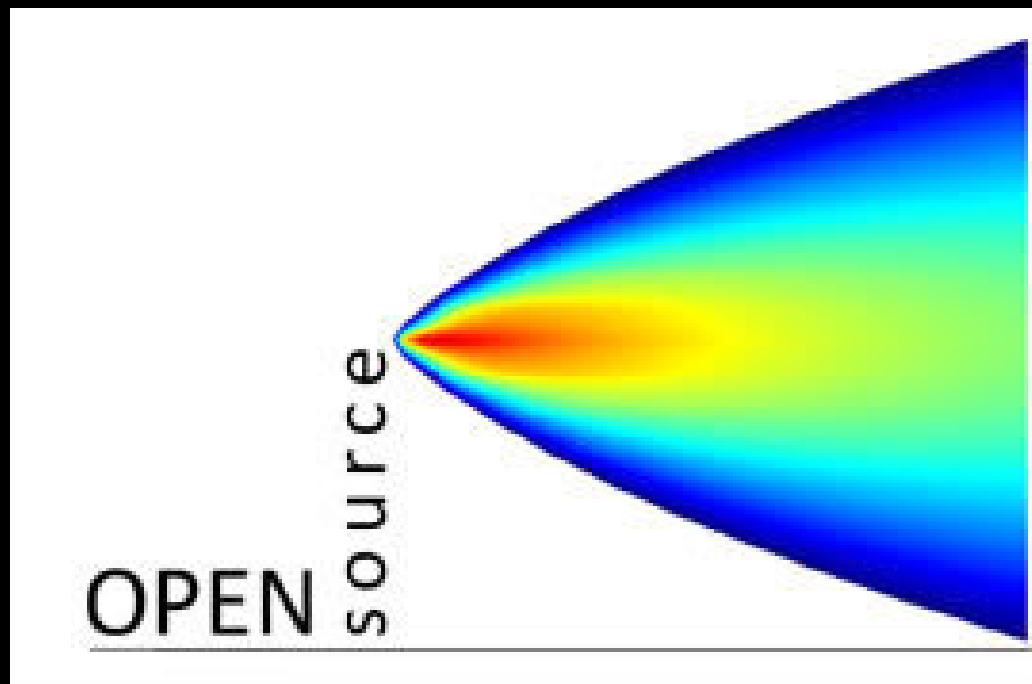


# OpenAir Tools for Data Analysis



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SCOTTISH AIR QUALITY DATABASE AND WEBSITE ANNUAL SEMINAR  
Stirling  
30<sup>th</sup> March 2011

# Outline: OpenAir for Air Quality in Scotland AEA

- Introduction.
- Demonstration of Tools and Outputs.
- Questions.



- Open Source data analysis tools in R were developed by Dr. David Carslaw and his team at the University of Leeds (and now KCL).
- You can visit the website <http://www.openair-project.org/> to find out more.
- A couple of years ago David made many presentations around the UK showing how the tools could be used to produce helpful and informative graphs of air quality data.
- AEA has developed a way of linking the tools directly to National AQ databases, with Scotland being the first made publicly available in this way.

# OpenAir for Air Quality in Scotland



## Air Quality in Scotland

[www.scottishairquality.co.uk](http://www.scottishairquality.co.uk)

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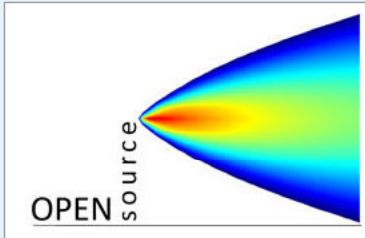
### Introduction to Openair

Openair provides free, open-source innovative [data analysis tools in R](#); a free and open-source programming language designed for the analysis of data. The tools, documentation and other resources are available through the [openair website](#). The powerful graphing capabilities of openair have been applied here to allow complex and innovative analysis of current and archived air pollutant to be readily undertaken.

Many of the tools benefit from a high volume of data. However the value of the tools is in being able to apply an additional ('conditioning') variable such as splitting plots out by different time periods (hour of the day, day of the week, month etc). In these cases, the volume of data available for each category may become significantly lower than plotting the entire data series up. It can also significantly increase the processing burden for the analysis and therefore the time required for the website to produce the plots. So if you've chosen a long time series, several sites or to plot them by hour of the day, please be patient.



Currently this website provides a subset of the complete functionality of Openair, focussing on those tools that do not require met data in order to run. However the [openair website](#) contains a full description of all functions as well as downloads and guidance to help users apply the tools to their own data.

