DRAFT EMEP MONITORING STRATEGY, 2020-2029

This document defines the monitoring strategy for the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) for the period 2020–2029. It was developed through a revision process led by the EMEP Chemical Coordinating Centre (CCC) in cooperation with the EMEP Task Force on Measurements and Modelling (TFMM), as mandated by the 3rd joint session of the EMEP Steering Body and the Working Group on Effects in 2017.

I. INTRODUCTION

1. The 1979 Convention on Long-Range Transboundary Air Pollution specifies a number of areas where close collaboration between its Parties is important to achieve its goals. These areas include i) requirements with respect to instrumentation and other techniques for monitoring ambient concentrations of air pollutants, ii) the need to exchange meteorological and physico-chemical data relating to the processes during transmission and iii) the need to use standardized or comparable procedures for monitoring and for the establishment of monitoring stations. The monitoring strategy specifies the detailed requirements for the Parties monitoring activities.

2. The main objectives of EMEP are:

(a) To provide observational and modelling data on air pollutant concentrations, deposition rates, emissions and transboundary fluxes on the regional scale and identify the trends in time;

(b) To identify the sources of the pollution concentrations and depositions and to assess the effects of changes in emissions;

(c) To improve our understanding of chemical and physical processes relevant to assessing the effects of air pollutants on ecosystems and human health in order to support the development of cost-effective abatement strategies;

(d) To explore the environmental concentrations of new chemical substances that might require the attention of the Convention in the future.

3. EMEP is requested to provide Parties to the Convention information on emissions, concentrations and deposition fluxes of air pollutants, with quantified source attribution in order to abate air pollution including long-range transport of air pollutants. This information is an important basis for developing emission control strategies and implementing the Convention and its Protocols, as well as for establishing additional measures and new Protocols.

4. The EMEP observations and model calculations are important elements in establishing the air pollution situation in the United Nations Economic Commission for Europe (UNECE) region and provide links both to global and to urban scales. Since air pollution is addressed also by other conventions, bodies and institutions, the links between EMEP observations and the information requirements of those other bodies, is discussed below.

5. The CLRTAP Executive Body adopted at its twenty-second session a Level-based monitoring strategy for the period 2004–2009 (EB.AIR/GE.1/2004/5) and further made a decision concerning its implementation (ECE/EB.AIR/83/Add.1, decision 2004/1). The decision urges Parties to make resources available for the full implementation of the strategy at national level within the geographic scope of EMEP without undue delay. It requests CCC to provide technical support to the Parties and the Steering Body to follow the implementation of the strategy closely, to review it and to keep the Executive Body informed on the progress. Later, the strategy was revised for the period 2010-2019 (ECE.EB.AIR.GE.1.2009.15), constituting mainly minor adjustments compared to the 2004-2009 version.

II. GENERAL OBJECTIVES AND REQUIREMENTS

6. The monitoring strategy for 2020–2029 continue the aspirations and established approaches for monitoring activities since EMEPs initiation, in order to provide consistent and adequate observational data supporting the objectives and knowledge needs of EMEP.

7. The monitoring activities needs to ensure:

(a) Sufficient ongoing long-term monitoring of concentrations and deposition fluxes to assess exposure and impacts on health, ecosystems, vegetation, materials and climate;
(b) Adequate spatial coverage in new EMEP areas as well as in areas that have been insufficiently covered up to now;
(c) Sufficient temporal resolution that will allow investigation of atmospheric processes, guide model improvements as well as allow analysis of individual pollution events important in relation to human health and ecosystem impacts;
(d) Co-located and concurrent monitoring of the relevant components and the adoption of standardized methodologies and adequate quality assurance procedures;
(e) Conduct of monitoring in an affordable way for all Parties, particularly those with economic limitations, but at the same time in a way that takes advantage of the scientific developments and emerging capabilities.

8. In line with the previous versions of the monitoring strategy, linkages of geographical, and of different but connected environmental topics, like air quality and climate change, are important objectives and considerations having impact on the monitoring requirements.

