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Working Group on Effects

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Progress in activities in 2014 and further development of effects-oriented activities

Integrated monitoring of air pollution effects on ecosystems

Report by the Programme Coordinating Centre of the International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems

Summary

The present report is being submitted for the consideration of the Working Group on Effects in accordance with the request of the Executive Body for the Convention on Long-range Transboundary Air Pollution in the 2014–2015 workplan for the implementation of the Convention (ECE/EB.AIR/122/Add.2, items 1.1.20 and 1.2.2).

The report of the International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems presents the results of the activities undertaken since its 2013 report and details, in particular, work on the relationships between critical load exceedances and empirical effect indicators (changes in ground vegetation and nitrogen and sulphur fluxes), changes in catchment retention of sulphur and nitrogen (indicating ecosystem impacts and recovery) and heavy metal budgets and processes.

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I. Introduction

1. The present report of the International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems (ICP Integrated Monitoring) is being submitted for the consideration of the Working Group on Effects in accordance with the request of the Executive Body for the Convention on Long-range Transboundary Air Pollution in the 2014–2015 workplan for the implementation of the Convention (ECE/EB.AIR/122/Add.2, items 1.1.20 and 1.2.2). The report presents the results of the activities undertaken between May 2013 and May 2014 and details, in particular, work on the relationships between critical load exceedances and empirical effect indicators (changes in ground vegetation and nitrogen and sulphur fluxes), changes in catchment retention of sulphur and nitrogen (indicating ecosystem impacts and recovery) and heavy metal budgets and processes.

2. The programme Task Force is led by Sweden, while the Programme Centre is hosted by the Finnish Environment Institute in Helsinki. The Programme involves some 150 scientists in 16 countries.

3. During the reporting period, ICP Integrated Monitoring held two meetings: the twenty-first Task Force meeting and a scientific workshop (Obninsk, Russian Federation, 21–23 May 2013); and the twenty-second Task Force meeting and a scientific workshop, (Westport, Ireland, 7–9 May 2014).

4. Key topics discussed at the most recent Task Force meeting included the status of the ICP Integrated Monitoring database, reports to be prepared according to the Convention's 2014–2015 workplan, cooperation with other bodies and activities, and the future workplan of ICP Integrated Monitoring. The scientific workshop focused on current work on the key scientific topics of the Programme (see section IV below). The minutes of the meetings are available on the ICP Integrated Monitoring website.[1]

II. Outcomes/deliverables in the reporting period

5. In 2013, ICP Integrated Monitoring produced or contributed to the following reports:

(a) The 2013 joint progress report on the activities of the International Coordinated Programmes and the Joint Task Force on the Health Aspects of Air Pollution (ECE/EB.AIR/WG.1/2013/3);

(b) Integrated monitoring (the 2013 technical report of ICP Integrated Monitoring to the Working Group on Effects) (ECE/EB.AIR/WG.1/2013/9);

(c) Benefits of air pollution control for biodiversity and ecosystem services (ECE/EB.AIR/WG.1/2013/14) and a brochure on the topic;

(d) *22nd Annual Report 2013* of ICP Integrated Monitoring;[2]

[1] See www.syke.fi/nature/icpim.

[2] Sirpa Kleemola and Martin Forsius, eds., *22nd Annual Report 2013, Convention on Long-range Transboundary Air Pollution. International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems*, Reports of the Finnish Environment Institute, No. 25 (Helsinki, 2013). Available from https://helda.helsinki.fi/handle/10138/40129.

(e) A report on relations between vegetation changes and critical load exceedances;[3]

(f) A report on mass balances for sulphur and nitrogen at the ICP Integrated Monitoring sites;[4]

(g) A progress report on the baseline heavy metal approach.[5]

6. The main results of the carried out activities are:

(a) The benefits of air pollution control for biodiversity and ecosystem services report (ECE/EB.AIR/WG.1/2013/14), which was presented to the Executive Body at its thirty-second session (9–13 December 2013);

(b) Parameters measured at ICP Integrated Monitoring sites and documented in the ICP Integrated Monitoring Programme Manual were included in the draft text of the revised National Emission Ceilings Directive[6] (annex V on monitoring requirements), which is being updated as part of the European Union Clean Air Policy Package;

(c) Three scientific papers based on ICP Integrated Monitoring activities were published during the reporting period, providing quality control for the work undertaken and disseminating the information to a wider scientific community.

III. Expected outcomes/deliverables over the next period and in the longer term

7. In the second half of 2014 and in 2015, ICP Integrated Monitoring is going to contribute to or produce the following deliverables indicated in the 2014–2015 workplan:

(a) The 2014 joint progress report on the activities of the International Coordinated Programmes and the Joint Task Force on the Health Aspects of Air Pollution (ECE/EB.AIR/WG.1/2014/3);

(b) A report and scientific paper on mass balances and indicators for sulphur and nitrogen in catchments (workplan item 1.2.2, in 2014);

(c) The twenty-third annual ICP Integrated Monitoring report (covering activities in 2014);

(d) A report on dynamic responses to vegetation changes in relation to nitrogen (workplan item 1.3.12, in 2015);

(e) A report and scientific paper on long-term trends in ecosystem effects of sulphur, nitrogen and heavy metals (workplan item 1.1.20, in 2015);

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[3] M. Holmberg and others, “Relationship between critical load exceedances and empirical impact indicators at Integrated Monitoring sites across Europe”, *Ecological Indicators*, vol. 24 (January 2013), pp. 256–265. Available from doi: http://dx.doi.org/10.1016/j.ecolind.2012.06.013.

[4] Jussi Vuorenmaa and others, “Sulphur and nitrogen input-output budgets at ICP Integrated Monitoring sites in Europe”, in Sirpa Kleemola and Martin Forsius, eds., *22nd Annual Report 2013*, pp. 35–43.

