Air Quality in Scotland

Welcome to the first Scottish Air Quality Database (SAQD) stakeholders newsletter. This newsletter is produced on behalf of the Scottish Government by Ricardo Energy & Environment (Ricardo) and is designed to provide regular updates and news regarding the SAQD and local air quality matters to all stakeholders. This may include; updates to the network; new information on air quality issues; updates on changes in policy and procedures; new initiatives and events; technical reports; and how to access data using the Air Quality in Scotland website.

If you have any information which you think would be beneficial to include in a future newsletter, please email us at info@scottishairquality.co.uk.

NEWS

New dates for the SAQD Annual Seminar and Stakeholders Meeting

We have taken the feedback from last year's seminar and stakeholders meeting on board and the dates have been revised. The annual seminar will be now held in January of each year starting next year (2017).

The 2017 Seminar will take place at Doubletree by Hilton in Edinburgh City Centre on 24th January 2017, speakers to be confirmed very soon. Please save this date in your diary and further information regarding the day will follow in the near future.

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Smoke Control Area guidance provided on the Air Quality Scotland website

Many parts of Scotland are designated Smoke Control Areas. These areas define where you can't emit smoke from a chimney unless you're burning an authorised fuel or using exempt appliances. To find out what the current guidance is, with regards to what fuels and appliances are permitted in Smoke Control Areas, please visit http://www.scottishairquality.co.uk/laqm/smoke-control-areas.

New United Kingdom (UK) 2013 Reference Year Background Maps

Scotland Specific background maps of NOx, NO_2 and PM_{10} concentrations for Local Authority Review and Assessment purposes have recently been updated. The updated maps use baseline data for 2013 (updated from 2011), in-line with recent updates to the Department for Environment, Food and Rural Affairs (Defra) UK-wide background maps. Background maps are provided for each 1 km x 1 km grid square in Scotland for 2013 to 2030. They are available for download by local authority from the Air Quality in Scotland website (http://www.scottishairquality.co.uk/data/mapping?view=data).

Please note that Scotland specific maps are not currently available for $PM_{2.5}$. It is recommended

that Defra UK-wide background maps be used for this pollutant.

Update to Scottish Air Quality website maps

In addition, annual mean PM_{10} and NO_2 modelled concentrations have been updated to 2014 at background and roadside locations. Maps of modelled annual mean PM_{10} and NO_2 concentration for Scotland can be found here http://www.scottishairquality.co.uk/data/mapping.

New reports published by Defra and Devolved Administrations

The Scottish Government, Defra, Welsh Government and the Department of the Environment in Northern Ireland recently published the following reports which can be downloaded from the 'Technical reports' page of the SAQD website.

- Investing the Feasibility of Innovative Technologies to Improve Air Quality Monitoring over the Medium to Long Term.
- UK Emission Mapping Methodology 2014

AIR POLLUTION IN SCOTLAND 2015 BROCHURE

Figure 1. 2015 Air Quality Scotland Brochure

The ninth in an annual series Air Quality Scotland Brochure 2015 is now available to view online at http://www.scottishairquality.co.uk/news/reports?view=technical&id=530 .

SCOTTISH ENVIRONMENT PROTECTION AGENCY

For each newsletter edition, we aim to gather updates from the Scottish Environment Protection Agency (SEPA) on their involvement with the SAQD, local community and various air quality activities.

Recent Air Quality Events

Throughout the summer, SEPA along with Glasgow City of Science and Young Scot worked in partnership to host a series of events around air quality. These events, supported by Scottish Government, were aimed at engaging young people across Scotland as part of this year's VentureJam, which is a national programme for young people to develop fresh ideas for solving real-world challenges. This year was no exception; with the focus on developing novel digital solutions that promote, protect and improve air quality.

AirTime

The events were kick-started in June by AirTime (run as part of the Glasgow Science Festival) which immersed young people in the challenges associated with air pollution. A collection of fun activities included science experiments supported learning around the harmful effects of air pollution. South Lanarkshire Council provided a practical floor game on city planning and the complexities of dealing with Air Quality Management Areas (AQMA), whilst others provided hands-on demonstrations showing how lifestyle choices affect air quality.

