



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 28th Task Force Meeting

The twenty-eight meeting of the Programme Task Force was held from 3-5 February, 2015 in Rome, Italy. The meeting was hosted by the Department of Environmental Biology, Sapienza University, Rome, with support from 'Corpo Forestale dello Stato' (National Forest Service) and 'Accademia Nazionale Delle Scienze Detta Del XL' (National Academy of Sciences).

1. The meeting was attended by 80 experts from 22 countries, including 20 Parties to the LTRAP Convention: Belgium, Croatia, Finland, France, Germany, Ireland, Italy, Macedonia, Netherlands, Norway, Poland, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom, USA and guests from China, and Egypt. Participation included the Head of the Programme Centre for ICP Forests and a representative of the Coordination Centre for Effects (CCE).
2. The Programme Task Force adopted the agenda of the meeting.
3. Welcome addresses were given by Prof. Vincenzo Nesi, Dean of the Faculty of Mathematics, Physics and Natural Sciences, and Prof. Teodoro Valente, Deputy Rector for Research, Innovation and Technology Transfer, Sapienza University of Rome.
4. In the first plenary session, Mr Harry Harmens (Chair of ICP Vegetation, UK) gave an overview of the activities and achievements of the ICP Vegetation in 2014. Important deliverables were:
 - Report on 'Deposition to and impact on vegetation in EECCA and SEE countries and South-east Asia';
 - 'Air pollution and vegetation: ICP Vegetation annual report 2013/14';
 - Updates of Chapter 3 ('Critical levels for vegetation) of the Modelling and Mapping Manual ('Manual on methodologies and criteria for modelling and mapping critical loads and levels and air pollution effects, risks and trends') of the LRTAP Convention;
 - Brochure on incidences of ozone injury;
 - Successful testing of the web-linked iPhone application to record incidences of ozone injury on vegetation (see also paragraph 6);He also described progress with preparations for the 2015/16 Moss Survey, with participation extended in South-eastern Europe (SEE), Eastern Europe, Caucasus and Central Asia (EECCA), and other parts of Asia, and progress with other deliverables for 2015, including brochures on:
 - 'Changing ozone profiles in Europe: implications for vegetation';
 - 'Climate change and reactive nitrogen as modifiers of vegetation responses to ozone pollution'.Finally, he presented a draft workplan for 2016 – 2018 (see Annex II).

Mr Harmens stressed the importance of the contributions of Parties and their experts to the work of the ICP Vegetation and thanked them for those contributions.

