

WP1 - Novel AQ metrics and advanced source apportionment STs for PM, and nanoparticles

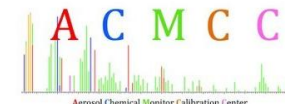
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RI-URBANS (101036245)
RI-URBANS Science meeting, 08-09 September 2025



Partners & Associated Collaborators



RI-URBANS (101036245)
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WP1 Objective

- WP1 aims to assess the measurement of novel AQ metrics and key source tracers and to provide advanced measurements and source apportionment STs for PM and nanoparticles.

WP1. Tasks

Task 1.1 Data survey and compilation of non-regulated pollutants.

- Duration: **M02-M36**
- Lead: CSIC & IMT & EMPA. Participants: PSI, UHEL, TROPOS, NILU, FMI, JRC

Task 1.2 Developing and implementing advanced source apportionment STs.

- Duration: **M02-M36**
- Lead: INERIS & CSIC. Participants: PSI, IMT, ICL, UOB, CNRS, FMI

Task 1.3. Developing products and methods for AQ from profiling observations.

- Duration: **M04-M36**
- Lead: CNR & KNMI. Participants: CNRS, INOE, FZJ

Task 1.4. Synergy of tools and data developed in WP1 in support of WPs 2-3 and SPs 2-3

- Duration: **M12-M40**
- Lead: PSI & CSIC. Participants: all WP1 partners

WP1 Progress: General

- WP1 was carried out according to the plans
- 11 WP1 general meetings; 30 Task meetings
- 8 deliverables (8/8) and 8 milestones (8/8)
- 52 scientific publications + 1 under review

Task 1.1. Progress (1/4)

Data survey and compilation of non-regulated pollutants (M02-M36)

1. Compilation of existing datasets for selected novel AQ metrics

- Selected novel metrics: **UFP-PNSD, eBC, PM composition, PM gaseous precursors (VOCs and NH₃) and OP**
INCLUDED IN THE NEW AQ DIRECTIVE 2024/2881/EC
- Number of sites providing data for the selected metrics.
 - UFP – PNSD from 29 European sites** (AQMN and research supersites): 18 UB; 6 TR; 4 SUB; 1 RB
 - BC from 53 European sites**: 26 UB, 18 TR, 7 SUB, 2 RB in 31 cities, and 14 countries
 - Offline chemistry: 55 sites**: France (24), Italy (9), Spain (8), CH (5), **UK (5; in RP3)**, Portugal (3), Greece (1)
 - Fine non-refractory compounds (ACSM / AMS): 35 datasets**; 2011-2023; 26 UB, 5 SUB, 3 TR & 1 RB sites
 - High-time resolution trace metals (Xact625i): 17 datasets**; 2018 to 2023: 10UB, 3 IND, 1TR, 1R & 1RB
 - VOCs: 22 sites**, 19 cities; 7 European countries; 2002 to 2023: 3 IND, 2 TR, 16 UB & 1 SUB
 - NH₃: 69 datasets**; Finland, France, Italy, Spain, and UK: 8 IND; 12 TR; 22 UB; 12 SUB; 15 RB



European
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RI-URBANS Science meeting, 08-09 September 2025



Task 1.1. Progress (2/4)

Data survey and compilation of non-regulated pollutants (M02-M36)

2. Data management

- PNSD, eBC, VOC, NH₃, and certain online chemical composition data have been made publicly available, following the reporting guidelines outlined in the RI-URBANS data management plan (D43/D5.9; WP5).
- Data curation follow the ACTRIS guidelines and be published in compliance with FAIR principles using the EBAS infrastructure (<https://ebas.nilu.no/>).
- **>3.600 datasets (and >1000 NRT datasets)** from 121 stations across 13 countries have been reported and made accessible through EBAS
- A summary of the available data on the RI-URBANS website (<https://riurbans.eu/results/#open-data>)

Task 1.1. Progress (3/4)

Data survey and compilation of non-regulated pollutants (M02-M36)

3. Pan-European overview: concentration of non-regulated pollutants (D2 (D1.2), CSIC, R/PU, M36)

- UFP and PNSD and sources across urban environments
- BC mass concentrations and sources in urban Europe
- PM speciation (offline and online) and sources across urban environments
- Volatile organic compounds (VOCS) concentrations and sources
- Ammonia (NH₃)
- Oxidative potential (OP)



RI-URBANS
Research Infrastructures Services Reinforcing Air
Quality Monitoring Capacities in European Urban &
Industrial Areas (GA n. 101036245)



6 September 2024

Task 1.1. Progress (4/4)

Data survey and compilation of non-regulated pollutants (M02-M36)

4. STs with protocols for measurement of novel air quality parameters and added value of measuring the non-regulated pollutants

- ST1 to ST3, ST5 and ST6 provided to WP6: RI-URBANS' deliverable D46 (D6.1, containing guidance for all service tools provided in the project).

– Protocols for the measurement of novel air quality parameters

ST1: Ultrafine (=nano)-Particle Number Size Distributions (UFP-PNSD)

ST2: Black Carbon (BC)

ST3: Offline and Online particulate matter (PM) speciation

ST5: Volatile Organic Compounds (VOCs)

ST6: Ammonia (NH₃)

<https://riurbans.eu/project/#service-tools>

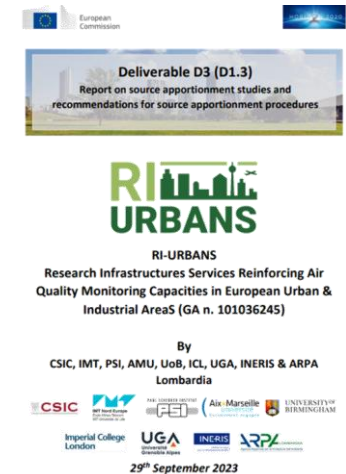


Task 1.2. Progress (1/3)

Developing and implementing advanced source apportionment STs

Sub task 1.2.1. ... to apportion novel health-related AQ metrics.

1. Compilation existing single pollutant and perform new SA studies at selected urban sites ([M1.4](#)) for the selected novel metrics
2. Pan-European overview of SA of PM and novel metrics (D2 ([D1.2](#)))
 - UFP and PNSD and sources across urban environments
 - BC mass concentrations and sources in urban Europe
 - PM speciation and sources across urban environments
 - Volatile organic compounds (VOCS) concentrations and sources
3. Report on SA studies and recommendations for SA procedures (D3 (D1.3))



Task 1.2. Progress (2/3)

Developing and implementing advanced source apportionment STs

Sub task 1.2.1. ... to apportion novel health-related AQ metrics.

4. STs for SA of PM speciation ([ST10](#)) and of novel metrics ([ST11](#)) showing the added value of applying the SA studies.

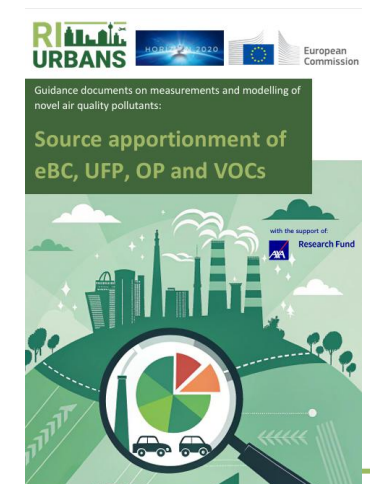
Final version provided to WP6: D46 (D6.1) containing guidance for all STs

– Methodologies for source apportionment receptor modelling

ST10: Source apportionment of PM based on offline and online PM speciation

ST11: Source apportionment of UFP, BC, OP and VOCs using receptor modelling

<https://riurbans.eu/project/#service-tools>



Task 1.2. Progress (3/3)

Developing and implementing advanced source apportionment STs

Sub task 1.2.2. Develop and provide new NRT SA service tool(s) for non-refractory submicron aerosols (measured by ACSM) and BC (measured by AE33)

- NRT-SA STs have been tested online in T4.1 pilot during 2023 and updated .
- T4.1 results demonstrate the potential of STs to be implemented at a larger scale.
- **D5 (D1.5)** NRT source apportionment ST for submicron carbonaceous matter (final)
- Further work associated to upscaling.



