Report of the ad hoc group of experts on the review of the International Cooperative Programmes of the Working Group on Effects.

I. Introduction

The Executive Body adopted decision 2011/14, Action Plan for the Implementation of the Long-term Strategy (LTS) for the Convention at its 29th session (ECE/EB.AIR/109/Add.1). As part of this decision, an Ad-hoc Group of Experts was tasked with reviewing the organization and operational structure of the Convention (Item 4(a) of the Action Plan). The report of the Expert Group (ECE/EB.AIR/2012/15) was adopted at the 31st session of the EB and included a recommendation that the EB initiates a review of the ICPs.

The report specifically states (paragraph 23): "*Additional bodies and centres under the Working Group on Effects (International Cooperative Programmes (ICPs) on Forests, Integrated Monitoring, Materials, Vegetation, Waters, and Modelling and Mapping) play an essential role in identifying air pollution problems and developing the effects-based approach to emissions controls. Besides developing United Nations Economic Commission for Europe-wide methodological standards, they provide monitoring networks and data as well as models to support development of effects science. Despite past efforts in streamlining, the range of issues being studied remains large and further possibilities for simplification and streamlining, consistent with the LTS, should be considered. However, the scientific and policy merits of organizational change cannot be quickly and easily evaluated through this report. Furthermore, most areas of the effects-related work are identified as priorities in the LTS, as already in the long-term strategy for the effects-oriented activities adopted by the Executive Body in 2009. It is therefore recommended that the Executive Body initiates a review of the ICPs that takes into account the needs as defined in the LTS and the strategy adopted in 2009, the overall needs of the Convention as defined in this document (including issues such as outreach), the needs of the Parties (in particular those in Eastern Europe, the Caucasus and Central Asia as well as Southeast Europe), the scientific relevance and the possibilities for achieving what is needed from the current ICPs. The review should be objective but take account of work being done under the other main subsidiary bodies to provide a forward looking plan for the effects-related work*".

This then represents the background to this report of the review of the ICPs and provides clear terms of reference for the ad-hoc expert group established to undertake the review.

There is a huge amount of relevant and synergistic scientific activity in the area of air pollution impacts and effects mostly not centrally funded via Convention channels. At the same time, much of the data collected are unique and of importance outside of the Convention. The same applies to harmonized methodologies for monitoring and modeling which constitute international standards. The goal of this review is to establish how best to obtain the most value added for the Convention.

II. Review of WGE/ICP Operations

Early in the discussions on the Convention on Long-range Trans-boundary Air Pollution it was recognized that a good understanding of the harmful effects of air pollution was a prerequisite for reaching agreement on effective pollution control. To develop the necessary international cooperation in the research on and the monitoring of pollutant effects, the Working Group on

Effects (WGE) was established under the Convention in 1980, i.e. immediately after the establishment of the Convention.

The Working Group on Effects provides information on the degree and geographic extent of the impacts on human health and the environment of major air pollutants, such as sulphur and nitrogen oxides, ozone and heavy metals. Its six International Cooperative Programmes (ICPs), the Joint Expert Group on Dynamic Modelling and the Task Force on Health identify the most endangered areas, ecosystems and other receptors by considering damage to human health, terrestrial and aquatic ecosystems and materials. An important part of this work is long-term monitoring. The work is underpinned by scientific research on dose-response, critical loads and levels and damage evaluation.

The Working Group meets annually to discuss the results of the international programmes and the current and future needs of the Convention. It considers its future work and that of the programmes and prepares a work-plan for the coming year for consideration by the Executive Body for the Convention. Important results and recommendations are brought to the attention of the Executive Body; results are also published in the scientific literature and disseminated to the public through the publication of reports and through UNECE press releases. The Working Group also publishes substantive reports summarizing and assessing the most important results of the activities of the international programmes. Specific activities are coordinated and implemented by the task forces of the ICPs, the Joint Task Force on the Health Aspects of Long-range Transboundary Air Pollution of the WHO European Centre for Environment and Health (ECEH) and the Convention's Executive Body (hereinafter, the Task Force on Health), and the Joint Expert Group on Dynamic Modelling.

The Long-Term Strategy of the Effects-Oriented Activities (ECE/EB.AIR/2009/17/Rev.1), including objectives, priorities and methods, was approved by the EB at its thirty-first session in December 2012.