5. Mr. Max Posch, representative of the Coordination Centre for Effects (CCE) discussed how to model impacts of nitrogen and ozone interactions on forest growth at the European scale. This work is part of the EU Framework Programme 7 project ECLAIRE (Effects of climate change on air pollution impacts and response strategies for European ecosystems), in which ICP Vegetation and various other subsidiary bodies of the LRTAP Convention participate. Mr. Walter Seidling, Head of the Programme Coordination Centre for ICP Forests, informed the Task Force about the current programme and objectives of the ICP Forests and encouraged further collaboration between experts of ICP Forests and ICP Vegetation, particularly regarding the assessment of ozone impacts on vegetation, further development of ozone risk assessment methods and including ICP Forests monitoring sites in the moss survey. At the end of the first plenary session, Ms. Angela Farina described the Italian forest monitoring activities within the ICP Forests network.
6. In the second plenary session, Ms. Katrina Sharps (ICP Vegetation Programme Coordination Centre, UK) reported on the test phase of the ICP Vegetation smart-phone App for recording incidences of ozone injury on vegetation in 2014 by ozone experts. Records of injury were received from three European countries, the USA (from ozone gardens) and China. Records for Europe were limited due to generally bad weather conditions resulting in low ozone 'uptake' by vegetation. Plans are in progress to release the App more widely in 2015. Ms. Sabine Braun (Switzerland) reported on the outcome of an Epidemiology Workshop held in Basel on 17/18-9-2014. Further details and presentations from the workshop are available on the ICP Vegetation web site (<http://icpvegetation.ceh.ac.uk/events/workshop.html>). The Task Force adopted the report from the workshop and appreciated the contribution in kind from the Swiss Federal Office for the Environment (FOEN) to host the workshop. The Task Force welcomed plans to publish the results of the workshop in a scientific journal and welcomed a planned follow-on workshop in the autumn of 2015, to be held in Sweden. Ms. Marina Frontasyeva (Head Moss Survey Coordination Centre, Russian Federation) described the progress with preparations for the 2015/16 moss survey, which has greatly extended into the EECCA (Eastern Europe, Caucasus and Central Asia) region and other parts of Asia. Potentially more than 35 countries will participate in the survey, reporting on heavy metal, nitrogen and persistent organic pollutants (POPs) concentrations in mosses. Some countries will also report on radionuclides. The Task Force welcomed the efforts from Ms. Frontasyeva to extend the participation of EECCA countries and other parts of Asia in the coming moss survey. In the following presentation, Mr. Eiliv Steinnes (Norway) gave an overview of the potential for using mosses as biomonitors for radionuclides, but at the same time reported on some limitations. Finally, Mr. Fausto Manes (Italy), host of the meeting, stressed how different vegetation types (green infrastructure) in the Metropolitan area of Rome contribute to air quality improvement and provide ecosystem services contributing to human well-being.
7. The next six sessions consisted of two parallel sessions considering the ozone and heavy moss survey sub-programmes. The topics of oral presentations and discussions in these parallel session are provided in Annex III. For further details on the content of the oral presentations we refer to the book of abstracts and power point files, available on the ICP Vegetation web site (<http://icpvegetation.ceh.ac.uk>). In addition, ca. 30 posters were presented during the meeting, covering similar topics as the oral presentations. Further details of the content of the poster can be found in the book of abstracts.

8. In the ozone sub-programme, the sessions had the following themes:
 - New developments in risk assessment for consideration for the Modelling and Mapping Manual;
 - Ozone smart-phone App. and other field-based evidence of ozone effects;
 - Ozone interactions with nitrogen and climate change: impacts on vegetation;
 - Further field-based evidence and climate change interactions;
 - Modelling ozone and its impacts on vegetation;
 - (Eco)physiological impacts of ozone on trees.

9. In the moss survey sub-programme, the following issues were discussed:
 - Further analysis of the results of the 2010/11 moss survey and new developments;
 - Preparations for the 2015/16 moss survey;
 - Assessment at the national or local scale of air pollution (heavy metals and nitrogen) using mosses and impacts on ecosystems.

10. In the final plenary session, the conclusions and recommendations of the parallel sessions were presented, discussed and adopted by the Task Force as described in Annex I. An updated medium-term workplan (2015-18) was agreed and adopted by the Task Force (see Annex II). The Task Force encouraged further participation from EECCA countries and outreach activities to regions outside the UNECE region. Mr Harmens (UK) drew attention to various workshops and conferences in 2015, particularly a joint session with ICP Vegetation at the 25th CCE Workshop & 31st Task Force Meeting of the ICP Modelling and Mapping. A second epidemiology workshop is planned for the autumn of 2015, organised by Mr. Per Erik Karlsson, IVL Swedish Environmental Research Institute, Sweden (subject to funding). The Task Force accepted the offer from the Russian Federation to host the 29th Task Force Meeting of the ICP Vegetation in Dubna, provisionally scheduled for 29 February – 4 March 2016. The Task Force took note of the offer from Poland to host the 30th Task Force Meeting in Poznan.

