ICOS Cities
Pilot Applications in Urban Landscapes

LSCE
Laboratoire des Sciences du Climat & de l'Environnement

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Bridging Political Pledges and Physical Observations:
Projection of Urban CO_2 Mitigation Strategies at High Spatial Resolution

Ivonne ALBARUS[1,2], Thomas LAUVAUX[3] , Valerie GROS[1], Hervé UTARD[2], Charbel ABDALLAH[3], Jinghui LIAN[1,2], Michel RAMONET[1], Olivier Laurent[1], Mali Chariot[1], and Philippe CIAIS[1]

[1] Laboratoire des Sciences du Climat et de l'Environnement, UMR 8212 (CEA-CNRS-UVSQ), 91191 Gif sur Yvette, France

[2] Origins.earth, Suez Group, 92040 Paris La Défense, France

[3] Groupe de Spectrométrie Moléculaire et Atmosphérique (GSMA), Université de Reims-Champagne Ardenne, UMR CNRS 7331, Reims, France

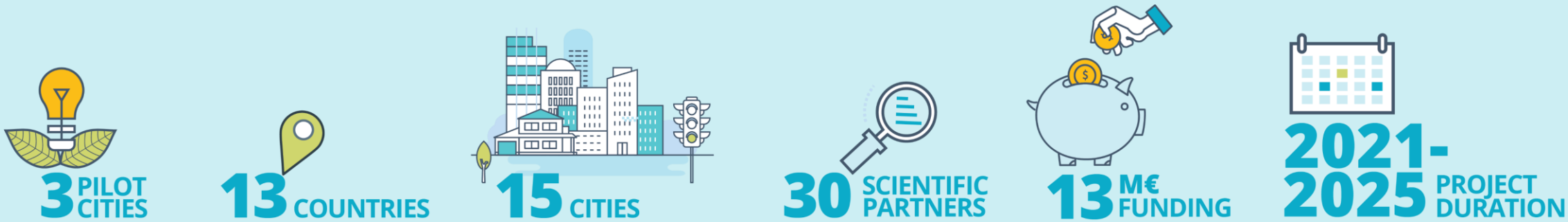
ICOS Cities, aka Pilot Applications in Urban Landscapes - Towards integrated city observatories for greenhouse gases (PAUL), has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101037319

Climate battle will be won or lost in cities

Goals of the **ICOS CITIES** project:

- **Testing comprehensive urban GHG measurement techniques**
- **Providing data services that have a societal impact**
- **Creating useful tools and services for cities in support of local climate actions**

