Aerosol Chemical Monitor Calibration Center

ACMCC

Aerosol Chemical Monitor Calibration Center

ACTRIS

Evelyn FRENEY, Jean-Eudes PETIT, Olivier FAVEZ, Valerie GROS,
And all ACMCC people + the whole ACTRIS-COLOSSAL ACSM Community
acmcc@lsce.ipsl.fr

Laboratoire des Sciences du Climat et de l'Environnement
LSCE (UMR 8212)

Laboratoire de météorologie physique
LaMP

cea

INERIS

cnrs INSU Observer & comprendre

COLOSSAL
Chemical On-Line cOmpoSition and Source Apportionment of fine aerosoL

ADDAIR

Aerodyne Research

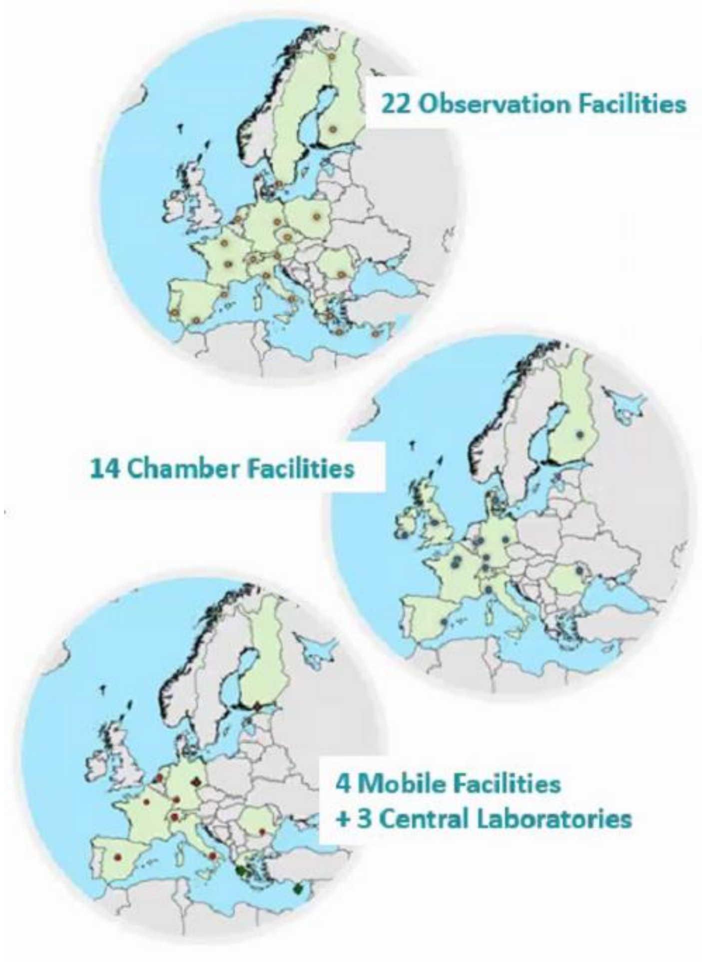
Aerosol chemical monitor calibration center (ACMCC)

The Aerosol, Clouds and Trace Gases Research Infrastructure (ACTRIS.net)

Pan-European research infrastructure for short-lived atmospheric constituents.

22 Observations facilities:
→ 144 measured variables
Simulation chambers
Mobile Facilities
Central laboratories

- Harmonisation of measurements
- Training
- Physical /Remote Access



Aerosol chemical monitor calibration center

ACTRIS Topical Centre for aerosol in situ: ECAC (https://www.actris-ecac.eu/)

CF	**European Centre for Aerosol Calibration and Characterization (ECAC)**					
Aerosol Particle Variables	Physical aerosol variables			Chemical aerosol variables		
	Number conc. and size distribution, scattering and absorption coef. CCN conc.	Number concentration and size distribution	Nanoparticle number concentration and size distribution	Mass concentration of organic tracers, organic and elemental carbon	Mass conc. of non-refractory particulate organics and inorganics	Mass concentration of particulate elements
Units	**WCCAP** Leipzig Germany	**PACC** Prague Czech Republic	**CCC** Helsinki Finland	**OGTAC-CC** Leipzig Germany	**ACMCC** Gif sur Yvette France	**EMC2** Firenze Italy
Subcontracting				**ERLAP** Ispra Italy		

Aerosol Chemical Monitor Calibration Centre

TC Unit head: Olivier FAVEZ

Main other responsible persons, scientists

Contact: acmcc@lsce.ipsl.fr

ACTRIS recommendation (for NF):
Each ACSM is calibrated at TC at least *once every two years.*

