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

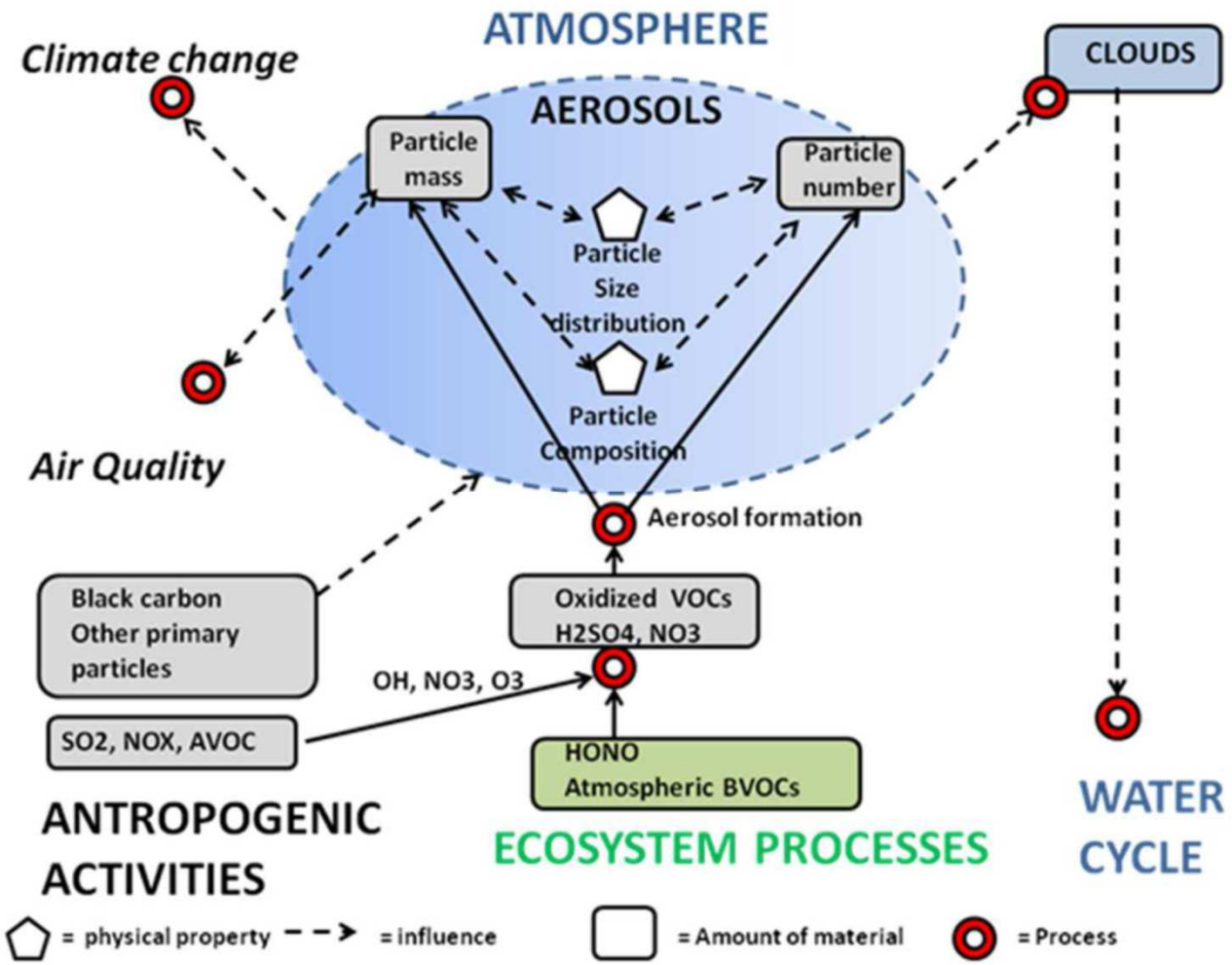
acmcc@lsce.ipsl.fr

Olivier FAVEZ, Evelyn FRENEY, Valerie GROS, Francois TRUONG, Tanguy AMODEO

AMS / CIMS user's meeting

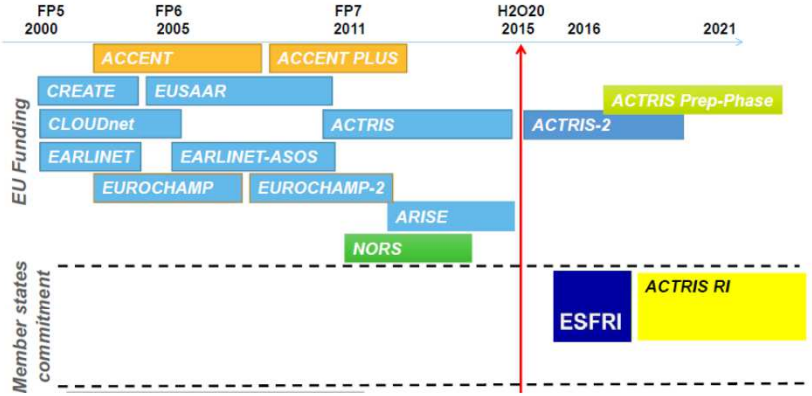
Beijing, 7-11 May 2017

Atmospheric processes relevant to ACTRIS:



ACTRIS: European Research Infrastructure for Aerosols, Clouds and Trace Gases

From research programs toward a multi-decade research infrastructure :

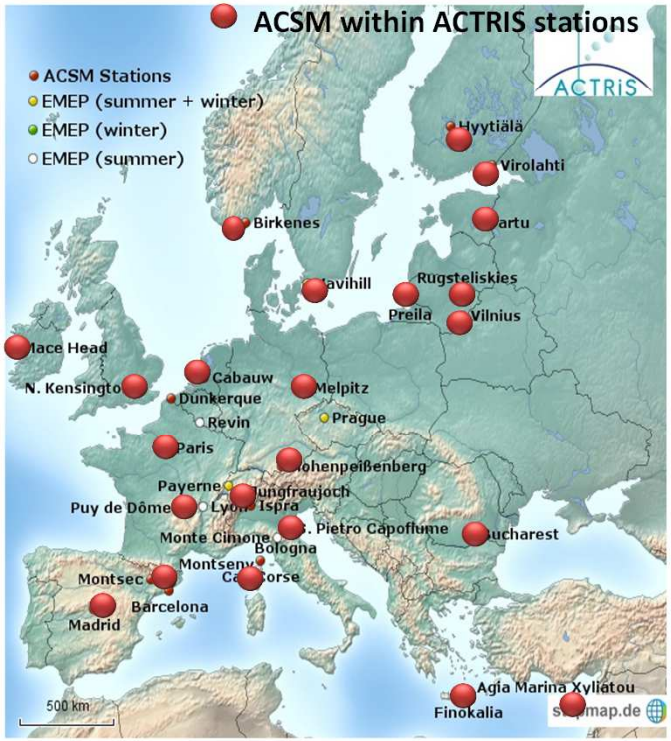


ACTRIS: European Research Infrastructure for Aerosols, Clouds and Trace Gases

Coordinated service provision:

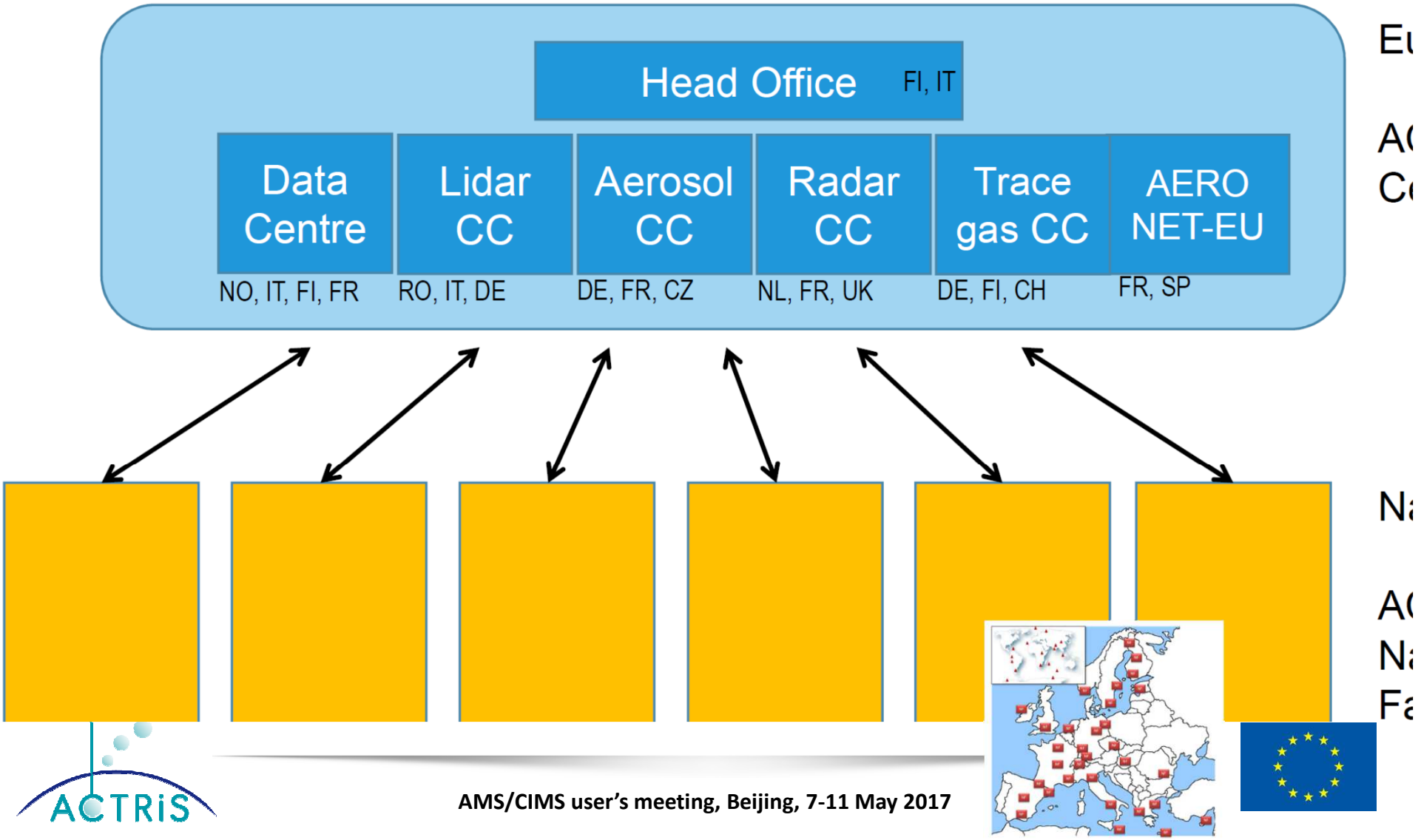
ACTRIS Services for users
- Data and data-product services
- Physical Access services
- Innovation and research-support services
- Training services