In three pilot cities: PARIS, MUNICH, ZURICH



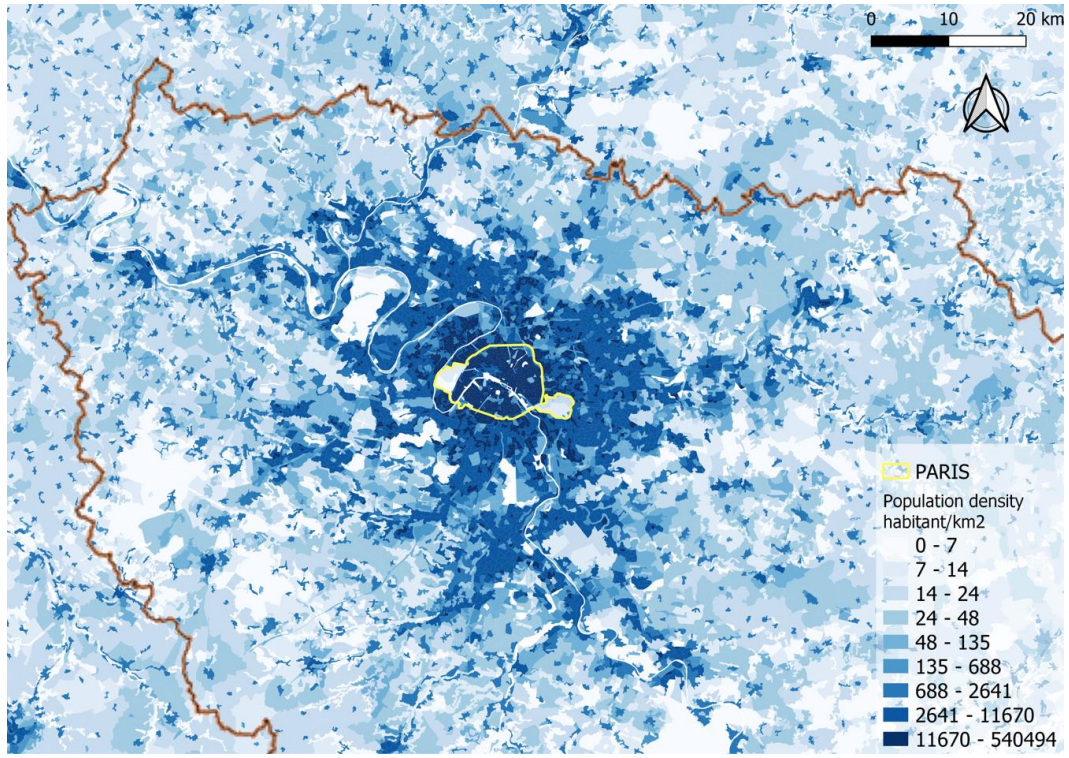
Research Questions

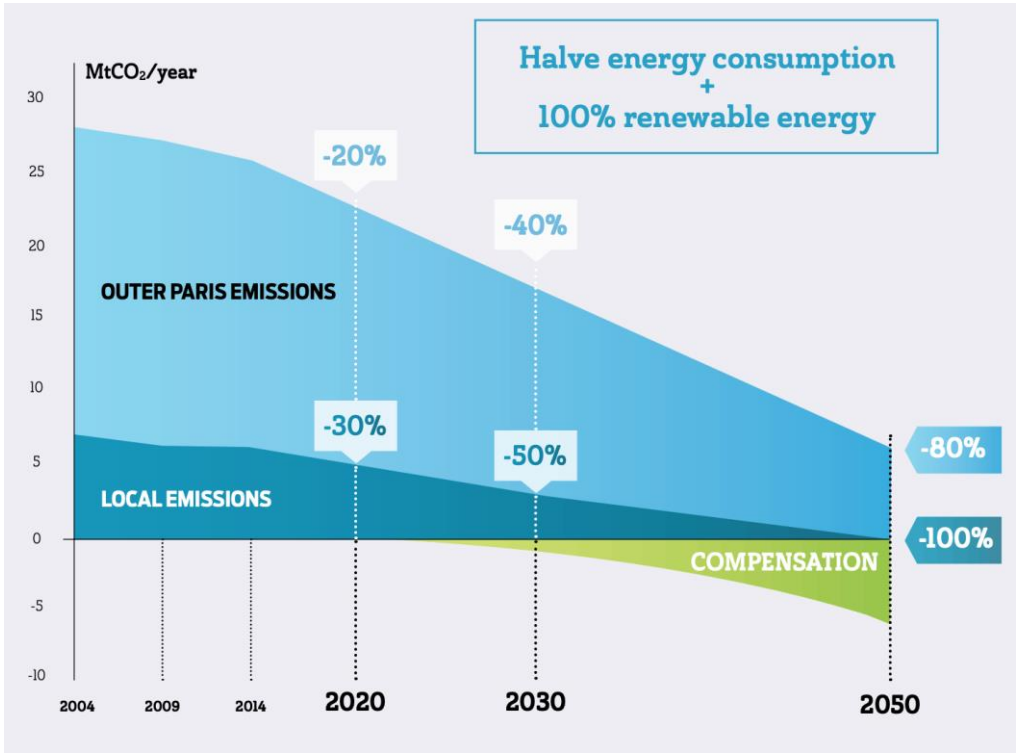
Is Paris and the region on track to meet their climate targets?

What influence has the Paris Climate Action Plan on the spatial distribution of future GHG emissions?

Which atmospheric monitoring networks are required to track future emission changes, based on Climate Action Plans?

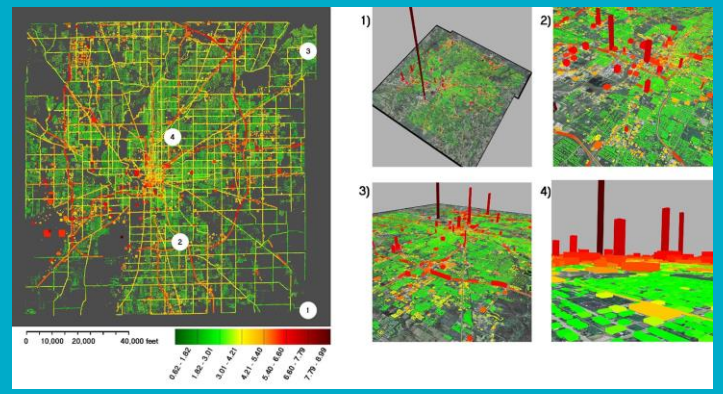
Paris: Zero local emissions by 2050



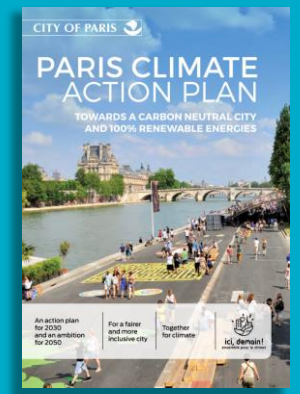


Paris Climate Action Plan Targets

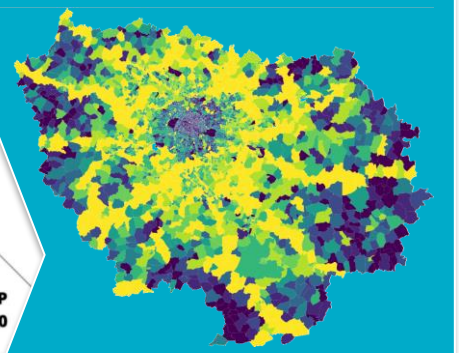
How to spatialize a Climate Plan?



