The Aerosol Chemical Monitor Calibration Center (ACMCC): A facility for the quality control of ACTRIS Aerosol Chemical Speciation Monitor (ACSM) measurements

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Atmospheric processes relevant to ACTRIS:
ACTRIS: European Research Infrastructure for Aerosols, Clouds and Trace Gases

From research programs toward a multi-decade research infrastructure:
ACTRIS: European Research Infrastructure for Aerosols, Clouds and Trace Gases

Coordinated service provision:

ACTRIS Services for users
- Data and data-product services
- Physical Access services
- Innovation and research-support services
- Training services

Access modes for the ACTRIS
- Physical access
- Data access/virtual access

ACSM within ACTRIS stations

AMS/CIMS user’s meeting, Beijing, 7-11 May 2017
ACTRIS: European Research Infrastructure for Aerosols, Clouds and Trace Gases

ACTRIS structure:

- **Head Office**
  - FI, IT

- **Data Centre**
  - NO, IT, FI, FR

- **Lidar CC**
  - RO, IT, DE

- **Aerosol CC**
  - DE, FR, CZ

- **Radar CC**
  - NL, FR, UK

- **Trace gas CC**
  - DE, FI, CH

- **AERO NET-EU**
  - FR, SP

AMS/CIMS user’s meeting, Beijing, 7-11 May 2017
Central facilities

ACTRIS current Central Facilities / Expertise centers:
Central facility for in situ aerosol measurements

3 distinct nodes:

- **WCCAP**: particle counters, aerosol size distribution, optical properties
- **ERLAP**: off-line measurements of major chemical species (EC-OC)
- **ACMCC**: on-line aerosol chemistry (ACSM)
A dense ACSM networks within ACTRIS

Bressi et al., in prep.
Collaboration between different institutes

Located 25km South-West of Paris, France

Co-located with the SIRTA ACTRIS monitoring station
In situ real-time PM1 chemical speciation at SIRTA

Aerosol chemical speciation monitor (ACSM)
Non-refractory chemical species (NR-PM$_1$):
- Organic aerosol (OA),
- nitrate (NO$_3$),
- sulfate (SO$_4$),
- ammonium (NH$_4$),
- chloride (Cl$^-$)

7-wavelength Aethalometer (AE31 then AE33)
Black Carbon (BC):
- Fossil fuel BC ($\text{BC}_{\text{ff}}$) & Wood burning BC ($\text{BC}_{\text{wb}}$), calculated from Aethalometer model

AMS/CIMS user’s meeting, Beijing, 7-11 May 2017
Nov. 2013: first ACTRIS ACSM intercomparison exercice at the ACMCC

10 European countries participating
15 aerosol mass spect. intercompared

✓ robust measurements of the NR-PM1 total mass and its major components.

13 Quad-ACSM:

![NR-PM1 composition (%) chart]

[Graph showing NR-PM1 mass concentrations over time]

AMS/CIMS user’s meeting, Beijing, 7-11 May 2017
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Major conclusions

😊 A good agreement with external data
😊 A high stability of the instruments
😊 Satisfactory Z-score analysis results for all the tested instruments

![Z-score graph showing comparison between measured data and ACSM results for different pollutants (Org, NO3, SO4, NH4, Chl, NR-PM).]
Nov. 2013: first ACTRIS ACSM intercomparison exercise at the ACMCC

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😊 RIE NH4 and SO4 calibrations might be improved
😊 Significant $f_{44}$ variability (Need to be careful when interpreting oxidation states)
😊 But good agreement between Source Apportionment results between from the 13 ACSMs
Nov. 2013: first ACTRIS ACSM intercomparison exercise at the ACMCC

**ACTRIS ACSM intercomparison – Part 1: Reproducibility of concentration and fragment results from 13 individual Quadrupole Aerosol Chemical Speciation Monitors (Q-ACSM) and consistency with co-located instruments**


**ACTRIS ACSM intercomparison – Part 2: Intercomparison of ME-2 organic source apportionment results from 15 individual, co-located aerosol mass spectrometers**


www.atmos-meas-tech.net/8/5063/2015/
doi:10.5194/amt-8-5063-2015
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Spring 2016: 2\textsuperscript{nd} ACTRIS ACSM intercomparison exercise at the ACMCC

Organization:
1. Three to four days pre-calibration intercomparison.
2. Calibration using single and mixed inorganic solutions
3. Three to four days post-calibration intercomparison (extended for ToF-ACSM).

