

# Measurement programme of the Large research infrastructure ACTRIS-CZ



## Aerosol particles

### Automatic measurement

Parameter	Instrument	Frequency of measurement
PM <sub>10</sub>	Environnement S.A. MP101M	continually
PM <sub>2.5</sub>	Environnement S.A. MP101M	continually
Vertical profile of atmospheric composition	LIDAR LR211-D300 (Raymetrics)	continually
Particle number size distribution (10–800 nm)	aerosol spectrometer MPSS (TROPOS)	5 min
Particle number size distribution (0.5–10 μm)	aerosol spectrometer APSS 3321 (TSI)	5 min
Total particle number concentration (d <sub>50</sub> @ 10 nm)	condensation particle counter CPC 3750 (TSI)	5 min
Total particle number concentration (d <sub>50</sub> @ 4 nm), at ground, in 230 m	condensation particle counter CPC 3775 (TSI)	1s
Particle number size distribution (> 1 nm; 1–4 nm)	dual condensation particle counter PSM A11 (Airmodus)	1s, minutes

Parameter	Instrument	Frequency of measurement
Size distribution of ion electrical mobility (0.8–40.0 nm) and particle number size distribution (2–40 nm)	ion and aerosol spectrometer NAIS (Airel)	1 s – 5 min
Total nuclei concentration and nuclei size distribution ranging from 0.75 to 20.00 $\mu\text{m}$ , both depending on supersaturation from 0.1 to 1.0%	dual Cloud Condensation Nuclei Counter CCNC-2000 (DMT)	total measurement cycle through all 5 supersaturations 1 hour, data collection 1/s
Chemical composition of aerosol particles	Aerosol Mass Spectrometer ToF-ACSM (Aerodyne)	10 min
PM <sub>10</sub> - elemental composition	Xact X-ray Elemental Analyzer (Cooper Environmental)	4 hour
Light absorption	Aethalometer (Magee AE33)	5 min
Light scattering	Nephelometer (Aurora-3000)	1 min
Organic and Elemental carbon	Semi-Continuous OC/EC Field Analyzer 4G (Sunset)	4 hour
Manual measurement		
Parameter	Instrument	Frequency of measurement
TSP chemical composition (1)	custom made (according to EMEP recommendation)	daily
PM <sub>10</sub>	Sven Leckel, SEQ 47/50	1× per 2 days
Heavy metals in PM <sub>10</sub> (2)	Sven Leckel, SEQ 47/50	1× per 2 days
PM <sub>10</sub> /PM <sub>2.5</sub> / PM <sub>1</sub>	Umwelttechnik MCZ GmbH, $\mu\text{PNS1}$	according to need
PM <sub>10</sub>	Sven Leckel, SEQ 47/50	1× per 2 days
PM <sub>2.5</sub>	Sven Leckel, SEQ 47/50	1× per 2 days
Heavy metals in PM <sub>2.5</sub> (2)	Sven Leckel, SEQ 47/50	1× per 2 days
PM <sub>1</sub>	Sven Leckel, SEQ 47/50	1× per 2 days
Heavy metals in PM <sub>1</sub> (2)	Sven Leckel, SEQ 47/50	1× per 2 days
EC/OC	Sven Leckel, MVS6	1× per 6 days
Base cations (3)	Sven Leckel, SEQ 47/50	7 days

(1) SO<sub>4</sub>, NH<sub>4</sub>, NO<sub>3</sub>

(2) As, Cd, Pb; + since 2004 Mn, Cu, Ni ; + since 2011 V, Cr, Fe, Co, Zn, Se

(3) Ca, K, Mg, Na

## Gaseous pollutants

### Automatic measurement

Parameter	Instrument	Frequency of measurement
SO <sub>2</sub>	Teledyne API T100	continually
CO	Teledyne API T300	continually
NO-NO <sub>2</sub> -NO <sub>x</sub>	Teledyne API T200UP Teledyne API T500U	continually
O <sub>3</sub>	Teledyne API T400	continually
Hg (4)	Tekran 2537X	5 min
Hg (4)	Tekran MerPAS	1–3 months

### Manual measurement

Parameter	Instrument	Frequency of measurement
VOCs (5)	sampling into canisters	twice a week (Mo + Th)
Metan	sampling into canisters	twice a week (Mo + Th)
PAHs (6)	Sven Leckel, MVS6	1× per 3 days