Onsite calibrations:
LT ambient: *every 6 months.*

In chambers: *Before and after experiments*

Laboratoire des Sciences du Climat et de l'Environnement

Unit	Host Institution	Main responsibilities in the CF	Required expertise(s)	E-mail of the contact person
ACMCC	CEA	Jean-Eudes Petit	L4 Expert Scientist	jean-eudes.petit@lsce.ipsl.fr
ACMCC	CNRS	Valérie Gros	L1 Expert Manager	valerie.gros@lsce.ipsl.fr
ACMCC	CNRS	Evelyn Freney	L4 Expert Scientist	e.freney@opgc.univ-bpclermont.fr
ACMCC	CNRS	Sabine Philippin	L2 Qualified Officer	s.philippin@opgc.univ-bpclermont.fr
ACMCC	CNRS	Alexandra Froment	L2 Qualified Officer	alexandra.froment@ipsl.fr
ACMCC	CNRS	François Truong	L5 Qualified Operator	francois.truong@lsce.ipsl.fr
ACMCC	CNRS	Nicolas Bonnaire	L5 Qualified Operator	nicolas.bonnaire@lsce.ipsl.fr
ACMCC	CNRS/ CEA	N.N.	L5 Qualified Operator	
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ACMCC	INERIS	Laurent Meunier	L5 Qualified Operator	laurent.meunier@ineris.fr
ACMCC	INERIS	Tanguy Amodeo	L5 Qualified Operator	tanguy.amodeo@ineris.fr
ACMCC	INERIS	Lydia Boutigny	L2 Qualified Officer	lydia.boutigny@ineris.fr
ACMCC	INERIS	Robin Aujay	L6 Technician	robin.aujay@ineris.fr

Aerosol chemical monitor calibration center

Recent activities :

Calibration exercises

2013: Intercomparison , 13 ACSM instruments (Crenn et al., 2015, Frohlich et al., 2015)

2016: Intercomparison , 15 ACSM instruments (ToF-ACSM, Quad ACSM) (Freney et al, 2019)

2018: Intercomparison , 15 ACSM instruments (ToF-ACSM, Quad ACSM (PM1, PM2.5)

-Application of calibration procedures for both ammonium nitrate and ammonium sulphate.
-Method evaluation using a large number of instruments.
-SOPs for ACSM instruments (collaboration COST COLOSSAL)

Research activity

2013: Long term comparison of 13 QACSM, source apportionment (Frohlich et al., 2015)

2016: Long term ambient comparison of 6 QACSM, 6 ToFACSM (In prep)

2018: Characterisation of artefacts with different organic species (Luminita et al in prep).

Characterisation of Organonitrates by ACSM (3 Q ACSM, 3 ToF-ACSM, LTOFAMS, PAM chamber)

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Aerosol Chemical Monitor Calibration Center

Current/future activities

❖ Next intercomparison → 2022

→ **SOPs for Quad ACSM instruments** *(collaboration COST* COLOSSAL *)*

→ SOPs for ToF ACSM instruments *(collaboration COST* COLOSSAL *)*

2. DOCUMENTATION AND RESOURCES

Website of the manufacturer Aerodyne:

https://sites.google.com/site/ariacsr

User manuals in English for Igor and t
site. It is also possible to download u
function, pump software, dryer softw

Software:

- DAQ: ACSM driver software
- Igor (Wavemetrics): scientific
  instruments
- Igor Function "ACSM_Local": r
- VS_PumpStats_Pfeiffer: pump

3. INSTALLATION OF THE ACSM ON SITE FOR LONG-TERM OBSERVATIONS

3.1. Sampling system

3.1.1. Cut-off diameter of the sampling line

It is recommended to use a cyclone upstream from the ACSM's sampling line. This cut-off diameter limits obstruction of the critical orifice at the inlet of the ACSM by preventing large particles from passing through. The actual cyclone cut-off diameter should be higher than the size fraction under investigation to avoid the particle cut-off to be applied twice: once at the sampling line's inlet and again at the inlet of the ACSM.

The $PM_{2.5}$ cyclone recommended by the manufacturer is compatible with a PM_1 ACSM sample flow rate of 3 l/min. When using such a cyclone upstream from a $PM_{2.5}$ ACSM, the sample flow rate should be reduced to 2 l/min.

3.1.2. Sampling line materials

It is recommended to use a sampling line made of a conductive material (stainless steel, copper) in

CAMS 21a : **fully traceable** and **quality-controlled data provision** for several in-situ aerosol variables relevant to air quality and climate change studies

- particle number concentration & size distribution (WP1, ECAC)
- particle light absorption and scattering coefficients (WP1, ECAC)
- aerosol particle chemical composition (WP2, ACMCC)

Collaboration with EUROCHAMP

Currently: 18 ACSM @ACTRIS NF

➢ 9 in EUROCHAMP chambers (↑).

➢ Calibration/intercomparison activities specific to simulation chambers

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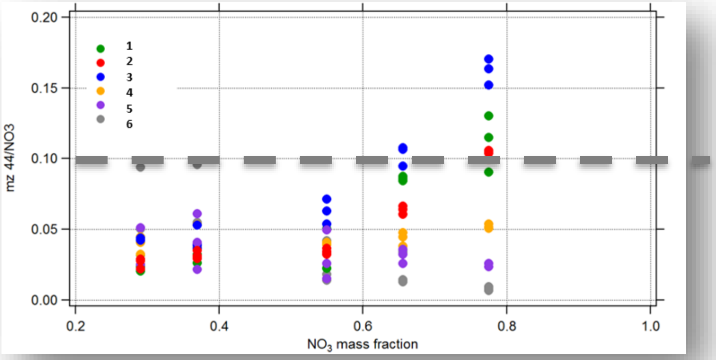
Among 2018 intercomparison activities :

Investigation of the so-called Pieber effect using Organic/Inorganic mixtures

Data treatment perfomed in strong collaboration with INOE: Luminita MARMUREANU, Jeni VASILESCU and Cristina MARIN (article in prep.)

