Seasonal variability of volatile organic compounds (VOC) at the SIRTA station (Île-de-France region) analyzed by GC/MS

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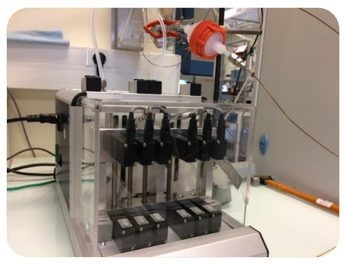
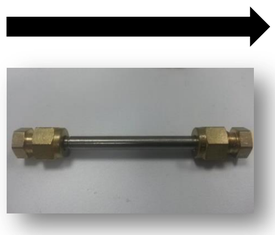
Abstract:

Volatile organic compounds (VOC) play an important role in the atmosphere. They participate in complex reactions which favor the formation of ozone, which is a pollutant and a greenhouse gas.
The ACTRIS project is an European research infrastructure for long-term observations of clouds, aerosols and reactive gases (including VOC). ACTRIS plays an important role in the definition of quality assurance measurement protocols. These measurements will allow to follow and to better understand the long-term trends of reactive compounds, and the link with climate change, air quality and long-range transport of pollutants.
Since 2013, the SIRTA station performs measurement of VOC in the framework of this project. With regular air sampling (4/week), analyses of VOC are produced by gas chromatography/mass spectrometry (GC/MS). We present here the instrumentation, the quality approach and the results obtained since 2013 for selected VOC.

Sampling and Analysis by GC/MS:



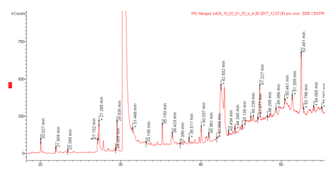


Cartridge Tenax TA

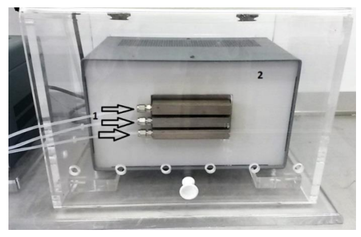
- 2 Liters of Sampling Air on Tenax TA cartridge
- 4 samples/week (Tuesday , Thursday 11h-13h and Wednesday, Friday 01h-03h)

Technique used:
- Thermodesorption
- Separation of compounds
- Quantification

Chromatogramme



Conditionning Cartridges



IMPORTANT

VOC: Volatile Organic Compounds
Differents sources:
- Anthropogenic: Human activity
- Biogenic: Natural emission from vegetation

The station measure actually 12 anthropogenic VOC and 5 biogenic VOC.
VOC participate in O_3 production and Secondary Organic Aerosols production

Repeatability tests :

Compounds	Benzene	Isoprene	Octane	Toluene	p&m Xylene	1,3,5 Trimethyl-benzene
Cartridges doped with 200 ml NMHC						
Area average	262 968	58 102	74 852	206 069	417 052	219 847
Standard deviation	20 513	4 150	10 217	25 191	86 966	65 644
Coefficient of variation (%)	8	7	14	12	21	30

Tests allow to calculate the uncertainties
Good repeatability for many compounds → Low uncertainty
Trimethyl-benzene : compound less volatile than the other compounds
→ Difficulty to analyse → Uncertainty increases

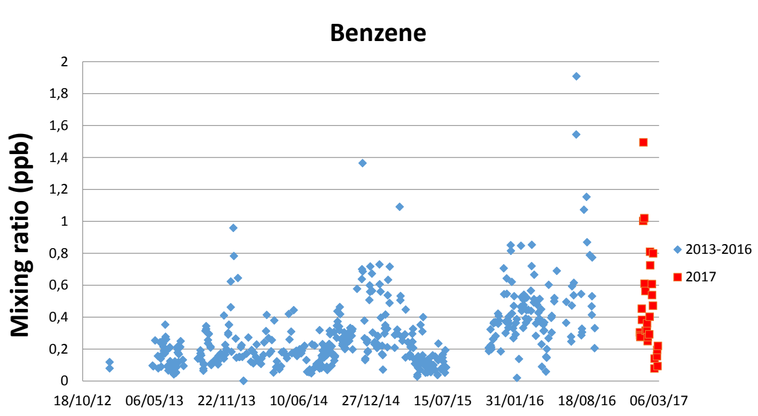
Control quality and submission at The European data base (EBAS)

