CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION (LRTAP)

WORKING GROUP ON EFFECTS (WGE)

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

Minutes of the 31st Task Force Meeting

The 31st meeting of the Programme Task Force was held from 5 – 8 March 2018 in Dessau-Roßlau, Germany. The meeting was hosted by the German Environment Agency (Umweltbundesamt, UBA) and organised together with the Justus-Liebig University, Giessen, and Thünen Institute for Biodiversity, Braunschweig.

1. The meeting was attended by 73 experts from 23 countries, including Albania, Armenia, Belarus, China, Czech Republic, France, Georgia, Germany, Greece, Italy, Kazakhstan, Norway, Poland, Romania, Russian Federation, Serbia, Slovakia, Spain, Sweden, Switzerland, Turkey, United Kingdom and USA. Participation included a member of the Bureau of the Working Group on Effects, a member of the Programme Centre for the ICP Forests and a member of EMEP/MSC-East.

2. The Programme Task Force adopted the agenda of the meeting.

3. The welcome address was given by Lilian Busse, Head of Division II – Environmental Health and Protection of Ecosystems, UBA. She highlighted the importance of the work of the ICP Vegetation, including the need to raise the awareness of ozone impacts on vegetation, in addition to its health impacts, and the need to monitor heavy metal deposition to vegetation with some areas in Germany still reporting exceedances of critical loads for lead and mercury. She also gave an overview of the structure and work conducted by UBA in Germany.

4. Mr. Harry Harmens (UK), Chair of ICP Vegetation, gave an overview of the activities and achievements of the ICP Vegetation in 2017. Important deliverables were:
   - Revision of Chapter 3 of the mapping manual of the Convention (https://icpvegetation.ceh.ac.uk/get-involved/manuals/mapping-manual);
   - Scientific Background Document A (supporting information for Chapter 3) and B (containing parameterisation of ozone stomatal flux model for additional plant species and new developments, respectively; https://icpvegetation.ceh.ac.uk/get-involved/manuals/mapping-manual);
   - Brochure on 'Flux-based critical levels of ozone pollution for vegetation – Overview of new developments, 2017' (https://icpvegetation.ceh.ac.uk/publications/thematic);
   - Paper showing that rising background and peak episodic ground-level ozone concentrations affect wheat yield according to the same flux-effect relationship (Harmens et al., 2018. Atmospheric Environment 173: 1-5);
   - Paper on 'Present day tropospheric ozone distribution and trends relevant to vegetation' as part of the Tropospheric Ozone Assessment Report (TOAR; http://www.igacproject.org/activities/TOAR; Mills et al., 2018. Elementa, Science of

the Anthropocene 6: 47). Long-term measured ozone data are available from https://join.fz-juelich.de/accounts/login/. Pre-compiled surface ozone metrics data sets can be downloaded from https://doi.pangaea.de/10.1594/PANGAEA.876108;

- Paper on impacts of ozone on global wheat production, showing a global yield reduction due to ozone of 9.4%, amounting to ca. £24 billion (Mills et al., 2018. Global Change Biology 24: 3560-3574);
- Contribution of the ICP Vegetation Coordination Centre to a guidance document developed by the European Commission on 'Ecosystem monitoring under Article 9 and Annex V of Directive 2016/2284' (National Emission Ceilings Directive; NECD) for implementation by EU Member States;
- Establishment of ICP Vegetation-Asia network as part of outreach activities. Participant will conduct the ICP Vegetation bean biomonitoring experiment in 2018/19;
- Data submission for the 2015/16 moss survey on heavy metals (34 countries), nitrogen (12 countries) and persistent organic pollutants (POPs; 6 countries). Nine countries from Eastern Europe, Caucasus and Central Asia (EECCA region) and eight countries from South-Eastern Europe (SEE) have submitted data. The final report will be published in the coming year.

He also drew attention to a draft of the revised mandate of the ICP Vegetation. Participants were encouraged to comment on the mandate during the meeting. The mandate will be submitted to the Executive Body of the LRTAP Convention for adoption at their meeting in December 2018 in Geneva.