RI-URBANS
Research Infrastructures Services Reinforcing Air
Quality Monitoring Capacities in European Urban &
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By
ACMCC (CNRS & INERIS)

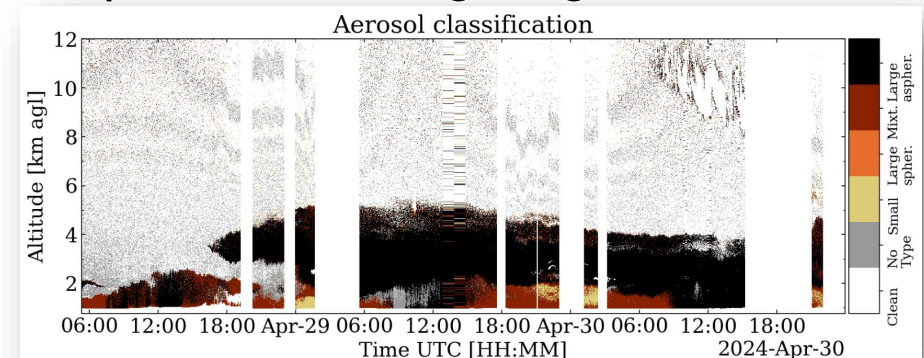


20th September 2024

Task 1.3. Progress (1/3)

Developing products & methods for AQ from profiling observations

- Digital tools available and used within RI-URBANS related to products and methods for AQ from profiling observations
 - Boundary layer height (BLH) demonstrator project is currently processing data from >17 measurement sites across Europe, including RI-URBANS pilot cities
 - Aerosol vertical profiles: a long-term analysis at suburban stations
 - Aerosol typing profiles by 26 ACTRIS/EARLINET stations in the 2015-2023 period
 - IAGOS profiles of AQ parameters have been analysed and provided through digital tools
- Operational Provision @ ACTRIS DC of:
 - Profiles of volume fine and coarse particles concentration
 - Profiles of High Resolution Aerosol Classification



Task 1.3. Progress (2/3)

Developing products & methods for AQ from profiling observations

- Service Tools (STs) for observations with vertical and/or horizontal scanning capability in and around urban environments

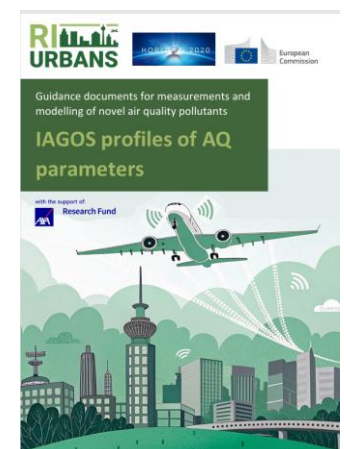
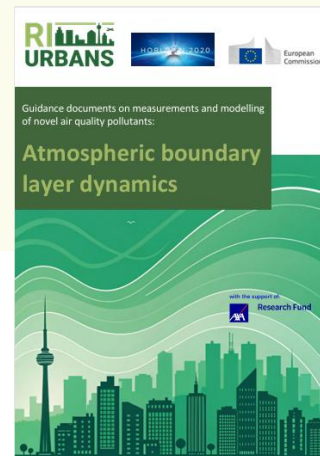
– Methodologies for vertical profiles of pollutants and meteorology

ST7: Measurements of boundary level height

ST8: Measurements of vertical profiles of aerosols

ST9: Measurements of vertical profiles by commercial aircrafts

<https://riurbans.eu/project/#service-tools>



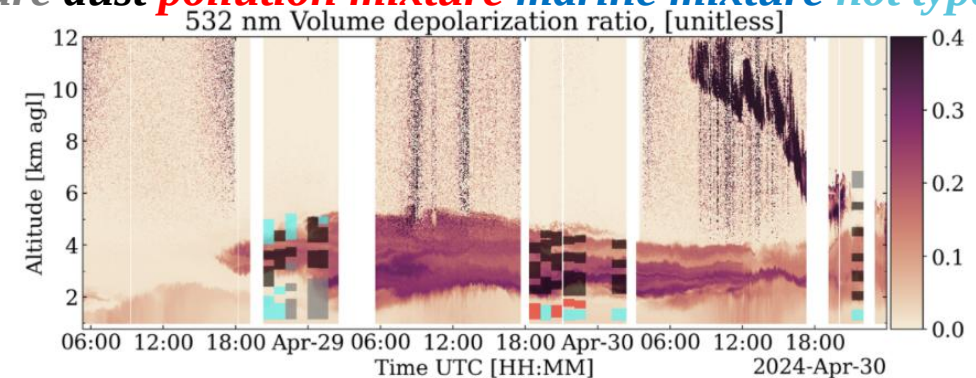
Task 1.3. Progress (3/3)

Developing products & methods for AQ from profiling observations



- Ongoing implementation of ***Profiles of Low Resolution Aerosol Classification***

dusty mixture **dust** **pollution mixture** *marine mixture* *not typed aerosols*.



- Update of the ***Aerosol Profiles Climatology to 2000-2021***

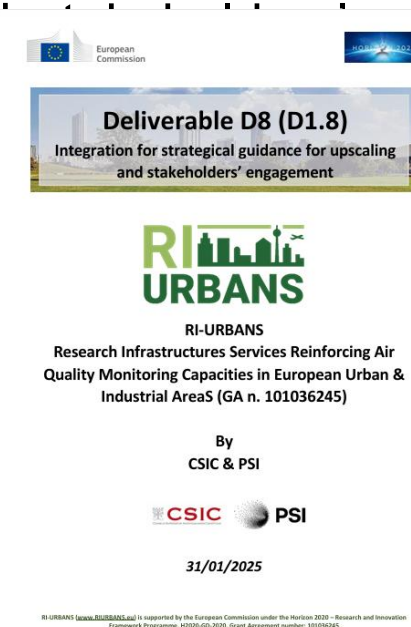
Long term plans

- QA/QC for aerosol profiles from ceilometers within ACTRIS

Task 1.4. Progress (1/4)

Synergy of tools and data developed in WP1 in support of WPs 2-3 and SPs 2-3 (**M12-M40**)

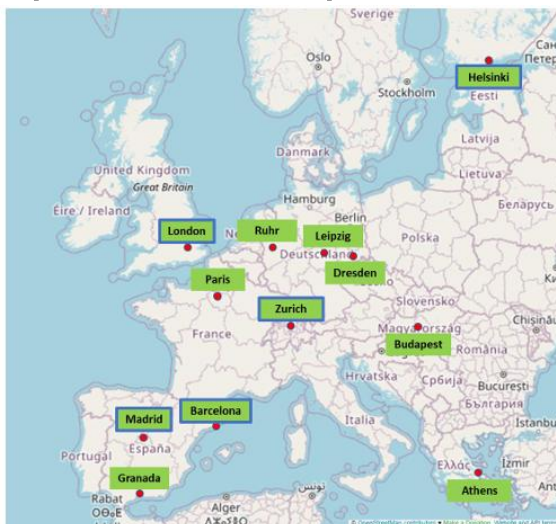
- To optimize the interaction of WP1 with **WP2-4** and to integrate WP1 results to support the roadmap for upscaling STs (**WP5-6**) on the novel AQ metrics and SA and spatially resolved information.
- **D8 - D1.8**: Integration and strategic guidance for upscaling and stakeholders' engagement (**CSIC, R/PU, M40**)



Task 1.4. Progress (2/4)

Interaction with WP2-WP3

- Processed and original databases were archived at RI-Urbans intranet and uploaded to EBAS and available for WP2 (health studies) and WP3 (modelling).
- The link between WP1 and WPs2-3 helped to have harmonized data for assessments and improves the uptake of novel observations.



	Mean concentration ($\mu\text{g}/\text{m}^3$)				Mean source attribution to fossil fuel (%)	
	EC observations	EC modelled	eBC observations	eBC modelled	Observations	Modelled
Mean stations	0.73	0.58 ($\sigma = 0.27$)	0.74	0.60 ($\sigma = 0.28$)	77.2	62.5
Paris Sirta	0.50	0.79 ($\sigma = 0.30$)	0.37	0.78 ($\sigma = 0.29$)	72.7	56.5
Athens NOA	1.16	0.66 ($\sigma = 0.30$)	1.02	0.65 ($\sigma = 0.29$)	67.1	77.8
Athens Demokritos	0.36	0.48 ($\sigma = 0.29$)	0.49	0.50 ($\sigma = 0.30$)	75.1	77.2
Bern Bollwerk	0.86	0.54 ($\sigma = 0.23$)	0.50	0.54 ($\sigma = 0.23$)	70.0	59.1
Marseille Longch.	0.96	0.34 ($\sigma = 0.11$)	0.92	0.48 ($\sigma = 0.17$)	83.2	61.2
Zurich Kaserne	0.54	0.68 ($\sigma = 0.36$)	0.47	0.66 ($\sigma = 0.33$)	76.2	58.4
Lille Villeneuve			0.41	1.25 ($\sigma = 0.52$)	72.4	50.9
d'Ascq						
Stockholm Torkel			0.17	0.29 ($\sigma = 0.12$)	74.9	53.8
Barcelona Palau Reial			0.92	0.73 ($\sigma = 0.31$)	81.1	56.1
Helsinki Itä-Hakkila			0.54	0.30 ($\sigma = 0.14$)	65.1	63.7
Milan Pascal			1.10	1.29 ($\sigma = 0.82$)	85.0	74.9
Stockholm			0.55	0.29 ($\sigma = 0.12$)	85.8	53.9
Hornsgatan						
Bucharest INO			1.10	0.88 ($\sigma = 0.42$)	61.8	42.2
Paris Blvd Haussman			1.36	0.88 ($\sigma = 0.36$)	87.8	65.7
SMEAR II Hyytiälä			0.18	0.11 ($\sigma = 0.05$)	89.0	54.1
Granada UGR			1.21	0.17 ($\sigma = 0.08$)	72.9	89.1
Madrid CIEMAT			1.19	0.11 ($\sigma = 0.04$)	81.2	65.0
Paris PA13			0.83	0.87 ($\sigma = 0.35$)	88.1	65.0

WP2. Mortality and hospitalisation time-series analysis

Metrics: PNC, UFP, PNSD modes, PM2.5, BC, BC & UFP sources D10 (D2.2)

WP3. Comparison between surface concentrations of EC and eBC measured and simulated by the

RI-URBANS (101036245) model Ensemble from CAMS in 2018 (from D19 (D3.4).

