



CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION

WORKING GROUP ON EFFECTS

INTERNATIONAL COOPERATIVE PROGRAMME ON EFFECTS OF AIR POLLUTION ON NATURAL VEGETATION AND CROPS (ICP VEGETATION)



Minutes of the 24th Task Force Meeting

The twenty-fourth meeting of the Programme Task Force was held from 31 January – 2 February, 2011 in Rapperswil-Jona, Switzerland and hosted by FUB (Forschungsstelle für Umweltbeobachtung) – Research Group for Environmental Monitoring.

1. The meeting was attended by 68 experts from 26 countries, including 22 Parties to the LTRAP Convention: Austria, Belarus, Belgium, Bulgaria, Czech Republic, Finland, France, Germany, Greece, Italy, Macedonia, Norway, Romania, Russian Federation, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom and Ukraine. Participation included a representative from EMEP/MS-CHEM-East and four guests from Egypt, India, Pakistan and South-Africa.
2. The Programme Task Force adopted the agenda of the meeting.
3. Mr Harmens (Chairman of the ICP Vegetation, UK) welcomed the participants to the 24th Task Force Meeting and thanked FUB for hosting the meeting at the Hochschule für Technik Rapperswil (HSR). Mr Piveteau, Deputy Director of HSR, welcomed the participants and gave an overview of HSR (University of Applied Sciences). Mr Achermann, Swiss Federal Office for the Environment (FOEN), also welcomed the participants to Switzerland and gave an overview of the current and future priorities of the LRTAP Convention, such as the revision of the Gothenburg Protocol and priorities defined in the new long-term strategy of the Convention (ECE/EB.AIR/106/Add.1). With appreciation he acknowledged the importance of the effects-based scientific work of the ICP Vegetation to support policy development within the Convention.
4. Mr Harmens (UK) gave an overview of the activities and achievements of the ICP Vegetation in 2010. An important development was the endorsement of 10 new/revised flux-based ozone critical levels for vegetation by various ICP Task Forces (Vegetation, Modelling and Mapping, Forests), the WGE and the Executive Body of the LRTAP Convention. Chapter 3 (Mapping critical levels for vegetation) of the *Manual on Methodologies and Criteria for Modelling and Mapping Critical Loads and Levels and Air Pollution Effects, Risks and Trends* (Modelling and Mapping Manual) was fully revised and restructured in the summer of 2010 to include the new/revised flux-based critical levels.

5. Mr Harmens continued with reporting on progress made with the ICP Vegetation workplan items for 2011 (see ECE/EB.AIR/106/Add.2), which will be reported to the secretariat of the Convention in May 2011 and presented at the 30th session of the WGE, 27 – 29 September, 2011 in Geneva:
- *Report on the 2010 biomonitoring exercise for ozone.* So far, data on the impacts of ozone on bean have been submitted from 11 sites in 8 countries (including Japan), indicating the occurrence of wide-spread leaf damage on the ozone-sensitive genotype across Europe (see also paragraph 8).
 - *Report on ozone impacts on food security.* This report is scheduled for publication by the end of March 2011. It will include: a review on the impacts of ozone on yield quantity, feed and food quality and safety in Europe and Asia; an economic impact assessment; impacts in a changing climate (global warming, elevated carbon dioxide, enhanced drought episodes); global concerns and policy recommendations (see paragraph 8 for further details).
 - *Progress report on European heavy metals and nitrogen in mosses survey 2010/11.* Twenty six countries have confirmed participation in the 2010/11 European moss survey, including three EECCA countries and nine countries from southern-eastern Europe (SEE). Fourteen of the 26 countries will also determine the nitrogen concentration in mosses and five countries have confirmed participation in a pilot study on POPs (see also paragraph 12).
 - *Report on mosses as biomonitors of POPs.* During the first half of 2011 the Programme Coordination Centre will, in collaboration with selected experts, conduct a literature review on the use of mosses as biomonitors of POPs. As far as possible, case studies and country-specific contributions will be included.

Common work plan items for all ICPs, Task Force on Health and Joint Expert Group on Dynamic modelling:

- *Report on the further implementation of Guidelines on reporting of monitoring and modelling of air pollution effects.*
- *Report on the heavy metals baseline assessment.*
- *Report on the comparison of activities across continents and regions (North America, Western Europe, and countries in South-Eastern Europe, Eastern Europe, the Caucasus and Central Asia).*

The Programme Coordination Centre will summarise progress with the above items in reporting to the WGE in spring 2011 and will include further details in the annual report, to be published in August 2011.