9. EMEP monitoring constitutes the core framework for regional scale monitoring of atmospheric composition change throughout the EMEP domain. Observations are made at remote and background sites, and allow in combination with other monitoring efforts closer to pollution sources the evaluation and assessment of the regional and transboundary contribution to local air pollution. The observations needs to be made with adequate geographical coverage within the EMEP region as well as by ensuring that that data can be combined also with observations made outside the EMEP region, e.g. for understanding the role of intercontinental- and global scale transport of pollutants of short- and long-lived species. EMEP observations and monitoring sites are particularly well suited to serve as complementary and reliable data for calibration and validation data to airborne and satellite based remote sensing instrumentation. EMEP observations are contributing to the Global Earth Observation System of Systems (GEOSS) and users include the European Union's Earth Observation Program (COPERNICUS).

10. EMEP monitoring support, in an integrated way, information needs associated with the coupling between atmospheric composition and deposition rates with the climate system and its variability. These include radiative forcing agents with a significant regional gradient (also named Short-lived Climate Forcers; e.g. aerosols, ozone and their precursors) where transboundary fluxes of the agents and their source-receptor relationships needs to be assessed. The EMEP observation efforts should support the coupling between the carbon cycle and reactive nitrogen cycle.

III. COORDINATION AND COOPERATION

11. Taking into account the complexity and costs of atmospheric composition monitoring, EMEP will, as far as possible, continue to harmonize with and make use of relevant data compiled under other networks.

12. The monitoring requirements include important data for the assessment of environmental issues considered by other conventions including local air quality, climate change, water quality and biodiversity. There is also a significant overlap in the technical infrastructures at the national level, and most EMEP supersites (see below) are also core infrastructures for measurements of parameters needed to assess such topics. Due to the significant interactions between the suite of chemical constituents and the associated physical properties of air pollutants, as well as the synergies in abatement measures, national and international monitoring efforts should be closely coordinated. Such an approach will ensure a sound observational basis for EMEP by combining resources and avoiding duplication of efforts. Examples of other initiatives and frameworks include European Union legislation (e.g. the Air Quality Directive), the CLRTAP Working Group on Effects and its International Cooperative Programmes (ICPs), as well as various national and international programmes and Conventions (e.g. the Arctic Monitoring and Assessment Programme (AMAP), the Commission of the Convention on the Protection of the Marine Environment of the Baltic Sea Area (HELCOM), the Commission for the Protection of the Marine Environment of the North-East Atlantic (OSPARCOM), the World Meteorological Organization Global Atmosphere Watch (WMO-GAW), the United Nations Framework Convention on Climate Change, the Stockholm Convention on Persistent Organic Pollutants and the Minamata Convention on Mercury under the United Nations Environment Programme (UN Environment), and others.

13. The monitoring strategy of EMEP aims to utilize progress in scientific understanding represented by new methods for the conduct of monitoring, new technologies and techniques to integrate observations from measurement platforms (e.g. in situ, profiles, remote sensing) and methods for integrating observational data with modelling efforts through, for example, data assimilation. EMEP will, where relevant and appropriate, continue its efforts to increase the monitoring and reporting of parameters and data at a timeliness allowing more rapid access to air pollution information. Such efforts will be based on voluntary contributions from Parties and will follow the guidance of the EMEP Steering Body. Data will be openly available for all interested users.

IV. SPECIFICATION OF THE MONITORING PROGRAMME (2020–2029)

14. The monitoring programme is organized to allow for monitoring stations to operate at three different levels of scope and complexity, each targeting EMEP objectives in different but complimentary ways. In addition, EMEP will make use of other relevant supplementary data of adequate quality at a relevant spatial representativeness.

15. The main objective of monitoring at level 1 is to provide long-term basic chemical and physical measurements of the traditional EMEP parameters. Level 1 activities should be the first priority when extending the network in areas with few sites like e.g Eastern Europe, Caucasus and Central Asia (EECCA) and in South-Eastern Europe (SEE). By undertaking a more demanding monitoring programme, a subset of the level 1 stations should gradually be upgraded to include variables listed at level 2.

