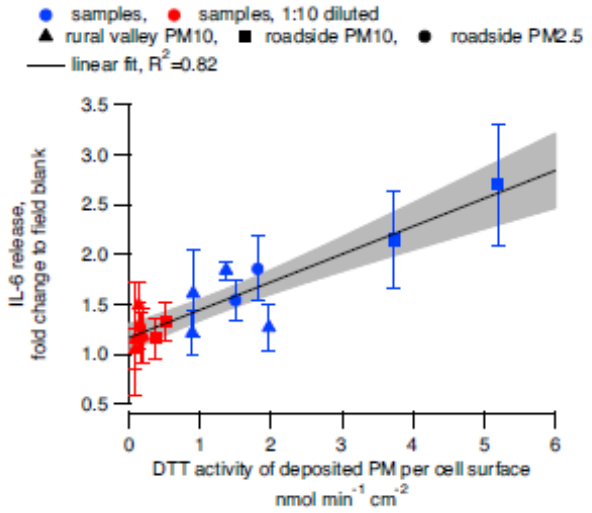
Task2.2 Oxidative potential (OP) of urban PM and PM components

Participants: CNRS, PSI, ICL, UOB, NOA, FORTH, CSIC

Presentation prepared by Gaëlle Uzu and Pamela Dominutti,
IGE, CNRS

Context

- EU regulation relies on PM mass to prevent health impacts
- All PM is not equal as it applies to toxicity



Urban PM are more inflammatory for lungs than rural PM

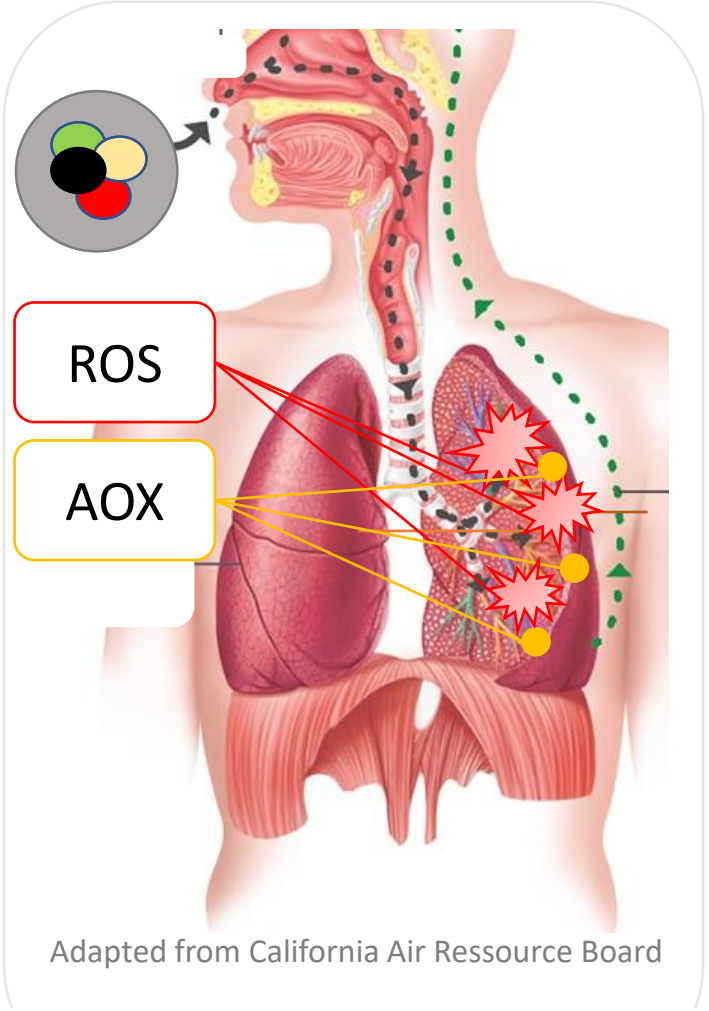
Daellenbach et al., 2020

- PM Exposure still not constrained: cocktail effects, size, chemistry, solubility and ageing effects are poorly documented
- Need for additional health exposure metric

Air pollution is a health public issue

Ambient particles are highly diverse: several sources and physico-chemical properties

