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Recent results and updating of scientific and technical knowledge

Integrated Monitoring

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

I. Introduction

1. The work of the International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems (ICP Integrated Monitoring) has recently focused particularly on the following key topics: (a) relationships between critical load exceedances and empirical chemical effect indicators. A scientific paper is under preparation and main results were presented at the Acid Rain conference in June 2011 (Beijing, China); (b) calculation of pools and fluxes of heavy metals and relations to critical limits and risk assessment. A report is included in the Annual report 2011 of the Programme; and (c) compilation of available biodiversity data and effect indicators at ICP Integrated Monitoring sites. An interim report is included in the Annual report 2011. The results are presented here in accordance with item 3.6 of the 2011 workplan for the implementation of the Convention on Long-range Transboundary Air Pollution (ECE/EB.AIR/106/Add.2), adopted by the Convention's Executive Body at its twenty-eighth session in December 2010.

II. Workplan items common to all programmes

A. Targets and ex post application

2. ICP Integrated Monitoring has explored the relationships between exceedances of site-specific critical loads for acidification and eutrophication for terrestrial and aquatic ecosystems and measured chemical indicators. The annual average runoff water fluxes and concentrations for the period 2000-2002 were used as empirical impact indicators. Clear relationships between several of these impact indicators and critical load exceedance (deposition based on NAT2000 scenario) were observed, e.g. between measured ANC (acid neutralising capacity) concentrations and the exceedance of the critical loads of acidity and between nitrate concentrations and the exceedances of the critical load for mass-balance nutrient nitrogen and empirical critical load for nutrient nitrogen. This increases confidence in the regional scale critical loads mapping approach. A scientific paper is under preparation and main results were presented at the Acid Rain conference in June 2011 (Beijing, China).

B. Robustness

3. The work on the relationships between calculated critical loads and measured chemical effect indicators refereed to above has provided a test of key concepts used in the integrated assessment modelling. The detailed information collected at the ICP Integrated Monitoring sites allows continued work in this field.

C. Links with biodiversity

4. The ICP Integrated Monitoring Annual Report 2011 contains a review of published results from monitoring and analyses made within the ICP Integrated Monitoring subprogrammes 'Trunk epiphytes', 'Aerial green algae', 'Understory vegetation and trees on intensive plots', and 'Vegetation structure and species cover', since the start of the ICP Integrated Monitoring programme. The aim of this study was to review and summarise the current state of knowledge gained from the vegetation subprogrammes. A second part of the report presents the status of data collection and preliminary results of the analyses.

5. In regions with higher air pollution (Austria, Czech Republic and Italy) lichens were more affected than in the Nordic countries. In Finland and Sweden, weaker but significant changes were found in the southern ICP Integrated Monitoring sites, where deposition was the highest for these countries. Depending on the degree of pollution, algae or lichens differed in their suitability as indicators. At low deposition sites such as the Nordic countries, algae may be more suitable as indicator than lichens. In many cases, it was difficult to separate cause-effects of air pollution from noise and natural variation. This may be overcome with new methods or adapted models which are currently begin developed within the ICP Integrated Monitoring subprogrammes.

6. The preliminary data analyses showed that species changes are highly variable between sites. The significant changes detected were restricted to few species and the relationship with air pollution was not very clear. The more data is available the more likely an intrinsic pattern can be detected. Reporting of missing data was thus considered extremely important. Further analyses will focus on community changes and changes of diversity using indicators.

D. Trends in selected monitored/modelled parameters

7. A new assessment on mass balances of nitrogen and sulphur compound at ICP Integrated Monitoring sites is planned for 2012. Previous work has confirmed the regional-scale decreasing trends of sulphur in deposition and runoff/soil water (see Annual reports 2009 and 2010). Acid-sensitive ICP Integrated Monitoring sites in northern Europe also indicated recovery from acidification. The situation regarding nitrogen was quite different with few decreasing trends in deposition and both decreasing and increasing trends in runoff/soil water concentrations and fluxes.

III. Acidification

8. Critical loads for acidification of aquatic ecosystems have been calculated for 18 ICP Integrated Monitoring sites across Europe (see above). The critical loads were compared to modelled deposition estimates provided by EMEP, and to measured chemical acidification indicators. At the most acidified or acid-sensitive sites, the critical load of acidification for aquatic ecosystems was exceeded to a higher degree, than at other less sensitive sites. These results support the use of the critical loads approach in the integrated assessment modelling.

IV. Nutrient nitrogen

9. Previous results of statistical trend analysis of ICP Integrated Monitoring data have indicated both increasing and decreasing trends in runoff/soil water concentrations and fluxes (see above), indicating the complexity of the nitrogen problem. Sites at which the empirical critical load of nutrient nitrogen for terrestrial ecosystems was exceeded, exhibited also higher nitrate concentrations in runoff. Correspondingly, the leaching of nitrate increased with increasing exceedance of mass balance critical loads of nutrient nitrogen.

V. Heavy Metals

10. Heavy metal budgets for years 1996-2008 of 13 ICP Integrated Monitoring catchments have been assessed using available information. A summary of the results is included in the Annual Report 2011, and a scientific paper is under preparation. In accordance with previous results, an ongoing very effective retention of the metals for most of catchments was still very evident. Disregarding sites with very large water discharge, the average metal outflow by runoff from the investigated sites was 17% of the input by throughfall deposition for lead (Pb) and 27% for cadmium (Cd). The outflow for mercury (Hg) was 10-20% of throughfall at four Swedish sites. It should be noted that the throughfall deposition likely underestimates total metal deposition to the forest ecosystems, with part of the litterfall to be added as well.

11. The measured very high degree of catchment retention took place in a decade with dramatically reduced metal loads in spite of large stores accumulated in earlier times. It is known that metal contents in the biologically important surface soil layers have been significantly reduced for Cd and Pb and to a lesser degree for Hg. This was reported for ICP Integrated Monitoring sites of southern Sweden in the Annual report 2007. The lost metals from upper layers have been relocated within the catchments.

12. The organic matter control of mercury and lead toxicity in moor layers have been investigated at an Swedish ICP Integrated Monitoring site (see Annual Report 2011). The

studies showed that soil layers can be expected to have very different toxicity thresholds related to the general activity of micro-organisms, this activity being governed by the availability of decomposable carbon. More studies on biologically active and at the same time sensitive soil layers would thus be needed.