



How effective is urban greenery in reducing CO₂ emissions in a Metropolitan Area?

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How effective is urban greenery in reducing CO₂ emissions in a Metropolitan Area?



01 Background

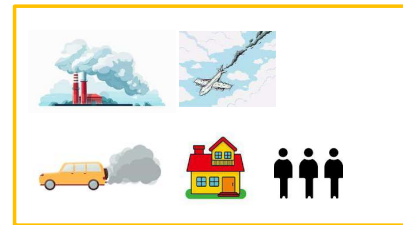
02 Emission Assessment

03 Observed and Simulated Concentration

1. Background

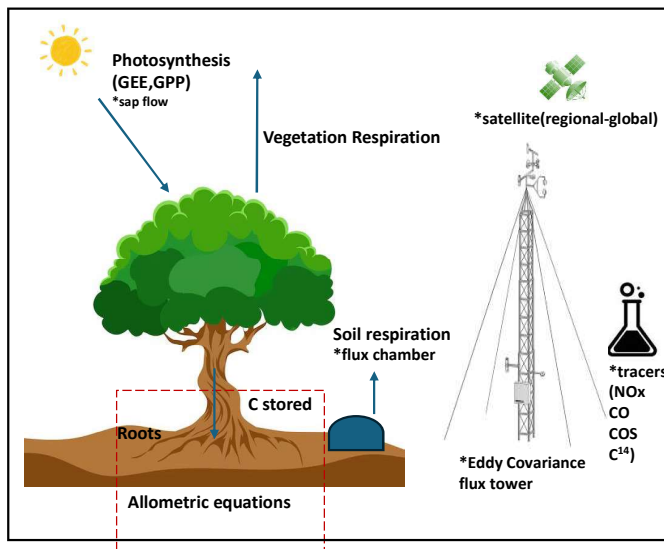
How effective is urban greenery in reducing CO₂ emissions in a Metropolitan Area?

Green infrastructure: a network of (semi-)natural areas which are protected and enhanced to deliver ecosystem services, while also benefiting biodiversity and human well-being.

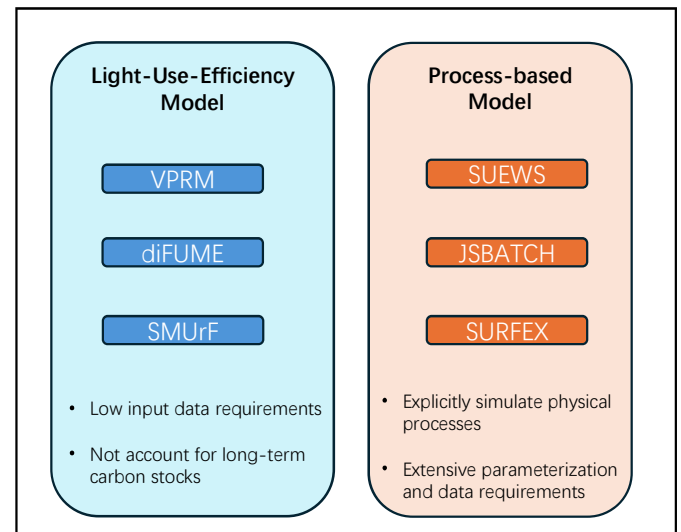


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1. Background_How to quantify the biogenic flux of a city?



Measurements



Modelling Approaches

In this work we apply the Vegetation Photosynthesis and Respiration Model [VPRM]

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2. Emission Assessment_Study Area and Model Setting

