

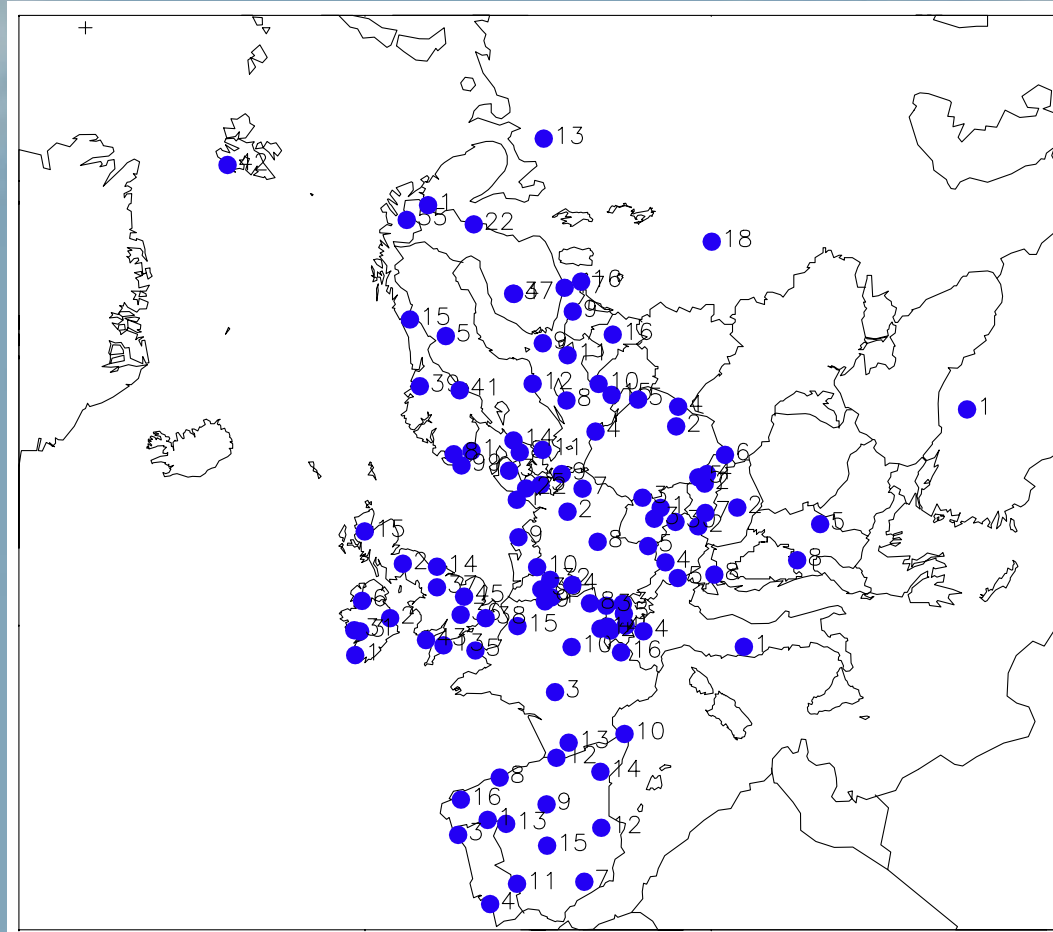


# Monitoring of background PM by EMEP network

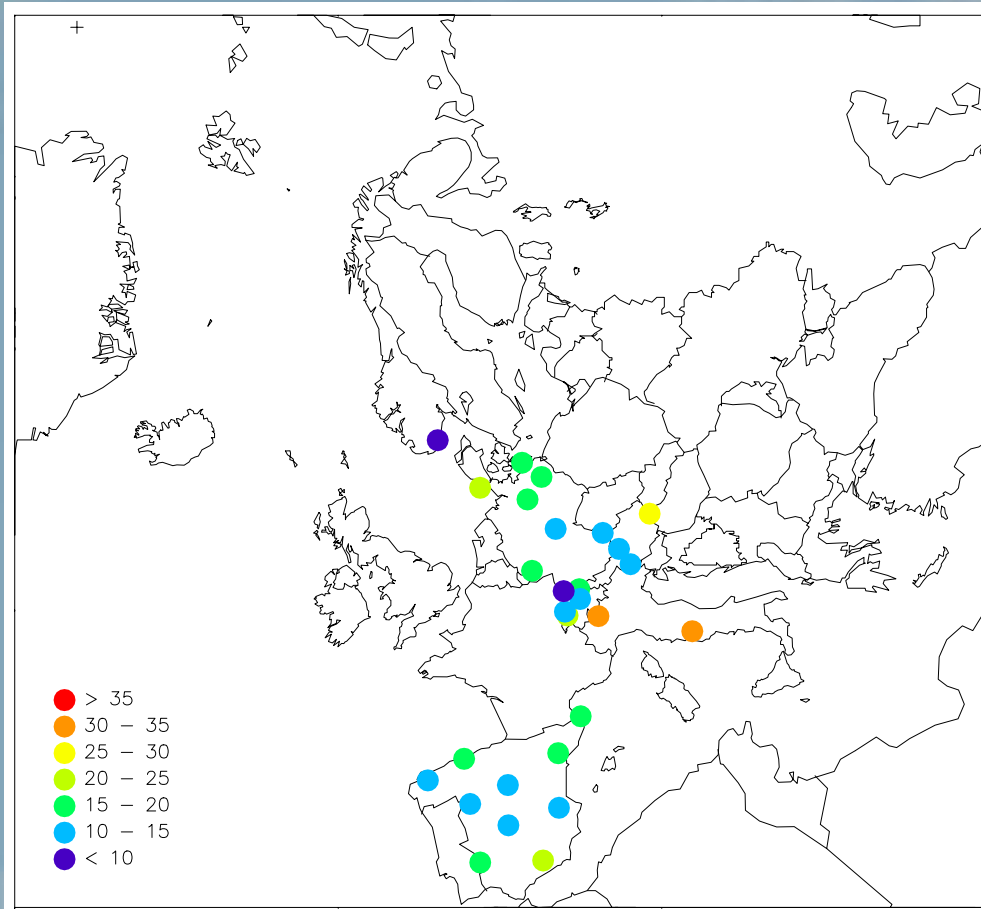
