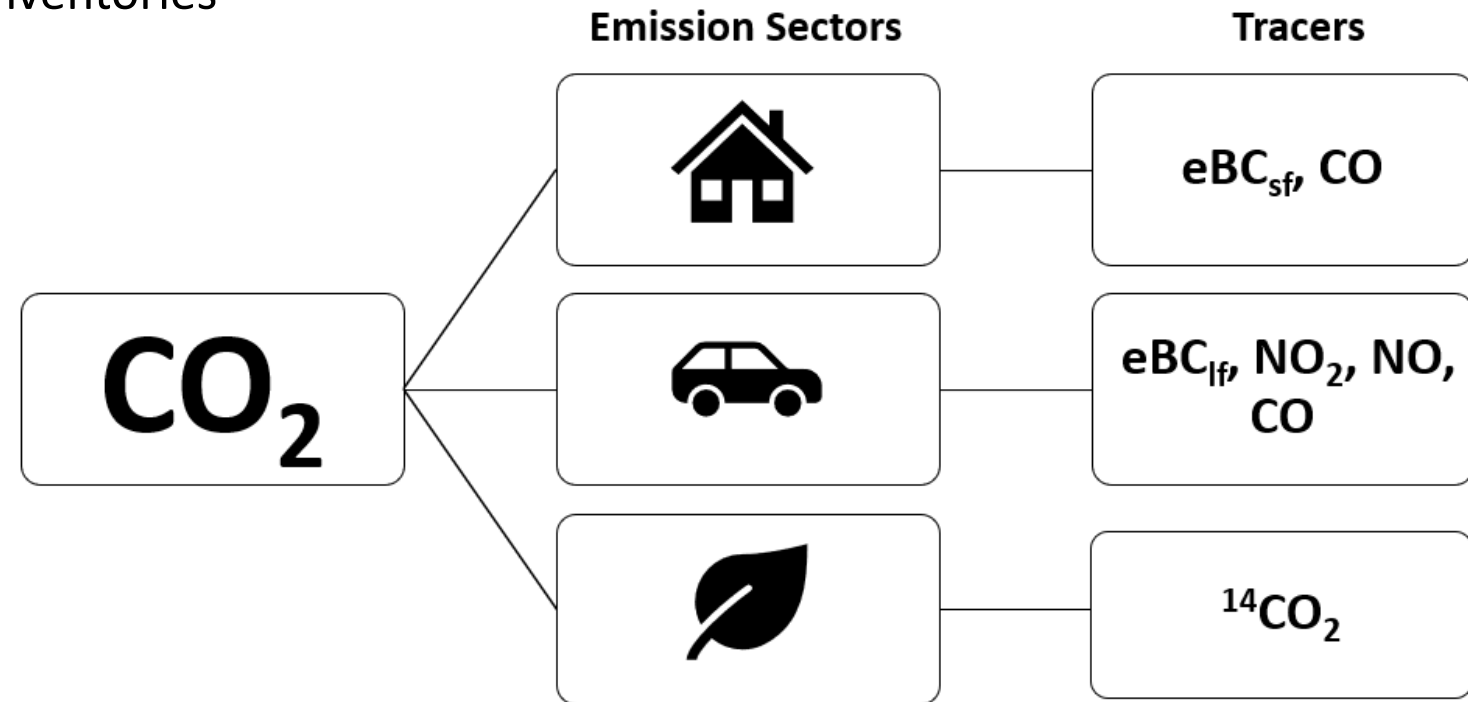
Sources



Objective of the study

Objective : • Using the multi-component atmospheric approach method to characterize the sources of CO₂ emissions in Paris

- Compare results with emission inventories

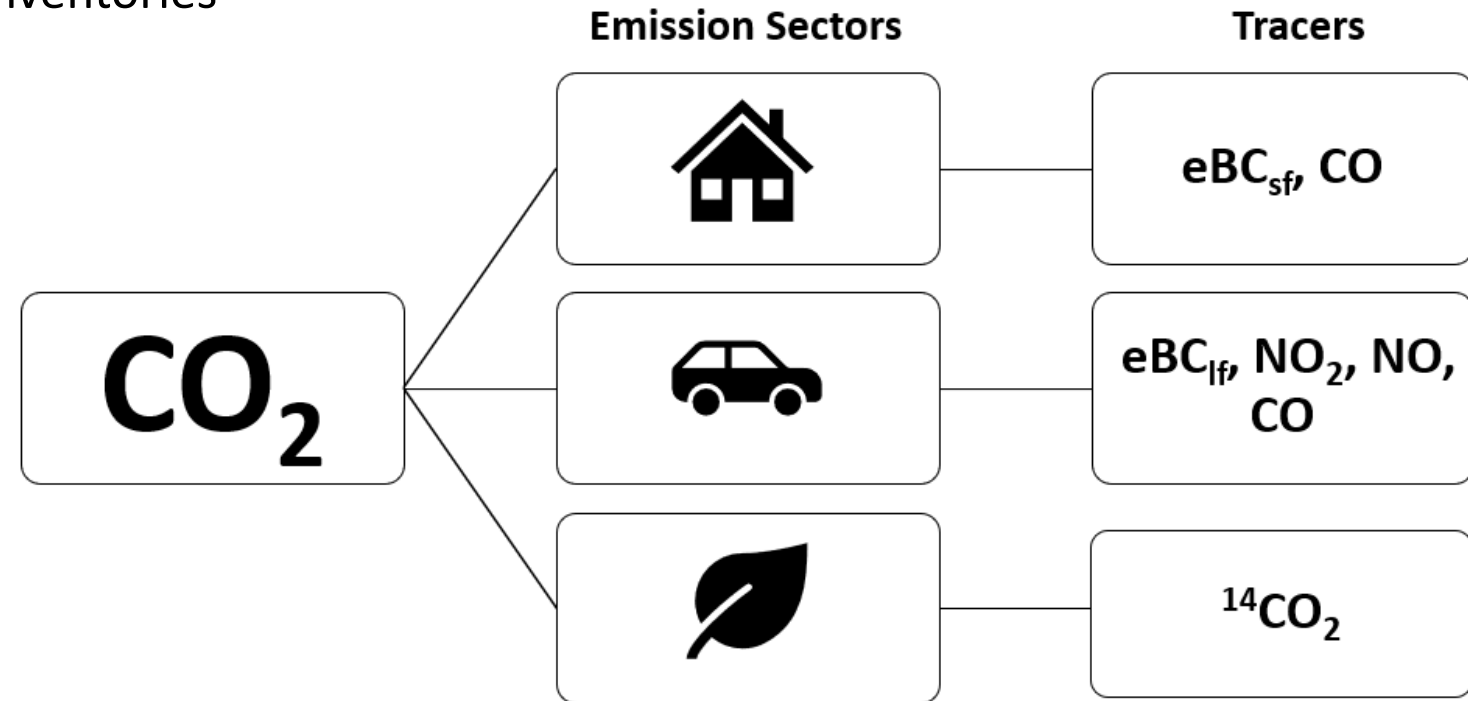


Objective of the study

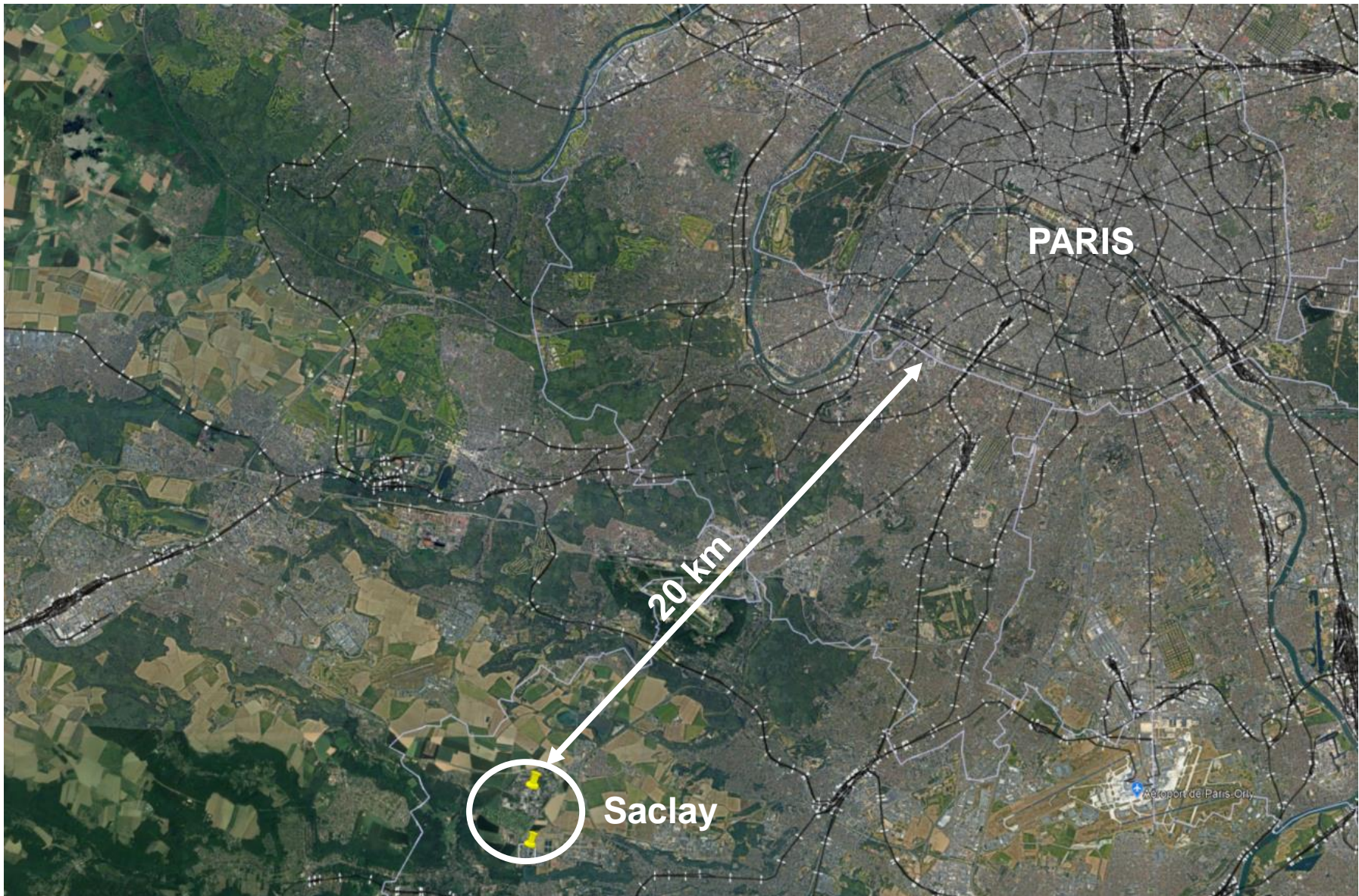
Objective : • Using the multi-component atmospheric approach method to characterize the sources of CO₂ emissions in Paris