Task 1.4. Progress (3/4)

Interaction with WP4

- All the STs produced in WP1, including the NRT tools for source apportionment of carbonaceous aerosols and for measuring PNSD, were tested in WP4.
- Interaction with pilots contributed to improving tailored STs to yield the final guidance documents.

Pilot	STs tested (WP)	ATH	BCN	BIR	BUC	HEL	MIL	PAR	ROT	ZUR
1. NRT source apportionment of carbonaceous aerosols	WP1: NRT-SA ST (D1.4/D1.5) WP1: ST10/ST11	X	F		F	X	X	X		X
2. NRT data provision of nanoparticle and PNSD	WP1: NRT-PNSD ST (M3(M1.3)) WP1: ST1		X	X		X+F				F
3. Urban fine mapping	WP1: ST1, ST2, ST3, ST5, ST6, ST7, ST8, ST9 ; WP2 STs & WP3 STs	X		X	X	F		X	X	
4. Novel health indicators	WP1: ST1, ST2, ST3, ST5, ST6, ST7, ST8, ST9, ST10, ST11 ; WP2: ST4, ST14	X	X					F		X
5. Hot spots	WP2: ST14				X	F	X		X	

Task 1.4. Progress (4/4)

Interaction with WP5-WP6

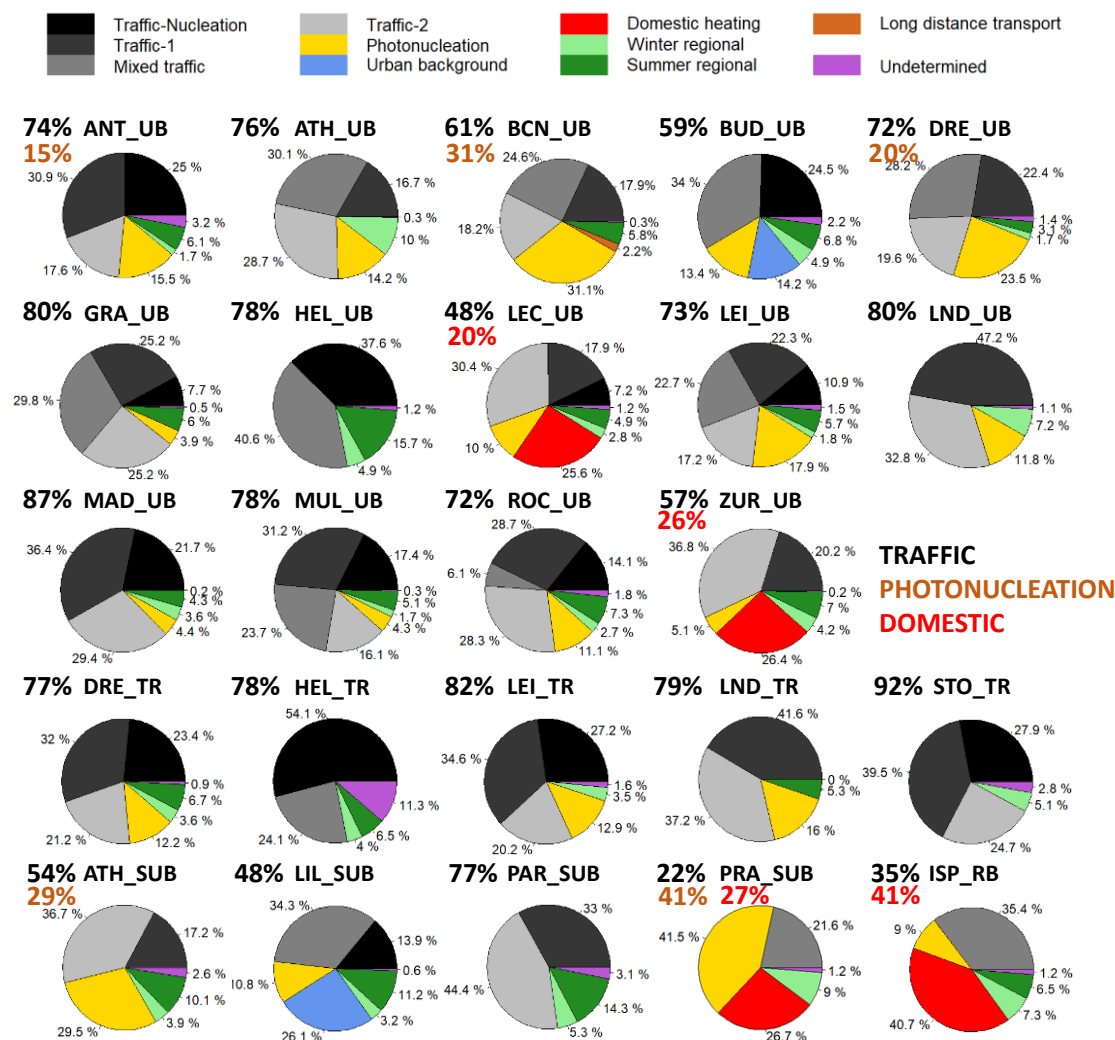
- Collaboration with WP5 for the Data Management Plan (D35 (D5.1) and D43 (D5.9)).
- Cooperation with WP5 resulted in the public availability of the data collected by WP1 at EBAS database (<https://ebas.nilu.no/>) D43 (D5.9).
- WP1 supported WP6 in evaluating the first draft of the NAQD, showing the added value of measuring the new variables proposed by the NAQD.
- Detailed guidance for measuring novel metrics and for SA were provided to WP6 to be included in the Guidance Documents for the Implementation of 11 STs
- WP1 published scientific articles and produced a Pan-European report for the added value of measuring these novel metrics now included in the NAQD (WP7 Dissemination)

WP1: Main results (1/7)

Source apportionment to UFP-PNSD

- PMF applied to 29 UFP-PNSD datasets from the period 2009-2019 covering from 3 up to 11 years of data.
- Road traffic as the main contributor (70-85% in most cities), followed by domestic (biomass and coal burning) sources (in specific cities) and photonucleation (including shipping in one city)

P1.4. Garcia-Marlès et al., 2024b. Environ. Int., 194, 109149, <https://doi.org/10.1016/j.envint.2024.109149>



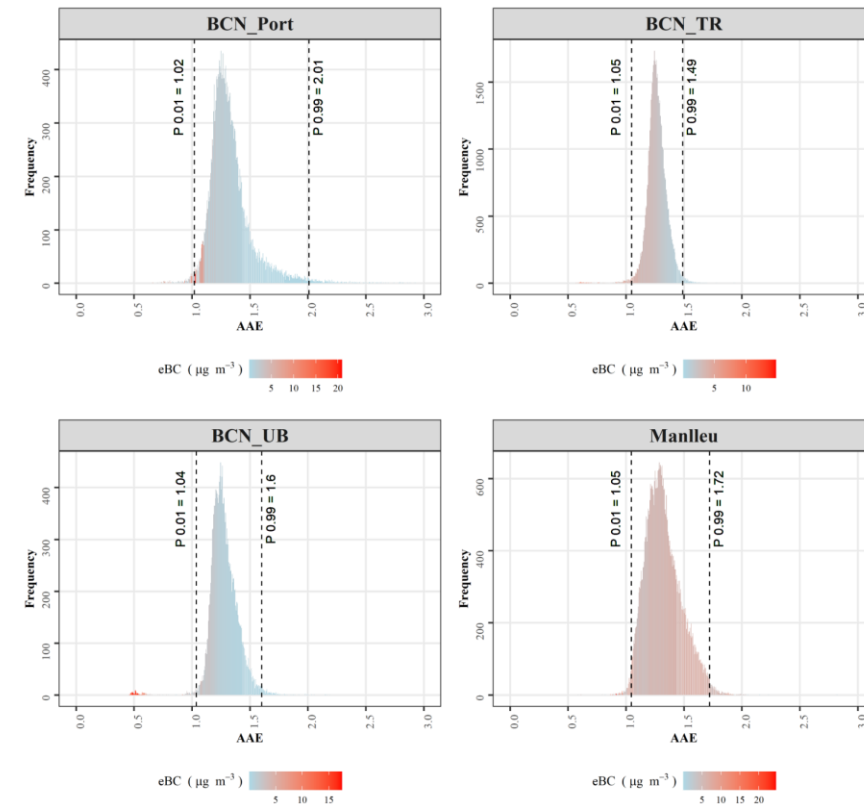
P1.4. Garcia-Marlès et al., 2024. Environ. Int., under review.