- Investigation into mz 44 artefact (Pieber et al., 2015).
- With inorganic mixtures an increasing trend in mz44/NO3 is observed at highest NO3 MF (Freney et al., 2019)
- In 2018: This artefact was determined for 3 different organic mixtures (Levoglucason, Glutaric acid, and Succinc acid).

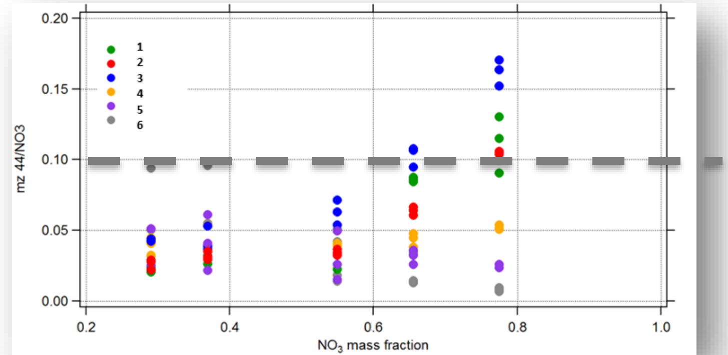


Aerosol chemical monitor calibration center

2018 intercomparison (Luminita Marmureanu et al.,)

- These artefacts for inorganic aerosols only appear significant at highest NO3 MF (> 50%)

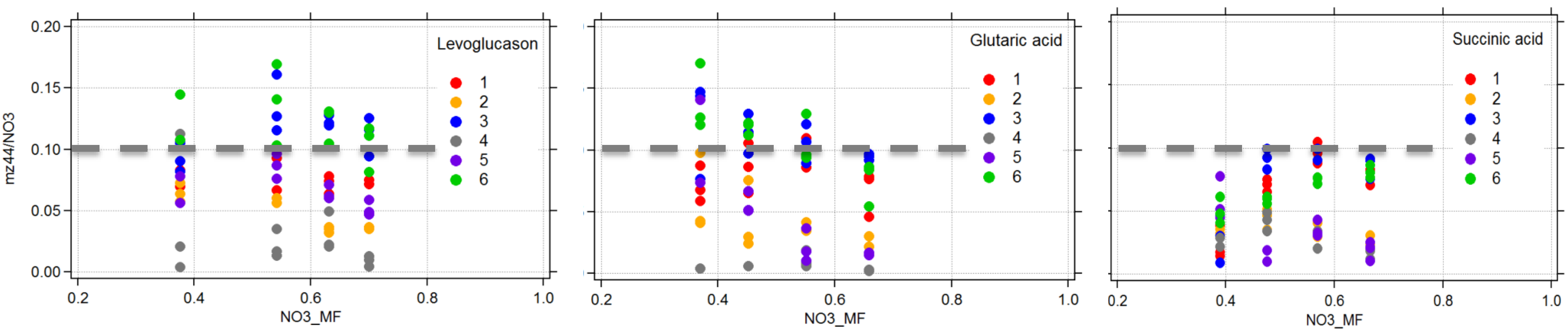
(relatively rare/or short lived in ambient atmosphere)



- For Organic mixtures these artefacts can be significant at much lower NO3MF (30 and 40%)

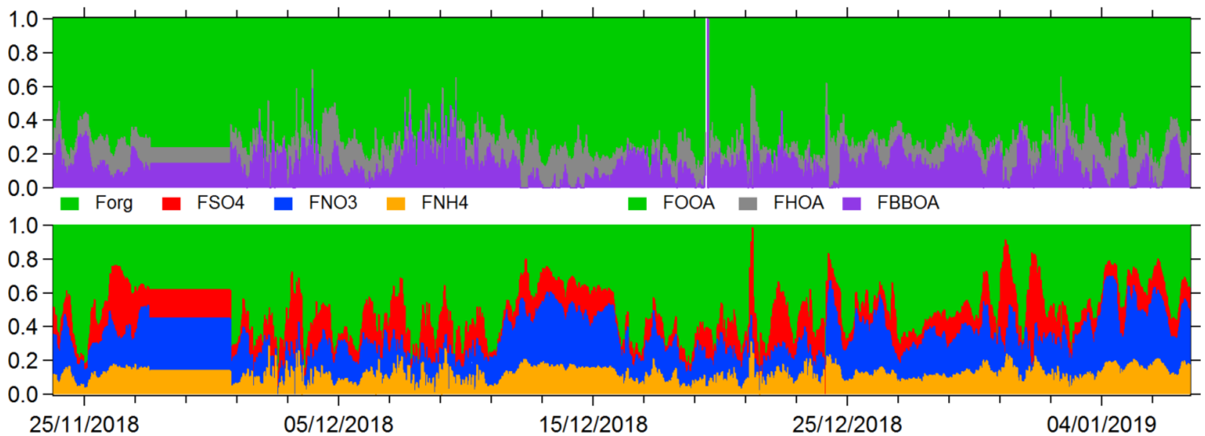
(more common in ambient atmospheres)

- Not consistent across all organic mixtures (Levoglucascon>Glutaric acid>Succinic acid).