The Extended Bureau of the Working Group is responsible for implementing the work-plan. The Extended Bureau comprises the Bureau of the Working Group, the Chairs of the individual task forces and the Joint Expert Group on Dynamic Modelling, and the representatives of the programme centres of the ICPs.

Conclusions and Recommendations

It is recognized that nationally funded activities must continue and that without them, the Convention (and the EU) would not be able to fulfill its aims regarding the abatement of air pollution effects. Such multiple uses of outputs from scientific projects is clearly beneficial but there is a requirement to ensure that research priorities, data collection and availability, reporting, organizational requirements and policy messages meet the needs and requirements of the Parties to the Convention. For example, annual reports may be needed to meet contractual requirements of funders but are not otherwise necessary for the Convention; annual meetings of networks/programmes are useful for maintaining the participation of the relevant science community but are not essential for the Convention unless individuals' participation depends on the status of such meetings as official Convention meetings. The Convention requires that well founded, highest scientific quality and most appropriate messages are delivered into the policy level (WGSR/EB). As the capacity at the political level is limited, too much information to the policy level

can cause information overload. This can lead to the key messages being overlooked. It is important, therefore, that the ICPs, together with the WGE, ensure clear communication focused on the most appropriate messages. This is only possible, however, if the EB and WGSR are clear in their expectations.

Capacity is not seen as an issue by any of the ICPs but this depends on continued funding at similar or increased levels to present. By implication, reduced funding will lead to reduced capacity for activities. This needs to be carefully managed by the ICPs to ensure that the expectations of the EB and other Convention Bodies regarding delivery of outputs is well managed.

The success of the ICPs and the WGE in delivering the needs of the EB with respect to the effects oriented activities relies on the active participation of the Parties in monitoring and data delivery to the respective ICP following the agreed scope and format.

All ICPs share a view of a 'one-sided' communication with the EB and other Convention Bodies. The ICPs see little or no feedback on whether the outputs delivered fulfilled the requirements, what impact the outputs had on policy or activities elsewhere in the Convention or on how outputs could be developed to further assist in the work of the Convention. As a result of this lack of 'downwards' communication, the ICPs mostly make their own interpretation of what is needed. This is often presented in a 'scientific' manner rather than in a more appropriate language for policy makers.

Communication between the various bodies of the Convention and the ICPs would be greatly improved through appropriate involvement and presentations at WGE meetings. It is also important that when an output is requested by the EB or another Convention Body, there is a clear obligation on that Body to take note of it and to provide feedback on its effectiveness, use, etc.

RECOMMENDATION; There should be an obligation for the WGSR/EB to take note of any output requested from the WGE/ICPs and to provide appropriate feedback.

The extent to which the CLRTAP is able to steer the work and organisation of the ICP's depends upon the funding received by the Programme Centre and Task Force members from other external organisations, Lead Party and other Parties. This issue was discussed in detail at the Informal Meeting of ICP Lead/Host Country representatives (Berlin, 2 October 2012), the minutes of which are at Annex A.

It is clear that the co-funding of activities and broader participation of the Programme Centres and Parties involved in the ICPs adds significant value to the work of the Convention and provides for essential 'horizon scanning' which will ultimately inform the Convention, particularly in alerting policy makers to new threats or issues. A clear work-plan for each ICP detailing the funding and outputs that support the needs of the Convention is required to enable appropriate results-oriented management.

RECOMMENDATION; The funding profile needs to made clear for each ICP such that the activities, recommendations and outputs requested by the EB are clearly identified enabling progress to be monitored against the funding allocated.

The existing ICPs are different in scope of activity, mode of operation and policy influence. Some are more monitoring oriented (e.g. Forests, Waters, IM, Materials) and others are more

modelling/scenario oriented and therefore closer to immediate policy needs (Vegetation, Mapping and Modelling). It is, therefore, difficult for them all to have the same level of policy links. Those that are monitoring oriented have a key role in demonstrating ("ground-truthing") the impacts of air pollution and the outcome of emission reductions and inform on their sufficiency, whereas those that are policy oriented have an additional key role in advising policy for future emission abatement strategies and providing spatial coverage.

There is further differences in the ICPs in that some are 'media' or 'multi-media' oriented (Forests, Waters, Materials, Integrated Monitoring), M&M and JEG are interpretive and Vegetation is oriented towards certain pollutants. These differences make it difficult to prescribe a 'one-size-fits-all' management and organisational model. What is essential, however, is that clear objectives are defined for each ICP within the work-plan.