High-resolved 2019 CO_2 emissions inventory



Mitigation actions from the Climate Plan



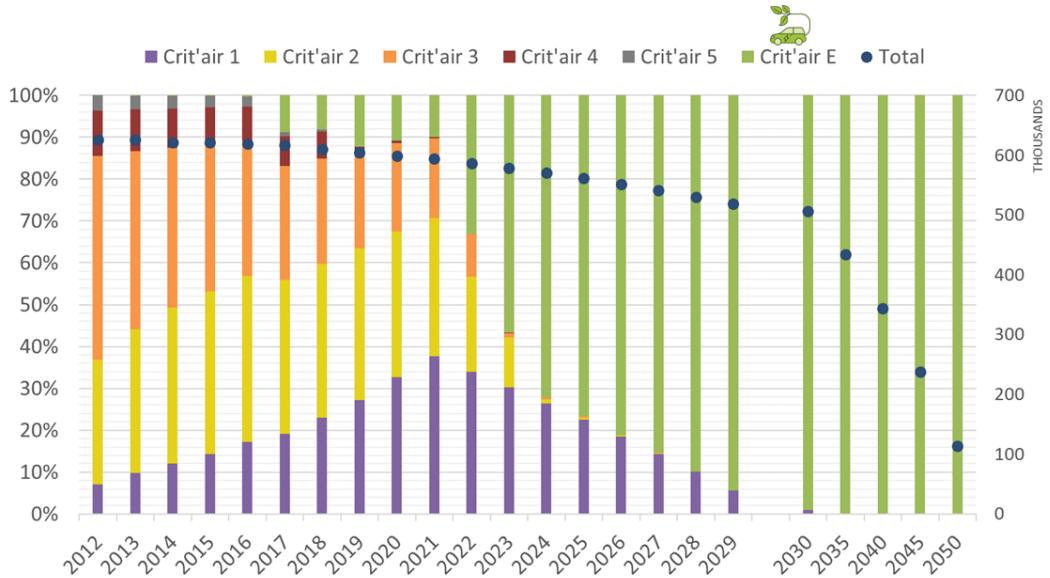
Projected emissions maps

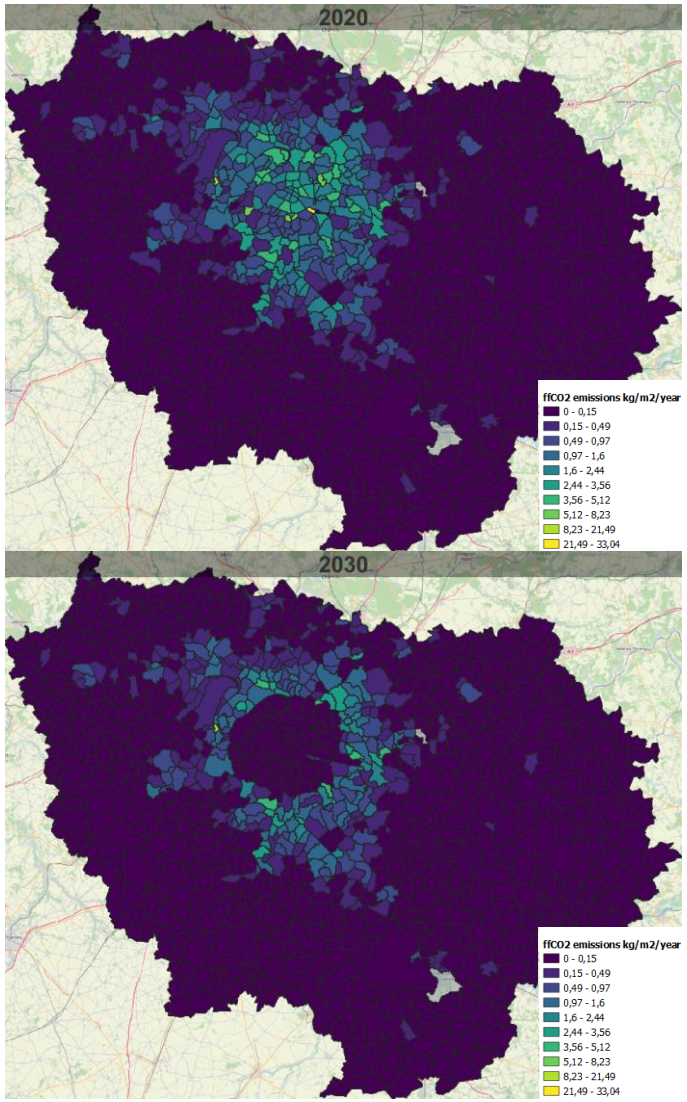
Harmonization | Quantification | Spatialization

Traffic sector CO_2 emissions evolution

The Paris Climate Plan foresees the phasing out of:

- diesel vehicles from 2024
- gasoline vehicles from 2030





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CO_2 Signal Detectability?