Area

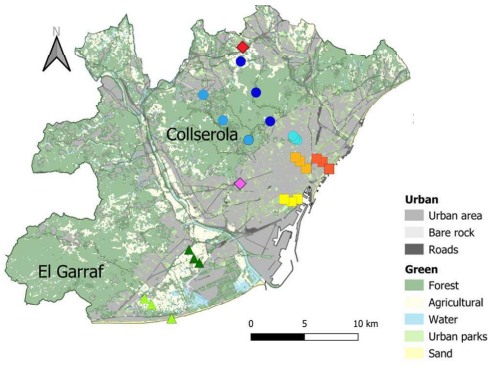
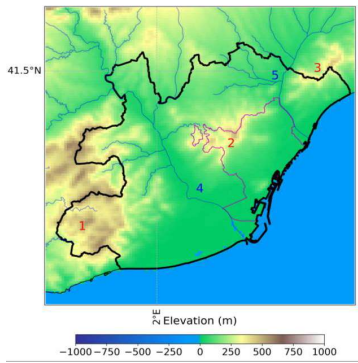
AMB: Metropolitan area of Barcelona

1km x 1km

Vegetated area: 58%

Population density: 16157 Inh/km²

Year:2023



Biogenic flux



Modis
500m



Sentinel2
(s2) 10-20m



Vegetation indexes
(500m;10m)

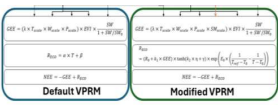


Meteorological data
(Temperature, Solar
Radiation, and Soil Moisture
from WRF at 1km)



Land Cover
(local map with tree classification;10m)

VPRMDefault VPRMModified



- Modified VPRM accounting for soil moisture effects and a better respiration parameterization⁽¹⁾

Anthropogenic inventory



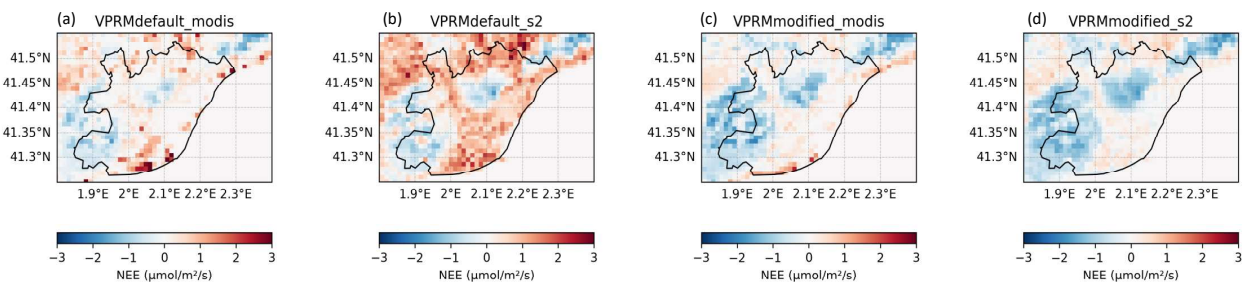
EDGAR2023



Human Metabolism

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2. Emission Assessment_Biospheric contributions among different configurations

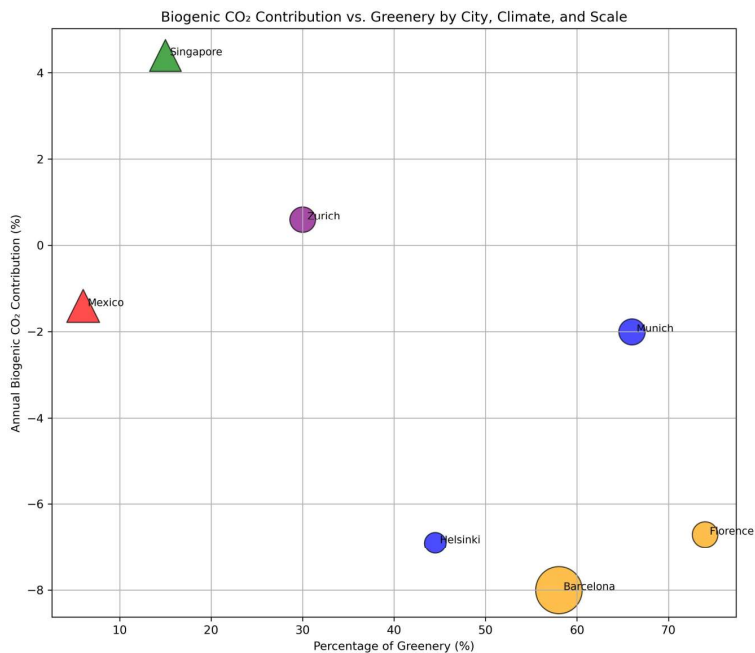


Biospheric contribution(%) = Biogenic Flux / (Biogenic Flux + Anthropogenic Flux)

