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Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe

Working Group on Effects

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Draft Monitoring Strategy of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe

Monitoring strategy for the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe for the period 2020–2029

Prepared by the Chemical Coordinating Centre in cooperation with the Task Force on Measurements and Modelling

Summary

This document presents 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. The document was developed through a revision process led by the EMEP Chemical Coordinating Centre in cooperation with the EMEP Task Force on Measurements and Modelling, as mandated by the third joint session of the Steering Body to EMEP and the Working Group on Effects in 2017 (ECE/EB.AIR/GE.1/2017/2−ECE/EB.AIR/WG.1/2017/2) and as specified in item 1.1.1.1 of the 2018–2019 workplan for the implementation of the Convention (ECE/EB.AIR/140/Add.1).

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I. Introduction

1. This document presents 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. The document was developed through a revision process led by the EMEP Chemical Coordinating Centre in cooperation with the EMEP Task Force on Measurements and Modelling, as mandated by the third joint session of the EMEP Steering Body and the Working Group on Effects in 2017 (ECE/EB.AIR/GE.1/2017/2−ECE/EB.AIR/WG.1/2017/2) and as specified in item 1.1.1.1 of the 2018–2019 workplan for the implementation of the Convention (ECE/EB.AIR/140/Add.1).

2. The 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 processes during transmission of air pollutants; and (iii) the need to use comparable or standardized procedures for monitoring and for the establishment of monitoring stations. The monitoring strategy specifies the detailed requirements for monitoring activities of the Parties to the Protocol to the Convention on Long-range Transboundary Air Pollution on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe.

3. The main objectives of EMEP are to:

(a) 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) Identify the sources of pollution concentrations and depositions and to assess the response to changes in emissions;

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

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

4. The EMEP observations and model calculations are important elements in assessing the air pollution situation in the United Nations Economic Commission for Europe (ECE) region and provide links both to global and to urban scales. Since air pollution is also addressed by other conventions and programmes, EMEP will collaborate closely with them to ensure harmonized approaches and efficient use of resources.

5. At its twenty-second session, the Executive Body for the Convention on Long-range Transboundary Air Pollution adopted a level-based monitoring strategy for the period 2004–2009 (EB.AIR/GE.1/2004/5) and made a decision concerning its implementation (ECE/EB.AIR/83/Add.1, decision 2004/1). Through the decision, the Executive Body: (a) urged Parties to make resources available for the full implementation of the strategy at a national level within the geographic scope of EMEP without undue delay; (b) requested the Chemical Coordinating Centre to provide technical support to Parties regarding the implementation of the strategy; and (c) requested the Steering Body to follow the implementation of the strategy closely, to review it and to keep the Executive Body informed of progress. The strategy was revised for the period 2010–2019 (ECE/EB/AIR/GE/1/2009/15), with minor adjustments compared to the 2004–2009 version.

II. General objectives and requirements

6. The monitoring strategy for 2020–2029 consolidates the established approaches and aspirations for monitoring activities in order to provide consistent and adequate observational

data supporting the EMEP objectives. Furthermore, it introduces some minor changes to the specific requirements in order to meet the needs of EMEP for the coming decade.

7. The monitoring activities aim to ensure:

(a) Adequate 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 the geographical domain of EMEP and improved access to information from areas that have been insufficiently covered up to now;

(c) Sufficient temporal resolution to enable investigation of atmospheric processes driving transport and transformation of pollution, to guide model improvements and to enable the analysis of individual pollution events;

(d) Co-located and concurrent monitoring of the relevant atmospheric variables, the adoption and use of standardized methodologies, and adequate quality assurance procedures;

(e) A level of ambition that is affordable for all Parties, while also taking advantage of scientific developments and emerging capabilities.

8. EMEP monitoring is the core framework for regional-scale monitoring of atmospheric constituents throughout the EMEP domain. Observations are made at remote and regional background sites and enable, in combination with other monitoring efforts within the ECE area, the evaluation and assessment of regional and transboundary contributions to local air pollution.

9. EMEP observations are also important for understanding the role of intercontinental and global scale transport of short- and long-lived species playing a role in air pollution and climate change processes. The measurement programme includes radiative forcing agents (also known as short-lived climate pollutants), for example, aerosols (including black carbon) and ozone and their precursors (including methane). EMEP monitoring supports, in an integrated way, information needs associated with coupling between atmospheric composition and deposition rates with the climate system and its variability, as well as the coupling between the carbon and nitrogen cycles.