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



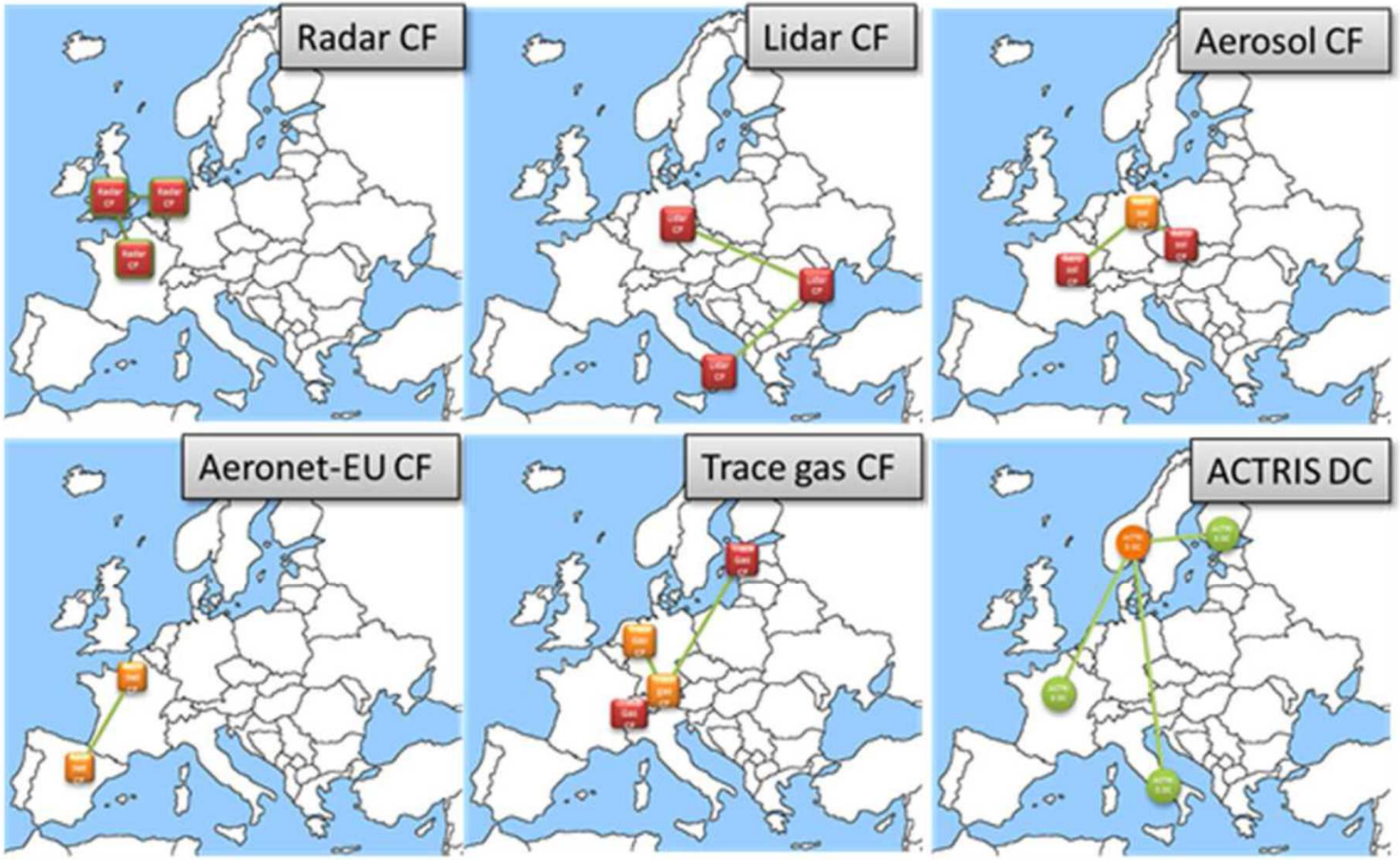
ACTRIS: European Research Infrastructure for Aerosols, Clouds and Trace Gases

ACTRIS structure:



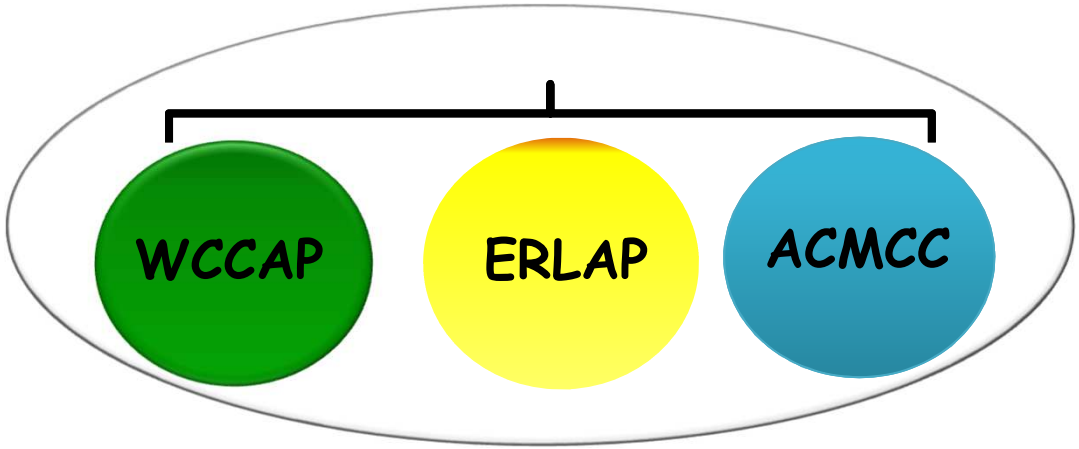
Central facilities

ACTRIS current Central Facilities / Expertise centers:



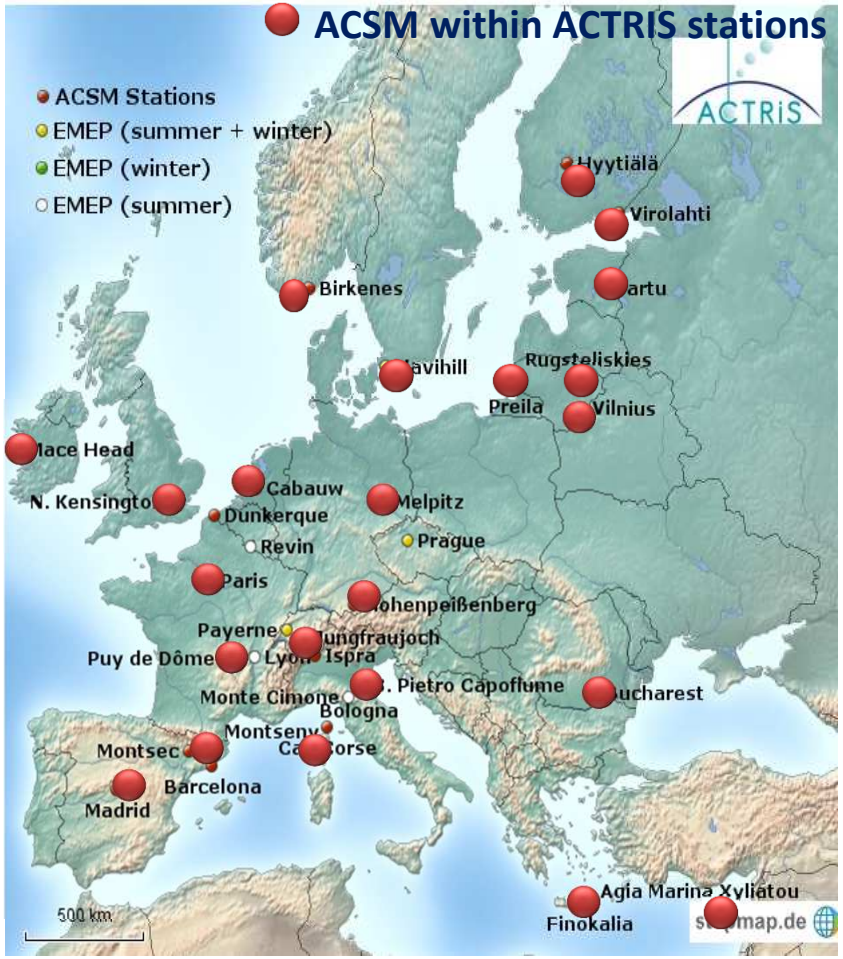
Central facility for in situ aerosol measurements