Ambient measurements
4th to 7th of March
7th to 10th of March
11th to 14th of March

Calibrations and PAM experiments
24th to 27th of March
27th of March to 18th of April
### Spring 2016: 2nd ACTRIS ACSM intercomparison exercise at the ACMCC

<table>
<thead>
<tr>
<th>Site</th>
<th>Q-ACSM</th>
<th>ToF-ACSM</th>
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<tr>
<td>Hohenpeissenberg</td>
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Spring 2016: 2\textsuperscript{nd} ACTRIS ACSM intercomparison exercise at the ACMCC

- 15 Q-ACSM + 1 ToF-ACSM
- Ambient measurements: 4th to 7th of March
- Calibrations: 7th to 10th of March
- Ambient measurements: 11th to 14th of March
Optimizing the standard calibration procedure using CPMA:

Like normal ACSM Calibration Setup but with CPMA after DMA
CPMA selects particles by Mass/Particle
Combined with DMA, this eliminates Q2s
Optimizing the standard calibration procedure using CPMA and calibrating in « full scan mode »
Spring 2016: 2nd ACTRIS ACSM intercomparison exercise at the ACMCC

Optimizing the standard calibration procedure using CPMA and calibrating in « full scan mode »

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- Ambient measurements: 4th to 7th of March
- Calibrations: (R)IE NO₃, SO₄...
- Ambient measurements: 7th to 10th of March
- Ambient measurements: 11th to 14th of March

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Optimizing the standard calibration procedure using CPMA and calibrating in « full scan mode »:
Also allowing to check if m/z44 observed during NH4NO3 IE calibration

Pieber et al., EST, 2016
Optimizing the standard calibration procedure using CPMA and calibrating in « full scan mode »:
Also allowing to check if m/z44 observed during NH4NO3 IE calibration
Comparison with SIRTA reference instrument

Exemple 1:

BEFORE

15 Q-ACSM + 1 ToF-ACSM

Ambient measurements
4th to 7th of March

Calibrations
7th to 10th of March

Ambient measurements
11th to 14th of March

2-7 March

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Spring 2016: 2nd ACTRIS ACSM intercomparison exercise at the ACMCC

Comparison with SIRTA reference instrument

Exemple 1:

11-14 March

15 Q-ACSM + 1 ToF-ACSM

Ambient measurements
4th to 7th of March

Calibrations
7th to 10th of March

Ambient measurements
11th to 14th of March
Instrument performance evaluated against the Median using the Z-score method (after checks and calibrations)
Preliminary) Conclusions on Q-ACSM 2016 campaign:

- The ACSM is still a research instrument on which we have to keep performing research activities.
- The data acquired during the ACMCC intercomparison exercises will be used to further determine robust uncertainties for these instruments.
- Calibrations in acquisition mode significantly improved the accuracy of SO4 measurements, and allows for tracking «Pieber effects».
- Tuning of ACSM (AMS) Analog Input used for CPC reading has to be checked.
Spring 2016: 2nd ACTRIS ACSM intercomparison exercise at the ACMCC

Ability of the PAM system to produce aerosols with a very wide range of oxidation states
Other / future activities at the ACMCC

Role:
- Calibration facility for various on-line in-situ chemical analyzers (ACSM, but also MARGA, Sunset Field Inst., ...);
- Intercomparison studies, training, exchange of knowledge, best-practices, ... at the ACMCC;
- Perform quality control audits and provide assistance directly at ACTRIS stations

Users: Research institutions, and (French) regional monitoring networks (AASQA)

Thank you

Any question?