10. Furthermore, EMEP observations are well-suited to serve as complementary and reliable data for calibration and validation data for airborne and satellite-based remote sensing instrumentation.

11. The EMEP monitoring strategy aims to utilize new developments in observational methods, new technologies and techniques to integrate observations from measurement platforms (for example, in situ, profiles, satellite remote sensing and methods for integrating observational data with modelling through, for example, data assimilation and measurement model fusion approaches).

12. EMEP will, where relevant and appropriate, continue its efforts to increase the monitoring and reporting of parameters and data timelines, facilitating more rapid access to air pollution information ("Near Real Time" or "Real Real Time" data delivery). Such efforts will be based on voluntary contributions from Parties and will follow the guidance of the EMEP Steering Body.

III. Coordination and cooperation

13. 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 be pursued by EMEP to ensure a sound observational basis by combining resources and avoiding duplication of efforts.

14. 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 conventions and frameworks. In particular, such data would include observations of local air quality, climate change, water quality and biodiversity. As a result, there is a significant overlap in technical infrastructures at national levels, i.e. most EMEP level 2 sites (see below) represent core infrastructures for observations supporting related initiatives. Within the Convention, there is close collaboration with the Working Group on Effects and the International Cooperative Programmes, with EMEP observations being used to derive pollution exposure data to assess impacts and effects.

15. At the European level, EMEP observations are fundamental in relation to the European Union Air Quality Directive[1] and the National Emission Ceilings Directive,[2] and there are close links between EMEP monitoring requirements and the Directives. Furthermore, EMEP observations are used as a part of European Environment Agency assessments of the air quality situation in Europe, and EMEP sites typically also deliver parts of their data to the European Environment Agency database.

16. There is close scientific and technical cooperation between EMEP and the World Meteorological Organization Global Atmosphere Watch Programme in Europe, comprised of harmonization of guidelines, observational practices, data quality control, quality assurance and data exchange. Through the efforts of Global Atmosphere Watch, EMEP observations are also harmonized with efforts in other parts of the world, and EMEP data contribute to Global Atmosphere Watch's services to society.

17. Examples of other initiatives and frameworks related to pollution include international programmes and conventions such as: the Arctic Monitoring and Assessment Programme; the Baltic Marine Environment Protection Commission; the OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic; 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.

18. EMEP observations are also made available to users and stakeholders though initiatives such as the Global Earth Observation System of Systems and the European Union's Earth Observation Programme (COPERNICUS).

IV. Specification of the monitoring programme (2020–2029)

A. Organization of the monitoring network

19. The monitoring programme is organized in such a way as to enable monitoring stations to operate at three different levels of scope and complexity, each targeting EMEP objectives in different but complementary ways. In addition, EMEP will make use of other relevant supplementary data of adequate quality at a relevant spatial representativeness, for example, the observations from the collaborating programmes and initiatives mentioned above.

20. The main objective of monitoring at level 1 is to provide long-term basic chemical and physical measurements of the basic EMEP parameters. Level 1 activities should be the first priority when extending the monitoring network in areas with few sites, such as Eastern Europe, the Caucasus and Central Asia and South-Eastern Europe. Through the undertaking of a more demanding monitoring programme, a subset of the level 1 stations should gradually be upgraded to include variables required for level 2.

21. Level 2 variables provide a more complete description of the physical/chemical speciation of relevant constituents, which is necessary for assessing air pollution, including long-range transport of air pollutants, and which thus represents an essential supplement to

[1] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe, *Official Journal of the European Union*, L 152, 2008, pp. 1–44.

[2] Directive (EU) 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC, *Official Journal of the European Union*, L 344, 2016, pp. 1–31.

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 that Parties may choose, with Parties being free to focus on considering their national priorities keeping in mind that, unless relevant, 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 motivating factor and provides appropriate recognition of the data providers. The goal of Level 2 observations is to provide long-term continuous monitoring data using measurement methods traceable to established international quality standards, as is the case with Level 1 observation data.