- Compare results with emission inventories

Outline : Measurement Station
Time Series
Seasonal Cycle
Diurnal Cycle by Season
Ratio



Measurement Station



Measurement Station

ICOS | Integrated Carbon Observation System



CO₂ and CO

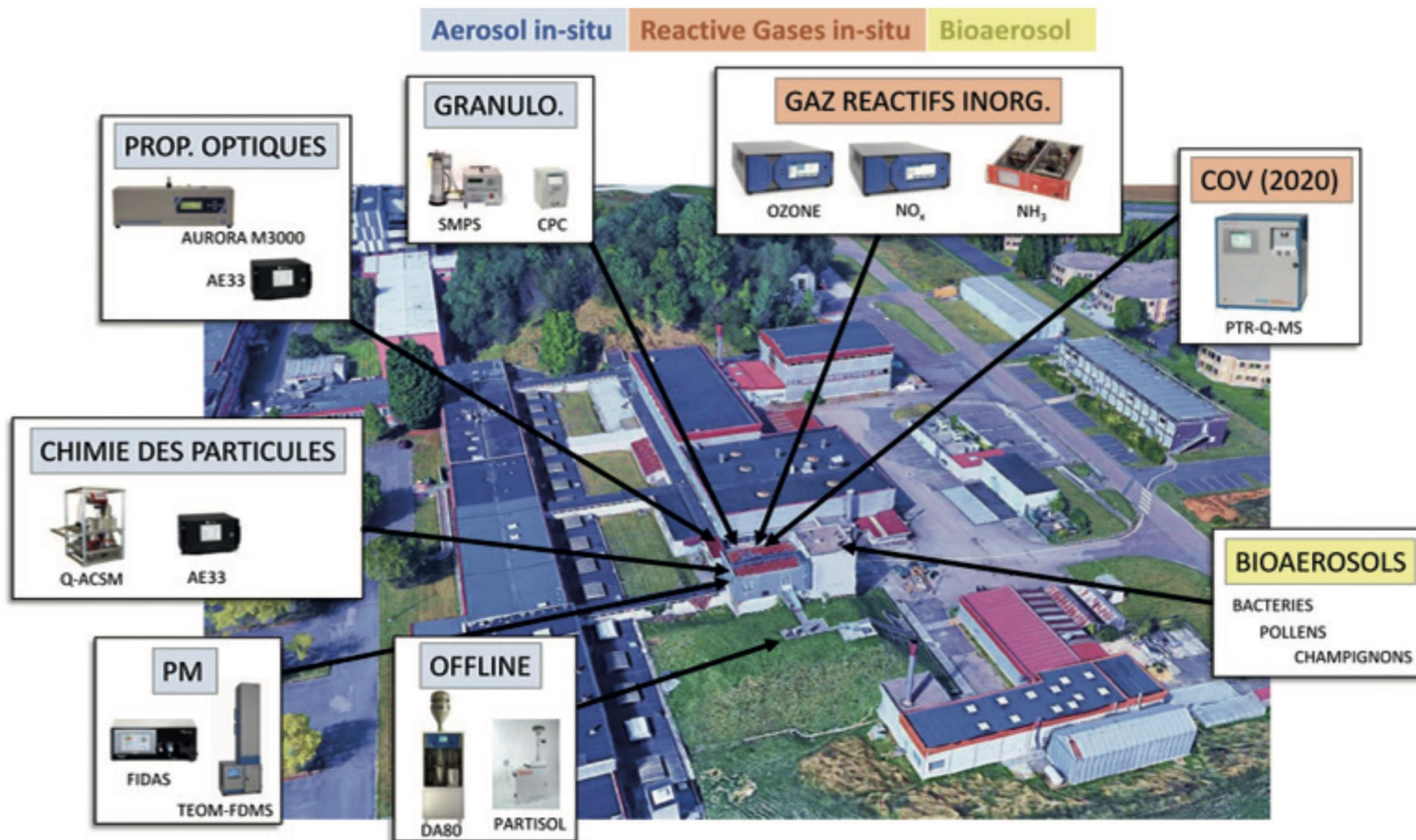


**NO_x and BC
(eBCsf, eBClf)**

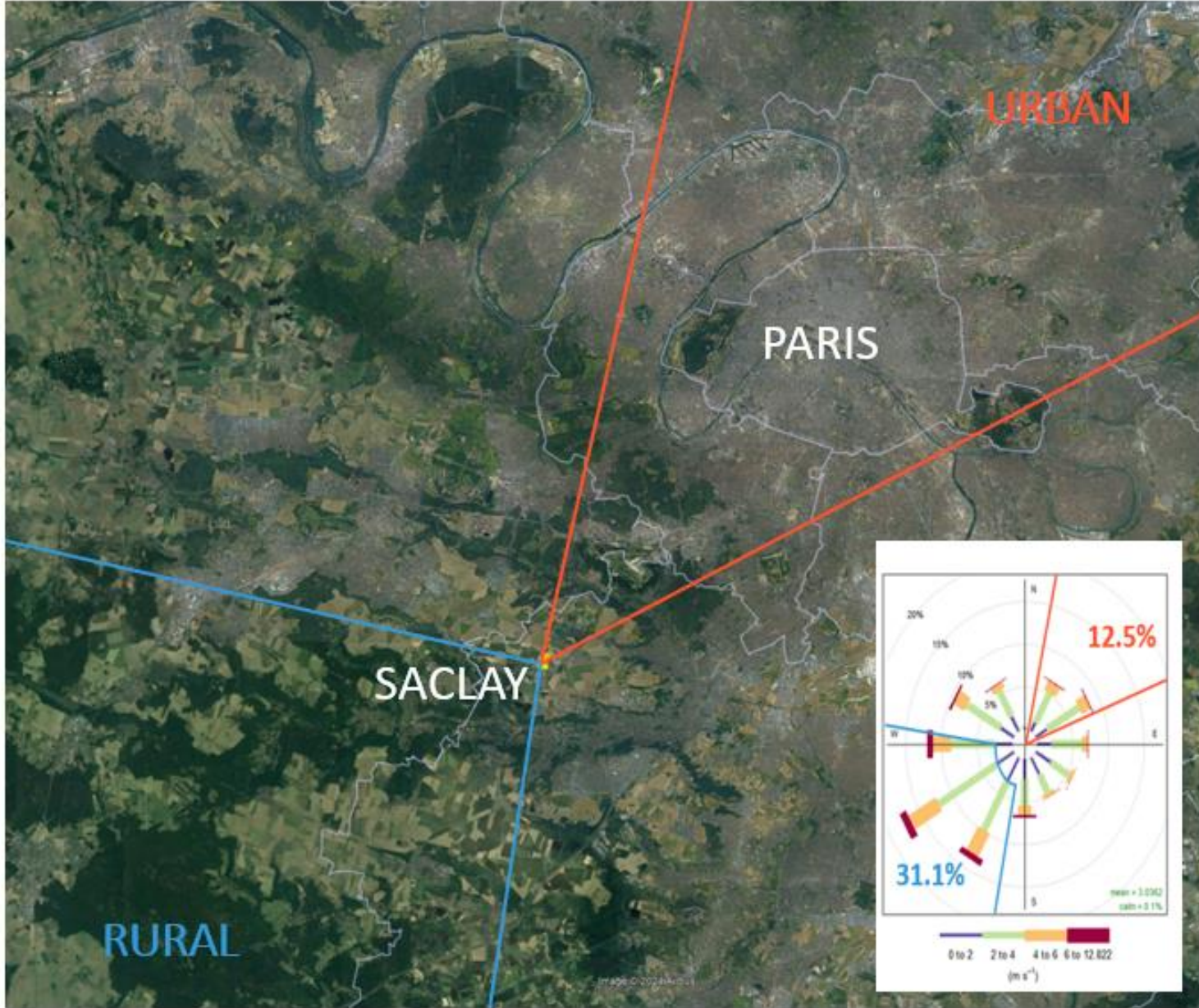


**Meteo and Heights
boundary layers**

SIRTA Zone 5



Measurement Station



ICOS | Integrated Carbon Observation System



ICOS tower
CO₂ and CO

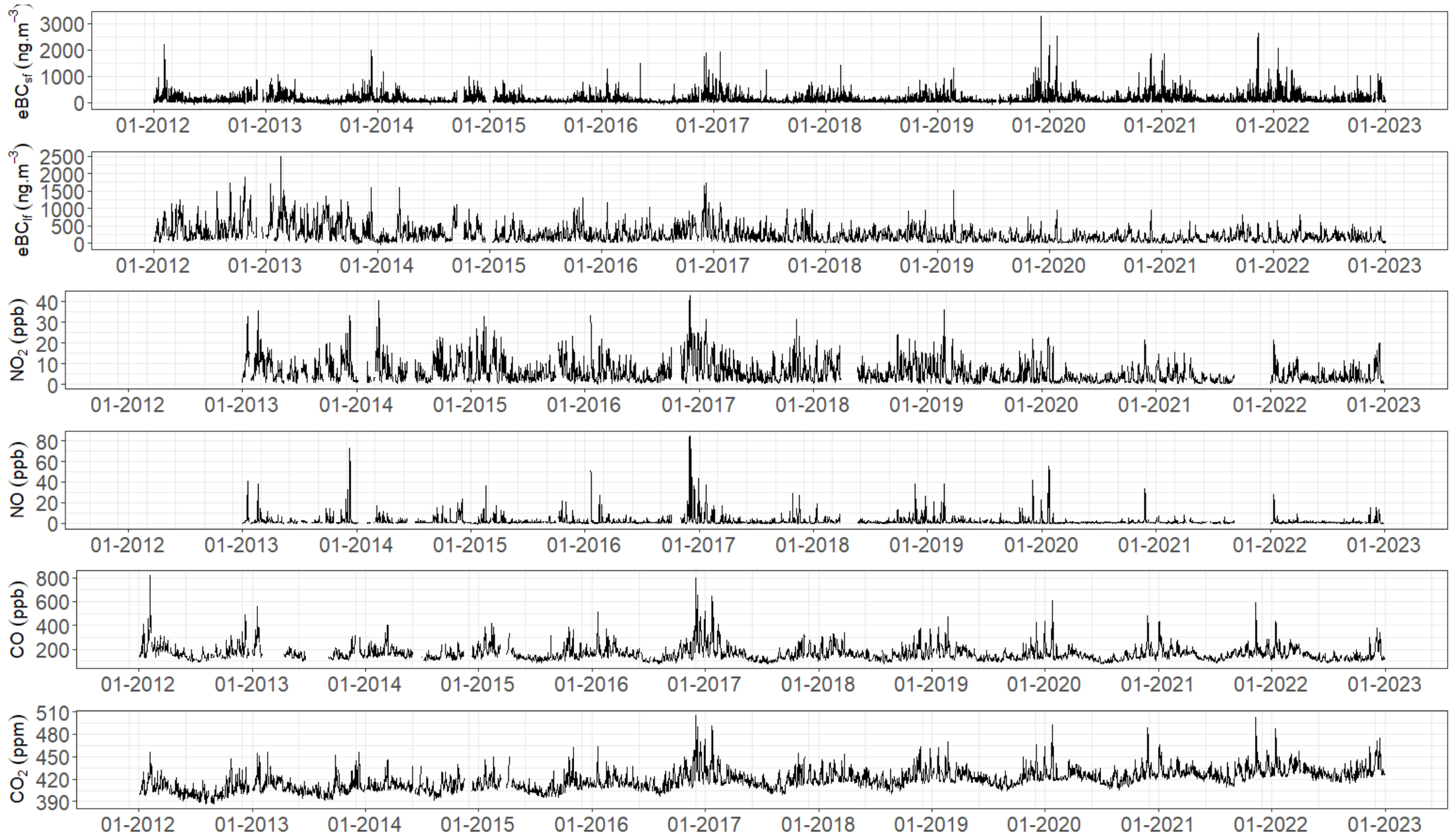


SIRTA site
NO_x and BC
(eBCsf, eBClf)

- Measurements classified in two sectors :
 - **Urban (URB)** sector (**12.5%**)
 - **Rural (RUR)** sector (**31.1%**)

