

The ACTRIS support for the implementation of the new AQ Directive

RI-URBANS

Research Infrastructures Services Reinforcing Air Quality Monitoring Capacities in European Urban & Industrial Areas

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ACTRIS ERIC and UHEL

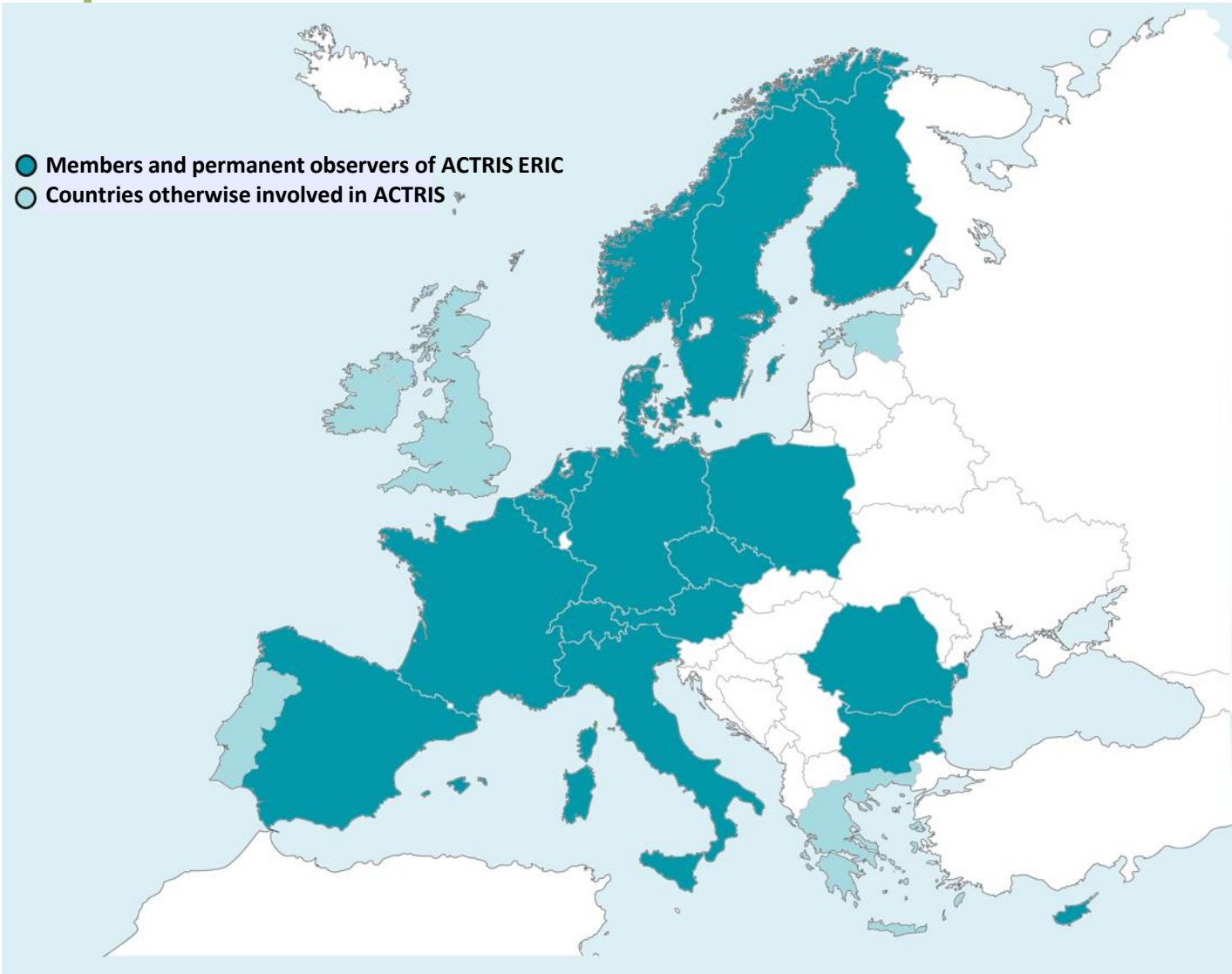
RI-URBANS (101036245)
8/9/2025



Main message:

- Implementation of the new air quality directive is a challenging task!
- Requires an open, active and constructive collaboration in EU, Member States, regional and local levels
- Individual pathways and priorities for the different Member States
- Important to utilize the expertise and established roles of different organizations (e.g., EEA, AQUILA, ACTRIS, EURAMET)

ACTRIS ERIC established on 25th April 2023



***17 member countries: Austria
Belgium Bulgaria Czechia Cyprus
Denmark Finland France Germany
Italy Netherlands Norway Poland
Romania Spain Sweden
Switzerland***

***One in membership process:
Greece***

***Three engaging countries:
Estonia Ireland Portugal***

ACTRIS support

- In training
 - material on-line for UFP, size distribution and eBC measurements (ACTRIS, RI-URBANS, AQUILA)
 - Discussions on new training events in collaboration with AQUILA, EEA and EMEP
- In development of NRT data workflows
 - On-going with EEA, AQUILA and ACTRIS DC
- Support for the new supersites
 - Instrumentation, data flow, co-location
- In coordinating and planning instrument harmonization / calibration structures
 - discussions with AQUILA, ACTRIS

T5.2 Establishment of the measurement quality framework



European
Environment
Agency



Schedule:

Training #1: 23 th January 2025	09:30 – 11:30 CET	Aerosol particle number concentration
Training #2: 27 th January 2025	09:30 – 11:30 CET	Aerosol particle number size distribution
Training #3: 11 th February 2025	09:30 – 11:30 CET	Equivalent Black Carbon
Training #4: 19 th September 2025	09:00 – 11:30 CET	Urban mapping of pollutants and citizen science
Training #5: 29 th September 2025	09:00 – 11:30 CET	Source apportionment

Available as recordings!

