

UNECE CONVENTION ON LONG-RANGE TRANSBOUNDARY
AIR POLLUTION

WORKING GROUP ON EFFECTS

International Cooperative Programme on
Effects of Air Pollution on Natural Vegetation and Crops

Minutes

The seventeenth meeting of the Programme Task Force was held from 10th to 12th February, 2004, Kalamata, Greece.

1. The meeting was attended by 50 experts from the following Parties to the Convention: Austria, Belgium, Bulgaria, Croatia, Czech Republic, Finland, France, Germany, Greece, Ireland, Italy, Poland, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, and the United Kingdom, together with the Secretary of the Working Group on Effects (WGE) and a representative of the ICP on Modelling and Mapping. Apologies were received from Mr H Gregor (Chairman, WGE) and other participants who were unable to attend.
2. Mr D Velissariou (Greece) opened the meeting, and welcomed the participants to Greece. Ms G Mills (Coordination Centre, United Kingdom), Chairperson of the ICP Vegetation, thanked Mr D Velissariou, Ms P Drogoudi (Greece) and the Technological Educational Institute of Kalamata for organizing and supporting the meeting.
3. The Programme Task Force adopted the agenda of the meeting.
4. Ms G Mills (ICP Vegetation Coordination Centre, United Kingdom), Chairperson of the ICP Vegetation, gave an overview of ICP Vegetation activities and achievements in 2003/4. Ms Mills described how the ICP Vegetation contributes to the Working Group on Effects of the Convention on Long-range Transboundary Air Pollution. The ICP Vegetation currently includes over one hundred and fifty scientists from thirty countries. Ms Mills described the biomonitoring programmes for ozone damage on white clover and *Centaurea jacea* (brown knapweed) and showed how relatively high ozone levels experienced across much of Europe in 2003 resulted in frequent occurrences of ozone injury on these biomonitors. She gave an overview of the progress made with the revision of the critical levels of ozone for vegetation and the contribution of the ICP Vegetation to the revision of the Mapping Manual (chapter 3). Ms Mills listed the reports and publications produced by the ICP Vegetation during 2003, described the work plan for 2004 and the anticipated deliverables to the Working Group on Effects in 2004 and 2005. Ms Mills also thanked the UK Department for Environment, Food and Rural Affairs for renewing and increasing financial support for the coordination of the ICP Vegetation (until March, 2006).
5. Mr H Harmens (ICP Vegetation Coordination Centre, United Kingdom) described the outcome of the 2000/2001 survey of heavy metal concentration in European

mosses, which was coordinated by the ICP Vegetation for the first time. Twenty eight countries participated in the survey, involving ca. one hundred scientists collecting moss samples from almost 7000 sites across Europe. After describing the history of the European heavy metals in mosses survey and the moss technique applied, Mr Harmens showed 'dot maps' and 'EMEP maps' (50 km x 50 km) for the heavy metals targeted by the Aarhus protocol, i.e. cadmium, lead and mercury. The report of the 'Heavy metals in European mosses: 2000/2001 survey' was published in 2003 by the ICP Vegetation Coordination Centre at the Centre for Ecology and Hydrology, Bangor, UK. Mr Harmens finished with recommendations for future work and for the next survey planned for 2005.

6. Mr M Johansson, Secretary of the Working Group on Effects (WGE), gave a review of the priorities of the WGE and the Executive Body of the LRTAP Convention (Long-range Transboundary Air Pollution). Priorities regarding heavy metals include adding new substances, continuing to collate information on effects and assessing the potential for using effect-based approaches. The priorities for ozone are to assess impacts of short- and long-term exposure (both for vegetation and human health), assess efficiency of control measures, assess trends and background levels and to continue to collate information on effects. A review of the Gothenburg protocol may start in the near future and will additionally include particulate matter and its health impacts. Mr Johansson advised that the AOT40 and flux-based work of the ICP Vegetation should be continued, including the practical link to pollution processes. Short-term critical levels for ozone should be open enough to link to human health impacts. The link between heavy metal content of mosses and atmospheric deposition should be studied further and the links between deposition to vegetation and health effects could be further exploited. Mr Johansson stressed that the outputs of ICP Vegetation were very important and relevant to the WGE and encouraged ICP Vegetation to keep the scientific motivation going. He encouraged ICP Vegetation to further cooperate with other Convention bodies, especially with ICP Modelling and Mapping, the Task Force on Health, EMEP, CIAM, and also with bodies outside the Convention.
7. Mr U Lorenz (Germany) of ICP Modelling and Mapping presented the results of the 19th Task Force Meeting and an overview of the activities in 2003 – 2004. He gave an update on the critical loads for sulphur, nitrogen and acidity, for which 19 National Focal Centres provided data. All chapters of the revised Mapping Manual were nearly completed and would be put forward formally for acceptance at the next ICP Modelling and Mapping Task Force Meeting in May, 2004. ICP Modelling and Mapping greatly appreciated the contributions of the ICP Vegetation to the revision of chapter 3 of the Mapping Manual. Mr Lorenz invited participants of ICP Vegetation to attend the expert workshop on critical loads of heavy metals, 4 - 5 March 2004, Potsdam, Germany. The Task Force took note of the expert meeting on land cover data harmonisation on 10th March in Laxenburg, Austria, which seeks to recommend a consistent and harmonised dataset for an official decision to incorporate it in LRTAP Convention activities. The meeting agreed that the work conducted within ICP Vegetation would conform with the forthcoming decisions on harmonised land cover data.