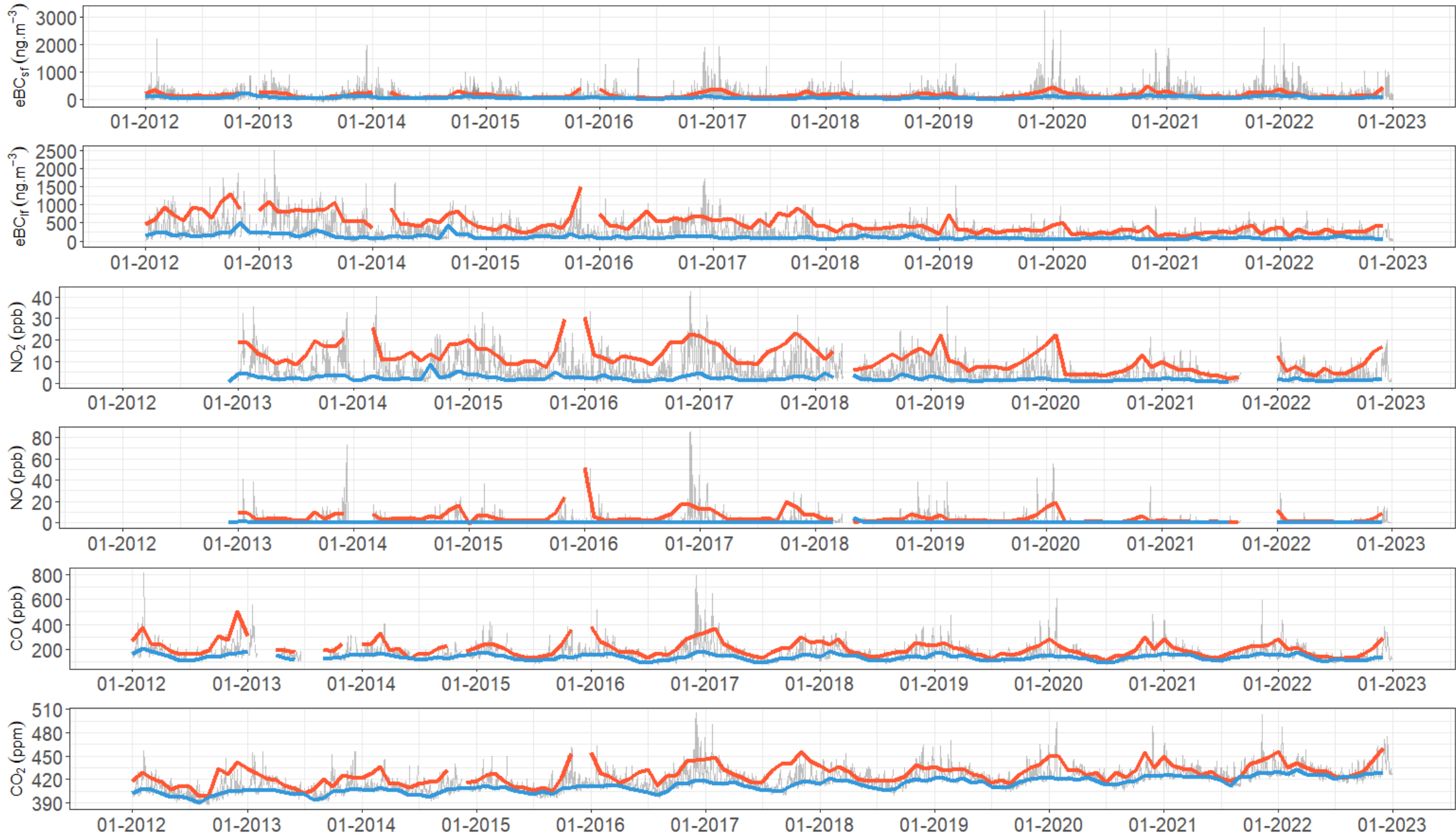
URB – **RUR** = URBAN offset

Time Series 2012-2022



Time Series 2012-2022

RURAL
URBAN

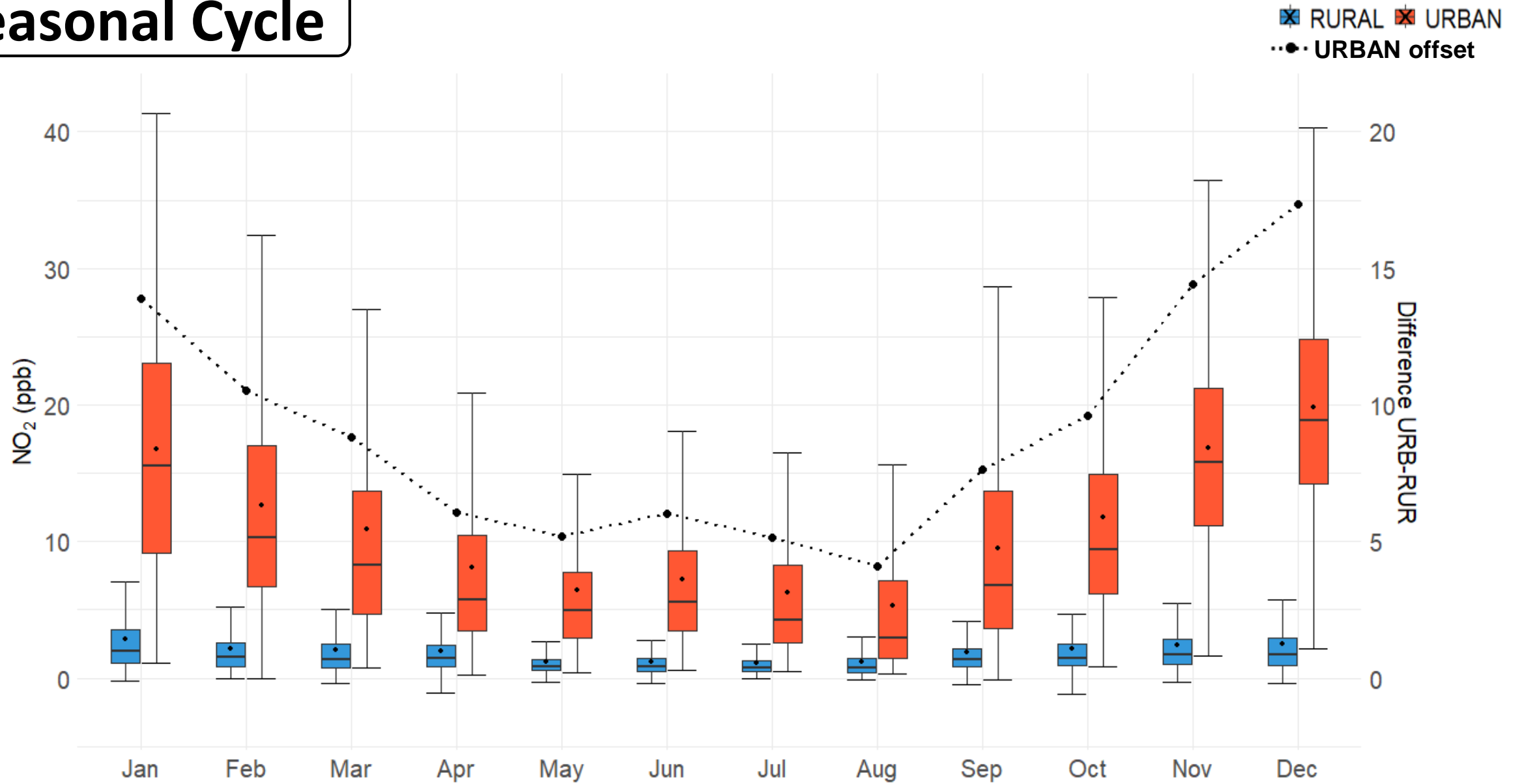


Time Series 2012-2022

Winter 2016-2017 RURAL
Covid 1st Lockdown URBAN