**Jan Schaug**

**Norwegian Institute for Air  
Research (NILU)**

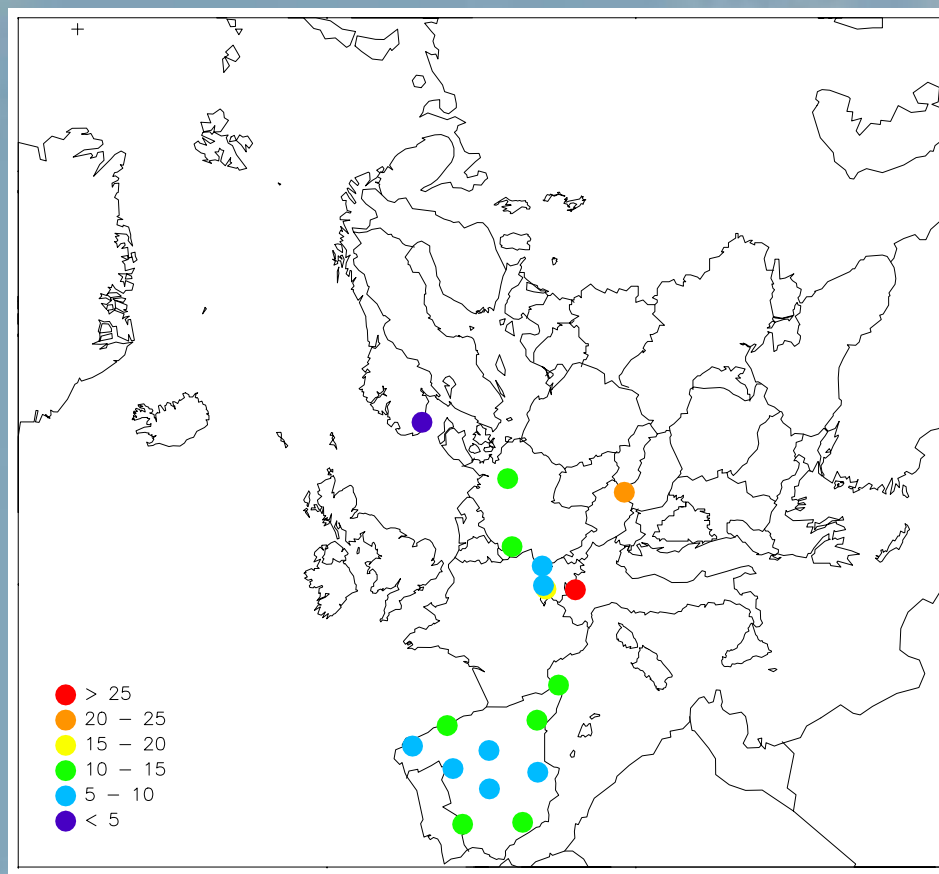
# EMEP network 2002 acidification/eutrophication