In addition to using these online tools to analyse and review automatic data from the Scottish air quality network, the user can also download the data as an R object, suitable for importing straight into R for further analysis. In this way, the user can select and preview the data desired using the online tools prior to downloading it for further analysis in the R environment.



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- <http://www.scottishairquality.co.uk/openair/openair.php>

# Data Definitions



## Air Quality in Scotland

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### Openair Data Definitions

All units are expressed in mass terms for gaseous species ( $\mu\text{g}/\text{m}^3$  for  $\text{NO}$ ,  $\text{NO}_2$ ,  $\text{NO}_x$  (as  $\text{NO}_2$ ),  $\text{SO}_2$  and  $\text{mg}/\text{m}^3$  for  $\text{CO}$ ).

If you select data that is less than 6-months old, this data is not yet ratified and may be changed during the QA/QC process. For complete information about the ratification status of a data set, please use the [online tool from the UK AIR website](#).

$\text{PM}_{10}$  concentrations are provided in gravimetric units of  $\mu\text{g}/\text{m}^3$  or scaled to be comparable with these units. Over the years a variety of instruments have been used to measure particulate matter and the technical issues of measuring  $\text{PM}_{10}$  are complex. In recent years the measurements rely on FDMS (Filter Dynamics Measurement System), which is able to measure the volatile component of PM. In cases where the FDMS system is in use there will be a separate volatile component recorded as 'v10', which is already included in the absolute  $\text{PM}_{10}$  measurement.



Prior to the use of FDMS the measurements used TEOM (Tapered Element Oscillating, Microbalance) and these concentrations have been multiplied by 1.3 to provide an estimate of the total mass including the volatile fraction. The few BAM (Beta-Attenuation Monitor) instruments that have been incorporated into the network throughout its history have been scaled by 1.3 if they have a heated inlet (to account for loss of volatile particles) and 0.83 if they do not have a heated inlet. The few TEOM instruments in the network after 2008 have been scaled using VCM (Volatile Correction Model) values to account for the loss of volatile particles.

The object of all these scaling processes is to provide a reasonable degree of comparison between data sets and with the reference method and to produce a consistent data record over the operational period of the network, however there may be some discontinuity in the time series associated with instrument changes.

$\text{PM}_{2.5}$  measurements are similar to  $\text{PM}_{10}$ , except no correction factor has been applied to any  $\text{PM}_{10}$  data regardless of the instrument. The volatile component of  $\text{PM}_{2.5}$  (where available) is shown in the 'v2.5' column.

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- [http://www.scottishairquality.co.uk/openair/openair\\_data\\_definitions.php](http://www.scottishairquality.co.uk/openair/openair_data_definitions.php)

# Summarise Data

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## Your Openair Plot


Your 'Summarise Data' Openair output has been generated and is shown below.


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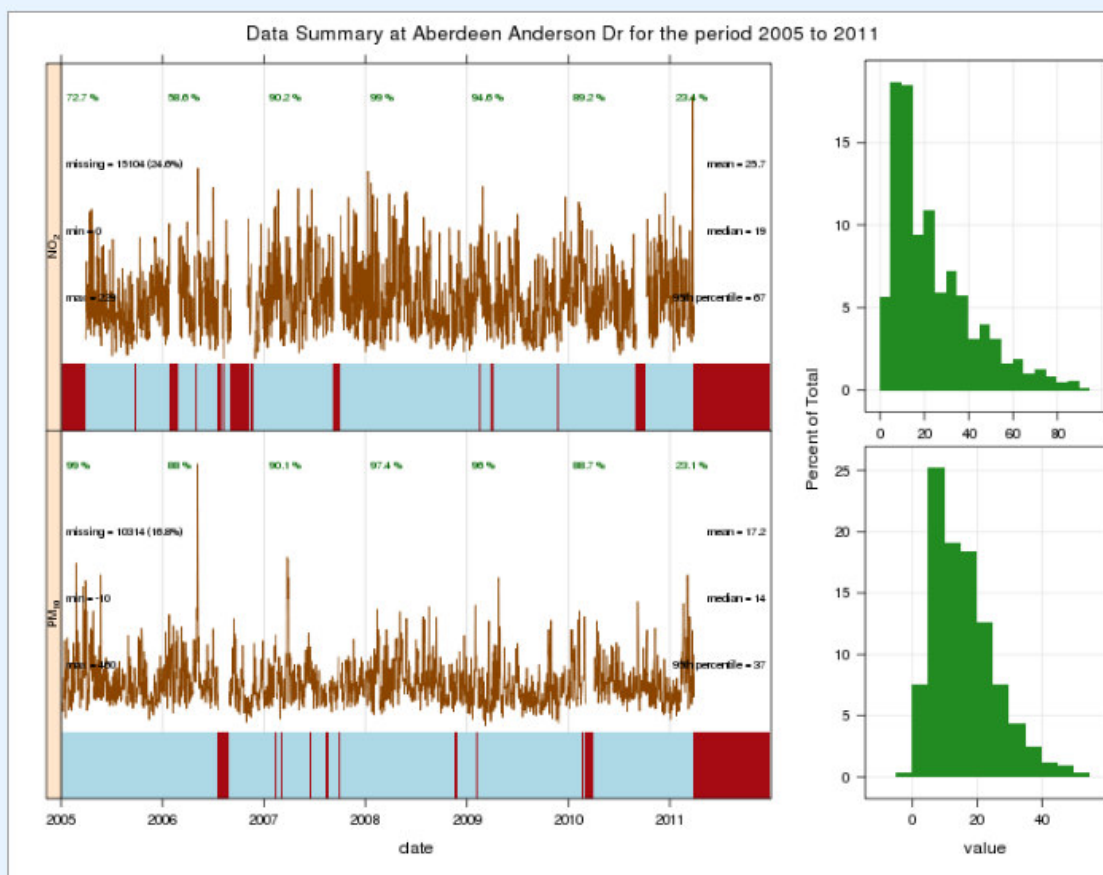
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## Your Openair Plot