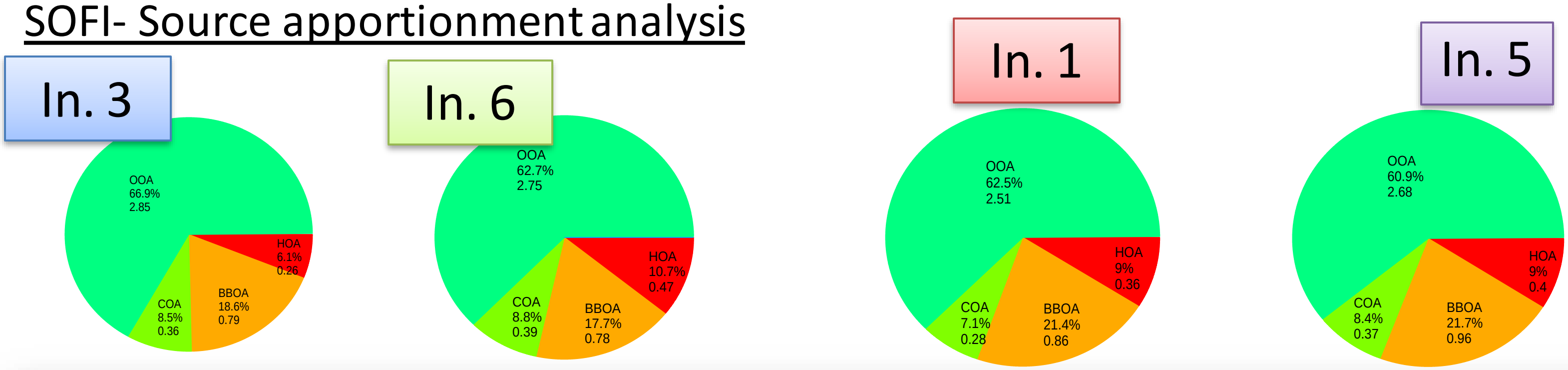


Aerosol chemical monitor calibration center

2018 intercomparison (Luminita Marmureanu et al.,)



SOFI- Source apportionment analysis

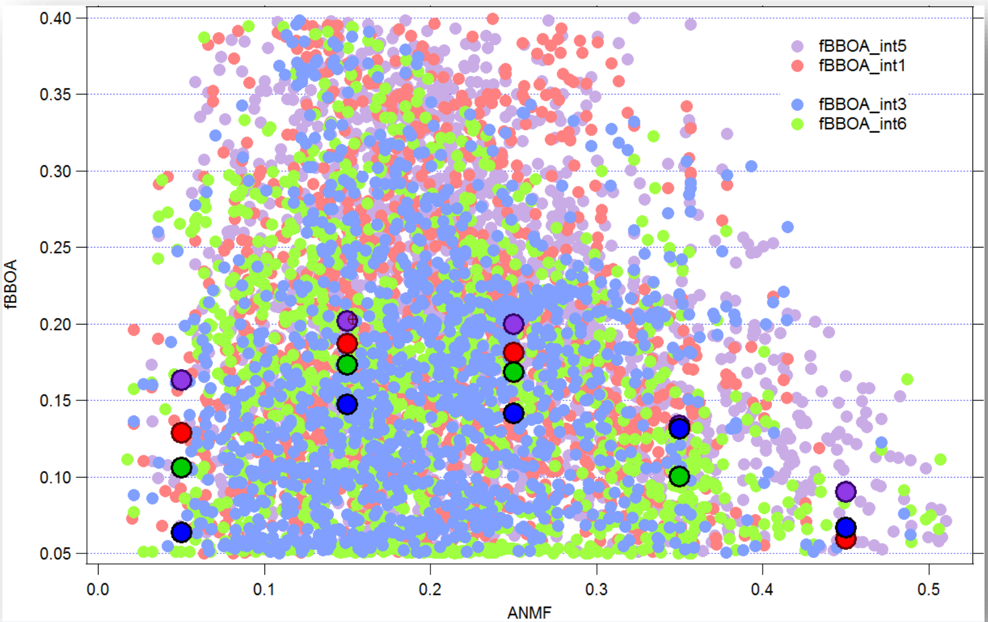


Instrument 3 and 6 have the highest artefact for levoglucon species, and have accordingly lower fractions of BBOA (5%) compared to those instruments with low or no artefacts (In. 1 and 5), and higher OOA.