16. Level 2 variables provide a more complete description of the physical/chemical speciation of relevant components that is necessary for assessing the air pollution including long-range transport of air pollutants, and thus represent an essential supplement to the level 1 activities. The aim is to operate at least 30 sites providing level 2 data throughout the EMEP domain. Level 2 variables are defined according to topics which Parties may choose to focus on considering national priorities, and not all topics need to be covered. A site extending its programme to include both level 1 and level 2 requirements will be identified as an “EMEP supersite”; this is an important motivation factor and provides appropriate recognition of the data providers. Level 2

variables will as for level 1 typically target long-term continuous monitoring, rather than time limited campaigns.

17. The main objective of level 3 data is to improve the scientific understanding of the relevant physico-chemical processes in relation to regional air pollution and its control. Level 3 activities will typically be based on short-term campaign data. Level 3 efforts is often based on methods and approaches for which standardized methods and procedures have not yet been established. Level 3 observations are a voluntary component of the monitoring network, and the involvement of researchers is an important motivation.

18. The specification of variables at the different levels of monitoring is as follows:

(a) Level 1: Measurements at level 1 include parameters required to describe basic aspects of tropospheric chemistry and deposition rates of substances involved in the atmospheric cycling of particulate matter, photochemical oxidants, acidifying and eutrophying compounds and heavy metals. Requirements also include standard meteorological parameters, but these may be taken from a distant meteorological site, if representative. Monitoring of persistent organic pollutants (POPs) is not required at level 1.

(b) Level 2: Measurements of level 2 parameters should be made at a subset of the sites at which level 1 measurements are made. The potential additional parameters include higher time resolution, reliable gas/particle distribution information for semi-volatile compounds (e.g. some POPs?), speciation of precursors to photochemical oxidants (nitrogen oxide (NOx) compounds and volatile organic compounds (VOCs)), physical and optical characterization of aerosols, aerosol optical depth, further chemical speciation of particles (elemental and organic carbon, mineral dust), tracers to address air mass origin and the role of anthropogenic versus natural influence, methane (CH_4) and halocarbons. For heavy metals, the level- 2 program includes air concentrations of cadmium (Cd) and lead (Pb) (with copper (Cu), zinc (Zn), arsenic (As), chromium (Cr) and nickel (Ni) as a secondary priority) and mercury (Hg) in precipitation and air (total gaseous mercury (TGM). POPs monitoring in level 2 should ideally include measurements both in air and in precipitation (PAHs, PCBs, HCB, chlordane, HCHs, DDT/DDE, and preferably congener or isomer specific). All parameters listed above are however not required in order to comply with the monitoring strategy.

(c) Level 3: Level 3 measurements are research-driven and may partly be available at locations other than sites offering level 1 and level 2 data. Interesting parameters for EMEP include: dry deposition flux measurements (sulfur, nitrogen, ozone, VOCs, Hg, others); vertical profiles of ozone and aerosols (soundings or lidar, observations of POPs and Hg in other compartments than in the atmosphere (to be obtained through collaboration with other relevant bodies and institutions); chemical speciation of organic carbon (OC) in aerosols, including also carbon dioxide (CO_2) and nitrous oxide (N_2O) measurements made at EMEP sites in association with other monitoring frameworks; and isotope information on OC and VOCs. The list is not exclusive and other parameters may be added to this list as they become relevant for EMEP.

19. Table 1 in annex to the present document summarizes the parameters recommended to be monitored at the three respective levels, as well as the recommended time resolution for measurements.

20. Since the different compounds studied under EMEP are intrinsically linked, it is important that the mandatory EMEP monitoring network consists of co-located and concurrent measurements in both precipitation and air. It is recognized, however, that POPs measurements

may not always be co-located with level 1 sites, since many of the POP sites are operated in support of other programs, such as OSPARCOM, HELCOM and AMAP as well as in line with the European Union Air Quality Directive and other relevant legislation. It is nevertheless recommended that Parties co-locate their POPs measurements with EMEP level 1/level 2 stations wherever possible.

