



Global Challenge Network on Ozone – 2nd Workshop

King's Manor, University of York, 31st of October 2013

Summary report & actions

1. Workshop summary

The second '*Consolidation*' workshop took place on Oct 31st at King's Manor, University of York and was geared towards presentations suggesting possible solutions to (common) issues and aspirations identified in the first workshop, fitness for purpose of new or current technologies, and outlines of possible future research needs. The focus was on where progress is possible now, or where there are reasonable expectations that significant progress can be made. A key outcome of this second workshop is a roadmap for joint grant proposals, publications and other activities emerging from the network.

The second workshop was attended by 22 participants from 13 different organisations. After a short introduction to the workshop by the network coordinator (see ANNEX A for the full programme), a brief round-table introduction allowed all participants to give a statement on their background and what their expectations were from the network and this workshop. After the round table introduction, the three objective champions *Mhairi Coyle* (observations), *Massimo Vieno* (modelling) and *Gina Mills* (effects) presented highlights of current activities and 'hot topics' in each of their domains, providing discussion topics for the following breakout session. The breakout session with the topic "***What can the network do?***" was designed to elicit possible activities of the network and was informed by a set of examples for activities circulated prior to the workshop (see ANNEX C). The key outcomes of this breakout session are summarised in Section 2.

After a lunch break, rapporteurs from the two parallel groups presented short summaries of the group discussions and based on the outcomes of the first group activity, a second breakout session with the guiding topic "***How will we do it? Who? When? Where?***" was conducted in the same groups. Each group reported back and the consolidated outcomes are summarised below in Section 3, with a focus on the identification of tangible outputs and lead individuals/organisations.

The workshop concluded with a short overview on previous actions and activities and a summary on next steps, actions and a tentative work plan for the second phase of the network (Nov 2013 - September 2014). This included a short presentation by Georgina Miles (STFC RAL) on satellite observations of ground level ozone (ECV project) and a short overview on key stakeholder requirements by Lynette Clapp (Defra).



2. Key outcomes

The detailed feedback from the breakout groups can be found in ANNEX C, with the key issues identified as follows:

- Spatial and temporal heterogeneity of tropospheric ozone concentrations (modelled and observed), including vertical profiles and stratospheric incursions.
- Quality assurance of ozone measurements (including the testing and development of fast ozone sensors)
- The assessment of effectiveness of policies in reducing tropospheric ozone concentrations.
- Data and meta-data on ozone observations and modelling (including ozone fluxes), especially making use of earth observation data products.
- Interactions of tropospheric ozone with other pollutants and the influence of climate change (past and future climate) on deposition and effects.

In ANNEX C, specific actions and leads for these have been listed and for each of these, a short profile comprising a timeline, activities and the most appropriate funding support, if required, will be identified in December 2013, with the aim to schedule and implement these activities in spring and early summer 2014. In addition, the proposed funding allocation to different support mechanisms will be discussed with the FUTURES programme leader at STFC to ensure that these activities are in line with the overarching plans of the funding stream for the Global Challenge Networks. The matrix of planned activities, lead individuals/organisations and implementation means will be made available on the network website in early January 2014.

3. Actions

3.1. General actions

Some immediate actions have again been identified, e.g. on the use of the network website, which will be implemented as soon as possible. These are:

- Ozone Network Website should contain table of known 'campaign' datasets, and details of how to access these and the UK network data held in UKAir.
(Action for Network core team to implement and set up means to collect this information)
- A monthly digest email showing updates to the website would keep the network's profile high.
(Action for Network core team to implement)



- A symposium could be scheduled for 2015 to highlight ozone research in UK and its interdisciplinary connections, either as a workshop tagged on to the ECLAIRE final meeting, or possibly as an offered EGU session.
(Action for Stefan Reis to explore options)
- Expansion of the network beyond the UK should be further explored, initial contacts with researchers in the US (e.g. Denise Mauzerall, Princeton University) and within Europe should be followed up and intensified.
(Action for Stefan Reis)
- Continuation of linking to national and international activities, e.g. COMEAP, Defra Air Quality Modelling Advisory Group, UNECE Convention on Long-range Transboundary Air Pollution and its task forces (TFEIP, TFIAM, TFMM, ICP Vegetation, WG Effects etc.). Explore options for joint meetings and other activities, publications, networking to promote the GCN on Ozone in these fora.
(Action for Network members with roles in these organisations)

3.2. Specific actions

During the first and second breakout sessions, specific actions and activities of the network were discussed in detail, based on a proposal by the core team for exemplary activities circulated before the workshop (ANNEX D). These included, but were not limited to:

- **Travel grants** (individual contributions of up to £500 for UK and £1,500) for international travel of network members to attend conferences or workshops with the aim to promote the network and contribute to national and international ozone research. Travel grants are particularly welcome for exchange visits between network partner institutions, e.g. to allow PhD students or PDRAs, as well as junior and senior researchers to spend time developing new methods, measurement approaches or working on joint publications together for a short period of time.
- **Workshop/Event support** (contributions of up to £5,000 for individual events) for network members to organise an ozone-themed event, covering venue and infrastructure, catering, T&S and communication materials etc.
- **Publication support** (contributions of up to £500 for individual publications) for either gold open access journal articles, brochures or other publications to communicate and disseminate core topics of the ozone research in the network.

Pending agreement of the STFC project officer, total funds of up to £10,000, £15,000 and £5,000 would be allocated for these three activity categories within the existing funding budget to these three areas and an open call within the network, but open as well to applicants not currently involved in the network, to extend and include the wider ozone



research community, would be launched in early 2014 (~February 2014) and all activities would have to be concluded by September 2014. The evaluation process as outlined in ANNEX D would be formally implemented and led by the network core team, as well as support from the wider network for peer-review of funding applications under this call. In ANNEX C, already some specific activities are detailed with lead individuals identified to take them forward.

These are (more details can be found in ANNEX C, 2nd breakout session notes):

- Comparison of vertical ozone distribution from EMEP model and satellite ozone data (Lead: **Georgina Miles**, STFC; **Massimo Vieno**, NERC-CEH)
- Analysis of how effective policies have been so far (Lead: **Martin Williams**, KCL)
- Quality assurance for ozone measurements (Lead: **Neil Cape**, NERC-CEH)
- Comparison of modelled and measured ozone fluxes (Lead: **David Carruthers**, CERC)
- How to use models to design monitoring networks for human health effects studies based on personal monitoring (Lead: **Stefan Reis**, NERC-CEH)
- Retrospective analysis of monitoring data to identify possible stratospheric incursions to ground level, and comparison with met reanalysis datasets (Lead: **Martin Williams**, KCL)
- Workshop on Control Policies and Synergies with CO₂ (Lead: **Ruth Doherty**, UED)
- People, their skills and instruments/tools available (Lead: **Mhairi Coyle**, NERC-CEH)
- Compilation of available ozone Meta-data (Lead: **Katie Read**, U York)
- Review how the UK ozone climate has changed from peaks/episodes to high ambient background levels (Lead: **Mhairi Coyle** and **Gina Mills**, NERC-CEH; **Lisa Emberson**, SEI-York)

The leads identified for each of these items are kindly asked to develop a work plan for the activity, consider outputs and implementation, resource requirements and timing of potential events and communicate their plans to the network coordinator by the end of January, 2014. The outputs emerging from these activities and other planned publications will be included in the communications plan for the 2nd year of the network and published on the network website accordingly.



ANNEX A: Programme

Start time	Activity	Lead
09:00	Arrival & Coffee	--
09:30	Welcome and opening the workshop, plan for the day	Stefan Reis
09:45	Introductions/roundtable – all network partners <i>short (~2 min introduction of who everyone is and what their personal and institutional interest in ozone is, expectation from the network and workshop) – no slides, just verbal update</i>	Scott Jones
10:30	Proposals for network activities in the consolidation phase <i>Short presentations & key questions - 5 min presentation and 5 min discussion each</i>	
	... on observations (sites, sensors, ...)	Mhairi Coyle
	... on modelling (space, time, scales, ...)	Massimo Vieno
	... effects (health, crops, ecosystems, ...)	Gina Mills
	Integrating activities and preparation of the breakout session	Scott Jones & Stefan Reis
11:15	First breakout session – discussion and ideas to implement network activities (“What can the network do?”) <i>2 parallel groups with a focus cross-cutting activities covering aspects of observations, modelling, effects; discussing the same key questions</i>	Scott Jones & Stefan Reis
12:00	Lunch	
13:00	Reporting back from first breakout session <i>2 x 5 min summary presentation & 10 min discussions</i>	Scott Jones
13:45	Second breakout session – developing a roadmap for implementation, timing, allocation of resources (“How will we do it? Who? When? Where?”) <i>2-3 parallel groups discussing specific activities identified in the first breakout group session and developing an outline work plan and roadmap for implementation</i>	Scott Jones & Stefan Reis
14:45	Coffee	
15:00	Reporting back from second breakout session <i>3 x 5 min presentation & 5 min discussions</i>	Scott Jones
15:30	Integration and cross cutting activities – Discussion on: “How can we enhance collaboration ... between observationists, modellers and effects experts? ... between the UK and international science community (e.g. Ozone ECV project, IOC, others)? ... between science and stakeholders?”	Stefan Reis Georgina Miles
16:15	Workshop close	



