

Urban Health Assessment through a Planetary Health Perspective: Rome NBFC Experiment

Carmina Sirignano
and many, many others



Article

Urban health assessment through a Planetary Health perspective: methods and first results from the Rome NBFC experiment

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Milan, 22/09/2025

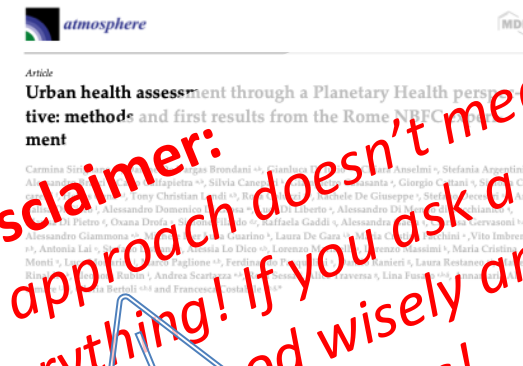
Rome, Villa
Ada Park

Mt Vesuvius-Naples,
11/08/2025

Rome, 30/06/2025
40°C

Rome,
16/05/2025





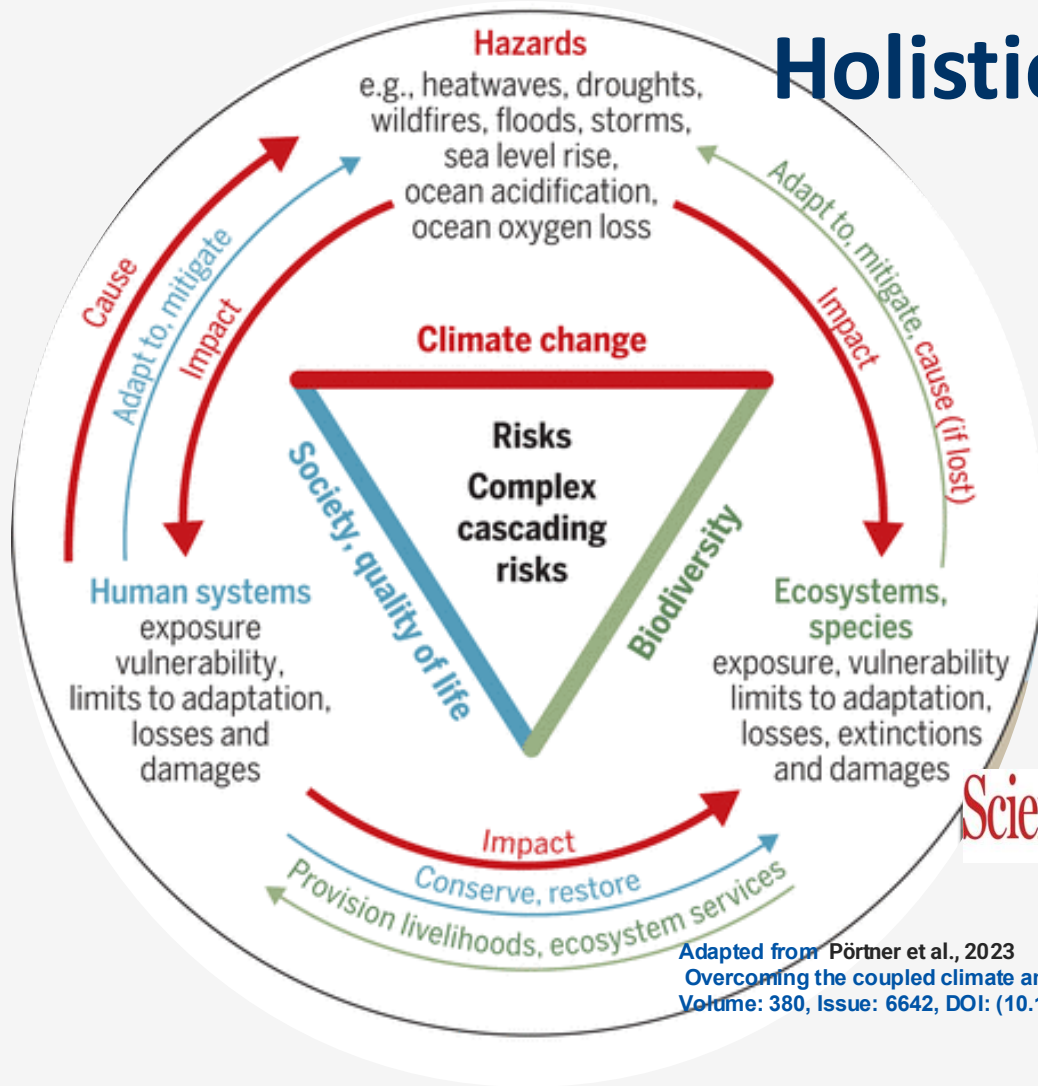
Daiane De Vargas Brondani, Chiara Anselmi, Stefania Argenti, Carlo Calfapietra, Annamaria Altomare, Michele Cicala, Michele Pierluca Guarino, Giovanni De Carlo, Tony Christian Landi, Rosa Coluzzi, Rachele De Giuseppe, Annalisa Di Cicco, Alessandro Dommenico, Di Giosa, Alessandra Di Menna, Buccianico, Oxana Drofa, Maria Cristina Facchini, Raffaella Gaddi, Alessandra Giammona, Laura De Gazi, Vito Imbrenda, Antonia Lai, Lorenzo Massimi, Maria Cristina Monti, Luca Mortarini, Marco Paglione, Danila Palleri, Eleonora Rabini, Andrea Scartazza, Rosa Sessa...

Disclaimer:
A transdisciplinary approach doesn't mean the presenter knows everything! If you ask a question outside my field, I'll just nod wisely and hope someone else answers!

more...

Introduction:

Planetary Crises and the Need for a Holistic Approach: Planetary Health



Adapted from Pörtner et al., 2023
Overcoming the coupled climate and biodiversity crises and their societal impacts,
Volume: 380, Issue: 6642, DOI: (10.1126/science.ab4881)