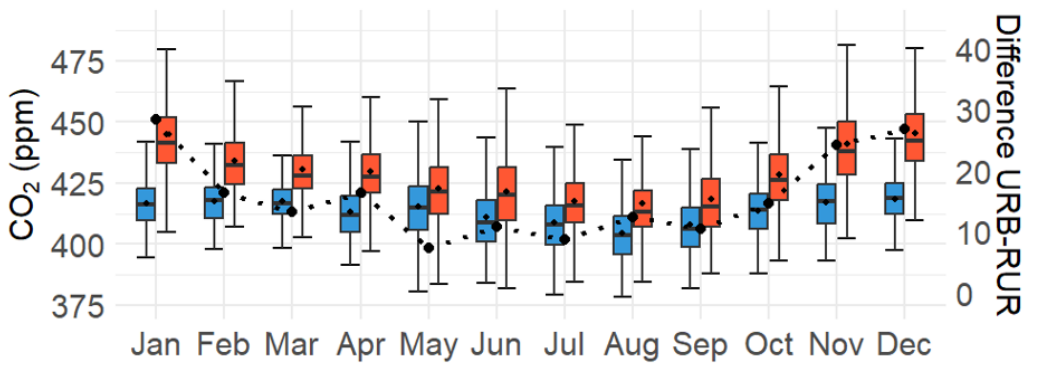
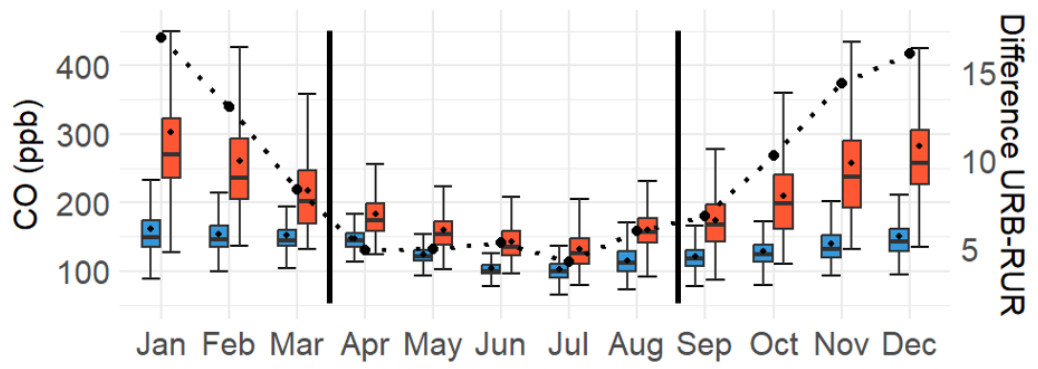
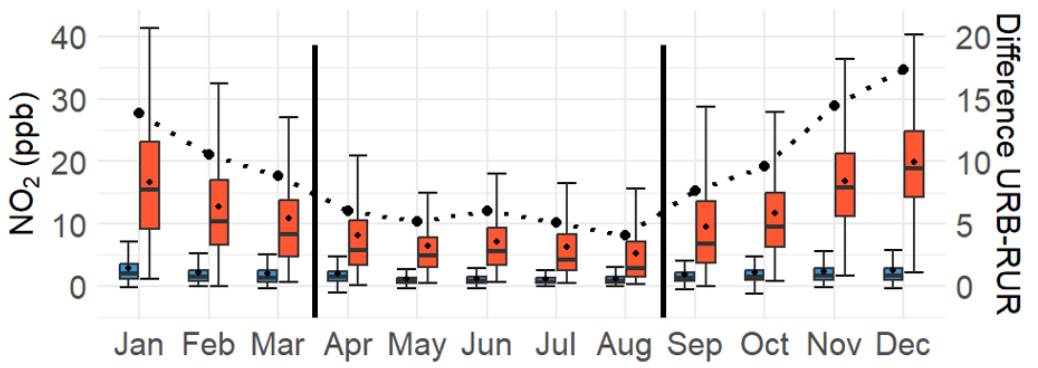
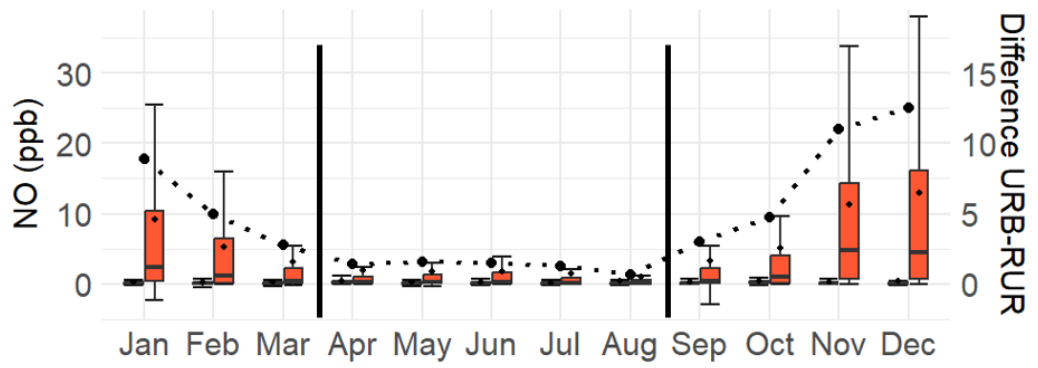
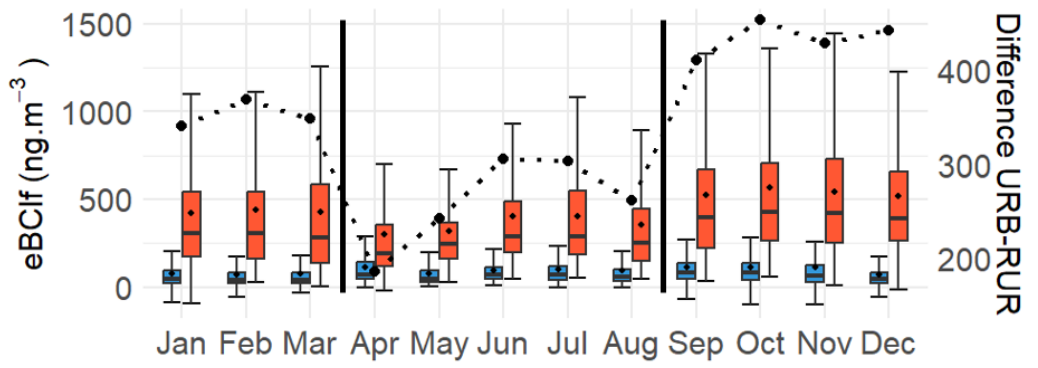
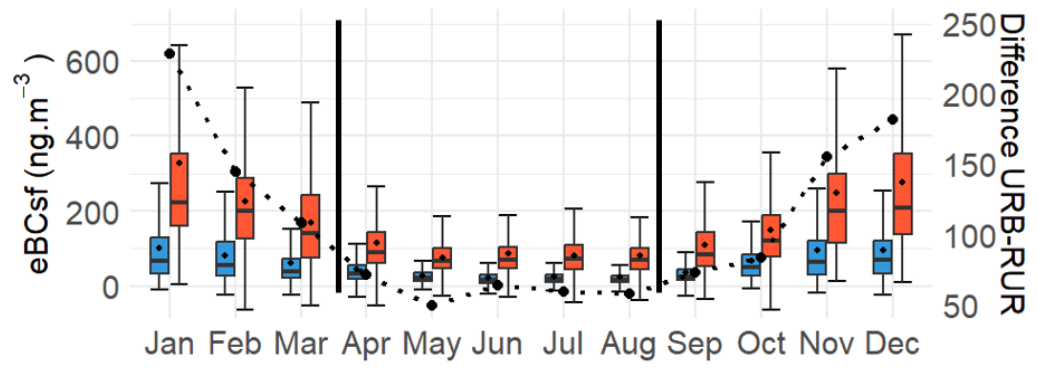
Seasonal Cycle