- *Report on ex-post analysis.* For the revision of the Gothenburg Protocol, the Programme Coordination Centre will produce ozone flux-based maps for generic crop and tree species using data provided by EMEP/MS-CHEM-West and the Coordination Centre for Effects based on current legislation emission scenarios (NAT2020 and Primes2030) and a technically maximum feasible reduction scenario (MFR2020). These maps will be compared with AOT40 and SOMO35 (the health matrix for ozone) maps based on the same scenarios to investigate their differences. Currently, the flux-based approach is not included in the integrated assessment model applied within the Convention for the optimization of cost-benefit of emission reduction of air pollutants. A first draft of the report will be discussed at the Extended Bureau meeting of the WGE (15 – 16 February 2011) and the report will be finalised in the summer of 2011.

Finally, Mr Harmens summarised the priorities identified in the new long-term strategy of the Convention and encouraged the Task Force to take these into consideration during

discussions on the future work of the ICP Vegetation. After summarising the outputs from the ICP Vegetation in 2010, he thanked the Parties for their invaluable contributions to the ICP Vegetation.

6. On behalf of the Stockholm Environment Institute, Mr Büker (UK) presented a plan for a future pan-Asian ozone and food security 'Research for Policy Programme' and discussed the potential linkages to the LRTAP Convention and the ICP Vegetation. The 'Research for Policy Programme' was based on recommendations from the seminar on 'Ground-level ozone and food security in Asia', hosted by the Global Atmospheric Pollution (GAP) Forum on 15th November 2010 in New Delhi, India. Mr Büker stated that raising awareness of the threats of ozone pollution to food security in Asia is still a key issue and engagement between scientists and key stake holders (e.g. farmers, crop breeders and policy makers) is one of the main priorities. The chair of the ICP Vegetation re-iterated that the Programme Coordination Centre is keen to facilitate outreach activities and welcomed the presence of guests from Egypt, India, Pakistan and South-Africa at the 24th Task Force meeting.
7. For most of the meeting there were two parallel sessions considering the ozone and heavy metals (HM)/nitrogen (N)/persistent organic pollutants (POPs) sub-programmes. The topics of oral presentations and discussions in the parallel sessions are provided below. For further details on the content of oral presentations and posters we refer to the book of abstracts and powerpoint files, both available on the ICP Vegetation web site (<http://icpvegetation.ceh.ac.uk>). The posters covered similar topics as discussed during the oral presentations and provided valuable additional information. Posters were on display throughout the meeting and time was allocated during the first parallel sessions for poster viewing with the authors present at the posters.
8. In the first ozone session, Ms Mills (Head Programme Coordination Centre, UK) gave a more in depth update on progress with the food security report, including maps of ozone fluxes to crops produced by EMEP/MSC-West. The concentration-based sensitivity index of crops was update from previous work published in 2007 and a first attempt to develop a flux-based sensitivity index for crops was presented. The maps for the ex-post report of the WGE were discussed in more detail within the ozone subgroup, and some issues were raised that require feedback from EMEP/MSC-West. Ms Hayes (Programme Coordination Centre, UK) presented further details on the bean biomonitoring experiment in 2010 and concluded that visible injury was widespread across Europe and many locations showed a reduction in pod or seed yield. However, the relationships between these effects and ozone concentrations were not clear. Although an ozone flux model was developed for bean, not enough suitable effects data are available yet to develop a flux-effect relationship for bean.
9. The second ozone session started with two presentations on ozone and drought interactions in plants. Ms Wilkinson (UK) described the mechanisms (hormonal control of stomatal opening) and implications of the interactions and Ms Wagg (UK) discussed the interactions in bean and a grass species in more detail. Ms Wagg showed that increasing ozone background concentrations enhanced stomatal conductance in both species and had a more negative impact on root than shoot growth. Ms Braun described how stomatal uptake functions in mature Norway spruce could be validated by sap flow measurements and suggested that the DO₃SE (Deposition of Ozone for Stomatal Exchange) model may overestimate stomatal conductance in mature Norway spruce. Mr Büker (UK) gave an update on further developments and application of the DO₃SE model, including a new soil moisture deficit module, and gave a

demonstration of the revised online version of the model (<http://sei-international.org/do3se>).

10. In the third ozone session, three discussion groups discussed the following subjects:
 - Impacts of ozone on carbon sequestration and feedbacks to the climate (2011 report);
 - Impacts of ozone on biodiversity and ecosystem services (2012 report);
 - Future role of biomonitoring within ICP Vegetation, outreach and the impacts of black carbon on vegetation.