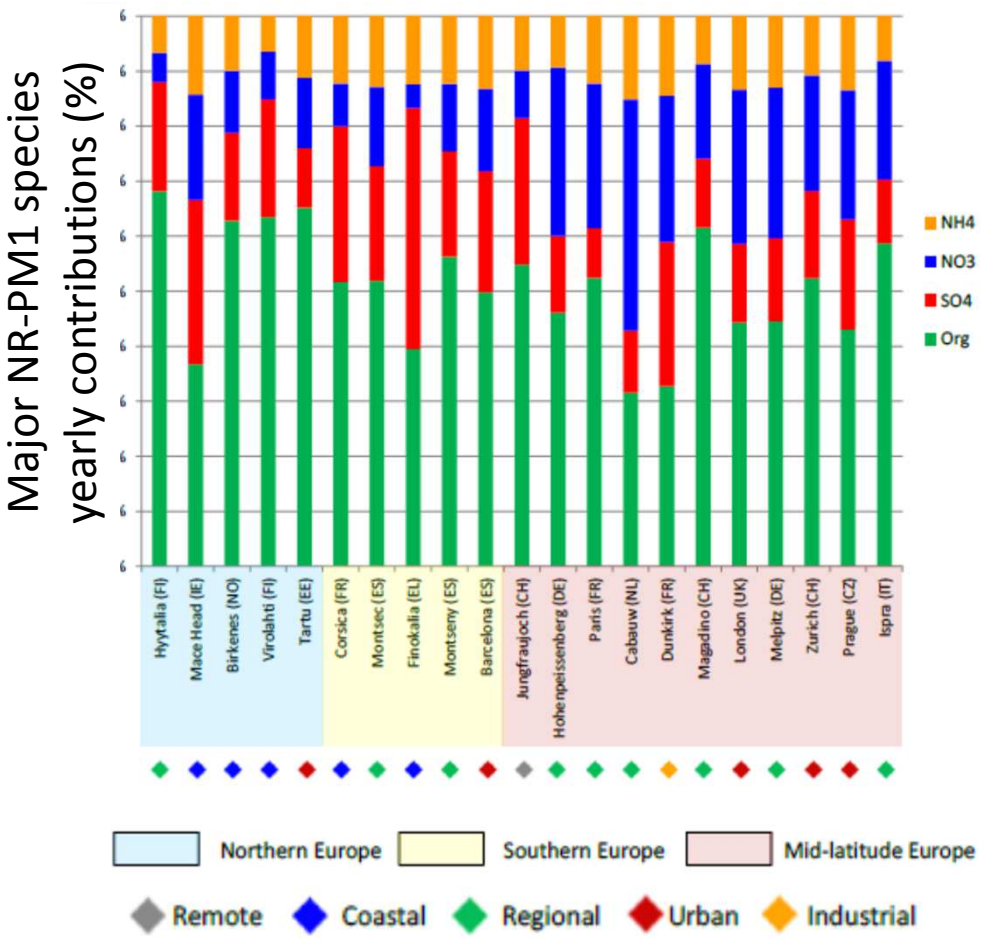
3 distinct nodes:



- 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.

ACMCC presentation

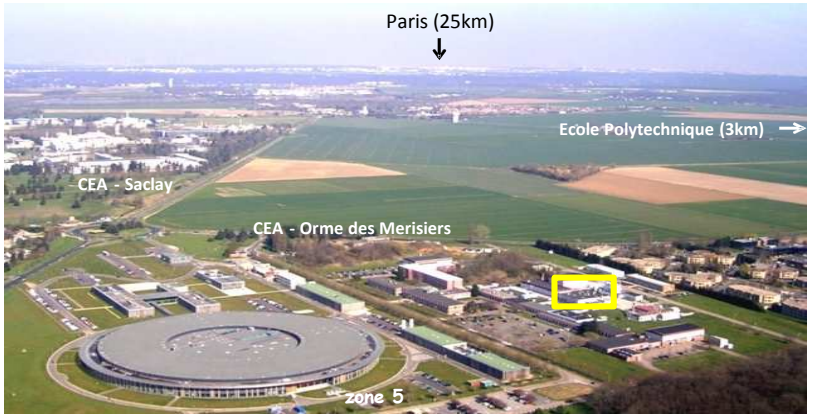
- ✓ **Collaboration between different institutes**

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

INERIS

LaMP

- ✓ **Located 25km South-West of Paris, France**



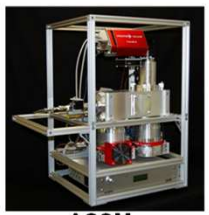
- ✓ **Co-located with the SIRTA ACTRIS monitoring station**


SMPS + OPC


TEOM - FDMS


EC-OC Sunset Field Inst. + PILS-IC


Nephelometers + Aethalometers


ACSM


Filter chemistry


NO, NO2, O3


PTR-MS & GC-FID

ACTRiS

In situ real-time PM1 chemical speciation at SIRTA

Aerosol chemical speciation monitor (ACSM)

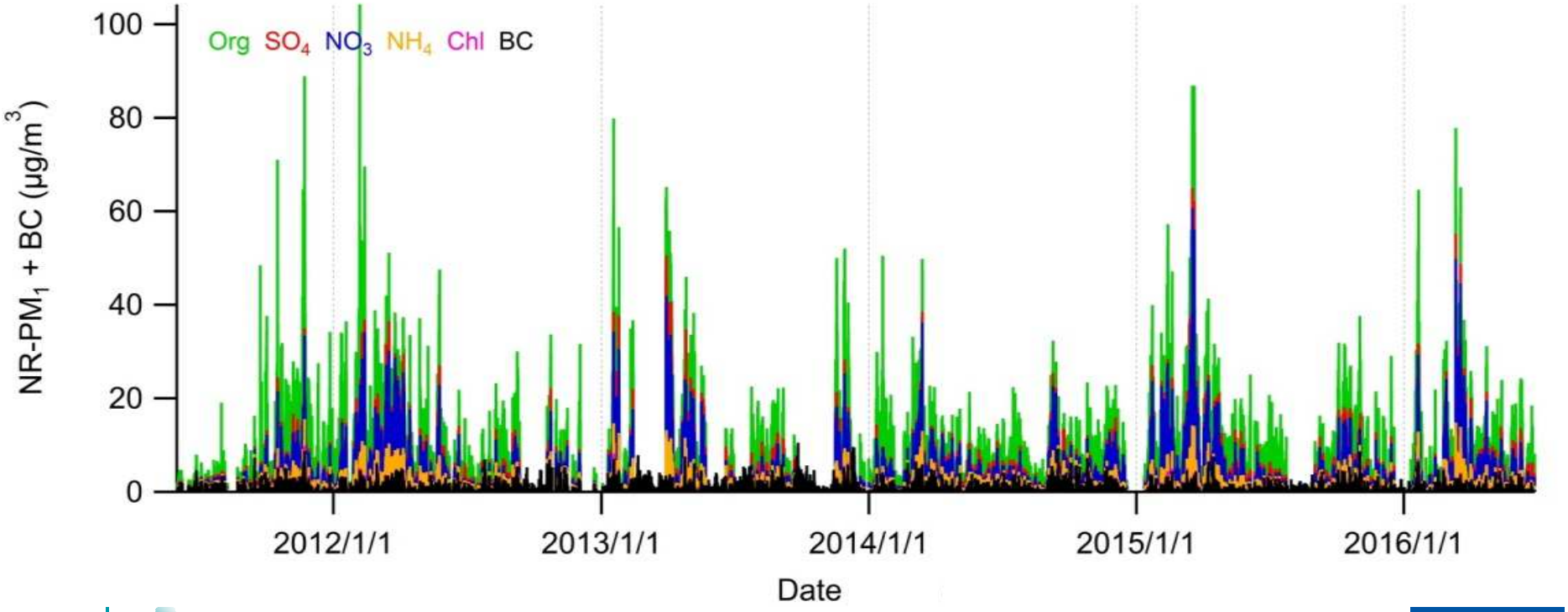
Non-refractory chemical species (NR-PM_1):

Organic aerosol (OA), nitrate (NO_3), sulfate (SO_4), ammonium (NH_4), chloride (Chl)

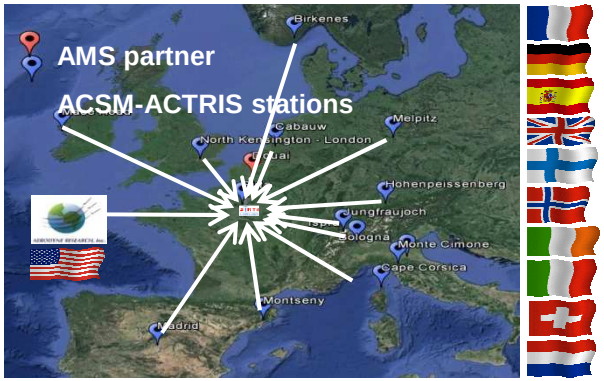
7-wavelength Aethalometer (AE31 then AE33)

Black Carbon (BC):

Fossil fuel BC (BC_{ff}) & Wood burning BC (BC_{wb}), calculated from *Aethalometer model*