On Air quality supersites

- 1 urban background supersite per 10 M people
 - EU population 450 M → 45 urban background sites
 - Exceptions for small population countries
 - 1 site < 19 M
 - 2 sites for >20 M
- 1 rural background site for 100 000 km²
 - EU surface area 4.2 M km² → 42 rural background sites
 - Exceptions for small countries

→ Approximately 80-90 supersites in Europe

- hot-spots need to be considered separately
 - Increases harmonized measurement for UFPs (0.5—1-2 per country = 14-27-54 sites)
- Supersites are being established independently by the Member States / Regions
- No general oversight or network optimization at European level

ACTRIS aerosol in-situ sites as a reference:

Currently approx 90 ACTRIS sites measuring UFP and eBC

Served by two calibration centres:

1) TROPOS in Leipzig, DE Germany

2) Czech Academy of Science in Prague, CZ

NOTE:

Estimation for the supersite number based on a simplified approach and should only be used as an order of magnitude estimation.

Standardization for UFP In-Situ Measurements

Microphysical: (UFP - ultrafine particles)

Aerosol Particle Number Concentration > 10nm

- EN 16976 - Ambient air - Determination of the particle number concentration of atmospheric aerosol
- ACTRIS follows the EN 16976 recommendations & quality assurance procedures

Aerosol Particle Number Size Distribution 10-800nm (mobility diameter)

- CEN/TS 17434 - Ambient air - Determination of the particle number size distribution of atmospheric aerosol using a Mobility Particle Size Spectrometer (MPSS)
- ACTRIS follows the CEN/TS 17434 recommendations & quality assurance procedures
- The CEN/TS 17434 is currently in the process to be upgraded to an EN.

Optical: (BC - black carbon)

Aerosol Particle Light Absorption Coefficient & Equivalent Black Carbon Mass Concentration

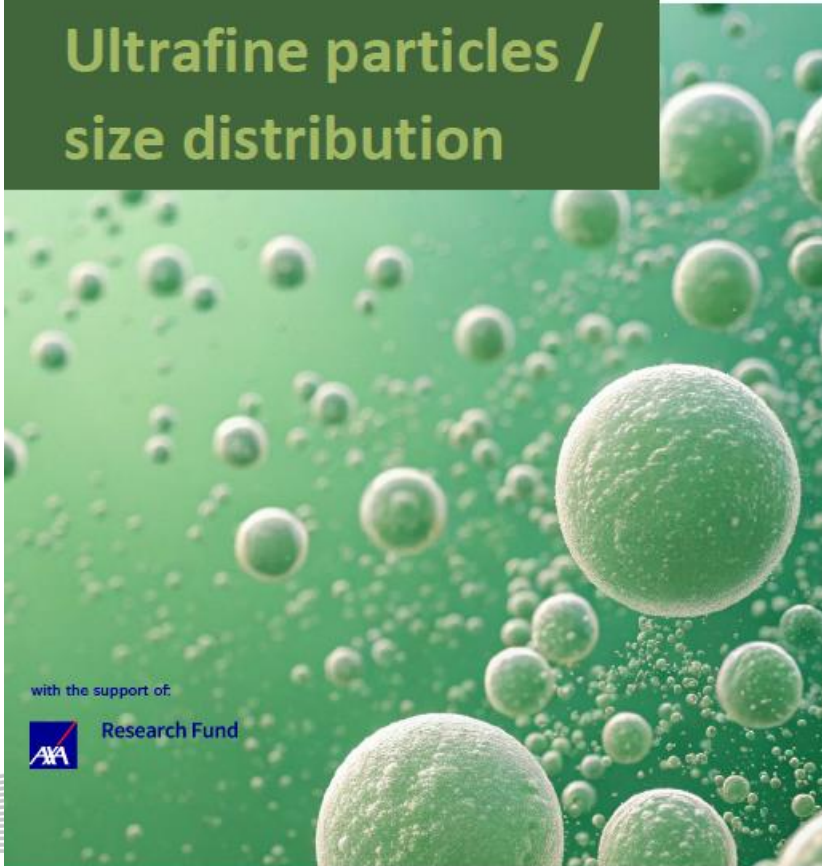
- No standardization document yet
- ACTRIS developed own recommendations & quality assurance procedures

Corresponding Service Tools (STs):