Science | AAAS

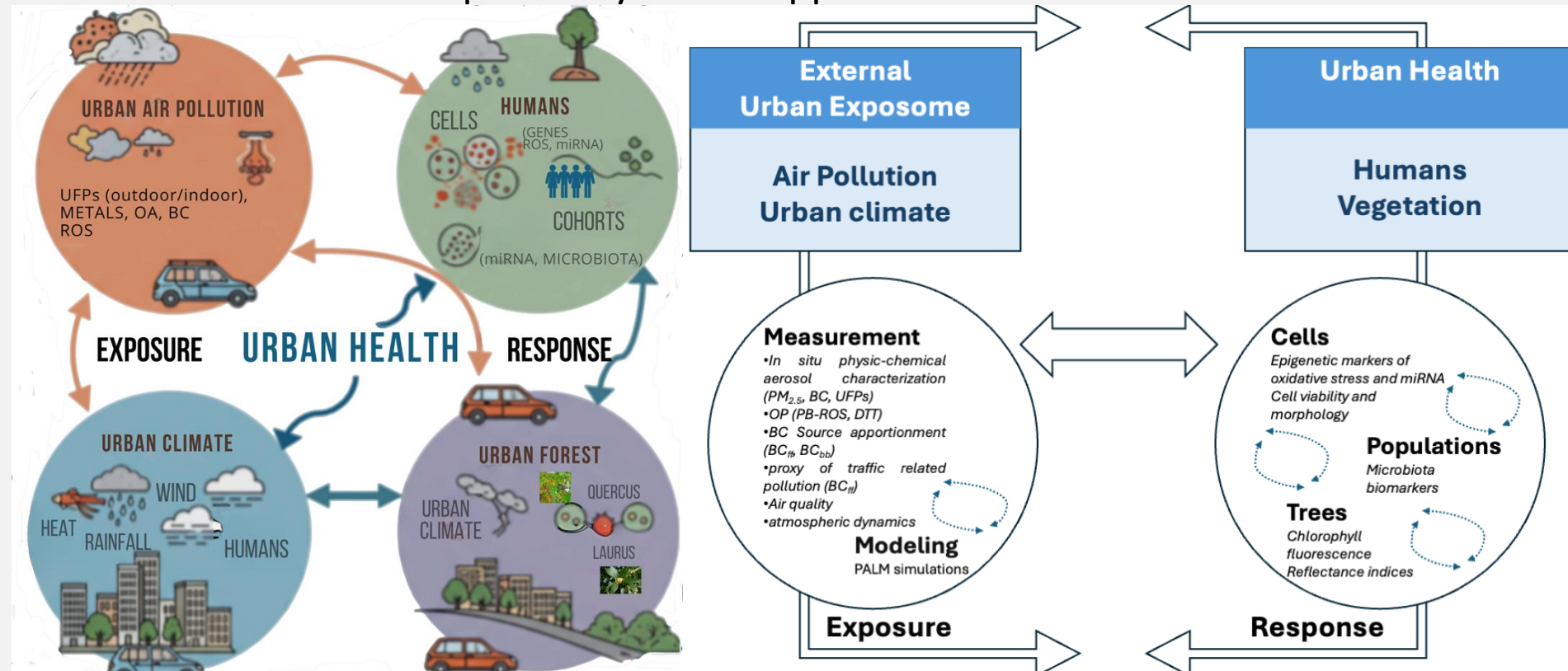


This is especially urgent
for **vulnerable urban areas**
in the **Mediterranean**

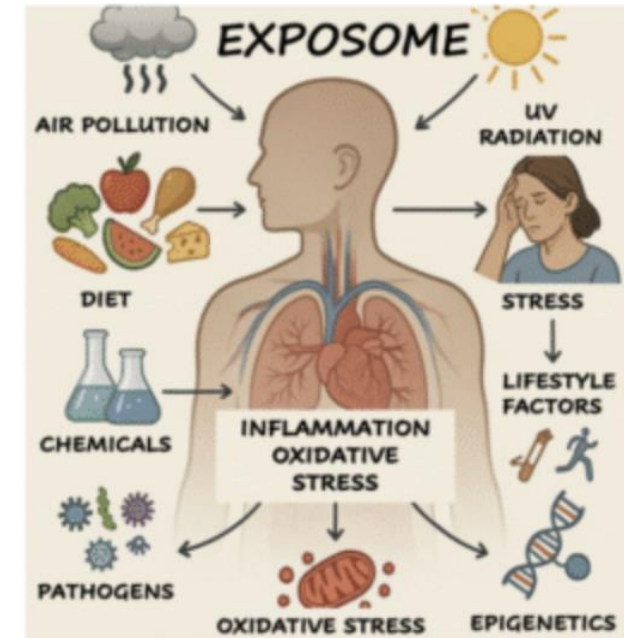
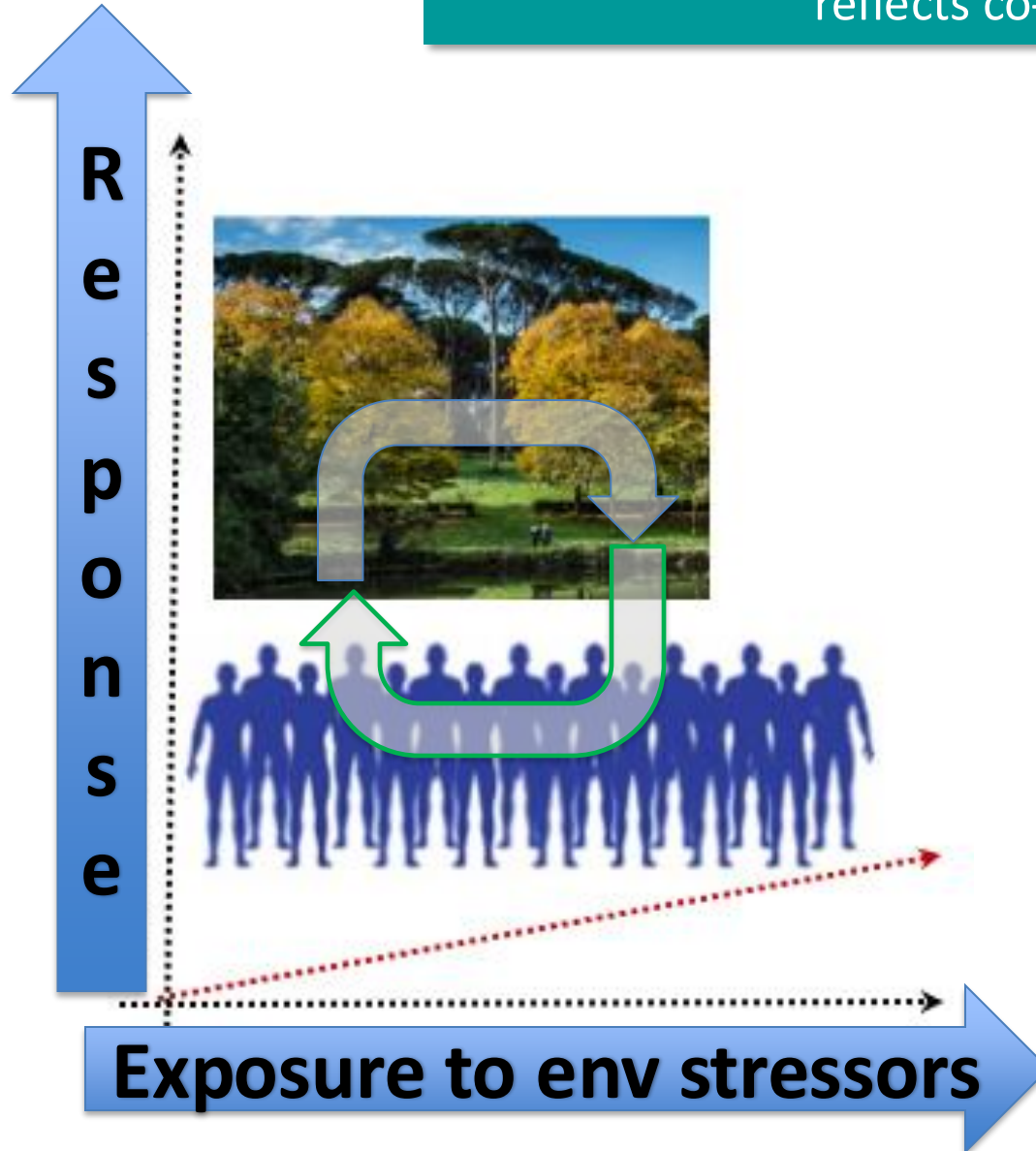
Study Objectives & Conceptual Model