(4) sampling is conducted at ground and in 230 m

(5) BZN [benzene], TLN [toluene], BZN [etilbenzen], MPXY [m, p-xylene], OXY [o-xylene], ethane [ethane], ethene [ethene], PRPA [propane], PRPE [propene], IBUT [i-butane], NBUT [butane], ACET [acetylene], SBUT [sum butene], IPEN [i-pentane], NPEN [n-pentane], SPTN [sum pentene], MCPti [methylcyclopentane], NHEX [n-hexane] CHEX [cyclohexane], NHEP [n-heptane], ISOP [isoprene], Nonno [nonane], MP23 [2 + 3 methylpentan], MH23 [2 + 3 methylhexan], CP [cyclopentane]; DMB22 [2,2-dimethylbutane]; DMB23 [2,3-dimethylbutane]; MHP23 [2-methyl heptane 3]; I\_OKT [i-octane] N\_OKT [n-octane]

(6) BaP [benzo[a]pyrene] (since y. 2004); A [anthracene], BaA [benzo[a]anthracene], BghiPRL [benzo[g,h,i]perylene], DBaA [dibenzo[a,h]anthracene], Fen [phenanthrene], Fl [fluorene], Flu [fluoranthene], Chry [chrysene], I123cdP [indeno[1,2,3-cd]pyrene], Pyr [pyrene] (since y. 2005); BbF [benzo[b]fluoranthene], BkF [benzo(k)fluoranthene] (since y. 2006); COR [coronen] (since y. 2009); PAHs [polycyclic aromatic hydrocarbons-sum] (2005–2012); BbF\_BkF [sum benzo(b)fluoranten a benzo(k)fluoranten] (in y. 2005)

## Semi-volatile organic compounds

### Active sampling

Parameter	Instrument	Frequency of measurement
POPs (7) in fraction PM <sub>10</sub>	Digitel DH77	1× per week (wed)
POPs (7, 8, 9) in fraction PM <sub>10</sub>	Digitel DH77	weekly
POPs (7) - wet deposition	Baghirra WS 1m	daily

### Passive sampling

Parameter	Instrument	Frequency of measurement
POPs (7) and (7, 8)	passive sampler	28 and 84 days

### Episodic sampling

Parameter	Matrix	Frequency of measurement
POPs (7)	surface water	1× per year
POPs (7) and metals (10)	sediments	1× per year
POPs (7) and metals (10)	soils	1× per year

(7) N [naphthalene] Acl [acenaphthylene] Ac [acenaphthene] Fl [fluorene] Fen [phenanthrene], A [anthracene] Flu [fluoranthene] Pyr [pyrene] BaA [benzo [a] anthracene] Chry [chrysene] BbF [benzo [b] fluoranthene] bKf [benzo [k] fluoranthene] BaP [benzo [a] pyrene] I123cdP [indeno [1,2,3-cd] pyrene] DBaH [dibenzo [a, h] anthracene] BghiPRL [benzo [g, h, i] perylene] PAHs [polycyclic aromatic hydrocarbons sum] PCB28 [PCB28] PCB52 [PCB52] PCB101 [PCB101] PCB118 [PCB118], PCB138 [PCB138], PCB153 [PCB153], PCB180 [PCB180], PCBs [polychlorinated biphenyls-sum] alpha\_HCH [alpha-HCH], beta\_HCH [beta-HCH], gamma\_HCH [gamma-HCH], delta\_HCH [delta -HCH] HCH [Hexachlorocyclohexane] HCB [hexachlorobenzene] PeCB [pentachlorobenzene] PeCB [pentachlorobenzene] PeCB [pentachlorobenzene] pp\_DDE, [p, p-DDE] pp\_DDD [p, p'-DDD] pp\_DDT [p, p-DDT]