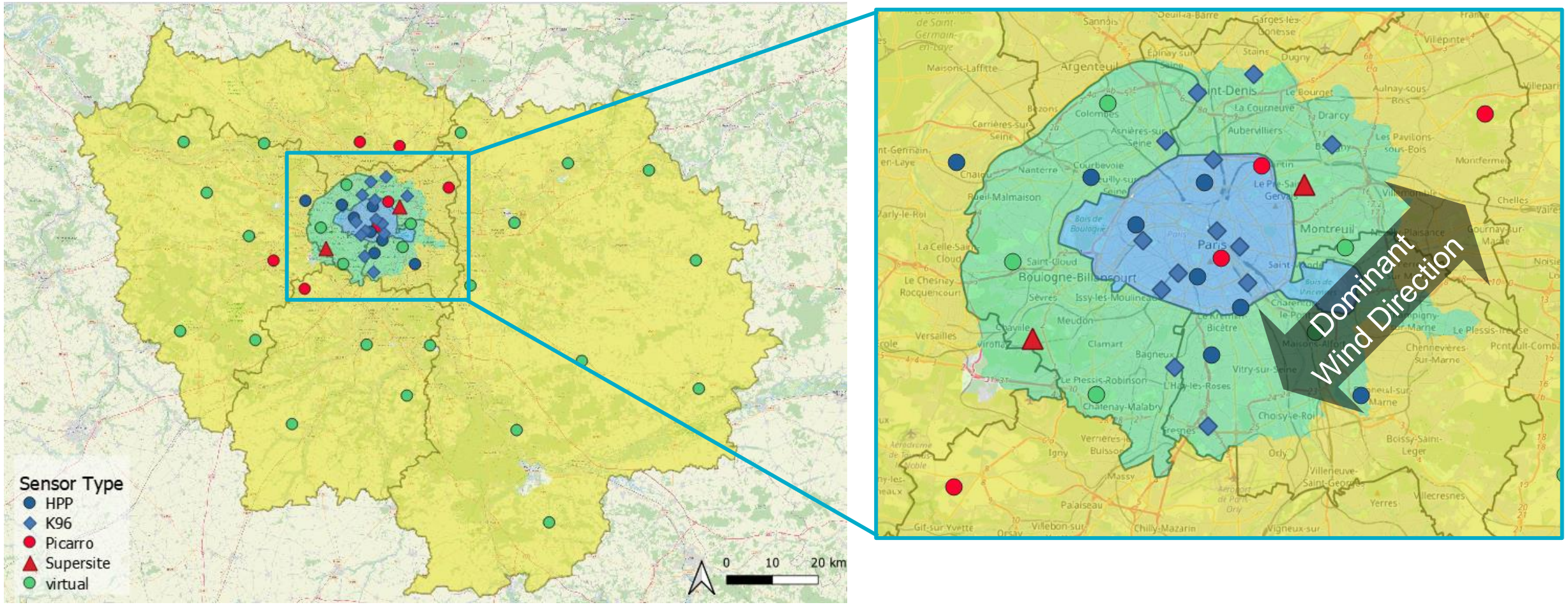
Are we capable of following Paris' emissions trend ?

Until when ?

With what kind of sensors ?

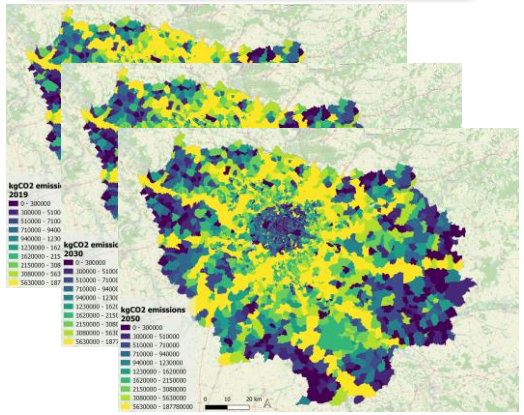
Footprint Analysis	• Computation of influence area • Extension of current network
Signal-to-Noise Analysis	• Introduce detection limits based on actual climate policy goals
Differentiation	• Division into spatial zones • Seasonal variability for signal detection