VPRMDef_modis	2%
VPRMDef_s2	9%
VPRMod_modis	-4%
VPRMod_s2	-8%

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2. Emission Assessment_ Biospheric contributions across cities



- Different calculations:

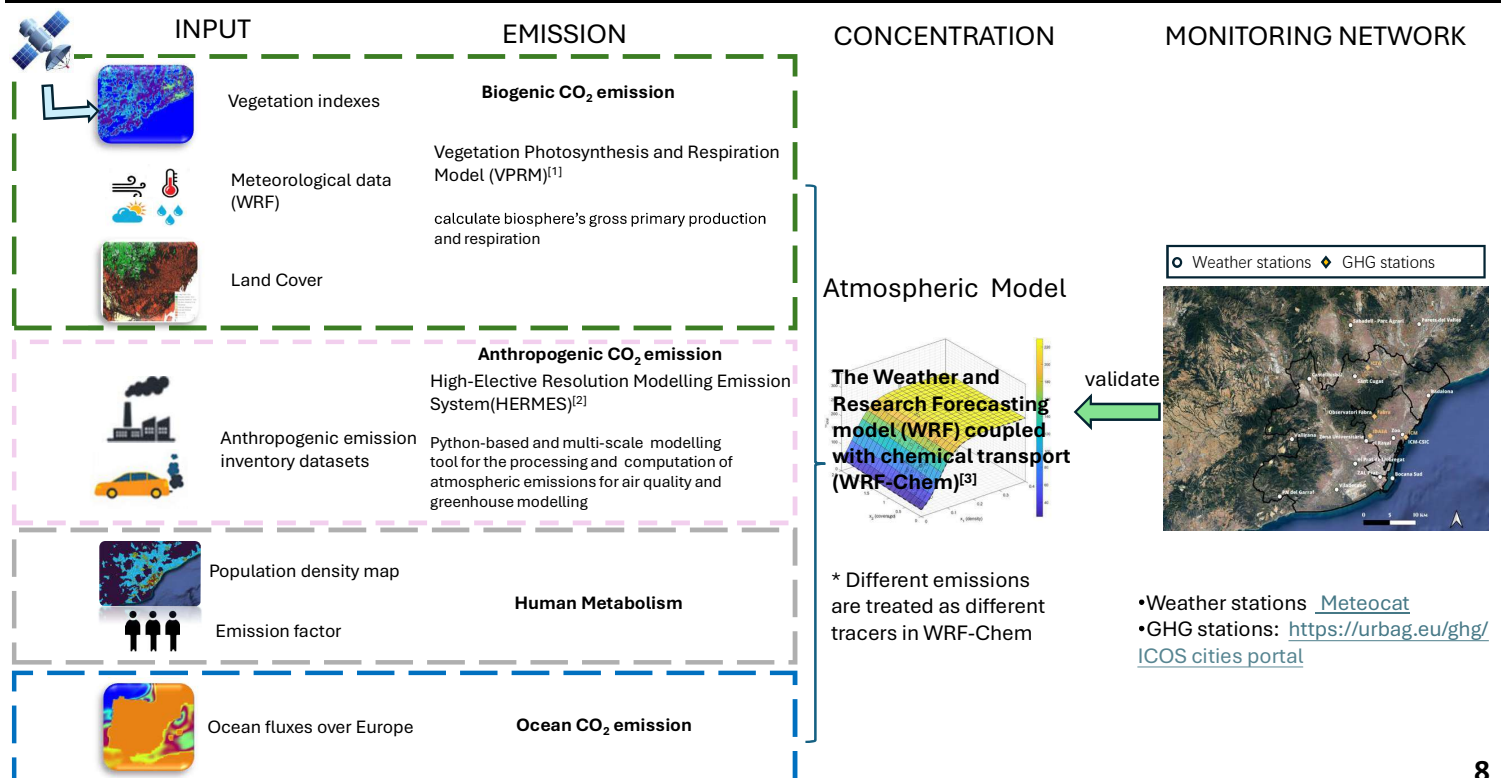
$$\frac{\text{Biogenic Flux}}{\text{Biogenic Flux} + \text{Anthropogenic Flux}}$$
- Different scales (neighborhood and city)