Each of the groups discussed what the contributions of the Task Force to any future reports could be and did some 'horizon scanning'. An overview of the outcome of these and other discussion throughout the meeting is provided in Annex II; expert groups on different themes were established at the end of the ozone sessions. It was decided that the food security report and any future state of knowledge reports will be presented in two formats: i) glossy summary report aimed at policy makers and ii) a full technical report aimed at scientists. It was also decided to downscale the ozone biomonitoring experiments with bean from 2011 onwards and report in the future on supporting evidence on the impacts of ozone on vegetation (see Annex I).

11. The fourth and fifth ozone session consisted of further presentations. Ms Blanke, Mr Volk and Ms Bassin (all Switzerland) gave a joint presentation on ozone and nitrogen effects on a sub-alpine pasture, including novel insights into belowground processes. Over seven years of exposure the sub-alpine pasture had responded to elevated nitrogen inputs (e.g. increased productivity, changes in carbon allocation and species composition), but had hardly responded to elevated ozone exposure. On the other hand, Ms Power (UK) observed changes in species balance when exposing mesotrophic grassland communities to elevated ozone. Elevated ozone reduced biomass production of the grassland communities under well-watered conditions but not under drought conditions. Ms Madkour (Egypt) and Mr Ahmad (Pakistan) followed with a presentation on a new Egyptian common bean bioindicator system for ozone and on measurements of tropospheric ozone in (semi-)rural sites of Rawalpindi and Islamabad to establish risks to food security, respectively. At the end, three presentations were given on wheat: Mr Pleijel (Sweden) summarised how ambient air filtration experiments (i.e. reduced ozone concentrations) had consistently shown an improvement in grain yield by 9% on average; Mr Grünhage (Germany) had developed an ozone risk evaluation model (CRO₃PS) for winter wheat for local application and Mr González-Fernández (Spain) discussed the parameterisation of the ozone stomatal flux model for wheat, proposing a lower maximum stomatal conductance and changes to the vapour pressure deficit and phenology function under Mediterranean conditions compared to those described in the Modelling and Mapping Manual.

12. In the first HM/N/POPs session, Mr Harmens (UK) gave an update on participation in the 2010/11 European moss survey, which for the first time will include a pilot study on POPs. The HM/N/POPs subgroup decided that a glossy report for heavy metals should be published by the end of March 2013. The outline of the report was discussed and it was decided that the report should include data and maps of heavy metal concentrations in mosses for 2010/11 and describe temporal trends for Europe between 1990 and 2010. Each participant will have the opportunity to write a succinct 1-2 page country-specific summary that will be included as annexes. Separate, non-glossy reports will be produced for nitrogen and POPs. To allow enough time for data processing and quality assurance of the data, data have to be submitted to the Programme Coordination Centre by 1st April 2012 at the latest, using the template provided. Mr Harmens re-iterated the importance of

including moss reference material M2 and M3 in the analyses. Finally, Mr Harmens reported on progress with the web-based European MossMet, developed by colleagues at the University of Vechta, Germany. MossMet is scheduled to be available on the web by the end of February 2011; Parties will be able to log site-specific metadata in this system and will have access only to their own password-protected data. For further details, participants should contact Mr Pesch (Germany).

13. The second HM/N/POPs session started with a presentation from Mr Ilyin (EMEP/MSC-East, Russian Federation) on local-scale modelling of heavy metal atmospheric pollution for selected European countries. As a case study, data from the Czech Republic were shown on the relationship between cadmium concentrations in mosses and modelled atmospheric deposition at a 5 km x 5 km grid scale. Mr Ilyin concluded that the moss data provide important information for the analysis of heavy metal pollution levels at the local scale due to high spatial resolution and coverage and expressed his appreciation for the collaboration with ICP Vegetation. Mr Steinnes (Norway) discussed whether it is possible to estimate atmospheric deposition of heavy metals by analysis of terrestrial mosses? In contrast to a general conclusion drawn by colleagues from Spain in a recent publication, Mr Steinnes concluded that given proper calibration, concentrations of certain elements can be precisely transformed to bulk deposition values within a given region when excluding influence from local point sources. However, separate calibrations may be required in different regions of Europe. Ms Foan (France) reported on progress made with a joint pilot study between France, Switzerland and Spain to determine spatial patterns of polycyclic aromatic hydrocarbon (PAH) concentrations in mosses. Mr Santamaria (Spain) described how stable nitrogen isotope analysis of mosses had helped to identify the sources of nitrogen pollution in Navarra. He proposed to conduct a pan-European analysis of stable nitrogen isotopes in mosses to investigate the spatial variation of sources of nitrogen pollution in 2005. So far, eight countries have volunteered to take part, with samples from Finland also being used to investigate temporal variations between 1985 and 2005.