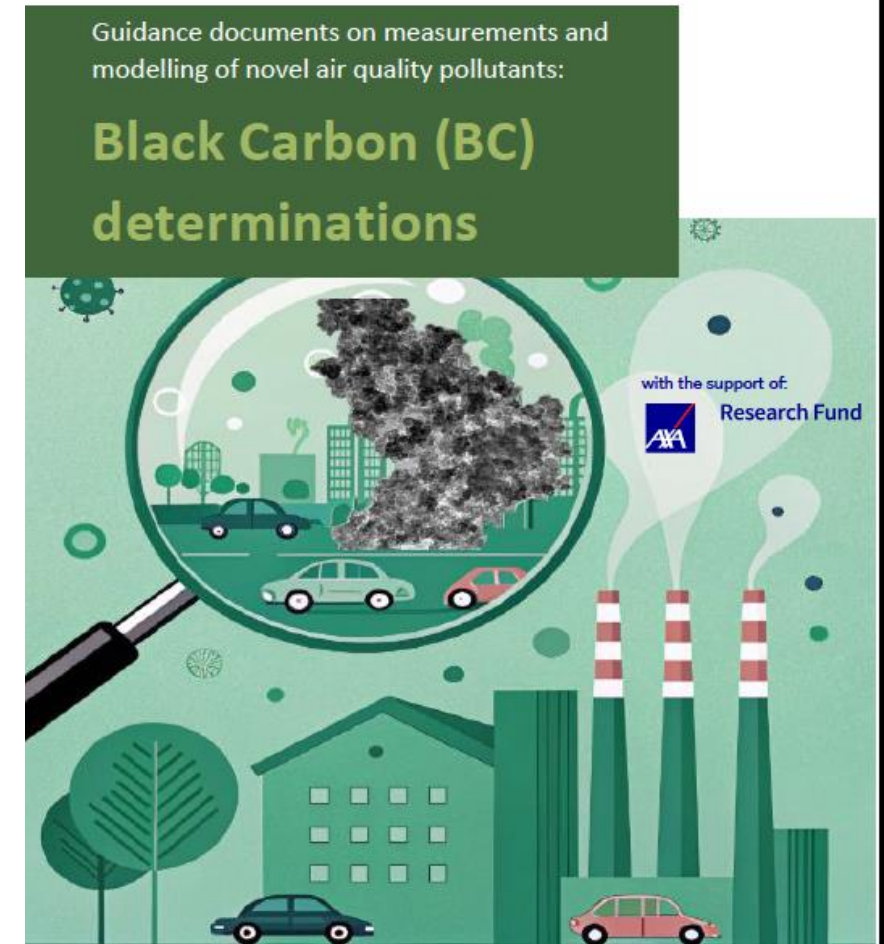
Guidance documents on measurements and modelling of novel air quality pollutants:

Ultrafine particles / size distribution



Guidance documents on measurements and modelling of novel air quality pollutants:

Black Carbon (BC) determinations



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Few practical examples



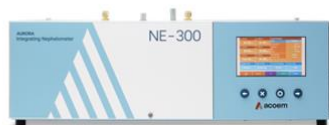
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ACTRIS Aerosol In Situ Real-Time Variables



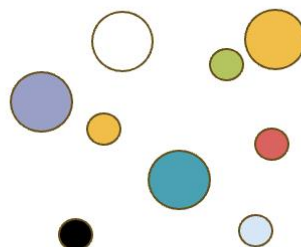
integrating nephelometer
aerosol particle light scattering
coefficient
aerosol particle light
backscattering coefficient



Filter absorption photometer
aerosol particle light absorption
coefficient



condensation particle counter
aerosol particle number
concentration



ACTRIS In Situ station

Continuous data provision:

- 24 h per day.
- 365(366) days per year.
- Except calibration periods.



particle mass spectrometer
aerosol particle chemical speciation



mobility particle size spectrometer
aerosol particle number size
distribution



European
Commission



Slide by Markus Fiebig, ACTRIS DC





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ACTRIS Tracegas In Situ Real-Time Variables



Photo: <https://agage.eas.gatech.edu/>

gas chromatograph / mass spectrometer (GC-MS)
volatile organic compound concentrations



Photo: <https://www.tesscorn-aerofluid.com/>

Proton Transfer – Mass Spectrometer (PTR-MS)
volatile organic compound concentrations



ACTRIS In Situ station

Continuous data provision:

- 24 h per day.
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- Except calibration periods.