VentureJam

AirTime was just a taster, preparing the young, would-be entrepreneurs for this year's three-day VentureJam workshop. Young people from across Scotland were brought together to co-design and co-develop new products that would improve the air we breathe.

Over the weekend, teams developed their ideas supported by a team of mentors from the world of television, gaming, product design, 3D

animation, legal experts and environmental scientists.

Figure 2. One of the VentureJam teams presenting their idea

A wide range of digital innovations were conceived and developed. At the end of the weekend teams pitched their ideas, with three selected to go forward to the Scottish innovation summit, Venturefest. The three winning teams from the VentureJam weekend (Futuristic 5, Ninions and Project AirTech) were supported by professionals from Social Investment Scotland (SIS) to develop their pitches ahead of Venturefest Scotland. The trio each presented to top innovation experts and business investors in the hope of persuading them to back their concepts. Project AirTech secured direct investment from SIS to take forward their idea; an app that reduces people's exposure to air pollution by directing them away from the most polluted areas, whilst promoting sustainable travel modes through a rewards-based scheme.

The winning team was also interviewed as part of BBC Scotland's Education Radio programme on young developers.

Figure 3. The winning team, Project AirTech, of VentureFest 2016

LIGHTING UP GLASGOW

To support our PR campaign, we projected dramatic aminations onto landmark buildings across Glasgow including the SECC, City Chambers and Glasgow Science Centre.

Figure 4. One of the strong advertisements highlighting air pollution projected across Glasgow's iconic SECC

Attracting both social media and press attention, this was an excellent way to raise awareness around the importance of taking positive action to tackle air pollution.

Contact: Colin Gillespie, SEPA

LOCAL AUTHORITY

In this section we plan to showcase local authority's contribution to Local Air Quality Management (LAQM). The aim of this section will be to provide information on what air quality initiatives the local authority are undertaking and the experiences gained. If you would be interested in contributing, please send an email to info@scottishairquality.co.uk. Many thanks to Kenny Bisset (Lead Environmental Officer Fife Council) for providing the first local authority article!

FIFE COUNCIL

Efforts to improve air quality in Fife have recently been highlighted as an example of 'Best Practice' by the Scottish Government and Defra. Fife council was one of the first local authorities in Scotland to develop an Air Quality Strategy in 2015, and its progress report setting out an

overview of air quality and how issues should be tackled (including emphasis on a collaborative approach) has been described as 'thorough' and 'comprehensive' by the Scottish Government and SEPA.

In general, Fife's air quality is good, but pollution can be caused by a range of substances being released into the air. Emissions from vehicles – nitrogen dioxide and fine particulate matter – are the main sources of air pollution for local authorities to deal with, and Fife council has established an extensive monitoring network targeted at the busiest roads in Fife, including the introduction of four monitors for the pollutant $PM_{2.5}$.

Actions taken to tackle air pollution caused by traffic congestion include traffic flow improvements, the promotion of cycling and walking, and the adoption of cleaner, greener technologies, such as low emission vehicles.

Bonnygate in Cupar and Appin Crescent in Dunfermline were previously identified as potential 'pollution hotspots' or Air Quality Management Areas (AQMA) and Action Plans (AQAPS) were implemented to reduce the concentration of pollutants, mainly caused by the build-up of traffic. The latest monitoring results for 2015 at these locations have revealed significant air quality improvements as a result of action plan measures.

Further council-led initiatives to tackle air quality issues include the introduction of a greener fleet of vehicles to reduce emissions, the establishment of an extensive electric vehicle charging network, and the setting up of the Fife ECO stars project, encouraging fleet operators to improve their eco-credentials, with this scheme extended to the taxi fleet in Fife.

The air quality education for schools programme is also being rolled out in the Fife area.

Figure 5. Fife ECO stars project launch

Contact: Kenny Bisset, Fife Council

SAQD QAQC ACTIVITIES

Since 2006, all automatic monitoring data within the SAQD on the website has been subject to harmonised QA/QC procedures. This ensures that all data in the database are quality assured and are traceable to UK national calibration standards for the various pollutants.