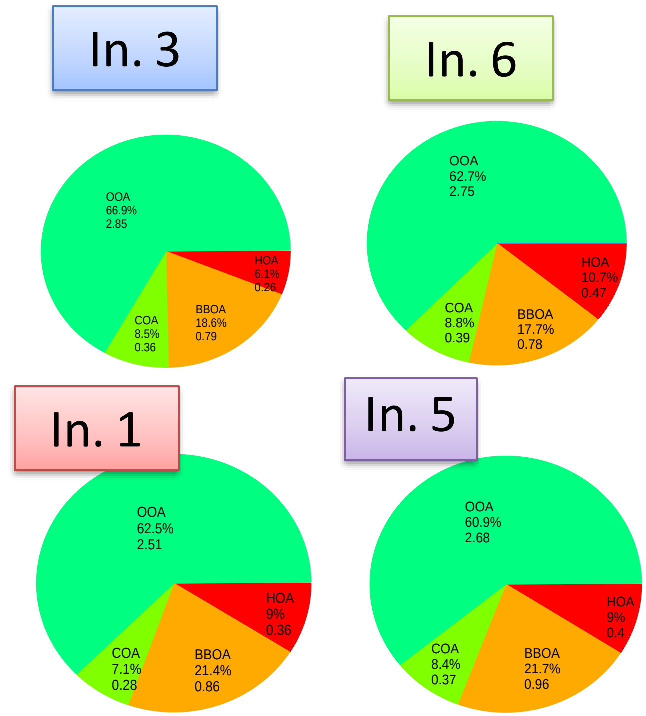
→ Artefact could result in an underestimation of BBOA or primary aerosols.

Aerosol chemical monitor calibration center

2018 intercomparison (Luminita Marmureanu et al.,)



<u>SOFI- Source apportionment analysis</u>



Instrument 3 and 6 have the highest artefact for levoglucon species, and have accordingly lower fractions of BBOA <u>(5%)</u> compared to those instruments with low or no artefacts (In. 1 and 5), and higher OOA.

→ Artefact could result in an underestimation of BBOA or primary aerosols.

Aerosol chemical monitor calibration center

Among 2018 intercomparison activities :

Investigation of ACSM responses to various OrganoNitrate (pON) compounds
(led by A. Albinet & J.-E. Petit)

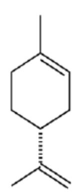
Objectives

- ❑ Get a robust and reproductible method to generate pON
- ❑ Compare simultaneously the response to pON of 9 different AMS/ACSM systems
- ❑ Investigate the pON physical properties and chemical composition

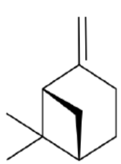
✓ <u>4 pON precursors investigated</u>

Biogenic

Limonene

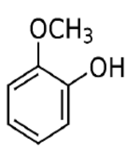


β-pinene

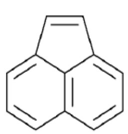


Anthropogenic

Guaiacol



Acenaphthylene



- ✓ 3 Q-ACSMs (standard vaporizer)
- ✓ 2 Q-ACSMs (capture vaporizer, $PM_{2.5}$)
- ✓ 3 Tof-ACSM (standard vaporizer)
- ✓ 1 Long-Tof-AMS

Aerosol chemical monitor calibration center

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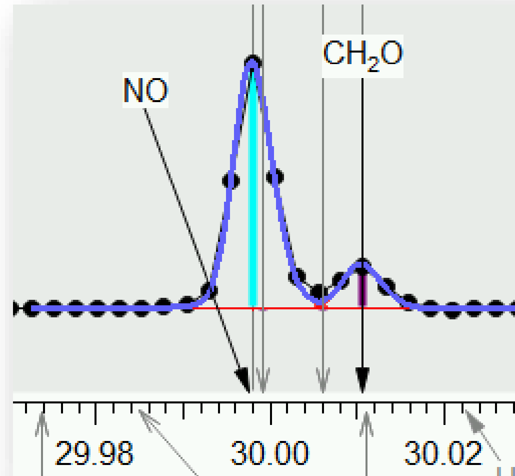
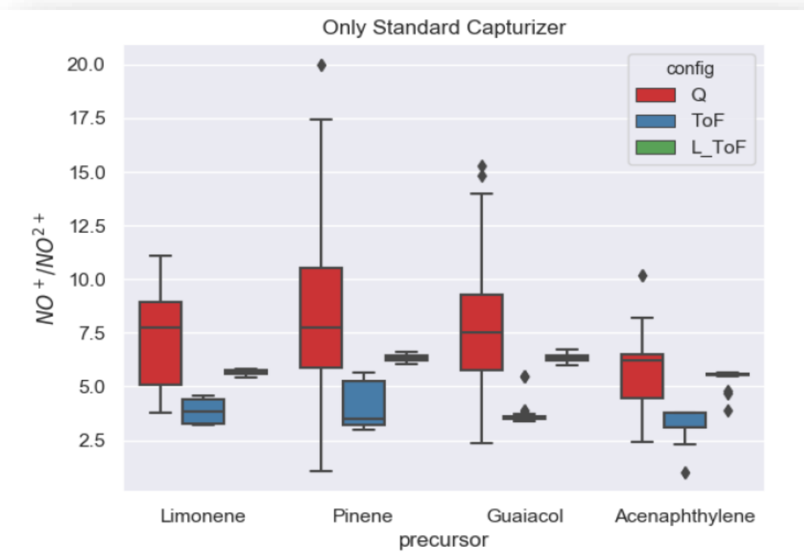
Organic Nitrates : ACSM intercomparison