The production of integrated thematic reports is a good development and there are now several examples of these (e.g. Benefits of Air Pollution Control for Biodiversity and Ecosystem Services; Impacts of Air Pollution on Ecosystems, Human Health and Materials Under Different Gothenburg Protocol Scenarios). Since these are produced by the combined efforts of several/all ICPs, these are rightly delivered as WGE outputs. In the future, following the LTS strategy and other recent CLRTAP documents, we can see an increased need for both tailored reports and broader assessments. Some of them could be written solely by the WGE community but we believe that these more often will be a result of combined efforts in particular between EMEP and WGE but also sometimes involving other groups under the Convention.

RECOMMENDATION; Define, in discussion with the EB and other Convention Bodies, in particular EMEP and WGSR, subject areas for future thematic/synthesis reports/communications.

CLRTAP bodies should also assist parties in their implementation of (international) air pollution strategies. For this, it is important that information and knowledge are easily accessible. A significant obstacle for that and for the production of these integrative/interpretive reports is the lack of a common entry point for data from the ICPs. Programme Centres tend to hold the data for individual ICPs but this is not made easily available on the web. The use of common data standards has been discussed within the WGE (Draft guidelines for reporting on the monitoring and modelling of air pollution effects, ECE/EB.AIR/2008/11; ECE/EB.AIR/WG.1/2008/16/Rev.16 adopted by the Executive Body at its twenty-sixth session in December 2008) but formal adoption of agreed common standards is required. A portal approach is an appropriate way forward to web access to data and the EMEP data system should be explored as a possible template.

RECOMMENDATION; The WGE should take steps to developing and adopting appropriate common data standards for all ICPs and develop a 'portal' approach to facilitate and improve data access via the web. WGE should develop a work and time plan for this activity.

Easily accessible maps and common presentation formats would further facilitate the production of consistent outputs. The production of integrative reports is important as these reports provide a (relatively) clear view of the scientific research and latest knowledge in a coherent way. To increase the effectiveness of these integrative reports could be accompanied by short summaries ('Brochures') which provide the key messages for policy makers.

RECOMMENDATION; All reports produced should be accompanied by summary brochures aimed at policy makers and other Bodies of the Convention.

The publication of 'Synthesis' papers in scientific journals have proved useful in communicating the value of the monitoring programmes to the wider scientific community and also provide a degree of scientific 'legitimacy' to the Convention. There are also good examples of scientific papers being produced describing serendipitous, scientific discoveries (e.g. the trends in dissolved organic carbon in surface waters). These provide important added value to the work of the ICPs.

RECOMMENDATION; There is a need to continue to publish scientific papers as well as interpretive reports as this provides the Convention with scientific legitimacy.

Several ICPs engage in the production of annual data/progress reports. These are perhaps less important than the interpretive/integrative reports and their frequency should be reduced. This should free up resources for producing a schedule of 'thematic' reports. The responsibility for leading the production of a thematic report is currently voluntarily assumed and there are rarely additional resources available for the activity. To ensure that this responsibility is appropriately distributed to the ICPs, the WGE should compose a plan on a two year (minimum) timescale.

RECOMMENDATION; ICPs should only produce bi-annual data/progress reports and the WGE should develop a work-plan/schedule for producing interpretive reports as part of the two year work-plan.

National needs can also provide a requirement for thematic assessment and data interpretation. The NFCs in individual countries need to be engaged more fully in this respect to reinforce national and international issues at the level of the EB.

RECOMMENDATION; the Parties should be more actively involved in the interpretation of data and preparation of assessment reports on themes/issues rather than just the Programme Centres. Parties should be encouraged to present their national work related to effects during the WGE sessions

The future needs of the Convention are likely to include coordinated scenario ('ex post') assessments and integrated assessment reports from across the WGE community and involving input from all ICPs.

RECOMMENDATION; Explore the options for competitive commissioning of such activities directly using a set-aside portion (10%-20% - to be proposed by the WGE Bureau) of the Convention's effects-oriented trust fund.

Details of the activity undertaken by ICPs and TFs are not required by the EB.