As such, Ricardo will begin the winter 6 monthly audits this month, December 2016. Ricardo will contact each local authority in advance to confirm the date of the scheduled audit. If there are new Local Site Operators (LSO) that require full training, please let Ricardo know. Likewise, current LSO may also attend site to meet the auditor and ask any questions.

HOW TO

This section gives advice to readers on all aspects of the website, including accessing/downloading data, as well as to address general site queries. If you have any requests that you would like included within the newsletter, please feel free to contact us.

ACCESS ANNUAL STATISTICS

The data selector tool has recently been updated. It has been separated into two distinct headings on the side bar menu: 'Measurement and Simple Statistics' and 'Annual Exceedance and Statistics'. Please take a moment to familiarise yourself with the new layout. If you have, or notice, any issues please contact Ricardo.

Within the 'Data & Maps' tab of the SAQD website, select 'Annual Exceedance and Statistics' from the side bar menu and follow these steps:

Firstly, the parameter group of interest must be selected from the drop down menu. Once complete select the 'Step 1' button. Secondly, the pollutant of interest and the desired year should be selected from the drop down menu. Once complete select the 'Step 2' button. Next, select the appropriate local authority region. Once complete select the 'Step 3' button. Lastly, select 'Go' and the results will be displayed on screen.

UTILISE THE QR STICKERS

Ricardo have provided QR code stickers to the outside of each air quality monitoring hut in a prominent position. These stickers, once scanned, will direct the user to the appropriate site information page on the SAQD website. These QR codes can be scanned using any QR code reader app on your smart phone. Try it out below!

Figure 6. SAQD QR Code

OPENAIR DATA ANALYSIS TOOL

Openair provides free, open-source and innovative tools to analyse, interpret and understand air pollution data using 'R' (a free programming language). Under the 'Data & Maps' tab on the SAQD website, select 'Openair data analysis tool' on the side bar menu. There are 12 different tools available under Openair, two of which are described below.

Time Plot

The 'Time Plot' function is designed to quickly plot time series of data, for one or several pollutants, for one or more years.

Monitoring sites are chosen from the drop-down 'Site Name' list. Multiple sites can be selected/de-selected by pressing and holding the 'CTRL' key. If there are no common measurements at the sites selected, *'Sorry, no pollutants found for the data options selected'* will be displayed.

When multiple sites are selected, the number of pollutants displayed in the pollutants list may decrease to reflect the extent of corresponding pollutant measurements undertaken at different sites within the network. To confirm which sites measure a certain pollutant, first choose the pollutant from the drop-down menu under 'Variables'. This will reduce the list of sites to only those at which the pollutant is measured. Then select the sites you would like to use.

Data can be plotted over user defined date ranges by clicking on the drop-down lists containing the day, month and year. Data can be chosen on an annual basis by highlighting the 'Specific Years' option and using the year drop-down menu to alter the start and end year. 'Averaging Time' sets the averaging period to be applied to the data for plotting. The options are: 'Default', i.e. no averaging applied, 'Hour', 'Day', 'Week', 'Month', 'Year' and 'Season'. Openair allows a data capture threshold to be set where averaging is applied using this tool. A data capture threshold of 75% has been set for the Time Plot function, meaning that 75% of data has to be present for the average to be calculated.

If the 'Stack by Year' tick box is selected then the time series will be plotted as separate series stacked by year. This is useful to see detail where a long time series is plotted particularly if

the averaging period is short. The 'Normalise' option can be set to normalise the plotted time series by their mean values. This is useful to observe the relative change in the plotted values, for example to compare the change in pollutants with concentration levels of different magnitudes.

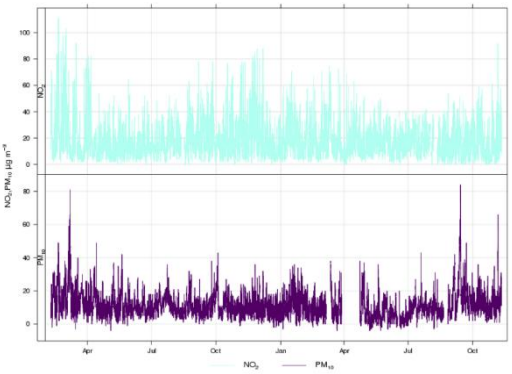

Figure 7. Time plot highlighting NO_2 and PM_{10} data from 2013 to 2014 for one site (colour scheme: increment)

Wind/Pollution Rose

The 'Wind/Pollution Rose' tool summarises either wind speed or pollutant concentrations by wind direction.