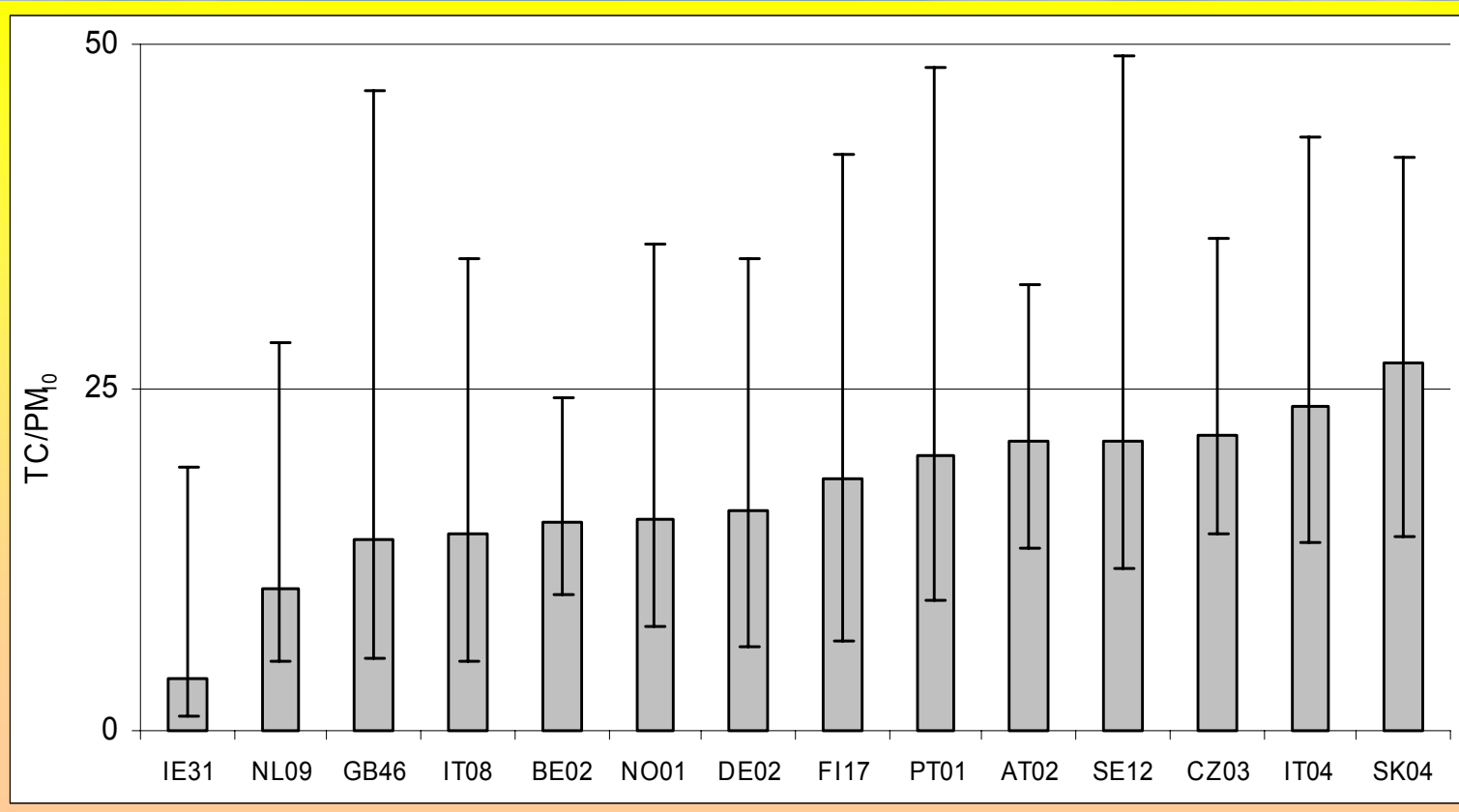
# Annual 2002 averages of daily PM<sub>10</sub> mass measurements. Unit $\mu\text{g}/\text{m}^3$ .