WP1: Main results (2/7)

P1.42. Savadkoobi *et al.*, 2025. Atmospheric Environment, 349. <https://doi.org/10.1016/j.atmosenv.2025.121121>

eBC source apportionment: to determine the optimal absorption Ångström exponents (AAEs) values

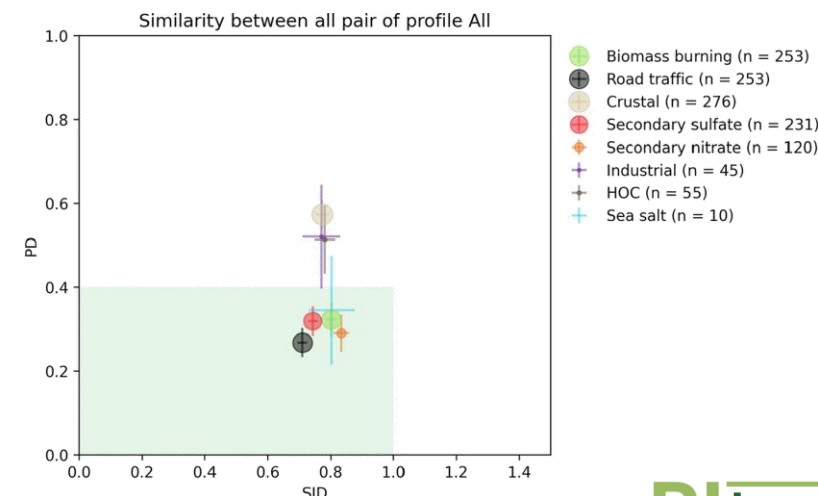
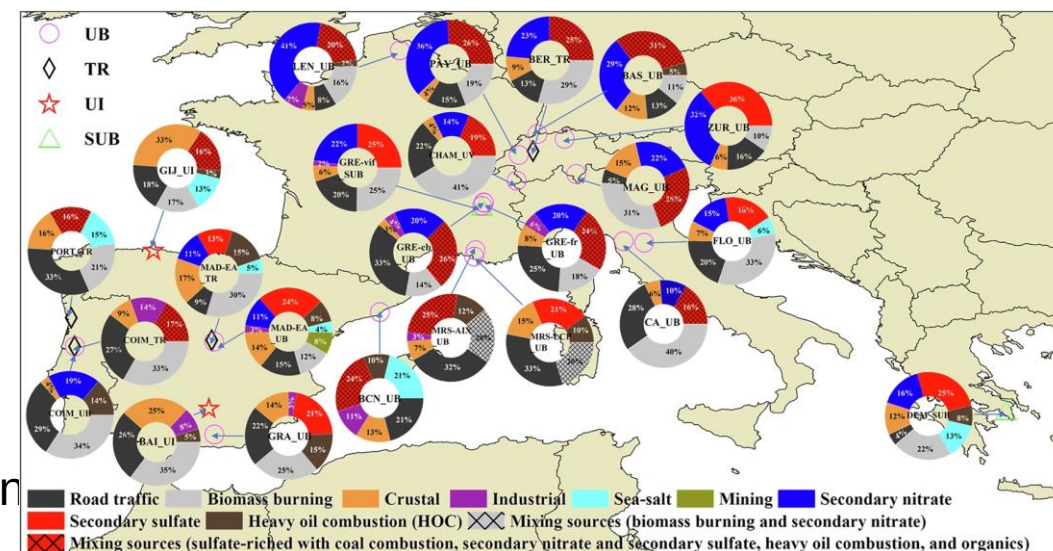
- **AE model:** based on wavelength dependence of light absorption (AAE)
 - **Limitation:** Only two sources of pollution **BC_{LF}** and **BC_{SF}**
- Commonly used Absorption Angstrom exponents (AAE) pairs:
 - Sandradewi *et al.* (2008): 1 (**AAE_{LF}**), 2 (**AAE_{SF}**)
 - Zotter *et al.* (2017): 0.9 (**AAE_{LF}**), 1.68 (**AAE_{SF}**)
- AAE values depend on site-specific characteristics: Fuel type, combustion conditions, particle aging, and morphology:
- RI-URBANS percentile-based AAE approach: AAE_{LF} can be estimated as PC1 from filtered summer data; and AAE_{SF} and PC99 of unfiltered winter data
- Optimal results for suburban sites; but BrC contributions in areas affected by shipping emissions and/or low-efficiency coal combustion may interfere with BC_{LF} apportionment



WP1: Main results (3/7)

PM source apportionment

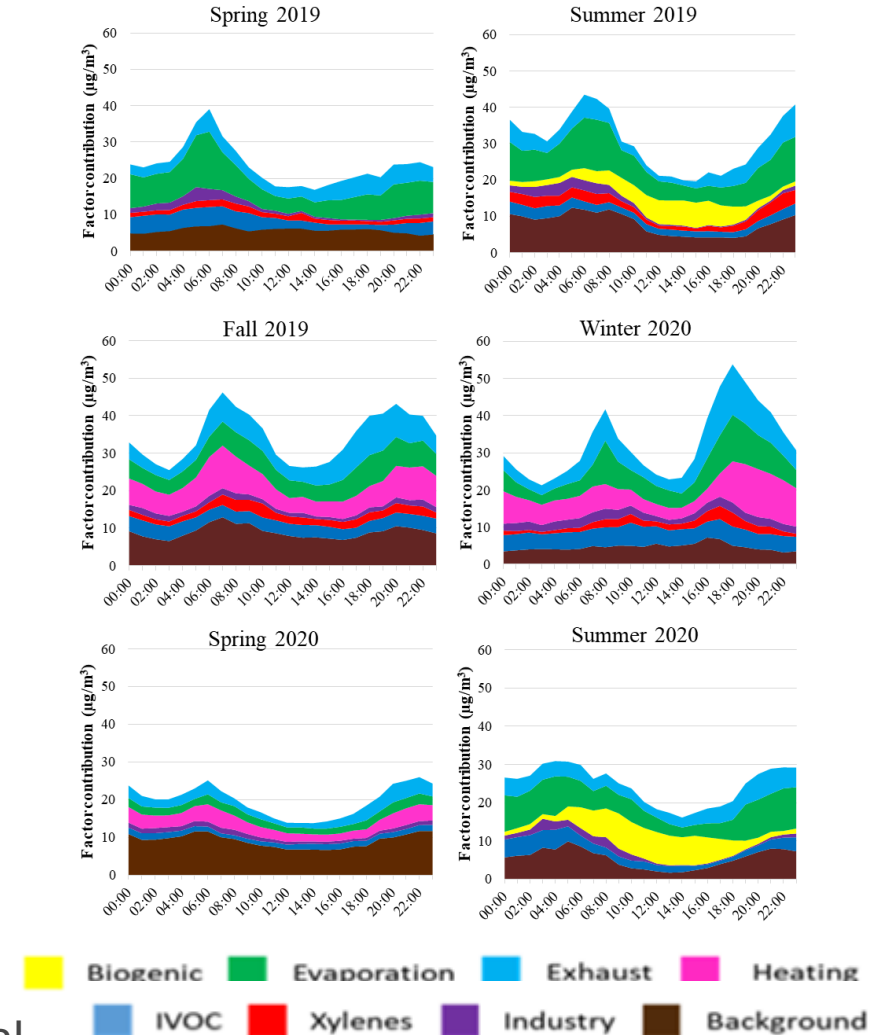
- PMF to PM10 speciation datasets: 24 urban sites from France, Greece, Italy, Portugal, Spain, and Switzerland, by using a consistent source apportionment tool
- Seven major PM10 sources: road traffic, biomass burning, crustal/mineral sources, secondary aerosols, industrial emission, sea salt, and heavy oil combustion
- Road traffic and secondary aerosols: consistent chemical profiles across sites; Industrial, HOC, and crustal sources significant site-specific variability.
- Road traffic: predominant PM10 source in urban areas (5-41%)
- Need for long-term PM speciation monitoring and tailored AQ strategies according to local sources



WP1: Main results (4/7)