ROS: Reactive Oxygen Species
AOX: Antioxidants



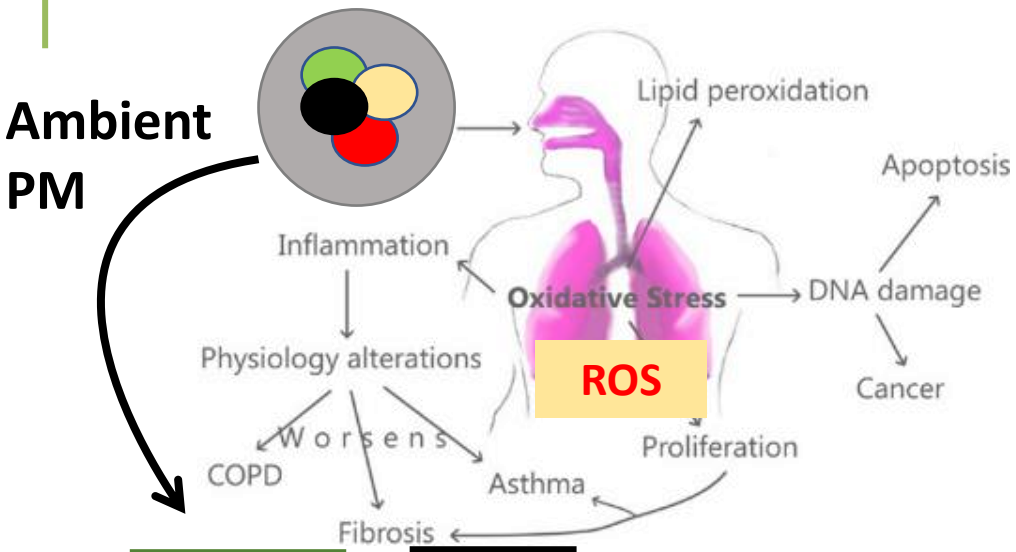
Adapted from California Air Ressource Board

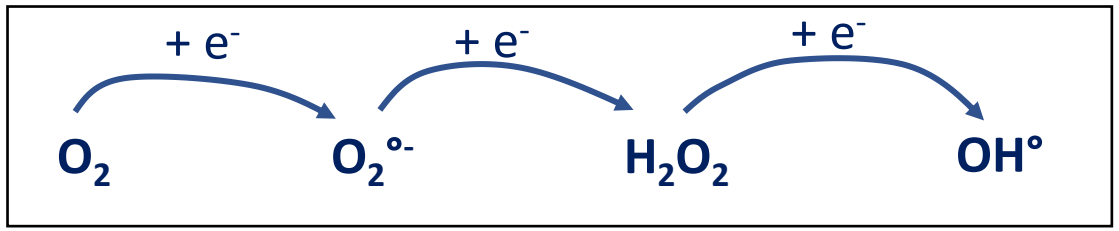
Ambient particles (PM) carry "redox-active molecules" or components which can induce ROS

ROS > AOX → **oxidative stress**

Adverse Health Outcomes

How the particles generate ROS?





Organics
Quinones
PAHs
HULIS

Metals
Mn
Cu
Zn
V

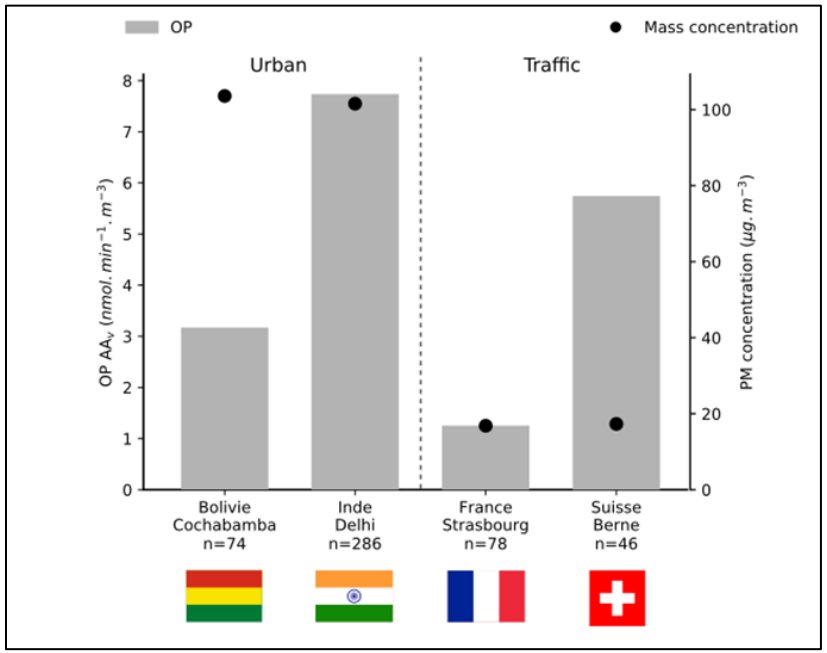
Redox-active molecules

The ROS production is often initiated by the interaction between antioxidants and the redox-active species of the PM → initiation of the "ROS cascade "

How to mimic such physiological process of oxidative stress?

