



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 27th Task Force Meeting

The twenty-seventh meeting of the Programme Task Force was held from 28-30 January, 2014 in Paris, France. The meeting was hosted by the French Environment and Energy Management Agency (ADEME), in collaboration with AgroParisTech, INRA, Muséum national d'Histoire naturelle (MNHN) and Université Paris-Est Creteil (UPEC). Financial support was provided by Ile-de-France Region, ADEME, City of Paris, UPEC, AgroParisTech and INRA.

1. The meeting was attended by 84 experts from 22 countries, including 17 Parties to the LTRAP Convention: Albania, Belgium, Croatia, Finland, France, Germany, Greece, Italy, Norway, Poland, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, The Netherlands, United Kingdom, USA and guests from Algeria, Egypt and Japan. Participation included the Secretariat of the UNECE LRTAP Convention, a Co-Chair of the Working Group on Effects, the Chair of ICP Modelling and Mapping; the Head of the Coordination Centre for Effects (CCE), and a representative from EMEP/MSC-East.
2. The Programme Task Force adopted the agenda of the meeting.
3. Welcome addresses were given by Ms Laurence Galsomies (ADEME) and Mr Jean-Philippe Sibley (MNHN).
4. In the first plenary session, Mr Krzysztof Olendrzynski of the Secretariat of the LRTAP Convention reported on updates and new developments within the Convention. He described the amendments to the Gothenburg Protocol and the Protocol on Heavy Metals, both revised in 2012. He also informed the Task Force on recent developments regarding the biannual workplan of the Convention for 2014-2015 and recent stimulation of activities in the EECCA countries. He acknowledged the important contribution of the ICP Vegetation to the technical documents of the WGE, which were also reported by the chair of the ICP Vegetation to the Executive Body in December 2013, and the Guidance Document on Health and Environmental Improvements for the amended Gothenburg Protocol.
5. Mr Harry Harmens (Chair of ICP Vegetation, UK) gave an overview of the activities and achievements of the ICP Vegetation in 2013. Important deliverables were the report on:
 - 'Ozone pollution: Impacts on ecosystem services and biodiversity'.
 - 'Heavy metals and nitrogen in mosses: spatial patterns in 2010/2011 and long-term temporal trends in Europe'.
 - 'Air pollution and vegetation: ICP Vegetation annual report 2012/13'.

The ICP Vegetation had also led the WGE report on ‘Benefits of air pollution control for biodiversity and ecosystem services’ and associated brochure for policy makers, and had contributed to the ‘Guidance document on health and environmental improvements’. Mr Harmens also reported on:

- Progress with ozone biomonitoring using snapbean;
- Development of a web-linked iPhone application to record incidences of ozone injury on vegetation (see paragraphs 7 and 9);
- Participation in the research activities in the European Framework Programme 7 project on ‘Impacts of climate change on air pollution impacts and response strategies for European ecosystems’ (ECLAIRE; see paragraph 10);
- Results of the pilot study in 2010 on using mosses as biomonitors of persistent organic pollutants (POPs).

He described progress with important deliverables for 2014 (see Annex II) and informed the Task Force of the intention to transfer coordination of the European moss survey to the Joint Institute of Nuclear Research (JINR), Dubna, Russian Federation, where the moss survey will be coordinated by Ms Marina Frontasyeva. The aim of the transfer is to enhance participation of countries in Eastern Europe, Caucasus and Central Asia (EECCA). Further details can be found on the ICP Vegetation web site (<http://icpvegetation.ceh.ac.uk>). Finally, Mr Harmens stressed the importance of the contributions of Parties and their experts to the work of the ICP Vegetation.