# Annual 2002 averages of daily PM<sub>2.5</sub> mass measurements. Unit $\mu\text{g}/\text{m}^3$ .



# Annual mean of TC/PM<sub>10</sub> ratios including the 5%- and 95% -ile. Sampling period 01.07.2002–01.07.2003.



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Convention on Long-Range Transboundary Air Pollution

**emep** Co-operative programme for monitoring and evaluation of the long-range transmissions of air pollutants in Europe

msc-w Meteorological Synthesizing Centre - West msc-e Meteorological Synthesizing Centre - East ccc Chemical Coordinating Centre ciam Centre for Integrated Assessment Modelling

EMEP Facts:  
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Meetings and Workshops  
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Technical comments:  
emep\_mscw@met.no  
CQ Counter

**Welcome to EMEP**

EMEP is a scientifically based and policy driven program under the Convention on Long-Range Transboundary Air Pollution for international co-operation to solve transboundary air pollution problems.

**NEWS AND UPDATES**

- 2002-10-08 **Workshop on Assessment Report**  
Workshop on Assessment Report in Vienna, 4-6 November 2002
- 2002-09-28 **NOSA Aerosol Symposium 2002**  
NOSA Aerosol Symposium at NILU, Norway, 7-8 November 2002.
- 2002-09-27 **EMEP measurement data**  
EMEP ozone data and data on acidification/eutrophication up to 2000 are available.
- 2002-09-06 **EMEP Assessment report**  
Latest updated information about deadlines, recieved data updates and available tools. Discussion forum.
- 2002-09-04 **Working Group on Strategies and Review (thirty-fourth session)**
- 2002-09-04 **EEA/WHO Workshop on health-related indicators of air quality**
- 2002-09-04 **EMEP workshop on Hemispheric Air Pollution**
- 2002-09-04 **Workshop on Validation and Evaluation of Air Emission Inventories**

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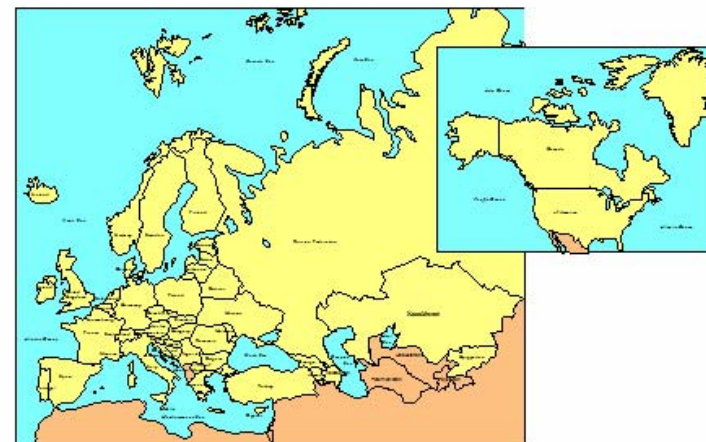
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## *The EMEP vision:*

*To be the main science based and policy-driven instrument for international cooperation in atmospheric monitoring and modelling activities, emission inventories and projections, and integrated assessment to help solve transboundary air pollution problems in Europe*

## **The EMEP monitoring strategy 2004-2009**

### **Background document with justification and specification of the EMEP monitoring programme 2004-2009**



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Chemical Co-ordinating Centre of EMEP (CCC)