8. Mr D Velissariou (Greece) described ozone impacts in Greece. He gave examples of hotspots for high atmospheric ozone concentrations and visible ozone damage to vegetation, with particular reference to injury to leafy horticultural crops that was associated with economic losses.
9. Twenty-seven posters were presented at the meeting. These showed the results of local and national heavy metal biomonitoring programmes, using mosses, lichens and vegetable crops, and ozone biomonitoring programmes, using white clover, *Centaurea jacea* (brown knapweed) and other species. In addition, interactions between impacts of ozone and nitrogen enrichment or drought stress on (semi-) natural vegetation, and physiological and biochemical mechanistic studies on the responses of white clover (NC-S and NC-R) and wheat to ozone were described.
10. The meeting split into parallel sessions considering the ozone and heavy metals sub-programmes.
11. Ms L Emberson (United Kingdom) opened the ozone sub-programme sessions by describing recent developments with modelling ozone uptake including a study in the United Kingdom comparing flux-based and AOT40-based calculations of yield losses for wheat and potato, and an ongoing investigation of photosynthesis-based methods for modelling ozone flux. Mr H Pleijel (Sweden) described an in depth analysis of several years of data from ozone exposure experiments in Sweden and highlighted the importance of impacts on yield quality as well as quantity for wheat. He also described a simplified flux modelling method that could be used for integrated assessment modelling (see item 12). The use of flux-based and AOT40-based relationships for crops for a cost-benefit analysis were described by Mr M Holland (United Kingdom). This study is supported by both ICP Vegetation and the European Union Clean Air for Europe (CAFE) programme and will include assessment of impacts on yield quantity and quality, visible injury and livestock production.
12. The ozone sub-group considered the draft of chapter 3 of the Mapping Manual and were informed by Mr U Lorenz (Germany, ICP Modelling and Mapping) that the document would be professionally prepared for publication including standardising equation formats, and would be distributed at their next Task Force Meeting in May, 2004, as an official publication with an ISBN number. The following recommendations were made, and endorsed by the whole Task Force in a plenary session:
 - The text of the chapter would be re-structured to improve access for users to the key components of the chapter.
 - Some ambiguities had been identified in the text, which would be removed in the final edit.
 - Additional sections or annexes would be included that provide separate recommendations for integrated assessment modellers and economists.

The Task Force took note of the concerns of atmospheric modellers about the uncertainty associated with modelling AFst6 and an additional method using AFst3 was discussed.