22. The main objective of Level 3 observations 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 are often based on methods and approaches for which standardized methods and procedures have not yet been established, and for which a decadal or multi-decadal time series is not realistic. Level 3 observations are a voluntary part of the monitoring activity and will be implemented in collaboration with the broader research community.

B. Specification of observations and variables

23. 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 (PM), 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;

(b) Level 2 – Measurements of level 2 parameters should be made at a subset of sites at which level 1 measurements are made. The potential additional parameters include: higher temporal resolution; reliable gas/particle distribution information for semi-volatile compounds; speciation of precursors to photochemical oxidants (nitrogen oxides (NOx) and volatile organic compounds (VOCs)); physical and optical characterization of aerosols (including "black carbon"); aerosol optical depth; further chemical speciation of particles (elemental and organic carbon in PM_{10}, 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 programme 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)). Monitoring of persistent organic pollutants (POPs) in level 2 should ideally include measurements, preferably congener or isomer specific, both in air and in precipitation (polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), hexachlorobenzene (HCB), chlordane, hexachlorocyclohexanes (HCHs) dichlorodiphenyltrichloroethane and dichlorodiphenyldichloroethylene (DDT/DDE. Full implementation of all the parameters listed above is, however, not required in order to comply with the monitoring strategy;

(c) Level 3 – level 3 measurements are research-driven and may be partly available at locations other than sites offering level 1 and level 2 data. Interesting parameters for EMEP include: dry deposition flux measurements (sulphur, nitrogen, ozone, VOCs, Hg, others); vertical profiles of ozone and aerosols (soundings or light detection and ranging (LiDAR), observations of POPs and Hg in other compartments than in the atmosphere; chemical speciation of organic carbon (OC) in aerosols, 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. This list is not exclusive and other parameters may be added to it as they become relevant for EMEP.

24. The annex to the present document contains a summary of the parameters recommended to be monitored at the three respective levels, as well as the recommended temporal resolution for measurements.

25. Since the different compounds studied under EMEP are intrinsically linked, it is important that the EMEP monitoring network should consist of co-located and concurrent measurements in both precipitation and air. It is recognized, however, that some measurements may not always be co-located with level 1 sites.

C. Temporal resolution – measurement frequency

26. The temporal resolution for the EMEP mandatory monitoring programme should be sufficient to support the analysis of chemical and physical characteristics of synoptic-scale transport. Thus, the temporal resolution should generally not exceed 24 hours. Higher temporal resolution is recommended where appropriate methods exist. However, Parties can undertake to monitor at a lower temporal resolution when the measurement activity requires significant financial resources, making a continuous time-integrated sampling at 24-hour resolution unrealistic. Similarly, longer sampling times should be considered if concentrations levels are so low that detection levels represent a problem. It should be noted that particular care should be taken to avoid sampling temporal resolution affecting data quality, for example, if methods are subject to sampling artefacts. In such cases, it is recommended to continue the current practice of limiting the sampling to a few short time-integrated samples per week as opposed to long sampling times (for example, weekly or monthly sampling for POPs and VOCs is not recommended).

D. Spatial resolution

27. Monitoring of spatial density should reflect the residence time of the individual pollutants in the atmosphere and should be sufficient to resolve the actual spatial gradients in concentrations and deposition on the regional scale. The site density is defined for each level, while providing for some flexibility.

28. For level 1 variables, it is recommended that there should be at least one to two sites per 100,000 km^2. All Parties with an area greater than 10,000 km^2 are requested to operate at least one site. It is recommended that small countries with large gradients in geography and climate further increase site densities, taking into account the fact that gradients in mountainous regions should also be monitored.

29. For level 2 variables, all Parties with a land area greater than 50,000 km^2 should operate at least one site. As stated in paragraph 21 above, Parties have the possibility to choose and focus on variables reflecting their national priorities. Possibilities for regional collaboration on the operation of sites should be explored if there are obstacles to or financial constraints regarding the implementation of monitoring programmes. Most of the existing level 2 sites currently contribute to the Aerosol, Clouds and Trace Gases Research Infrastructure (ACTRIS).