Assessing urban health

Understanding the hazards and their impacts and asses the complex cascading risks using a planetary health approach



The Rome NBFC experiment: External urban exposome reflects co-exposures

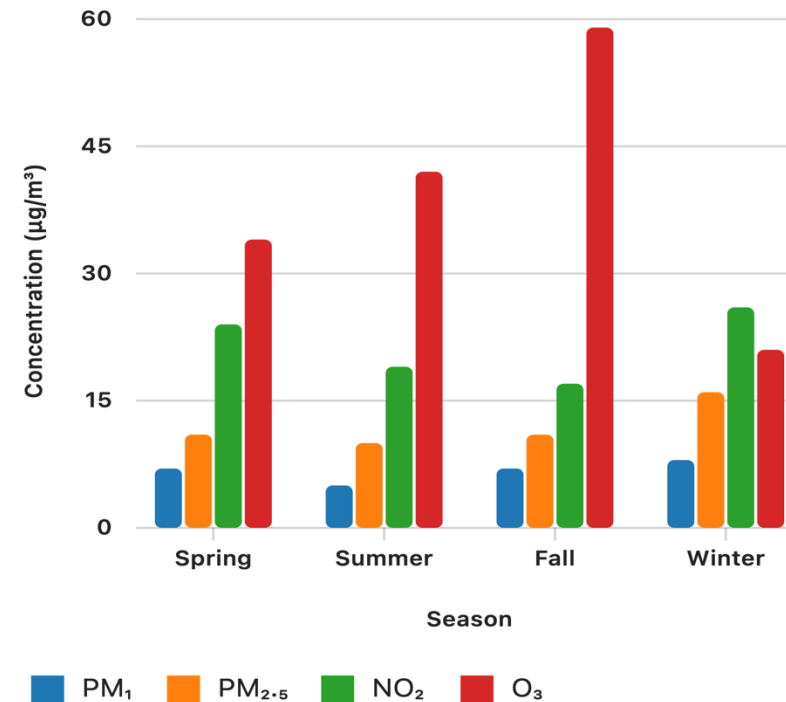


Oxidative stress and inflammation induced by exposure to urban stressors (hazards) can lead to different biological processes in humans and plants

Urban air pollution and urban climate

Air pollution proxies

Which specific characteristics of urban pollution induce oxidative stress? How do we measure them?



Sirignano et al 2025– Atm

Exposure to env stressors

C.Sirignano | 1st FutureMed Workshop & Training School | Chania, Crete



Urban air pollution and urban climate

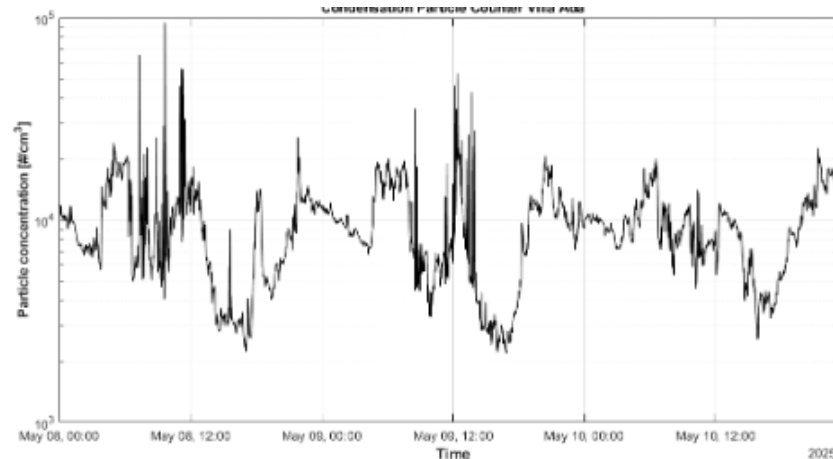
Air pollution proxies

Which specific characteristics of urban pollution induce oxidative stress? How do we measure them?

New metrics



- **Number Concentration (*N_{tot}*)**
- **Black Carbon (*BC*)**
- **Oxidative Potential (*OP*)**