RECOMMENDATIONS; continue with the current practice of submitting annually 1-3 reports of WGE to EB making clear statements of policy relevance; one of the these reports should be the joint report that would include highlights from all (or selected - on a rotational basis) ICPs; consider the options around country level reporting to WGE; explore the opportunities for increasing the cooperation between the NFCs of different ICPs at a national scale.

The requirement for integrated working, reporting and assessments in future, calls into question the current structure and timetable of TF meetings. These are currently undertaken in isolation from each other and from the WGE annual meeting.

RECOMMENDATION; assess the options for establishing integrated science and TF meetings and for re-invigorating the annual WGE meeting. Such meetings may be organized as common (CLRTAP or WGE) scientific meetings or as topical workshops e.g. due a certain request from the EB.

The voluntary trust fund in support of the scientific and technical work of the subsidiary bodies under WGE may only give limited support to the overall costs for running the centres. The issue of a mandatory financial mechanism has repeatedly been discussed within the Convention but the issue has always been turned down. Even if there doesn't seem to be an immediate threat to the national support, there is a need to consider how a long term mechanism may work. It is however important that parties that finance ICP centres and chairs signal well in advance any substantial changes in financial support.

RECOMMENDATION; EB should further consider a more stable long term financial mechanism.

III. Review of the ICPs

The international cooperative effects-related activities under the Convention are:

(a) ICP on Effects of Air Pollution on Natural Vegetation and Crops, led by the United Kingdom

(b) ICP on Assessment and Monitoring of Air Pollution Effects on Rivers and Lakes, led by Norway

(c) ICP on Integrated Monitoring of Air Pollution Effects on Ecosystems, led by Sweden

(d) ICP on Assessment and Monitoring of Air Pollution Effects on Forests, led by Germany

(e) ICP on Effects of Air Pollution on Materials, including Historic and Cultural Monuments, led by Sweden and Italy

(f) ICP on Modelling and Mapping of Critical Loads and Levels and Air Pollution Effects, Risks and Trends, led by France

(g) The Joint Expert Group on Dynamic Modelling of the Effects of Air Pollution, led by the United Kingdom and Sweden.

The Joint Task Force on the Health Aspects of Air Pollution of the WHO European Centre for Environment and Health (ECEH) and the Convention's Executive Body (Task Force on Health) contributes to the effects oriented activities under the auspices of the WGE but is not considered as part of this review.

A. ICP Vegetation

The potential for damage to crops by air pollution in many areas of Europe is high and the annual economic cost may be considerable. The programme was therefore established to consider the underlying science for quantifying crop damage but later to also include semi-natural vegetation.

The objectives of ICP Vegetation are to; evaluate the effects of air pollutants and other stresses on crops and non-wood plants by monitoring the onset of injury and reductions in the yield/biomass of sensitive species; identify realistic dose-response functions, incorporating modifying (level II) factors for a range of economically important crops and for crops at risk from pollution; validate and substantiate critical levels of ozone for crops and non-wood plants including incorporation of level II factors; facilitate the production of European maps showing where critical levels for ozone are exceeded; assist in assessing the economic loss due to ozone pollution; conduct literature reviews and specific experiments on the accumulation of atmospheric deposition of heavy metals and other substances via moss monitoring. The ICP Vegetation is planned and coordinated by a Task Force led by the United Kingdom and supported by a coordination centre at the Centre for Ecology and Hydrology (CEH) in Bangor, United Kingdom.

In the last 25 years, ICP Vegetation has developed dose-response relationships for the impacts of ozone on vegetation. Based on these, critical levels of ozone for vegetation were defined, initially based on the ground-level ozone concentrations in the air, but more recently based on the ozone 'taken up' by vegetation (ozone flux). Since 2006, the ICP Vegetation has developed, in close collaboration with EMEP/MSC-West and in consultation with TFIAM, simplified flux-based methods for application in integrated assessment modelling. Over the last year, the flux-based method has been provisionally integrated in the GAINS model.

Whereas in earlier years the focus has been on monitoring and experimental work to collate field-based evidence on spatial patterns and temporal trends on the impacts of ozone on vegetation, more recently information has been collated and reported on other policy-relevant indicators applying the flux-based method, for example the impacts of ozone on food security (2011), carbon sequestration (2012) and ecosystem services and biodiversity (2013). The ICP Vegetation will continue to focus on this in the future.