- Higher concentration in URB sector

Seasonal Cycle

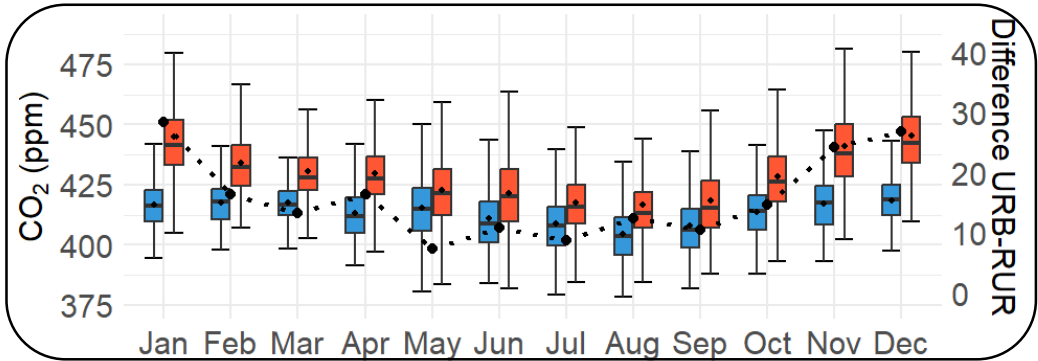
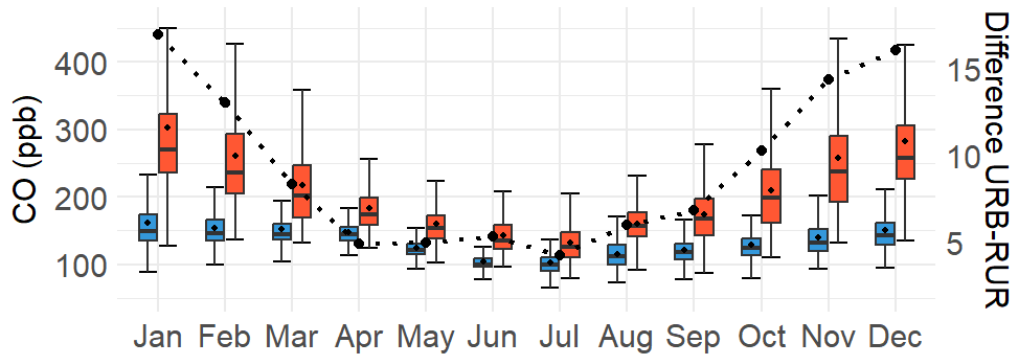
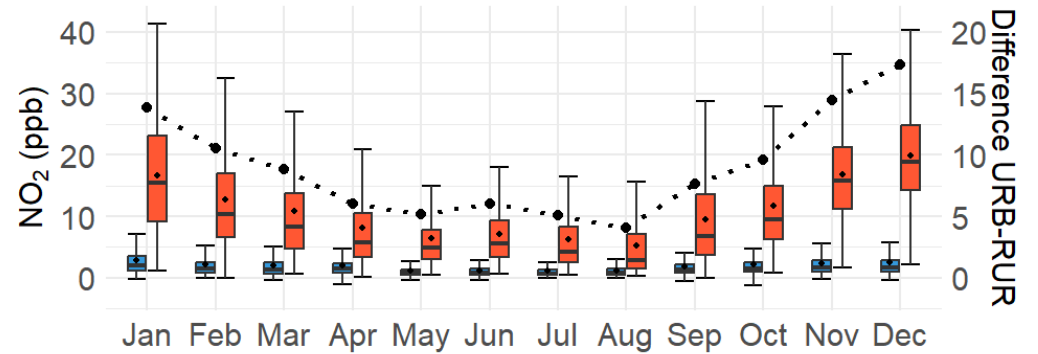
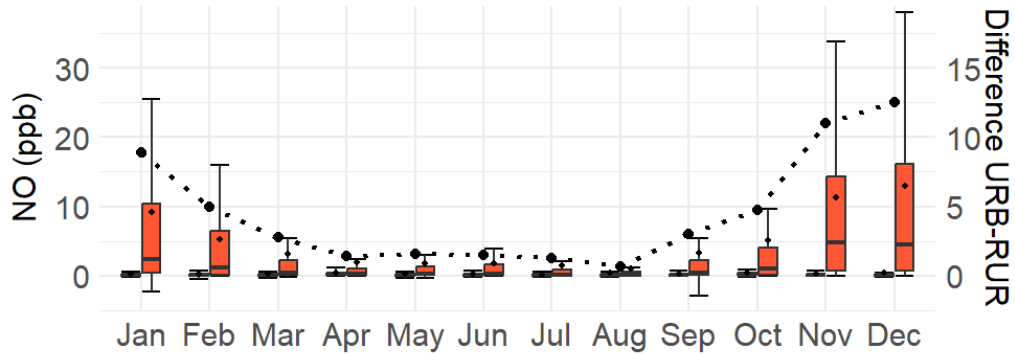
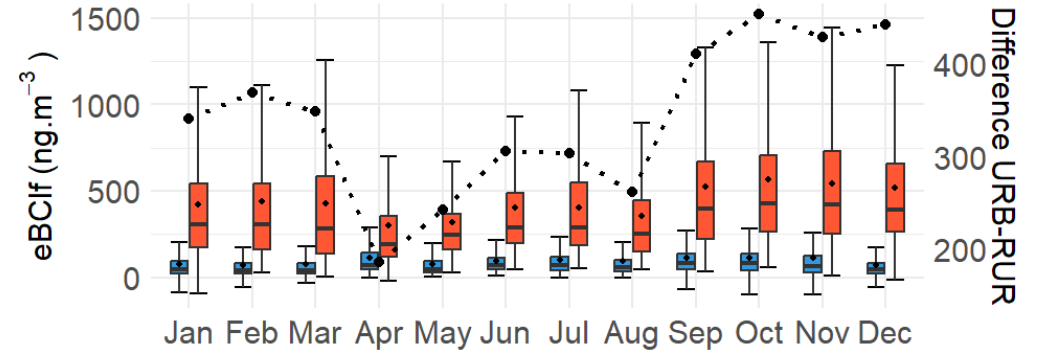
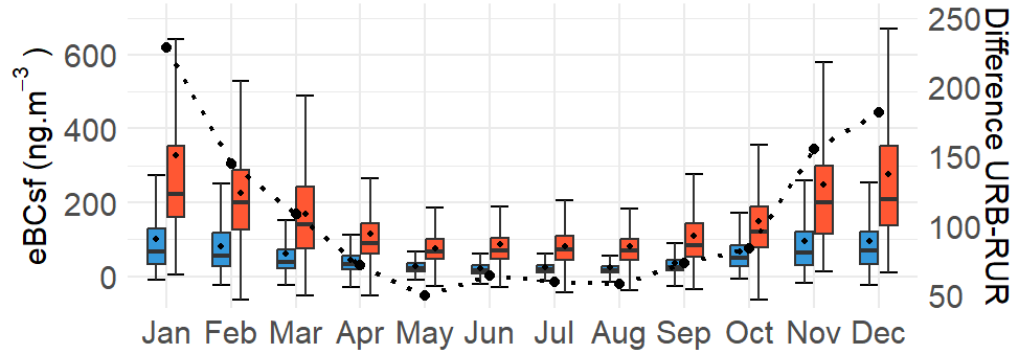
RURAL URBAN
URBAN offset



- Higher concentration in **URB** sector
- Concentrations of tracers decrease between April and August

Seasonal Cycle

■ RURAL ■ URBAN
● Difference URB-RUR

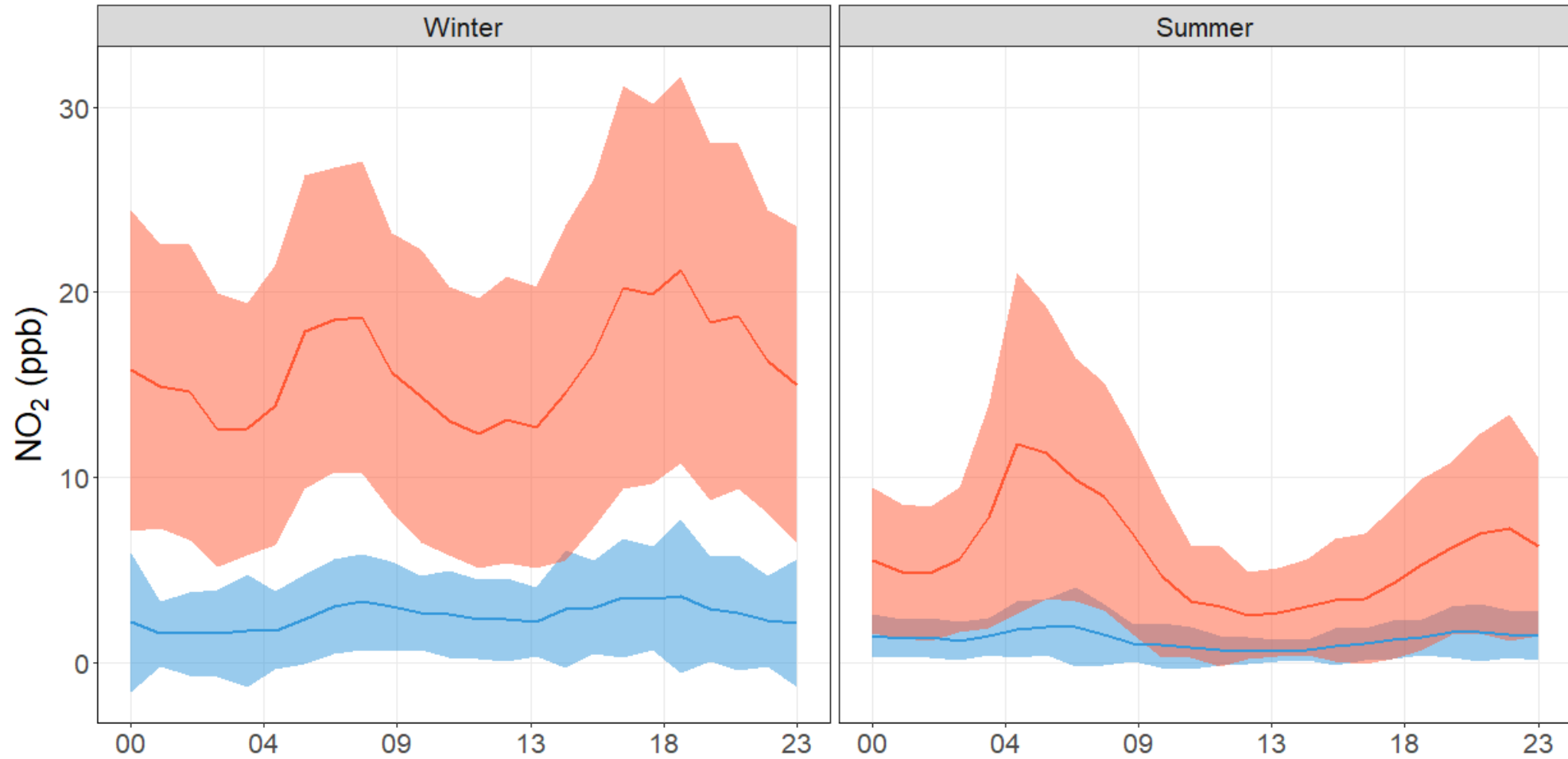


- Higher concentration in **URB** sector
- Concentrations of tracers decrease between April and August

- Concentrations of CO₂ increase in two sectors between April and August with a greater biogenic impact