Exposure to env stressors

Urban air pollution and urban climate

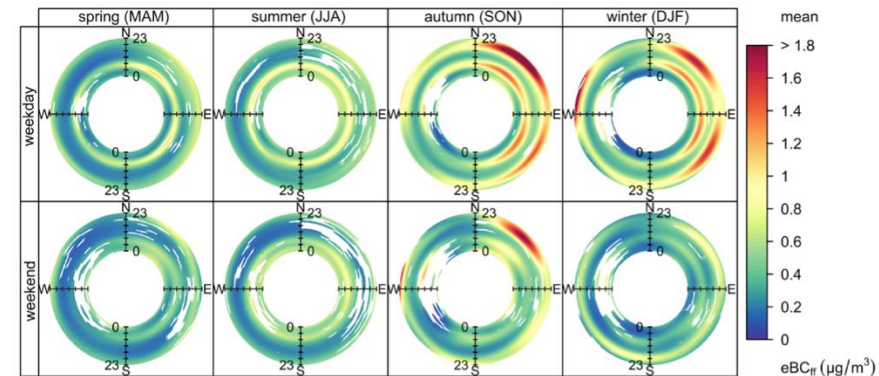
Air pollution proxies

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Exposure to env stressors

Urban air pollution and urban climate

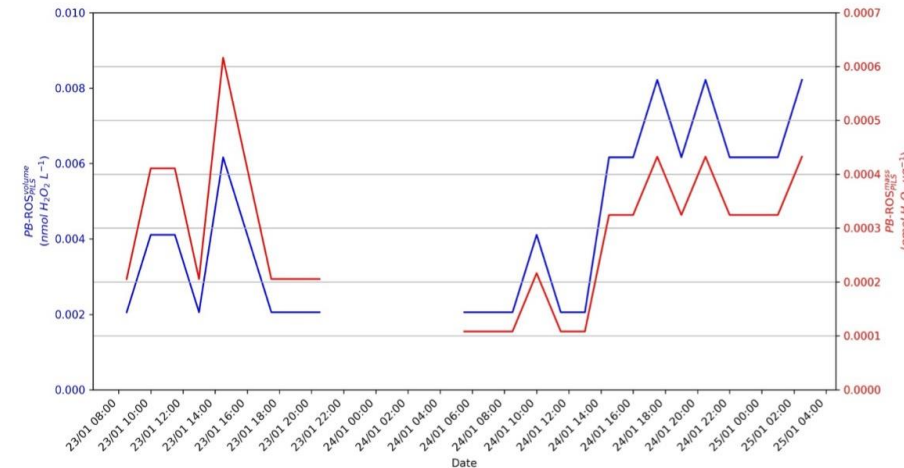
Air pollution proxies

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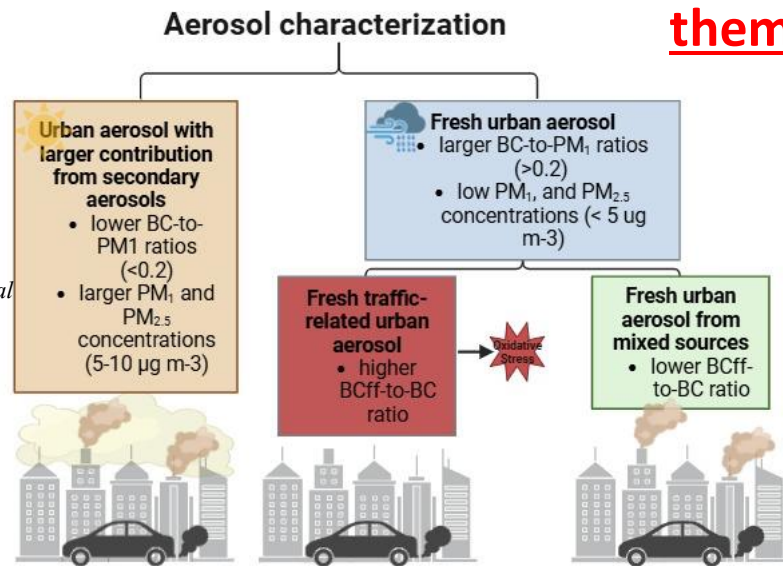
Exposure to env stressors

Urban air pollution and urban climate

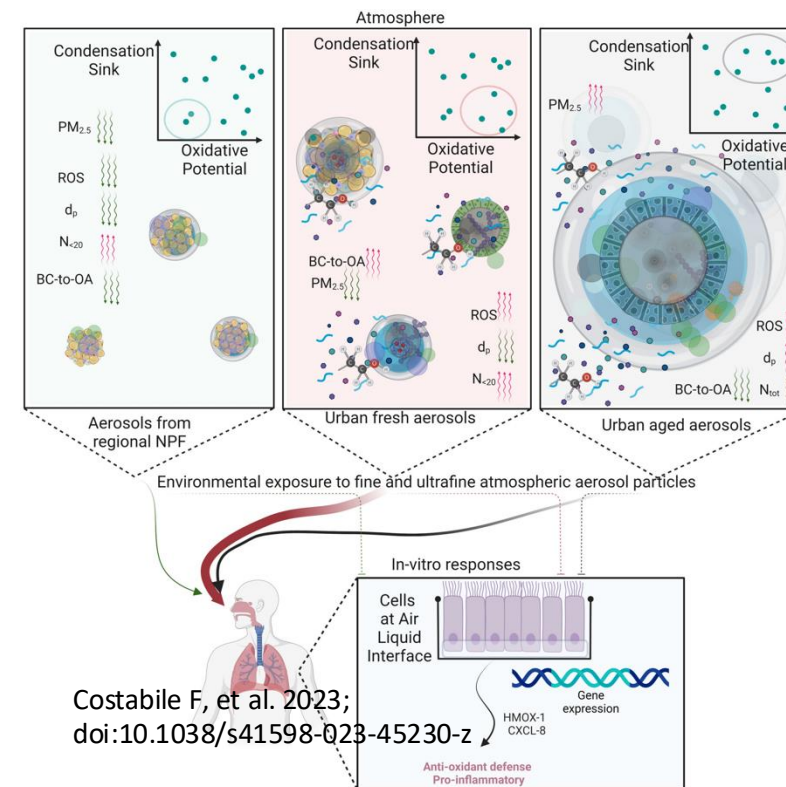
Air pollution proxies

Which specific characteristics of urban pollution induce oxidative stress? How do we measure them?

Giammona A, Gervasoni C, di Iulio G, et al. 2025. *Environmental Toxicology and Pharmacology*.



PAH's, surface properties, particle size, and transition metals, are potent oxidants or able to generate **reactive oxygen species (ROS)**