30. Level 3 measurements are voluntary and no specific requirements are set out with respect to site densities. Most Parties already operate sites addressing level 3 components, and efforts should be made to involve relevant scientific groups in the EMEP work. Traditionally, the EMEP Task Force on Measurements and Modelling has arranged a number of intensive campaigns, which have proven to be an essential contribution to EMEP developments. The level 3 measurements can to some extent address priority pollution issues for different subregions, and the availability of data might depend on the availability of research funds and the interest of these subregions in sharing resources and data.

E. Data quality and exchange

31. 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 as defined in section II above. Field intercomparisons and laboratory ring tests are important, as is the maintenance of good communication between national data providers and the EMEP centres. These activities can be strengthened through collaboration with the central quality assurance facilities in the European Union (for example, the Network of Air Quality Reference

Laboratories, the European Committee for Standardization, ACTRIS and the World Meteorological Organization Global Atmosphere Watch Programme. Close links to the services offered by the metrology community (European Association of National Metrology Institutes) are also important.

32. Measurements must satisfy requirements for quality assurance, quality control and data reporting. Reporting formats, as well as criteria for instrumentation and analytical methods, are also defined and provided at the Chemical Coordinating Centre website.[3] However, other methods may be used, provided that data quality can be proven to be equivalent.

33. An open data policy will apply for all data from the monitoring efforts at EMEP levels 1, 2 and 3. Data will be available to all interested users, together with information about metadata on data originator, quality assurance measures, 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

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

35. It is essential to extend the implementation of the EMEP monitoring programme throughout the ECE region, in particular in Eastern Europe, the Caucasus and Central Asia and South-Eastern Europe, starting with level 1 variables.

36. 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 that does not fully satisfy the level-oriented requirements. Any major change in or deviation from the monitoring programme by any Party should be made in consultation with the Chemical Coordinating Centre. 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, if necessary, at a lower level of ambition, for example, by implementing only parts of the programme in the beginning. The Chemical Coordinating Centre is committed to providing guidance to the Parties on priorities with respect to which parameters to monitor.

37. 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 need to be maintained to monitor trends in atmospheric composition. This requires the strategy and its implementation to be regularly reviewed and, as appropriate, revised. The Chemical Coordinating Centre will coordinate reviews and, together with the Task Force on Measurements and Modelling, the EMEP Centres and other relevant bodies, present recommendations for revisions to the EMEP Steering Body.

[3] See https://ebas-submit.nilu.no/Standard-Operating-Procedures.

Annex

Monitoring requirements for the various levels specified by the monitoring strategy

Levels 1 and 2 are mandatory. Information on reference methods is provided in the EMEP Manual for Sampling and Chemical Analysis and in the Quality assurance/Quality control section available on the EMEP Chemical Coordinating Centre website (www.emep.int; https://projects.nilu.no//ccc/index.html).

Level 1 - "variables to be measured at all basic EMEP sites"		*Recommended temporal resolution*
Inorganic compounds in precipitation	SO_4^{2-}, NO_3^-, NH_4^+, H^+ (pH), Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^-, precipitation amount	24 hours
Inorganic compounds in air	SO_2, SO_4^{2-}, NO_3^-, HNO_3, NH_4^+, NH_3, (sNO_3, sNH_4), HCl, Na^+, K^+, Ca_2^+, Mg_2+	24 hours
Elemental and Organic Carbon	EC and OC in $PM_{2.5}$	24 hours /7 days
Nitrogen dioxide	NO_2	1 hour/24 hours
Ozone	O_3	1 hour
PM mass concentration	$PM_{2.5}$, PM_{10}	24 hours
Heavy metals in precipitation	Cd, Pb (1st priority), Cu, Zn, As, Cr, Ni (2nd priority)	7 days
Meteorology	Precipitation amount (RR), temperature (T), wind direction (dd), wind speed (ff), relative humidity (rh), atmospheric pressure (pr)	24 hours (RR), others 1 hour

Level 2 - "additional variables to be measured at a subset of sites - EMEP level 2 sites"		*Recommended temporal resolution*
Oxidant precursors and gaseous short-lived climate pollutants		
Nitrogen oxide	NO	1 hour
Light hydrocarbons	C_2–C_5, BTEX (Benzene, Toluene, Ethylbenzene and Xylene)	1 hour/grab sample once or twice per week
OVOCs	Aldehydes and ketones	Absorbing Solution tube, once or twice per week
Hydrocarbons	C_6–C_{12}	1 hour/ABS tube, once or twice per week
Methane	CH_4	1 hour
Carbon Monoxide	CO	1 hour
Particulate matter (PM) observations contribute to the assessment of particulate matter and its source apportionment		
PM mass	PM_1	1 hour
Elemental and Organic Carbon in air	EC and OC in PM_{10}	24 hours/7 days