**Your 'Smooth Trend' Openair output has been generated and is shown below.**


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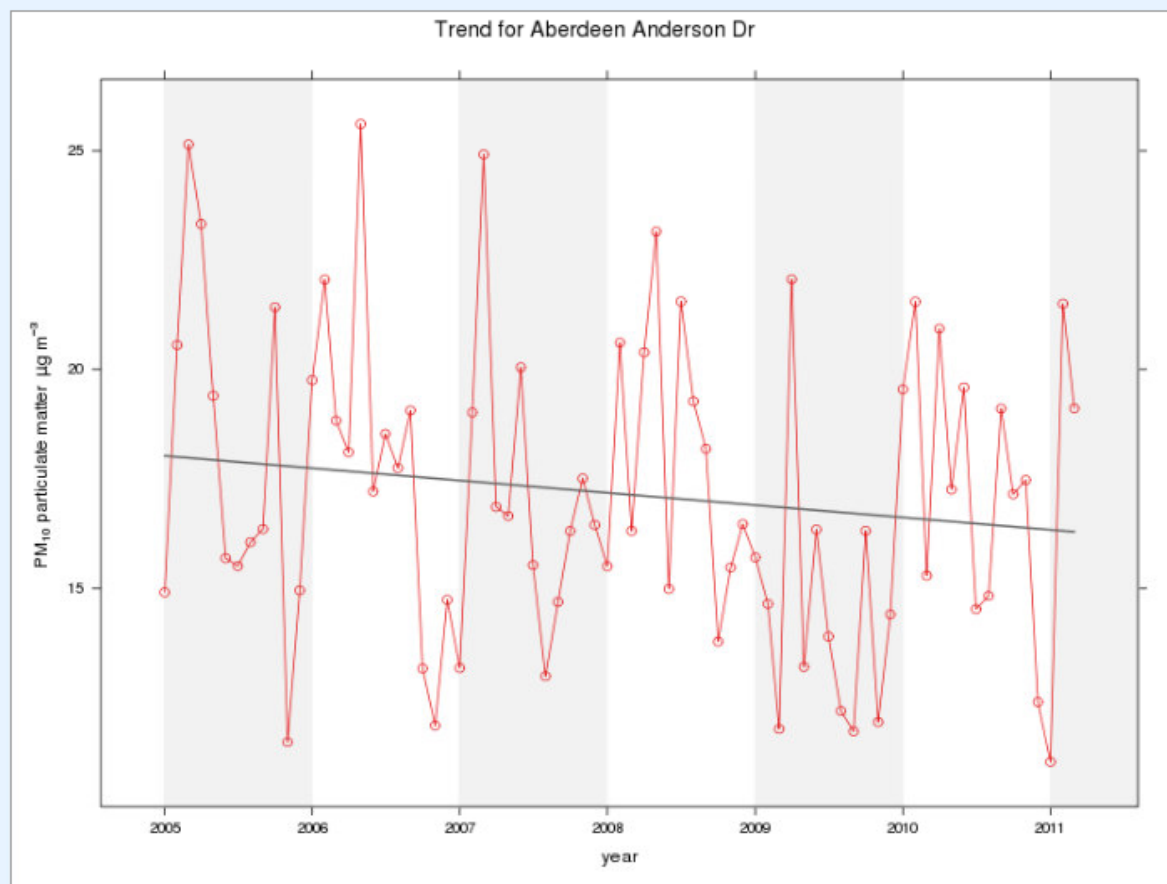
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## Your Openair Plot