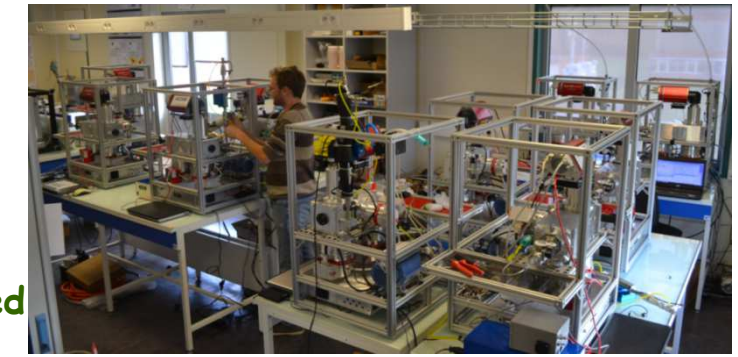


Nov. 2013: first ACTRIS ACSM intercomparison exercice at the ACMCC

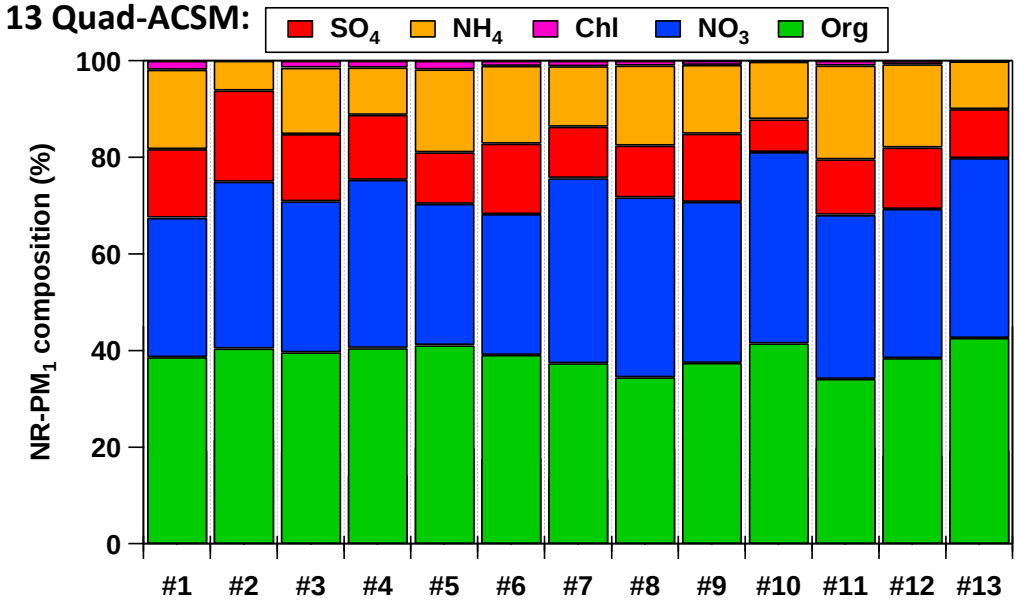


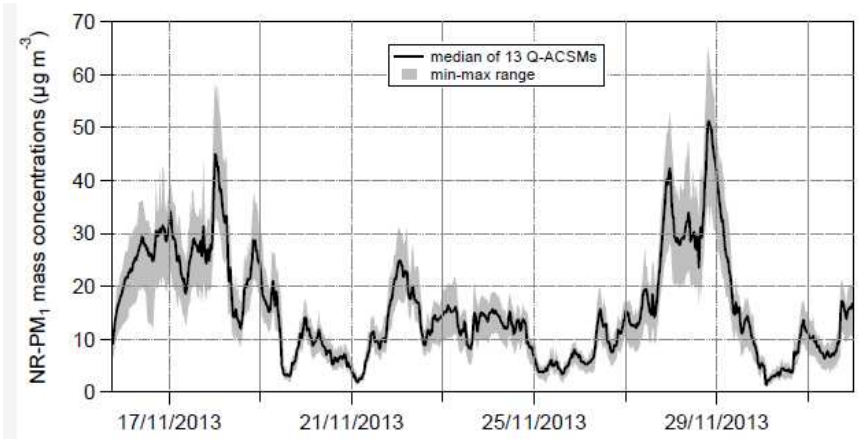
10 European countries participating

15 aerosol mass spect. intercompared



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





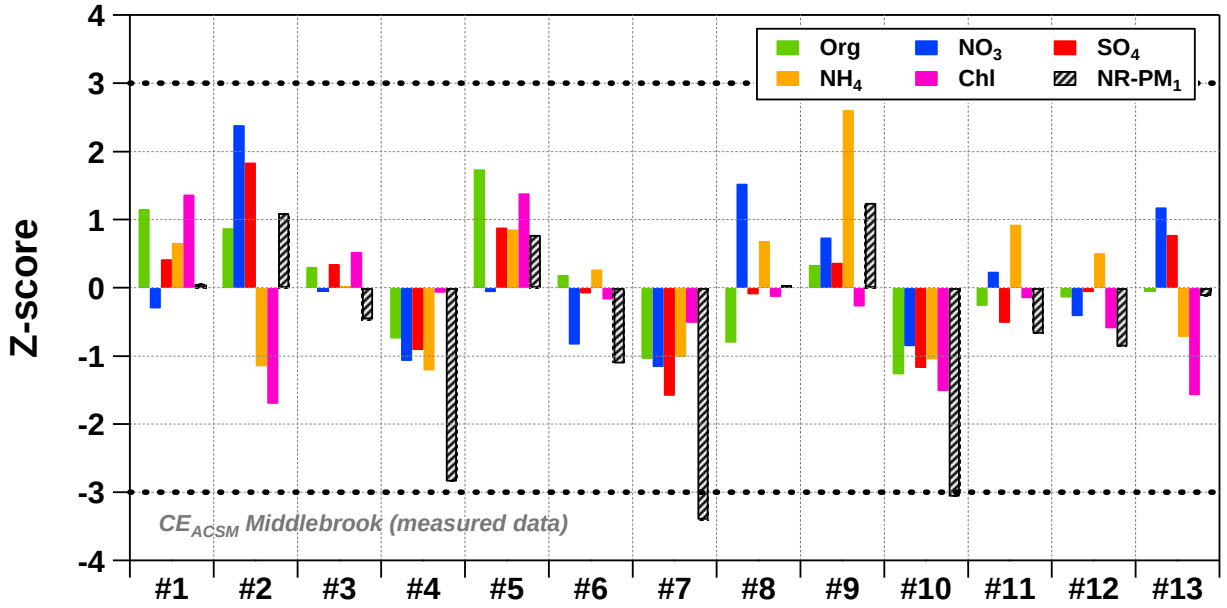
Nov. 2013: first ACTRIS ACSM intercomparison exercice at the ACMCC

Major conclusions

☺ A good agreement with external data

☺ A high stability of the instruments

☺ Satisfactory Z-score analysis results for all the tested instruments



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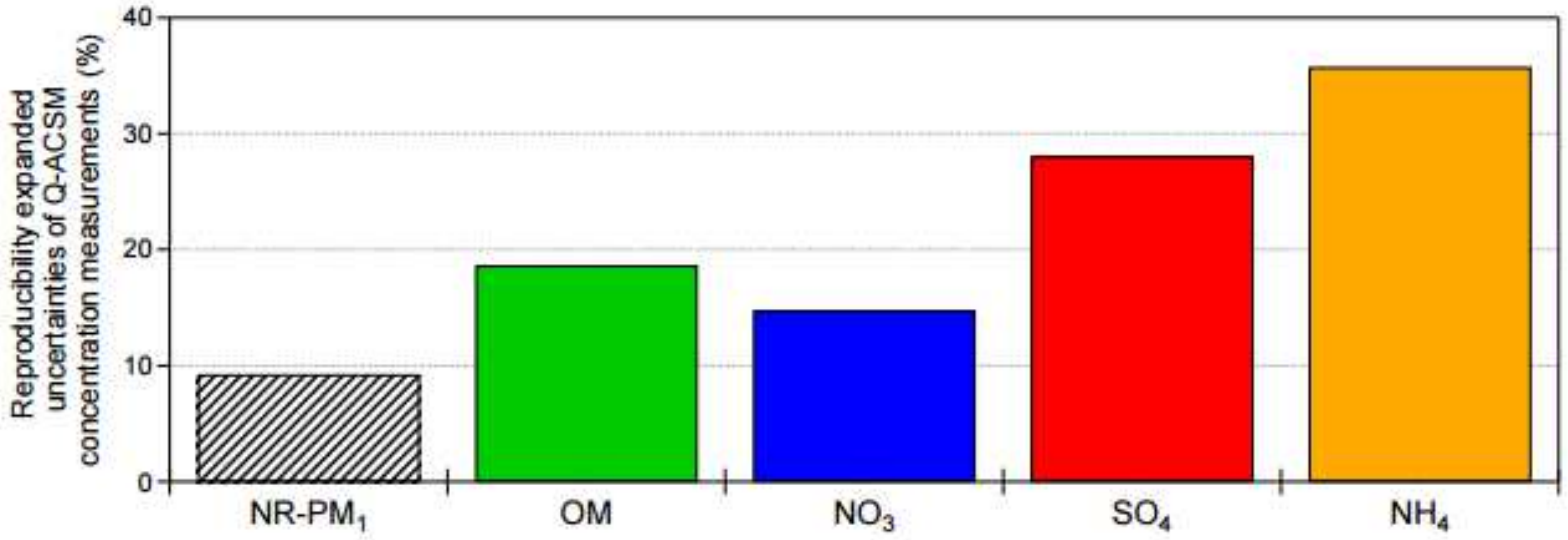

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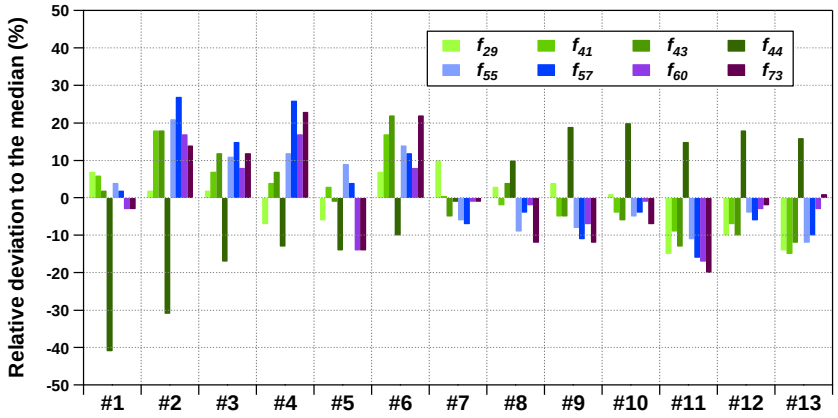

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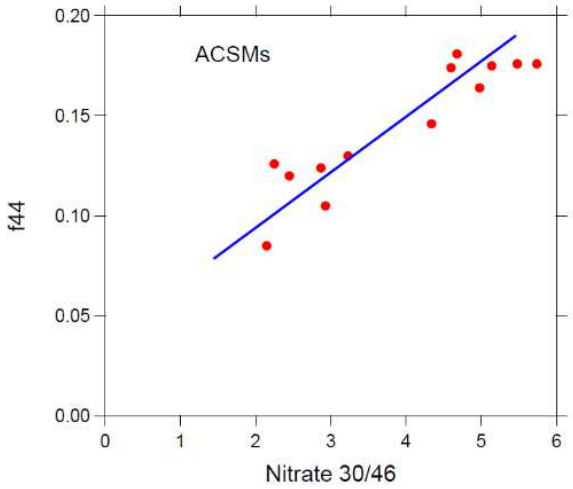

Relationship Between 30/46 and m/z 44 from NH_4NO_3

Nov. 2013: first ACTRIS ACSM intercomparison exercice at the ACMCC

Major conclusions

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☺ A high stability of the instruments

☺ Satisfactory Z-score analysis results for all the tested instruments

☺ Relativley low uncertainties for the major species

☹ RIE NH4 and SO4 calibrations might be improved

☹ Significant *f44* variability (Need to be carefull when interpreting oxidation states)

