Total gaseous mercury monitoring at Harwell, UK – trends, patterns and a source analysis

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Location and Method

Figure 1: Location of the Harwell Field Site as seen on Google Earth.

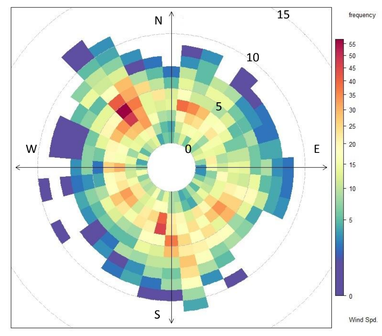

Figure 2: Wind direction and frequency (Dec 12 – May 13)[1,2].

- The Harwell field site is located about 21 km south of Oxford in the county of Oxfordshire. It is a semi-rural compound on the Harwell Science and Innovation Campus. The surrounding land is generally agricultural and has some small wooded areas [Figure 1.]
- Atmospheric mercury: (Total Gaseous Mercury (TGM) is measured using the Tekran 2537A, which uses Cold Vapour Atomic Fluorescence Spectroscopy (CVAFS) to detect elemental mercury.
- Measurements of atmospheric mercury have been made at the site since November 2012 on behalf of the UK government's Department for Food and Rural Affairs and the devolved administrations.
- The site is one of the two UK EMEP Supersites, operated at Level II and will shortly be opted in to the Global Mercury Observation System (GMOS).

Results

	Winter			Spring		
TGM (ng m^{-3})	**December 2012**	**January 2013**	**February**	**March**	**April**	**May**
Mean	1.34	1.46	1.40	1.47	1.33	1.26
Seasonal Mean	1.40			1.35		
Period Mean	1.38					

Table 1: Annual and Seasonal Means concentrations of Hg species

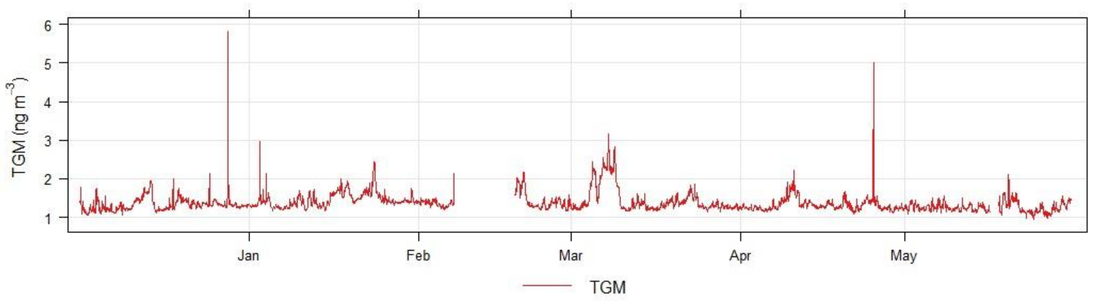

Figure 3: Annual and Seasonal Means concentrations of Hg species. [1,2]

- The mean concentration for TGM for the 6 months was 1.38 ± 0.25 ng m^{-3}, which is in good agreement with the Tekran instrument at the Auchencorth Moss field site which showed an average concentration of 1.44 ng m^{-3} for the same period.
- The concentrations observed are slightly lower than other observations in the northern hemisphere, between 1.5 and 1.7 ng m^{-3}, but is in good agreement with average level observed at the Auchencorth Moss field site between 2009 and 2011.
- The maximum value of Hg^0 observed was 7.3 ng m^{-3}, but values as high as this are sporadic and are episodic in nature.

Trends & Patterns

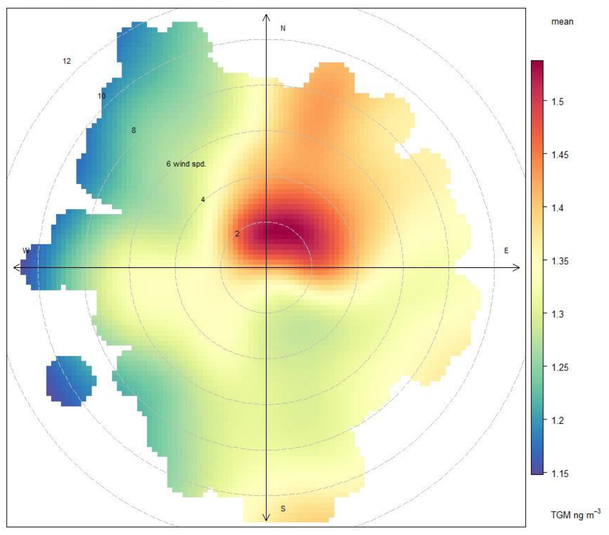

Figure 5: Polar plot of TGM concentration in relation to wind speed and direction.[1,2]

