

Using Openair to Review Air Quality Monitoring Data in Neath Port Talbot

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Llywodraeth Cynulliad Cymru
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1. Introduction

Air Quality Management Resource Centre (AQMRC), University of the West of England, Bristol (UWE) was appointed by the Welsh Assembly Government to undertake a project entitled 'An Independent Review of Monitoring Measures Undertaken in Neath Port Talbot in Respect of Particulate Matter (PM₁₀)'.

The project contained 2 key pieces of work:

- 1: A review of all policy documents relating to air quality in Port Talbot;
- 2: An analysis of all available air quality and meteorological data for Port Talbot.

Due to the extensive datasets available, it was decided that Openair /R would provide an ideal environment in which to manage and analyse the data.

3. Methodology

The data analysis was planned out in 3 main sections:

Spatial analysis – mainly using polar plots to determine the relative strength of pollution from different directions

Temporal Analysis – looking at patterns in pollution across the 9 years of available data, and over seasonal, weekly and daily cycles

Analysis of Exceedance Days and Hours >50µg/m³ – mainly using R to manage and categorise the data.

The draft report contains 65 figures generated using Openair and R (many containing more than one plot). Below are range of some of the most informative from each analysis area.

2. Available datasets

A start date of 1st January 2000 was set for the data analysis providing over 9 years of data.

Data was available from 11 pollution monitoring stations (all with collocated wind speed and direction data), and additional meteorological data from the Met Office station at Mumbles Head.

Monitoring Stations:

- Port Talbot Groeswen (Hospital) AURN site
- Port Talbot Margam (Fire Station) AURN site
- Environment Agency Wales monitoring campaigns:
 - Arts Centre 2002
 - Taibach 2004 and 2007
 - Corus Sports and Social Club 2007
- 5 Topas PM monitors operated by Corus on the site of the Port Talbot steelworks.

Data Management

All data was entered into a single database in Microsoft Access which was then interrogated through R. This allows a comprehensive dataset to be shared between various stakeholders who can then easily undertake their own analyses and share the exact commands used to generate plots.

Spatial Analysis

Figure 1 shows polar plots of PM₁₀ at the AURN (Hospital) site from 2000 to 2007, clearly indicating the reductions in concentrations associated with south-westerly winds. Data for 2006/7 are shown using a different key.

Figure 2 shows polar plots for all pollutants monitored at the AURN (Fire Station) site, clearly indicating a strong relationship of PM₁₀ with CO and SO₂, but not with NOx, O₃ or, most interestingly, PM_{2.5}.

Figure 3 shows polar plots for PM₁₀, PM_{2.5}, PM_{10-2.5} and PM₁ from the Topas monitors on the steelworks site. These clearly indicate the range of different sources on the site in terms of both location and particle size.

Temporal Analysis

Figure 4 shows trend analyses for AURN data since 2000 by wind sector. The vertical grey lines indicate the approximate date at which the monitor was changed to a TEOM FDMS (Feb 2007) and the relocation of the monitor to the Fire Station site (July 2007).

Figure 5 shows plots of mean and maximum PM₁₀ concentrations by hour, month and year, clearly showing the tendency for concentrations to be highest in the afternoons, and in the second quarter of the year.

Figure 6 shows a comparison of PM₁₀ at the Port Talbot AURN sites and the Swansea Roadside AURN, demonstrating the difference in diurnal profile, with concentrations in Port Talbot peaking in the afternoon, along with a weekly cycle showing lower concentrations on Fridays and weekends, and the tendency for higher concentrations in the second quarter.

Additional Analyses

Having R as the basis of Openair provides a very functional environment for the manipulation and presentation of data.

Figure 7 shows archetypal exceedance days based on statistical characterisations of the relationship between daily maximum and daily mean concentrations of PM₁₀. This shows the different types of problem with some exceedances caused by single very high peaks, and others by elevated concentrations throughout the day.