Conclusions

The structure of ICP Vegetation and the approaches used to assess the effect of ozone on crops provides a good starting point to assess the impacts of other air pollutants such as nitrogen, PM and black carbon. The ICP maintains an emphasis on research/new science to establish an appropriate scientific basis for quantifying ozone effects, particularly damage to crops. In addition, it has hosted the moss monitoring with a focus on heavy metal deposition and has established that concentrations have decreased and are largely stable in Western Europe but not in Eastern Europe. Air pollution impacts on biodiversity and ecosystems services are difficult to monetize but are clearly important and relevant to the Long Term Strategy of the Convention. In future, the ozone issue will need to be considered at hemispheric scale and needs to be considered as a key component in the global food security issue.

Recommendations

Expand the focus from ozone to include other air pollutants, particularly nitrogen; pursue the reorganization of moss monitoring to focus on the Eastern Europe, Caucasus and Central Asia countries where heavy metal pollution continues to be a major air pollution issue; look for further opportunities to cooperate with EMEP. ICP Vegetation and ICP Forest should increase their cooperation with respect to ozone impacts to forests, including carbon sequestration.

B. ICP Waters

Acidification of freshwater systems provided some of the earliest evidence of the damage caused by sulphur emissions. The sensitivity of these systems suggested that they were ideal for studying the effects of, and response to changes in, pollution deposition. The objectives for ICP Waters are to assess, on a regional basis, the degree and geographical extent of acidification of surface waters. The data collected should provide information on dose/response relationships under different conditions and correlate changes in acidic deposition with the physical, chemical and biological status of lakes and streams.

The Programme is planned and coordinated by a Task Force under the leadership of Norway. Chemical and biological data from more than 200 catchments in 24 countries in Europe and North America are available in the database of the Programme Centre at the Norwegian Institute for Water Research (NIVA), Oslo. This data set represents the largest and most comprehensive information on acidification and recovery of freshwaters in the world which has been widely used as a research resource. These data will be vital to future research projects focused on recovery from air pollution impacts and interactions with climate change.

The programme has clearly demonstrated that surface waters show strong signs of chemical recovery in response to reduced acid deposition; that biological recovery is, so far, slow and patchy; that climate change will affect acidification and recovery in the future; and that heavy metals and persistent organic pollutants (POPs) are found in fish, sediments and waters in remote areas.

In future, the Programme aims to continue to document the effects of the various existing protocols, to document the remaining ecosystem damage due to air pollution, and to assess the need for further reductions in emissions as part of the protocol revision process.

Conclusions

ICP Waters provides a unique synthesis of trends in recovery from acidification of surface waters and has engaged closely with the dynamic modeling efforts to assess the delay times to biological recovery; there is an apparent lack of broad participation and a focus on lakes rather than streams and rivers. ICP Waters monitoring programme already includes nitrogen, phosphorus and dissolved organic carbon which provides a good starting point to assess nutrient enrichment and eutrophication impacts.

Recommendations

Shift the focus of activity from acidification to more comprehensively assess the impacts of nitrogen, heavy metals, and POPs; maintain periodic trend assessments; consider stronger links

with the river sites monitored as part of ICP Integrated Monitoring; pursue interaction with other international waters monitoring programmes e.g. UNEP, GEMS, etc .

C. ICP Integrated Monitoring

Investigations of air pollutants acting on particular receptors have shown that an integrated approach is needed to understand the mechanisms of damage and the resulting effects. Thus, the impacts of acidic deposition may take place in the soil, but effects are more likely to be seen in vegetation growing in the soil or in the water draining from the system. Further, while biological impacts are of prime concern, it is the chemical processes and the physical parameters in the various parts of the ecosystem that determine its suitability for biota.

The objective of the ICP Integrated Monitoring is to determine and predict of the state of ecosystems (or catchments) and their changes from a long-term perspective with respect to the regional variation and impact of air pollutants, especially nitrogen, sulphur, ozone, and metals and including effects on biota.

The programme Task Force is led by Sweden, while the Programme Centre at the Finnish Environment Institute (SYKE) in Helsinki is entrusted with collecting, storing, processing and analysing data from countries taking part in the programme. The network currently covers some 50 sites in 19 countries.

The Programme aims to; monitor the state of ecosystems (catchments/plots) and provide an explanation of changes in terms of causative environmental factors, in order to provide a scientific basis for emission controls; develop and validate models for the simulation of ecosystem responses; estimate responses to actual or predicted changes in pollution stress, and in concert with survey data to make regional assessments; and, carry out bio-monitoring to detect natural changes, in particular to assess effects of air pollutants and climate change.