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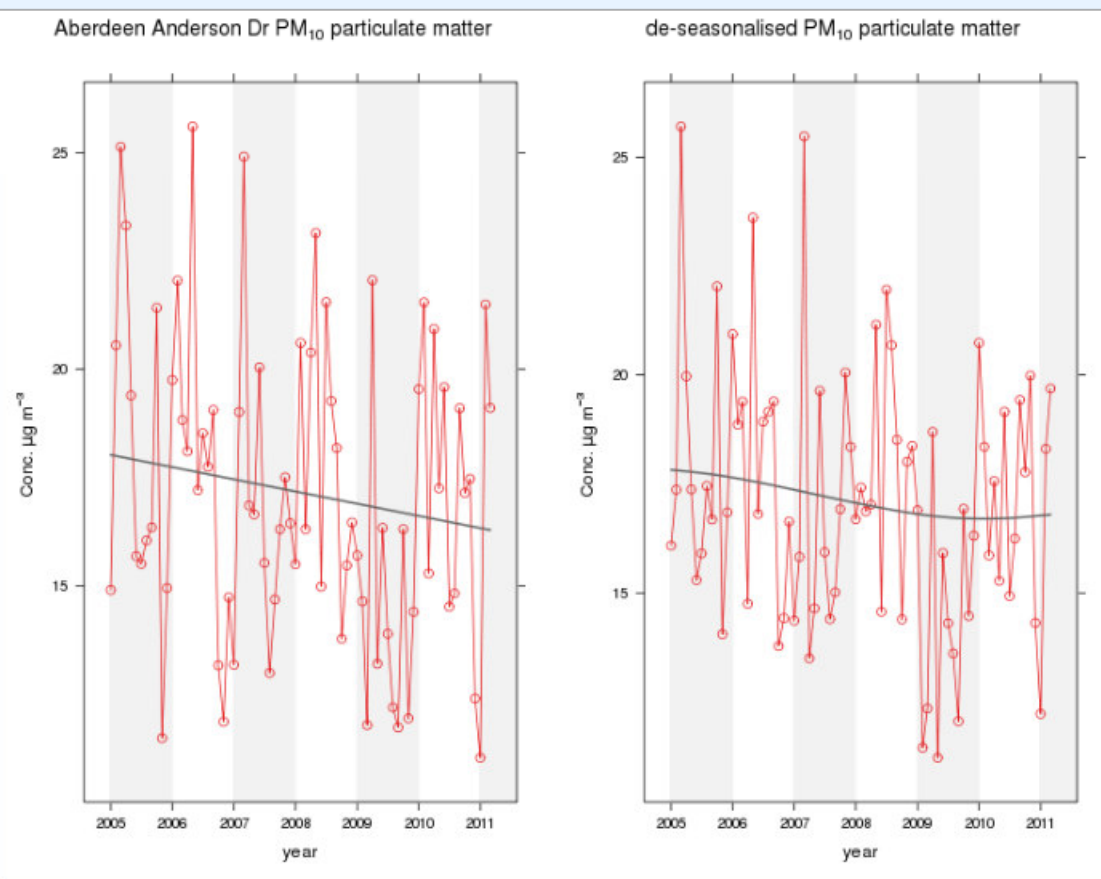
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## Your Openair Plot

Your 'Time Variation' Openair output has been generated and is shown below.