11. On behalf of the Task Force, Mr. Harmens (UK) closed the meeting by thanking the local organisers for hosting and funding the meeting, particularly Mr. Fausto Manes, Ms. Elisabetta Salvatori, Ms. Lina Fusaro and all the support staff at Sapienza University of Rome. ‘Corpo Forestale dello Stato’ (National Forest Service) and ‘Accademia Nazionale Delle Scienze Detta Del XL’ (National Academy of Sciences) were also thanked for their support. 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 by the Task Force of the ICP Vegetation as agreed at their 28th meeting, 3 – 5 February, Rome, Italy

OZONE RELATED ACTIVITIES:

- The Task Force continues to support the flux-based approach for ozone risk assessment, and draws particular attention to the importance of soil moisture as a flux-modifying factor.
- Critical levels for horticultural crops based on tomato are to be revised in Chapter 3 of the Modelling and Mapping Manual with flux parameterization and critical levels (AOT₄₀, POD₆) as described in González-Fernández et al. (2014). Setting ozone critical levels for protecting horticultural Mediterranean crops: Case study of tomato. *Environmental Pollution* 185: 178 – 187:
 - AOT₄₀: 8 ppm h;
 - POD₆: 3 mmol m⁻² for fruit yield, 4 mmol m⁻² for fruit quality.
- Although progress has been made towards refining critical levels for forest trees (including Mediterranean trees) and Dehesa grasslands, no changes to Chapter 3 of the Modelling and Mapping Manual are currently recommended.
- The next ozone critical level workshop will be held in the autumn of 2016, most likely in Spain. The Task Force established the following five themed working groups (and chairs) to re-assess methodology and currently available data in preparation for the Task Force Meeting in 2016:
 - 1) Methodology (Ms. Sabine Braun – Switzerland);
 - 2) Evidence (Ms. Felicity Hayes – UK);
 - 3) Trees (Mr. Patrick Büker – UK);
 - 4) Grasslands (Mr. Ignacio González-Fernández – Spain);
 - 5) Crops (Mr. Håkan Pleijel – Sweden).

Preparatory research will be conducted by each group in readiness for the workshop in 2016, with updates reported and remaining work needed discussed at the 29th Task Force Meeting. Background documents will be prepared for the workshop and circulated beforehand. Draft text for changes to Chapter 3 of the Modelling and Mapping Manual will then be proposed to the 30th Task Force Meeting in 2017.

- The following recommendations were made for further collation of field-based evidence on ozone impacts on vegetation, in preparation for a report on this theme in 2016:
 - Review published data on visible injury and effects in filtered versus non-filtered air;
 - Where possible include epidemiological evidence, e.g. from forests surveys (tree growth, visible leaf injury, crown conditions);
 - Ozone leaf injury data recorded using smart-phone App. (see below).
- Regarding the smart-phone App., ozone experts but also other citizens ('citizen science') are encouraged to record data on ozone-induced leaf injury. The Programme Coordination Centre will develop a protocol for use by ozone experts, including a protocol for establishing 'ozone gardens' in Europe (as was done in the USA, see http://science-edu.larc.nasa.gov/ozonegarden/pdf/Bio-guide-final-3_15_11.pdf). To engage other citizens, ozone experts from ICP Vegetation are encouraged to undertake national media activities and contact national networks (e.g. crop field trials, tree nurseries, plant volunteer organisations).

MOSS SURVEY RELATED ACTIVITIES:

- The following time-schedule was agreed for the report of the 2015/16 survey:
 - If mosses are collected in 2015: data submission by 1 October 2016;
 - If mosses are collected in 2016: data submission by 1 April 2016;
 - Draft maps: 1 October 2017;
 - Final report: 1 April 2018.
- Content moss survey report (to be translated into Russian too):
 - Spatial patterns and temporal trends (where feasible) of concentrations of heavy metals, nitrogen and persistent organic pollutants in mosses;
 - Country reports (maximum of 2 page) can be included on a voluntary basis;
 - A separate reports will be produced for radionuclides.
- A working group was established to discuss the establishment of new moss material within the medium-high metal concentration range for surveys beyond 2015/16. Members of the working group are Eero Kubin (Finland), Eiliv Steinnes (Norway), Stefan Fränzle (Germany) and Sebastien Leblond (France).
- Moss survey participants expressed the wish to set up a formal agreement between the new Moss Survey Coordination Centre (Joint Institute for Nuclear Research, Russian Federation) and national data providers regarding storage and use of data. The feasibility of this will be further explored by the Moss Survey Coordination Centre with guidance from the ICP Vegetation Programme Coordination Centre.
- The datasheet for submission of core data will be extended to include additional meta data as included in MossMet. The Moss Survey Coordination Centre will discuss with experts from Germany the content of the extended datasheet and implementation of reading data into the new database. Participants will only have electronic access to their own data.
- The Task Force recommended to combine sampling sites of mosses with deposition sampling sites such as ICP Forests, EMEP and national networks. National representatives of the different networks are encouraged to collaborate.
- The Moss Survey Coordination Centre will investigate the potential for setting up an EU COST Action.

Annex II. Medium-term workplan (2015 – 2018) ICP Vegetation

(updated on 5 February 2015)

Workplan items for 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, to be included in the biannual workplan of the LRTAP Convention for 2016-2017, to be adopted by the Executive Body in December 2015.

Ongoing annual activities:

- Report on supporting evidence for ozone impacts on vegetation;
- Report on progress with the moss survey 2015/2016;
- Contributions to common workplan items of the WGE, e.g. WGE ‘Trends report’ (2015) and LRTAP Convention ‘Assessment Report’ (2015-2016).

New activities:

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.

2016:

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

2017:

- Report on revised ozone risk assessments methods;
- Revision of Chapter 3 of the Modelling and Mapping Manual.

2018:

- Final report of the European moss survey 2015/2016.

Annex III. Programme of presentations 28th Task Force Meeting of the ICP Vegetation

Tuesday 3rd February, 2015

Session 1: 9:00 – 10:30 Plenary session ('Aula Giacomini') Chair: Fausto Manes

- 09:00 Welcome address.
- 09:15 *Harry Harmens* et al. – Overview of the achievements of the ICP Vegetation in 2014 and future workplan (2015-2017).
- 09:40 *Max Posch* et al. – Nitrogen and ozone interactions influencing forest growth - How to model on a European scale?
- 10:00 *Walter Seidling* et al. - ICP Forests – The programme and its current objectives.
- 10:20 *Angela Farina* – Italian forest monitoring activities within the ICP Forests network.

Session 2: 11:00 – 13:00 Plenary session ('Aula Giacomini')

Chair: Harry Harmens

- 11:00 *Katrina Sharps* et al. – ICP Vegetation ozone smart-phone App: Update on 2014 pilot study.
- 11:20 *Sabine Braun* et al. – Conclusions from the Epidemiology Workshop held in Basel 17/18-9-2014.
- 11:40 *Marina Frontasyeva* et al. – Preparations to the moss survey in 2015/2016: tentative plans in Europe and Asia.
- 12:00 *Eiliv Steinnes* – Atmospheric deposition of radionuclides monitored by moss analysis: Facts and fallacies.
- 12:20 *Fausto Manes* et al. - Green Infrastructures and Ecosystem Services: different vegetation types and air quality improvement in the Metropolitan area of Rome.
- 12.40 General discussion

Session 3a: Ozone: New developments in risk assessment for consideration for the Modelling and Mapping Manual Chair: Gina Mills

- 14:00 *Victoria Bermejo* et al. - Setting ozone critical levels for protecting horticultural Mediterranean crops: case study of tomato.
- 14:10 *Ignacio González-Fernández* et al. - Revision of ozone exposure experiments of annual Mediterranean pastures for setting ozone critical levels.
- 14:30 *Alessandra de Marco* et al. - The importance of soil water limitation in ozone risk assessment and its dependence by POD thresholds.
- 14:50 *Rocio Alonso* et al. - Ozone critical levels for Mediterranean forests.
- 15:10 *Patrick Büker* et al. - New stomatal ozone flux dose-response relationships and critical levels for forest trees.