Paris Atmospheric Monitoring network

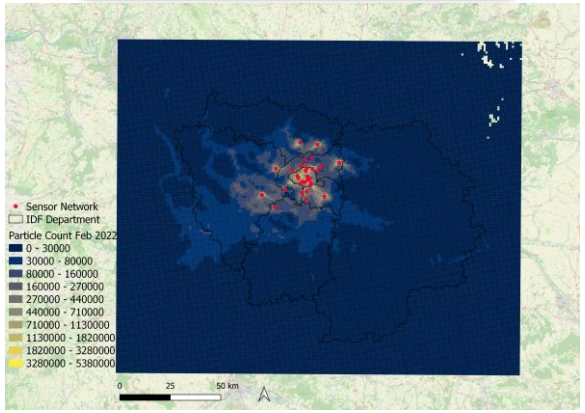


Determining the visible fraction of $ffCO_2$

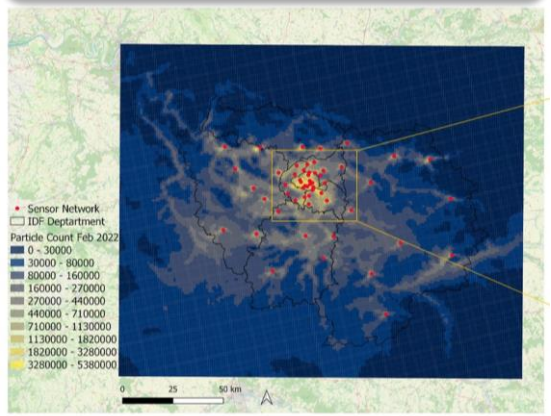
Projected emissions



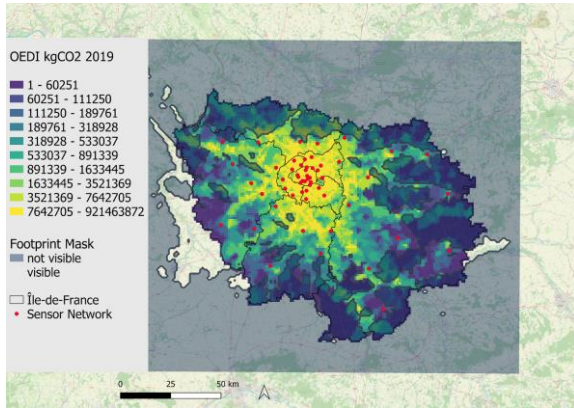
Footprint
Current Network



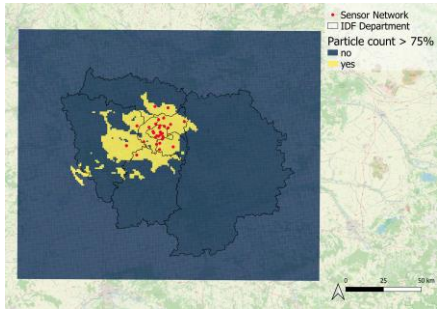
Footprint
Extended Network



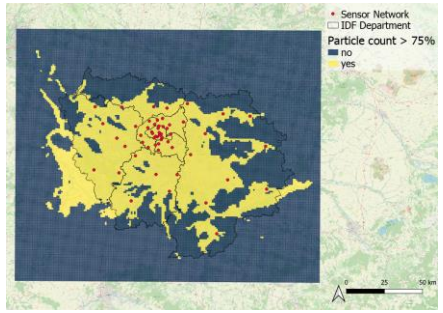
Projected emissions w/
extended Network



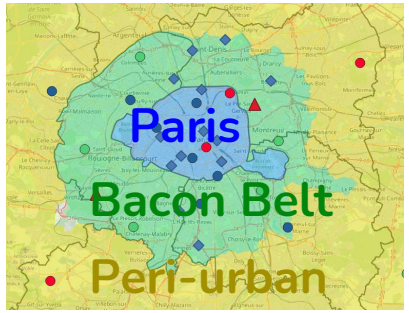
- We do not see everything !
- Double the number of sensors to increase coverage to 94%



65% coverage



94% coverage



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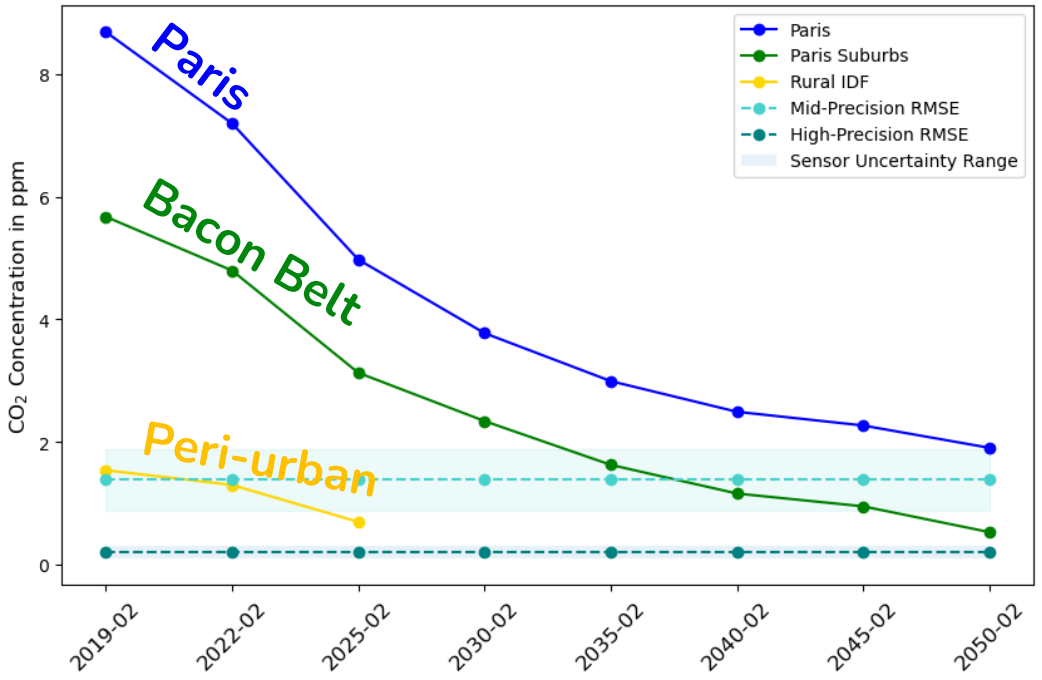
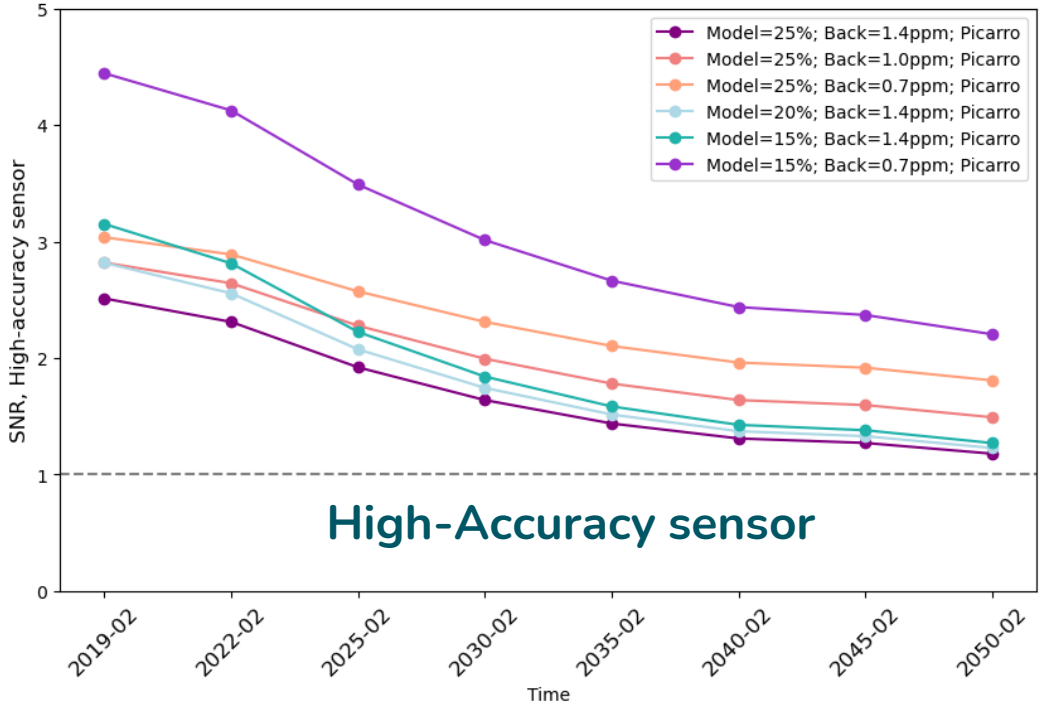
Spatio-temporal measurement capacity