Previous results

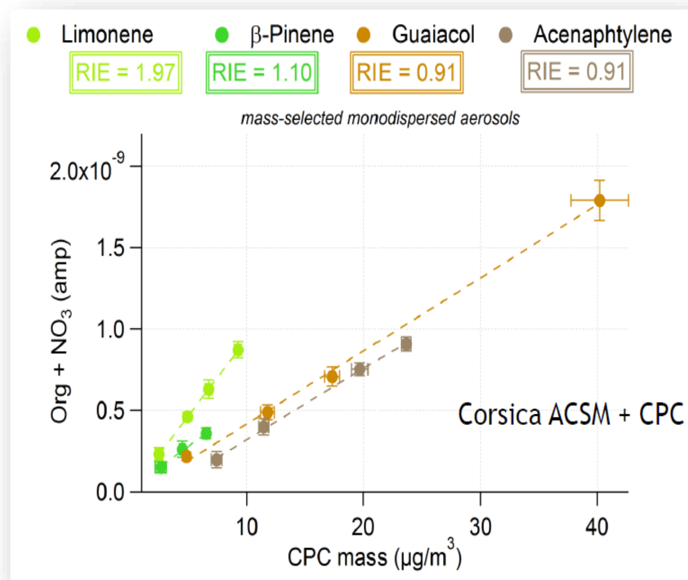
New UMR frag table entry for Org at m/z 30 (from Long-ToF data)