Diurnal Cycle

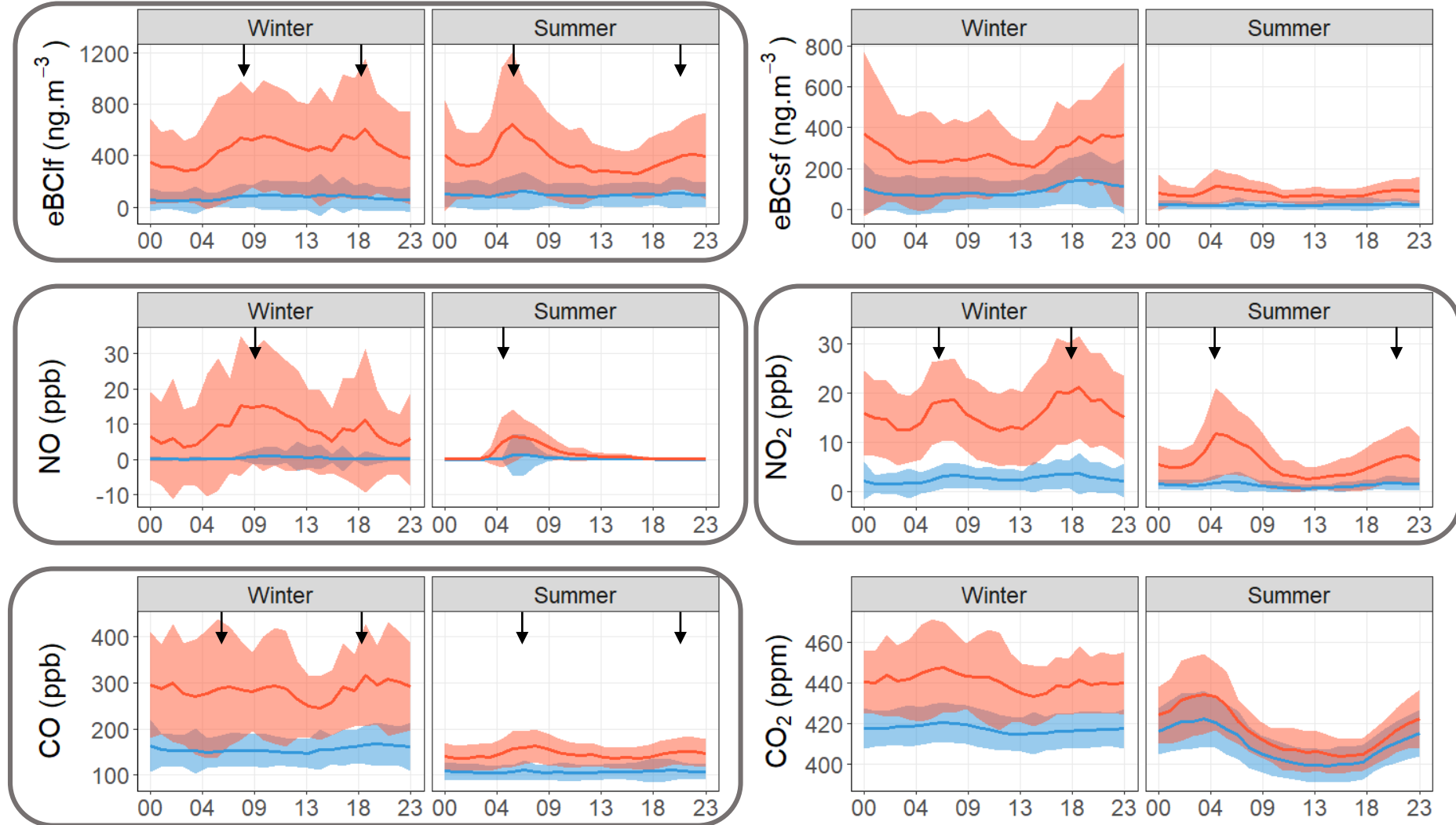
RUR URB



- Higher concentrations in winter for **RUR** and **URB** sectors

Diurnal Cycle

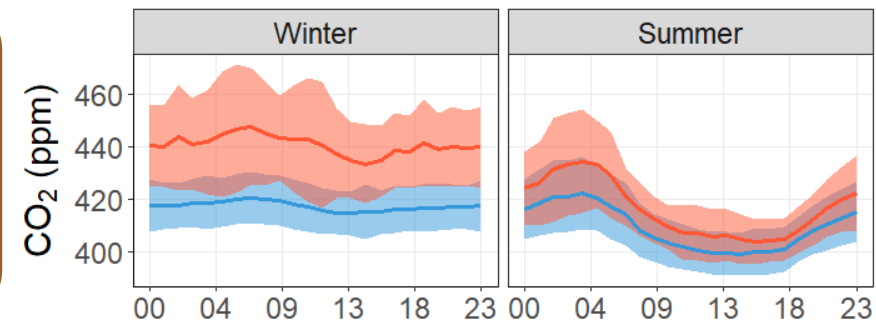
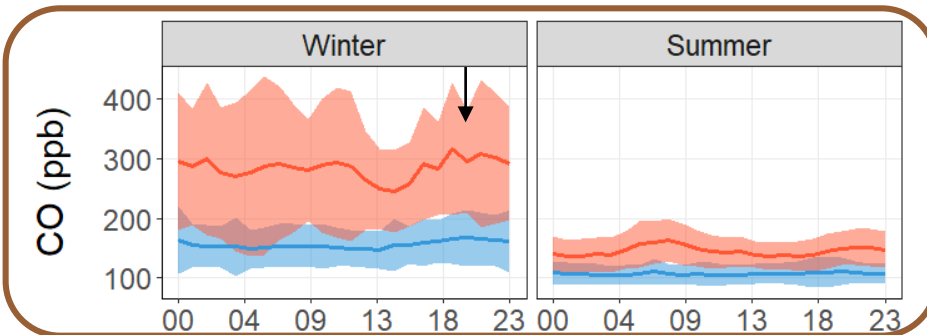
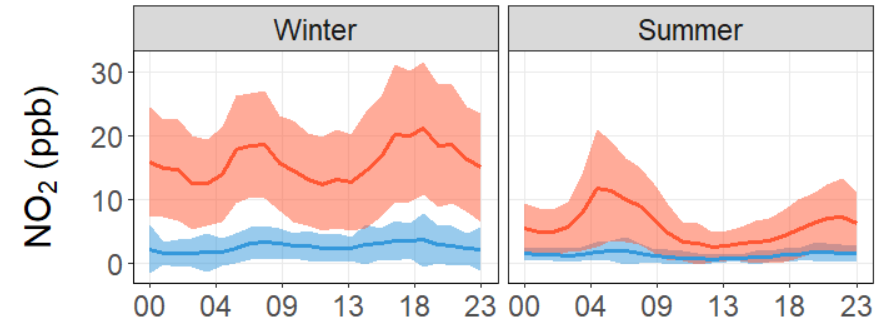
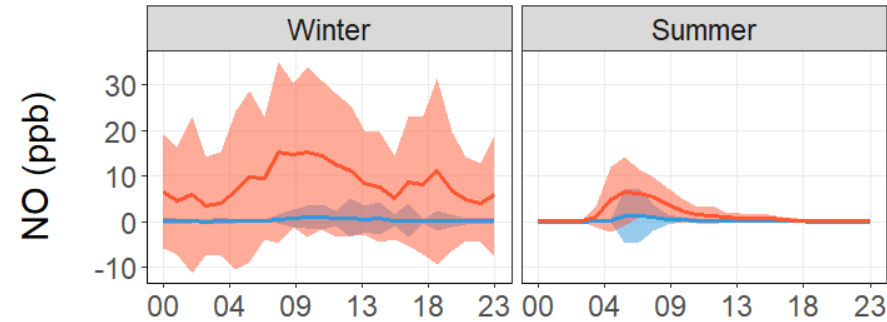
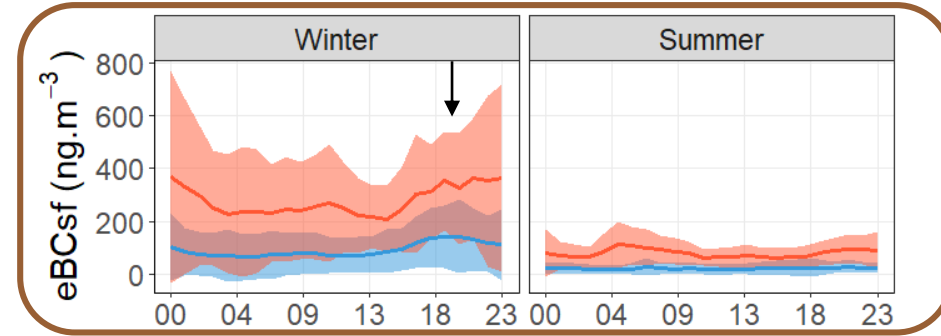
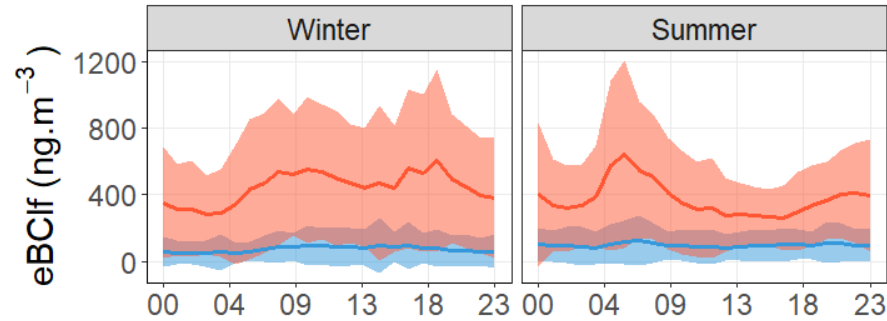
RUR URB



- For road traffic tracers, concentrations increase at peak times

Diurnal Cycle

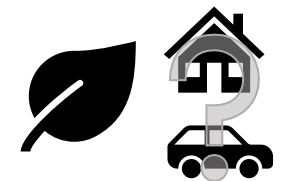
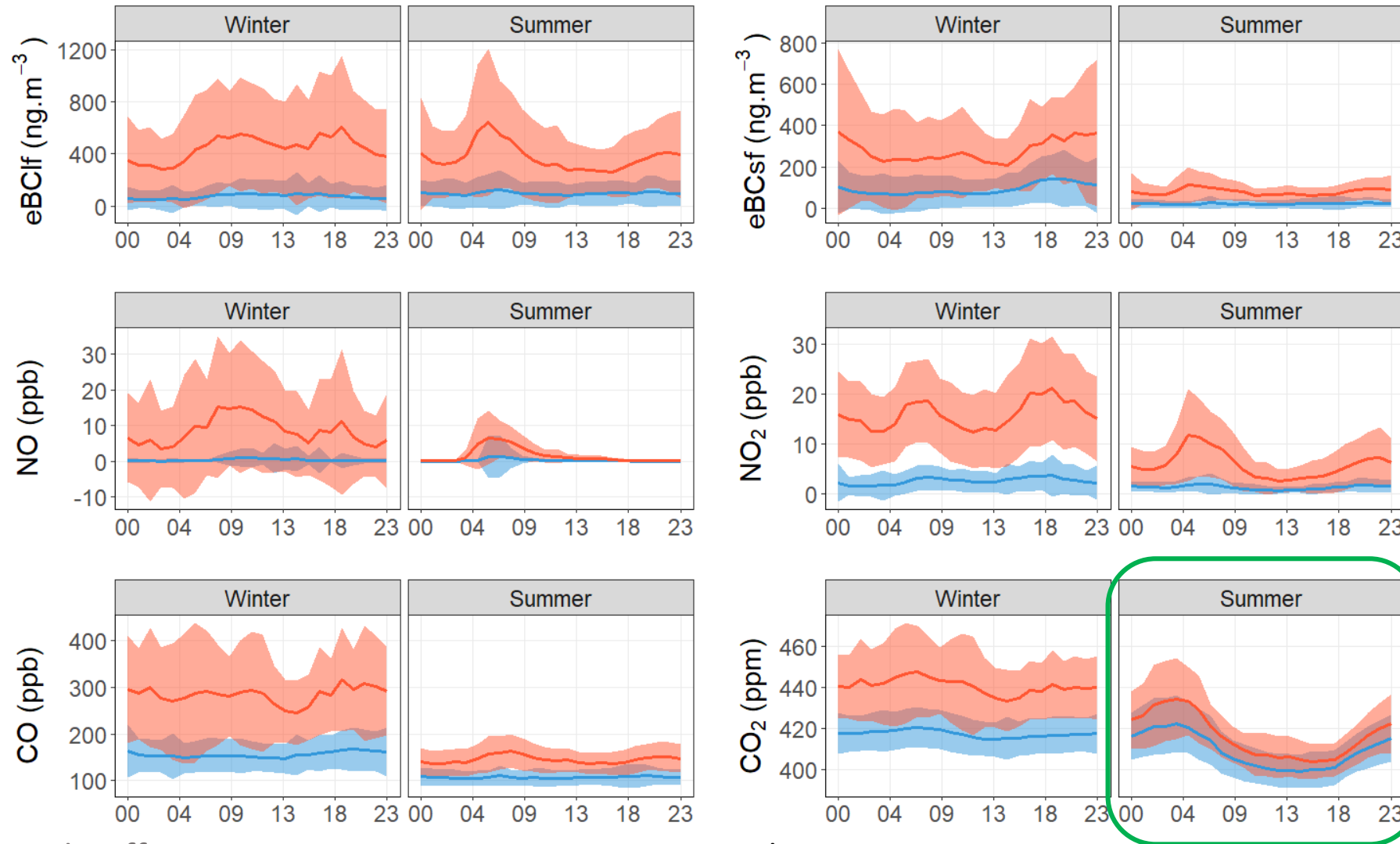
RUR URB



