Compilation of research topics that were identified during the preparation of the scientific part of the CLRTAP Assessment report

FOR DISCUSSION

In connection with the work with the Assessment Report, in particular at the workshop in Oslo 20-22 January and the EMEP/WGE Bureau meeting in March, future research and improvements of the activities under the Convention were identified. In this informal document these suggestions are compiled sorted with respect to the topics in the CLRTAP Scientific Assessment Report. These points should be seen as an inspiration for discussions with respect to the Work Plan for 2016/17

A1: Health risks from particulate matter (and other air pollutants)

For most air pollutants covered under the REVIHAAP project, several critical data gaps have been identified (a-e) that prevent a comprehensive and thorough assessment of health hazards and concentration–response functions.

a) More epidemiological studies that contribute to updated exposure–response functions based on meta-analyses for integrated risk assessments will result in a significant reduction in the outstanding uncertainties in risk quantification for the hazards currently identified. (TFH)
b) The coordinated application of atmospheric science, epidemiological, controlled human exposure and toxicological studies is needed to advance our understanding of the sources responsible for the most harmful emissions, physical–chemical composition of the pollution and biological mechanisms that lead to adverse effects on health. Such studies should include better characterization of the pollution mix, improved exposure assessments and better identification of susceptible groups in the general population. (TFH)
c) The correlation between many regulated air pollutants is often high, and large uncertainties exist about the effects on human health of short- and long-term exposures to non-regulated components of the air pollution mix, including some size fractions and metrics of PM. The currently regulated pollutants PM, NO2 and ozone, as well as such important particle metrics as black carbon and coarse and ultrafine particles, often have been assessed independently; this is a critical gap. (TFH, TF MM)
d) Furthermore, the REVIHAAP review has clearly identified traffic as one of the major air pollution sources that affect health in Europe; however, it remains uncertain whether reducing concentrations of currently regulated pollutants will directly lead to a decrease in the health impacts of traffic-related air pollution. (TFH, TF MM, TF IAM)
e) Air pollution should therefore be considered to be one complex mix, and conditions under which this mix has the largest effect on human health need to be identified. In addition to (or even instead of) studies on single components or metrics, the one-atmosphere concept has been put forward as a novel way to investigate the effects on health of complex mixes. Advances in atmospheric modelling, in conjunction with validation studies that use targeted monitoring campaigns, will provide a more efficient way forward in research on health effects, rather than relying on increasing the number of components measured by routine monitoring networks (TFH, TF HTAP, TF IAM)

f) Investigate influence of climate change on atmospheric transport of toxic substances and PM on human health and the environment. (TF MM, TF IAM, TFH)
g) Update WHO air quality guidelines. Goal: take into account latest evidence on air pollution related diseases (e.g. Alzheimer, cognitive disorders of children, etc) and advice on robust policies given uncertainties in knowledge. Method: TFH advice on how to include uncertainties in integrated assessment modelling and cost-benefit studies. (TFH/TF IAM)
h) Ammonia and health. Goal: to what extend is ammonia reduction beneficial for the reduction of PM2.5 exposure? Method: national and European air quality modelling. (TF MM)
i) Local versus European action. Goal: assessing the benefits of European wide action by reducing the costs of local action to meet health targets and the protection of Natura2000 areas. Method: National and European IAM studies. (ICP M&M, TF MM, TF IAM)
j) Investigate influence of climate change on atmospheric transport of toxic substances and PM on human health and the environment (TF HTAP, TF IAM, TFH)

A2: Biodiversity and eutrophication

a) Further integrate studies of N deposition effects on ecosystems between the different ICP monitoring programs. (ICPs)

b) More research on N storage and losses from ecosystems (nitrogen saturation). Time-scales and delays. Also interactions climate-change-air pollution-land use on storage and loss of N from ecosystems (forests, semi-natural). (ICP M&M, JEG DM)

c) More research on modelling plant species and plant community responses (biodiversity) to changes in N deposition (ICP M&M, JEG DM)

d) Continued research on development of process-oriented models for biogeochemistry of nitrogen and carbon in ecosystems, including focus on terrestrial carbon sequestration. (ICP M&M, JEG DM)

e) Seen that excessive nitrogen deposition violates the C/N Threshold Elemental Ratio (TER), there is a need to model the productivity of EUNIS class E under changed atmospheric N deposition in 2020 and 2050 based on community-based averages of TERs for plants and soil invertebrates". (ICP M&M)
f) Marine ammonia emission. Goal: improved estimates of coastal ammonia concentrations and depositions. Method: Closing the dispersion loop of reactive nitrogen through air, soil and water, taking into account factors (nitrate run-off, temperature) that determine ammonia emissions from algae/diatoms in coastal seas. (TF RN/TF IAM)
g) Interaction N and C-cycle. Goal: linking of air pollution with climate and biodiversity issues. Method: dynamic modelling of the C and N cycle in terrestrial and aquatic/marine ecosystems based a.o. on ECLAIRE findings. (ICP M&M/TF IAM)

