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Options for revising the annexes to the Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone: technical annexes

Draft revised annex I

Note by the secretariat

Summary

This document presents proposals for amendments to annex I to the 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone for consideration by the Working Group on Strategies and Review at its forty-ninth session. It is based on document ECE/EB.AIR/WG.5/2011/5, as revised at the forty-eighth session of the Working Group in April 2011.

This revised version reflects modifications and proposals made during the forty-ninth session of the Working Group on Strategies and Review.

Proposed new text is indicated in bold. Text in square brackets that is not marked for deletion has not been provisionally agreed by the Working Group.

Critical loads and levels

I. Critical loads of acidity

A. For Parties within the geographical scope of EMEP

1. Critical loads (as defined in article 1) of acidity for ecosystems are determined in accordance with the Convention’s [*Manual on methodologies and criteria for mapping critical levels/loads and geographical areas where they are exceeded* – delete] ***Manual on Methodologies and Criteria for Modelling and Mapping Critical Loads and Levels and Air Pollution Effects, Risks and Trends*** **(available online at www.icpmapping.org/)**. They are the maximum amount of acidifying deposition [an ecosystem can tolerate in the long term without being damaged. Critical loads of acidity in terms of nitrogen take into account of within-ecosystem nitrogen removal processes (e.g. uptake by plants). Critical loads of acidity in terms of sulphur **are loads that** [do not – delete] **— in the long term — will not cause adverse effects to the structure and functions of ecosystems**]. A combined sulphur and nitrogen critical load of acidity considers nitrogen only when the nitrogen deposition is greater than ecosystem nitrogen removal processes [**, such as uptake by vegetation**]. All critical loads reported by Parties [**, and approved by the Executive Body to the Convention,**] are summarized for use in the integrated assessment modelling employed to provide guidance for setting the emission ceilings in annex II.

B. For Parties in North America

2. [For eastern Canada, critical sulphur plus nitrogen loads for forested ecosystems have been determined with scientific methodologies and criteria (1997 Canadian Acid Rain Assessment) similar to those in the Convention's *Manual on methodologies and criteria for mapping critical levels/loads and geographical areas where they are exceeded.* Eastern Canada critical load values (as defined in article 1) of acidity are for sulphate in precipitation expressed in kg/ha/year. Alberta in western Canada, where deposition levels are currently below the environmental limits, has adopted the generic critical load classification systems used for soils in Europe for potential acidity. Potential acidity is defined by subtracting the total (both wet and dry) deposition of base cations from that of sulphur and nitrogen. In addition to critical loads for potential acidity, Alberta has established target and monitoring loads for managing acidifying emissions. – delete] **In Canada, critical acid deposition loads and geographical areas where they are exceeded are determined and mapped for lakes and upland forest ecosystems using scientific methodologies and criteria similar to those in the Convention’s *Manual on Methodologies and Criteria for Modelling and Mapping Critical Loads and Levels and Air Pollution Effects, Risks and Trends*. Critical load values for total sulphur plus nitrogen and exceedance levels have been mapped across Canada (south of 60° N latitude) and are expressed in acid equivalents per hectare per year (eq/ha/yr) (2004 Canadian Acid Deposition Science Assessment; 2008 Canadian Council of Ministers of the Environment). The province of Alberta has also adapted the generic critical load classification systems used for soils in Europe for potential acidity to define soils as highly sensitive, moderately sensitive and not sensitive to acidic deposition. Critical, target and monitoring loads are defined for each soil class and management actions are prescribed as per the Alberta Acid Deposition Management Framework, as appropriate.**

3. For the United States of America, the effects of acidification are evaluated through an assessment of the sensitivity [**and response**] of ecosystems [**to**] the [total] loading [within ecosystems – delete] of acidifying compounds, [**using peer-reviewed scientific methodologies and criteria,**] and [**accounting for**] the [uncertainty – delete] [**uncertainties**] associated with nitrogen [removal processes – delete] [**cycling processes**] within ecosystems.

4. These loads and effects are used in integrated assessment [modelling – delete] [**activities, including providing data for international efforts to assess ecosystem response to loading of acidifying compounds,**] and provide guidance for setting the emission ceilings and/or reductions for Canada and the United States of America in annex II.

II. Critical loads of nutrient nitrogen

[A.] For Parties within the geographical scope of EMEP

5. Critical loads (as defined in article 1) of nutrient nitrogen (eutrophication) for ecosystems are determined in accordance with the Convention's [*Manual on methodologies and criteria for mapping critical levels/loads and geographical areas where they are exceeded* – delete] ***Manual on Methodologies and Criteria for Modelling and Mapping Critical Loads and Levels and Air Pollution Effects, Risks and Trends***. They are the maximum amount of eutrophying nitrogen deposition [an ecosystem can tolerate in the long term without being damaged – delete] [**that — in the long term — will not cause adverse effects to the structure and functions of ecosystems**]. All critical loads reported by Parties are summarized for use in the integrated assessment modelling employed to provide guidance for setting the emission ceilings in annex II.

B. For Parties in North America

5 bis. For the Unites States of America, the effects of nutrient nitrogen (eutrophication) for ecosystems are evaluated through an assessment of the sensitivity and response of ecosystems to the loading of nitrogen compounds, using peer-reviewed scientific methodologies and criteria, and accounting for uncertainties associated with nitrogen cycling within ecosystems.