- For road traffic tracers, concentrations increase at peak times
- For residential tracers, concentrations increase more at the end of the day, during the winter (RUR)

Diurnal Cycle

RUR URB



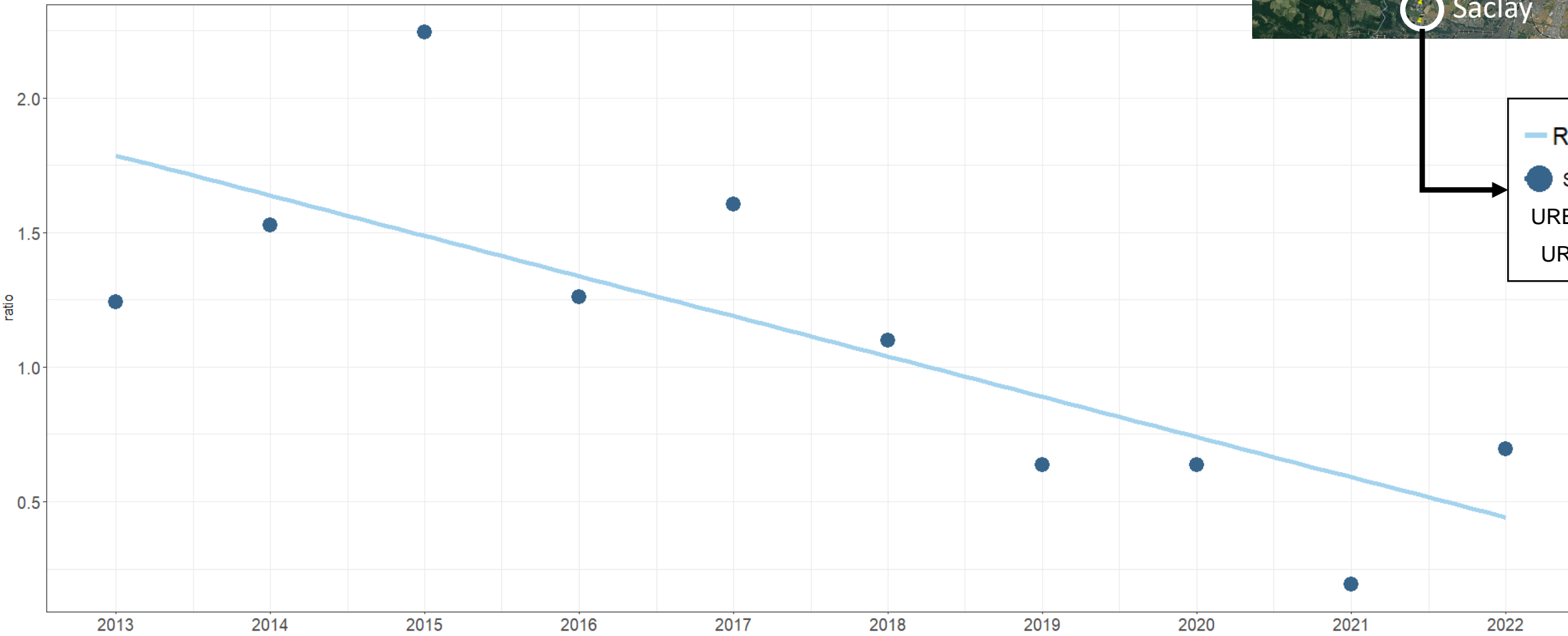
- For road traffic tracers, concentrations increase at peak times
- For residential tracers, concentrations increase more at the end of the day, during the winter (RUR)
- The CO₂ cycle is very marked by biogenic emissions in summer → anthropogenic emissions more visible in winter

Airparif Inventories



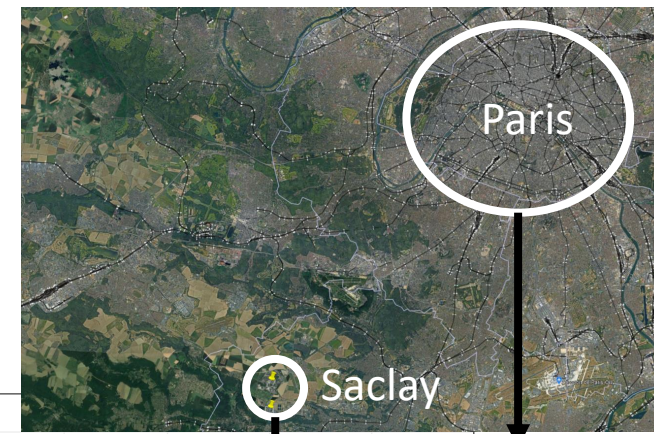
- The Airparif inventories are calculated for Paris region
- For this study → Airparif inventories used are calculated for the city of Paris
- Calculated for different emission sectors
- Calculated yearly, for years :
2005, 2010, 2012, 2015, 2019, 2021

Ratio NO_x/CO_2



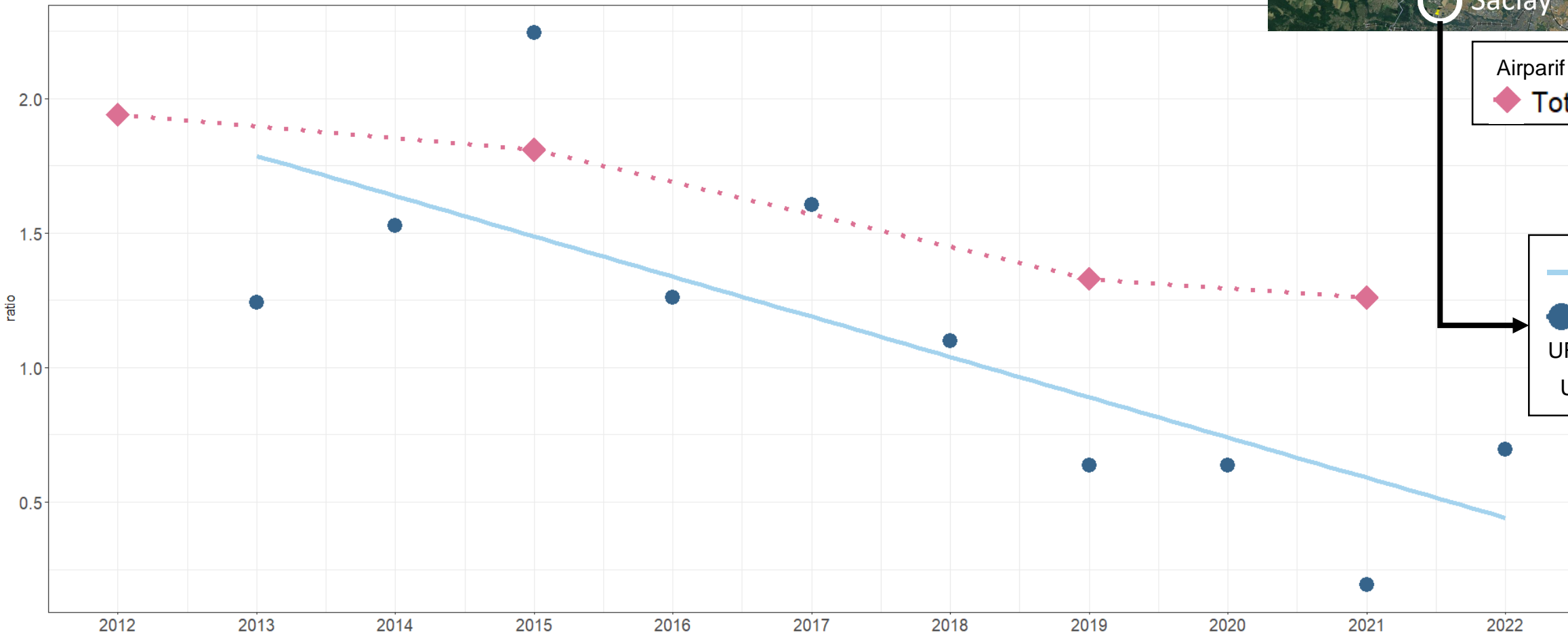
- Regression
- SACLAY
- URBAN offset
- URB - RUR