Volatile organic compound sources apportionment

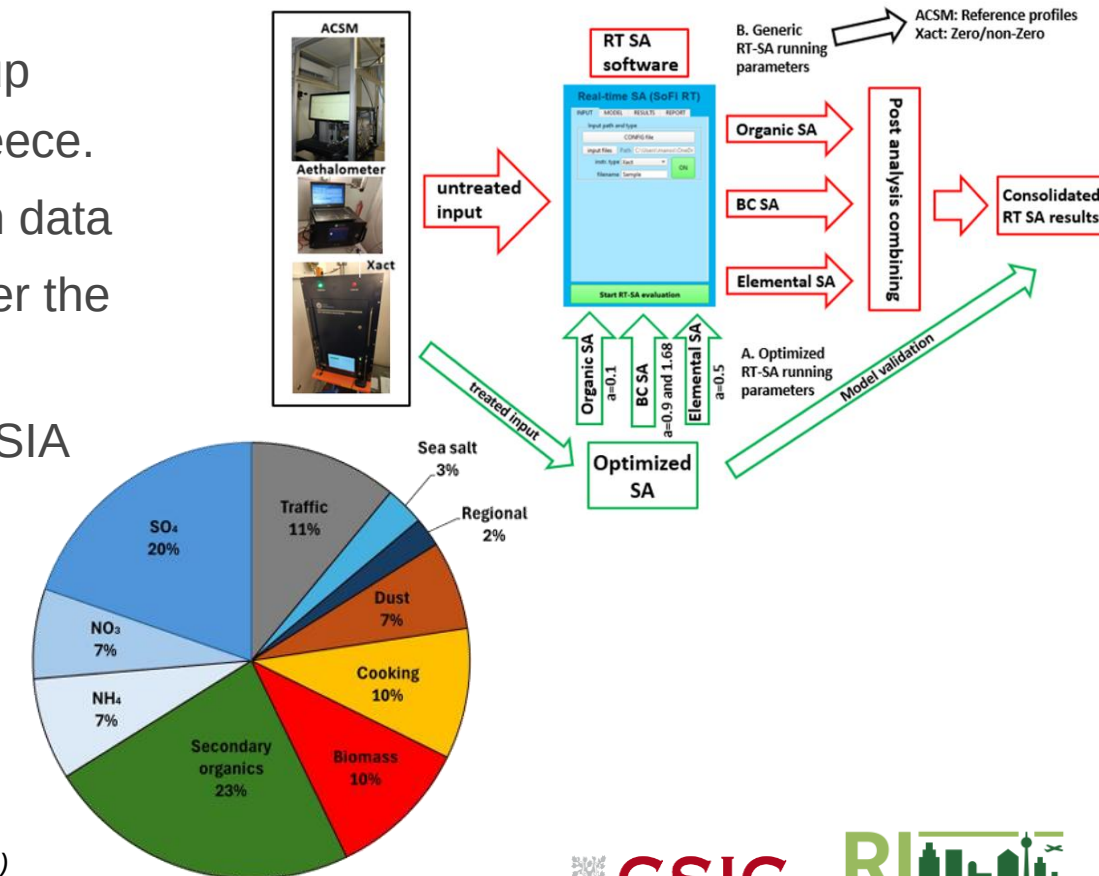
- Online measurements in Marseille (18 months; 03/2019 to 08/2020)
- C2 to C16 non-methane hydrocarbons (NMHCs) by two TD-GC-FID.
- PMF: 8 factors identified
 - Traffic exhaust: 41%
 - Fuel evaporation
 - Industrial sources
 - Shipping
 - Regional and local urban backgrounds
 - intermediate-volatility organic compounds (IVOCs)
 - Biogenic sources in summer
 - Residential heating during cold periods
- Traffic (exhaust and evaporation) 40 %, of NHMC
- Shipping is potentially important contributors to SOA formation potential



WP1: Main results (5/7)

Real-Time (RT) Source Apportionment (SA) Approaches Using ONLINE PM speciation

- First application of the ACSM-Xact-Aethalometer (AXA) setup combined with SoFi RT software for PM RT-SA: Athens, Greece.
- AXA setup integrates chemical, elemental, and black carbon data
- SoFi RT: continuous and automated SA in NRT (minutes after the measurements).
- Traffic-related emissions: with significant contributions from SIA and SOA: 57 % of the PM mass.
- Biomass burning and cooking: 10 % each
- Natural sources like dust and sea salt: 10%.
- AXA system: advancing urban AQ monitoring



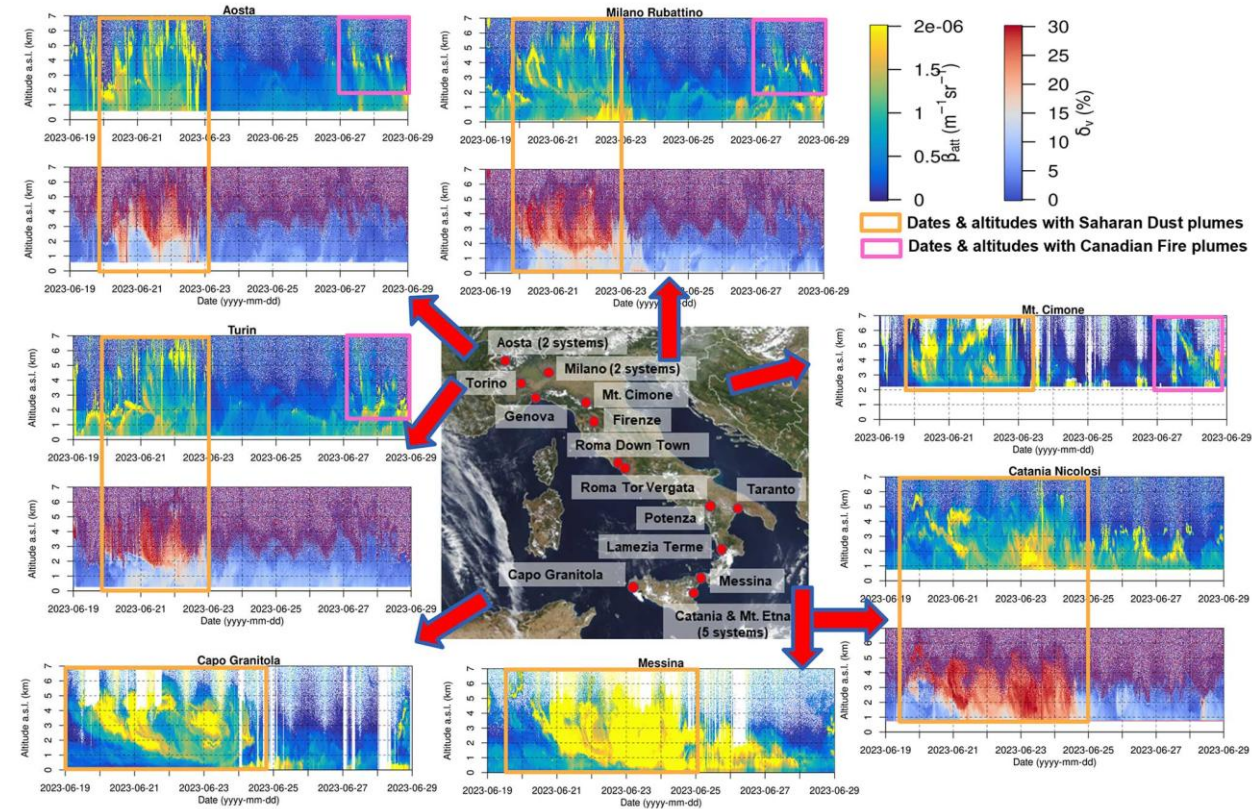
WP1: Main results (6/7)

ALICENET – An Italian network of Automated Lidar-Ceilometers (ALC) for 4D aerosol monitoring

- Tools for the automatic processing of ALC data to derive vertical profiles of aerosol mass and optical properties, plus automatic identification of aerosol layers have been tested
- A long-term analysis (2016-2022) of ALC data in 4 urban ALICENET sites in Italy was also performed.
- The upscaling of these tools to other urban sites in Europe (France, Spain) is in progress

P1.20. Bellini, A., et al., 2024. Atmos. Meas. Tech., 17, 6119–6144, <https://doi.org/10.5194/amt-17-6119-2024>

P1.50. Bellini et al., 2025. Remote Sensing, 17(3), p.372, <https://doi.org/10.3390/rs17030372>