5. The following plenary presentations were given:
   - Mrs. Marina Frontasyeva (Head Moss Survey Coordination Centre – MSCC, Russian Federation) reported on the preliminary results of the 2015/16 moss survey;
   - Mrs. Gina Mills (Head ICP Vegetation Programme Coordination Centre, UK) discussed how the ICP Vegetation could contribute to a cleaner air environment in 2040;
   - Mrs. Katrina Sharps (ICP Vegetation Programme Coordination Centre, UK) reported on the effects of ozone on crops in developed and developing countries;
   - On behalf of Mrs. Kim Oanh (Coordinator ICP Vegetation-Asia network, Thailand), Mr. Harry Harmens reported on the newly established ICP Vegetation-Asia network, a new policy-focused evidence collecting and risk assessment network for ozone;
   - Mrs. Anne-Katrin Prescher (ICP Forests Programme Coordination Centre, Germany) gave an update on ICP Forests activities and invited experts from the ICP Vegetation to a joint expert meeting with ICP Forests in 2019;
   - Mr. Ilia Ilyin (EMEP/MSC-East, Russian Federation) evaluated the spatial distribution of modelled pollution levels in new EMEP grid using heavy metal concentrations in mosses.

   The Task Force (TF) took note of the many deliverables of the ICP Vegetation since the previous TF meeting, acknowledged the progress made by the MSCC to process the 2015/16 moss data, welcomed the suggestions put forward by Mrs. Mills regarding the priorities for ICP Vegetation activities in the long-term (until 2040), welcomed outreach activities to Asia (but noted that activities within the UNECE region remain the main focus of the ICP Vegetation), accepted the invitation from the ICP Forests for a joint expert meeting in 2019 and welcomed the ongoing collaboration with other Convention Bodies such as the other ICPs and EMEP (including EMEP/MSC-East and EMEP/MSC-West). For further details, see Annex I.

6. The next six sessions consisted of two parallel sessions considering the ozone and moss survey sub-programmes. The topics of oral presentations and discussions in these parallel sessions are provided in Annex III. For further details on the content of the oral

presentations we refer to the book of abstracts available on the ICP Vegetation web site (http://icpvegetation.ceh.ac.uk). In addition, almost 40 posters were presented during the meeting, covering similar topics as the oral presentations.

7. In the final plenary session, a summary of the parallel sessions was provided, and conclusions and recommendations were presented, discussed and adopted by the Task Force as described in Annex I. An updated medium-term workplan (2018-20) was agreed and adopted by the Task Force (see Annex II). Mr. Harmens (UK) drew attention to various workshops and conferences in 2018. The Task Force accepted the offer from Romania to host the 32nd Task Force Meeting of the ICP Vegetation in Targoviste, to be held from 18 – 21 February 2019.

8. On behalf of the Task Force, Mr. Harmens (UK) closed the meeting by thanking Germany for supporting and hosting the meeting and acknowledging particularly the contributions from Mrs. Gudrun Schütze (UBA, host of the meeting), Mr. Ludger Grünhage (Justus-Liebig University, Giessen, organiser) and Mr. Jürgen Bender (Thünen Institute for Biodiversity, Braunschweig, organiser). 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. Mr. Harmens thanked the participants of the ICP Vegetation for their valuable contributions to the programme. Last but not least, the TF thanked Mrs. Gina Mills (Head ICP Vegetation Coordination Centre) for her invaluable contributions to the ICP Vegetation for ca. 30 years (including her role as Chair of the Task Force in the past). Mrs. Mills will retire at the end of March 2018. The Task Force also thanked the following participants for their invaluable contributions to the ICP Vegetation over the years: Mr. Patrick Büker (UK; moving to a different job), Mr. Ludger Grünhage (Germany, retiring) and Mr. Eiliv Steinnes (Norway, likely to retire this year).

Annex I.
Decisions and recommendations by the Task Force of the ICP Vegetation as agreed at its 31st meeting, 5 – 8 March 2018, Dessau-Roßlau, Germany. Workplan items for 2018 - 2020 are included in Annex II.