A guideline for accounting biogenic contributions should be established and applied to more cities

Higher green coverage, regardless of climate and population density, is generally associated with more negative (sink-like) biogenic CO₂ contributions.

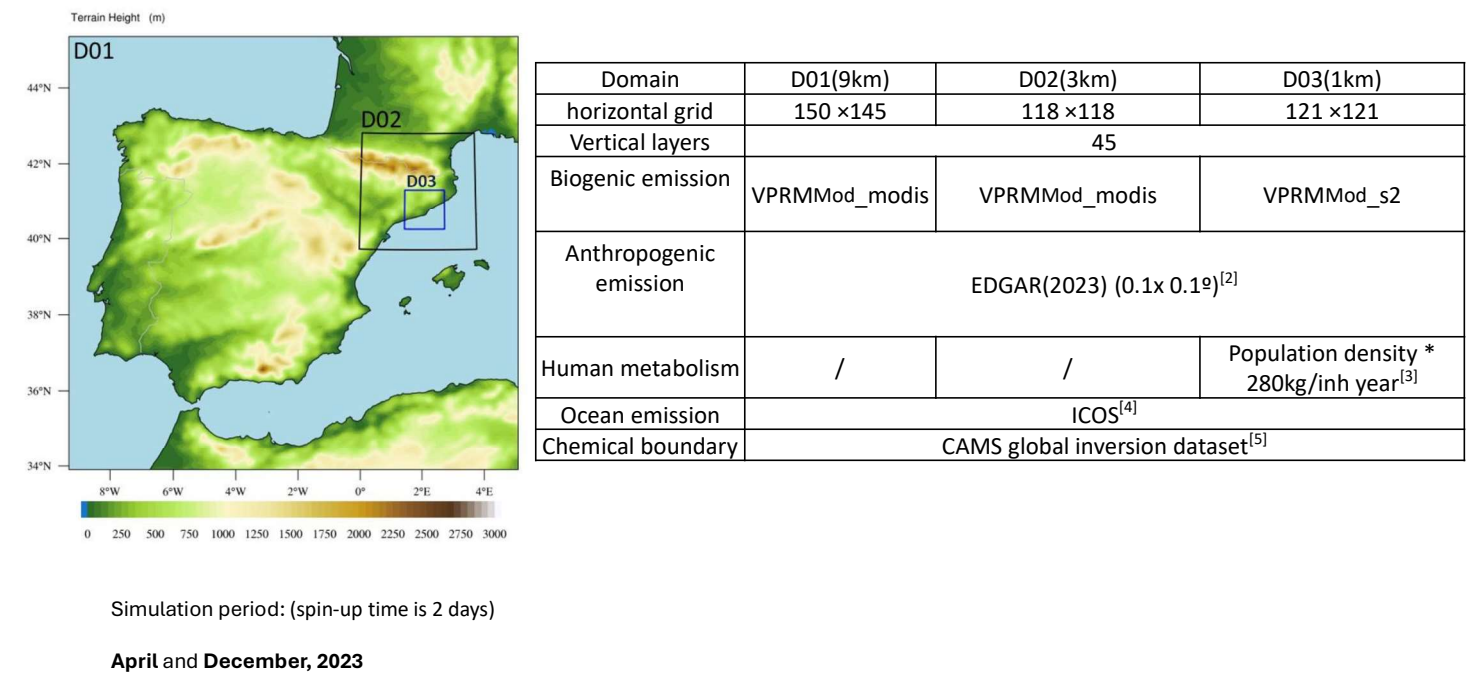
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3. Observed and Simulated Concentration_ Overview