Level 2 - "additional variables to be measured at a subset of sites - EMEP level 2 sites"		*Recommended temporal resolution*
Mineral dust in PM_{10}	Si, Al, Fe, Ca	24 hours/7 days
Particle light absorption/equivalent black carbon	Light absorption coefficient, eBC	1 hour
Particle number concentration	dp >10nm	1 hour
Particle number size distribution	dN/dlogDp, (sub/supermicrometer)	1 hour
Particle light-scattering coefficients	Light-scattering coefficient, Light backscatter coefficients (multi-wavelengths)	1 hour
Particle chemistry speciation	Non-refractory organic and inorganic composition (ACSM, AMS)	1 hour
Aerosol Optical Depth	AOD at 550 nm	1 hour
Acidification and eutrophication observations contribute to the assessment of nitrogen chemistry, influence by local emissions and dry deposition fluxes		
Gas particle ratio of N-species	NH_3/NH_4^+, HNO_3/NO_3 - (artefact-free methods)	1 hour/24 hours
Gas particle ratios of N-species	NH_3, NH_4^+, HNO_3, NO_3- (HCl) (complementing the filter pack sampling)	1 month
Heavy metals observations contribute to the assessment of mercury and heavy metals fluxes		
Mercury in precipitation	Hg	7 days
Mercury in air	Hg (TGM)	1 hour/24 hours/7 days
Heavy metals in air	Cd, Pb (1st priority), Cu, Zn, As, Cr, Ni (2nd priority)	7 days
Persistent organic pollutants (POPs) observations contribute to the assessment of persistent organic pollutants		
POPs in precipitation	PAHs, PCBs, HCB, chlordane, HCHs, DDT/DDE	7 days
POPs in air	PAHs, PCBs, HCB, chlordane, HCHs, DDT/DDE	24 hours/7 days/24 hours or 48 hours once or twice per week (depending on sampling with respect to artefact problems)
Tracers observations contributes to the assessment of individual long-range transport events and their source apportionment		
Halocarbons	CFCs, HCFCs, HFCs, PFCs, SF_6	1 hour

Level 3 – Research-based and voluntary measurements, preferably, but not limited to EMEP level 1/2 sites. May also include both campaign and long-term observations. Observations contribute to the understanding of processes relevant to long-range transport of air pollutants and support model development and validation		*Recommended temporal resolution*
NOy chemistry	HNO_2, NO_3, N_2O_5, PAN, organic nitrates	1 hour
Ammonia in emission areas (optional)	NH_3	1 month
Vertical profiles	O_3 soundings, aerosol LiDAR	1 hour
Organic tracers, OC fractionation	Levoglucosan, others, Water soluble and water insoluble OC (WSOC/WINSOC)	24 hours/7 days
Organic tracers	Levoglucosan, others	24 hours/7 days
Isotopic information	OC, EC, VOCs, CH_4, CO_2, Hg	24 hours/7 days
Greenhouse gases	CO_2, N_2O	1 hour
Hydrogen	H_2	1 hour
Hydroxyl radical	OH-	1 hour
Hydroperoxide	H_2O_2	1 hour
OVOC Alcohols	Methanol, Ethanol	ABS tube, once or twice per week
Major inorganics in $PM_{2.5}$ and PM_{10}	SO_4^{2-}, NO_3^-, NH_4^+, Na^+, K^+, Ca_2^+, Mg^+ (Cl^-)	7 days
Mercury speciation	RGM and TPM	1 hour/24 hours/7 days
POPs passive sampling at higher spatial resolution	For example, PAHs, PCBs, HCB, chlordane, HCHs, DDT/DDE	1 month
POPs other than those listed above, as well as organic contaminants of emerging concern	For example, PBDEs, PFAS, SCCPs	As considered appropriate
Dry deposition flux	nitrogen species, O_3, VOCs, particles, other	1 hour