III. Critical levels of ozone

A. For Parties within the geographical scope of EMEP

6. Critical levels (as defined in article 1) of ozone are determined to protect plants in accordance with the Convention's [*Manual on methodologies and criteria for mapping critical levels/loads and geographical areas where they are exceeded* – delete] ***Manual on Methodologies and Criteria for Modelling and Mapping Critical Loads and Levels and Air Pollution Effects, Risks and Trends***. They are expressed [as a cumulative exposure over a threshold ozone concentration of 40 ppb (parts per billion by volume). This exposure index is referred to as AOT40 (accumulated exposure over a threshold of 40 ppb). The AOT40 is calculated as the sum of the differences between the hourly concentration (in ppb) and 40 ppb for each hour when the concentration exceeds 40 ppb. – delete] **in terms of the cumulative value of either stomatal fluxes or concentrations at**

the top of the canopy. Critical levels are preferably based on stomatal fluxes as these are considered more biologically relevant since they take into account the modifying effect of climate, soil and plant factors on the uptake of ozone by vegetation.

7. [The long-term critical level of ozone for crops of an AOT40 of 3000 ppb.hours for May-July (used as a typical growing season) and for daylight hours was used to define areas at risk where the critical level is exceeded. A specific reduction of exceedances was targeted in the integrated assessment modelling undertaken for the present Protocol to provide guidance for setting the emission ceilings in annex II. The long-term critical level of ozone for crops is considered also to protect other plants such as trees and natural vegetation. Further scientific work is under way to develop a more differentiated interpretation of exceedances of critical levels of ozone for vegetation. – delete] **Critical levels of ozone have been derived for a number of species of crops, (semi-)natural vegetation and forest trees. The critical levels selected are related to the most important environmental effects, e.g., loss of security of food supplies, loss of carbon storage in the living biomass of trees and adverse effects on forest and (semi-)natural ecosystems.**

8. [A critical level of ozone for human health is represented by the WHO Air Quality Guideline level for ozone of 120 µg/m3 as an 8-hour average. In collaboration with the World Health Organization's Regional Office for Europe (WHO/EURO), a critical level expressed as an AOT60 (accumulated exposure over a threshold of 60 ppb), i.e. 120 µg/m3, calculated over one year, was adopted as a surrogate for the WHO Air Quality Guideline for the purpose of integrated assessment modelling. This was used to define areas at risk where the critical level is exceeded. A specific reduction of these exceedances was targeted in the integrated assessment modelling undertaken for the present Protocol to provide guidance for setting the emission ceilings in annex II. – delete] [**The critical level of ozone for human health is determined in accordance with the World Health Organization (WHO) air quality guidelines to protect human health from a wide range of health effects, including increased risk of premature death and morbidity.**]

B. For Parties in North America

9. [For Canada, critical levels of ozone are determined to protect human health and the environment and are used to establish a Canada-wide Standard for ozone. The emission ceilings in annex II are defined according to the ambition level required to achieve the Canada-wide Standard for ozone. – delete] **For Canada, it is understood that there is no lower threshold for human health effects from ozone. That is, adverse effects have been observed at all ozone concentrations experienced in Canada. The Canadian standard for ozone was set to aid management efforts nationally, and by jurisdictions, to significantly reduce the effects on human health and the environment.**

10. For the United States of America, critical levels [of ozone are determined – delete] [**are established in the form of national ambient air quality standards for ozone in order**] to protect public health with an adequate margin of safety [**and**] [as well as – delete] to protect [the – delete] public welfare [**including vegetation**] from any known or expected adverse effects [, and are used to establish a national ambient air quality standard – delete]. Integrated assessment modelling and the air quality standard[**s**] are used in providing guidance for setting the emission ceilings and/or reductions for the United States of America in annex II.

IV. Critical levels of particulate matter

A. For Parties in the geographical scope of EMEP

11. The critical level of particulate matter (PM) for human health is determined in accordance with the WHO air quality guidelines as the mass concentration of $PM_{2.5}$ (particles with aerodynamic diameter less than 2.5 µm). Attainment of the guideline level is expected to effectively reduce health risks. The long-term $PM_{2.5}$ concentration, expressed as an annual average, is proportional to the risk to health, including reduction of life expectancy. This indicator is used in integrated modelling to provide guidance for emission reduction. In addition to the annual guideline level, a short-term (24-hour mean) guideline level is defined to protect against peaks of pollution which have significant impact on morbidity or mortality.

B. For Parties in North America

12. For the United States of America, critical levels are established in the form of national ambient air quality standards for PM in order to protect public health with an adequate margin of safety, and to protect public welfare (including visibility and man-made materials) from any known or expected adverse effects. Integrated assessment modelling and the air quality standards are used in providing guidance for setting the emission ceilings and/or reductions for the United States of America in annex II.

13. For Canada, it is understood that there is no lower threshold for human health effects from PM. That is, adverse effects have been observed at all concentrations of PM experienced in Canada. The Canadian national standard for PM was set to aid management efforts nationally, and by jurisdictions, to significantly reduce the effects on human health and the environment.

V. Critical levels of ammonia

14. Critical levels (as defined in article 1) of ammonia are determined to protect plants in accordance with the *Manual on Methodologies and Criteria for Modelling and Mapping Critical Loads and Levels and Air Pollution Effects, Risks and Trends*.

VI. Acceptable levels for materials

15. Acceptable levels (as defined in article 1) of acidifying pollutants and PM are determined to protect materials and cultural heritage in accordance with the Convention's *Manual on Methodologies and Criteria for Modelling and Mapping Critical Loads and Levels and Air Pollution Effects, Risks and Trends*. The acceptable levels of pollutants are the maximum exposure a material can tolerate in the long term without resulting in damage above specified target corrosion rates. This damage, which can be calculated by available dose-response functions, is the result of several pollutants acting together in different combinations depending on the material: acidity (SO_2, nitric acid (HNO_3)), ozone and PM.