21. The temporal resolution for the EMEP mandatory monitoring programme should be sufficient to support analysis of chemical and physical characteristics of synoptic scale transport. Thus, the temporal resolution should generally not exceed 24 hours. Finer temporal resolution is recommended where appropriate methods exist. However, Parties can undertake monitoring at a lower level and with lower time resolution when the measurement activity requires significant financial resources making a continuous time integrated sampling at 24-hour resolution unrealistic, or if concentrations levels are so low that detection levels become a problem. In such cases it is recommended to continue current practice of limiting the sampling to a few short-time integrated samples per week (2 hours, 24 or 48 hours per week, e.g. VOCs, carbonyls, POPs, EC/OC) or alternatively to integrate over a full week (inorganic compounds in $PM_{2.5.}$ and Hg).

22. The site density is defined through target densities for each level, whilst providing for some flexibility. The monitoring density should reflect on the residence time of the individual pollutants in the atmosphere and be sufficient to resolve the actual spatial gradients in concentrations and deposition on regional scale. For level 1 variables, a target site density of at least one to two sites per 100,000 km^2 is recommended, and all Parties with an area larger than 10,000 km^2 are requested to operate at least one site. Small countries with large gradients in geography and climate are encouraged to increase site densities further, and also mountainous regions should be monitored. For level 2 variables, all Parties with a land area larger than 50,000 km^2 are expected to operate at least one site. Possibilities for regional collaboration on the operation of sites should be explored, and the collaboration with WMO through the operation of joint EMEP-GAW supersites is essential in the implementation. Most of these sites are also represented in ACTRIS, the European Research Infrastructure for the observation of Aerosol, Clouds and Trace Gases. Level 3 measurements are voluntary, and no specific requirement are given with respect to site densities. Most Parties already operate sites addressing such components, and efforts should be made to involve the relevant groups in the EMEP work. Traditionally, EMEP TFMM have arranged a number of intensive campaigns, which have proven to be an essential contribution to EMEP developments. The level 3 sites can to some extent be expected to reflect the priority pollution issues for different sub-regions, and the availability of data may depend on the availability of research funds.

23. EMEP will maintain and further improve its quality assurance programme to make sure that observation data are of known quality and adequate for their intended use. Field intercomparisons and laboratory ring tests are important, as well as the maintenance of good links between national data providers and the EMEP centers. These activities can be strengthened through collaboration with the central quality assurance facilities in the European Union, in the WMO-GAW system and with ACTRIS. Measurements should also satisfy the requirements for quality assurance, quality control and reporting formats provided at (http:\\ebas-submit.nilu.no). Here, also criteria for instrumentation and analytical methods are defined. Other methods can however be used provided that the data quality can be proven equivalent.

24. All data from the monitoring efforts at EMEP level 1, 2 and 3 will be openly available to all interested users, together with information about metadata on data originator, QA-measures, data policies etc. to achieve the most efficient and transparent use of observations in support of the Convention needs.

V. IMPLEMENTATION AND FURTHER EVOLUTION OF THE MONITORING STRATEGY

25. All Parties are requested to ensure the full implementation of the monitoring strategy.

26. It is essential to extend the implementation of the programme throughout the UNECE region, in particular in EECCA and SEE, starting with level 1 variables.

27. Due to the large number of parameters to be measured, and the proposed site density, some Parties might for various reasons have different priorities or have difficulties in conducting all activities defined at level 1 and level 2. EMEP will thus accept information not fully satisfying the requirements given. Any major change or deviation in the monitoring programme of any Party should be made in consultation with CCC. Parties with economies in transition that have not been able to operate an adequate EMEP monitoring site in the past are encouraged to enter the programme as soon as possible, and if necessary at a lower level of ambition, e.g. by implementing only parts of the programme in the beginning. EMEP-CCC is committed to provide guidance to the Parties on priorities with respect to which parameters to monitor.

28. The EMEP monitoring strategy must be ready to adapt to new needs and requirements identified by EMEP and the Convention. At the same time, consistent long-term time series needs be maintained in to monitor trends in atmospheric composition. This requires the strategy and its implementation to be regularly reviewed and, as appropriate, revised. The EMEP-CCC will coordinate reviews and together with the Task Force on Measurements and modeling, the EMEP Centers and other relevant bodies, present the recommendations for revisions to the EMEP Steering Body.