Session 3b: Moss survey: Further developments and preparation 2015 survey Chair: Marina Frontasyeva

- 14:00 *Eero Kubin* et al. - Development of specimen banking in Finland and distribution of reference material for heavy metal moss surveys.

- 14:20 *Winfried Schröder, Stefan Nickel et al.* - Heavy metals and nitrogen concentrations in moss collected across Europe 2010 / 2011: statistical analyses covering four spatial scales.
- 14:40 *Michaela Meyer et al.* - Relevance of canopy drip for the accumulation of nitrogen in mosses across Europe.
- 15:00 *Hilde Uggerud* – POPs analysis at NILU.
- 15:15 Discussion on further preparations 2015 survey, including new database developments at JINR and linking with MossMet, relevance of measuring distance to nearest tree in forested areas.

Session 4a: Ozone: Ozone App and other field-based evidence of ozone effects
Chair: Felicity Hayes

- 16:30 *Pierre Sicard, Elena Paoletti et al.* - An epidemiological assessment of stomatal ozone flux-based critical levels for southern European forests.
- 16:50 Discussion on further field-based evidence of ozone impacts on vegetation: 1) Ozone App for recording incidences of ozone injury;
 2) Ozone gardens in Europe (<http://science-edu.larc.nasa.gov/ozonegarden/>);
 3) Additional evidence to update 2007 Evidence Report, including epidemiological data – what new data is available? (contributions to report)
 4) Ozone impacts on biodiversity (contributions to report)
- 17:30 Continuation of discussion of changes to the Mapping Manual.

Session 4b: Moss survey **Chair: Trajce Stafilov**

- 16:30 *Zdravko Spiric et al.* - Mercury concentrations in mosses in Croatia.
- 16:50 *Anatolii Dunaev et al.* - Environmental quality assessment of the town of Rodniki (Ivanovo region, Russia) by complex biomonitoring study.
- 17:10 Further discussions on preparations for 2015 survey.

Wednesday 4th February, 2015

Session 5a: Ozone: Interactions with N and climate change
Chair: Ignacio González-Fernández

- 08:30 *Gina Mills et al.* – An update from the EU FPVII ECLAIRE project.
- 08:45 *Patrick Büker et al.* - Further development of process-based flux models, taking into account other pollutants and climate change.
- 09:05 *Matthias Volk et al.* - Assessing soil organic carbon sequestration in an alpine pasture during seven years of increased atmospheric ozone and nitrogen deposition.
- 09:25 *Giacomo Gerosa et al.* - Ozone and nitrogen effects in oak and hornbeam young trees after two years of treatments.
- 09:45 *Per Erik Karlsson et al.* - Ozone impacts on vegetation in northern Europe - climate change impacts on the ozone sensitivity period and the change in ozone concentrations with height above ground.
- 10:05 *Lorenzo Cotrozzi et al.* - Evolution of ozone and drought stresses, singly or combined, in *Quercus cerris*.

Session 5b: Moss survey: Heavy metals

Chair: Michaela Meyer

- 09:00 *Trajce Stafilov et al.* – Environmental pollution with heavy metals in the republic of Macedonia.
- 09:30 *Alexander Alekseev et al.* - Forest ecosystems biodiversity assessment and inventory: case study for Karelian Isthmus of Leningrad region, Russia.
- 09:50 *Iselin Pettersen, Eiliv Steinnes et al.* - A study of emissions from adjacent metal industries using "moss bags".
- 10:10 General discussion.