OZONE RELATED ACTIVITIES:

- The Task Force (TF) took note of progress with the workplan item on 'Improving and validating soil moisture index in the EMEP model' and acknowledged the efforts of CIEMAT (Madrid, Spain) to coordinate this work in collaboration with EMEP/MSC-West.

- The TF took note of progress with the Scientific Background Documents (SBD-A and B) associated with Chapter 3 of the Modelling and Mapping Manual of the LRTAP Convention. For SBD-A the TF recommended to finalise Chapter 6 on flux model parameterisation for selected (semi-)natural vegetation species by September 2018. For 2019 for SBD-B, the TF accepted an offer from Sweden and Switzerland to prepare a chapter on interactive impacts of ozone and nitrogen on vegetation and a more detailed chapter on phenology, respectively. The TF recommended that the Programme Coordination Centre should prepare a chapter for SBD-B on guidelines for gap filling in data required for flux modelling, for discussion at the next TF meeting.

- The TF welcomed and accepted the invitation from the ICP Forests to organise a joint expert group meeting with ICP Vegetation in 2019 on 'Assessing and estimating ozone impacts on forest vegetation'.

- Several ICP Vegetation experts advise their ministries on the selection of sites, ozone flux calculations and foliar damage assessments as requirement for assessing air pollution impacts on ecosystems as part of the EU National Emission Ceilings Directive (NECD). The TF encouraged experts from all EU Member States to engage in this process and report on involvement and progress at the next TF meeting.

- The TF welcomed the establishment of the ICP Vegetation-Asia network and discussed how the ozone biomonitoring protocol (with a focus on foliar injury assessments) can be extended and advice to new participants can be improved. The TF recommended to explore the possibility to establish an ICP Vegetation-Africa network and to develop links with 'The Agricultural Model Intercomparison and Improvement Project (AgMIP)'.

- The TF discussed developing areas for ozone for the long term (up to 2040), including:
  a. Long-term environmental improvements based on monitoring of air pollution impacts on ecosystem as part of the NECD;
  b. Flux-based global impacts modelling regarding food production, biodiversity and carbon sequestration, in conjunction with i) the collation of evidence of acute and chronic effects of ozone on vegetation, ii) location-specific flux calculations, iii) region-specific flux effect relationships, and iv) developing links with AgMIP;
  c. Increase cooperation with countries in South-Eastern Europe (SEE), Eastern Europe, the Caucasus and Central Asia (EECCA) and new regional networks;
  d. Establish links within the framework of the draft resolution of the United Nations Environment Programme (UNEP) on 'Preventing and reducing air pollution to improve air quality globally';
  e. Interactive impacts of ozone with other pollutants and climate change on vegetation;
  f. Case-studies of local impact assessments from sites around the world;
  g. The role of vegetation in cleaning the air, including urban environments.

MOSS SURVEY RELATED ACTIVITIES:

- The TF thanked the Moss Survey Coordination Centre (MSCC) at the Joint Institute for Nuclear Research (JINR), Dubna, Russian Federation, for the development of the moss survey Database Management System (DMS). Data in the DMS have been checked by participants and are now ready for final processing and reporting. The TF encouraged participants to make use of the various features of the DMS, report back on any issues to the database manager and suggest new useful features to be included.

- The TF discussed the draft maps and noted that the east-west gradient for metals has become more apparent with more eastern European countries reporting data in 2015/16; metal concentrations are generally higher in eastern than western Europe. Factors contributing to the east-west gradient include:
  a) Higher anthropogenic emissions (conform EMEP-modelled deposition data) and sampling in more polluted areas;
  b) Higher contribution of wind-blown dust from drier mineral soils;
  c) Analyses by neutron activation, resulting in higher values for some metals.

- The TF requested that the MSCC, in consultation with Mr. Harry Harmens (UK) and Mr. Eiliv Steinnes (Norway), conducts a quality check of the submitted data and discusses the fate of any outliers or poor data with the relevant participants. Parties are encouraged to provide explanations for sources of hotspots of heavy metals, nitrogen and POPs ones the draft maps are available.

- The TF recommended that the MSCC delivers the final report by the end of 2018 and recommended to include the following in the report:
  - Maps for heavy metal and nitrogen concentrations in mosses;
  - Charts with median values for 2015 and 2010;
  - Temporal trends (1990 – 2015) of median values for countries that reported at least data for four out of six surveys;
  - A summary section for POPs (ca. 1 page per country).