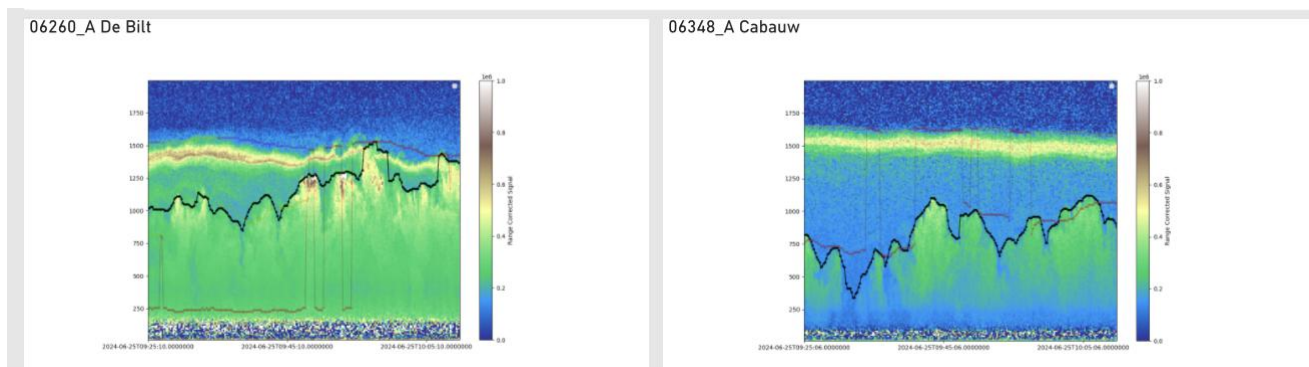


WP1: Main results (7/7)

NRT implementation of AI/ML Mixing Layer Height (MLH) detection algorithm

Based on the experience with the RI-Urbans hot-spot pilots (T4.5) KNMI is upscaling and implementing the Deep Pathfinder (Wijnands et al, 2024) algorithm, in near real time for a representative number of ceilometers in the Dutch network.

MLH estimates shall be available every 15 minutes with 12 second time resolution



Example of NRT retrievals of MLH for two locations in Cabauw and De Bilt. Examples are shown for 45 minutes at full resolution



Wijnands, J. S., et al., 2024, Atmos. Meas. Tech., 17, 3029–3045,
<https://doi.org/10.5194/amt-17-3029-2024>, 2024

WP1: Publications (1/6)

- **P1.1.** [Trechera et al., 2023](https://doi.org/10.1016/j.envint.2023.107744), Phenomenology of ultrafine particle concentrations and size distribution across urban Europe. Environ. Int., 172, 107744, ISSN 0160-4120. <https://doi.org/10.1016/j.envint.2023.107744>
- **P1.2.** [Liu et al. 2023](https://doi.org/10.1016/j.scitotenv.2023.165466). Total Lung Deposited Surface Area; particle number size distribution; spatial variability; urban environment; traffic emission. Sci. Total Environ. 898, 165466 <https://doi.org/10.1016/j.scitotenv.2023.165466>.
- **P1.3.** [Garcia-Marlès et al., 2024](https://doi.org/10.1016/j.envint.2024.108510). Inter-annual trends of ultrafine particles in urban Europe. Environ. Int., 185, 108510. <https://doi.org/10.1016/j.envint.2024.108510>
- **P1.4.** [Garcia-Marlès et al., 2024b. Source apportionment of UFP-PNSD in urban Europe. Environ. Int., 194, 109149, <https://doi.org/10.1016/j.envint.2024.109149>](https://doi.org/10.1016/j.envint.2024.109149)
- **P1.5.** [Savadkoohi et al., 2023](https://doi.org/10.1016/j.envint.2023.108081). Variability of mass concentrations and source apportionment of equivalent Black Carbon (eBC) in urban sites of Europe. Environ. Int., 178, 10808. <https://doi.org/10.1016/j.envint.2023.108081>
- **P1.6.** [Rovira J. et al., 2022](https://doi.org/10.1016/j.envres.2022.113269). Non-linear models for black carbon exposure modelling using air pollution datasets. Atmos. Res. 212, B, 113269. <https://doi.org/10.1016/j.envres.2022.113269>
- **P1.7.** [Savadkoohi et al., 2024](https://doi.org/10.1016/j.envint.2024.108553). Recommendations for reporting equivalent black carbon (eBC) mass concentrations based on long-term pan-European in-situ observation. Environ. Int. 185, 108553. <https://doi.org/10.1016/j.envint.2024.108553>
- **P1.8.** [Liu, X. et al., 2024a. PM10-bound trace elements in pan-European urban atmosphere. Environ. Res., 119630, <https://doi.org/10.1016/j.envres.2024.119630>](https://doi.org/10.1016/j.envres.2024.119630)
- **P1.9.** [Chen et al., 2022a](https://doi.org/10.1021/acs.est.2c02509), European aerosol phenomenology – 8: Harmonised source apportionment of organic aerosol using 22 Year-long ACSM/AMS datasets, Environ. Int., 166, 2022, 107325, ISSN 0160-4120. <https://doi.org/10.1021/acs.est.2c02509>

WP1: Publications (2/6)

- **P1.10.** [Liu et al., 2025a](#). Measurement report: Exploring the variations in ambient BTEX in urban Europe and their environmental health implications. *Atmos. Chem. Phys.*, 25(1), 625–638. <https://doi.org/10.5194/ACP-25-625-2025>.
- **P1.11.** Liu et al 2025b. Decreased Abundance of Volatile Organic Compounds in Selected European Cities and Their Secondary Formation Potentials, submitted to *Geophys.Res.Lett.*, 2025
- **P1.12.** [Reche et al., 2022](#). 2011–2020 trends of urban and regional ammonia in and around Barcelona, NE Spain. *Chemosphere*, 304, 135347. <https://doi.org/10.1016/J.CHEMOSPHERE.2022.135347>.
- **P1.13.** [Liu, et al., 2024a](#) Variability of ambient air ammonia in urban Europe (Finland, France, Italy, Spain, and the UK). *Environ. Int.*, 185, 2024, 108519, ISSN 0160-4120, <https://doi.org/10.1016/j.envint.2024.108519>.
- **P1.14.** [Harni et al. S.D., 2023](#). Effects of emission sources on the particle number size distribution of ambient air in the residential area. *Atmos. Environ.* 293, 119419. <https://doi.org/10.1016/j.atmosenv.2022.119419>
- **P1.15.** [Amato F., et al. 2024](#). Aerosol source apportionment uncertainty linked to the choice of input chemical components. *Environ. Int.*, 184, art. no. 108441. <https://doi.org/10.1016/j.envint.2024.108441>
- **P1.16.** [Chen et al., 2022b](#), Real-Time Source Apportionment of Organic Aerosols in Three European Cities. *Environ. Sci. Technol.* 2022, 56, 22, 15290–15297. <https://doi.org/10.1021/acs.est.2c02509>
- **P1.17.** [Vía M. et al., 2023](#). Towards a better understanding of fine PM sources: online and offline datasets combination in a single PMF. *Environ. Int.*, 177, 108006, <https://doi.org/10.1016/j.envint.2023.108006>
- **P1.18.** [in'tVeld et al., 2024](#). Identification of volatile organic compounds and their sources driving ozone and secondary organic aerosol formation in NE Spain. *Sci of the Total Environ* 906:167159. <https://doi.org/10.1016/j.scitotenv.2023.167159>

WP1: Publications (3/6)

- **P1.19.** [Kotthaus, S. et al., 2023](#). Atmospheric boundary layer height from ground-based remote sensing: a review of capabilities and limitations, *Atmos. Meas. Tech.*, 16, 433–479, <https://doi.org/10.5194/amt-16-433-2023>
- **P1.20.** [Bellini, A., et al., 2024](#). Alicenet – An Italian network of Automated Lidar-Ceilometers for 4D aerosol monitoring: infrastructure, data processing, and applications. *Atmos. Meas. Tech.*, 17, 6119–6144, <https://doi.org/10.5194/amt-17-6119-2024>
- **P1.21.** [Harni, S. D., et al., 2024](#). Source apportionment of particle number size distribution at the street canyon and urban background sites, *Atmos. Chem. Phys.*, 24, 12143–12160, <https://acp.copernicus.org/articles/24/12143/2024/>
- **P1.22.** [Fung, P.L., et al., 2024](#). Constructing transferable and interpretable machine learning models for black carbon concentrations, 184, 108449, <https://doi.org/10.1016/j.envint.2024.108449>.
- **P1.23.** [Vasilakopoulou, C.N., et al., 2023](#). Development and evaluation of an improved offline aerosol mass spectrometry technique, *Atmos. Meas. Tech.*, 16, 2837–2850, <https://doi.org/10.5194/amt-16-2837-2023>
- **P1.24.** [Atabakhsh S., et al., 2023](#). A 1-year aerosol chemical speciation monitor (ACSM) source analysis of organic aerosol particle contributions from anthropogenic sources after long-range transport at the TROPOS research station Melpitz. *Atmos. Chem. Phys.*, 6963–6988. <https://doi.org/10.5194/acp-23-6963-2023>
- **P1.25.** [Canals A., et al., 2024](#). Evaluation of air quality changes in a Chinese megacity over a 15-year period (2006–2021) using PM2.5 receptor modelling. *Environ. Poll.*, 340, 1, 22803, <https://doi.org/10.1016/j.envpol.2023.122803>
- **P1.26.** [Davulienne L., et al., 2024](#). Synergic use of in-situ and remote sensing techniques for comprehensive characterization of aerosol optical and microphysical properties. *Sci. Total Environ.*, 906, 167585, <https://doi.org/10.1016/j.scitotenv.2023.167585>