$$ffCO_2\ signal = \sqrt{(ffCO_2)^2 - (error\ terms)^2}$$

- ✓ Inside urban areas the CO_2 signal remains sufficiently strong for measurements using mid-accuracy sensors until at least 2030.

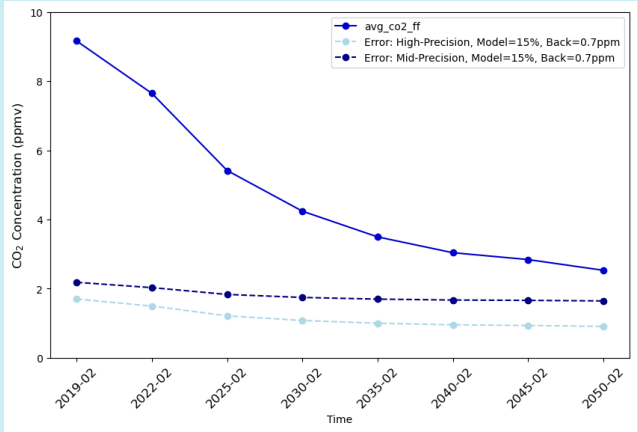


- ✓ Background error reduction has a high influence on the sensor's lifetime regarding detection capacity

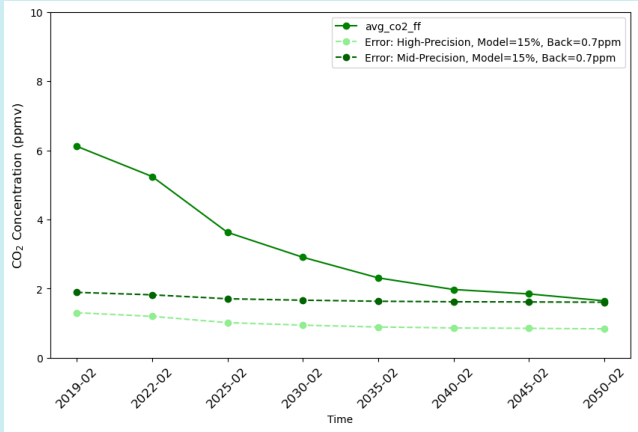
Seasonal measurement capacity

Winter (February)