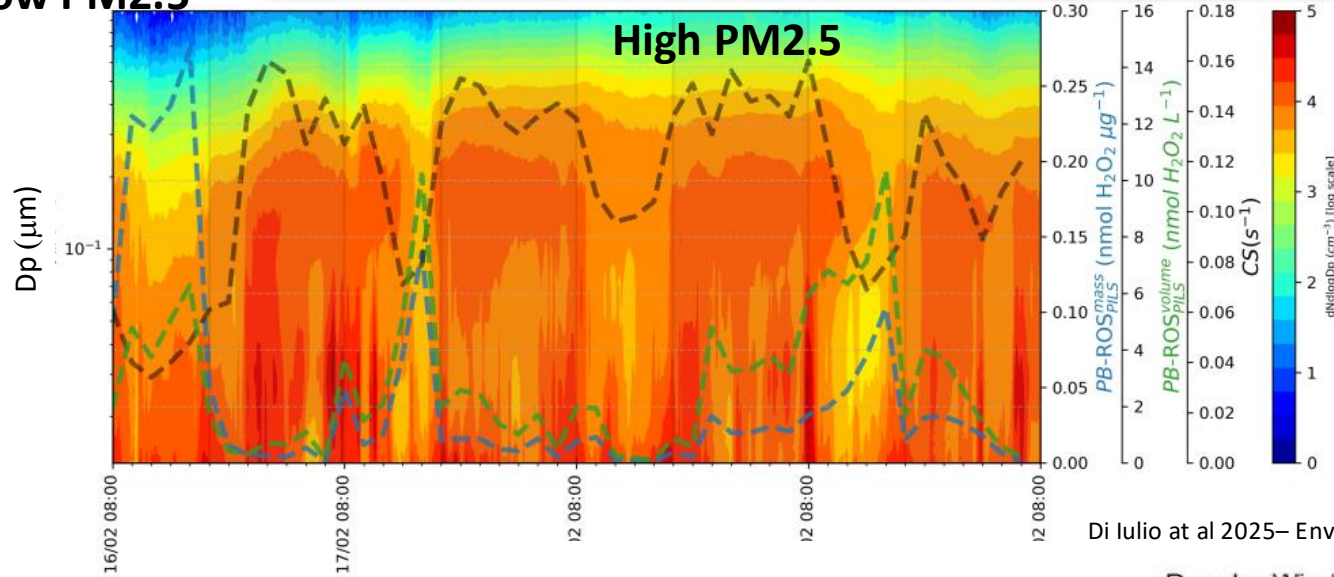


Exposure to env stressors

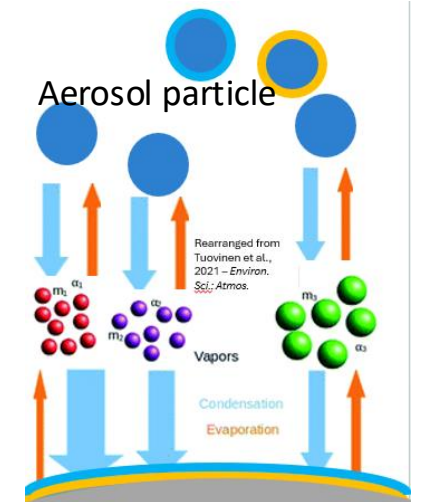
Urban air pollution and urban climate

Low PM2.5

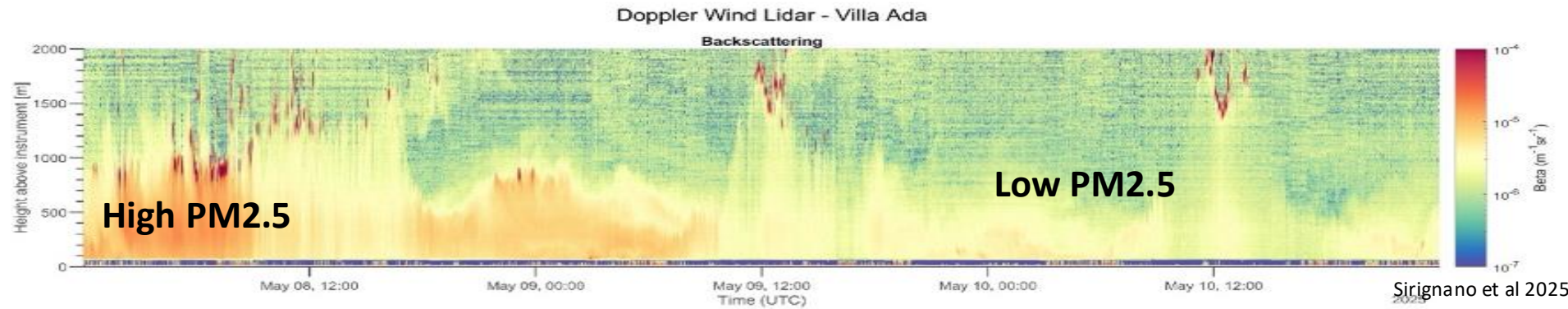
Association between particle-bound Reactive Oxygen Species and urban nanoparticles



Di Iulio et al 2025- Env. Poll



Urban air pollution must be examined within the broader context of urban climate

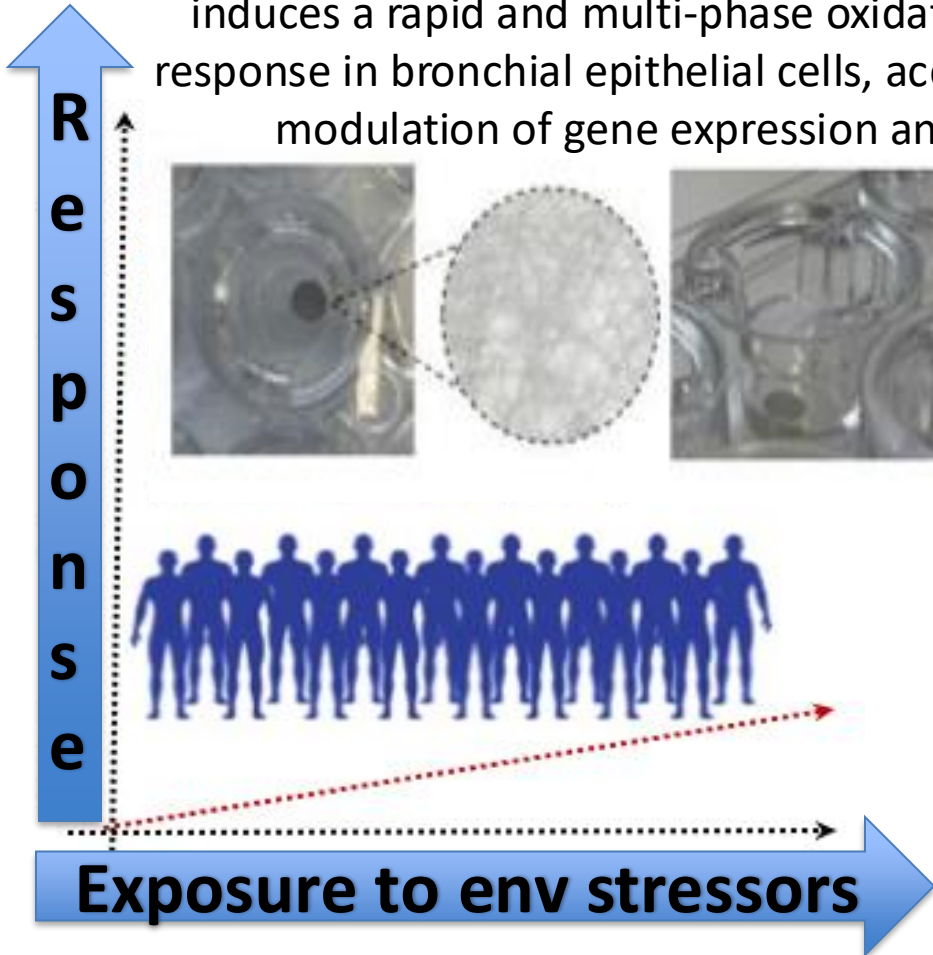


Sirignano et al 2025- Atm

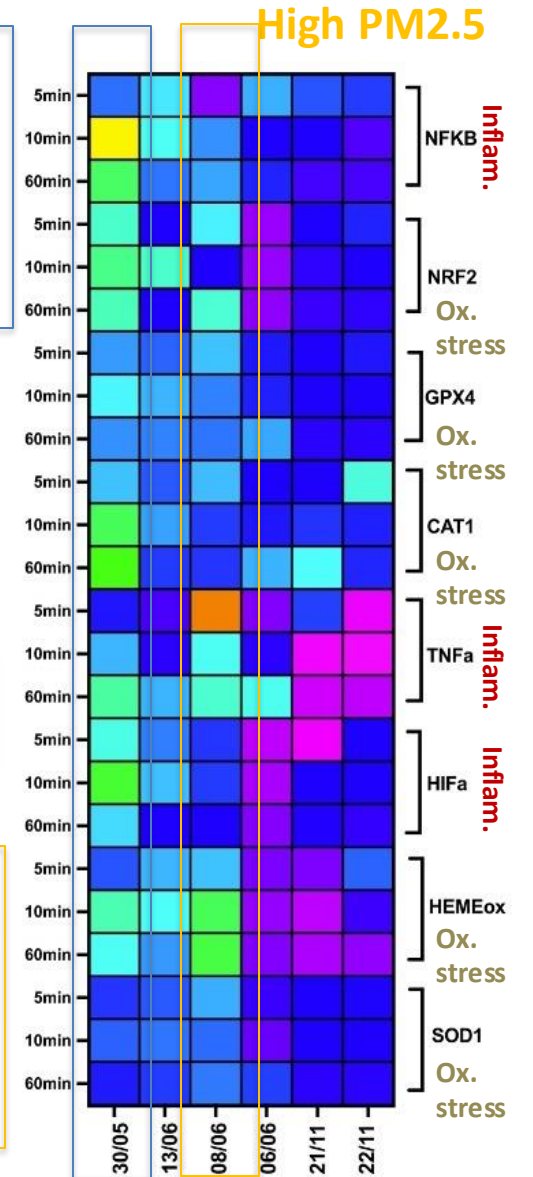
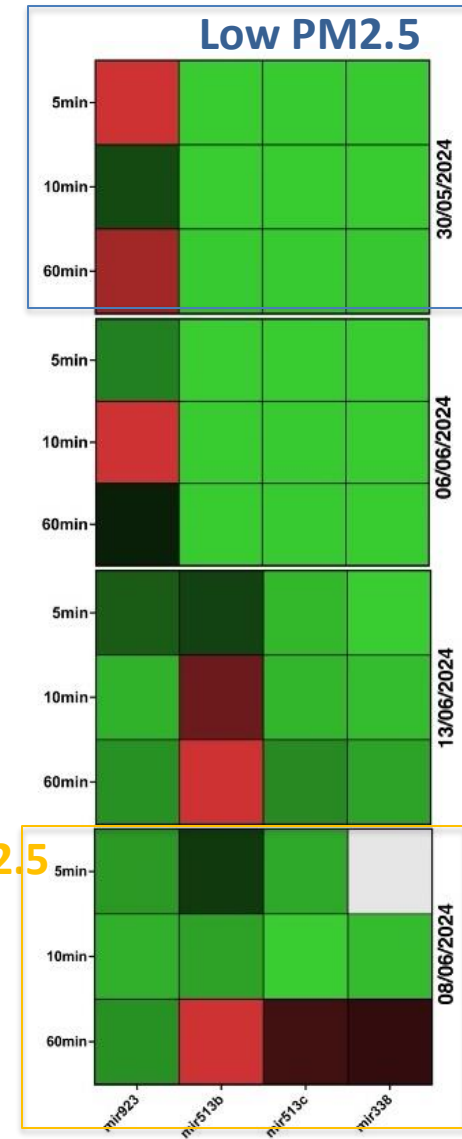
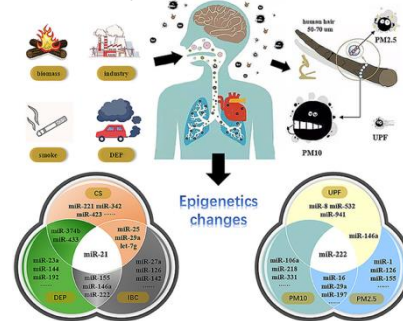
Urban Health