  The TF recommended that Parties submit a 2-page country report as an Annex to the report.

- The TF recommended that the MSCC starts preparations for the next moss survey in 2020. The TF encouraged the MSCC to finalise the protocol ('manual') for the 2020 survey by the end of 2018. Where feasible, comments by Fernández et al. (Science of the Total Environment (2015) 517: 132-150) on the previous protocol should be included.

- The TF encouraged experts from all EU Member States to engage in monitoring and reporting nitrogen impacts on vegetation under the EU NECD. Nitrogen concentrations in mosses provide an early warning and indication of terrestrial ecosystems at risk from adverse impacts of nitrogen pollution.

- Future activities to explore include:
  - A working group was established to explore the development of a statistical manual for processing elemental concentrations in mosses. The working group includes experts from Armenia, France, Germany (to be confirmed) and the MSCC in the Russian Federation);
  - Monitoring heavy metal concentration in mosses in urban areas;
  - Detailed analysis of composition of particulate matter accumulated on moss surfaces.
  - Making historic moss data available via the DMS or via a repository with DOI number.

Annex II. Medium-term workplan (2018 – 2020) ICP Vegetation
(updated on 5 March 2018)

Workplan items in *italics* for 2018 and 2019 are not included in the biannual workplan (http://www.unece.org/fileadmin/DAM/env/documents/2017/AIR/EB/_E__ECE_EB.AIR_2017_1.pdf) of the LRTAP Convention.

2018:

- Improving and validating soil moisture index in the EMEP model (in collaboration with EMEP/MSC-West and ICP Forests. Lead institute: CIEMAT, Madrid, Spain);
- Report on available evidence of ozone impacts on crops in developing regions;
- Final report of the 2015/16 survey on concentrations of heavy metals, nitrogen and persistent organic pollutants (POPs) in mosses (Lead institute: JINR, Dubna, Russian Federation).

2019:

- Ozone flux-based risk maps for HTAP regions for current and future air pollution emission scenarios (in collaboration with the Task Force on Hemispheric Transport of Air Pollution (HTAP) and EMEP/MSC-West);
- Ozone flux-based risk maps adapted for soil moisture limited areas (in collaboration with EMEP/MSC-West);
- Monitoring manual for 2020 survey on concentration of heavy metals, nitrogen and POPs in mosses (Lead institute: JINR, Dubna, Russian Federation).
- *Report on networking activities in developing regions, including first season field evidence ozone impacts;*
- *Report on ecosystem monitoring activities of ICP Vegetation participants as a requirement for the EU National Emission Ceilings Directive (Directive 2016/2284).*

2020:

- Report on ozone impacts in developing regions (risk assessment, evidence, policy).
- Report on the state of knowledge of interactive impacts of ozone and nitrogen on vegetation (Lead institute: University of Gothenburg, Sweden).
- Report on progress 2020 moss survey on heavy metals, nitrogen and POPs (Lead institute: JINR, Dubna, Russian Federation).

Annex III. Programme of presentations 31st Task Force Meeting of the ICP Vegetation

Session 1: 9:00 – 10:45 Plenary Chair: Ludger Grünhage

09:00 *Lilian Busse*, Head of Division II, Environmental Health and Protection of Ecosystems of the German Environment Agency (UBA) – Welcome and overview of the tasks and activities of UBA.

09:30 *Harry Harmens et al.* – Summary of the achievements of the ICP Vegetation in 2017 and future workplan (2018-2020).

09.50 *Marina Frontasyeva* – Preliminary results of the 2015/16 moss survey.

10:10 *Gina Mills* – Towards a cleaner air environment in 2040: What can ICP Vegetation contribute?

10:30 General discussion.

10:45 – 11:30 Coffee/tea and poster viewing (with authors at poster)

Session 2: 11:30 – 13:00 Plenary Chair: Gina Mills

11:30 *Katrina Sharps et al*. – Quantifying effects of ozone on crops in developed and developing countries.