6. Mr Jean-Paul Hettelingh (Head of CCE, The Netherlands) provided an overview of the activities of the ICP Modelling and plans for the future. He reported on i) The call for indicators and data for modelling and mapping of nitrogen-induced ‘no net loss of biodiversity’; ii) Testing of novel critical threshold for use in integrated assessment modelling; iii) The CCE workshop and Task Force meeting, 7-11 April, 2014, Rome, Italy; iv) plans to update the Modelling and Mapping Manual in April, 2014 and to publish the next CCE status report in 2014. Mr. Hettelingh highlighted the successful collaboration with ICP Vegetation, including the ECLAIRE project, WGE documents and Chapter 3 on critical levels for vegetation in the Modelling and Mapping Manual. He emphasized the remaining challenge for the ICP Modelling and Mapping and ICP Vegetation to address the trade-offs between the potential positive and negative impacts of nitrogen and ozone respectively on plant production in the short term and plant production in the short term versus nitrogen-induced impoverishment of soil chemistry in the long term.
7. In the second plenary session, Mr Jean-Francois Castell (France) reported on the validity of the use of dose-response functions for wheat exposed to free-air fumigation in the Paris region, followed by a presentation from Mr Thomas Verbeke (France) on the incorporation of a more mechanistic ozone impact parameterisation in the ORCHIDEE global vegetation model. Mr Beat Achermann (Switzerland) highlighted the effects of nitrogen deposition on species richness and diversity in Switzerland. Ms Marina Frontasyeva (Russian Federation) described the capabilities of her institute (JINR, Dubna) to take over the coordination of the European moss survey from the ICP Vegetation Coordination Centre, a development in agreement with the priority of the LRTAP Convention to enhance participation of EECCA countries in Convention bodies with the aim to stimulate ratification of Protocols by EECCA countries. Ms Frontasyeva described the extensive collaboration her institute already has with various countries (including EECCA countries) and her plans for the next European moss survey planned for 2015/2016. Ms Katrina Sharps (ICP Vegetation Programme Coordination Centre, UK) reported on the new ICP Vegetation smart-phone App for recording incidences of ozone

injury on vegetation. The aim is to have the application ready by April 2014, for testing by ozone experts during the coming growing season.

8. The next four sessions consisted of two parallel sessions considering the ozone and heavy moss survey 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 in the evening.
9. In the first ozone session, Mr Håkan Pleijel (Sweden) reported on the latitude dependence and temporal trend of the yearly peak in surface ozone in middle and northern Europe. Mr Matthias Volk (Switzerland) and Ms Seraina Bassin (Switzerland) gave a joint presentation on seven years of nitrogen and ozone pollution and climate interaction in subalpine grassland: ecosystem carbon budget, nitrogen pools and ozone flux modelling. Mr Dan Hewitt (ICP Vegetation Programme Coordination Centre, UK) discussed whether ozone is reducing the nitrogen fixation capacity of managed pasture. As a follow up from her earlier presentation (see paragraph 7), Ms Katrina Sharps (UK) gave a demonstration of the smart-phone App for recording ozone damage to vegetation, currently under development and being linked to the ICP Vegetation web site. Examples of ozone injury will be available from the site, participants are asked to answer a few basic questions and the location of injury can be recorded via an interactive map.
10. In the second ozone session, Ms Felicity Hayes (ICP Vegetation Programme Coordination Centre, UK) provided an overview of progress with component 3 of the EU ECLAIRE project. In Component 3, data from existing long-term field databases, the scientific literature and new experimental work on the impacts of combined air pollutants (including ozone and nitrogen) on vegetation is being used to develop new modelling methods for quantifying impacts at the leaf, plant and ecosystem scale. Modelling methods feed through to regional and global modelling within other components of the project. Several Convention bodies are participating in the ECLAIRE project. In a following presentation, Ms Hayes reported on the impacts of ozone and nitrogen on silver birch from experiments conducted at the Programme Coordination Centre. The session concluded with a presentation by Mr Giacomo Gerosa (Italy) on stomatal uptake and non-stomatal ozone removal by a mixed oak-hornbeam mature forest in the Po Valley, a study conducted as part of the ECLAIRE project.
11. The third ozone session focused on the impacts of ozone on the physiology of crops. Ms Marien Havé (France) described how vacuolar endoproteolytic activities and protein carbonylation levels in leaf can be used as a model for depicting ozone tolerance and sensitivity in winter wheat. Ms Samia Madkour (Egypt) reported on the role of jasmonate and salicylic acid in conferring tolerance against ozone injury in tomato plants. Ms Elisa Pellegrini (Italy) then discussed circadian profiles of photosynthetic parameters and primary metabolites in grapevine varieties exposed to ozone., followed by a presentation from Yuri Maia (France) on the involvement of plastidial terminal oxidase and mitochondrial proteins in the response of cowpea to combined drought stress and ozone exposure.
12. The fourth ozone session started with a presentation from Lorenzo Cotrozzi (Italy) on the response of *Quercus cerris* (Turkey oak) to combined ozone and drought stress, and

finished with a general discussion on the final conclusions and recommendations from the ozone workshop and the discussions of the ozone group during the Task Force meeting, in order to present these in the final plenary to the whole Task Force for adoption (see Annex I).