Humans (in-vitro)

Exposure to urban environmental stressors (traffic emissions), induces a rapid and multi-phase oxidative and inflammatory response in bronchial epithelial cells, accompanied by extensive modulation of gene expression and miRNA profiles.



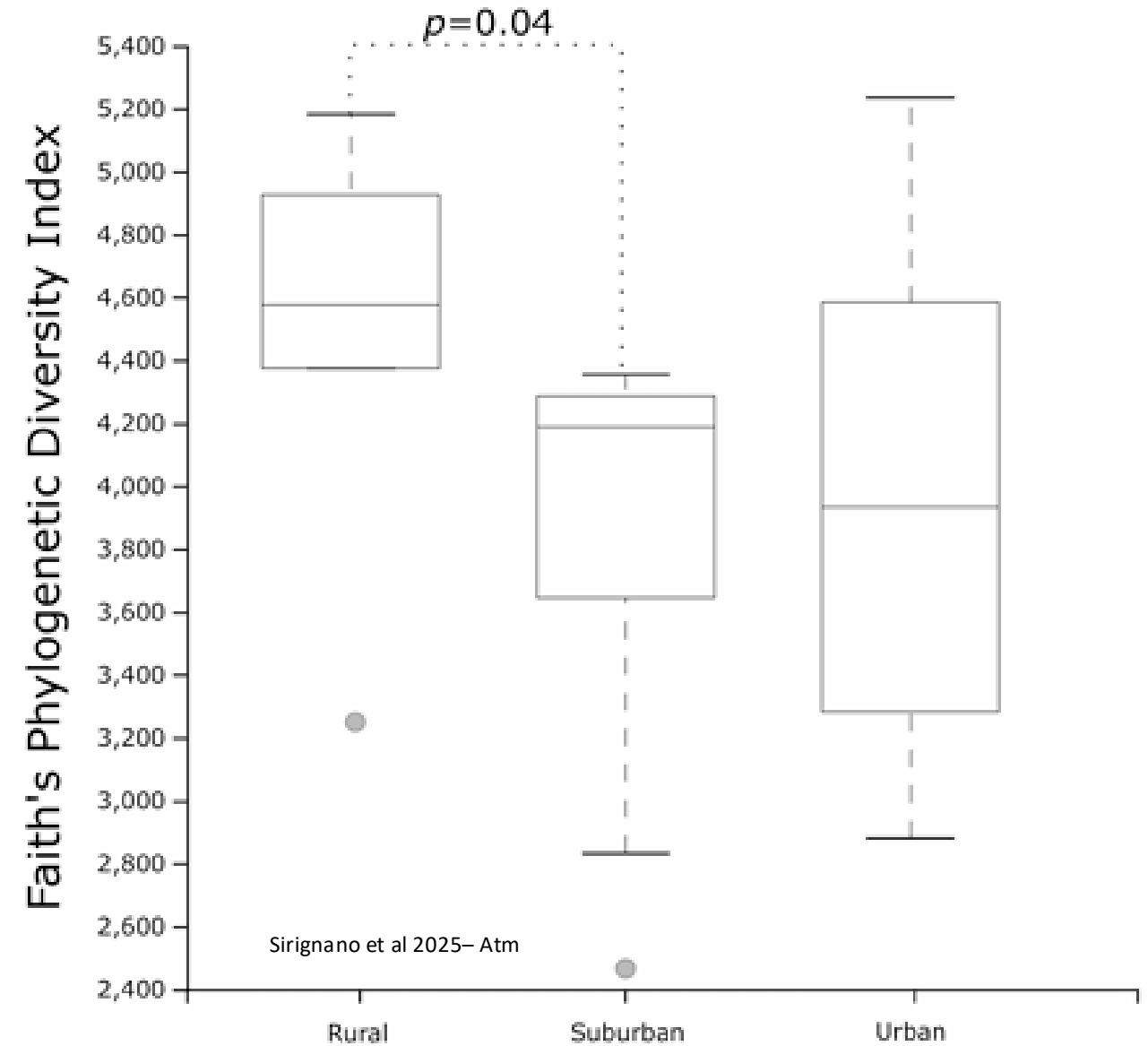
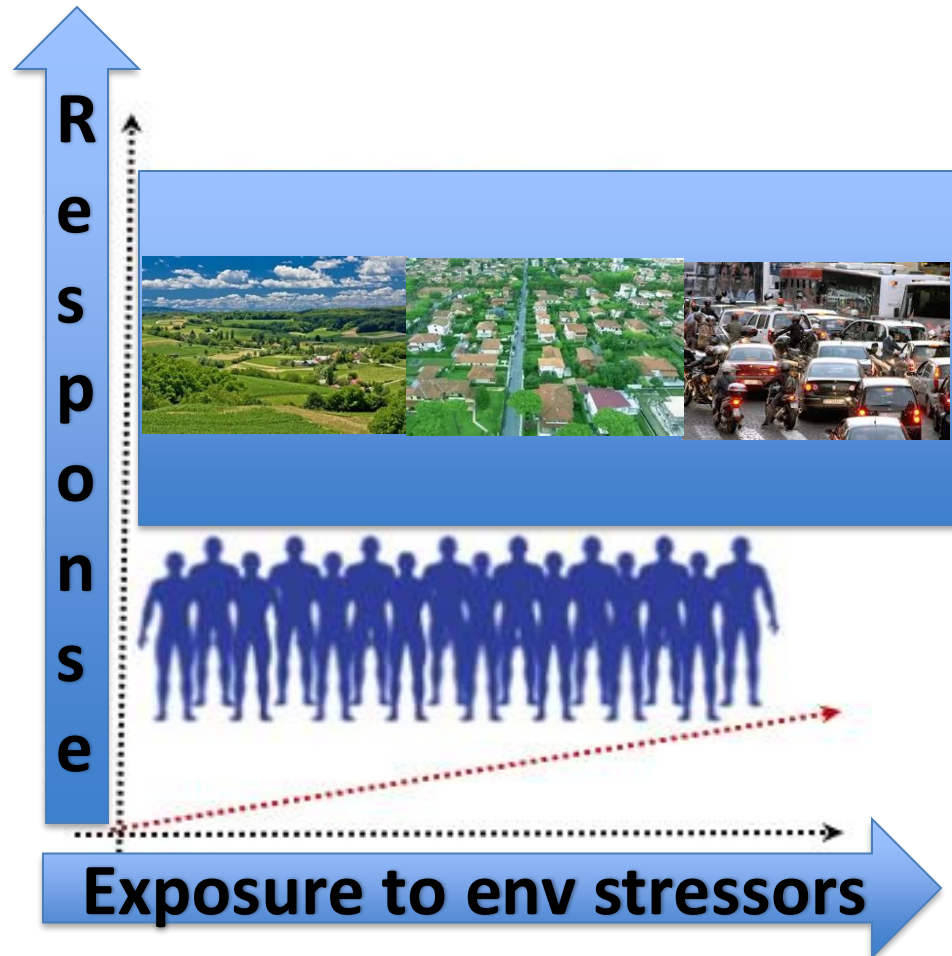
Cheng M, et al., 2020
doi:10.1016/j.envpol.2020.113961