- Daily averages (Figure 4.) show concentrations of TGM are elevated during the working week, peaking on a Wednesday.
- Higher concentrations of TGM are seen at lower wind speeds (local influences), as well as on winds arriving at the site from the north-east (intermediate influences) (Figure 5.).
- The weekly cycle and highest concentrations at low wind speed from this direction suggest that the primary influence of TGM is the Harwell Science and Innovation Campus, to the sites immediate north east.
- These trends are likely due to increased activity on the campus during the working week, but also could be heavily influence by the decommissioning work of buildings ?m away to the immediate north east.
- The intermediate influence from the same direction is likely to be Didcot A coal fired power station, approximately ?km away.
- Didcot A was shut down on 22nd march 2013, the effects of which will be better discerned with a larger data set.

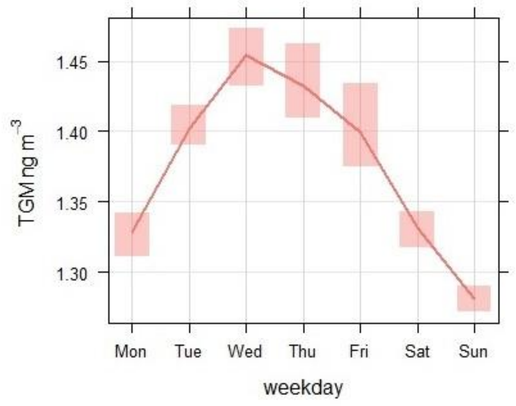

Figure 4: Daily average TGM.[1,2]

Events

- 'Episodes' of elevated TGM concentrations can be better seen in Figure 3, where concentrations far exceed the northern hemispherical background level for extended periods. Figure 6 shows a period in early March 2013.
- At Auchencorth Moss, these events have been shown to be related to the movement of air masses bringing more contaminated air from other regions[3].
- Figure 7 shows a NOAA HYSPLIT air mass back trajectory[4] plot for air masses arriving between the 7th and 10th March 2013 and the areas from which they originated. The trajectories arrive at site at time indicated by the coloured dots in Figure 7.

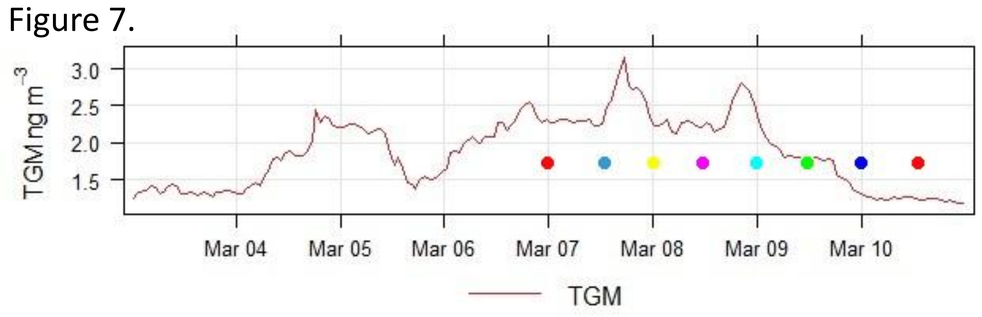

Figure 6: TGM plot for 4th – 10th March 2013.

- This shows continental air masses bringing higher concentrations of TGM to site, then falling when the air arrives from a different direction, from about midday on the 9th. (Green, Dark Blue and Red lines.)
- In Figure 3, the lowest concentrations are seen from the west, consistent with previous studies[3,5] and indicative of the influence longer range transport of TGM.

Figure 7: Air mass back trajectory for 4th – 10th March 2013.

References:

1. Carslaw, D.C. and K. Ropkins, (2012). openair — an R package for air quality data analysis. Environmental Modelling & Software. Volume 27-28, 52-61.
2. Carslaw,D.C. (2012). The openair manual—open-source tools for analysing air pollution data. Manual for version 0.6-0, King's College London.
3. Kentisbeer et al, (2010), An analysis of total gaseous mercury (TGM) concentrations across the UK from a rural sampling network, *Journal of Environmental Monitoring*, 13 (6). 1653-1661.
4. R. R. Draxler and G. D. Rolph, HYSPLIT (HYbrid Single-Particle Lagrangian Inetgrated Trajectory) Model, http://ready.arl.noaa.gov/HYSPLIT.php, 2012.
5. Witt et al, (2009), Aerosol trace metals, particles morphology and total gaseous mercury in the atmosphere of Oxford, UK, Atmospheric Environment, 44. 1524-1538.

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