13. The first moss survey session focused on nitrogen. Mr Harry Harmens (UK) described the relationship between site-specific nitrogen concentrations in mosses and bulk atmospheric nitrogen deposition. Subsequently, Mr Winfried Schröder (Germany) reported on the correlations between nitrogen concentrations in atmospheric deposition and mosses, mapped for natural landscapes in Europe. Ms Michaela Kluge (Germany) discussed how canopy drip effects can result in differences in concentration of nitrogen in mosses in Germany, and Mr Mitja Skudnik (Slovenia) reported on the content of nitrogen (N), sulphur and $\delta^{15}\text{N}$ in moss in the southern part of Central Europe.
14. Ms Marina Frontasyeva (Russian Federation) started the second moss survey session with a presentation on moss biomonitoring of trace elements and radionuclides in rural and urban areas experiencing environmental stress. The session finished with a the moss group adopting the transfer of the coordination of the European moss survey from the UK to the Russian Federation, followed by a more detailed discussion on how to proceed with the transfer and the preparations for the next European moss survey, taking place in 2015/2016. The conclusions and recommendations from the moss survey group are described in more detail in Annex I.
15. In the third moss survey session, Mr Ilia Ilyin (EMEP/MSC-East, Russian Federation) evaluated heavy metal and persistent organic pollutant (POP) pollution levels in the EMEP region using atmospheric deposition modelling and measurement data from moss concentrations. As shown before, temporal trends in heavy metal (cadmium, lead and mercury) concentrations in mosses agree well with temporal trends in modelled deposition when including the data for the most recent moss survey. As before, correlations between concentrations in mosses and modelled atmospheric deposition were country-specific, with good correlations being observed in some (Scandinavia and parts of central Europe) but not all countries. Similarly, modelled deposition of benzo[a]pyrene correlated well with its concentration in mosses in some countries, a comparison conducted for the first time. Mr Martijn Schaap (The Netherlands) reported on atmospheric deposition of heavy metals to terrestrial ecosystems in Germany and Ms Pranvera Lazo provided an indication of the atmospheric deposition of selected metals in Albania by using moss biomonitoring. Mr Winfried Schröder (Germany) proposed a statistical design for the evaluation of the results of the 2010 moss survey data.
16. In the fourth moss survey session, Mr Zdravko Spiric (Croatia) reported on the results from the Croatian moss survey since Croatia started to participate in 2005. Ms Flora Qarri (Albania) provided an assessment of trace elements pollution around the Vlora area in Albania. Mr Sergio Esposito (Italy) discussed a possible role of heat shock proteins as sensors of heavy metal pollution in mosses. Finally, Mr Anatoliy Dunaev (Russian Federation) described in detail the outcome of biomonitoring of trace elements in the Ivanovo region in the central part of the Russian Federation.
17. In the final plenary session, the conclusions, recommendations and decisions of the Task Force were agreed, including those put forward from the one-day ozone workshop (see Annex I) and subsequently discussed within the ozone sessions. Regarding the ozone work, the main decisions and recommendations related to the revision of the text of Chapter 3 of the Modelling and Mapping Manual and future work. Regarding the

European moss survey, the Task Force adopted transfer of the coordination of the European moss survey from the ICP Vegetation Coordination Centre at CEH Bangor, UK, to the Joint Institute for Nuclear Research (lead coordinator: Marina Frontasyeva), Dubna, Russian Federation, with to aim to enhance participation from countries in Eastern Europe, Caucasus and Central Asia (EECCA) and South-East Europe (SEE) and encourage outreach to Asia. The transfer will be completed the start of the next European moss survey in 2015.

18. An updated draft medium-term workplan (2014-17) was agreed (see Annex II) regarding the years 2016 and 2017 as the 2014 and 2015 workplan had already been adopted by the Executive Body of the LRTAP Convention at its 32nd Session in December 2013. The Task Force encouraged further participation from EECCA/SEE countries and outreach activities to regions outside the UNECE region such as Asia and North Africa. Mr Patrick Büker (UK) gave a short overview of the outcome from a study on air pollution deposition to and impacts on vegetation in South-East Asia, a study conducted for inclusion in the planned report for 2014 on this theme for EECCA/SEE countries, South-East Asia and North Africa.
19. Mr Harmens (UK) drew attention to various workshops and conferences in 2014, particularly to the conference ‘Ozone and plants’, organised in China in collaboration with the ICP Vegetation. The conference also has a session focussing on ‘Atmospheric chemistry and exchanges with the biosphere’, organised in collaboration with the Task Force on Hemispheric Transport of Air Pollution. The Task Force accepted the offer from Italy to host the 28th ICP Vegetation Task Force meeting in Rome, tentatively scheduled for the first week in February. The Task Force also took note of the offer from the Russian Federation to host the 29th Task Force meeting in Dubna in 2016, most likely in the spring.
20. On behalf of the Task Force, Mr Harmens (UK) closed the meeting by thanking the local organisers for hosting and funding the meeting (see paragraph 1 for details), particularly Ms Laurence Galsomies (ADEME), Mr Jean-Francois Castell (AgroParisTech), Mr Olivier Bethenod (INRA), Mr Sebastien Leblond (MNHN) and Ms Sophie Formisano (INRA). 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.