Figure 8 shows how the R environment can be used to easily plot multi-variate data. These scatter plots of CO and SO₂ also indicate represent hours where PM₁₀ concentrations exceeded 50µg/m³. The plots show how pollution events throughout the years have had different 'fingerprints'.

Figure 9 shows a set of comparisons between different monitoring sites. R provides a much quicker and consistent means of plotting similar graphs than conventionally used tools such as Excel.

Figure 1: AURN (Hospital) PM₁₀

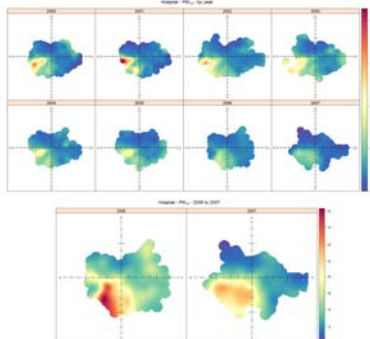


Figure 4: Trends in PM₁₀ by wind sector at AURN

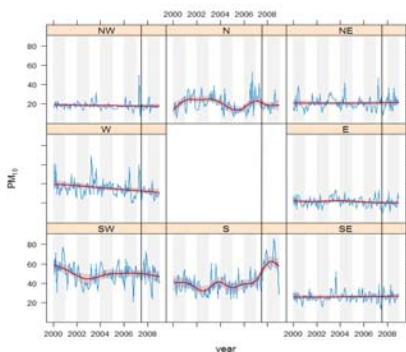


Figure 7: Classification of Exceedance Days by 'Type'

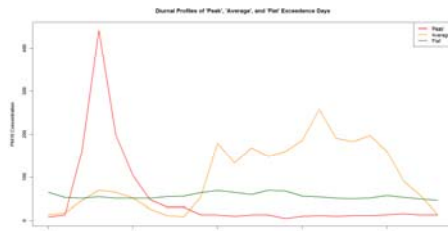


Figure 2: AURN (Fire Station) All Pollutants

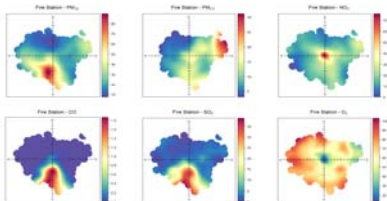


Figure 5: Mean and Maximum PM₁₀ by hour/month/year

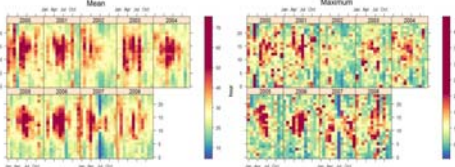


Figure 3: Corus Topas monitors (PM Fractions)

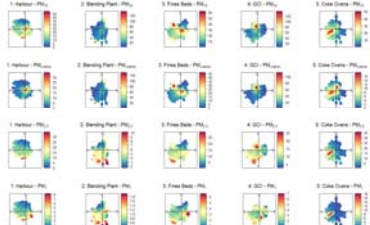


Figure 6: Time Variation of at Port Talbot and Swansea (Roadside) AURNs

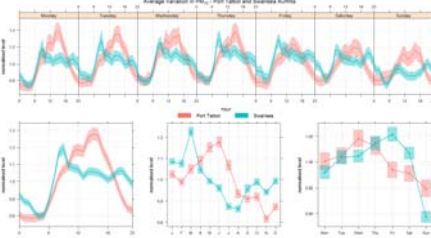


Figure 8: Relationship between CO and SO₂ (PM₁₀ Hours >50 in Red)

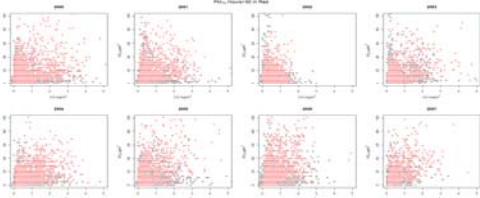


Figure 9: Comparison of AURN (TEOM FDMS) with concurrent TEOM monitoring (using 1.3 & VCM)

