Findings from the ACTRIS March 2016 inter-laboratory comparison exercise for the calibration of quadrupole Aerosol Chemical Speciation Monitors (Q-ACSM)

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Aerosol, Clouds, TRace gases


- 20+ ACSM stations in Europe
- Calibration centers for each of the main variables
  - Center of Aerosol IN-situ measurement (CAIS)
  - Center of Aerosol Remote Sensing (CARS)
  - Center of Reactive Trace Gases remote sensing (CRTG)
  - Center of Cloud Remote Sensing (CCRS)
  - Center of Reactive Trace Gases *in-situ* measurements (CRTG-SIM)
  - Center of Cloud in-situ measurements (CIS)
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- Calibration centers for each of the main variables

Center of Aerosol IN-situ measurement (CAIS) is including the Aerosol Chemical Monitor Calibration Centre (ACMCC)

- Located south west of PARIS (LSCE)
- Initiated by Jean Sciare & Olivier Favez
- Lead by INERIS (O. Favez)
- Main other contributors:
  - CNRS: Evelyn Freney, Valerie Gros, François Truong
  - INERIS: Tanguy Amodeo, Yunjiang Zhang
  - CEA: Jean-Eudes Petit
Aerosol Chemical Monitor Calibration Center

- **2 intercomparison exercises so far:**
  - Dec 2013: 15 Q-ACSMs (see Crenn et al., AMT, 2015 & Fröhlich et al., AMT, 2015)
  - March/April 2016 (15 Q-ACSMs + 6 ToF-ACSMs), 2 phases:
    1) Calibration procedures: Freney et al., in prep
    2) PAM experiments & ToF intercomp

- **Next intercomp campaigns: Nov-Dec. 2018**

- **Complementary instruments**
  - ACSMs
  - SMPS & CPMA
  - PAM
  - Online PILS-IC (SO$_4$, NO$_3$, ...) and SUNSET (OC/EC) + offline filters
  - TEOMs, OPC
  - Aethalometer & Nephelometer
  - PTR-MS
Aerosol chemical monitor calibration center - 2016 overview

ACTRIS calibration protocol:

- Pre-cal period – Calibration – Post Cal Period
- Pre calibration intercomparison (3 days)
- Calibrations (2 days).
- Post calibration intercomparison (4 days)
Both jump scan (JS) and full scan (FS) calibrations (Phil’s talk yesterday afternoon)

FS: solutions containing mixtures of AS and AN were used: pure AN, 2:1, 1:2, pure AS, generated using 4 different atomizers.

- SO₄ RIE and NH₄ RIE were determined using chi square minimisation of errors (Xu et al., AST 2017).
- The new FS mode results in globablly higher RIE SO₄.

Calibration set-up

![Calibration diagram](image-url)
Aerosol chemical monitor calibration center - 2016 results

- FS RIE SO$_4$: Improved agreement between instruments.

![Graph showing improved agreement between instruments for FS RIE SO$_4$.]
Aerosol chemical monitor calibration center -2016 results

• FS RIE SO$_4$: Improved agreement between instruments.
Relatively high variability in organic aerosol concentrations, due to discrepancies between f44 from an instrument to another (Crenn et al., 2015).

But no significant impact on the SA analysis (Fröhlich et al, 2015).

Q-ACSM ILC 2016
Then, Pieber et al. identified the m/z 44 artefact during pure AN calibrations, → Maybe related to vaporizer « dirtiness »

\[ b = \frac{m/z\text{44}}{NO_3\text{measured during AN calibration}} \]

\[ \text{frag}_{\text{organic}}[44] = 44, \text{-frag}_{\text{air}}[44], \text{-b*1.05*frag}_{\text{nitrate}}[30], \text{-b*1.05*frag}_{\text{nitrate}}[46]) \]

**Q-ACSM ILC 2016**

Pieber et al., 2016
Aerosol chemical monitor calibration center -2016 results

**Organic aerosol (2016 campaign):**

a) Uncorrected organic concentrations compared to OC (circles) from OC/EC
b) Application of the fragmentation table correction to the ACSM organic concentrations
Aerosol chemical monitor calibration center -2016 results

**Organic aerosol (2016 campaign):**

a) Uncorrected organic concentrations compared to OC (circles) from OC/EC

b) Application of the fragmentation table correction to the ACSM organic concentrations

Pieber et al., correction
Seemed to introduces additional variability among other organic fragments
Results in unrealistically low f44 values + high variability within instruments.

What effect does this have on SA analysis?
Aerosol chemical monitor calibration center - 2016 results

Organic aerosol
Aerosol chemical monitor calibration center - 2016 results

Organic aerosol

![Graph showing f44 vs 44/NO3 with color-coded points representing different intensities.](attachment:image.png)
Aerosol chemical monitor calibration center - 2016 results

**Organic aerosol**

![Graph showing organic aerosol data](image-url)
Aerosol chemical monitor calibration center - 2016 results

Organic aerosol
Aerosol chemical monitor calibration center - 2016 results

Organic aerosol

Highest artefact instrument: 0.266
After filament change and new calibration at end of intercomparison
Artefact decreased to 0.166.

Maybe artefact is not only related to vapourizer age?
**Aerosol chemical monitor calibration center - 2016 results**

**Other ongoing issues (SO4)**

**SO4 artefact:**

Significant m/z 30 signal measured for some ACSM during pure AS calibrations.

SO4 artefact:

m/z 30 measured during pure AS calibrations.

NO+ or CH₂O⁺

After vapourizer replacement (by a brand new one), this instrument still showed a (lower) m/z30 artefact during AS calibration.

→ Maybe artefact is not only related to vapourizer age?
Combined ACTRIS2/COST-COLOSSAL (MC Minguillon) exercise

2 Phases:

- ACSM calibration and intercomparison campaign from 16th to the 26th of November
- 27th Nov - 15th Dec: second research-oriented campaign
  « Investigations of ACSM response to organic nitrate »

Using PAM-generated ON

Comparison between ACSMs vs. HR-ToF-AMS (U. MAN? Other one ??)