ANNEX B: List of Participants

	First Name	Surname	Organisation	Email
1	Judith	Agnew	STFC RAL	judith.agnew@stfc.ac.uk
2	Neil	Brough	British Antarctic Survey	nbro@bas.ac.uk
3	Patrick	Bueker	York University	patrick.bueker@york.ac.uk
4	Neil	Cape	CEH	jnc@ceh.ac.uk
5	David	Carruthers	CERC	david.carruthers@cerc.co.uk
6	Lynette	Clapp	Defra	lynette.clapp@defra.gsi.gov.uk
7	Mhairi	Coyle	CEH	mcoy@ceh.ac.uk
8	Ruth	Doherty	University of Edinburgh	ruth.doherty@ed.ac.uk
9	Lisa	Emberson	SEI University of York	l.emberson@york.ac.uk
10	Zoe	Fleming	University of Leicester	zf5@le.ac.uk
11	Mathew	Heal	University of Edinburgh	m.heal@ed.ac.uk
12	Scott	Jones	<i>Mind-the-gap *</i>	<i>Scott@mind-the-gap.net</i>
13	James	Lee	York	james.lee@york.ac.uk
14	Georgina	Miles	STFC	georgina.miles@stfc.ac.uk
15	Gina	Mills	CEH	gmi@ceh.ac.uk
16	Sarah	Moller	NCAS & Defra	sarah.moller@york.ac.uk
17	Katie	Read	York University	katie.read@york.ac.uk
18	Stefan	Reis	CEH	srei@ceh.ac.uk
19	Massimo	Vieno	CEH	mvi@ceh.ac.uk
20	Oliver	Wild	Lancaster University	o.wild@lancaster.ac.uk
21	Martin	Williams	Kings College London	martin.williams@kcl.ac.uk
22	Kirsten	Wyness	Newcastle University	kirsten.wyness@newcastle.ac.uk

* *facilitator*



ANNEX C: Notes from breakout groups

1st session - What can the network do? What are the big questions?

- deploying sensors to understand how sensors/models differ and how they measure physically different things (roundtable comparison results, central point for the network?)
- cross-validation of sensors, high vs. low-cost
- spatial and temporal variability, how to measure better?
- optimum design of field measurements to allow plant effect models to improve
- measurement of fluxes – how to improve? relative vs. absolute change in concentration estimated from low-cost sensors, vertical flux measurements
- is there a no-effect threshold for ozone wrt health? if there is not, then the health impacts globally would be greater than generally thought
- biogenic emissions, are these adequately represented in the network? or links? Plant physiology – e.g. how does ozone exposure change VOC emissions (could be investigated by measurements in solar domes)
- current vs. future ozone related issues? IPCC? Plant effects, water system interactions, broad linkage for ozone in biosphere (e.g. hydrology), Earth System Modelling (how to feed into this?) global (people, focus)? long-term, international links?
- aim to stimulate larger research projects/proposals and get better at working together, with a focus on cross-discipline, and representation of diverse interests – who else do we need to involve? dynamical/meteorology; chemists, epidemiologists, data assimilation
- modelling scales from small to large, including future climate effects with meteorology
- the network can provide expertise and facilities, making list of relevant facilities and expertise, e.g. solar dome measurements, labs (for the network website)
- need to avoid presenting solutions without problems
- possible output: compendium of ozone research in the UK, to inform policy/policy makers? Important, because ozone is a difficult pollutant in policy terms, but an important one for health, crops, climate!
- Unique selling point of the network: UK focal point for ozone to engage with other networks, can contribute by organising symposia, be forward looking, applying a co-benefit approach in order to raise profile of ozone (in science, policy, general public)
- prepare a European network application? (e.g. COST Action)
- evidence-based emission limit – informing policy
- satellites to verify/validate vertical distribution within models, understand the differences and identify what's missing
- joined-up approach needed