13. Ms G Mills (ICP Vegetation Coordination Centre, United Kingdom) described the progress with analysis of data from the ICP Vegetation clover experiments (1997 – 2002). The results indicated a carry-over of effects of ozone on biomass from one harvest interval to the next. She reported that two papers were being prepared and should be submitted in the near future. An analysis of three years of ozone injury data for Sweden was described by Mr P Karlsson (Sweden). The study showed that injury was most closely related to the maximum 5-day AOT30 or AOT40, as well as to the AOT30 or AOT40 accumulated during the entire weeks 2 and 3 between harvests and that the biomonitoring system did not appear to be a good indicator of exceedance of EU standards that use maximum 8h mean concentration. The Task Force agreed to continue to use NC-S clover to monitor incidences of ozone injury in the 2004 growing season and that an NC-S/NC-R comparison would be optional for high ozone sites.
14. The ozone sub-group considered the results of the 2003 pilot study using *Centaurea jacea* (brown knapweed) as an indicator of ozone injury. Ms F Hayes (ICP Vegetation Coordination Centre, United Kingdom) summarised the results and described how ozone injury was detected at 8 of the 11 participating sites. Results of a detailed study conducted in Sweden were presented by Mr P Karlsson (Sweden), and Ms S Bassin (Switzerland) described the inter- and intra-specific variation in response to ozone in populations collected from Italy, Hungary, Norway, Slovenia and Switzerland. The Task Force agreed to continue with experiments with this species in 2004 with the following improvements to the method: use of one seed source, one batch only involving 10 replicate plants, improved injury assessment method for the rosette and flowering shoot leaves and standardised soil mix. It was strongly recommended to use two nitrogen treatments (with a third one being optional).
15. In the heavy metals sub-programme sessions, recent work on the moss biomonitoring system was described. Ms L Thöni (Switzerland) gave an overview of the results of the heavy metals in mosses research in Switzerland in 1990, 1995 and 2000. Mr W Schröder (Germany) described spatial and temporal trends of metals in mosses applying a geostatistical and multivariate statistical analysis to the moss surveys conducted in Germany in 1990, 1995 and 2000. Mr I Suchara (Czech Republic) presented the trace element contents of moss in the Czech Republic, discussed trends and provided explanations. Ms M Frontasyeva (Russian Federation) compared heavy metal accumulation in different moss species and described the extension of the moss survey into arid areas of southern Europe and Asia (REGATA: Russian-European Gate To Asia).
16. In the heavy metal sub-group, Mr H Harmens (ICP Vegetation Coordination Centre, United Kingdom) presented the outcome of a questionnaire which was sent in 2003 to all participants in the heavy metals in mosses survey. The questionnaire made clear that participants would like to participate in the European survey again in 2005, but that most are struggling to obtain national funding. In the ensuing discussion, recommendations were made for the 2005

survey regarding interspecies calibration, quality control by distributing standards to participating laboratories and enhancement of collaboration between participants. It was noted that Europe-wide, there is a lack of suitable sites which monitor atmospheric dry and wet deposition of heavy metals as well as the heavy metal concentration in mosses. Mr E Kubin (Finland) described the preparation of reference materials for the European heavy metal in mosses survey in 1995 and kindly agreed to make this material available again to all participants in the next moss survey in 2005 at a reduced cost. The Task Force accepted his offer and thanked his Institute for its cooperation. The inclusion of the analysis of nitrogen concentration in mosses in the 2005 survey was discussed, but further experimental and literature research was recommended to justify nitrogen analysis at a European scale.

17. Mr H Harmens (ICP Vegetation Coordination Centre, United Kingdom) led a discussion on the revision of the experimental protocol for monitoring atmospheric heavy metal deposition in Europe using mosses. Based on this discussion, Mr H Harmens will revise the experimental protocol and send the revision to all participants of the moss survey in 2005 (including those not present at the 17th Task Force Meeting) for comments. A final version of the experimental protocol for 2005 will be distributed to all participants before the start of the next survey.
18. In a plenary session, four presentations were given on possible new areas to be developed in ICP Vegetation. Two presentations were given regarding the inclusion of nitrogen within the remit of ICP Vegetation. Mr B Gimeno (Spain) described effects of ozone and nitrogen enrichment on the biomass and forage quality of Mediterranean pastures. He concluded that nitrogen fertilization might enhance ozone-induced detrimental effects and issues related to nutritive value should be included in ozone sensitivity analyses of vegetation. Mr A Terry (United Kingdom) introduced a feasibility study to assess the history of nitrogen deposition in Europe by using herbarium samples of mosses. Mr Terry kindly requested that ICP Vegetation delegates participate in this exercise by identifying appropriate national herbaria, and if possible, by trying to obtain a small number of samples for nitrogen analysis to be conducted at the ICP Vegetation Coordination Centre. Mr L de Temmerman (Belgium) presented data on heavy metal, particularly cadmium concentration in food crops and the link to health effects. Finally, Ms L Emberson (United Kingdom) described the development of new links with Asia in the RAPIDC programme (Regional Air Pollution in Developing Countries). The aim is to develop a network similar to ICP Vegetation in Asia. It was suggested to invite a selected group of Asian participants in RAPIDC to the next ICP Vegetation Task Force Meeting.
19. Seven small discussion groups considered ongoing and developing areas of interest for the ICP Vegetation and reported their key recommendations to the Task Force. The subjects covered were ozone flux modelling, ozone injury assessment methods, ozone and nitrogen interactions, new biomonitoring systems, ICP Vegetation contributions to health impact assessments for heavy metals, climate change as a modifier of pollutant impacts and developing links with Asia.