## **Level 1**

- **Main objective of level-1 monitoring is to provide in the long-term basic chemical and physical measurements of the traditional EMEP parameters.**
- **Basic parameters in relation to particulate matter, acidification, eutrofication and heavy metals. Also meteorological data are requested. Low cost methods are allowed for gas/particle partitioning. POP measurements are not requested**
- **Level-1 parameters are first priority when extending the network.**
- **By undertaking a more demanding programme, the level 1 sites should gradually be upgraded to level-2 sites**

## Level 2

- **Main objective of level-2 monitoring is to provide parameters essential for process understanding and further chemical speciation of relevant components.**
- **Includes parameters required at level-1 plus a series of additional ones.**
- **These additional parameters include measurements at a higher temporal resolution, reliable gas/particle distribution, chemical speciation of aerosol mass, VOCs, heavy metals in air, Hg and POPs in air and precipitation.**
- **The aim is to establish 20-30 level-2 sites over Europe by 2009**
- **Level-2 sites are defined according to topics and a particular site do not have to cover all topics**
- **Level-2 sites will be identified as an "EMEP supersite" (or joint EMEP/GAW supersite)**



## Level 3

- **Research driven and may often be available at locations other than level-1 and level-2 sites, further data would typically be provided by other institutions than those being responsible for implementing the national monitoring obligations**
- **A number of relevant parameters are identified as being of interest for EMEP**
- **Level-3 sites may include campaign data**

## Important issues

- EMEP observations should to the extent possible consist of co-located and concurrent measurements in both air and precipitation
- The temporal resolution should be sufficient to support the interpretation of the chemical and physical characteristics of synoptic scale transport and should generally not exceed 24 hours.

exceptions include

1. when significant cost are associated, sampling may be limited to grab samples, sampling one or two days per week or weekly integrated samples
2. when Parties parties provide highly spatially resolved data at level-1 but at longer sample integration times

## **Important issues cont.**

- **The site densities are defined as "target" densities for each level, providing some flexibility for the Parties**
- **Site densities should reflect the residence time of the pollutants and should be highest in regions with strong gradients in concentrations/depositions**
  - **Target site density at level-1; 1-2 sites per 100.000 km<sup>2</sup>**
  - **All Parties with an area larger than 10.000 km<sup>2</sup> are requested to operate at least one level-1 site**
- **The short term target for level-2 sites (until 2009) is 20-30 sites across Europe.**
- **All Parties with an area larger than 50.000 km<sup>2</sup> are requested to operate at least one level-2 site**
- **Possibilities for regional cooperation should be explored**

## **Further relaxations;**

- **Monitoring at level-1 and level-2 includes a large number of parameters and also requires an increase in the number of sites in some regions. From experience, Parties might for various reasons have different priorities or have financial or technical difficulties in conducting all mandatory activities**
- **EMEP will thus on a provisional basis, acknowledge information not fully satisfying the requirements given for level-1.**
  - **Such a relaxation would be acceptable if**
    - **it would allow for extension into level 2 or**
    - **provide information of higher spatial resolution**

## **Final comments;**

- **Parties with economies in transition that have not been able to operate any adequate monitoring in the past are encouraged to enter the programme as soon as possible, but if necessary at a lower level of ambition.**
  - **The CCC is comitted to provide guidance on the programme and site location etc.**
- **All Parties are requested to ensure the full implementation of the monitoring strategy**
- **The monitoring network must be dynamic and ready to adapt to new needs and requirements, but at the same time preserve consistent and long-term time series.**
  - **The strategy and its implementation should be regularly reviewed and as appropriate revised by the Centres and the Parties through the TFMM.**