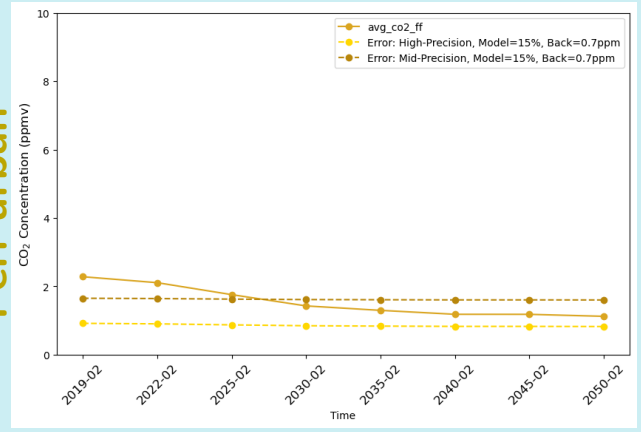
Paris



Bacon Belt

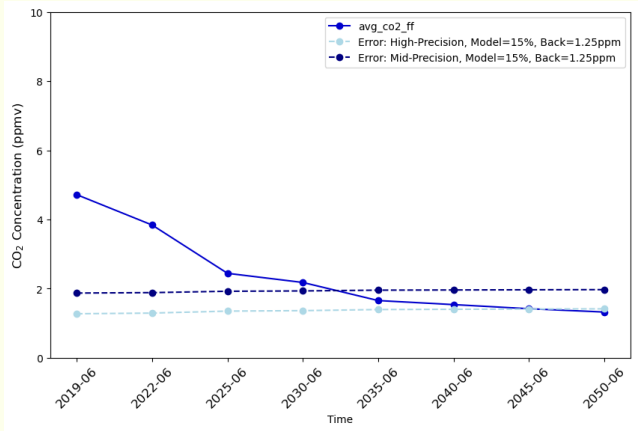


Peri-urban

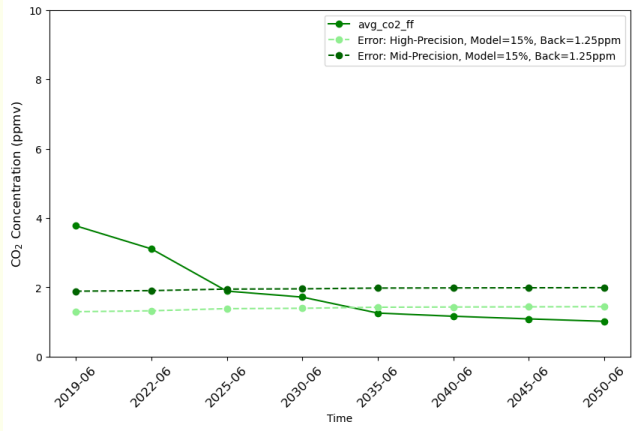


Summer (June)