2nd session – *proposed activities*

- **Comparison of vertical ozone distribution from historical EMEP model and satellite ozone data:** this could focus on 3 summers, and on Mediterranean, with additional comparisons with available ozone sonde data. Work could start almost immediately as a scoping study, with more time required for full comparison, and identification/analysis of available sonde data.
(Lead: Georgina Miles, contributions Massimo Vieno and others to be identified)
- **Analysis of how effective policies have been so far?** Although peak concentrations decreased from 1970s, there have been no obvious changes in past decade. What is appropriate metric to use for trend detection – 95thile or hours over 60 ppb? Effectiveness needs to be evaluated at global, regional and local scales. This is potentially a large project involving analysis of measurements and models; for measurements care will be needed in identifying ‘representative’ sites, preferably with other available data to aid in interpretation of trends. Patrick suggested some similar work may be already underway. The study would be confined to the UK in the first instance. Next stage is discussion with interested parties, possibly with small workshop/meeting.
(Lead: Martin Williams)
- **Quality assurance for measurements.** Priority for comparison of different types of passive ozone samplers across the range of UK conditions, but could extend to comparisons of other low-cost techniques. Use co-location at AURN sites to establish ‘calibration factors’ for ozone passive samplers, and develop an understanding of how discrepancies arise. Costings could be estimated quickly, but need negotiation with AURN and LSOs about sample changeovers. Could establish pilot at key sites over short period before full grant proposal.
(Lead: Neil Cape or other)
- **Comparison of model and measurements of ozone fluxes.** Needs method for extraction of fluxes from models, and collation of all UK ozone flux measurements. Eventual aim is link to ecosystem responses. Initial stage is compilation of measurement data, followed by discussions on whether sufficient overlap exists to make comparisons meaningful.
(Lead: David Carruthers)
- **How to use models to design monitoring networks for human health effects studies based on personal monitoring.** Some work on PM and NO_x is already underway at KCL. Mixtures of ozone with other pollutants will be important in designing the monitoring strategy. Next stage is discussion/workshop with interested parties.
(Lead: Stefan Reis)



- **Retrospective analysis of monitoring data to identify possible stratospheric incursions to ground level, and comparison with met reanalysis datasets.** This may permit identification of typical incursion conditions, and spatial/temporal extent which could be used to estimate impact on strat/trop exchange budgets for ozone. Possible PhD topic, could start immediately.

(Lead: Martin Williams)

What questions can the network help answer and what are the issues we are concerned about?

- It is often assumed that ozone is relatively **spatially** homogenous, compared to other compounds such as NH₃ - Is this true? How representative are measurements at a single point of concentrations across the wider area, particularly in urban environments? The methodology used to map ozone from a sparse rural network to a 1 km x 1 km scale, using altitude as a surrogate for wind speed and the range of the diurnal cycle, has never been verified in the field.
- How does the **vertical structure** of ozone in the troposphere influence spatial variability on local/regional scales and how does this impact of exposure metrics.
- What **metrics** should we focus on, can we derive a single metric to protect human & ecosystem health?
- How does **surface deposition/uptake by vegetation** influence exposure – particularly in urban environments, can designing the environment to increase uptake mitigate effects?
- How do we **assess personal exposure and disseminate the information** to the relevant groups without causing people to avoid health outdoor activity.
- How can we best **utilise and integrate data** from different platforms (surface sites, towers, UAV's, aircraft and satellite)
- What kind of **citizen science projects** could we develop? ICP-Vegetation are developing a phone app for visible injury to vegetation – individuals send in photos for assessment. Could the ICP-Veg app be linked to asthma episodes in sensitive individuals (visible injury generally only occurs with episodes of ozone > 80 ppb or so). What can we learn from the Heathrow project with many low-cost monitors over a small area? Investigate the BBC archives for the experiment they did in the 70's where children were shown how to make little ozone detectors (homemade Schoenbein paper) with a view to repeating it (local science festival projects?, http://ciese.org/curriculum/bus/teachers/teachers_ozonetools.html)

What do we want to do and how can we achieve it?

- **Workshop on Control Policies and Synergies with CO₂:** simple spreadsheet based source-receptor model, could be applied to the UK; Toolkits for assessing effects of



control measures. Long-range transport/local controls.

(Lead: Ruth Doherty)

- **People, their skills and instruments/tools available:** Compile a list including commercial manufacturers; Review instruments and methods available; Define future needs; Bring group together with manufacturers/instrument developers
(Lead: Mhairi Coyle, with input from Zoe Fleming, Katie Read & Judith Agnew)
- **Meta-data:** Compile a list of all UK ozone data sets, including short-campaigns; Including ozone sondes & deposition data;
(Lead: Katie Read)
- **Review how the UK ozone climate has changed from peaks/episodes to high ambient background:** UK data starts ~1972 with the PORG database and rural network being established in the 80's; Identify sites with consistent high quality long-data sets; Examine trends in several metrics (exceedances, averages etc); Link with emissions, annual weather patterns and hydrology (hot dry summers – low deposition, high ozone and vice-versa, BVOC?); Is the current chemical climate VOC or NO_x dominated;
(Lead Mhairi/Lisa/Gina, invite others to contribute to sub-group)