(8) polybrominated diphenyl ethers PBDE [BDE 28, BDE 47, BDE 99, BDE 100, BDE 153, BDE 154, BDE 183, BDE 209], BATE [2-bromoallyl-2,4,6-tribromophenyl ether], DBDPE [decabromodiphenylethane], DPTE [2,3-dibromopropyl-2,4,6-tribromophenyl ether], HBB [hexabrombenzene], HCDBCO [hexachlorocyclopentenyl-dibromocyclooctane], PBEB [pentabromomethylbenzene], PBT [pentabromotoluene], TBBPA [tetrabromobisphenol A], beta TBCO [1,2,5,6-tetrabromocyclooctane], BTBPE [1,2-bis[2,4,6-tribromophenoxy]ethane], beta TBEC [1,2-dibromo-4-[1,2-dibromomethyl]-cyclohexane], pTBX [tetrabromo-p-xylene], antiDP [anti-Dechloran Plus], synDP [syn-Dechloran Plus ], T23BPIC [Tris[2,3-dibromopropyl] isocyanurate], TBCT [3,4,5,6-Tetrabromo-2-chlorotoluene], alphaTBCO [3,4,5,6-Tetrabromo-2-chlorotoluene], alphaTBEC [α-Tetrabromoethylcyclohexane], PBBZ [1,2,3,4,5-Pentabromobenzene] heptachlor, heptachlorepoide cis- [= exo, B], heptachlorepoide trans- [= endo, A], aldrin, dieldrin, endrin, endrin aldehyde , endrin ketone, isodrine, oxychlordane, cis-nonachlor, trans-nonachlor, trans-chlordane [= gamma], cis-chlordane [= alpha], endosulfan I [= alpha], endosulfan II [= beta], endosulfan sulfate, chlordecone , methoxychlor, mirex; 1-nitronaphthalene, 2-nitronaphthalene, 3-nitroacenaphthene, 5-nitroacenaphthene, 2-nitrofluorene, 9-nitroanthracene, 9-nitrophenanthrene, 3-nitrophenanthrene, 2-nitrofluoranthene, 3-nitrofluoranthene, 1-nitropyrene, 2-nitropyrene, 7-nitrobenzoanthrac, 6-nitrochrysene, 1,3-dinitropyrene, 1,6-dinitropyrene, 1,8-dinitropyrene, 6-nitrobenzoapyrene, 1,4-naphthoquinone, naphthalene-1-aldehyde, 9-fluorenone, 9,10-anthraquinone, 1,4-anthraquinone, 9,10-phenanthroquinone, benzo-a-fluoren-1 one, benzo-b-fluoren-1 one, benzanthrone, benz[a]anthrac-7,12one, 5,12-naphthacequinone

(9) acetochlor, alachlor, atrazine, azinphos-methyl, carbaryl, clopyralid, diazinon, dichlofluanid, dimetachlor, dimethoate, disulfoton, diuron, fenitrothion, fenoxaprop ethyl, fenpropimorph, florasulam, fluroxypyr, fonophos, chlorothalonil, chlorpyrifos, chloresulfuron, chlortoluron, isoproturon, malathion, metamitron, metazachlor, metolachlor, metribuzin, methyl parathion, pendimethalin, phosmet, pirimicarb, prochloraz, propiconazole, pyrazone, simazine, tebuconazole, temefos, terbufos, terbuthylazine, tribenuron methyl, trifluralin, aldicarb, boscalid, cyprodinil, imidacloprid, iprovalicarb, metalaxyl, quizalofop ethyl, thiacloprid, spiroxamine, fenpropidine, omethoate, prosulfocarb, carbofuran, kresoxim-methyl, oxadiazon, phosalone, bifenthrin, deltamethrin, esfenvalerate, fenpropathrin, permethrin, 2,4-D [2,4-dichlorophenoxyacetic acid] , acetamiprid, mercoprop, MCPA [4-chloro-o-tolyloxyacetic acid], carbendazim

(10) As, V, Cd, Co, Cr, Mo, Cu, Hg, Ni, Pb, Sb, Zn

## Greenhouse gases and their precursors

### Automatic measurement

Parameter	Instrument	Frequency of measurement
O <sub>3</sub> (11)	Thermo 49i	1 min
CO (12)	LGR N2O/CO-23d Analyser model 913-0015 EP	< 1 min
CO <sub>2</sub> (12)	Picarro G2301	< 1 min
CH <sub>4</sub> (12)	Picarro G2301	< 1 min
N <sub>2</sub> O (12)	LGR N2O/CO-23d Analyser model 913-0015 EP	< 1 min

### Manual measurement

Parameter	Instrument	Frequency of measurement
<sup>14</sup> C v CO <sub>2</sub> (13)		1 × per two weeks

(11) at a height of 50, 125 and 230 m

(12) at a height of 10, 50, 125 and 250 m

(13) at a height of 250 m

## Meteorological parameters

### Measurement within the professional CHMI network according to WMO rules

Climatology (14)

SYNOP (15)

Photon dose equivalent

Solar radiation components (16)