A3: Acidification of lakes and forest soils

a) In connection with monitoring of acidifications effects on waters, there are needs for case studies of biological recovery over time, and the bottlenecks and factors governing the delayed response of biological recovery. (ICPs)
b) Analysis of long-term data with respect to response times of ecosystems to changes in acid deposition. Especially needed are case studies in forest ecosystems that examine the response of forest vegetation and soil to decreased acid deposition. (ICPs)
c) The nitrogen deposition is in many regions now the main driver for acidification (in Switzerland ca. 85% of the acidifying inputs in forests). Acidification is still a problem, and evaluations show that the critical value of the BC/Al ratio used in CL calculations might be too low to protect the ecosystems. (ICPs, ICP M&M, JEG DM)
d) An update of the state of knowledge regarding acidification parameter (BC/Al, BS%, pH) and effects might be useful. (ICP M&M, JEG DM)

A4: Ozone impacts on health and ecosystems

a) Impact of rising background ozone concentrations on vegetation (note: much evidence gathered in the past on ozone impacts on vegetation has focussed on impacts of peak ozone concentrations (‘episode’), little is known about the chronic impacts of rising background ozone concentrations, currently occurring in Europe). (ICP Veg)

b) Data from long-term, field-based exposure of ecosystems to ozone, including impacts on biodiversity, below-ground processes and upscaling from leaf-level to whole plant to ecosystem responses (using current day realistic ozone profiles and profiles predicted for the future; and include the modifying impact of changing nitrogen deposition and climate (interactions between ozone, nitrogen, drought, flooding, rising temperature and carbon dioxide), including extreme pollution and climate events: Establish tipping points and support the development, parameterisation and validation of multi-factor models capable of predicting multi-stress impacts at a range of spatial and time-scales. (ICP Veg and others)

c) Further development of process-based models to assess current and future impacts of multiple stresses, including ozone, on terrestrial ecosystems, e.g. inclusion of ozone impacts on vegetation in global climate models. (TF HTAP, ICP Veg)

d) Further quantification of ozone impacts on various ecosystem services, including further development of flux-based ozone critical levels for vegetation based on dose-response curves and assessment of epidemiological data to provide further field-based evidence of ozone impacts on vegetation. (ICP Veg)

e) Data on ozone impacts on vegetation in EECCA countries. (ICP Veg)

f) Evaluation of available information on combined effects of O3, N-deposition and climate change – identification of hot-spots of ozone sensitive vegetation and biodiversity effects. Consolidation of the flux-based approach of risk assessment for ozone (parametrisation of still uncertain or missing physiological parameters, combination of different experimental research (free air fumigation, sapflow measurements, eddy-covariance approach) in order to sophisticate the quantitative ozone risk assessment with POD approach, integrative approaches to assess effects on the ecosystem level (effects on resilience, ecosystem functions). (ICP Veg).

A5: Persistent pollutants (HM and POPs)

a) Contribute to the effect community work with information on ecosystem-depended deposition fluxes of HMs and POPs to different land use types to support evaluation of the pollutants adverse effect on human health and the environment. (TF MM, ICP Veg)
b) Update of the state of knowledge regarding fate and effects of Pb, Cd, Hg (maybe more metals) in the environment and update of Chapter 5.5 of the M&M Manual. Reasoning: When the Chapter 5.5 was written, we used state of knowledge from 2000 – 2004. Since then a lot of new knowledge might have been produced. According to the M&M Manual CL should always reflect the current state of knowledge. (TF MM, ICP M&M)
c) Further develop our understanding of mercury distribution and processes in soil and waters. (ICP Waters, ICP Forest, ICP IM)
d) Assess pollution levels of HMs with fine spatial resolution in selected EECCA countries in order to support ratification and implementation of the Protocol on HMs. (TF MM)
e) Emission inventories. Alternative methods for emission inventories for HMs and POPs based on either a combination of monitoring and modelling at regional and local scales, or on substance flow analyses, should continue to be developed, and incorporated into emission inventories. In addition, historical emission data and models are needed to be able to take into account re-emissions of POPs and Hg. (TF EIP)
f) Occurrence in ecosystems and process understanding. As a basis for model testing and development, there is a need for better knowledge on occurrence of HM (particularly Hg) and POPs in relevant compartments of the environment and with global geographical coverage. Especially important for capability to model transfers between different ecosystem compartments such as air-water, air-soil and air-vegetation exchange. Also to link global transport to human exposure there is a need to better understand bioaccumulation/biomagnification in terrestrial and marine food chains. (TF MM, TF HTAP)
g) Abatement strategies. Knowledge on abatement options for Hg and POPs needs to be improved and the knowledge applied to assess benefits of action. Since Hg and POPs have more complex emission sources and pathways than traditional pollutants (point sources, diffuse emissions from industry and households etc.) current tools for assessing abatement strategies (e.g. GAINS) are not applicable. Systematic methods for assessing and evaluating abatement options are thus needed. (TF TEI, TF IAM)

B1: Economic aspects

a) Comparison of the cost-effectiveness of air pollution measures with other measures aimed at increasing life-expectancy. Goal: prove that air pollution abatement should be part of a cost-effective strategy to reduce the global burden of disease. Method: analysis of cost-effectiveness to reduce health risks based on Global Burden of Disease data per country (TFH/TF IAM).