General issues:

- What is the relative importance of local, regional, long-range ozone in relation to air quality thresholds for different receptors?
- Vertical structure – important for local/regional spatial variability?
- Effects metrics – which and for what purpose?
- Is spatial heterogeneity an issue?
- Personal exposure, incl. indoor exposure (not currently the focus of the network)
- How representative is a single point measurement (in particular regarding urban heterogeneity)? Measurements using satellite data in combination with UAVs/aircraft/towers/surface to identify sources, hotspots.
- ICP Vegetation mobile phone app under development to map ozone effects (Feb 2014, full release in 2015), could be linked to measurements/episodes and expanded to human health
- Link vegetation/surface deposition/materials and exposure/health effects and citizen science



ANNEX D: Proposed Network activities – circulated prior to the workshop

The following are options for different support mechanisms for the network's core objectives, i.e. expanding the network, developing new sensors etc. Proposals for funding have to be community-led and fall within the remit of the network and are to be organised and completed by mid 2014:

- **Travel grants: (up to a total of 10,000£)**
 - individual travel grants to attend national or international conferences and workshops, or visit a network partner institution to exchange knowledge/skills and foster collaboration on ozone across the network
 - limited to up to £500 for UK events and £1,500 for international travel per person, resp. T&S for exchange visits depending on detailed cost justification on a by-case basis
 - **Requirement:** application with a short (max. 200 word) justification for participation) at least 3 months prior to the event; active participation, i.e. having a poster/paper accepted; information about the event, its relevance for ozone research and willingness to disseminate network results/activities; detailed outline of research/knowledge exchange activities during a visit
 - **Decision:** network coordination team (and STFC project officer?)
 - **Example activities:** attending a conference presenting work on ozone (that would otherwise not be possible/funded), travel support for PhD Students and PDRAs on ozone related work, exchange visits to share expertise or learn new methods/instruments at a network partner institution.
- **Workshop/event support: (up to a total of 15,000£)**
 - institutions wanting to organise a topical event with strong relevance for ozone research & communication; can be related to monitoring, modelling or effects, or a combination of these; can include field intercomparisons of different sensors
 - contribution of up to £5,000 (depending on the number of participants, international scope and scale) per event
 - **Requirement:** outline of the event, scope and scale, topic, anticipated/invited participants, timing, outputs; linking to ozone network on workshop material and open to network partners if funded
 - **Decision:** network coordination team (and STFC project officer?)
 - **Example activities:** proposal writing workshops, measurement comparisons/validation experiments etc.
- **Publication support (up to a total of 5,000£):**
 - includes support for brochures and other ozone related material, as well as support for (not full cover of) page charges for gold open access publication of high level publications on ozone
 - contribution of up to £500 for individual requests (more, if core activity of the network)
 - **Requirement:** application with a short justification explaining the relevance and relationship to the network; publications, if funded, would acknowledge the funding support in the acknowledgements;
 - **Decision:** network coordination team (and STFC project officer?)
 - **Example activities:** (preferably) papers authored by several network partners, reviews of current state-of-the-art of monitoring or modelling ozone, processes, effects.



ANNEX E: Status of actions from 1st workshop

D.1 Network infrastructure and composition

- Circulating 1st workshop notes & presentations to the network **completed**
- Circulating Doodle for 2nd workshop timing **completed**
- Developing draft overview notes on topics observations, modelling, effects **in progress (Phase 2)**
- Website development & group profiles **completed**
- Increase the interaction with STFC staff (e.g. Damien Weidmann, Brian Kerridge - remote sensing group at RAL, Richard Siddins, Georgina Miles - earth observation) **in progress (proof of concept study with Damien Weidmann through Mhairi Coyle; collaboration on stratospheric incursions with Georgina Miles through Massimo Vieno)**
- Explore interactions involving STFC large data store (Victoria Bennet) and fast computers (e.g. JASMIN, CEMS) **in progress (Stefan Reis linking to NERC IEM strategy)**
- Link to other GCN network activities and reports (e.g. env. radioactivity) **in progress**

D.2 Networking activities

- Develop a scheme for funding applications from network participants for exchange visits, travel grants, STFC collaborations, joint field campaigns etc. **completed**
- Explore the possibility for summer/winter schools, which could be hosted by STFC (e.g. Abingdon) **in progress (Stefan Reis to discuss with STFC project officer)**
- Develop a roadmap for horizon scanning, future scenarios e.g. to explore a potential thematic workshop on future development of ozone concentrations **in progress (Stefan to contact Jeff McBride @ STFC)**