Programme	Parameters	Minimum time resolution	Reference methodology <sup>1</sup>	Notes
<b>Level-1 sites</b>				
Inorganic compounds in precipitation	SO <sub>4</sub> <sup>2-</sup> , NO <sub>3</sub> <sup>-</sup> , NH <sub>4</sub> <sup>+</sup> , H <sup>+</sup> (pH), Na <sup>+</sup> , K <sup>+</sup> , Ca <sup>++</sup> , Mg <sup>++</sup> , Cl <sup>-</sup> (cond)	24h=Daily	Wet-only/bulk IC/AES/AAS	Needs to be complemented with low-cost denuders Continuous NOx monitors with photolytic converter may be used
Heavy metals in precipitation	Cd, Pb (1st priority), Cu, Zn, As, Cr, Ni (2nd priority)	Daily/weekly	Wet-only/bulk ICP MS or GF-AAS	
Inorganic compounds in air	SO <sub>2</sub> , SO <sub>4</sub> <sup>2-</sup> , NO <sub>3</sub> <sup>-</sup> , HNO <sub>3</sub> , NH <sub>4</sub> <sup>+</sup> , NH <sub>3</sub> , (sNO <sub>3</sub> , sNH <sub>4</sub> ), HCl, Na <sup>+</sup> , K <sup>+</sup> , Ca <sup>++</sup> , Mg <sup>++</sup>	24h=Daily	FP-filter pack IC/AES/AAS	
NO <sub>2</sub> in air	NO <sub>2</sub>	24h=Daily	NaI method	
Ozone in air	O <sub>3</sub>	Hourly	UV-abs	
PM mass in air	PM <sub>2.5</sub> , PM <sub>10</sub>	Hourly/Daily	LVS-PM <sub>10</sub> , HVS-PM <sub>10</sub> or equivalent	Gravimetric methods preferred, but monitors can be used where equivalence can be demonstrated. Low-cost alternative to basic PM speciation that provides necessary gas-particle ratios for level-1 sites.
Gas particle ratios	NH <sub>3</sub> , NH <sub>4</sub> <sup>+</sup> , HCl, HNO <sub>3</sub> , NO <sub>3</sub> <sup>-</sup> (in combination with filter pack sampling)	Monthly	Low cost Denuder	
Meteorology	Precipitation amount (RR), temperature (T), wind direction (dd), wind speed (ff), relative humidity (rh), atmospheric pressure (pr)	Hourly	AWS	Can be taken from a representative meteorological site



**Level-2 sites (additional parameters)***Level-2 sites should also measure all parameters required at level 1*

<b>Acidification and eutrophication</b>				
Gas particle ratio	$\text{NH}_3/\text{NH}_4^+$ , $\text{HNO}_3/\text{NO}_3^-$ (artifact-free methods, contribute also to PM)	Hourly/Daily	Manual denuders	Continuous denuders/steam-jet may also be used. Replace low cost denuders from level 1. See also PM speciation. Optional low-cost alternative to provide high spatial resolution information in emission areas, where desired.
Ammonia in emission areas (optional)	$\text{NH}_3$	Monthly	Low cost denuders	
<b>Photochemical oxidants</b>				
NOx	$\text{NO}$ , $\text{NO}_2$	Hourly	Monitor	NOx monitors with photolytic converter Monitoring 10-15 min twice a week may also be used
Light hydrocarbons	$\text{C}_2\text{-C}_7$	Hourly	Monitor or canister/GC	
Carbonyls	Aldehydes and ketones	8hourly twice a week	2,4 DNFH silica cartridges/ HPLC	
<b>Heavy metals</b>				
Mercury in precipitation	Hg	Weekly	Wet-only/bulk CV-AFS	Spec. sampling of borosilicate or halocarbon
Mercury in air	Hg (total gaseous mercury)	Hourly/Daily	Monitor or gold traps CV-AFS	Sampling 1 day per week (or weekly)
Heavy metals in air	Cd, Pb (1st priority), Cu, Zn, As, Cr, Ni (2nd priority)	Daily/Weekly	HVS or LVS/ICP MS or GF-AAS	Analytical method is determined by the concentration level