### Measurement in vertical profile

Basic meteorological paramaters (17)

Solar radiation components (18)

## Measurement in vertical profile

Atmospheric boundary layer height (19)

Total cloud cover (20)

Measurement of sunlight and moonlight (21)

(14) air temperature, air pressure, air humidity, wind speed and direction, amount of precipitation, sunshine duration, visibility, cloudiness -type, degree of cloudiness coverage; soil temperature (depth of 5, 10, 20, 50 and 100 cm), height of new snow, evaporation

(15) air temperature, air pressure, air humidity, vapor pressure, dew point, wind speed and direction, amount of precipitation, sunshine duration, visibility, weather conditions cloudiness -type, degree of cloudiness coverage, soil temperature (depth of 5, 10, 20, 50, 100 cm), soil moisture (depth of 7, 25 and 75 cm), evaporation, height of new snow; maximum, minimum and ground temperature

(16) Global radiation, Diffuse radiation, UV-B radiation

(17) air temperature, air pressure, air humidity, wind speed and direction at heights 10, 50, 125, 230 and 250 m

(18) UV-A and UV-B radiation at heights 10 m and 240 m, Kipp & Zonen SUV-A a SUV-B

(19) Ceilometr Vaisala CL 51, measurement frequency 16 s, measured profile up to 15 km

(20) Sky InSight infrared camera

(21) Multispectral photometer CIMEL CE318 TS9

## Precipitation quality

### Automatic measurement

Parameter	Instrument	Frequency of measurement
Chemical composition in wet deposition (21)	Eigenbrodt NSA 181	daily

(22) pH, conductivity, SO<sub>4</sub>, NO<sub>3</sub>, NH<sub>4</sub>, Ca, Mg, Na, K, Cl, F; + since 2005 Fe, Zn, Mn, Pb, Cd, Ni; since 2010 Cr, As; since 2011 Co, Cu, V, Se

## Intensive Campaign Measurements

### Aerosol particles

#### Automatic measurement

Parameter	Instrument
Aerosol particles chemical composition	cTOF-AMS (Aerodyne)
Hygroscopicity of aerosol particles	HTMDA
Aerosol fluxes-Eddy covariance	CPC (TSI) + 3D Anemometer (Gill)

### Semi-volatile organic compounds

#### Active sampling

Parameter	Instrument
POPs (7, 8, 9) and metals (10) - TSP, PM <sub>10</sub> , PM <sub>2.5</sub> , PM <sub>1</sub> ,	PS1 Anderson, Sven Leckel MVS6, Digitel DH77, Baghirra SAM 50 Auto, Baghirra FV 3-12 Solar
POPs (7) - particle size separation	Cascade impactors Tisch-Environmental, Moundi, Sioutas

Parameter	Instrument
POPs (7, 8, 9) sampling air by wind direction, source identification	Multi-directional high- and low-volume samplers BaghirraBaghirra HI 30 Auto and Baghirra LV 30 Auto
Automatic particle analyzers	Grimm 11-E, Palas Fidas 200S
POPs (7) - total deposition	Baghirra 314 GL

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(9) acetochlor, alachlor, atrazine, azinphos-methyl, carbaryl, clopyralid, diazinon, dichlofluanid, dimetachlor, dimethoate, disulfoton, diuron, fenitrothion, fenoxaprop ethyl, fenpropimorph, florasulam, fluroxypyr, fonophos, chlorothalonil, chlorpyrifos, chlorsulfuron, chlortoluron, isoproturon, malathion, metamitron, metazachlor, metolachlor, metribuzin, methyl parathion, pendimethalin, phosmet, pirimicarb, prochloraz, propiconazole, pyrazone, simazine, tebuconazole, temefos, terbufos, terbuthylazine, tribenuron methyl, trifluralin, aldicarb, boscalid, cyprodinil, imidacloprid, iprovalicarb, metalaxyl, quizalofop ethyl, thiacloprid, spiroxamine, fenpropidine, omethoate, prosulfocarb, carbofuran, kresoxim-methyl, oxadiazon, phosalone, bifenthrin, deltamethrin, esfenvalerate, fenprothrin, permethrin, 2,4-D [2,4-dichlorophenoxyacetic acid] , acetamiprid, mercoprop, MCPA [4-chloro-o-tolyloxyacetic acid], carbendazim

(10) As, V, Cd, Co, Cr, Mo, Cu, Hg, Ni, Pb, Sb, Zn