☺ But good agreement between Source Apportionment results between from the 13 ACSMs

Nov. 2013: first ACTRIS ACSM intercomparison exercice 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

V. Crenn[1], J. Sciare[1,2], P. L. Croteau[3], S. Verlhac[4], R. Fröhlich[5], C. A. Belis[6], W. Aas[7], M. Äijälä[8], A. Alastuey[9], B. Artiñano[10], D. Baisnée[1], N. Bonnaire[1], M. Bressi[6], M. Canagaratna[3], F. Canonaco[5], C. Carbone[11], F. Cavalli[6], E. Coz[10], M. J. Cubison[12], J. K. Esser-Gietl[13], D. C. Green[14], V. Gros[1], L. Heikkinen[8], H. Herrmann[15], C. Lunder[7], M. C. Minguillón[9], G. Močnik[16], C. D. O'Dowd[17], J. Ovadnevaite[17], J.-E. Petit[1,4], E. Petralia[18], L. Poulain[15], M. Priestman[14], V. Riffault[19], A. Ripoll[9], R. Sarda-Estève[1], J. G. Slowik[6], A. Setyan[19], A. Wiedensohler[15], U. Baltensperger[5], A. S. H. Prévôt[5], J. T. Jayne[3], and O. Favez[4]

Atmospheric Measurement Techniques Open Access EGU

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

R. Fröhlich[1], V. Crenn[2], A. Setyan[3], C. A. Belis[4], F. Canonaco[1], O. Favez[5], V. Riffault[3], J. G. Slowik[1], W. Aas[6], M. Aijälä[7], A. Alastuey[8], B. Artiñano[9], N. Bonnaire[2], C. Bozzetti[1], M. Bressi[4], C. Carbone[10], E. Coz[9], P. L. Croteau[11], M. J. Cubison[12], J. K. Esser-Gietl[13], D. C. Green[14], V. Gros[2], L. Heikkinen[7], H. Herrmann[15], J. T. Jayne[11], C. R. Lunder[6], M. C. Minguillón[8], G. Močnik[16], C. D. O'Dowd[17], J. Ovadnevaite[17], E. Petralia[18], L. Poulain[15], M. Priestman[14], A. Ripoll[8], R. Sarda-Estève[2], A. Wiedensohler[15], U. Baltensperger[1], J. Sciare[2,19], and A. S. H. Prévôt[1]

Atmos. Meas. Tech., 8, 5063–5087, 2015
www.atmos-meas-tech.net/8/5063/2015/
doi:10.5194/amt-8-5063-2015
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Atmosp Measure Techn
Atmos. Meas. Tech., 8, 2555–2576, 2015
www.atmos-meas-tech.net/8/2555/2015/
doi:10.5194/amt-8-2555-2015
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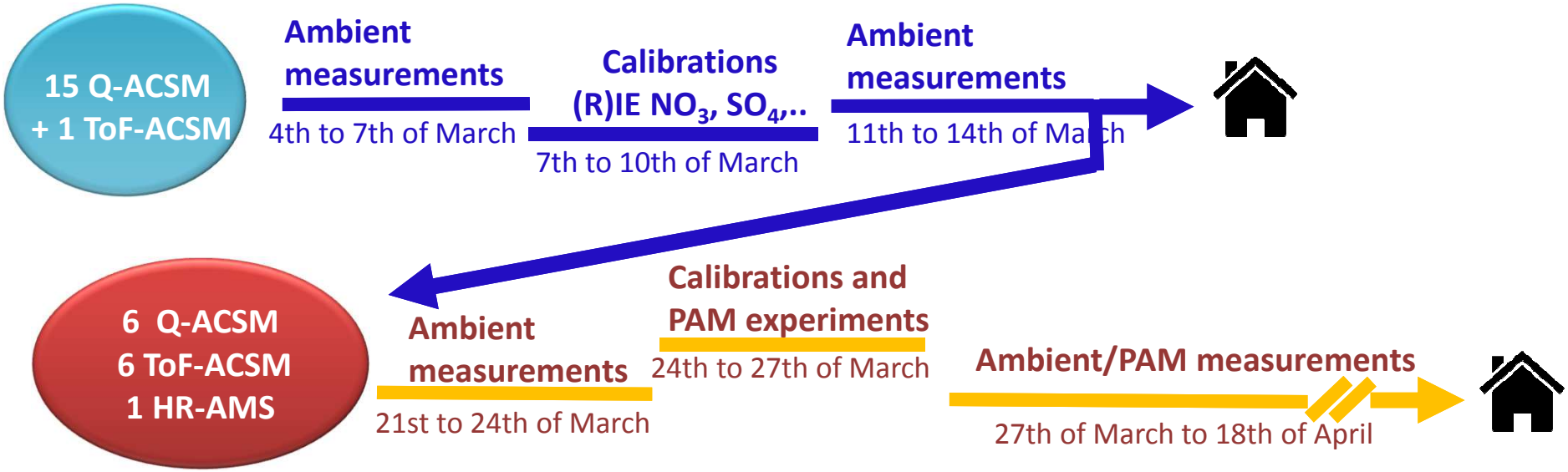
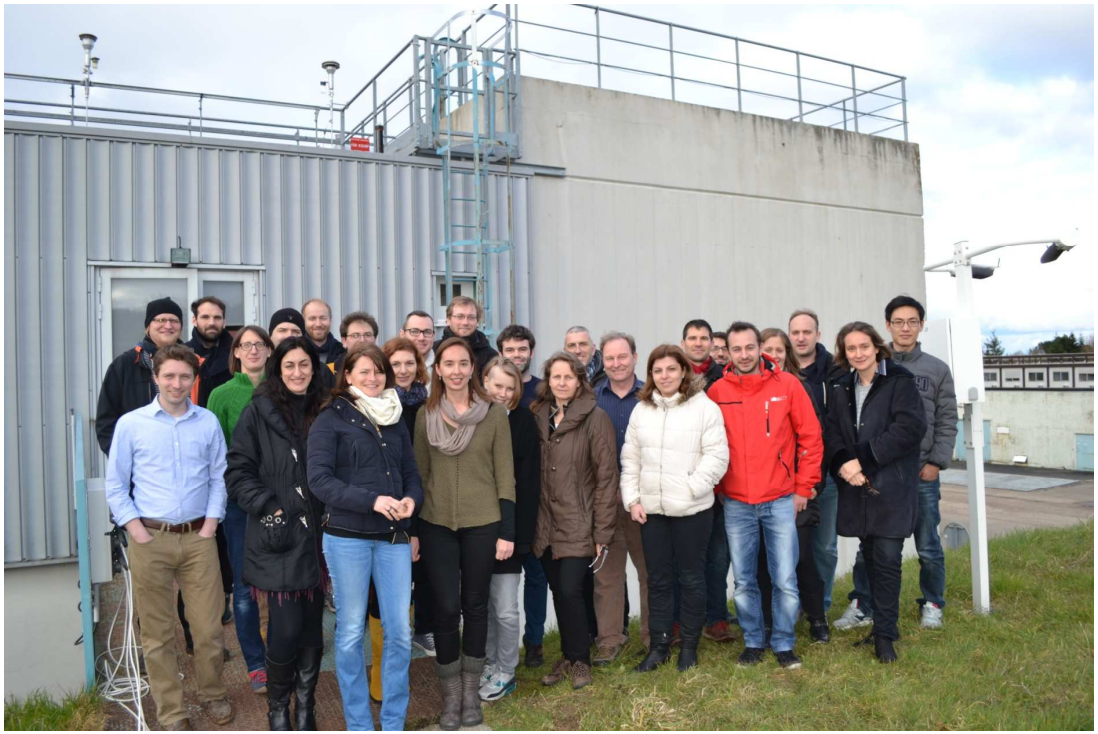
Spring 2016: 2nd ACTRIS ACSM intercomparison exercice at the ACMCC

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).



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



Site	Q-ACSM	ToF-ACSM
Hohenpeissenberg		
Hyytiala		
Cyprus		
Melpitz		
Finokalia		
London		
Bologna		
Madrid		
Vavihill		
SMEAR		
Zurich		
JFJ		
Bucharest		
Barcelona		
PUY		
SIRTA		
CapCorse		
Tartu		
ToFwerk		

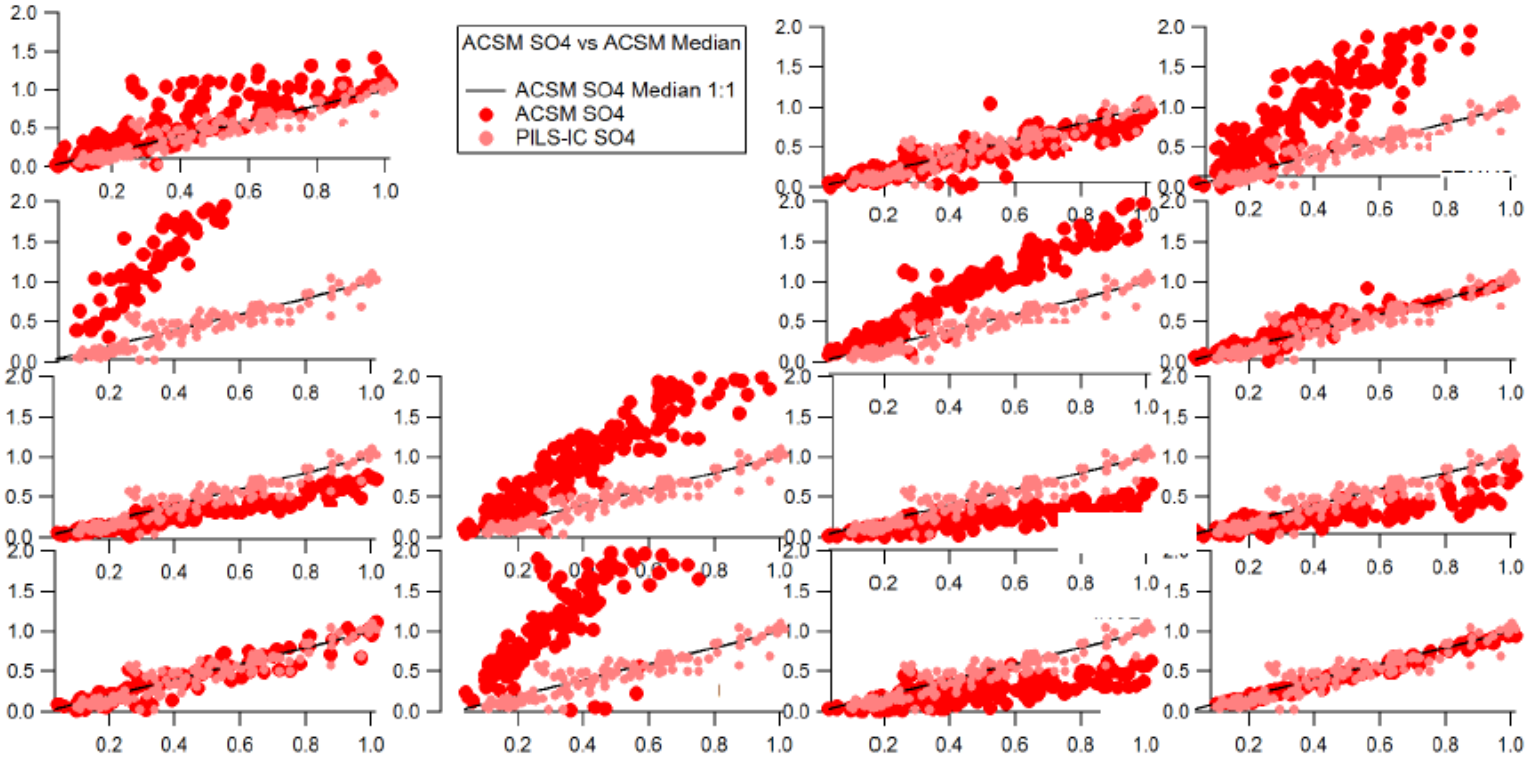
Spring 2016: 2nd ACTRIS ACSM intercomparison exercice at the ACMCC