The objectives of the ICP Integrated Monitoring are firmly focused on long-term effects and on long-term monitoring. In the short term, however, mathematical models are being developed which can simulate ecosystem response to specific pollutant stress. The data collected in the programme are used to calibrate and test models that can then be used to predict ecosystem changes under a variety of bio-geophysical conditions and pollution scenarios.

Conclusions

ICP Monitoring focuses on 'whole catchments' and so must integrate and understand other factors that are driving changes, including air pollution. This, perhaps necessarily, leads to the work tending to focus on looking for and analyzing ecosystem effects rather than quantifying and attributing them to anthropogenic drivers. The data collected at some sites have proven extremely useful for testing dynamic and process based models. The data have also provided the basis for studies of chemical input-output budgets at catchment scale. It is apparent, however, that the number of active sites is declining. This is the only ICP that is process-oriented in approach and as such is capable of identifying feedbacks and multiple stresses.

Recommendations

Consider merging the activities (in particular interpretations) undertaken within this programme with ICP Waters and/or ICP Forests; increase the focus of activity to cover carbon and nitrogen pools and fluxes, more specifically.

D. ICP Forests

ICP Forests was set up to monitor the effects of air pollution on Europe's forests. The objectives of ICP Forests are; to monitor effects of anthropogenic (in particular air pollution) and natural stress factors on the condition and development of forest ecosystems in Europe, and; to contribute to a better understanding of cause-effect relationships in forest ecosystem functioning in various parts of Europe. The programme is planned and coordinated by a Task Force under the leadership of Germany with the cooperation of a Programme Coordinating Centre (at the Johann Heinrich von Thunen Institute, Germany). There are currently 41 countries participating in the work.

Since 1986, ICP Forests has conducted an annual transnational survey of forest condition in Europe, from 1991 this has been in close cooperation with the European Commission (EC). This transnational survey aims to document the development of forest condition at the European level rather than on the national scale. This is accomplished by means of annual large-scale monitoring of tree vitality (6 000 sample plots with about 130 000 sample trees) and a number of site parameters on a uniform 16 km x 16 km transnational grid of sample plots (known as "level I" monitoring). In addition to tree vitality surveys, soil and foliar analyses are performed on parts of these level I plots.

In order to contribute to a better understanding of air pollution and other factors which may influence forest ecosystems, a programme for intensive and continuous monitoring of forest ecosystems (level II) has been implemented. In this context 860 permanent observation plots for intensive monitoring of forest ecosystems have been established across Europe. The intensive monitoring includes the assessment of crown condition, increment and chemical composition of foliage and soils on all plots. Additional measurements on a limited number of plots include (i) atmospheric deposition (60% of the plots), (ii) meteorological parameters (20% of the plots), (iii) soil solution chemistry (30% of the plots), ground vegetation assessments (expected on 70% of the plots) as well as ambient air quality. The data from the level II intensive monitoring plots are currently stored and maintained at the Programme Coordinating Centre.

In the future, the Programme aims to undertake further studies on the links between air pollution (mainly N, O3, HM and S) and observed effects (on soil condition, tree nutrition, forest health, and forest growth); extension of studies on Critical Loads and exceedances to the large-scale (Level I); and, studies of the relationships between air pollution, carbon fluxes, climate, forest health and biodiversity.

Conclusions

ICP Forests is the biggest ICP with a broad focus on forest monitoring in general rather than specifically on the impacts of air pollution. It has a wide geographical. The extent to which it is a forest monitoring programme per se and to what extent it is an air pollution impacts monitoring

programme requires specification. The wide network of Level 1 and 2 plots have provided unique data to support dynamic model assessments and to disentangle air pollution and climate effects including on biodiversity. There seems to be little interaction with other ICPs e.g. ICP Waters.

Recommendations

Streamline the activities to focus on the air pollution policy related issues identified by the EB; assess and coordinate deposition monitoring in relation to the data collected as part of EMEP; explore the possibility of adding integrated monitoring to its mandate; undertake a comprehensive assessment as to whether and to what extent the Level 1 monitoring is still relevant and useful for air pollution impact assessment. ICP Forest and ICP Vegetation should increase their cooperation with respect to ozone impacts to forests, including carbon sequestration.