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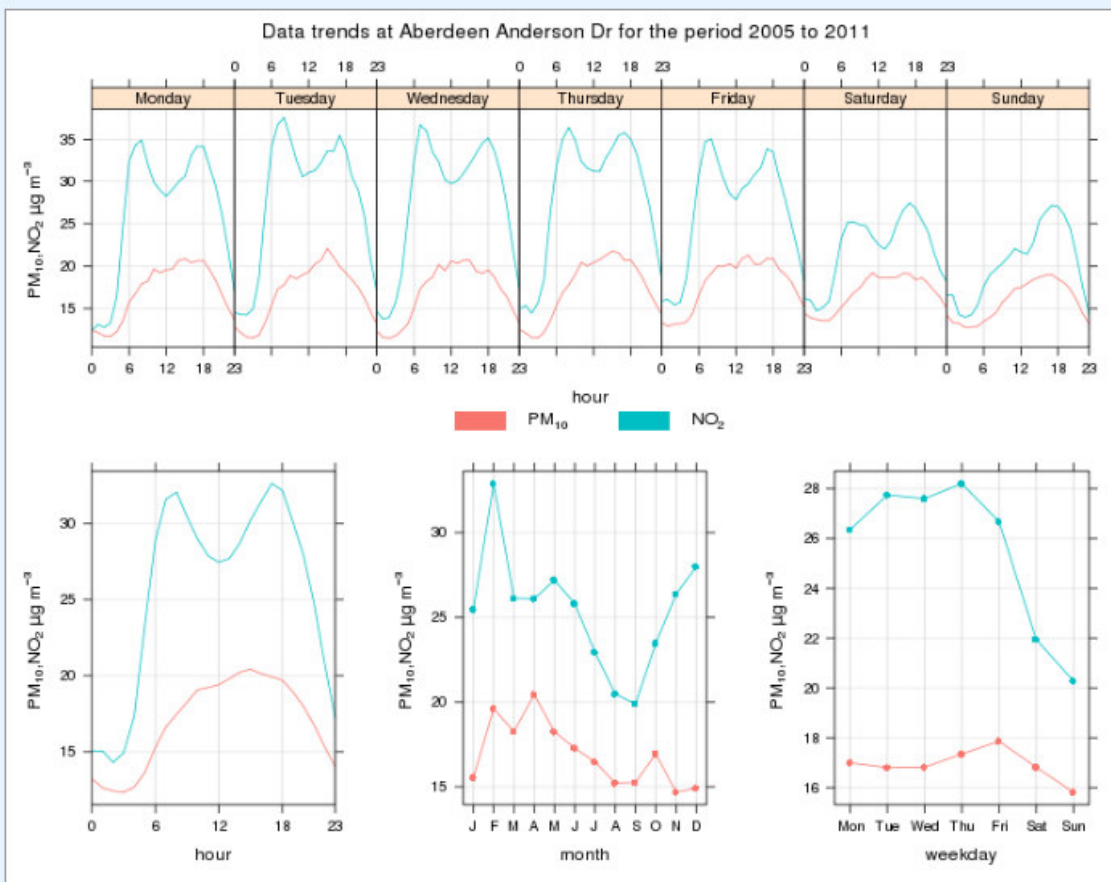
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## Your Openair Plot

Your 'Trend hour weekday plots' Openair output has been generated and is shown below.

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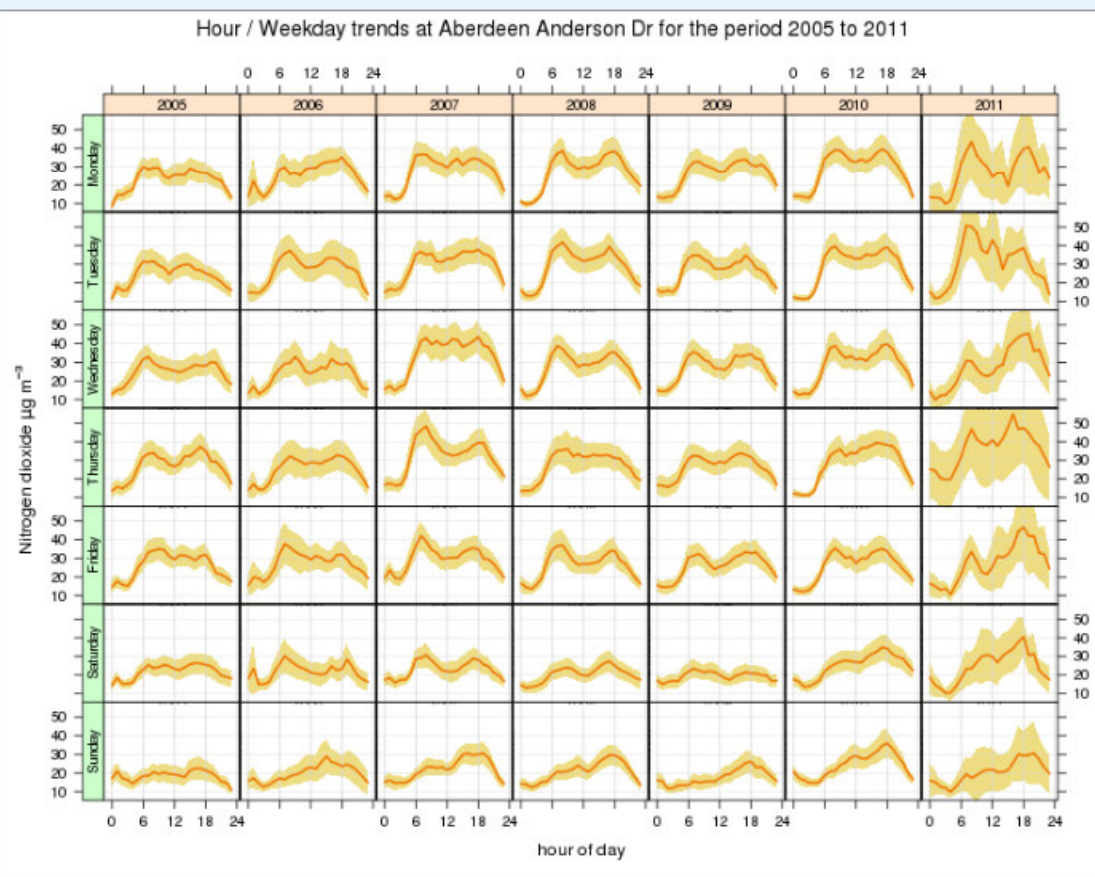
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## Your Openair Plot