B2: Transboundary and multisectoral approach

a) The WHO Air Quality Guideline for Ozone of an 8-hour mean of 100ug/m^3 cannot be achieved by local actions only for all areas of the LRTAP region. In particular, methane emissions are contributing to the transboundary levels of ozone. (TFH, TF HTAP, TF MM)

b) The WHO guidelines for PM 2.5 are 10/ug/m^3 annual mean and 25 ug/m^3 24-hour mean. The measured values in the CLRTAP region are significantly affected by internationally transport. What sources in which regions are the greatest contributors to this international transport and how do we best achieve reductions that will assist the LRTAP region in achieving the levels? (TF MM, TF IAM)

c) Condensables. Goal: harmonised method to include condensated particles from chimneys (especially domestic stoves) in effective emission estimates used in air dispersion models. Method: either via update of emission guidebook or via co-ordinated adaptation of air quality model input. (TF EIP, TF MM)

d) Evaluate background levels of HMs and POPs in selected EMEP cities. (TF MM)

B3: Air pollution at a wider scale

a) Global emissions of methane are expected to continue to increase significantly by 2030. If this growth is not significantly addressed by a Climate Change Agreement how best can the Convention reach out beyond its borders to other regions to effect reductions in the trend line? WGSR Further collaboration with Asian air pollution initiatives is vital to halt rising background ozone concentrations and to transfer knowledge and skills developed within the LRTAP Convention. (ICP Veg, TF HTAP)
b) Contribution to and visibility in a variety of different reports from other organizations, bodies, programmes and projects. Share information gathered and prepared as required by the Convention with other Conventions and international bodies. (EB, WGSR, secretariat)
c) Collaboration on POPs and HM with Stockholm and MInamata conventions on emission inventories etc. (TF TEI, TF MM)
d) Evaluate pollution of the EMEP domain influenced by global sources and re-emission of Hg and POPs (TF MM)
e) Synergy PM-abatement and abatement of heavy metals and POPs. Goal: illustrate to what extent a focus on abatement of heavy metals and POPs, will contribute to abatement of PM-exposure and related health risks. Method: model assessment of CLE and MFR scenarios for heavy metals and POPs (TF TEI/TF IAM).
f) Enhancing cooperation and activity on modelling POPs and making best use of available data to improve science based, effects oriented strategies for POPs. The main points to be investigated could /should include emission inventories, air-surface exchange, and improving understanding of the kinetic and thermodynamic controls on POPs in the global environment; global transport pathways for new POPs. This would also articulate the many commonalities and co benefits of POPs work with other LRTAP pollutants. (TF MM, TF HTAP ICP Vegetation, ICP Waters)

B4. Air quality and climate change: two sides of the same coin

a) Include climate change parameters in studies of air pollution effects on health and ecosystems. Such parameters many include wind speed, solar radiation, water temperature, ice cove and effect-related parameters such as primary productivity, soil respiration, pCO2 in water, water transparency. (ICPs, TFH)

b) Experiments with whole ecosystems with altered climate and air pollution in various combinations and scales. (ICPs)

c) Consider effects of climate and climate mitigation and adaptation policy on air pollution and on ecosystem sensitivity to air pollution (ICPs, TF MM, JEG DM, TF IAM)

d) Global versus European. Goal: show that a co-operative approach to hemispheric approach to ozone would lead to more health and ecosystem benefits (including crop & wood production) for all regions, than a regional (European, American) approach. Method: global/European modelling (TFHTAP/TFIAM/ICPVEG).

e) Illustrate the short term and local climate benefits (precipitation, temperature) for regions of abatement of short lived climate forcing. Method: linking climate and air quality models (TFHTAP/TFIAM).

B6. Air pollution policy contributes to sustainable development targets

B7. Institutional arrangements

The goal of air pollution policy is to mitigate the damage being done by air pollution emissions to health and the environment. Without the scientific infrastructure to track the effect of our emission reduction policies, how will we know if our strategies are achieving the result? How do we create sustainable funding for this infrastructure to ensure we are achieving our goals?

Requirements for the EECCA Countries

a) Assess pollution levels of HMs with fine spatial resolution in selected EECCA countries in order to support ratification and implementation of the Protocol on HMs. (TF MM)

b) Data on deposition of heavy metals, nitrogen and POPs to vegetation in EECCA countries, as can be assessed every five years by sampling naturally growing mosses, to assess benefits of further emissions reductions. (TF MM)