20. The meeting reviewed the work plan for 2004 as indicated in Annex I, revised the objectives for the programme as indicated in Annex II and reviewed the deliverables to the WGE. The meeting took note of new EU documents which mention the use of plants as bioindicators for atmospheric pollution: COM(2003)423 (Air Guideline on Arsenic, Cadmium, Mercury, Nickel and PAH) and COM(2003)338 (European Strategy on Environment and Health).
21. The meeting agreed that final edits to chapter 3 of the Mapping Manual will be completed by early March, this draft version will then be circulated to participants and the final text will be sent to ICP Modelling and Mapping by the end of March.
22. Ms Mills (ICP Vegetation Coordination Centre, United Kingdom) described the contributions of the ICP Vegetation to the Substantive report to the WGE.
23. After ten years of chairing the ICP Vegetation, Ms G Mills handed over the chair to her colleague Mr H Harmens. On behalf of the ICP Vegetation community, Mr Harmens thanked Ms Mills for her invaluable contributions and commitment to the work of ICP Vegetation over the years and emphasized the growth of ICP Vegetation in recent years under the leadership of Ms Mills.
24. Mr H Harmens closed the meeting by thanking the local organisers and the Technological Educational Institute of Kalamata for their hospitality and support, colleagues at CEH Bangor for their contributions, the participants and the steering committee for their continuing support of the programme and the UK Department for Environment, Food and Rural Affairs for continued financial support for the coordination of the ICP Vegetation.
25. The 18th Task Force Meeting of the ICP Vegetation was tentatively agreed to be in Spain in 2005. The provisional offer from Ireland to host the 19th Task Force Meeting in 2006 was gratefully acknowledged.

ANNEX I: Workplan of the ICP Vegetation for 2004
(Updated 12-2-04)

Ozone	Heavy Metals	Nutrient N
<ul style="list-style-type: none"> • Clover biomonitoring as in 2003 • <i>Centaurea</i> biomonitoring with improved method • Developing a horticultural crop monitoring system • Complete Mapping Manual chapter • Economic impact assessment (flux vs AOT40) • Mapping impacts on (semi-) natural vegetation 	<ul style="list-style-type: none"> • Organising distribution of standards • Refining method and distribution of experimental protocol • Start to analyse temporal trends 	<ul style="list-style-type: none"> • N content of mosses from selected countries, 1980 – 2000. • Collecting herbaria samples for analysis

ANNEX II: Objectives of the ICP Vegetation
(Updated 12-2-04)

Long-term objectives

1. To meet the requirements of the UNECE Convention on Long-range Transboundary Air Pollution for information on the responses of (semi-) natural vegetation and crops to atmospheric pollutants.
2. To evaluate experimental data on the responses of (semi-) natural vegetation and crops to air pollutants to validate the critical levels defined in the mapping manual and to show the effects of exceedance.
3. To provide information for the further development of effects-driven protocols with respect to (semi-) natural vegetation and crops.

Short- and medium- term objectives

1. To monitor the impacts of ambient ozone on crops and (semi-) natural vegetation.
2. To complete the revision of the critical levels of ozone for crops, (semi-) natural vegetation and trees.
3. To produce maps of exceedance of the revised critical levels (in collaboration with the ICP Forests, EMEP and the ICP on Modelling and Mapping).
4. To further develop ozone flux-response relationships for trees, semi-natural vegetation and additional crop species.
5. To provide further information on response functions and land cover for use in an economic assessment of crop losses due to ozone.
6. To conduct literature reviews and specific experiments to provide further information on the critical levels of air pollutants for selected plants, plant communities and biodiversity.
7. To conduct literature reviews and experiments on the accumulation of atmospheric deposition of heavy metals by vegetation and the transfer of heavy metals into the human food chain (in collaboration with the TF Health).
8. To prepare for and conduct the 2005 survey of heavy metal concentrations in mosses in Europe.
9. To investigate methods for estimating and mapping heavy metal deposition from the heavy metal concentration in mosses data.
10. To study the temporal trends in the atmospheric deposition of nitrogen by analysing the nitrogen content of mosses.

11. To review the literature on, and conduct studies of, the interactions between ozone and nitrogen.
12. To review the literature on the effects of ozone in a changing climate and to consider the possibility of including experimental and modelling work within the programme.