<b>Persistent organic pollutants</b>				
POPs in precipitation	PAHs, PCBs, HCB, chlordanes, HCHs, DDT/DDE	Weekly	Wet-only/bulk GC-MS/HPLC	
POPs in air	PAHs, PCBs, HCB, chlordanes, HCHs, DDT/DDE	Daily/Weekly	HVS, PUR foam GC-MS/HPLC	Sampling 1 day per week (or weekly)
<b>Particulate matter</b>				
Major inorganics in both PM <sub>2.5</sub> and PM <sub>10</sub>	SO <sub>4</sub> <sup>2-</sup> , NO <sub>3</sub> <sup>-</sup> , NH <sub>4</sub> <sup>+</sup> , Na <sup>+</sup> , K <sup>+</sup> , Ca <sup>++</sup> , Mg <sup>+</sup> (Cl <sup>-</sup> )	Hourly/Daily	Manual denuders or continuous monitors	Continuous denuder/steam-jet and other instruments may also be used
Mineral dust in PM <sub>10</sub>	Si	Daily/Weekly	XRF, INAA, PIXE	Reference methodology is under development
Elemental carbon (EC) Organic carbon (OC)	EC, OC	Daily/Weekly	Thermo-optical	

**Level-3 sites (monitoring at these sites does not require all level 1 and level-2 parameters)**

Dry deposition flux of sulphur and nitrogen species	SO <sub>2</sub> , NH <sub>3</sub> , HNO <sub>3</sub> (SO <sub>4</sub> <sup>2-</sup> , NH <sub>4</sub> <sup>+</sup> , NO <sub>3</sub> <sup>-</sup> )	Hourly/Daily	-	Contributes to acidification and eutrophication EMEP programme for evaluation of effects on ecosystems and health
Dry deposition flux of O <sub>3</sub>	O <sub>3</sub>	Hourly/Daily	-	Contributes to photo-oxidant EMEP programme for evaluation of effects on ecosystems and health.
Hydrocarbons	C <sub>6</sub> -C <sub>12</sub>	Hourly/Daily	-	Contributes to photo-oxidant EMEP programme for evaluation of effects on ecosystems and health.
NO <sub>y</sub> chemistry	NO, NO <sub>2</sub> , PAN, organic nitrates	Hourly/Daily	-	Contributes to photo-oxidant and particulate matter EMEP programmes for evaluation of effects on ecosystems and health.
OC speciation	Both water soluble and water insoluble OC	Hourly/Daily	-	Contributes to EMEP programme for PM evaluation of effects on health and analysis of synergies with global change
“Black carbon”	BC	Hourly/Daily	-	Contributes to EMEP programme for PM evaluation of effects on health and analysis of synergies with global change
Size/number distribution	dN/dlogDp	Hourly/Daily	-	Contributes to EMEP programme for PM evaluation of effects on health and analysis of synergies with global change
Light scattering	Aerosol optical depth	Hourly/Daily	-	Contributes to EMEP programme for PM evaluation of effects on health and analysis of synergies with global change
Vertical profiles	O <sub>3</sub> soundings, PM lidar	Hourly/Daily	-	Contributes to EMEP modelling of intercontinental pollution transport

Mercury speciation	TGM, RGM and TPM	Daily/Weekly	-	Contributes to EMEP programme on heavy metals for evaluation of effects on ecosystems and health.
Congener-specific	POPs: PCBs, PAHs, PCDDs and PCDFs	Daily/Weekly	-	Contributes to EMEP programme on POPs for evaluation of effects on ecosystems and health.
Multi-compartment (air, soil, water)	POPs and Hg	Daily/Weekly	-	Contributes to EMEP programme on heavy metal and POPs for evaluation of effects on ecosystems and health.

1) Reference methods can change in time as new methods become available. AAS: Atomic Absorption Spectroscopy; CV-AFS: Cold Vapour Atomic Fluorescence Spectroscopy; GF-AAS: Graphite Furnace Atomic Absorption Spectroscopy; DNFH: Dinitrophenylhydrazin; FP: Filter Pack; PUR: Polyurethane, GC: Gas Chromatography; HPLC: High Performance Liquid Chromatography; HVS: High Volume Sampler; LVS: Low Volume Sampler; ICP-MS: Inductively Coupled Plasma Mass Spectrometry; PIXE: Proton Induced X-ray Emission; INAA: Neutron Activation Analysis; XRF: X-ray Fluorescence; IC: Ion Chromatography; AES: Atomic Emission Spectroscopy, GC-MS: Gas Chromatography- Mass Spectroscopy. AWS: Automatic Weather Station.

# EMEP annual PM reports

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