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Photo: Teledyne

Chemiluminescence detector + photolytic converter
NO, NO₂, NO_x concentrations



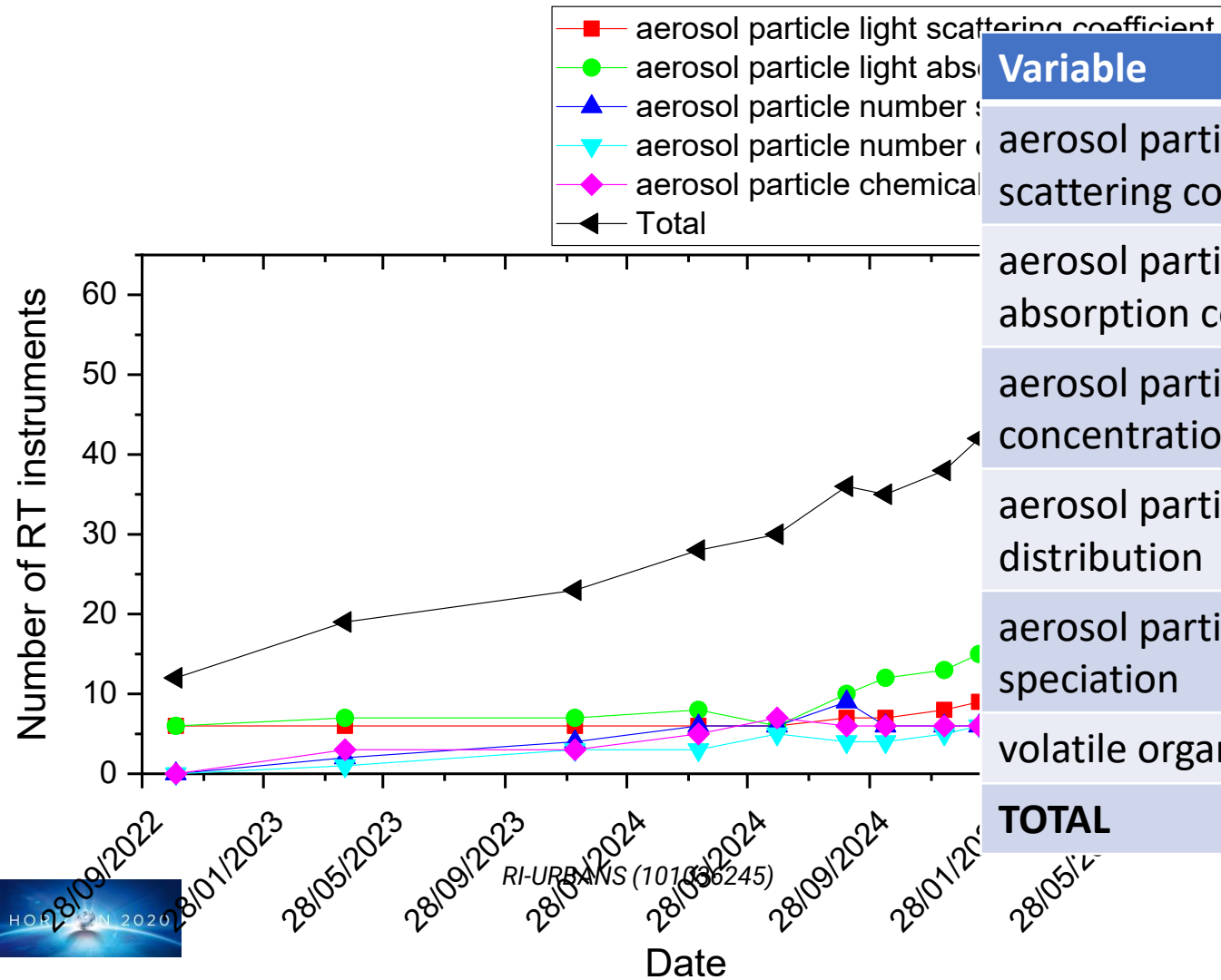
Photo: Thermo Fisher

UV differential absorption photometer
ozone concentration

emep

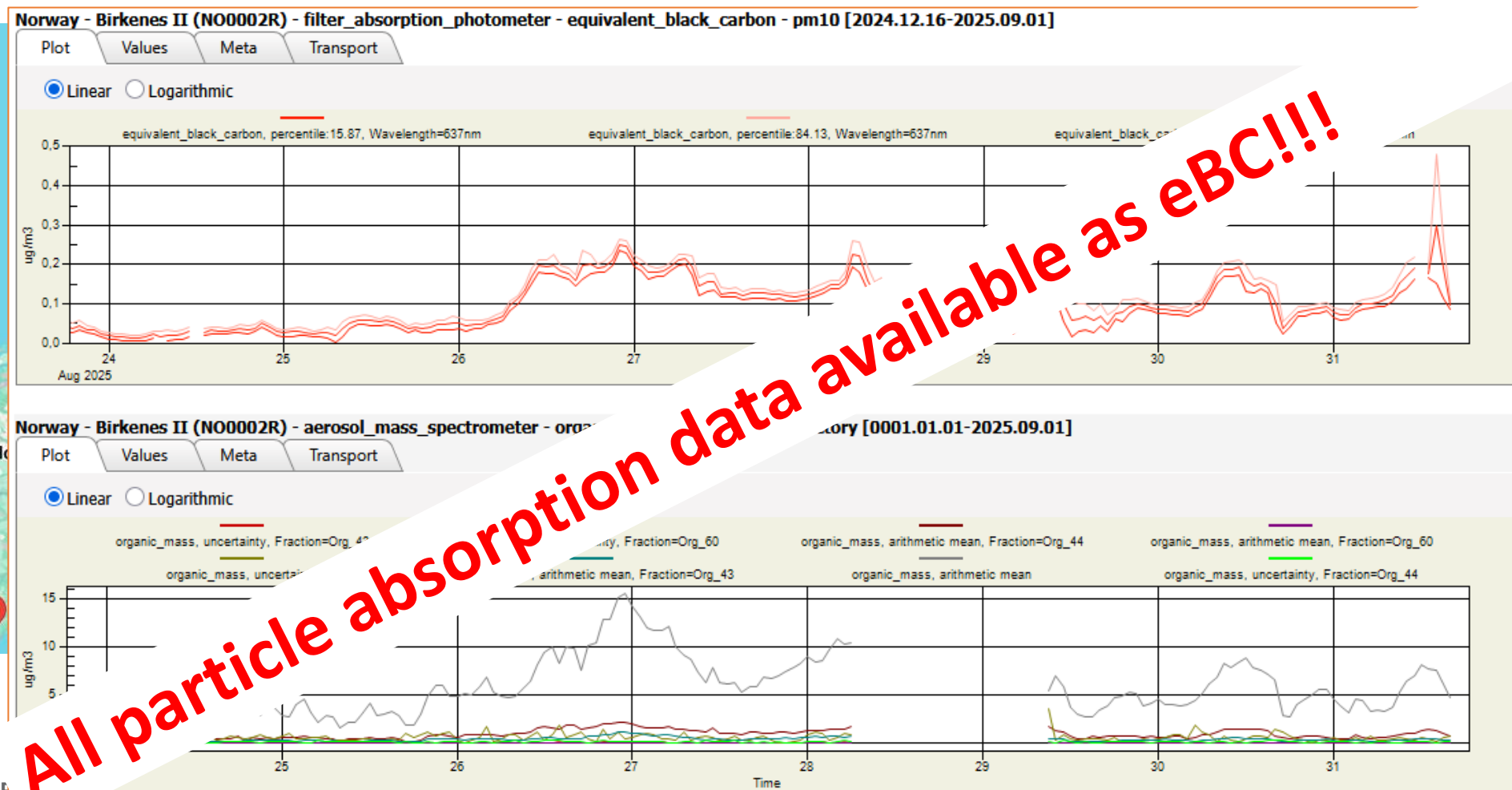
Number of Instruments Online

Slide by Markus Fiebig, ACTRIS DC

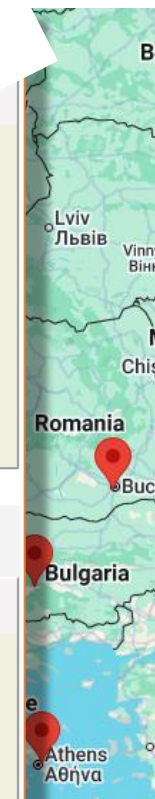


Variable	number
aerosol particle light scattering coefficient	14
aerosol particle light absorption coefficient	19
aerosol particle number concentration	8
aerosol particle number size distribution	9
aerosol particle chemical speciation	7
volatile organic compounds	4
TOTAL	61