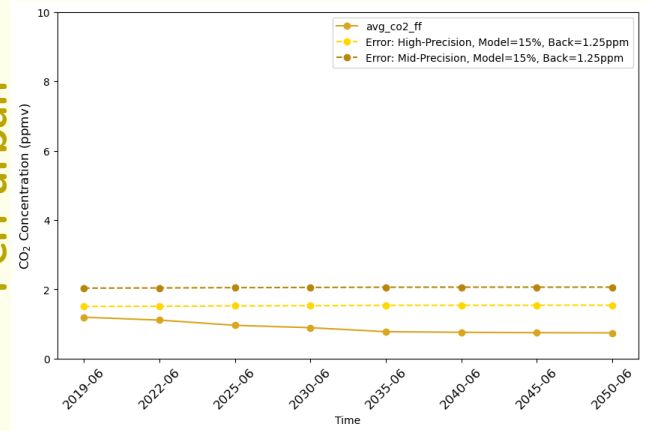
Paris



Bacon Belt

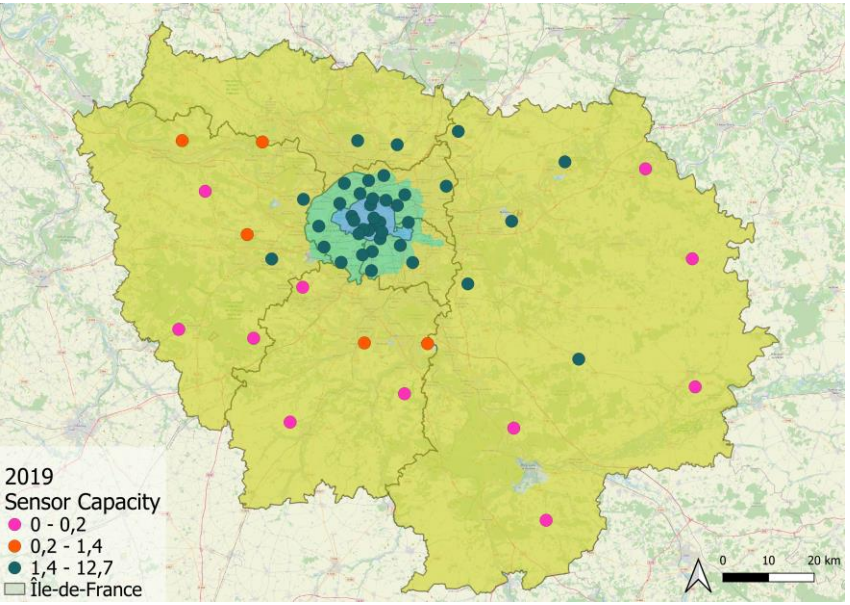


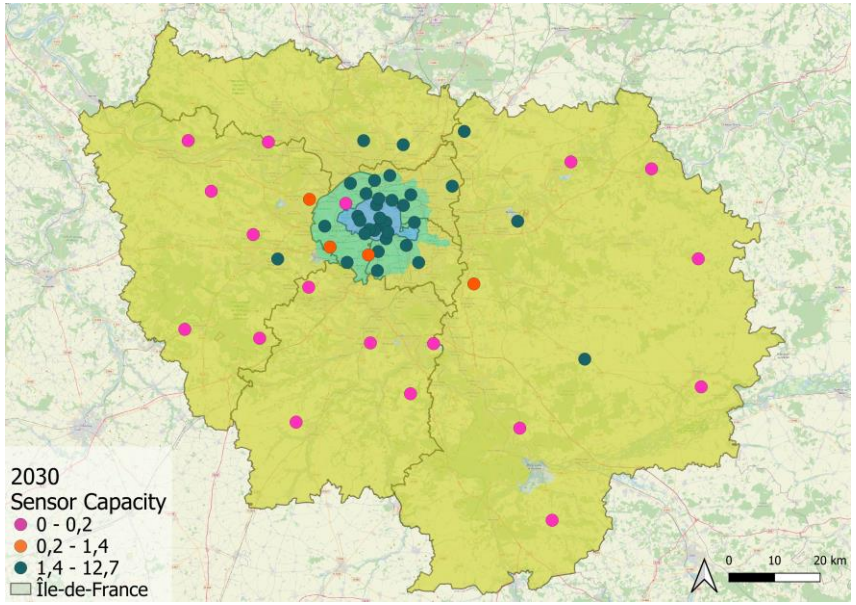
Peri-urban

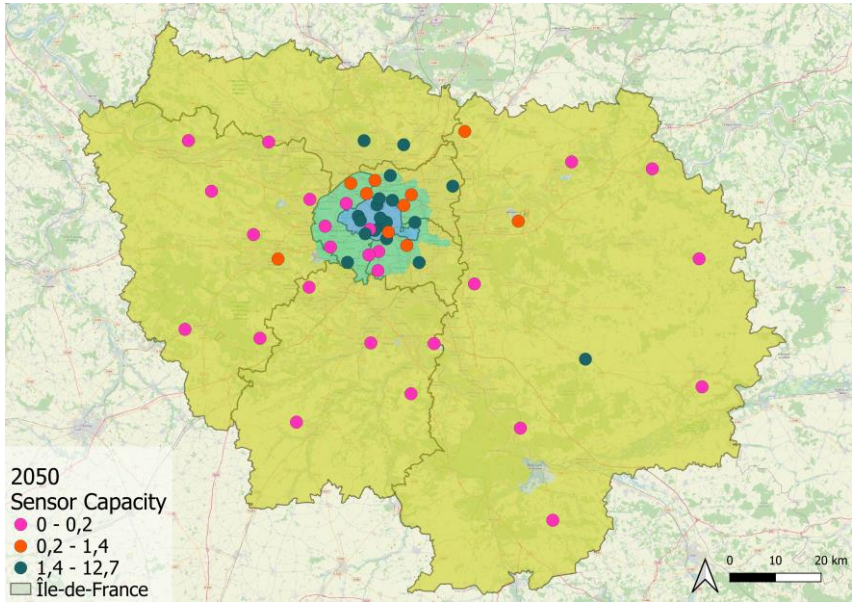


- ✓ Biogenic fluxes and reduced ffCO_2 signal in summer lead to reduced CO_2 signal detection capacities
- ✓ Despite its dense population, about half of the IDF region is used for agricultural activities

What kind of sensors and where?







- none
- high-accuracy only
- high-accuracy & mid-accuracy sensors

- ✓ Mid-precision sensors are more effective inside the city center
- ✓ High-precision sensors are needed to capture signals in the peri-urban areas

Take away messages

Paris' climate actions seem promising for the short-term but further efforts are needed for long-term

We can observe highly heterogeneous CO_2 reduction distributions with large spatial gradients.

With high-granularity and spatially quantified information, climate strategies can be effectively fine-tuned, social aspects included, and citizen support triggered

The number of initial sensors need to be doubled to cover the entire IDF region

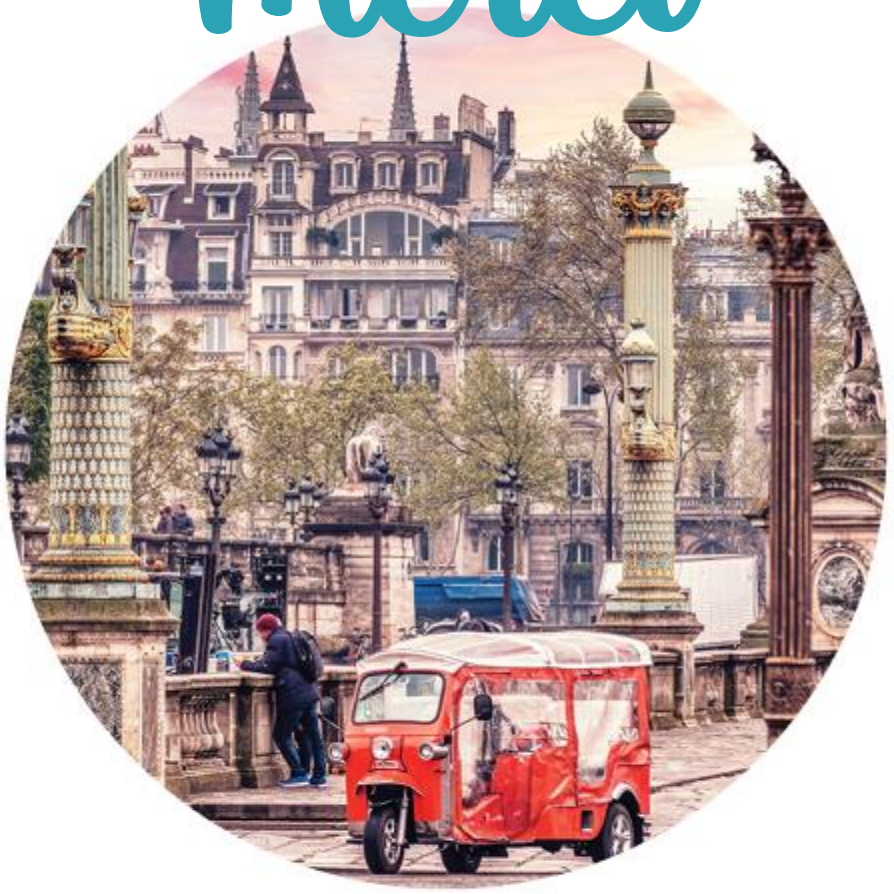
Reducing error sources in the inversion system will bring significant progress

Growing season remains a challenge for $ffCO_2$ emissions monitoring

Mid-cost sensors remain effective inside the urban core until at least 2030

We need to enhance mid-cost sensors performance and decrease inversion model errors to monitor negative future emissions trends.

Merci



ivonne.albarus@lsce.ipsl.fr

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