Ratio NO_x/CO_2

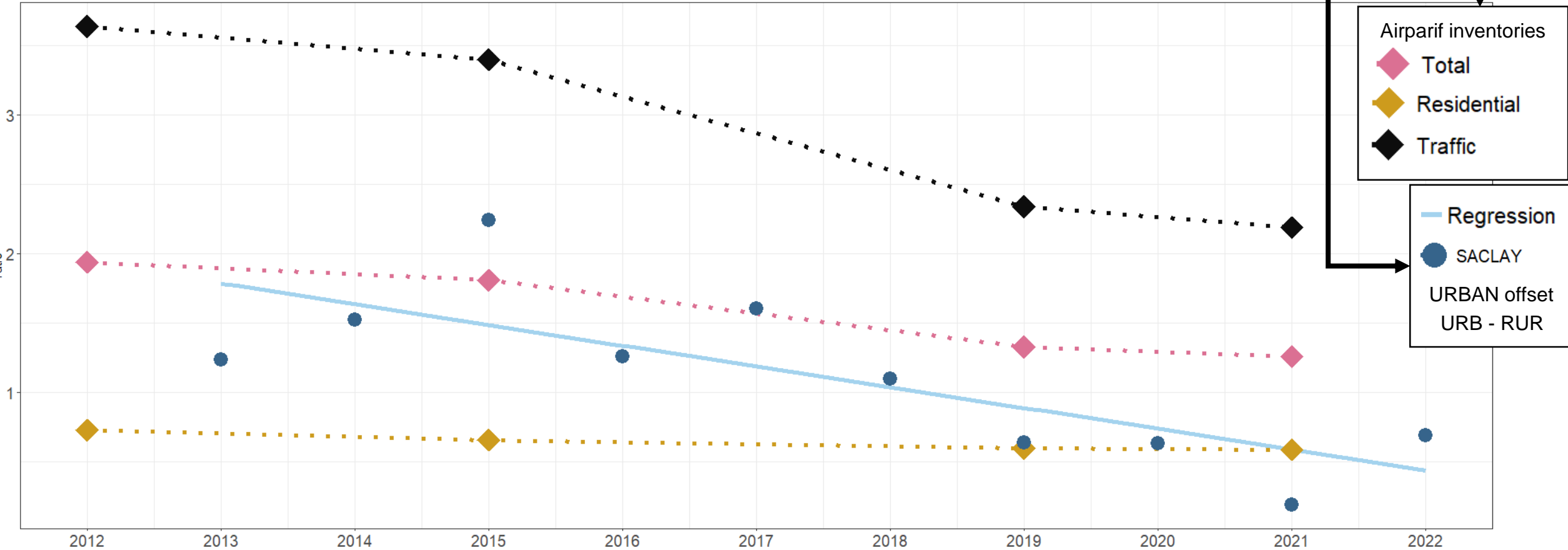
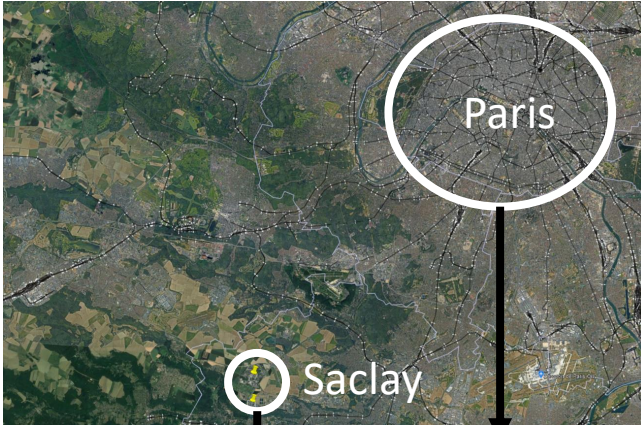


Airparif inventories
◆ Total

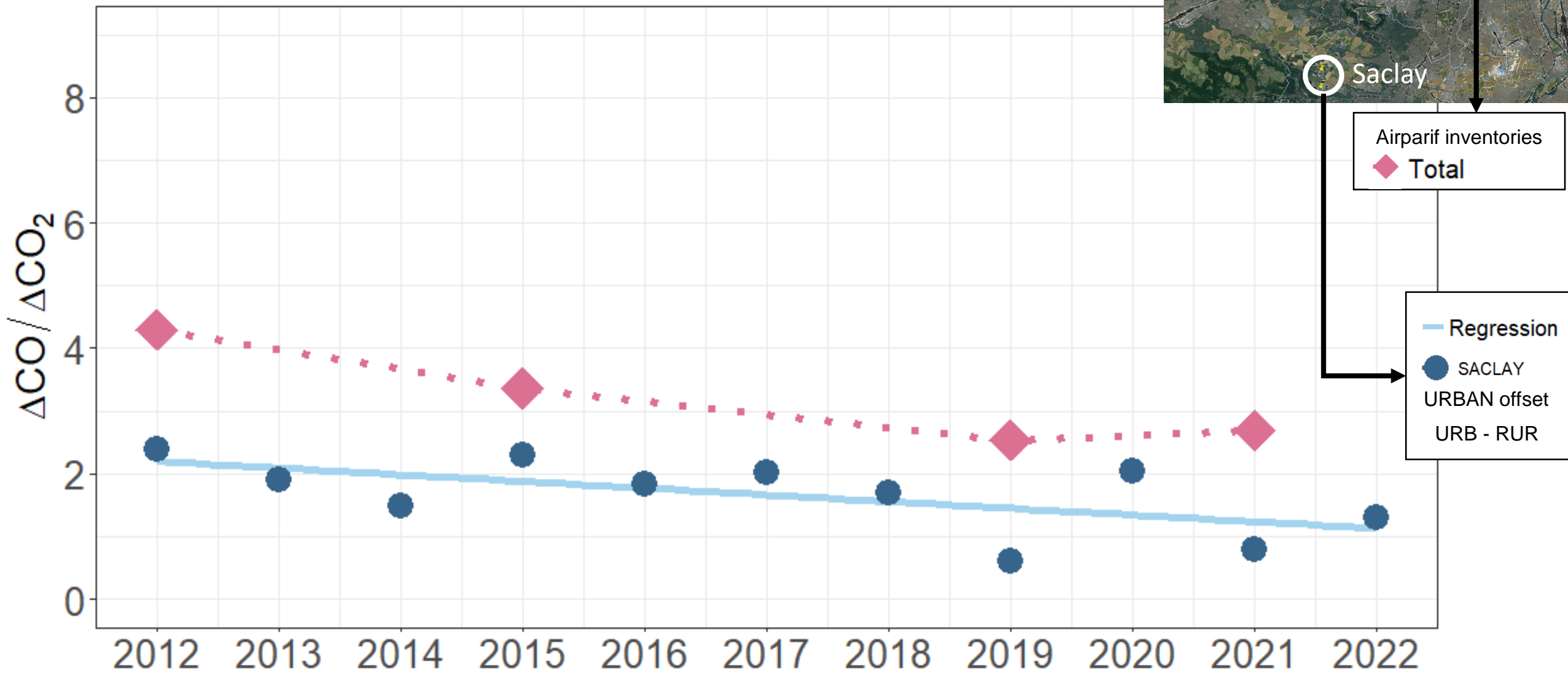
— Regression
● SACLAY
URBAN offset
URB - RUR



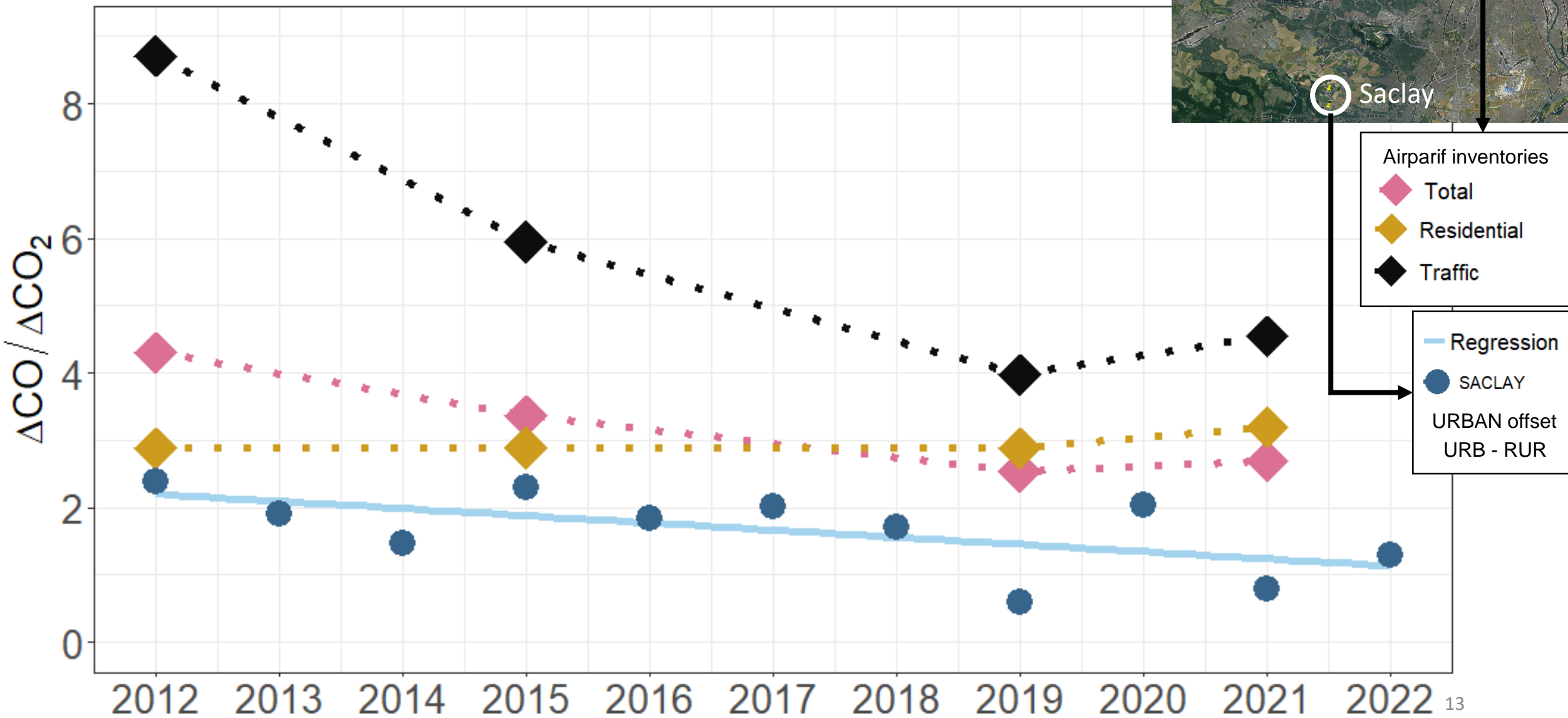
Ratio NO_x/CO_2



Ratio CO/CO₂



Ratio CO/CO₂



Conclusion and Perspectives

- The **rural** (South-West) sector appears to be a good estimate of the background concentrations at Saclay
- Subtracting **Urban** - **Rural** gives a good estimate of urban offset due to Paris emissions
- Concentrations measured in winter provide a better estimate of anthropogenic emissions
- The comparison between the Airparif inventories and our study shows similar trends over the last decade
- Comparison ratio with other species (NO_x/CO_2 , eBC/CO_2 , CO/CO_2)
- Very specific measurements are underway to calculate the ratio of these sources
- Use the multi-component atmospheric approach on other stations



**Thank you for your
attention**

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