Data quality control at N-1 year

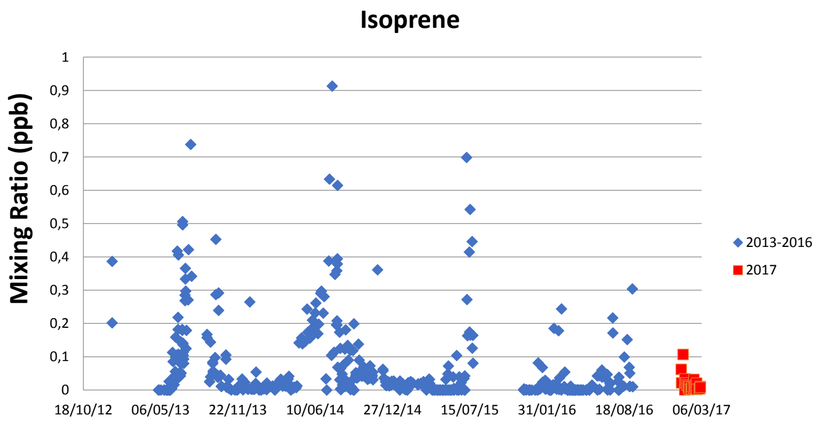
January-March N : internal verification at each laboratory in the ACTRIS network
31 March N : sending raw data
30 April N : consistency tests carried out by ACTRIS
May N : meeting, discussion of problems
31 May N : new submission of corrected data
→ Publication of labeled data ACTRIS

Intercomparison between 17 laboratories in ACTRIS on 34 VOC mixed – SIRTA's Results	
	Global Atmosphere Watch quality objective
Mixing in Dinitrogen	Achieved for 8 VOC measured out of 9 ✓
Mixing in Air	Achieved for 7 VOC measured out of 9 ✓

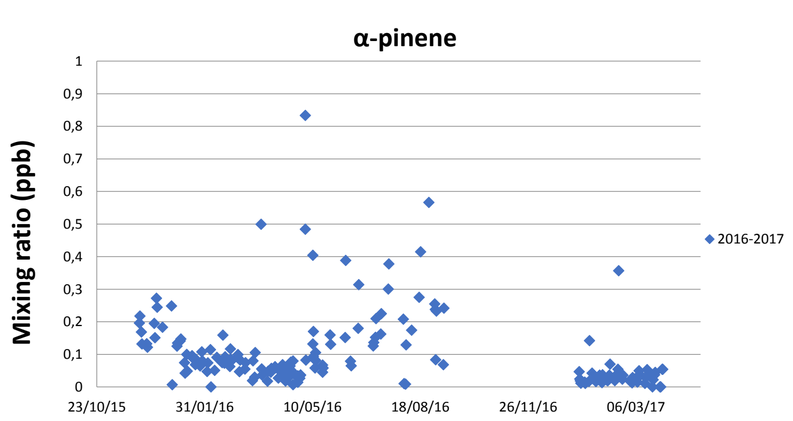
Variability of selected VOC between years 2013 and 2016:



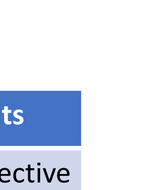
Anthropogenic compound:
Benzene
Maximum in winter due to enhanced source and dynamics



Biogenic compound: Isoprene
Maximum in summer due to more intense activity of the vegetation



Biogenic compound: α-pinene
Maximum in summer due to more intense activity of the vegetation



Conclusion:

- The objective of the rigorous measurement protocol used in SIRTA is the approval of data by the ACTRIS network. Based on this protocol, data are reliable and suitable for long-term monitoring of VOC.
- Currently, the first calculations of uncertainty are in progress
- The annual variability is marked, natural VOC are more abundant in summer, while anthropogenic VOC are more abundant in winter.