Sirignano et al 2025– Atm

Urban Health

Humans (gut microbiota)



Urban Health Vegetation

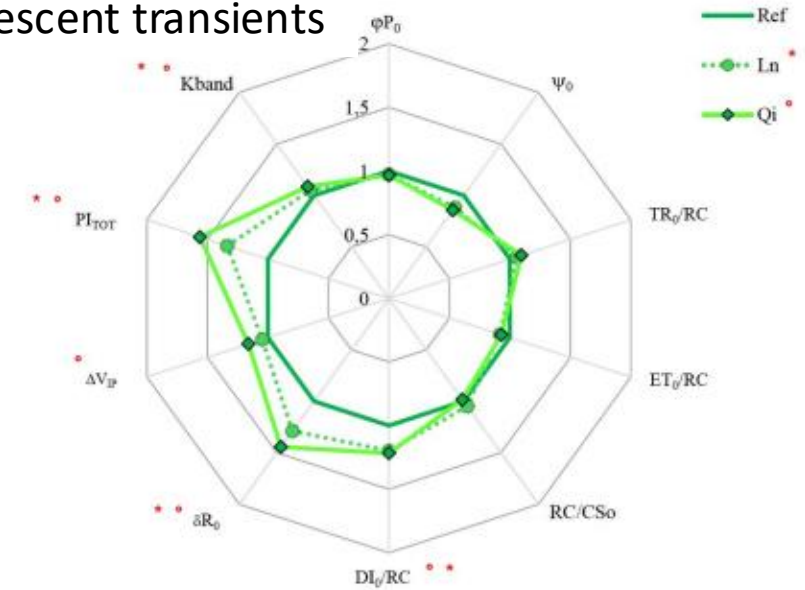
Functional trait alterations observed in urban trees exposed to roadside pollution point to early signs of oxidative and thermal stress.



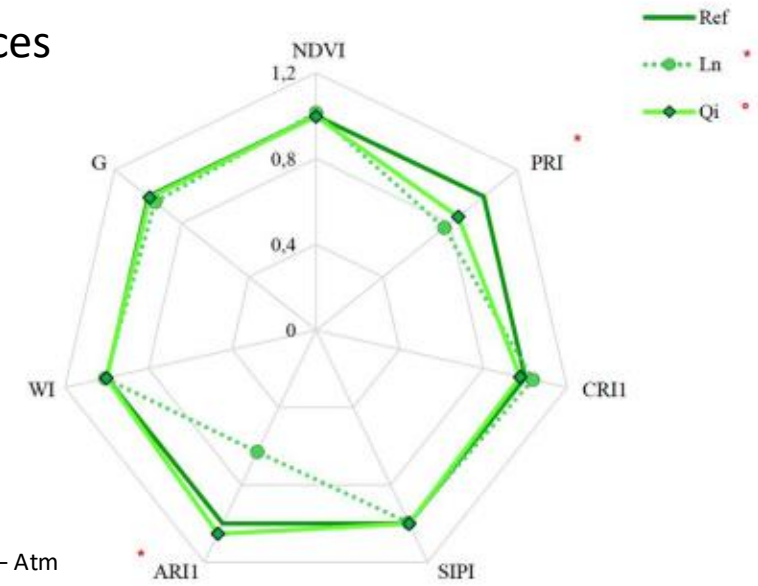
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Exposure to env stressors

fast fluorescent transients



reflectance indices



Sirignano et al 2025– Atm

Conclusions

The complex urban exposome scenario must be examined within the broader context of urban climate and ecosystem complexity.

Urban environments are prone to produce oxidative stressors.

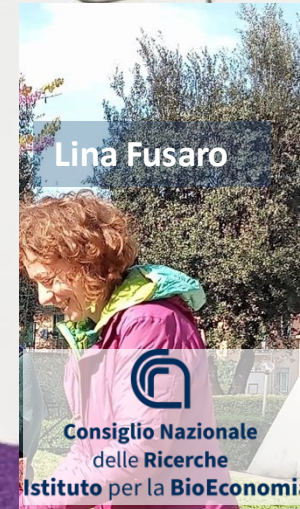
Exposure to urban oxidative stressors induces a rapid response in bronchial epithelial cells

Differences in gut microbiota diversity across urban, suburban, and rural settings suggest environmental influences on microbial composition.

Functional trait alterations observed in urban trees exposed to roadside pollution point to early signs of oxidative and thermal stress.