Similar to the 'Time Plot', monitoring sites are chosen from the drop-down 'site name' list. Multiple sites can be selected/de-selected by pressing and holding the 'CTRL' key. Each monitoring site on the website includes a default modelled wind direction taken from the UK Air Quality Forecast. As there is a reliance on the Openair tool having wind direction data available, certain time ranges may not be available for some sites.

Data can be plotted over user defined date ranges by clicking-on the drop-down lists containing the day, month and year and using these to change the start and end dates accordingly. Data can be chosen on an annual basis by highlighting the 'Specific Years' option and using the year drop-down menu to alter the start and end year. Type allows the user to split the data in several ways. The default option will produce a single plot using the entire data over the selected time range. The 'Colours' drop-down menu provides the user with more control over the colour scheme used to plot.

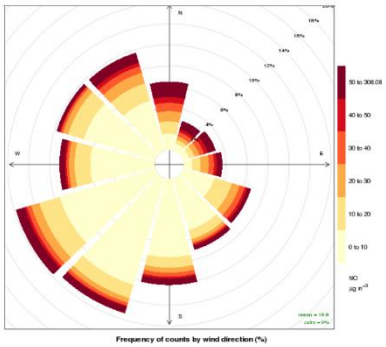

Figure 8. Pollution rose plot displaying NO from 2012 to 2013 (colour scheme: heat)

Please note that rose plots can only be produced for one site and one pollutant (or modelled wind speed) at a time on this website.

LAQM POLLUTANT OVERVIEW

Within LAQM there are eight pollutants of concern, these are nitrogen dioxide (NO_2), fine particles (PM_{10} & $PM_{2.5}$), benzene (C_6H_6), 1,3-Butadiene (C_4H_6), Lead (Pb), sulphur dioxide (SO_2) and carbon monoxide (CO). These major ambient air pollutants are known to have a significant impact on human health and have been set legally binding limits. Two of these pollutants are described below.

NITROGEN DIOXIDE

The main source of NO_2 in Scotland is road traffic. Nitrogen dioxide (NO_2) can irritate the lungs and lower resistance to respiratory infections such as influenza. Continued or frequent exposure to concentrations that are typically much higher than those normally found in the ambient air may cause increased incidence of acute respiratory illness in children.

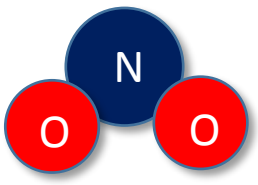

Figure 9. Molecular structure of NO_2

SULPHUR DIOXIDE

Sulphur dioxide (SO_2) is produced when a material, or fuel, containing sulphur is burned. Globally, much of the sulphur dioxide in the atmosphere comes from natural sources, but in the UK the predominant source is power stations burning fossil fuels, principally coal and heavy oils. Widespread domestic use of coal can also lead to high local concentrations of SO_2.

Even moderate concentrations may result in a fall in lung function in asthmatics. Tightness in the chest and coughing occur at high levels, and lung function of asthmatics may be impaired to the extent that medical help is required. SO_2 pollution is considered more harmful when particulate and other pollution concentrations are high.

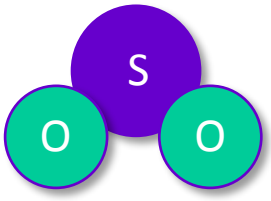

Figure 10. Molecular structure of SO_2

POLLUTION EPISODE

HOW CAN SAHARAN DUST AFFECT THE UK'S AIR QUALITY?

It is possible for Saharan dust to be uplifted into the atmosphere after a Saharan sandstorm. Once the particles are air borne, airmasses are more susceptible to come into contact with them. Figure 11 demonstrates atmospheric dust originating from the Saharan, been blown into the Atlantic Ocean and becoming caught in airmasses rotating around a high-pressure system centred over Europe. This clockwise flow successfully redirected the dust particles into westerly airstreams causing the dust-laden air to hit the UK.