Variability of NO_2^+/NO^+ ratio



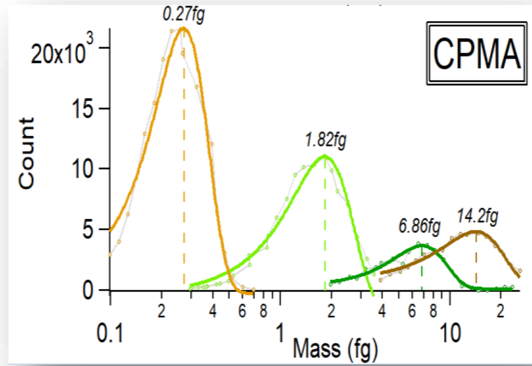
pON RIEs

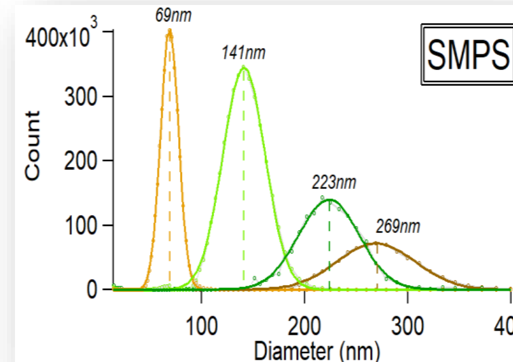


Organic Nitrates : ACSM intercomparison

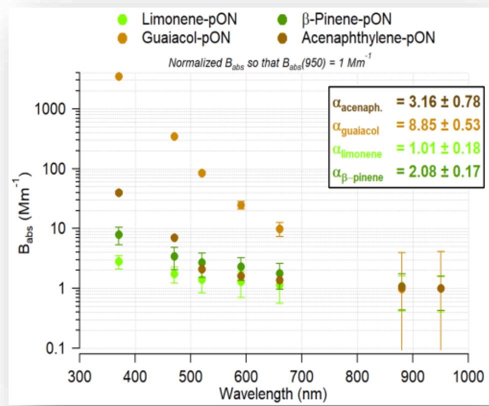
Previous results

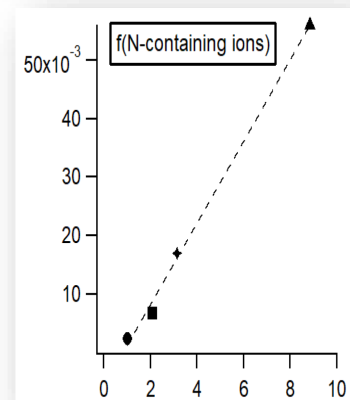
Size and Mass Distributions





Absorption





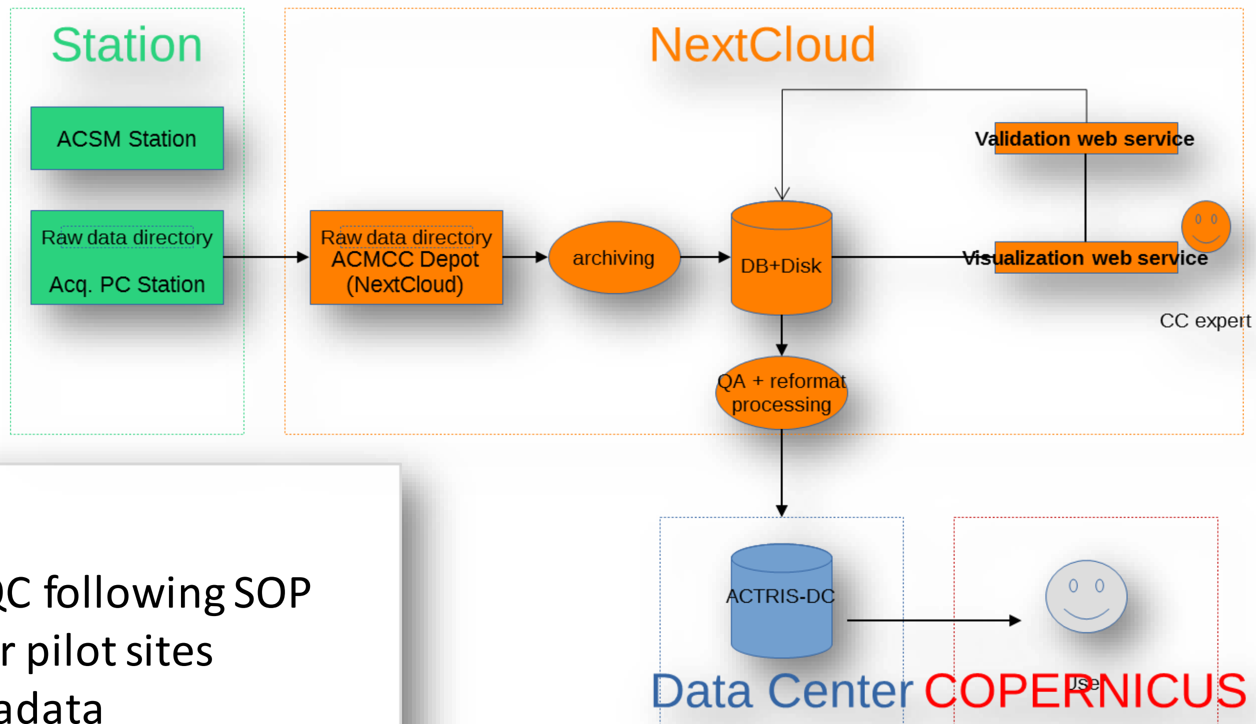
What's next ?

- Develop ambient frag table
- Non-target analyses from filters (LC & GC-Q-ToF-MS) to be linked with absorption data
- Evaluate the impact of our findings on ambient data -> uncertainties

Aerosol chemical monitor calibration center

CAMS 21a : **fully traceable** and **quality-controlled data provision**

- Keep the ACSM export as simple as possible with no human intervention
- Centralized Cloud in order to apply harmonized & traceable QA/QC