Aerosol Particle Light Absorption Coefficient – Current Coverage



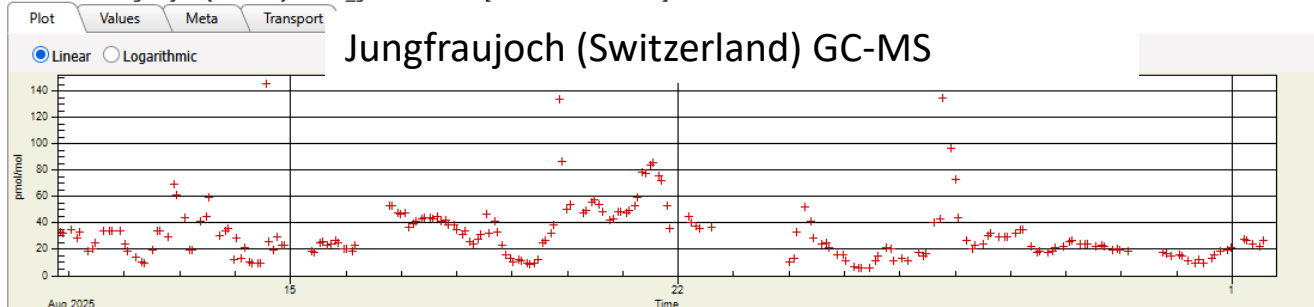
Slide by Markus Fiebig, ACTRIS DC



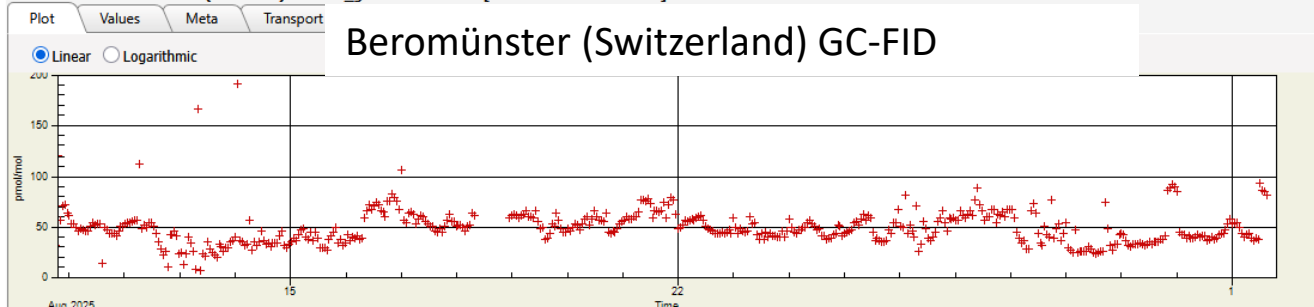
RT VOC Data from Pilot Stations Available!

Benzene (traffic/biomass burning)

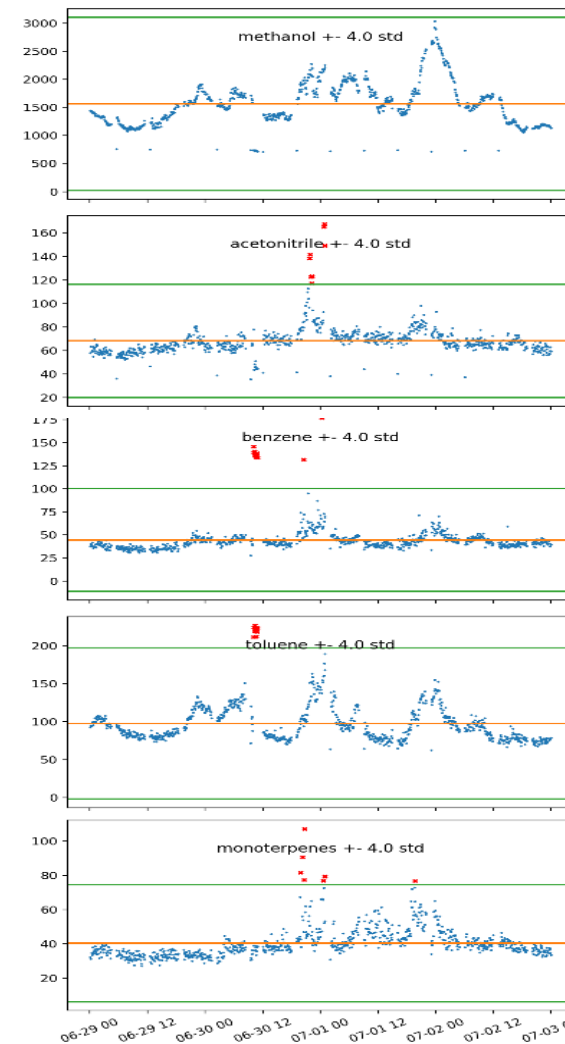
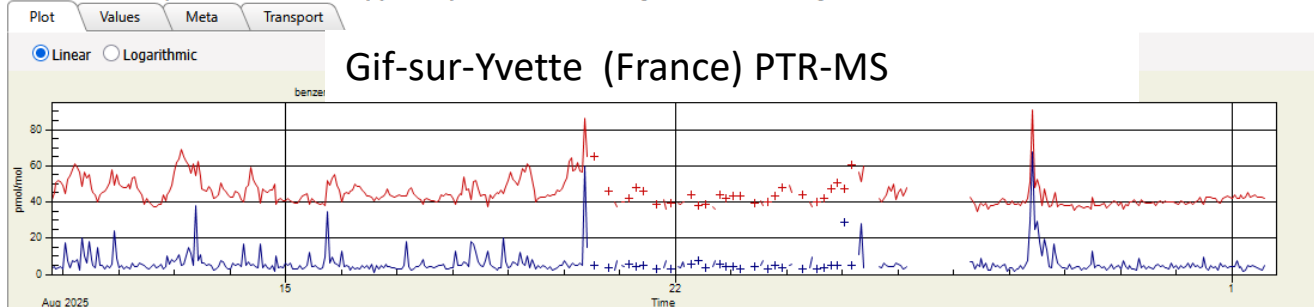
Switzerland - Jungfrauoch (CH0001G) - online_gc - benzene - air [2024.09.01-2025.09.01]