WP1: Publications (4/6)

- **P1.27.** [Di Antonio, L., 2023](#). Aerosol optical depth climatology from the high-resolution MAIAC product over Europe: differences between major European cities and their surrounding environments. Atmos. Chem. Phys. 23, 12455–12475, <https://doi.org/10.5194/acp-23-12455-2023>
- **P1.28.** [Foreback, B., et al., 2022](#). Measurement report: A multi-year study on the impacts of Chinese New Year celebrations on air quality in Beijing, China. Atmos. Chem. Phys, 22, 11089–11104, <https://doi.org/10.5194/acp-22-11089-2022>
- **P1.29.** [in 't Veld M., 2023](#). Characterizing the sources of ambient PM10 organic aerosol in urban and rural Catalonia, Spain. Sci. The Total Environ., 902, 166440, <https://doi.org/10.1016/j.scitotenv.2023.166440>
- **P1.30.** [Kulmala, M., et al., 2024](#). A paradigm shift in investigating the general characteristics of atmospheric new particle formation using field observations, Aerosol Res., 2, 49–58, <https://doi.org/10.5194/ar-2-49-2024>
- **P1.31.** [Mahura, A., et al., 2024](#). Towards seamless environmental prediction – development of Pan-Eurasian EXperiment (PEEX) modelling platform. Big Earth Data, 8, 2, <https://doi.org/10.1080/20964471.2024.2325019>
- **P1.32.** [Okuljar, M., et al., 2023](#). Influence of anthropogenic emissions on the composition of highly oxygenated organic molecules in Helsinki: a street canyon and urban background station comparison, Atmos. Chem. Phys., 23, 12965–12983, <https://doi.org/10.5194/acp-23-12965-2023>
- **P1.33.** [Panahifar, H., et al., 2023](#). Simultaneous Use of Ground-Based and Satellite Observation to Evaluate Atmospheric Air Pollution over Amman, Jordan. Atmosphere, 14, 2, 274, <https://doi.org/10.3390/atmos14020274>
- **P1.34.** [Petzold, A., et al., 2024](#). New directions in atmospheric research offered by research infrastructures combined with open and data-intensive science, Atmos. Chem. Phys., 24, 5369–5388, <https://doi.org/10.5194/acp-24-5369-2024>
- **P1.35.** [Stolzenburg, D., et al., 2023](#). Improved counting statistics of an ultrafine differential mobility particle size spectrometer system, Atmos. Meas. Tech., 16, 2471–2483, <https://doi.org/10.5194/amt-16-2471-2023>

WP1: Publications (5/6)

- **P1.36.** [Zhang X., et al., 2024.](https://doi.org/10.1016/j.atmosenv.2024.120487) New particle formation event detection with convolutional neural networks. Atmos. Environ., 327, 120487, <https://doi.org/10.1016/j.atmosenv.2024.120487>
- **P1.37.** [Kadantsev, E., et al., 2024.](https://doi.org/10.5194/npg-31-395-2024) On dissipation timescales of the basic second-order moments: the effect on the energy and flux budget (EFB) turbulence closure for stably stratified turbulence. Non-Linear* Processes in Geophys. 31, 395–40, <https://doi.org/10.5194/npg-31-395-2024>
- **P1.38.** [Rowell, A., et al., 2024.](https://doi.org/10.5194/acp-24-9515-2024) Insights into the sources of ultrafine particle numbers at six European urban sites obtained by investigating COVID-19 lockdowns, Atmos. Chem. Phys., 24, 9515–9531, <https://doi.org/10.5194/acp-24-9515-2024>
- **P1.39.** [Dufresne, M., et al., 2025.](https://doi.org/10.5194/acp-25-5977-2025) Volatile organic compound sources and impacts in an urban Mediterranean area (Marseille, France), Atmos. Chem. Phys., 25, 5977–5999, <https://doi.org/10.5194/acp-25-5977-2025> , 2025
- **P1.40** [Kalkavouras, P., et al., 2024.](https://doi.org/10.1016/j.scitotenv.2024.170042) Source apportionment of fine and ultrafine particle number concentrations in a major city of the Eastern Mediterranean, Science of The Total Environment, Volume 915,2024, 170042, ISSN 0048-9697, <https://doi.org/10.1016/j.scitotenv.2024.170042>.
- **P1.41** [Garcia-Marlès M., et al., 2025.](https://doi.org/10.1016/j.atmosenv.2025.121375) Spatiotemporal variation and source apportionment of ultrafine particles near Brussels airport (Belgium) (2025) Atmospheric Environment, 359, art. no. 121375, <https://doi.org/10.1016/j.atmosenv.2025.121375> .
- **P1.42.** [Savadkoohi, M., et al., 2025.](https://doi.org/10.1016/j.atmosenv.2025.121121) Addressing the advantages and limitations of using Aethalometer data to determine the optimal absorption Ångström exponents (AAEs) values for eBC source apportionment. Atmospheric Environment, 349, <https://doi.org/10.1016/j.atmosenv.2025.121121>
- **P1.43.** [Barreira L.M.F., et al., 2024.](https://doi.org/10.1016/j.scitotenv.2024.177089) Characterizing winter-time brown carbon: Insights into chemical and light-absorption properties in residential and traffic environments. Sci. Total Environ., 955, 177089, <https://doi.org/10.1016/j.scitotenv.2024.177089>
- **P1.44.** [Savadkoohi, M., et al., 2025.](https://doi.org/10.1016/j.scitotenv.2024.178095) Source-dependent absorption Ångström exponent in the Los Angeles Basin: Multi-time resolution factor analyses of ambient PM2.5 and aerosol optical absorption. SCITOTEN, 958, 178095. <https://doi.org/10.1016/j.scitotenv.2024.178095>

WP1: Publications (6/6)

- P1.45. Savadkoobi, M., et al., 2025. Multi-site comparison and source apportionment of equivalent Black Carbon mass concentrations (eBC) in the United States: Southern California Basin and Rochester, New York. *Atmospheric Pollution Research*, 16(1). <https://doi.org/10.1016/j.apr.2024.102340>
- P1.46. Rovira, J., et al., 2025. A European aerosol phenomenology – 9: Light absorption properties of carbonaceous aerosol particles across surface Europe. *Environment International*, 195, 109185. <https://doi.org/10.1016/J.ENVINT.2024.109185>
- P1.47 Liu, X., et al., 2025c. Source apportionment of PM₁₀ based on offline chemical speciation data at 24 European sites. *Npj Climate and Atmospheric Science* 2025 8:1, 8(1), 1–14. <https://doi.org/10.1038/s41612-025-01097-7>
- P1.48 Liu, Y., et al., 2025d. Source apportionment of PM₁₀ particles in the urban atmosphere using PMF and LPO-XGBoost. *Environmental Research*, 278, 121659. <https://doi.org/10.1016/J.ENVRES.2025.121659>
- P1.49 Dinh Ngoc Thuy, V., et al., 2024. Unveiling the optimal regression model for source apportionment of the oxidative potential of PM₁₀, *Atmos. Chem. Phys.*, 24, 7261–7282, <https://doi.org/10.5194/acp-24-7261-2024> , 2024.
- P1.50. Bellini et al., 2025. Aerosols in the Mixed Layer and Mid-Troposphere from Long-Term Data of the Italian Automated Lidar-Ceilometer Network (ALICENET) and Comparison with the ERA5 and CAMS Models. *Remote Sensing*, 17(3), p.372, <https://doi.org/10.3390/rs17030372>.
- P1.51 Nicolae, D. et al., 2024. NATALI Earlinet Typing 2015-2023 (Version 2) [Data set]. ACTRIS-ARES Data Centre Unit. https://doi.org/10.57837/CNR-IMAA/ARES/NATALI-EARLINET-TYPING-2015_2023
- P1.52 Nicolae, D. et al., 2025. Examining the characteristics of aerosols: a statistical analysis based on a decade of lidar and photometer observations at the Eastern border of ACTRIS, *EGUsphere* [preprint], <https://doi.org/10.5194/egusphere-2025-2092>
- P1.53 Manousakas, M. I. et al., 2025. Implementation of Real-Time Source Apportionment Approaches Using the ACSM-Xact-Aethalometer (AXA) Set-Up with SoFi RT: The Athens Case Study, *EGUsphere* [preprint], <https://doi.org/10.5194/egusphere-2025-542>, 2025.