Decisions and recommendations from the 27th ICP Vegetation Task Force meeting (as also discussed at the one-day ozone workshop on 28th January 2014 in Paris, and agreed in by the Task Force in the final plenary).

OZONE RELATED ACTIVITIES

The Task Force agreed to make the following modifications to Chapter 3 of the Modelling and Mapping Manual of the LRTAP Convention for the 2014 revision as scheduled by the ICP Modelling and Mapping (final deadline of submission of text to ICP Modelling and Mapping by mid March):

I) Revisions to the main text in Chapter 3:

- i. The Task Force endorses the existing critical levels within the Manual and does not recommend any changes to them;
- ii. New references will be included where ozone response functions have since been published in the scientific literature;
- iii. Text relating to supporting evidence for ozone critical levels will be updated by reference to recent publications;
- iv. The text related to integrated assessment modelling (Section 3.5.2.6) will be updated to include:
 - New terminology for the simplified generic ozone flux (POD_YIAM will replace POD_Ygen);
 - A new POD₃IAM – effect relationship for use in integrated assessment modelling only (for effects of ozone on wheat, 90d exposure period);
 - A new POD₃IAM – based critical level of 8 mmol m⁻² (accumulated over 90 days);

This response function and associated critical level **are for integrated assessment modelling only** at the European scale. They are provided for use in scenario analysis and optimisation runs within the GAINS (Greenhouse Gas and Air Pollution Interactions and Synergies) model to provide an indication of potential effects on wheat yield under non-limiting water availability. The generic crop flux model provides an estimation of the worst case for damage for crops with adequate water supply (either rain-fed or irrigated). Reductions in ozone flux associated with dry soils such as those found in Mediterranean areas are not included in this model and thus effects may be over-estimated where irrigation is not used in these areas.

The parameterisation for ozone exposure (stomatal flux), as calculated for the source-receptor matrix used in GAINS, should be based on two parameterisations for cereals: 1) Northern and Central Europe; 2) Mediterranean areas (as defined in the Manual). For local and national application, it is recommended that the full wheat flux model (Section 3.5.2.2-5) is used; for Mediterranean areas, the Mediterranean-specific parameterisation described in Section II should be used.

II) Revisions to the Annexes of Chapter 3:

New information describing the latest science will be added to the Annexes as follows:

Annex 1 – Crops:

- New ozone flux parameterisations (and associated explanatory text) will be included for grapevine, maize, soybean and sunflower. New flux parameterisations for other

species may be included for local application as long as they have been published in peer-reviewed journals, have a complete parameterisation, and are submitted to the ICP Vegetation Programme Coordination Centre in time (by Friday 21 February) for the scheduled revision of the Manual;

- A new/revised Mediterranean ozone flux parameterisation will be added for wheat based on a recent publication from data obtained in Spain

Annex 2 - Forest trees

- New ozone flux parameterisations (and associated explanatory text) will be included for poplar. New flux parameterisations for other species may be included for local application as long as they have been published in peer-reviewed journals, have a complete parameterisation, and are submitted to the ICP Vegetation Programme Coordination Centre in time (by Friday 21 February) for the scheduled revision of the Manual;
- A description of methodology for establishing ozone flux-effect relationships based on leaf mass area (LMA) will be included.

Annex 3 - Semi-natural vegetation

- No changes at this stage.