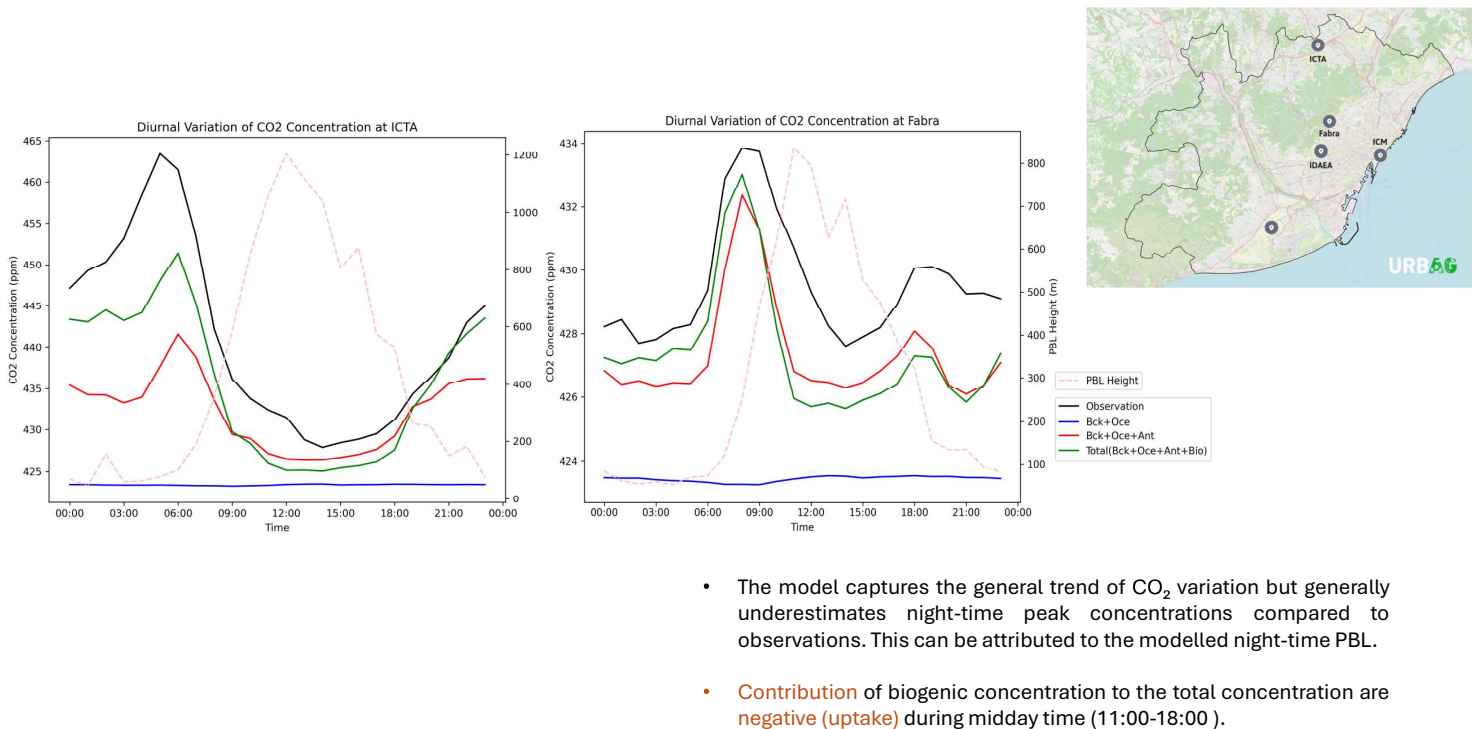


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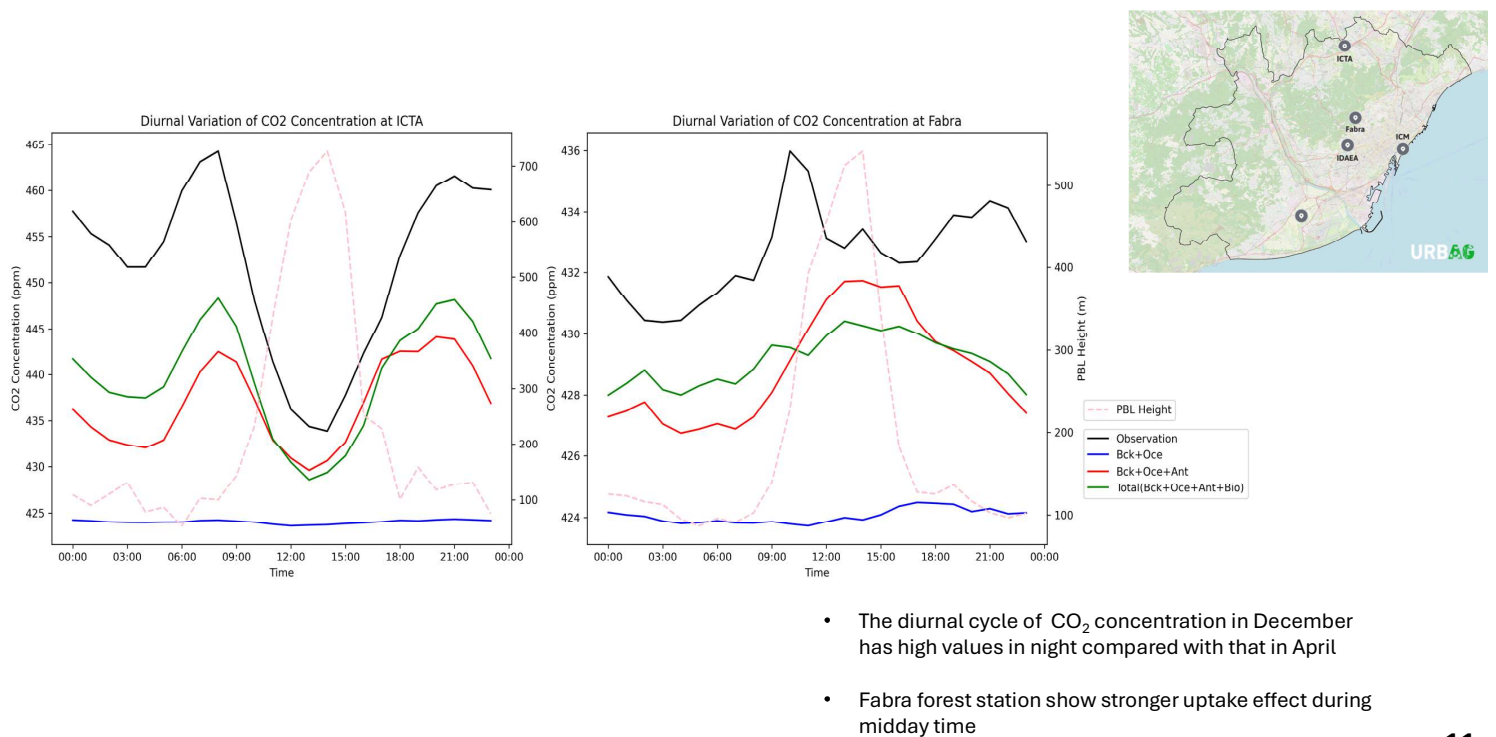
3. Observed and Simulated Concentration WRF-Chem setting



3.Observed and Simulated CO₂ Concentration_April



3. Observed and Simulated CO₂ Concentration_December



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Key take aways

- Different VPRM configurations show different annual biogenic CO₂ fluxes contributions, with **the modified VPRM using sentinel2 indices estimating the highest uptake(-8%).**
- Greener cities regardless of climate generally show more negative biogenic CO₂ contributions. **A guideline for accounting biogenic contributions should be established and applied to more cities**
- WRF-Chem well simulates the diurnal trend of total CO₂ concentration. During midday, the uptake effect can be captured, however, during the night, the high uncertainty in the anthropogenic emissions and the errors in the atmospheric transport model, does not allow us to discern the biogenic contribution.

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Reference

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Question?

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GHG seminar
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