14. In the third HM/N/POPs session, two discussion groups discussed the following subjects:

- Relationship between element concentration in mosses and impacts on ecosystems (2012 report);
- Future role of the European moss survey, outreach and horizon scanning.

Discussions also included ideas for future state of knowledge reports and activities. The first group summarised what is known about the relationship, but stated to be careful with the interpretation of correlations without knowledge of causalities. The group suggested to conduct a pan-European biomonitoring study of heavy metals with a standard moss system developed in France. Exposure of such a system at selected EMEP monitoring sites would improve our knowledge of the relationship between measured deposition and concentrations in mosses for selected heavy metals. The Programme Coordination Centre will investigate the potential of such a study further in collaboration with participants of the moss survey and EMEP/MSC-East. In the second group, Mr Ilyin of EMEP/MSC-East emphasised the importance of the European moss survey in the assessment of the performance of EMEP's heavy metal deposition model. Parties expressed their wish to continue current participation and enhance participation in EECCA and SEE countries. An additional challenge would be to expand collaboration with Asia. The Programme Coordination Centre is willing to facilitate the development of new networks outside the UNECE region. It will also produce a leaflet based on the 2008 moss report to raise awareness of the existence of the European moss monitoring network; others can translate such a leaflet in their own language.

After the discussions, Mr De Temmerman (Belgium) gave a presentation on the complexity of physical-chemical processes that govern deposition of heavy metals; mosses integrate all deposition fractions. Heavy metal deposition can potentially be estimated from concentrations in mosses with the help of models containing information on particle size distribution, heavy metal concentrations in the different fractions, deposition velocities and the proportion of wet and dry deposition. In the ensuing discussion it was noted that Parties report either wet deposition only or bulk deposition (i.e. wet deposition including some dry deposition) of heavy metals to EMEP, depending on the type of precipitation collectors used. It is not possible to estimate the total deposition with these methods, but they will give the lowest estimate of the total deposition. The wet only and bulk collector give similar results only at wet rural sites where the total deposition arises mainly from precipitation.

15. The fourth and fifth HM/N/POPs session consisted of further presentations. In two separate presentations Mr Kubin (Finland) i) drew attention to the value of archiving plant material in environmental specimen banks as done for example in Finland and ii) showed that the total nitrogen concentration in mosses correlated very well with stand throughfall measured at the same six sites in forests. However, correlations were poor for nitrate deposition measured in between trees, nitrogen concentrations in mosses were generally higher in spruce than pine stands and declined in senescing segments at the end of the growing season. A circulated questionnaire by Mr Kubin revealed that currently over 80% of countries store moss samples from previous surveys and four out of seventeen countries store samples in a specimen bank. In two separate presentations Mr Suchara (Czech Republic) showed that i) element concentrations in moss, grass, spruce needles and forest floor humus changes proportionally with the spatial gradient of industrialization across the Czech Republic and ii) it was difficult to separate the effect of distance to forests roads and traffic volume on element concentrations in mosses from influences of litter fall and throughfall deposition near the forests. Mr Werner (Germany) also showed that spatial patterns of wet deposition and element concentrations in mosses measured at 18 locations are determined by the spatial variation of dominant emission sources. In two separate presentations Mr Saxena (India) i) reported on the contribution of different emission sources in Uttarakhand, India, on the accumulation of metals in mosses, which was higher during the summer season, followed by the winter and then the monsoon season and ii) discussed a conceptual framework for large scale monitoring of atmospheric deposition using mosses in India. Ms Frontasyeva (Russian Federation) provided an overview of her contributions to the European moss survey since 1995 and the increase in collaboration with many eastern and southern-eastern European countries in the last decade and plans to extend collaboration to Asia. Ms Boltersdorf (Germany) concluded that epiphytic lichens can reflect the quality as well as the quantity of atmospheric nitrogen deposition.
16. In the final plenary session, Mr Bender (Germany) gave an overview of presentations, conclusions and recommendations from the ozone sub-group, followed by a summary from Mr De Temmerman (Belgium) on the presentations and the outcome of discussions in the HM/N/POPs sub-group. The Task Force took note of the conclusions and recommendations of both sub-groups (as described above) and the establishment of four ozone expert groups as described in Annex II. The Task Force discussed and adopted the medium-term (2012 – 2014) workplan of the ICP Vegetation as described in Annex I. The medium-term workplan includes some activities that were identified in the new long-term strategy of the LRTAP Convention as priorities of effects-based research in the coming ten years. It was agreed to include a short review on the impacts of black carbon on vegetation in the ICP Vegetation Annual Report for 2010/11.