Oxidative potential: capability of PM to oxidise the lung environment
Principle : Depletion of lung anti-ox in presence of PM.
When? year 2005 to now <15 groups leading OP developments, >50 groups of users

Pros: Faster than cells tox assays, acellular, integrative of PM properties (size, composition, solubility)
Cons : exogenous ROS, not endogenous ROS



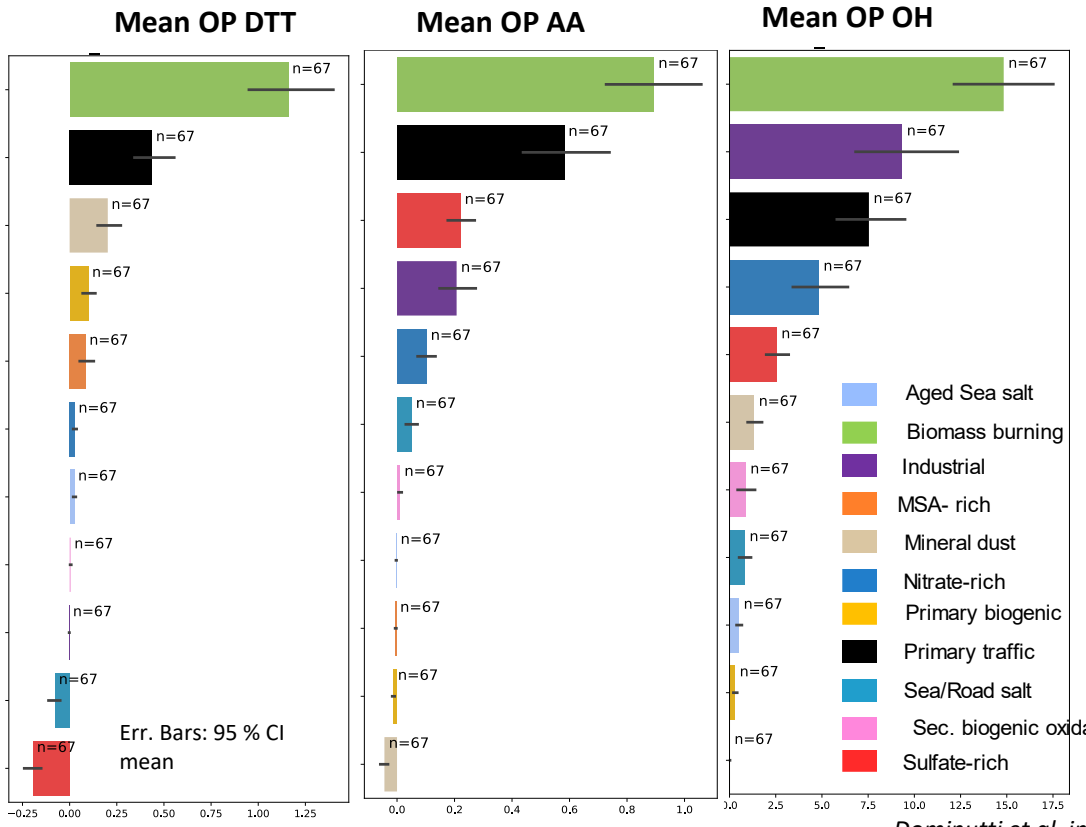
Internal data, IGE

For equal PM mass, differences of OP according to the site typology and PM composition

An expanding research field

- ✓ **Several offline methodologies**
- ✓ **Several probes: AA, DTT, DCFH, GSH, FOX,…**
- ✓ **Link between OP and PM sources not fully investigated**
- ✓ **Links between OP and acute/chronic diseases are limited**
- ✓ **Available time-series limited**
- ✓ **No standard test so far**

OP apportionment, cold season, Alpine Valley



Dominutti et al, in prep

OP apportionment differs according the OP assay , which source ranking to provide for stakeholders?