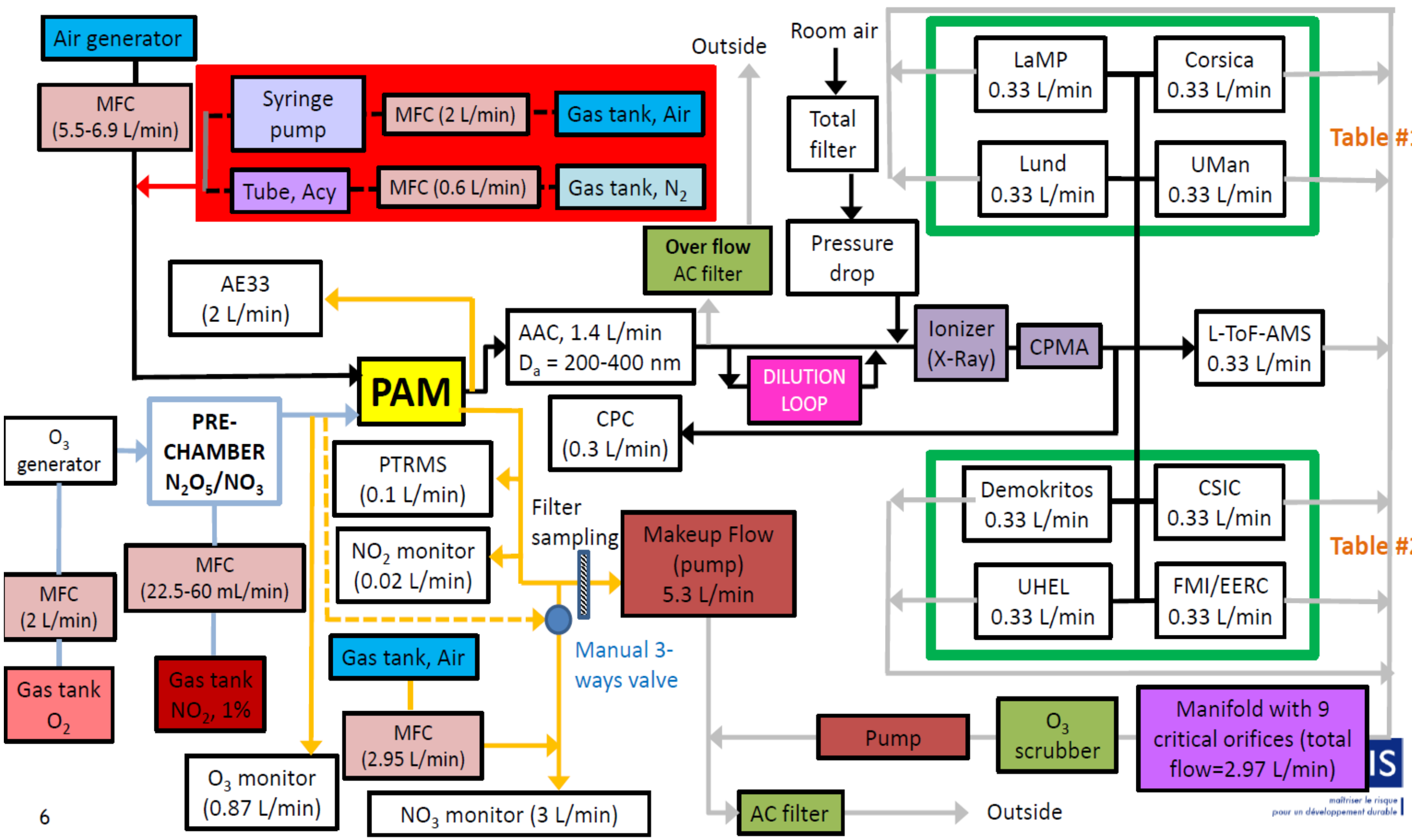


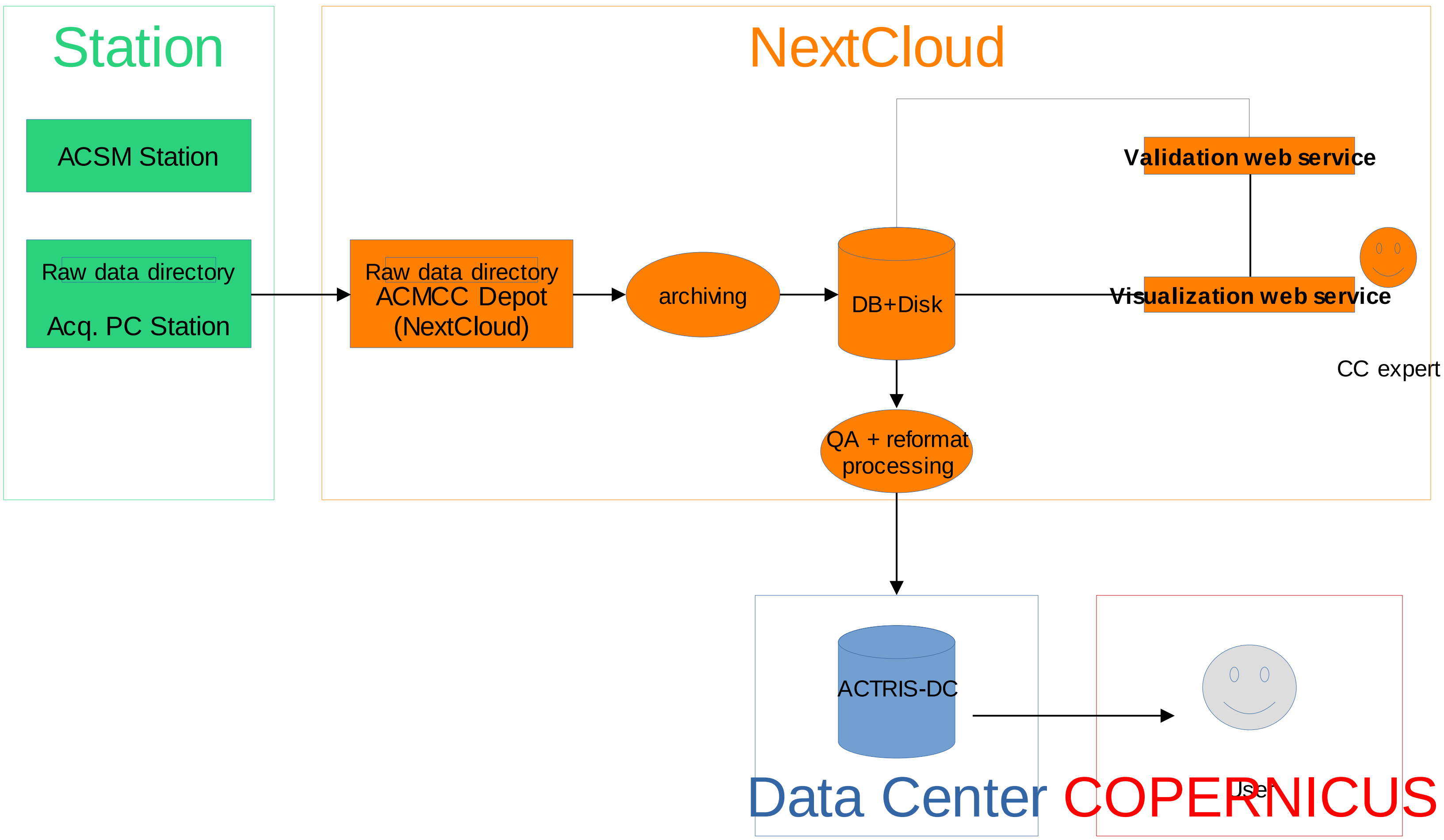
What's next ?

- Automatization of QA/QC following SOP
- Implementation at other pilot sites
- File formating with metadata
- Consolidate code for the ToF-ACSM

Aerosol chemical monitor calibration center

Organic Nitrates : ACSM intercomparison




Station
ACSM Station
Raw data directory
Acq. PC Station
NextCloud
Raw data directory
ACMCC Depot
(NextCloud)
archiving
DB+Disk
Validation web service
Visualization web service
CC expert
QA + reformat
processing
ACTRIS-DC
Data Center
COPERNICUS