E. ICP Materials

Several studies of materials have indicated that atmospheric corrosion influenced by acidifying pollutants is costly. Extensive damage has also been observed on historical and cultural structures and monuments calcareous stones, medieval glass and metals. For these reasons, the Materials Programme was launched in 1985 to fill some of the major gaps in our knowledge with two objectives; to perform a quantitative evaluation of the effect of sulphur and nitrogen compounds and other major pollutants, including the effects of low concentrations of these pollutants on the atmospheric corrosion of important materials, and; to assess the trends of corrosion and pollution.

The Task Force of the programme is led by Sweden, which provides the Main Research Centre at the Corrosion and Metals Research Institute (KIMAB), Stockholm. Since 2005 Sweden and Italy (ENEA) are co-chairing the programme. The Czech Republic, Germany, the United Kingdom, Norway, Austria and Switzerland are responsible for sub-centres, which prepare and distribute specimens of particular materials and evaluate corrosion attack after exposure. A network of 30 exposure sites across 18 ECE countries covers a broad band of geographic zones in Europe and North America. At these, atmospheric pollution is characterized by measuring the gases sulphur dioxide (SO_2) and nitrogen dioxide (NO_2) and ozone (O_3) concentrations. The reduction of the sulphur pollution has created a new multi-pollutant situation where SO_2 is no longer the dominating corrosive pollutant. Therefore, a second "multi-pollutant programme" was performed in 1997-2001 using a subset of test sites and materials from the original programme, along with some new test sites. A new set of dose-response functions was developed describing the deterioration of material in the new mixture of pollutants.

The concept of a threshold of harmful pollution, a critical load or level, is not applicable to materials as any amount of pollution leads to some deterioration. Instead an "acceptable" deterioration rate has been defined as a multiple (e.g. 1.5) of the background deterioration rate. Acceptable levels of pollution can be calculated using dose-response relations for the individual materials and the acceptable deterioration rate. This concept is now used for mapping of areas with exceedance and together with assessments of the stock of materials, especially cultural heritage objects, at risk for cost-benefit analyses in different pollution scenarios.

Future key activities for ICP Materials are; maintaining scientific excellence on the effect of air pollution and confounding factors such as climate change on materials and cultural heritage ; strengthening of the geographical coverage and outreach activities, especially to Eastern Europe, Caucasus and Central Asia countries ; further developing policy relevant information on the effect of key pollutants for materials: PM/BC, ozone and acidifying pollutants; further developing UNESCO cultural heritage sites as user-friendly indicators and for cost assessments.

Conclusions

The focus on dose-response for economic evaluation and damage assessment, including at UNESCO sites, is important, high profile activity for the Convention. The work on economic assessment is an important contribution to the assessment of air pollution impacts.

Recommendations

Consider a possible future 'call' for data in collaboration with ICP Mapping and Modelling; take appropriate actions to communicate directly with other bodies of the Convention and not only via CCE/ICP M&M; maintain the focus on improving the assessment of the economic costs of air pollution impacts on a regional scale; consider, at least from time to time, to have common workshops/meetings with CCE/ICP M&M.

F. ICP Mapping and Modelling

The objectives of the ICP Modelling and Mapping are to; assess damage to forests, crops, natural vegetation, soils, surface and groundwater, and materials by determining critical levels and loads for the response of these systems, with particular attention to the direct effects of air concentrations of sulphur dioxides (SO_2), nitrogen dioxides (NO_2) and ozone (O_3), and the indirect effects of (long-term) deposition of sulphur and nitrogen compounds; map geographical areas to determine the scope and extent of pollutant depositions and concentrations which exceed critical loads and levels; establish appropriate methods as a basis for assessing potential damage.

A programme Task Force led by France is responsible for the detailed planning and coordination of the Programme, in collaboration with the Coordination Centre for Effects (CCE) at RIVM, the Netherlands. CCE supports the programme by providing scientific and technical assistance for the Task Force and the Working Group on Effects. It also provides assistance to national focal centres (NFC) in participating countries, helping them to develop methods and data for calculating and mapping critical loads, critical levels and exceedance as a basis for developing potential abatement strategies for sulphur, nitrogen and other relevant pollutants.