Program of Task 2.2 for OP evaluation

- **How to fill some gaps?**
  - ✓ Global OP offline intercomparison using a simplified protocol
  - ✓ Intensive field campaign for OP ROS online intercomparison (end 2023, gathered withT4.4)

- **Deliverables**
  - ✓ Harmonization of oxidative potential of PM monitoring for application in pilots (D.2.3 : T0 + 18)
  - ✓ Epidemiology analysis of the short-term health outcomes of OP existing values (D2.4: task 2.1 leading)

Advances offline OP intercomparison

1) Requirements for the determination of repeatability and reproducibility of a standard measurement method

INTERNATIONAL STANDARD **ISO 5725-2**

Second edition
2019-12

Each combination of a laboratory and a level is called a cell of the precision experiment. In the ideal case, the results of an experiment with *p* laboratories and *q* levels consist of a table with *pq* cells, each containing *n* replicate test results that can all be used for computing the repeatability standard deviation and the reproducibility standard deviation. This ideal situation is not, however, always attained in practice. Departures occur owing to redundant data, missing data and outliers.

⇒ The method of analysis consists of estimating (the mean) *m* and the precision (*sigma*) at each level *q (= sample)* separately…

⇒ **Key messages from the Iso 5725-2**

1 sample tested in triplicates could be enough

Statistical power relies mainly on the number of participants

Advances offline OP intercomparison

Technical aspects acknowledged by task-members

1) Basics/ requirements of OP intercomparison

- 10 groups needed to participate at least
- 6 samples to be tested
- Simplified OP DTT protocol developed at CNRS
- To be performed by each research group + all “home” protocols

2) Anonymous data treatment to be done by Joint Research Center

3) When? January-February 2023

Advances offline OP intercomparison

- **16 groups confirmed so far**
  - 12 from EU
  - 3 from USA
  - 1 from Canada

- **6 different extracted samples to be tested (triplicates)**
  - Blank
  - Urban background
  - Traffic
  - BB
  - Naphthoquinone
  - Copper

Advances on simplified OP protocol

Choice : OP DTT voted by task members

1) Oldest assay with the most hindsight
2) Most widely used
3) Easy to deploy (probably 70 % of groups users)
4) Probably the test with the most promising link with health (Saffari et al., 2014, Bates et al., 2015, Borlaza et al., 2022)

Advances on simplified OP DTT protocol

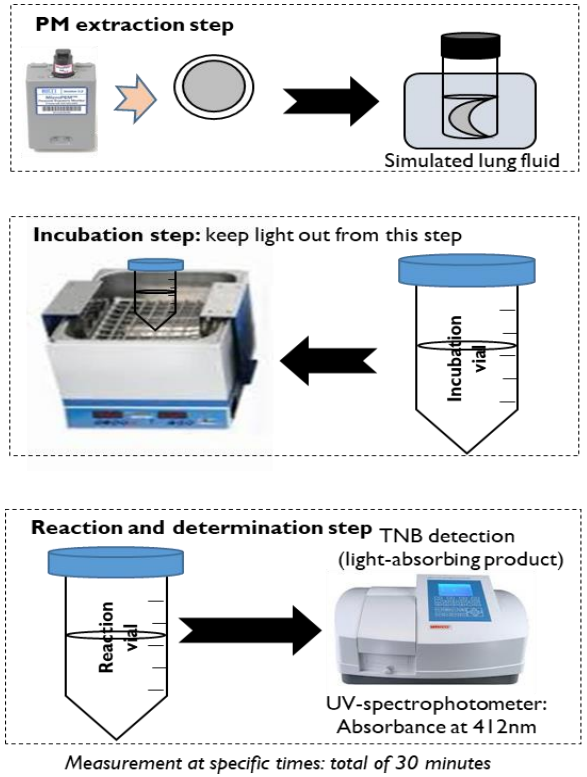
CNRS worked on a simplified DTT protocol

1) NOA-FOTH/KC and CNRS delivered their own protocol in July 2022

2) Tested all 3 protocols of NOA-FORTH/CNRS/KC for 3 samples to know how to perform them

3) Tested differences of the 3 assays in September 2022 and discussion in the group.

4) Delivery of the simple protocol : November 2022



Will be available for spectrophotometer:

- ✓ Platereader
- ✓ Quartz Cuvette (single measurement)

Borlaza et al., 2022

Next steps

- Reference samples to be done by KC (traffic and UB) and FORTH (BB)
- Homogeneity tests (*15 replicates per sample) : Nov-Dec 2022, CNRS
- Shipment to participants : January 2023
- Treatment of intercomparison results by JRC

- Scientific discussion and valorisation : mid 2023

Thank you very much for your attention!

Breathe!!!

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