Thanks to all who are adding their piece to this puzzle, making the whole greater than the sum of its parts



Silvia Canepari, Simona
Ceccarelli, Marisa Di Pietro,
Simone Filardo, Alice Traversa



SAPIENZA
UNIVERSITÀ DI ROMA



Daiane De Vargas Brondani, Chiara Anselmi, Stefania Argentini, Carlo Calfapietra, Giampietro Casasanta, Giorgio Cattani, Hellas Cena, Tony Christian Landi, Rosa Coluzzi, Rachele De Giuseppe, Annalisa Di Cicco, Alessandro Domenico Di Giosa, Alessandro Di Menno di Bucchianico, Oxana Drofa, Maria Cristina Facchini, Raffaella Gaddi, Alessandra Gaeta, Laura De Gara, Vito Imbrenda, Antonia Lai, Stefano Listrani, Lorenzo Marinelli, Lorenzo Massimi, Maria Cristina Monti, Luca Mortarini, Marco Paglione, Danilo Ranieri, Eleonora Rubin, Andrea Scartazza, Rosa Sessa

DISCLAIMER:

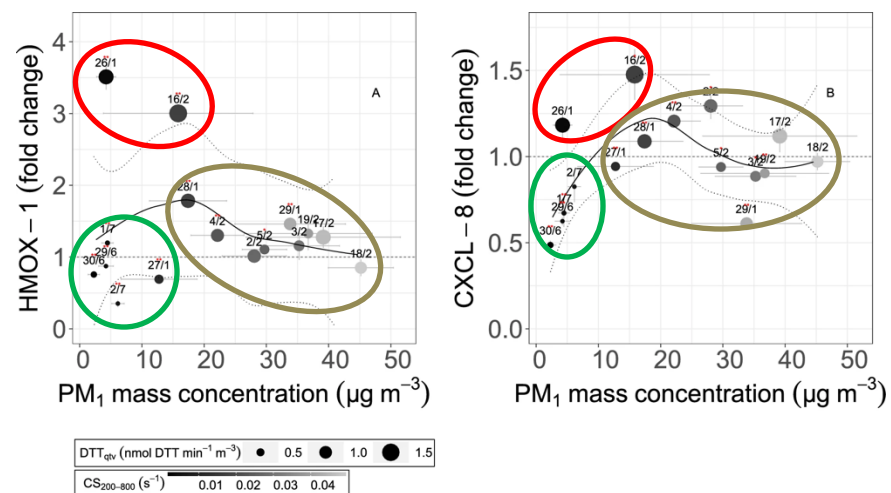
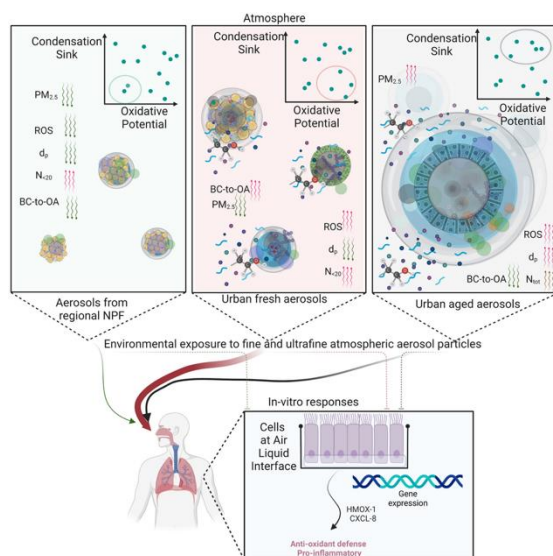
Just because this is a transdisciplinary talk doesn't mean I'm a walking encyclopedia. It just means I'm equally confused in several fields at once!



“The first principle is that you must not fool yourself—and you are the easiest person to fool.” — Richard P. Feynman

Introduction

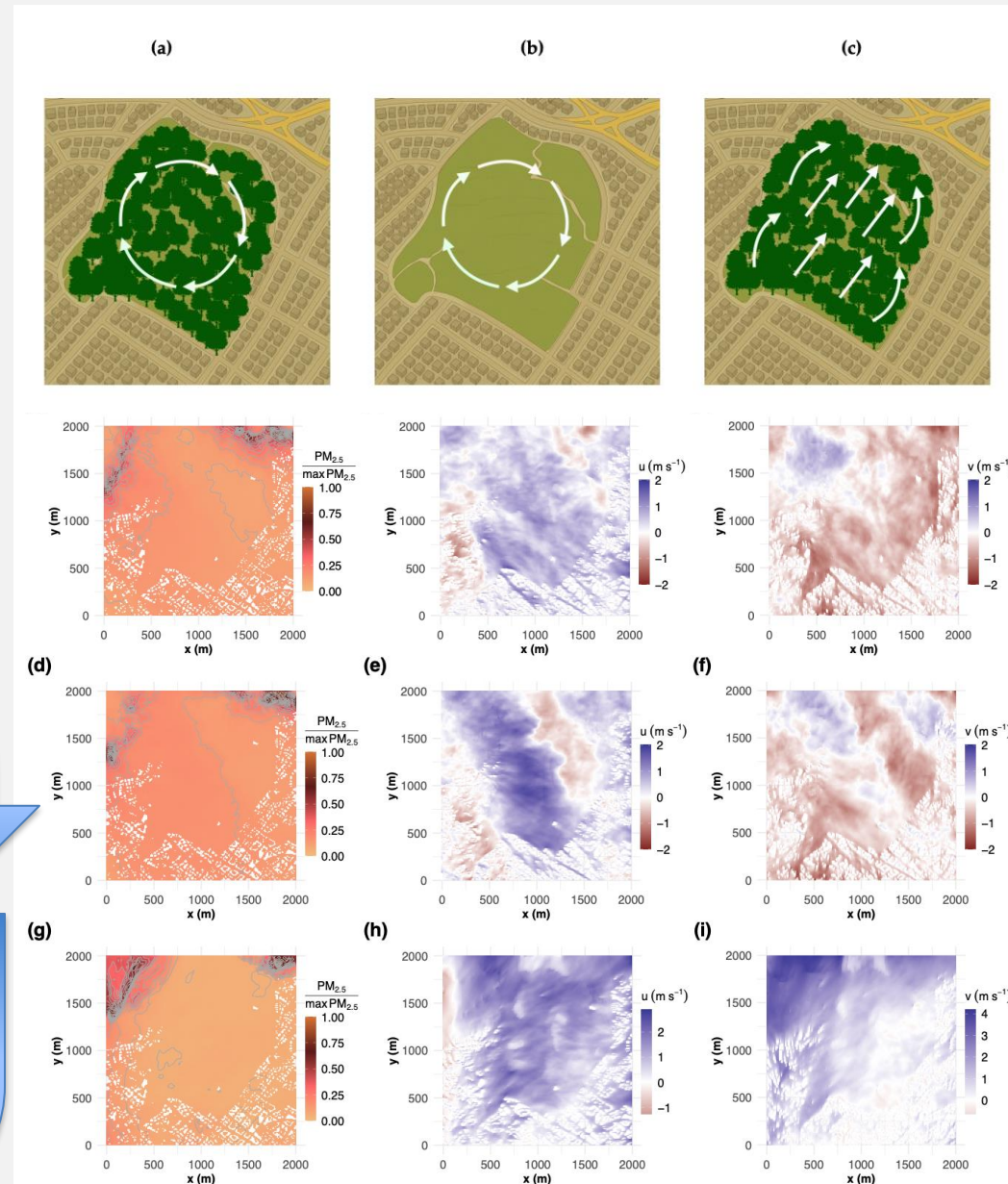
- PM mass concentration does not represent particle size distribution, particle chemistry, or the ability to generate ROS.



External Urban Exposome

RESULTS:
PM_{2.5} Dynamics &
Modeling

feedback mechanisms between
vegetation and atmospheric conditions,
where urban greenery not only
mitigates pollution but also influences
microclimate and exposure dynamics.



Exposure