While CCE is charged with compiling European critical loads/levels maps and databases, NFCs are responsible for producing the national data on critical loads/levels and maps for inclusion in the European maps. At present, 25 countries have contributed national data. CCE uses various European databases on soil, land, climatic and other variables to calculate critical loads for countries that are unable to provide national data. It maintains a database of critical loads data, which is used for integrated assessment modelling by the TFIAM and its CIAM.

A Modelling and Mapping Manual ("Manual on methodologies and criteria for modelling and mapping critical loads and levels and air pollution effects, risks and trends"), incorporating the results of years of methodological development and refinement, was published first in 1986, and thoroughly updated in 1995 and 2004, with several partial updates thereafter. The Modelling and mapping manual details the methods for calculating and mapping critical levels and loads that have been agreed at workshops organized under the auspices of the Executive Body for the Convention and Task Force meetings. The Manual, and its major updates, has been adopted by the EB and is explicitly referred to in the Gothenburg Protocol (Annex 1).

The critical loads and levels approach for pollution abatement has been successfully applied to strategies for emission reductions under the 1994 Protocol on Further Reduction of Sulphur Emissions and the 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone.

Close collaboration with TFIAM and integration of methods and data has resulted in the integration of critical loads in the RAINS and GAINS models and in the use of GAINS output for scenarios analysis with available indicators (ex-post assessment for the Revision of the Gothenburg Protocol). ICP M&M has produced indicators and model results to demonstrate the impact of air pollution in the context of climate and biodiversity changes.

In the future, nitrogen impacts, and wider air pollution impact, on biodiversity will remain a focus and acidification will remain a topic of vigilance to enable assessment of the efficiency of the protocols. Increasing attention will be focused on the identification of novel biodiversity endpoints and related indicators that can be used on broad spatial scales for the identification of (adverse) effects of emission reduction strategies under climate change. Additionally, Systems analysis and modelling will be undertaken to understand the processes by which short lived climate forcers may affect the environment, and whether it is useful to seek options to include these in integrated assessment.

Conclusions

The interaction between the CCE and the NFCs in developing and applying methodologies and in developing, undertaking and assessing the 'Calls' for data, have been instrumental to the work of the Convention. The CCE has undertaken a range of activities for the WGE in support of the needs of the WGSR and EB. The focus has appropriately moved from acidification to nitrogen effects including biodiversity changes, and assessment of critical loads for heavy metals.

Recommendations

Focus activity on supporting the NFCs in Eastern Europe, Caucasus and Central Asia countries and pursuing the extension towards biodiversity/nature conservancy issues and the identification of (adverse) effects of emission reduction strategies under climate change (especially short lived climate forcers)..

G. JEG Dynamic Modelling

The JEG was established in 2000 by the WGE to provide a forum for progressing dynamic modelling of ecosystem effects. The development, testing and application of dynamic models was, at that time, being undertaken by scientists operating across ICPs and using data from many ICPs. In addition, a great deal of dynamic modelling was being undertaken outside of the Convention funded activities. Mission of JEG DM was to bring the time dimension of the ecosystem effects into the work of WGE and to complement the static concept of critical loads with time-dependent effect based indicators. The JEG gave a focus to the dynamic modelling requirement of the WGE and provided the opportunity to operate without 'institutional', 'programmatic' or 'funding' barriers and constraints.

Since its formation the JEG has underpinned the development of the 'UN-ECE wide' dynamic modelling system, currently administered by CCE. JEG has developed the Target Loads concept, providing the timescale to ecosystem recovery in response to emission reductions. JEG has assisted in the further development of the dynamic models, has prompted their consistent testing against observations and provided the opportunity for integration of data from across all ICPs and sources outside of the Convention. Focus of JEG has shifted over the years from addressing recovery from acidification to eutrophication, biodiversity change and also to interactions between air pollution, and climate change. This development was directly driven by the evolving needs of WGE.

Conclusions

JEG has provided a unique forum for science discussion, bringing together experts from within and outside of the Convention and from many ICPs; has contributed substantially to the Convention in developing the European scale dynamic modeling framework and in the assessment of time delays to recovery from air pollution effects; hasno Centre, no NFCs *sensu strictu*; tests, discusses and reviews methodologies at an annual meeting and reports to WGE annually.

Recommendation

Consider the options for integrating JEG meeting into a broader WGE science meeting to enhance collaboration between all ICPs through the participation of all ICPs.