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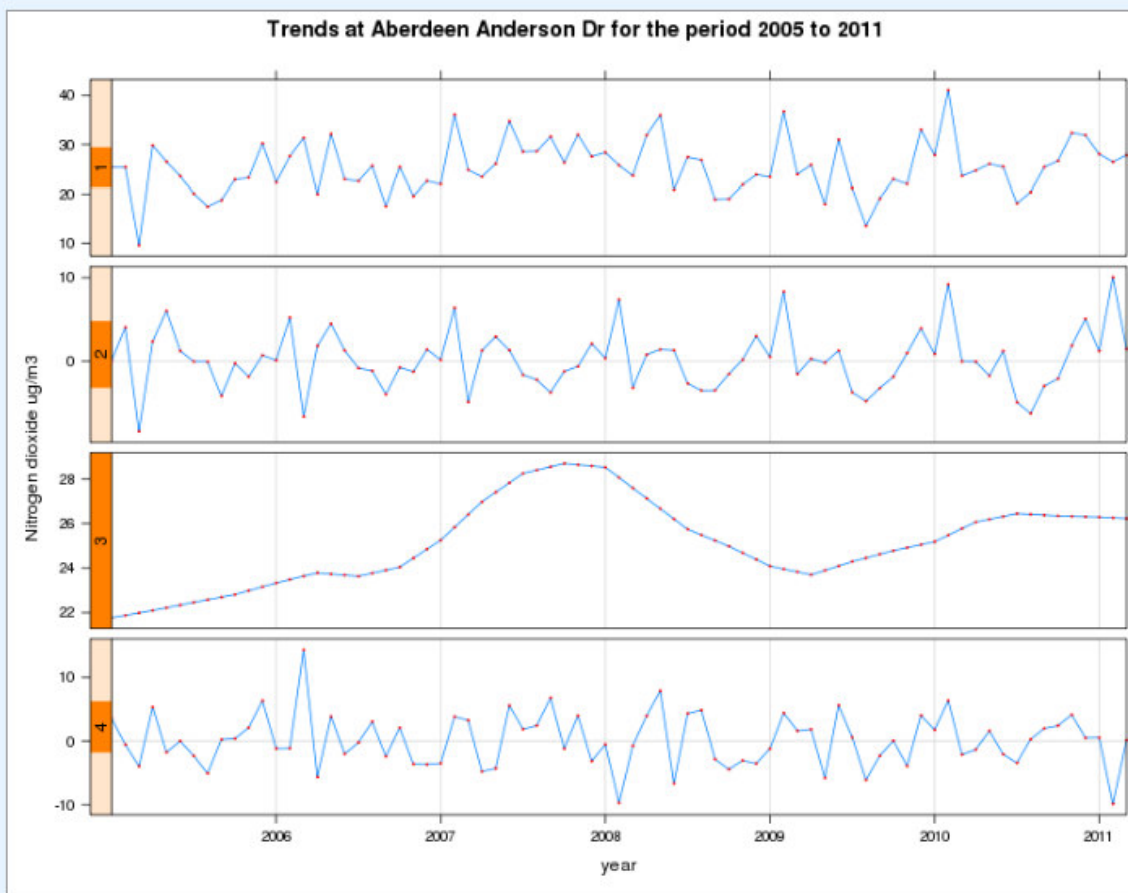
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# Mann-Kendall Trends Tool