15 Q-ACSM
+ 1 ToF-ACSM

Ambient measurements
4th to 7th of March

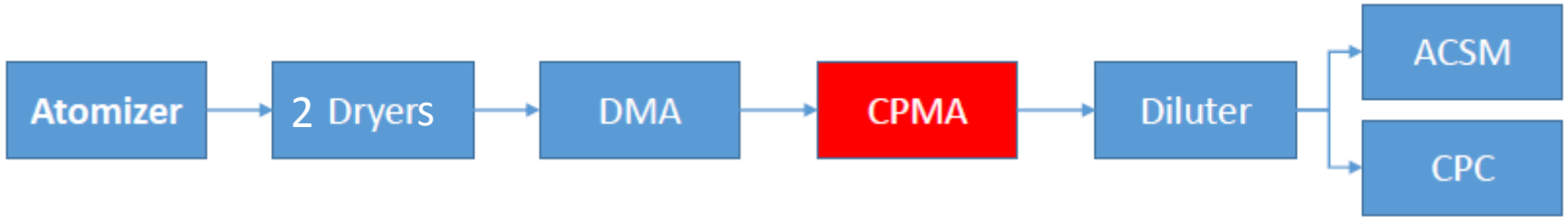
Calibrations
(R)IE NO_3, SO_4,..
7th to 10th of March

Ambient measurements
11th to 14th of March

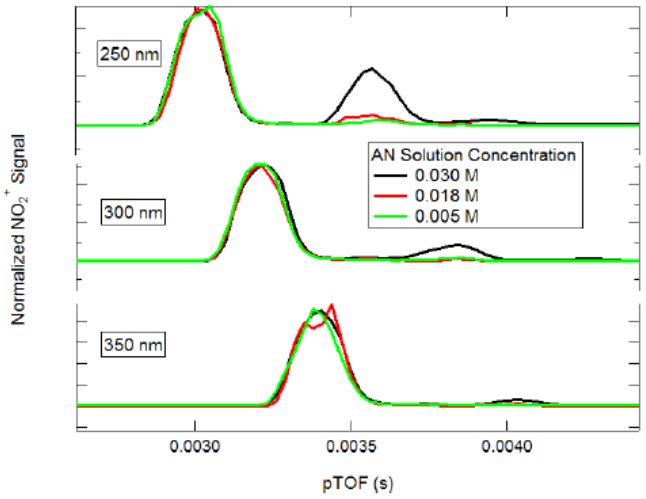


Spring 2016: 2nd ACTRIS ACSM intercomparison exercice at the ACMCC

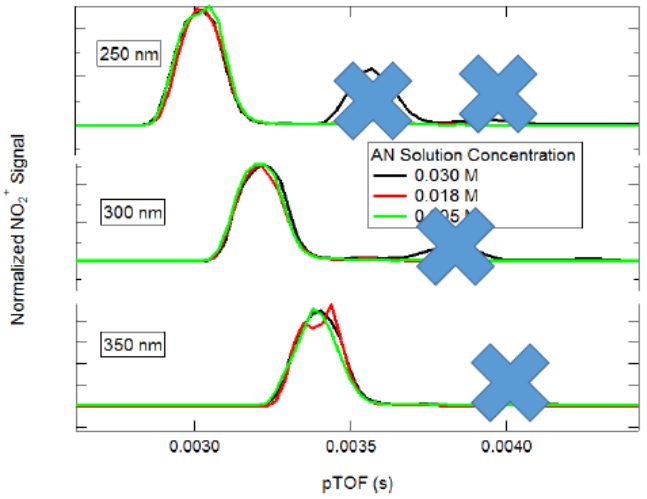
Optimizing the standard calibration procedure using CPMA :



Like normal ACSM Calibration Setup but with CPMA after DMA
CPMA selects particles by Mass/Particle
Combined with DMA, this eliminates Q2s