Switzerland - Beromünster (CH0053R) - online_gc - benzene - air [2025.01.01-2025.09.01]

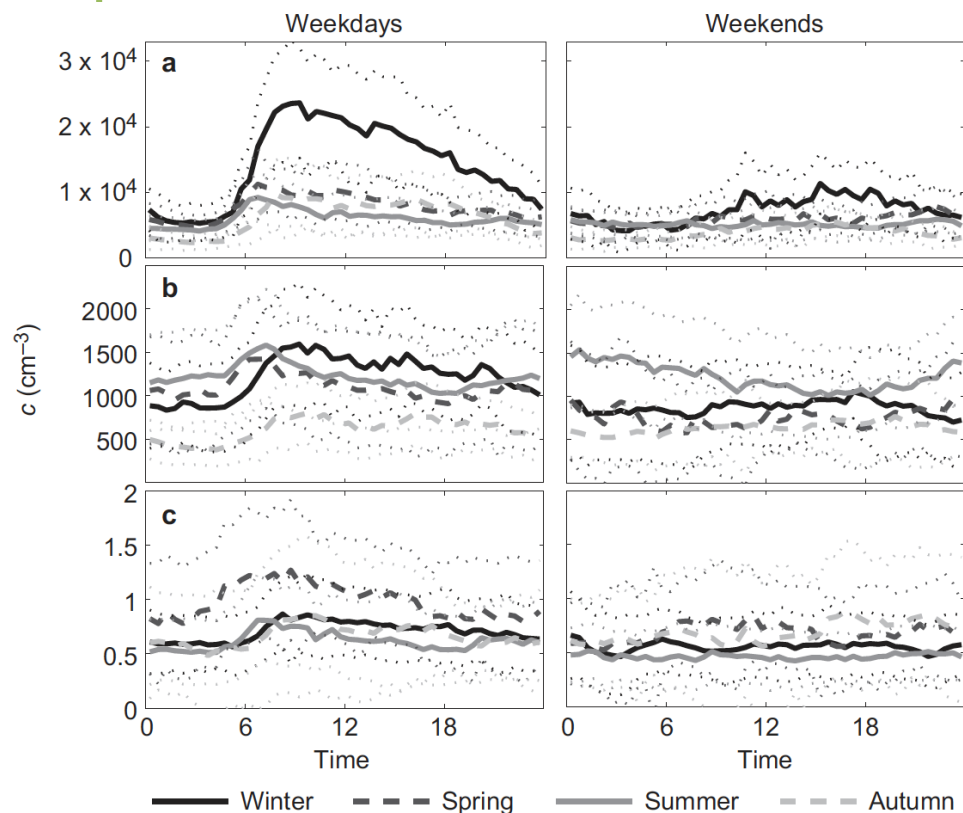


France - SIRT Atmospheric Research Observatory (FR0020R) - PTR-MS - benzene - air [2025.05.11-2025.09.01]



Slide by Markus Fiebig, ACTRIS DC

SMEAR III urban background site in Kumpula Campus in Helsinki



Diurnal cycle of UFPs (top), accumulation mode (middle) and coarse mode (bottom)

Example:

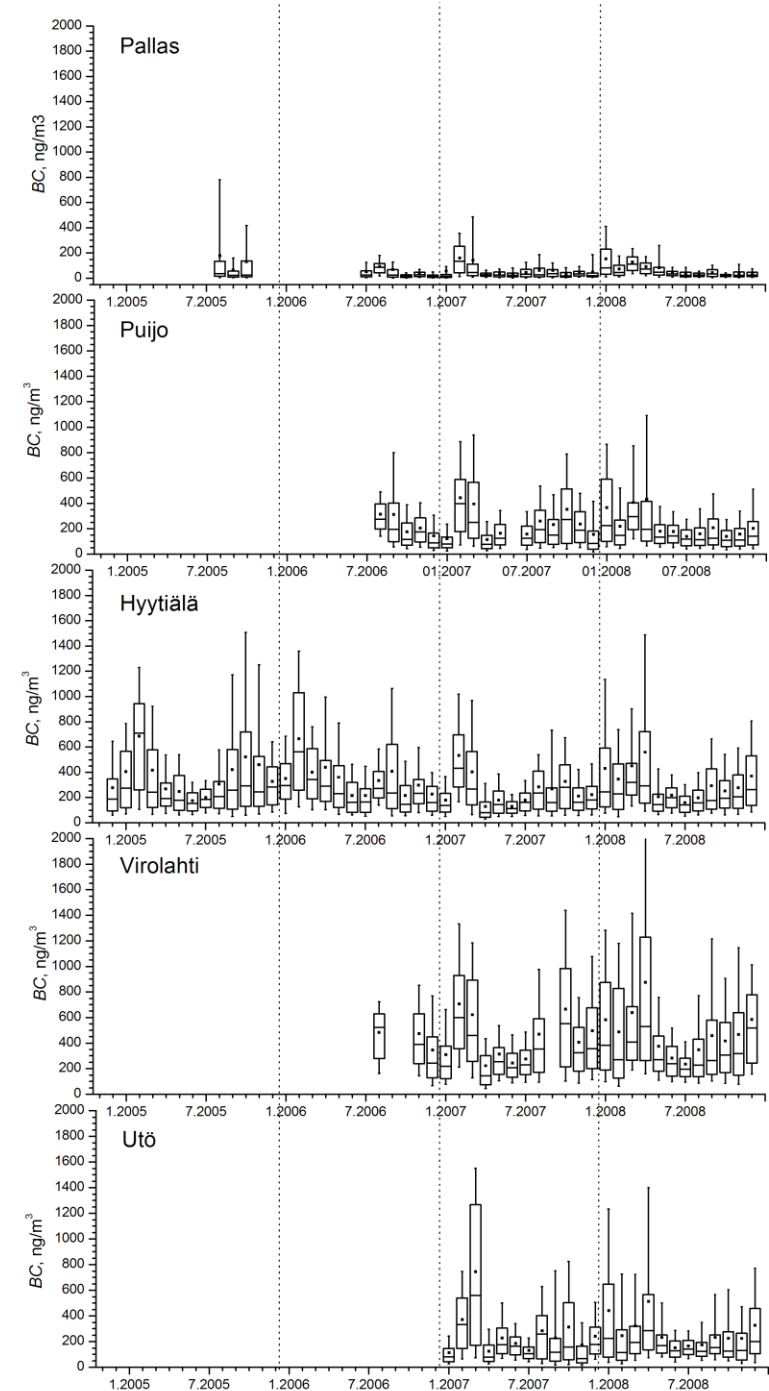
Finland



- Collaborative effort of University of Helsinki (UHEL), Finnish Meteorological Institute and Helsinki (FMI) Region Environmental Services (HSY)
- Aerosol size distribution and number concentration measurements since 2001
- Black Carbon measurements
- ACTRIS aerosol in-situ and trace gas in-situ observation site
- ICOS Ecosystem site

Rural background sites in Hyytiälä and Pallas

- Long-term observations since 1990s
- Background sites in boreal and sub-Arctic environment
- Already includes UFP, eBC measurements
- Contributes to ACTRIS, ICOS, eLTER and ANAEE infrastructures



What ACTRIS can offer:

- 1) Training and education, dissemination and outreach
- 2) Coordination, collaboration and cohesion in Member States
 - via ACTRIS National Contact Persons + national consortia + AQ community
 - Will facilitate scientific advances
- 3) Technical expertise and capacity building:
 - support instrument selection (through national contact points and scientific communities within Member States)
 - Supersites, co-location
 - instrument calibrations (capacity?)
 - Data management and data harmonization (guidance)
 - Development of integrated data products, such as annual reports regarding UFP and eBC concentrations

Practical steps forward:

- Establish joint working groups to support Member States in the implement the new air quality directive:
- Include representation from AQUILA, EEA, ACTRIS, EURAMET
 - Measurements of UFP, eBC and other emerging pollutants and implementation of supersites
 - EU-level oversight is needed on the development
 - Data management and data harmonization
 - Critical step for utilizing UFP and eBC data for health studies!

Thank you for your attention!