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## Your Openair Plot

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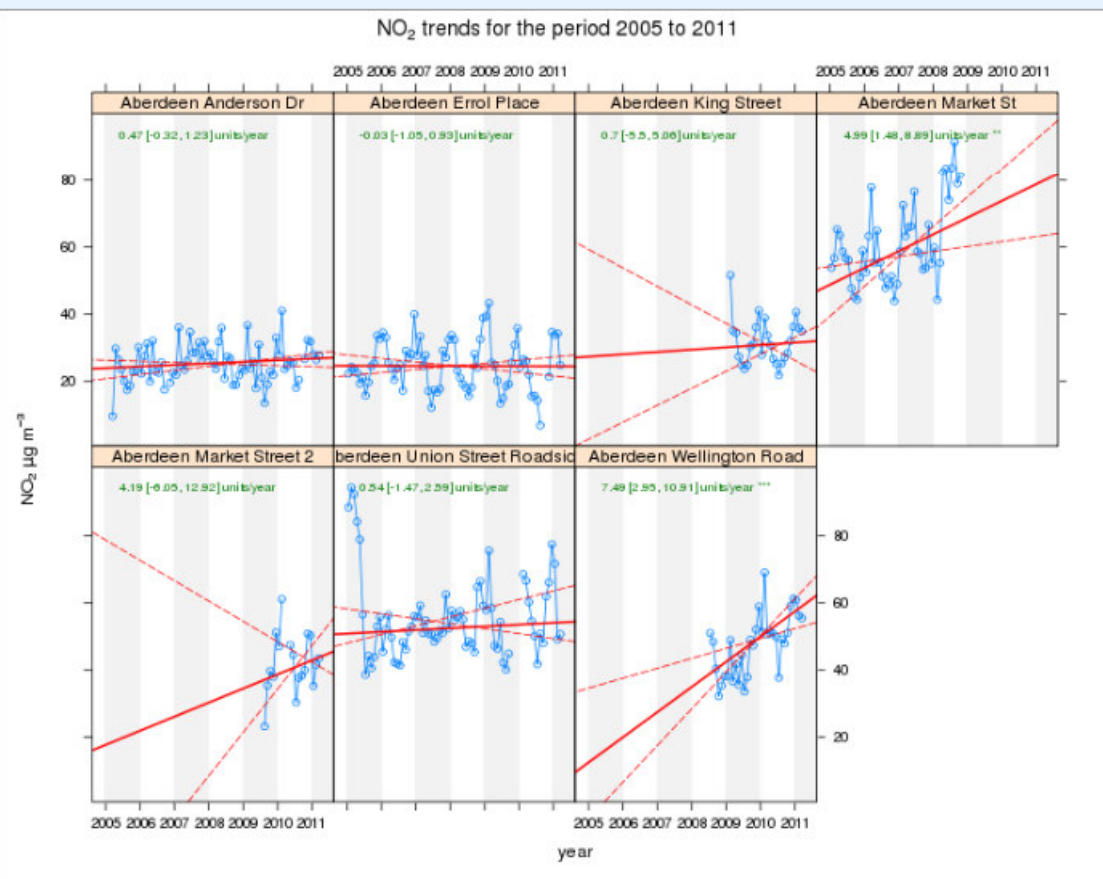
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## Your Openair Plot