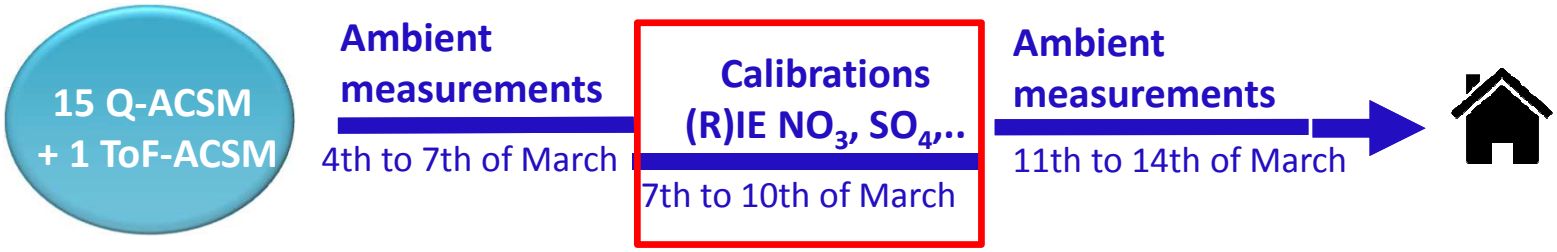


No CPMA

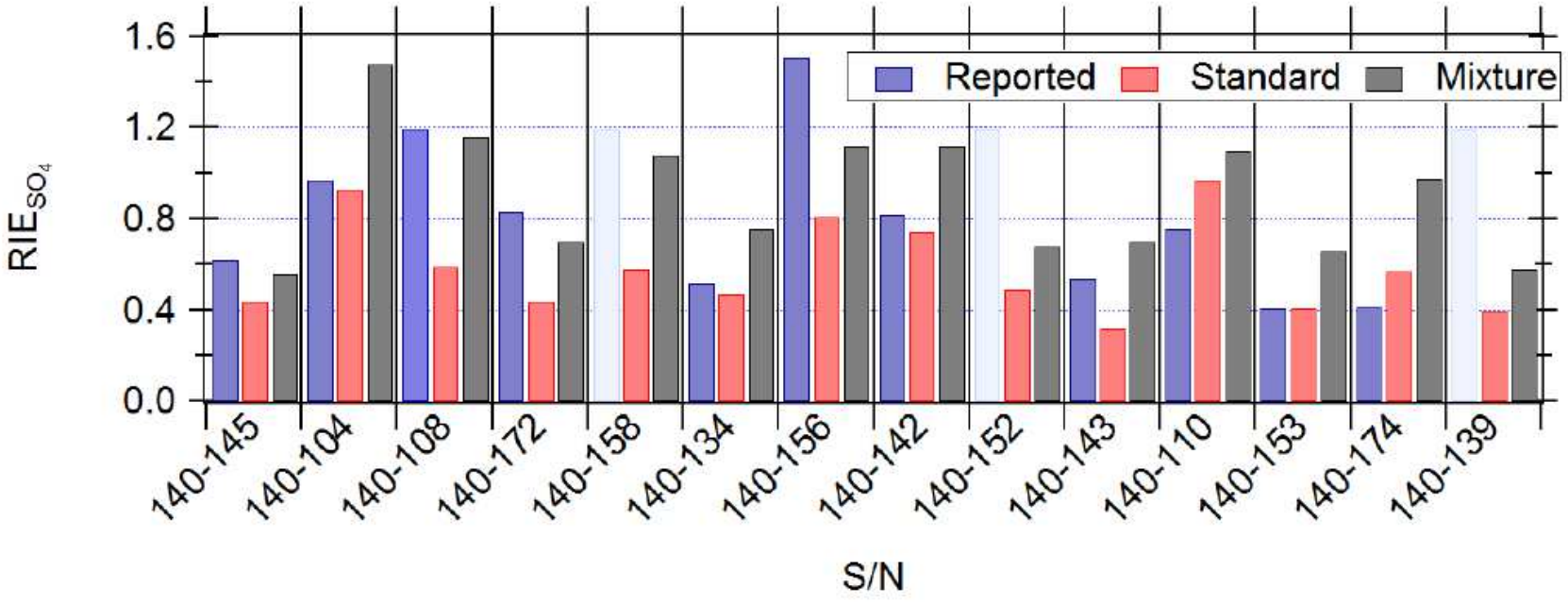


With CPMA

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



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



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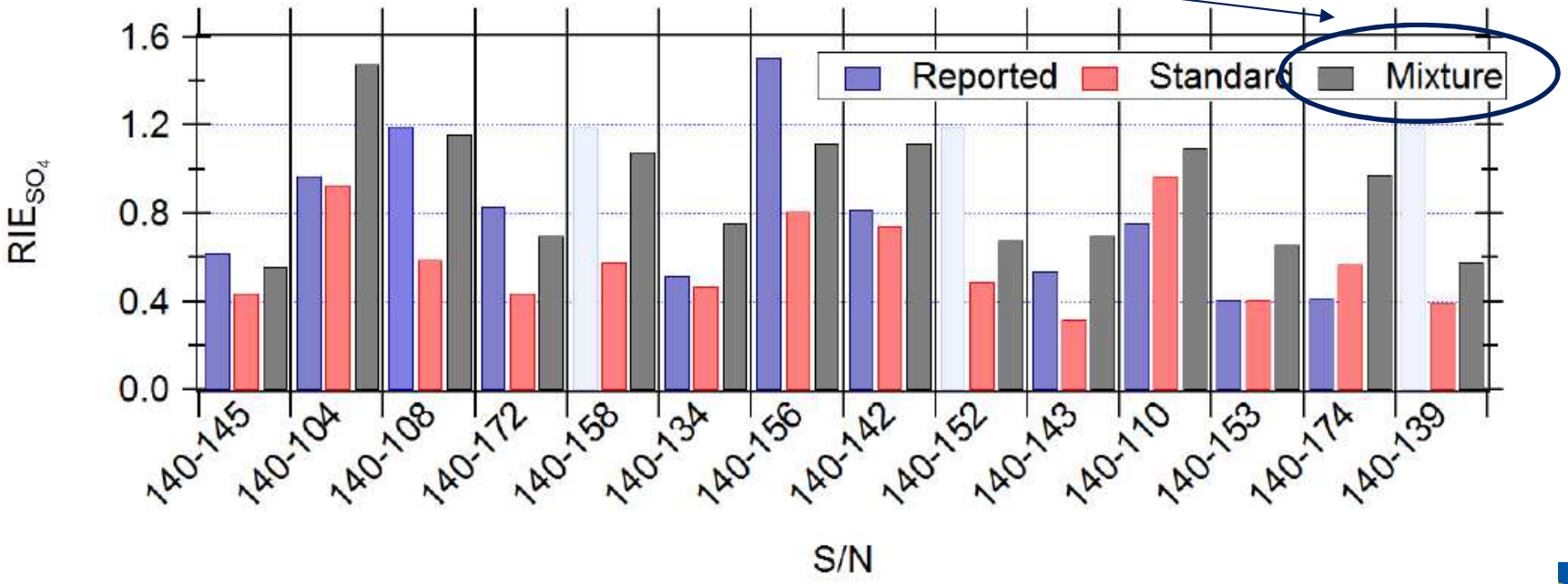
15 Q-ACSM + 1 ToF-ACSM

Ambient measurements
4th to 7th of March

Calibrations (R)IE NO_3, SO_4,..
7th to 10th of March

Ambient measurements
11th to 14th of March

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



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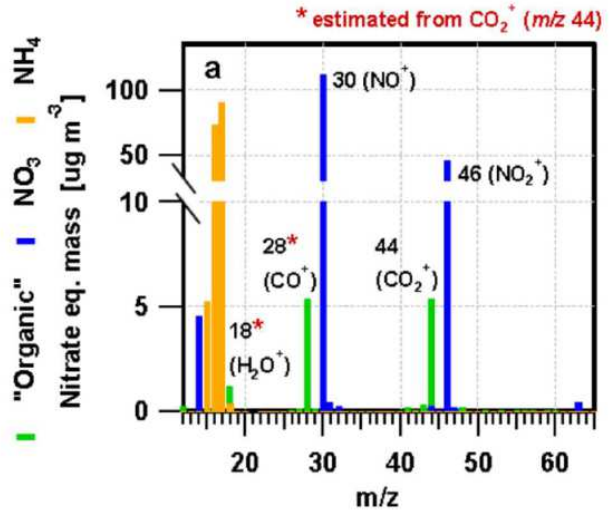
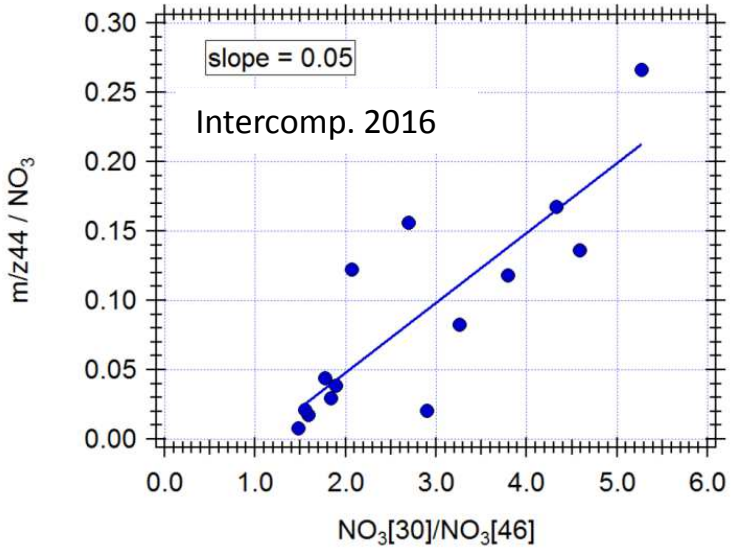
Optimizing the standard calibration procedure using CPMA and calibrating in « full scan mode »:

Also allowing to check if m/z44 observed during NH4NO3 IE calibration



Pieber et al., EST, 2016



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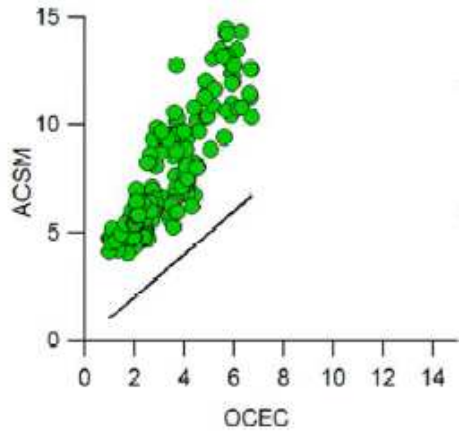
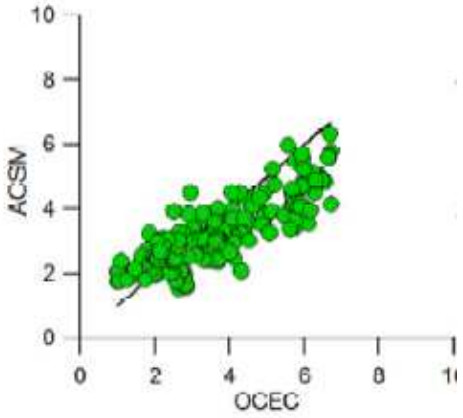


'Pieber corrections'



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

Comparison with SIRTA reference instrument

Exemple 1:

BEFORE

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+ 1 ToF-ACSM

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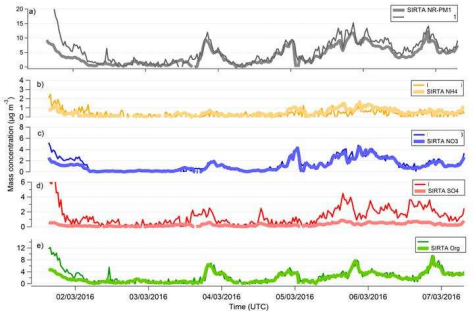
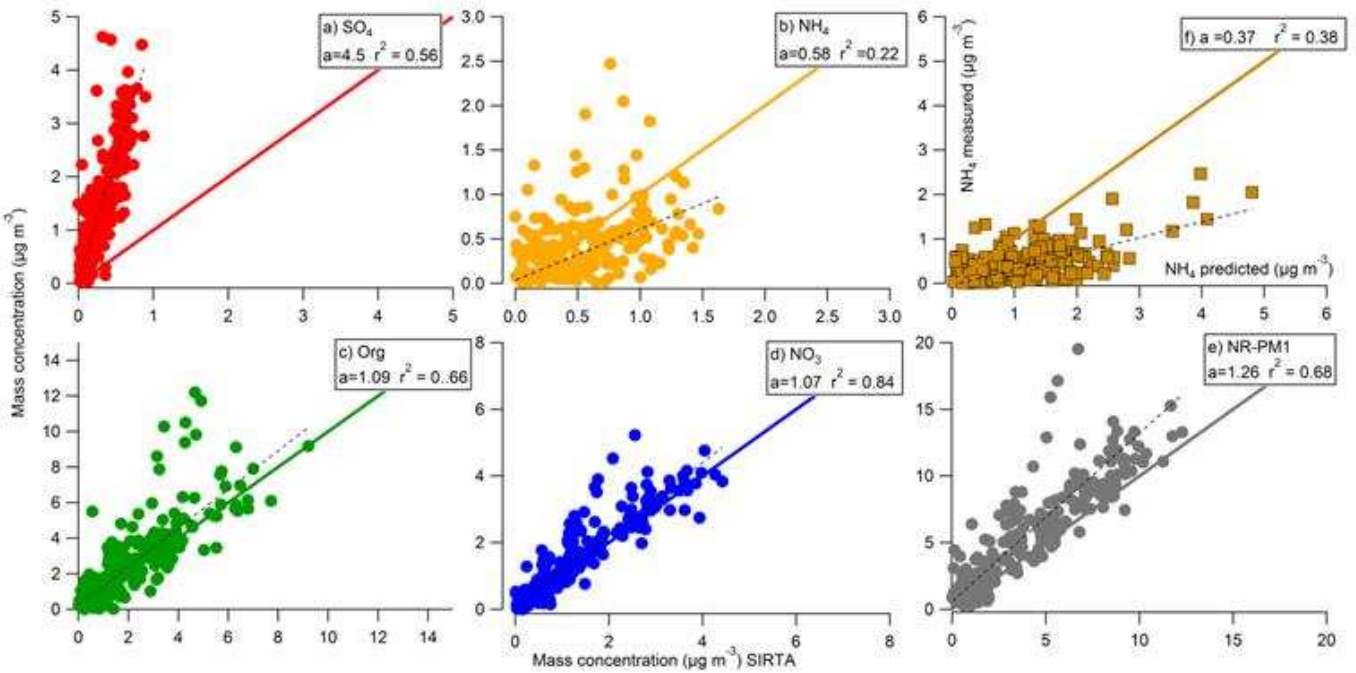
2-7 March