[5] Lage Bringmark and others, “Progress report on base line heavy metal approach”, in Sirpa Kleemola and Martin Forsius, eds., *22nd Annual Report 2013*, pp. 29–34.

[6] Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants.

(f) The twenty-fourth annual ICP Integrated Monitoring report (covering activities in 2015).

IV. Cooperation with other groups, task forces or subsidiary bodies, notably with regard to synergies and possible joint approaches or activities

8. ICP Integrated Monitoring has established useful collaboration with the following bodies under the Working Group on Effects: the International Cooperative Programme (ICP) on Modelling and Mapping of Critical Levels and Loads and Air Pollution Effects, Risks and Trends (on critical load calculations); the Joint Expert Group on Dynamic Modelling (on changes in biodiversity); the ICP on Assessment and Monitoring of the Effects of Air Pollution on Rivers and Lakes; and the ICP on Assessment and Monitoring of Air Pollution Effects on Forests (on long-term trends calculations on effects indicators). ICP Integrated Monitoring also uses emission scenario data of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP).

V. Strengthening the involvement of countries of Eastern and South-Eastern Europe, the Caucasus and Central Asia in the work under the Convention

9. With regard to actions taken to strengthening the involvement of countries of Eastern and South-Eastern Europe, the Caucasus and Central Asia in the work under the Convention, the online *Manual for Integrated Monitoring* was translated into Russian during the reporting period and a PDF version is now available from the ICP Integrated Monitoring website.[7]

10. In addition, the next ICP Integrated Monitoring Task Force meeting in May 2015 is tentatively scheduled to be held in the subregion – in Minsk.

VI. Scientific and technical cooperation activities with relevant international bodies

11. In terms of cooperation with international bodies, ICP Integrated Monitoring collaborates closely with the European Long-Term Ecosystem Research (LTER) network[8] and many of the sites are common to both bodies. Joint scientific work is currently ongoing.

VII. Highlights of the scientific findings: policy-relevant issues

12. The following findings of ICP Integrated Monitoring are of particular scientific relevance:

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[7] See http://www.syke.fi/en-US/Research__Development/Ecosystem_services_and_biological_diversity/Monitoring/Integrated_Monitoring/Manual_for_Integrated_Monitoring.

[8] See www.lter-europe.net.

(a) Critical loads for acidification and eutrophication and their exceedances have been determined for a selection of the ICP Integrated Monitoring sites.[9] The level of protection of these sites with respect to acidifying and eutrophying deposition was estimated for 2000 and 2020. In 2020, more sites were protected from acidification (67 per cent) than in 2000 (61 per cent). However, due to the sensitivity of the sites, even the maximum technically feasible emission reductions scenario would not protect all sites from acidification;

(b) In 2000, around 20 per cent of the ICP Integrated Monitoring sites were protected from eutrophication. In 2020, under reductions in accordance with current legislation, about one third of the sites would be protected, and, at best, with the maximum technically feasible reductions, half of the sites would be protected from eutrophication;

(c) Across the ICP Integrated Monitoring sites there was a clear correlation between the exceedance of critical loads for acidification and key acidification parameters in run-off water, both with annual mean fluxes and concentrations. There was also evidence of a link between exceedances of critical loads of nutrient nitrogen and nitrogen leaching;

(d) A European-scale study on long-term monitoring data on temporal trends in forest floor vegetation species cover and diversity indicated that the cover of plant species that prefer nutrient-poor soils (oligotrophic species) decreased the more the measured nitrogen deposition exceeded the empirical critical load for eutrophication effects. The observed gradual replacement of oligotrophic species by species preferring nutrient-rich soils (eutrophic species) as a response to nitrogen deposition seemed to be a general European pattern;[10]

(e) Data from the ICP Integrated Monitoring sites have provided evidence of a connection between estimated critical loads and empirical monitoring results. This increases the confidence in the European-scale critical loads mapping used in integrated assessment modelling;

(f) Estimated sulphate budgets at ICP Integrated Monitoring sites indicate that forest soils are now releasing deposited sulphur that accumulated in the past. This indicates recovery of the terrestrial ecosystems, but may delay recovery in downstream surface waters;[11]

(g) Input/output budgets and catchment retention for priority heavy metals such as cadmium, lead and mercury in the years 1997–2011 were determined for 15 ICP Integrated Monitoring catchments across Europe.[12] Excluding a few sites with high discharge, between 74 and 94 per cent of the input lead was retained within the catchments; significant cadmium retention was also observed. Almost complete retention of mercury, 86–99 per cent of input, was reported in the Swedish sites. Methylation of mercury followed by leaching to limnic systems has detrimental effects on water organisms, with hazardous consequences for human fish consumption. These high levels of metal retention were maintained even in the face of recent dramatic reductions in pollutant loads.

[9] See M. Holmberg and others, "Relationship between critical load exceedances and empirical impact indicators".

[10] See T. Dirnböck and others, "Forest floor vegetation response to nitrogen deposition in Europe", *Global Change Biology*, vol. 20, No. 2 (February 2014), pp. 429–440, available from http://www.ncbi.nlm.nih.gov/pubmed/24132996.

[11] See Jussi Vuorenmaa and others, "Sulphur and nitrogen input-output budgets".

[12] See Lage Bringmark and others, "Trace metal budgets for forested catchments in Europe — Pb, Cd, Hg, Cu and Zn", *Water, Air, & Soil Pollution*, vol. 224, pp. 1502–1516, doi: http://dx.doi.org/10.1007/s11270-013-1502-8.

VIII. Publications

13. For a list of ICP Integrated Monitoring publications and references for the present report, please visit the ICP Integrated Monitoring website.[13]

[13] See http://www.syke.fi/nature/icpi.