Of course, weather can interfere with the particles and other airstreams could redirect the dust plumes elsewhere. However, for those occasional instances when the weather conditions are right the dust plumes can reach as far as the UK, creating a national natural air pollution episode.

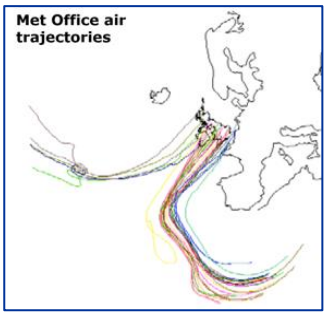

Figure 11. Met office air trajectory of Saharan sandstorm affecting the UK (23/01/2008)

The Air Quality in Scotland website provides a 5 day pollution forecast (http://www.scottishairquality.co.uk/latest/forecast-summary). As part of this forecast, experts analyse air mass back trajectories as well as weather and dust models to identify when these incidents may occur.

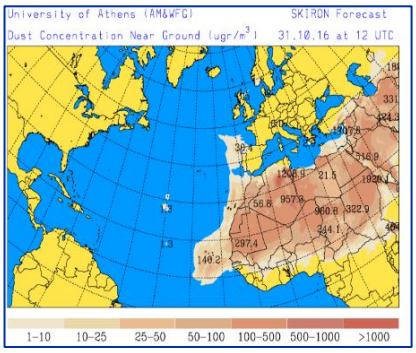

Figure 12. Forecast illustrating the dust concentrations near ground (µg/m³)

LOCAL AIR QUALITY MANAGEMENT (LAQM)

We would like to say a massive thank you for the great response regarding the LAQM reports! If you haven't already, can you please forward your current and historic LAQM reports to david.hector@ricardo.com for upload to the SAQD website. http://www.scottishairquality.co.uk/laqm/tools

QUESTION AND ANSWERS SECTION

This section will provide answers to frequently asked questions that relate to different aspects of LAQM ranging from LSO duties to advanced data analysis queries. If you have a question you would like to be answered in this section please contact info@scottishairquality.co.uk.

Q: Why is it important to change the NO_x filter? How often should they be changed?

A: It is important for the NO_x sample inlet filter to be changed regularly to ensure the analyser is able to measure concentrations that are truly representative of ambient conditions. With time, dust collected on the filter can absorb gases and reduce the accuracy of the measurements made by the analyser. Regular filter changes ensure that the amount of gas removed by the dust is kept to an absolute minimum. The NO_x filter should be changed after every calibration visit – if a site is an auto calibration set up, routine visits to change the filter should be incorporated into the LSO's schedule. The frequency of these filter changes is dependent on the site location.

Likewise, it is also important to inspect the condition of the filter i.e. if the filter appears to be badly soiled or shows signs of water ingress there could be a potential leak and the LSO should inform the Engineer Support Unit (ESU).

Q: What is the importance of weather?

A: Weather has a powerful and complex effect on ambient concentrations of pollutants. Still, calm and dry weather can cause concentrations to increase as it provides an optimum environment for locally sourced pollution to build-up. Conversely, wet and turbulent weather allows for locally sourced pollution to be dispersed more easily.

For example, ozone (O_3) pollution episodes are more apparent during periods of high temperatures and sunshine levels. These conditions allow for the photochemical reaction, which creates O_3, to occur in the atmosphere. Whereas, during periods of heavy rainfall and high winds, O_3 pollution episodes are less apparent.

Q: *How can you tell a pollution episode is occurring whilst at site?*

A: The trigger levels in Table 1 indicate a pollution episode. If the analyser is showing concentrations in excess of these levels the analysers must not be calibrated and a visit to the site should be rearranged. Ideally calibrations should not be carried out during periods of known elevated concentrations (i.e. rush hours).

Table 1. Table of pollutants and their trigger levels for a pollution episode

Pollutant	Level
NO_2	75 ppb
O_3	70 ppb
PM_{10}	100 µg/m^3
SO_2	90 ppb
CO	10 ppb

STAY CONNECTED

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