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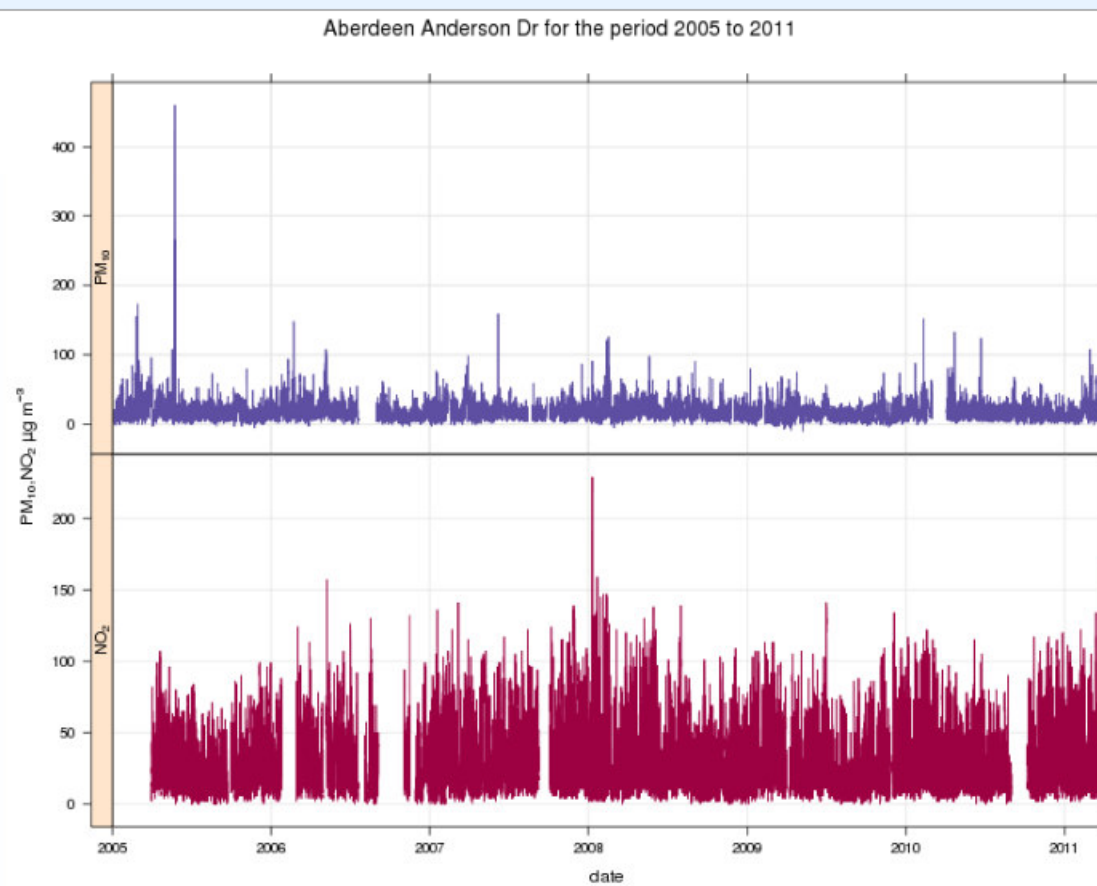
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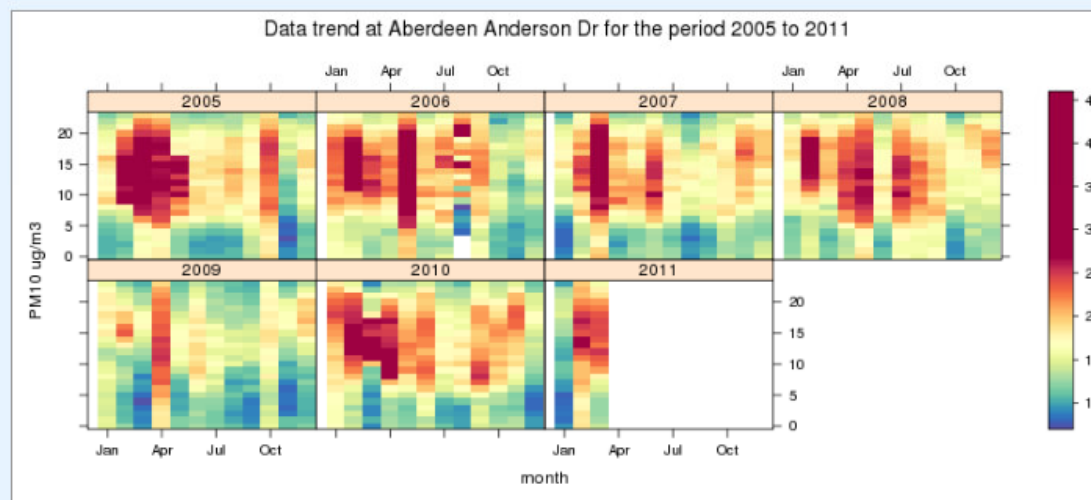
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### Description of the Trend Level Hour tool

Trend level hour provides a way of rapidly showing a large amount of data in a condensed format. In a single plot, the variation in the concentration of a pollutant is shown by time of day and year. The plot therefore provides information on trends, seasonal effects and diurnal variations. Each year is presented sequentially in a separate pane. The hour of the day is represented on the vertical axis whereas time throughout the years is represented in the horizontal axis to show the seasonality. The concentration is represented by the colour scale on the right of the plot.

[View an example of this output](#) (opens in a new window)

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- OpenAir Data Analysis Tools are now available to use simply through a few clicks on “Air Quality in Scotland”.
- You don’t have to worry about data formatting or remembering the correct codes and commands.
- Please try it and see how much more information you can extract from your data!
- Any Questions?