WP1. Milestones

Mil #	Mil name	Month	Responsible	Means of verification
M1.1	Datasets for source apportionment, health studies, modelling and measurement guidelines	M13	IMT	data stored in repositories and guidelines available on-line
M1.2	Provision of data management and QA/QC tools for centralising, communicating and analyses	M11	NILU	tools available
M1.3	NRT aerosol number size distribution ST for RIURBANS	M05	TROPOS	adaptation available
M1.4	NRT source apportionment ST for submicron carbonaceous matter (pilots)	M24	CSIC	datasets available
M1.5	New source apportionment (incl. multi-time) at selected EU supersites	M28	CSIC	datasets available
M1.6	Data management for online source apportionment ST	M12	CNRS	visualization interface ready
M1.7	Accuracy check of online SA ST vs. offline SA analysis	M32	INERIS	accuracy check available
M1.8	Requirements for the implementation of vertical profiling measurements in pilot sites	M18	FZJ	requirements for implementation provided

WP1. Deliverables

- D1.1: Guidelines, datasets of non-regulated pollutants incl. metadata, methods, QA (CSIC, OTHER/PU, M12)
- D1.2: Pan-European overview of concentrations of the non-regulated pollutants (CSIC, R/PU, M36)
- D1.3: Centralized source apportionment study on PM_x and novel AQ variables, including VOCs, in Europe and recommendations on source apportionment procedures (CSIC, R/PU, M24)
- D1.4: NRT source apportionment ST for submicron carbonaceous matter (pilots) (INERIS, OTHER/PU, M15)
- D1.5: NRT source apportionment ST for submicron carbonaceous matter (final) (INERIS, OTHER/PU, M36)
- D1.6: Observational methodologies for horizontal and vertical profiling for AQ purposes (CNRS, R/PU, M12)
- D1.7: Processing and experimental digital tools for AQ from 3D remote sensing (CNR, S/PU, M36)
- **D1.8: Integration and strategic guidance for upscaling and stakeholders' engagement (CSIC, R/PU, M40)**

Summary of work done in RP3

Data curation continued, both regular data as well as NRT

15 Papers published related to activities carried out in T1.1, T1.2 and T1.3.

Collaboration with WPs 2-3: datasets and SA outputs provided for health studies and modelling.

Collaboration between WPs 1-4: T4.1: interaction with pilots will contribute to improving tailored STs.

Support the roadmap for upscaling STs (WPs 5-6) on the novel AQ metrics and SA and spatially resolved information.

D1.8: Integration and strategic guidance for upscaling and stakeholders' engagement (CSIC, R/PU in M40).

Discussion and Next Steps

- New Directive: measurement of UFP PNC & PNSD, eBC, VOCs, NH₃, and OP at supersites and at hotspots
- The implementation of the NAQD has increased interest in developing and providing STs to measure the selected novel metrics and quantify the contribution of sources to AQ levels
- Upscaling STs: the implementation of the new measurements in the AQMN and the interaction with AQ technicians will likely reveal potential limitations and the need to adapt the tools to their needs
- Assistance needed for setup, operation and calibration of new instruments: ACTRIS-ERIC/AQUILA/AQMN
- Data Management: ACTRIS-DC and AQMN: need to streamline the process and to interact with official databases for upscaling.

Discussion and Next Steps

- UPF PNC/PNSD
- BC: corection of measurement
- PM speciation
- VOCs: instrument
- NH3: instrument?
- OP

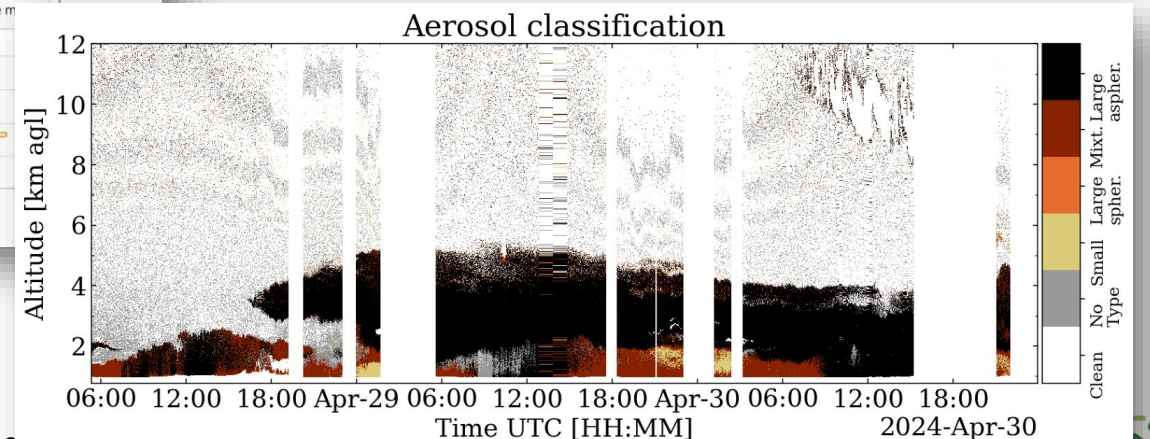
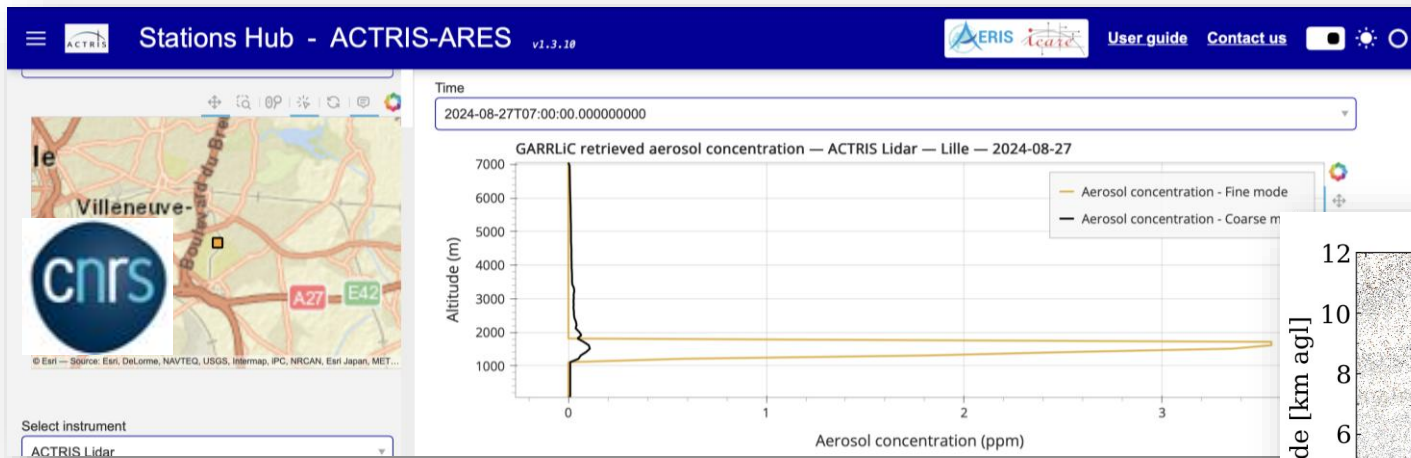
Thank you very much for your attention!!!

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T1.3 Profiling observations for urban environments

- Operational Provision @ ACTRIS DC of ***Profiles of volume fine and coarse particles concentration***
- Operational Provision @ ACTRIS DC of ***Profiles of High Resolution Aerosol Classification***



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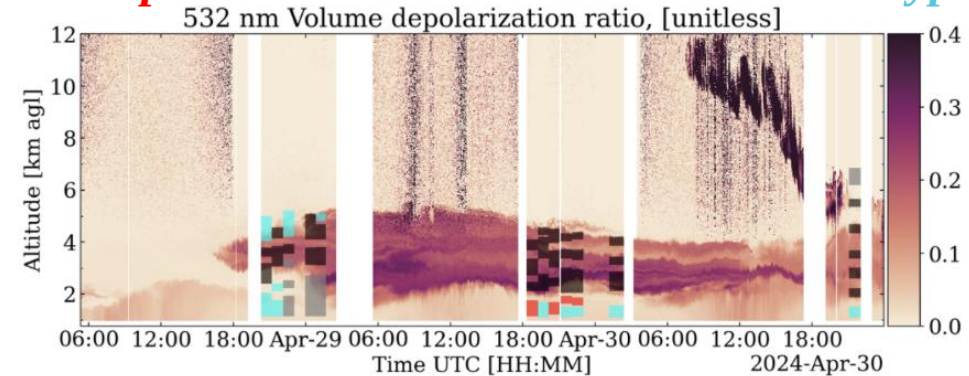
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T1.3 Profiling observations for urban environments



- Ongoing implementation of **Profiles of Low Resolution Aerosol Classification**
dusty mixture dust pollution mixture marine mixture not typed aerosols.



- Update of the **Aerosol Profiles Climatology to 2000-2021**

Long term plans

- QA/QC for aerosol profiles from ceilometers within ACTRIS