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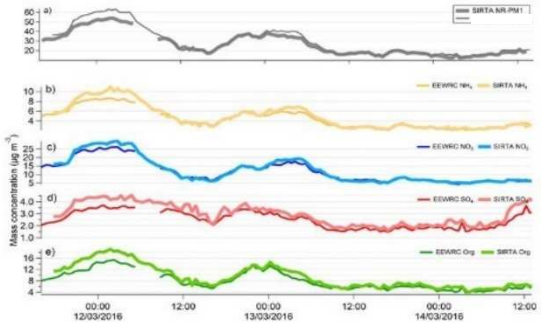

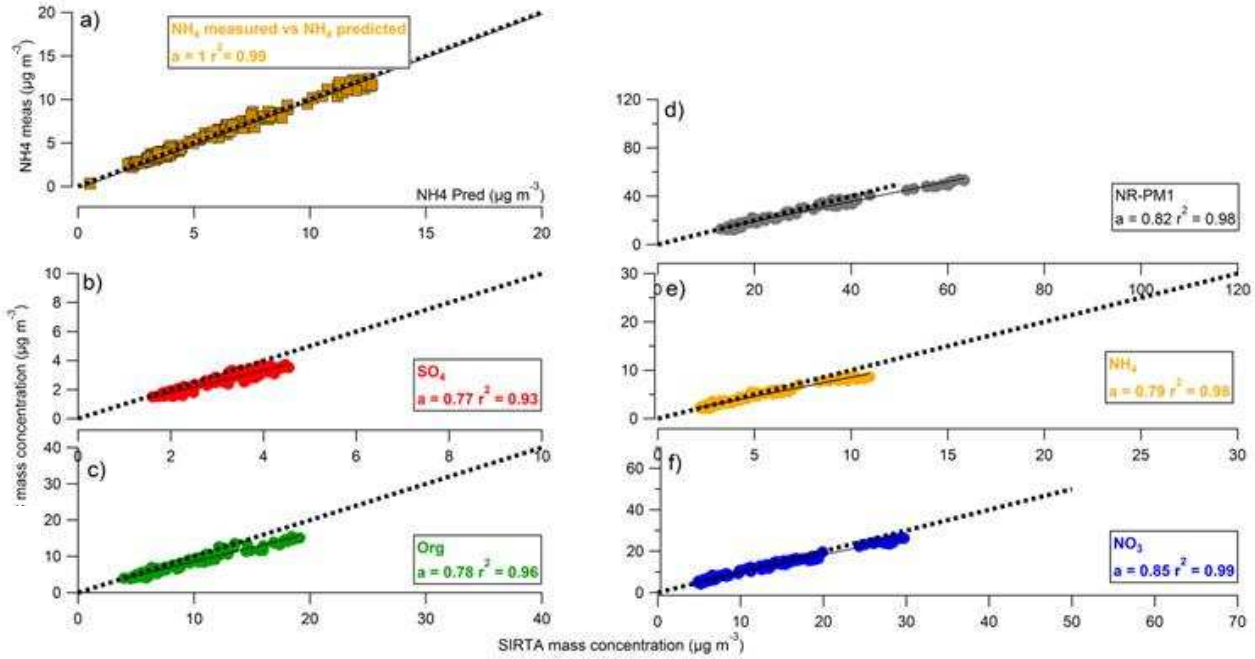

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Instrument performance evaluated against the Median using the Z-score method (after checks and calibrations)

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

(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 »
- Tunning of ACSM (AMS) Analog Input used for CPC reading has to be checked

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

6 Q-ACSM
6 ToF-ACSM
1 HR-AMS

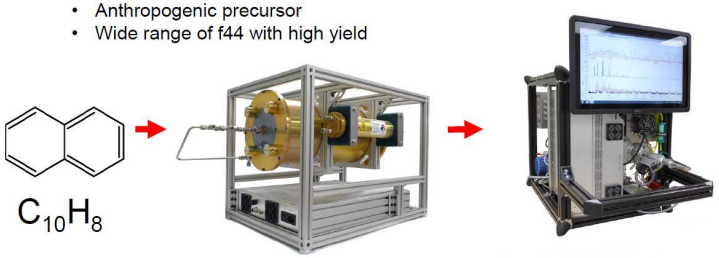
Ambient measurements
21st to 24th of March

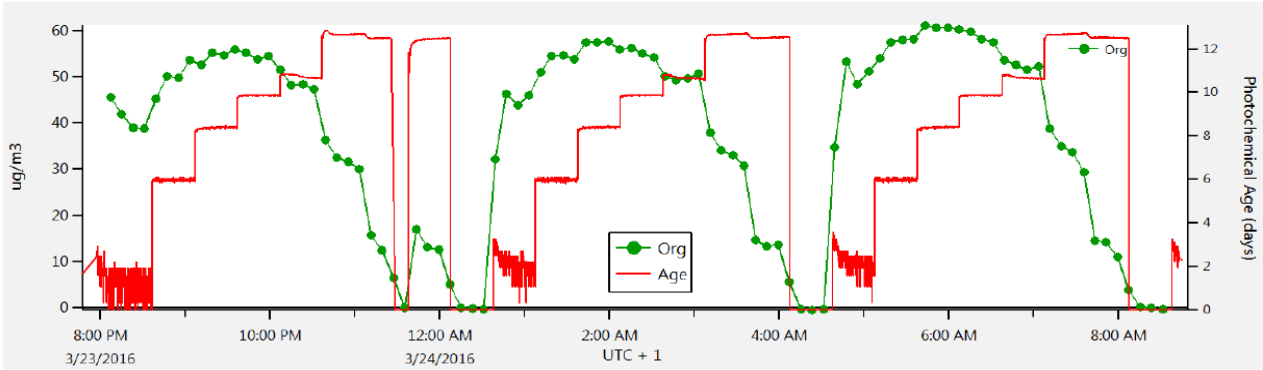
PAM experiments
24th to 27th of March

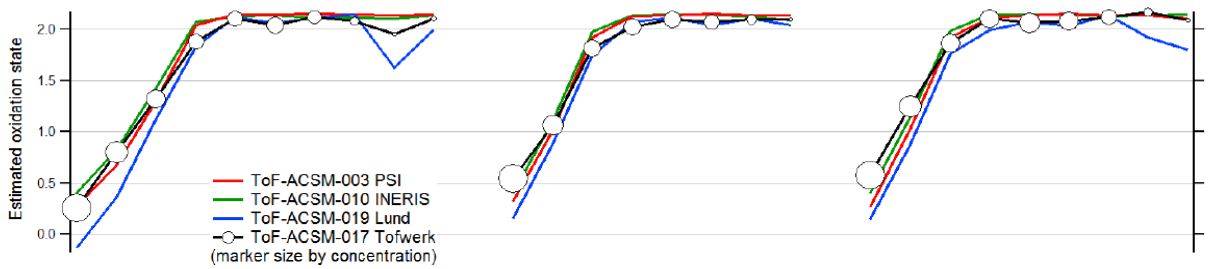
Ambient/PAM measurements
27th of March to 18th of April

Ability of the PAM system to produce aerosols with a very wide range of oxidation states

- Napthalene PAM SOA as test aerosol
  - Anthropogenic precursor
  - Wide range of f44 with high yield





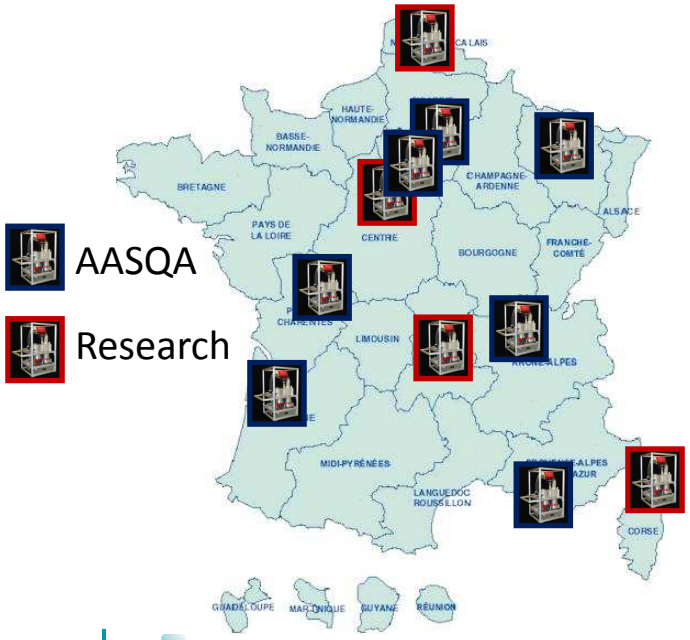


Other / future activities at the ACMCC

Role:

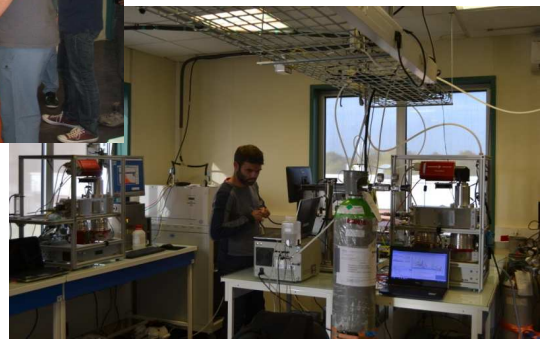
- Calibration facility for <u>various on-line *in-situ* chemical analyzers</u> (ACSM, but also MARGA, Sunset Field Inst., …) ;
- Intercomparison studies, training, exchange of knowledge, best-practices, … at the ACMCC ;
- Perform quality control audits and provide assistance directly <u>at ACTRIS stations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

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



Calibrations and trainings for French AQ networks,

Oct. 2014 & Nov. 2015



Thank you

Any question ?