11:50 *Harry Harmens (on behalf of Kim Oanh et al.*) – ICP Vegetation-Asia: A new policy-focused evidence collecting and risk assessment network for ozone.

12:10 *Anne-Katrin Prescher et al.* – Update of ICP Forests activities.

12:30 *Ilia Ilyin* – Evaluation of spatial distribution of modelled pollution levels in new EMEP grid using heavy metal concentrations in mosses.

12:50 General discussion

13:00 – 14.00 Lunch

Session 3: 14:00 – 15:30 (Two parallel sessions: Ozone and Moss survey)

Session 3a: Ozone - Impacts on food production Chair: Håkan Pleijel

14:00 *Gina Mills et al.* – Tropospheric Ozone Assessment Report: Present day tropospheric ozone distribution and trends relevant to vegetation.

14:20 *Lisa Emberson et al.* – Developing ozone effect modules for crop growth models.

14:40 *Amos Tai et al.* – Evaluation and uncertainty quantification of the impacts of surface ozone on global primary productivity using a coupled atmospheric chemistry-biosphere modeling framework.

15:00 *Jérôme Schneuwly et al*. – Data and model evaluation to estimate O_3-induced crop yield losses in Switzerland.

15:20 General discussion

Session 3b: Moss survey - 2015/16 survey Chair: Harry Harmens

14:00 *Alexander Uzhinsky* – Data management systems (DMS) of UNECE ICP Vegetation moss survey programme: current status and future perspectives.

14:20 **Discussion** on preliminary results moss survey 2015/16 – heavy metals and nitrogen, led by Marina Frontasyeva:

- Quality assurance of the data;
- Spatial distribution: draft maps, resolution of maps; identification of hotspots;
- Temporal trends: comparison with EMEP deposition trends, identification of anomalies;
- Mosses as biomonitors in more arid regions.

15:30 – 16.00 Coffee/tea and poster viewing

Session 4: 16:00 – 17:30 (Two parallel sessions: Ozone and Moss survey)

Session 4a: Ozone – Crop-sensitivity Chair: Kent Burkey

16:00 *Felicity Hayes et al.* – Impact of ozone on physiology and yield of African crops.

16:20 *Pleijel et al.* **–** Fertilizer efficiency in wheat is reduced by ozone pollution.

16:40 *Kent Burkey et al.* – Interactive effects of elevated temperature and ozone on soybean biomass production and seed yield.

17:00 *Victoria Bermejo et al.* – Breeding wheat towards more ozone sensitive cultivars in Spain causes lower tolerance to water stress under an ozone-polluted atmosphere.

17:20 General discussion.

Session 4b: Moss survey – Results 2015/16 Chair: Zaida Kosonen

16:00 *Hilde Uggerud et al.* – Temporal trends and spatial distribution of trace metals in mosses in Norway.

16:20 *Sebastien Leblond* et al. – Interspecies moss comparison in France.

16:40 *Gevorg Tepanosyan et al.* – Studying atmospheric deposition of trace elements in Armenia by the moss biomonitoring technique.

17:00 *Chrysoula Betsou et al.* – Heavy metal concentrations in moss samples in Greece.

17:20 General discussion.

Wednesday 7th March, 2017

Session 5: 08:45 – 10:30 (Two parallel sessions: Ozone and Moss survey)

Session 5a: Ozone - Risk assessment Chair: Ignacio González-Fernández

08:45 *Alessandra De Marco et al.* – A multi-model framework for ozone risk assessment.

09:05 *Sabine Braun* – Validation of the drought module of DO_3SE for Swiss forest sites.

09:25 *Yasutomo Hoshika et al.* – Ozone risk assessment for forest trees as affected by soil water deficit and nutritional availability.

09:45 **General discussion** related to the updated Chapter 3 of the Modelling and Mapping Manual

- Progress with validation EMEP soil moisture index modelling;
- Potential new material for Scientific Background Document B;
- Any other new developments, including EU NEC Directive.

Session 5b: Mosses - Trends **Chair: Sébastien Leblond**

08:45 *Stefan Nickel et al*. – Spatial generalization of canopy drip effects on element concentrations in moss by example of Germany.