The Task Force made recommendations to further develop areas within the ICP Vegetation for advancement of ozone risk assessment methodologies, as described below. The developments should be reviewed at the 28th ICP Vegetation Task Force meeting in 2015:

General recommendations:

- Further epidemiological studies should be conducted to validate critical levels. The methodology to separate climate and direct ozone effects should be discussed amongst experts;
- Further development of process-based flux models (e.g. based on Ball-Berry model) is encouraged;
- The simplified flux methodology as developed for national application in Sweden should also be tested for other climates;
- Develop a multi-layer, multi-species version of the DO₃SE (D_eposition of O₃ for S_tomatal E_xchange) model for up-scaling to canopy level;
- Further develop the non-stomatal deposition term in the DO₃SE model;
- Further develop flux-based critical levels for visible ozone injury, including using data from tree surveys in Italy and France;
- The Task Force welcomed the development of a web-based smart-phone App. to record incidences of ozone leaf injury for vegetation. The Programme Coordination Centre will launch the App. by April 2014 for testing by ozone experts within the ICP Vegetation, participation of the national ozone experts was encouraged;
- Develop dose-response relationships for plant functional types;
- Develop flux-effect relationships and associated critical levels for vegetation, taking into account modifying factors such as other pollutants (specifically nitrogen) and climate change;
- EMEP model outputs should be compared with national monitoring and modelling data to assess the robustness of the EMEP model.

Recommendations for crops

- Revision of the tomato flux-effect relationship and the associated critical level, based on the availability of new data;

- Expansion of range of species with flux-effect relationships.

Recommendations for trees

- Revision of forest tree flux-effect relationships based on updated analyses;
- Develop flux-based critical levels for different endpoints, e.g. net annual increment of tree biomass (NAI) and flux-effect relationships based on leaf mass area (LMA).

Semi-natural vegetation

- A list of species for which flux-effect relationships are available should be put on the ICP Vegetation web site;
- Potential for grouping of species using different approaches for dividing them into ecologically relevant groups (e.g. annuals, perennials, legumes).

EUROPEAN MOSS SURVEY RELATED ACTIVITIES

The Task Force made the following decisions and recommendations regarding the European moss survey to monitor atmospheric deposition of air pollutants:

- The Task Force adopted transfer of the coordination of the European moss survey from the ICP Vegetation Coordination Centre at CEH Bangor, UK, to the Joint Institute for Nuclear Research (lead coordinator: Marina Frontasyeva), Dubna, Russian Federation, with to aim to enhance participation from countries in Eastern Europe, Caucasus and Central Asia (EECCA) and South-East Europe (SEE) and encourage outreach to Asia;
- The European moss survey shall remain a core activity of the ICP Vegetation;
- The next European moss survey shall be conducted in 2015/16. Parties of the LRTAP Convention are encouraged to provide financial support to allow participation of national experts;
- Amendments to the moss monitoring manual should be submitted by May 2014 to the new coordination centre, including details on sampling in arid areas and priority moss species appropriate for eastern Europe;
- The new coordination centre shall investigate the need for establishing contracts with national experts and their institutes regarding data storage, accessibility, usage and dissemination;
- Moss standards M2 and M3 will be distributed by colleagues at Metla, Finland, for quality assurance purposes. The development and distribution of a standard with higher heavy metal concentrations should be investigated.
- The Task Force encouraged:
 - Submission of data for more heavy metals, radio nuclides, and meta-data, particularly the sampling distance from a projected tree canopy;
 - Inclusion of the analysis of persistent organic pollutants (POPs);
 - Development of an electronic link to country maps;
 - Initiation of a moss analysis discussion group.

Annex II. Draft medium-term workplan (2014 – 2017) ICP Vegetation

(updated on 30 January, 2014)

Workplan items for 2014 and 2015 were adopted at the 32nd session of the Executive Body of the LRTAP Convention in December 2013 (see ECE/EB.AIR/122/Add.2 – in preparation). Workplan items for 2016 and 2017 have been proposed and adopted by the Task Force

Ongoing annual activities:

- Report on supporting evidence for ozone impacts on vegetation;
(*Note: this includes bean biomonitoring and smart phone App for recording incidences of ozone injury*)
- Report on preparations and progress with the moss survey 2015/2016;
- Contributions to common workplan items of the WGE.

New activities:

2014:

- Report on air pollution deposition to, and impacts on vegetation, in EECCA/SEE countries and South-East Asia (*note: North Africa will also be included*);
- Update of Chapter 3 of the Modelling and Mapping Manual.

2015:

- Report on the implications of rising background ozone for vegetation in Europe;
- Report on the interacting effects of co-occurring pollutants (ozone and nitrogen) and climatic stresses on vegetation.

Tentatively for 2016:

- Update report on field-based evidence of ozone impacts on vegetation;
- Report on ozone impacts on biodiversity;
- Ozone critical levels workshop.

Tentatively for 2017:

- Report on revised ozone risk assessments methods;
- Revision of Chapter 3 of the Modelling and Mapping Manual;
- Final report of the European moss survey 2015/2016.