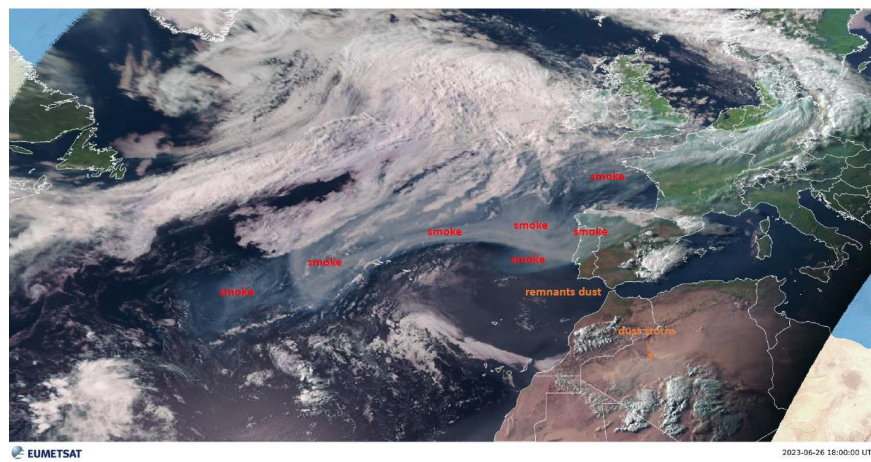
tuukka.petaja@helsinki.fi

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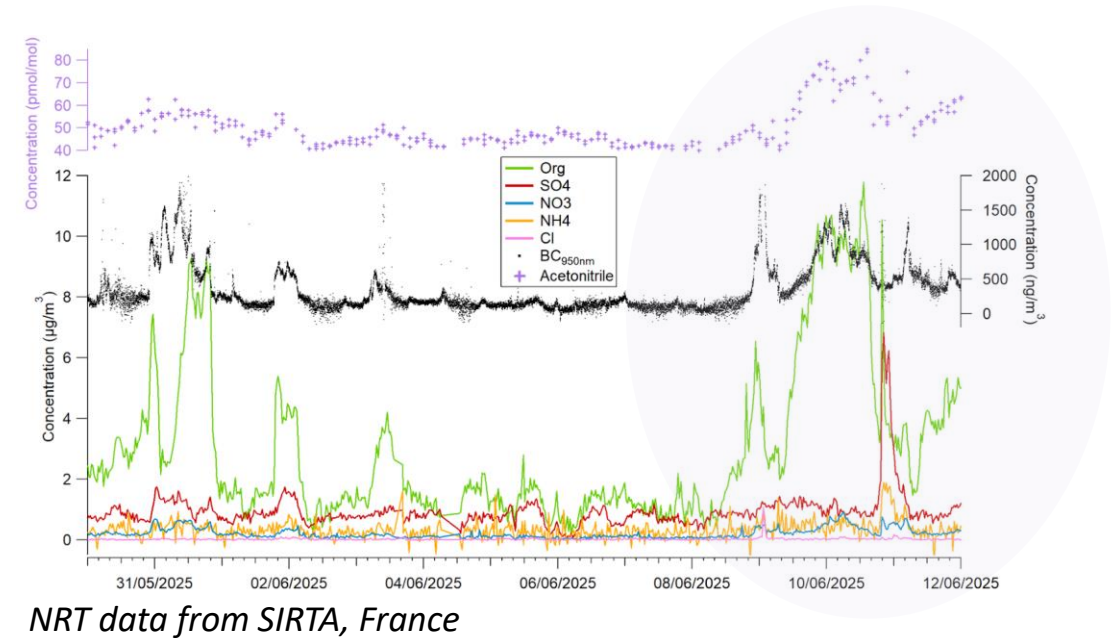
Support Monitoring of Major Atmospheric Events

- The example of wildfires

Record-breaking fire season in Europe (eg Spain, Portugal, France, Greece)
+ Advection of plumes from Canada



Wildfire plume from Canada reaching Europe



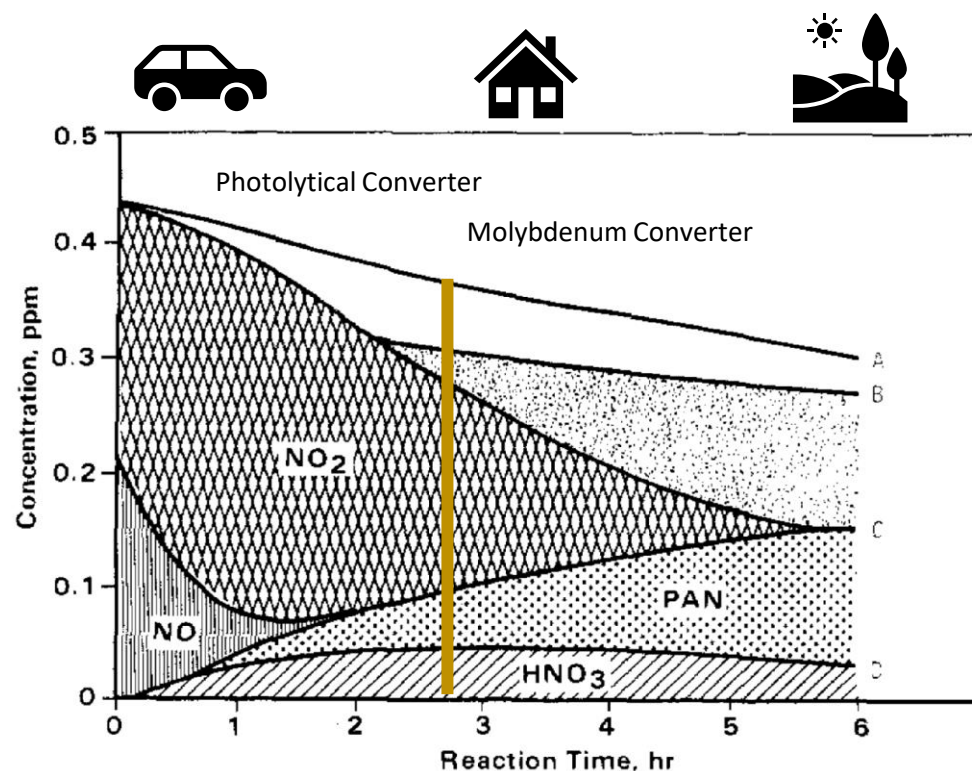
NRT data from SIRTa, France

CAMS21a program can provide in NRT :

- Detailed composition of plumes (aerosols & trace gases)
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- Microphysical (size distribution and optical) properties

Nitrogen oxides and reactive nitrogen



NO	}	NO_x	Nitric oxide
NO ₂			Nitrogen dioxide
N ₂ O			Nitrous oxide
N ₂ O ₅			Dinitrogen pentoxide
N ₂ O ₄			Dinitrogen tetroxide
NO ₃			Nitrate radical

HNO ₃	Nitric acid
HONO	Nitrous acid
RONO ₂	Alkyl nitrates
RCOONO ₂	Peroxyacyl nitrates, PANS

NO_z

Spicer, C. W. (1983). "Smog chamber studies of nitrogen oxide (NOx) transformation rate and nitrate precursor relationships." *Environmental Science & Technology* **17**(2): 112-120.

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NO₂ is overestimated with Mo Converters

Measurements in the City

Station Zürich Kasernenstraße

- Good agreement at night
- Overestimation during the day