Session 6 a: Ozone: Further field-based evidence and climate change interactions

Chair: Elisabetta Salvatori

- 11:00 *Kent Burkey et al.* - A new approach for studying ozone-temperature interactions in the field – system development and initial results for soybean.
- 11:20 *Alsayed Mashaheet* - Yield components of winter wheat as affected by leaf rust disease under elevated CO₂ and/or O₃.
- 11:40 *Zhaozhong Feng et al.* - Assessing effects of ambient ozone on snap bean cultivars by using ethylenediurea (EDU).
- 12:00 *Elena Gottardini, Marco Ferretti et al.* - Ozone EFFORT, a five-year study on ozone exposure, flux and effects on vegetation in Trentino (northern Italy): a synthesis.
- 12:20 *Silvano Fares et al.* - Ozone sequestration and ozone-VOC interactions in a Holm oak peri-urban forest.
- 12:40 Discussion on remaining items from Tuesday and Wednesday morning.

Session 6b: Moss survey

Chair: Eiliv Steinnes

- 11:00 *Stefan Nickel et al.* – Comparing results of modelling and mapping spatio-temporal trends of cadmium, mercury and lead accumulation in moss and natural surface soil throughout Norway derived by different statistical methods.
- 11:20 *Stefan Fränzle et al.* - Heavy metal biomonitoring in/by animals avoiding metabolic fractionation.
- 11:40 *Lucienne de Witte et al.* - Changes in ectomycorrhizal diversity and community composition along the nitrogen deposition gradient in Swiss beech forest.
- 12:00 *Mitja Skudnik et al.* – Mosses as biomonitors of trace elements in urban and peri-urban forests: preliminary results for the city of Ljubljana, Slovenia.
- 12:20 *Adriana Basile, Sergio Esposito et al.* – Ultra-structural and functional changes induced by atmospheric pollution in *Lunularia cruciata* L. (Dumort.).
- 12:40 General discussion.

Session 7 a: Ozone: modelling

Chair: Zhaozhong Feng

- 14:00 *Felix Leung* - Quantifying the impact of tropospheric ozone on crop productivity using JULES-Crop.
- 14:20 *Felicity Hayes et al.* - Combined effects of ozone and nitrogen on ecosystem services: experimental results and modelled future impacts.

- 14:40 *Angelo Finco et al.* - Above and below canopy ozone flux measurements at Bosco Fontana site. Implications for modeling and risk assessment.
- 15:00 *Yasutomo Hoshika et al.* – Stomatal conductance modelling for assessing ozone impacts on deciduous trees.
- 15:20 *Alessandro Anav, Alessandra De Marco* - Flux-based risk assessment in Europe with different approaches: a case study using CHIMERE model.
- 15:40 General discussion.

Session 7b: Moss survey **Chair: Harry Harmens**

14:00 *Harry Harmens* – Further general discussion and decisions/ recommendations to take forward to plenary on Thursday.

- Discussion points:
- Further preparations 2015/16 survey
 - Funding opportunities
 - Web discussion forum, data processing, mapping
 - Time schedule 2015 moss survey
 - How to improve moss monitoring survey?

Session 8 a: Ozone: (Eco)physiology of trees **Chair: Giacomo Gerosa**

- 16:15 *Lina Fusaro et al.* - Ecophysiological response of *Quercus ilex* L. In urban and peri-urban forests of Rome: an Ecosystem Services perspective.
- 16:30 *Sabine Braun et al.* - Towards ozone uptake of oak (*Quercus robur*): sap flow measurements in a north-south gradient, including Bosco Fontana.
- 16:45 *Elisa Pellegrini et al.* - Reactive oxygen species and antioxidant machinery in *Liriodendron tulipifera* plants exposed to ozone.
- 17:00 *Gina Mills* - General discussion and decisions/recommendations to take forward to plenary on Thursday.

Session 8b: Moss survey

General discussion on issues to take forward to the plenary on Thursday.

Thursday 5th February, 2015

Session 9: 8:30 – 10:00 Plenary session ('Aula Giacomini')

Chair: Harry Harmens

- Reporting decisions and recommendations.
- ICP Vegetation work programme 2015 – 2018.
- Collaboration with other relevant bodies/organizations.
- Conclusions and review of the 28th Task Force Meeting.
- Next Task Force Meeting.
- Any other business.