09:05 *Zaida Kosonen et al*. – The use of mixed archive moss samples for completing heavy metal data in Switzerland from1990-2010.

09:25 *Yulia Aleksiayenak et al*. – Results of the ten-year study of the territory of Belarus.

09:45 *Pranvera Lazo et al*. – Temporal and spatial distribution on multi-element atmospheric deposition in Albania (2010-2015 moss survey).

10:05 **Continued discussion** moss survey results 2015/16.

10:30 – 11:00 Coffee/tea and poster viewing

Session 6: 11:00 – 13:00 (Two parallel sessions: Ozone and Moss survey)

Session 6a: Ozone - Impacts on grasslands **Chair: Jürgen Bender**

11:00 *Ignacio González-Fernández et al*. – Ozone effects on nitrogen cycling in Mediterranean annual pastures.

11:20 *Seraina Bassin et al*. – Combined effects of nitrogen deposition and climate change on species composition of subalpine grassland.

11:40 *Ane Vollsnes et al*. – The double punch: Ozone and climate stresses to sub-arctic vegetation.

12:00 **General discussion**:

- ICP Vegetation workplan;
- Future development of ICP Vegetation Asia.

Session 6b: Moss survey **Chair: Claudia Stihi**

11:00 *Aneta Krakovská et al*. – Assessment of heavy metal deposition and air pollution in the southern part of Silesian coal basin using moss biomonitoring.

11:20 *Maria Zielińska et al*. – Biomonitoring of the forest areas of southern and north-eastern Poland.

11:40 *Annekatrin Dreyer et al*. – Persistent organic pollutants (POP) in Germany: Results from the 2015/2016 moss and tree sampling.

12:00 *Muhammad Adrees et al*. – Impact of brick kiln emission pollution on surrounding vegetation in Faisalabad-Pakistan.

12:20 **Discussion** on reporting of heavy metal, nitrogen and POPs concentrations in mosses, led by Marina Frontasyeva:

- Maps, tables and text on spatial and temporal trends;
- Country reports;
- Time schedule for finalising report by July 2018;
- Printing of report;
- Any new developments, such as role in EU NEC Directive.

13:00 – 14.00 Lunch

Session 7: **14:00 – 15:45 (Two parallel sessions: Ozone and Moss survey)**

Session 7a: **Ozone - Impacts on trees** **Chair: Rocio Alonso**

14:00 *Hanieh Eghdami et al*. – Time series of ozone flux in German forests - comparison of DO_3SE and FO_3REST.

14:15 *Pierre Sicard et al.* – MOTTLES: a new-generation long-term monitoring stations across Europe for forest protection against surface ozone.

14:30 *Elisabetta Salvatori et al*. – Effects of the antiozonant ethylenediurea (EDU) on *Fraxinus ornus* L.: The role of drought.

14:45 *Lulu Dai et al*. – A comparative analysis of apoplastic and symplastic antioxidative responses to elevated ozone in the leaves of poplar, tobacco and soybean.

15:00 **Discussion**:
- Finalise future work programme, including for ICP Vegetation Asia;
- Feedback from ozone group to plenary (Felicity Hayes);
- Decisions and recommendations related to ozone.

Session 7b: **Moss survey** **Chair: Marina Frontasyeva**

14:00 *Caroline Meyer et al*. – Comparison of pollen uptake by three forested mosses species in France.

14:20 *Vladislav Svozilik et al*. – Verification of the mathematical air pollution dispersion models using neutron activation analysis.

14:40 **Discussion** on:
- Preparations 2020 moss survey: monitoring manual, data collection and management; future developments in EECCA countries;
- Feedback from moss group to plenary (Marina Frontasyeva);
- Decisions and recommendations related to moss survey.

Thursday 8th March, 2018

Session 9: **08:45 – 10:30 Plenary** **Chair: Harry Harmens**

- Reporting back from ozone (Felicity Hayes) and moss sessions (Harry Harmens): decisions and recommendations;
- Medium-term work plan ICP Vegetation 2018 – 2020;
- Decisions and recommendations of the 31st Task Force Meeting;
- 32nd ICP Vegetation Task Force Meeting;
- Other business.