17. The Task Force encouraged continuation of collaboration with other bodies within the LRTAP Convention. It encouraged further participation of EECCA and SEE countries and further development of outreach activities and collaboration with regions and countries outside the ECE region (see Annex II).
18. Mr Harmens (UK) drew attention to the following meetings:
 - COST Action FP 0903: Ozone, climate change and forests, 14-16 June 2011, Prague, Czech Republic. Contributions from all vegetation types are welcome and a session on 'ICP Vegetation: insights from crop science' is included in the programme (<http://cost-fp0903.ipp.cnr.it/events/conferenceprague.html>).
 - Nitrogen and global change. Key findings – future challenges, 11-14 April, Edinburgh, UK (<http://www.nitrogen2011.org/call>).
 - 8th APGC Symposium: 'Plant Functioning in a Changing Global and Polluted Environment', Groningen, The Netherlands, June 5-9, 2011 (www.apgc.eu).
19. Although no firm offers were received during the meeting to host the 25th ICP Vegetation Task Force meeting in 2012, tentative offers were received from three countries after the meeting (depending on national funding). The Task Force accepted an offer from Sweden to host the 26th Task Force meeting in 2013.
20. On behalf of the Task Force, Mr Harmens (UK) closed the meeting by thanking Ms Thöni (Switzerland) and her colleagues at FUB - Research Group for Environmental Monitoring for hosting and financially supporting the meeting. He also thanked Mr Achermann (FOEN, Switzerland) for providing financial support for the meeting and HSR for providing an excellent venue. Mr Harmens acknowledged the UK Department for Environment, Food and Rural Affairs (Defra), the United Nations Economic Commission for Europe (UNECE) and the Natural Environment Research Council (NERC) for their continuous financial support of the ICP Vegetation Programme Coordination Centre. Last but not least Mr Harmens thanked his colleagues at the Programme Coordination Centre and the participants of the ICP Vegetation for their continuing support of the programme.

Annex I. Medium-term workplan of the ICP Vegetation (updated on 2 February, 2011).

2012:

- Report on supporting evidence for ozone impacts on vegetation;
- Report on ozone, carbon sequestration, and linkages between ozone and climate change;
- Progress report on European heavy metals and nitrogen in mosses survey 2010/11;
- Report on the relationship between i) heavy metal and ii) nitrogen concentrations in mosses and impacts on ecosystems.

2013:

- Report on supporting evidence for ozone impacts on vegetation;
- Report on ozone impacts on biodiversity and ecosystem services;
- Report on the European heavy metals and nitrogen in mosses survey 2010/11;
- Report on the pilot study of mosses as biomonitors of POPs.

2014 (tentatively):

- Report on supporting evidence for ozone impacts on vegetation;
- Report on update of ozone flux-based critical levels for additional plant species;
- Report on ozone impacts on vegetation in a changing climate.

Annex II. ICP Vegetation ozone expert groups and timetable of deliverables.

	Ozone and climate change interactions (incl. interaction with N)	Ongoing ozone flux model development and AOT40 and flux map validation	Outreach activities	Ozone impacts on C sequestration¹
Deliverables (in addition to updates in ICP Vegetation Annual Report)	Review paper(s)	Updates to LRTAP Convention Modelling and Mapping Manual chapter 3 to include additional critical levels, flux model development and validation. Possible papers.	Position paper, annual updates in ICP Vegetation report, letters of support for funding applications.	ICP Vegetation State of Knowledge Report (December 2011) – long report to include chapters prepared by participants and the Coordination Centre (see footnote 1 below), short report for policy makers. Journal papers in 2012.
Estimated date of deliverable	2012	Ongoing, annual reporting, with next Critical Levels workshop tentatively in 2013-14	Ongoing, first position paper to be written in 2011.	Reports in late 2011, papers in 2012.
Editorial group (in addition to ICP Vegetation Coordination Centre)	Sally Power (GB) Karine Vandermeiren (BE) Jürg Fuhrer (CH)	Sabine Braun (CH) Patrick Büker (GB) Ignacio González-Fernández (ES) Ludger Grünhage (DE)	Patrick Büker (GB)	Gerhard Soja (AT)
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¹The following contributions to the ozone and C sequestration report are already agreed from the UK; we would like to also include other contributions from ICP Vegetation participants:

- Review of current knowledge
- Modelling to estimate the impacts of current and predicted future ozone on carbon storage in forests and grasslands in Europe using existing ozone flux-effect relationships (a) using DO₃SE and flux-effect relationships derived for the mapping manual and from solardome experiments (b) using UK Met Office's global climate models for 2000 and 2030.
- Review of climate change and ozone, focus on drought
- Policy implications and future research.