PM 2.5 Speciation data and the identification of the urban excess.

Ohio EPA operates a large network of Federal Reference Method (FRM) PM 2.5 monitors, primarily located in the expected high PM 2.5 concentration areas with additional attention to more highly populated areas as well. Included in the FRM network is a subset of monitor sites which also monitor PM 2.5 species (sulfate, nitrate, organic carbon, elemental carbon and 'crustal' or 'other'). The majority of the speciation monitors are co-located with the highest reading FRM monitors. In some cases, though, the speciation monitor is located in a more rural or less industrialized area. It is the comparison of the speciation monitoring from the two types of sites (higher reading nonattainment sites and those currently reading attainment) which provides insight into the species and source types that contribute to the urban/industrial 'excess'.

General description

Each of the five PM 2.5 species has a number of known source types which contribute to that species (although some of the sources of organic carbon are acknowledged to be underestimated in existing inventories).

Sulfates concentrations are dominated by the primary source of SO2 in the region, which is coal combustion. There is additional sulfate associated with the combustion of oil, diesel, gasoline and natural gas which can contribute to some extent within an urban industrial area. In general, the highest concentration of SO2 emissions in the Midwest is along the Ohio River. There are additional sources of SO2 along Lake Erie and a few in the east central portion of Ohio. The concentration of sulfates is highest in the southern portion of the state and the concentrations generally decrease towards the northern portion of the state. While there is not a sufficiently dense network to identify gradients adequately, it is expected that there are higher concentrations on a local basis in the vicinity of all of the major coal burning electric generating facilities within the state. Within the urban/industrial hot spots, though, it is expected that there will be regional concentrations augmented by several smaller contributions from industrial and transportation sources. This would indicate that a small contribution to the urban excess due yo local sources of SO2/sulfates.

Nitrates are also associated with coal burning electric generating facilities which would contribute to a fraction of the regional component of nitrates. Unlike sulfates, there are significantly more local sources of nitrates (percentage of the total) associated with on-road and off-road transportation sources as well as many industrial sources and even population based sources such as home heating. Therefore, it is expected that there would be an urban excess associated with nitrates from the local sources.

Organic Carbon has been identified as a significant source of the urban excess in most urban areas. While the potential sources of organic carbon are somewhat understood, the level of the concentrations being measured at most urban/industrial hot spots exceeds that which would be expected from existing emissions inventories and existing regional photochemical grid modeling. Potential sources of organic carbon being under

represented in the inventories are on-road and off-road transportation sources (both gasoline and diesel), incomplete combustion associated with industrial sources, man caused and natural wood combustion sources and other nontraditional sources such as the cooking/preparation of meets (grills, broilers, etc.).

Ohio EPA and the Midwest RPO have contracted with various researchers to assist in analyzing the make up of the organic carbon being monitored, using chemical mass balance and statistical analyses to assign portions of the organic carbon to the various potential sources. Some of the expected sources may be regional in nature, but the majority are expected to coincide with transportation, industrial and nontraditional urban sources. Organic carbon is a significant component of the urban excess in Ohio's PM 2.5 nonattainment areas.

Elemental Carbon and Other/crustal represent a small fraction of the total PM 2.5 mass and would be expected to be higher in more highly urban/industrial areas, but, in general, do not contribute significantly to the urban excess.

The bar graphs below compare urban sites with more rural and less industrialized sites. Ohio actually has very little speciation information from rural locations, so the comparisons have been made using the available information from the state network as well as similar networks being operated in and around the state.