Technical Support Document: Potential for Excess Local Deposition of U.S. EGU-Attributable Mercury in Areas near U.S. EGUs

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Technical Support Document: Potential for Excess Local Deposition of U.S. EGU-Attributable Mercury in Areas near U.S. EGUs

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Executive Summary

Previously, the analysis of the potential for excess local mercury deposition surrounding U.S. EGUs was located in Appendix G of the National-Scale Mercury Risk Assessment. In response to public comments, we have moved this information to a separate TSD, re-titled the analysis, and provided additional technical details. EPA calculated the average EGU-attributable deposition (based on CMAQ modeling of mercury deposition) in the area 500 km around each plant and the average EGU attributable deposition in the area 50 km around each plant. The difference between those two values is the excess local deposition around the plant. This analysis shows that there is excess deposition of Hg in the local areas around EGUs, especially those with high Hg emissions. Although this is not necessarily indicative of higher risk of adverse effects from consumption of MeHg contaminated fish from watersheds around the U.S. EGUs, it does indicate an increased potential that Hg from U.S. EGUs will impact local watersheds.

Purpose and Scope of Analysis

Published research shows that U.S. coal-fired power plants significantly contribute to local and regional mercury deposition (Caffrey et al., 2010; Keeler et al., 2006; White et al., 2009). As discussed in the preamble to the proposed MATS (U.S. EPA, 2011b), for the purposes of the appropriate and necessary finding, EPA determined that information on the potential for excess deposition of mercury in areas surrounding power plants would be useful in informing the finding. The purpose of this analysis was to evaluate at the national-scale whether there existed excess U.S. EGU-attributable deposition of Hg in locations near EGUs, which would indicate that U.S. EGUs are potentially contributing to mercury exposures locally as well as to the potential exposures that result from the combined deposition from U.S. EGUs at a regional scale. This analysis does not address total mercury deposition because global sources of mercury deposition account for a large fraction of total mercury deposition, which would not provide useful information regarding the comparison of local and regional mercury deposition from U.S. EGUs.

This analysis is not intended to show "mercury hotspots" based on elevated concentrations of methylmercury in fish tissue but rather of mercury deposition hot spots, defined as excess local U.S. EGU-attributable mercury deposition around power plants relative to regional U.S. EGU-attributable deposition. To reduce the confusion about the term "hotspot", we have re-titled this analysis to "Potential for Excess Local U.S. EGU Attributable Deposition of Mercury in Areas near U.S. EGUs".

Methods

EPA evaluated the potential for "hotspot" deposition near U.S. EGU emission sources on a national scale, based on the CMAQ-modeled Hg deposition for the 2005 and 2016 scenarios (U.S. EPA, 2011a). Locations of U.S. EGUs in 2005 and 2016 were mapped based on latitude

and longitudes extracted from the Integrated Planning Model (IPM), a model of the power system used by EPA. We calculated 50 km and 500 km buffers around each EGU location using the ArcGIS® geographic information system software (Environmental Systems Research Institute, 2010).

We then calculated the spatial averages of the U.S. EGU-attributable deposition (obtained by subtracting estimated mercury deposition with U.S. EGU Hg emissions zeroed out from baseline mercury deposition from all sources including U.S. EGU Hg emissions) across the grid cells with centers falling inside the 50 km and 500 km buffers. The average deposition within the 500 km buffer represents the likely area in which an EGU contributes to regional deposition. The average deposition within the 50 km buffer is used to characterize local deposition plus regional deposition near the EGU.

The spatial surfaces were generated by applying an averaging kernel to the CMAQ deposition estimates for U.S. EGU-attributable mercury, which have a 12 km by 12 km gridded spatial resolution. Averaging kernels assign a mean value to each grid cell based on the averages of all neighboring grid cells within a predefined window as a method to smooth the deposition surface. In this case, kernel sizes were 50 km and 500 km radiuses. Then 50 km radius average values were subtracted from 500 km radius averages to create the map of excess local deposition.

If there were only general regional mixing of U.S. EGU mercury and relatively even deposition across broad regions, then we would expect that the average U.S. EGU attributable deposition within 50 km of an EGU would be about the same as the average U.S. EGU attributable deposition within 500 km of the EGU. The difference between the averages of the 50 km and 500 km buffers is thus a measure of excess local deposition.

Results

This analysis shows that there is excess deposition of Hg in the local areas around EGUs, especially those with high Hg emissions. Although this is not necessarily indicative of higher risk of adverse effects from consumption of MeHg contaminated fish from watersheds around the U.S. EGUs, it indicates an increased potential that Hg from U.S. EGUs will impact local watersheds around the EGU sources, and not just impact regional deposition.

Figure 1 shows a map of the excess local deposition based on the 2005 CMAQ modeling. Figure 2 shows excess local deposition based on the 2016 Base Case. As shown in Figure 1, there is heterogeneity in the amount of excess local deposition around plants. Some plants, especially those with high mercury emissions, have local deposition that is less than the regional average deposition, suggesting that most of the mercury from those plants is transported regionally, or that other EGUs in the vicinity of those plants dominate the deposition of mercury near the plants.

Summary statistics for the excess local deposition are provided in Table 1. Table 1 shows both the mean excess deposition around all U.S. EGUs and the mean excess deposition around just the top 10 percent of Hg emitting U.S. EGUs. Table 1 also shows the excess Hg deposition as a percent of the average regional deposition to provide context for the magnitude of the local excess deposition. In 2005, for all U.S. EGU, the excess was approximately 1.2 times the average deposition, while local deposition was approximately 3.5 times the regional average for the top 10 percent of Hg emitting U.S. EGUs. By 2016, the absolute levels of excess deposition decrease, but the local excess still remains approximately 3 times the regional average for the highest 10 percent of Hg emitting U.S. EGUs.

This analysis shows that there is excess deposition of Hg in the local areas around EGUs, especially those with high Hg emissions. Although this is not necessarily indicative of higher risk of adverse effects from consumption of MeHg contaminated fish from waterbodies around the U.S. EGUs, it does indicate an increased chance that Hg from U.S. EGUs will impact local waterbodies around the EGU sources, and not just impact regional deposition.

Figure 1. Excess Local Deposition in 2005

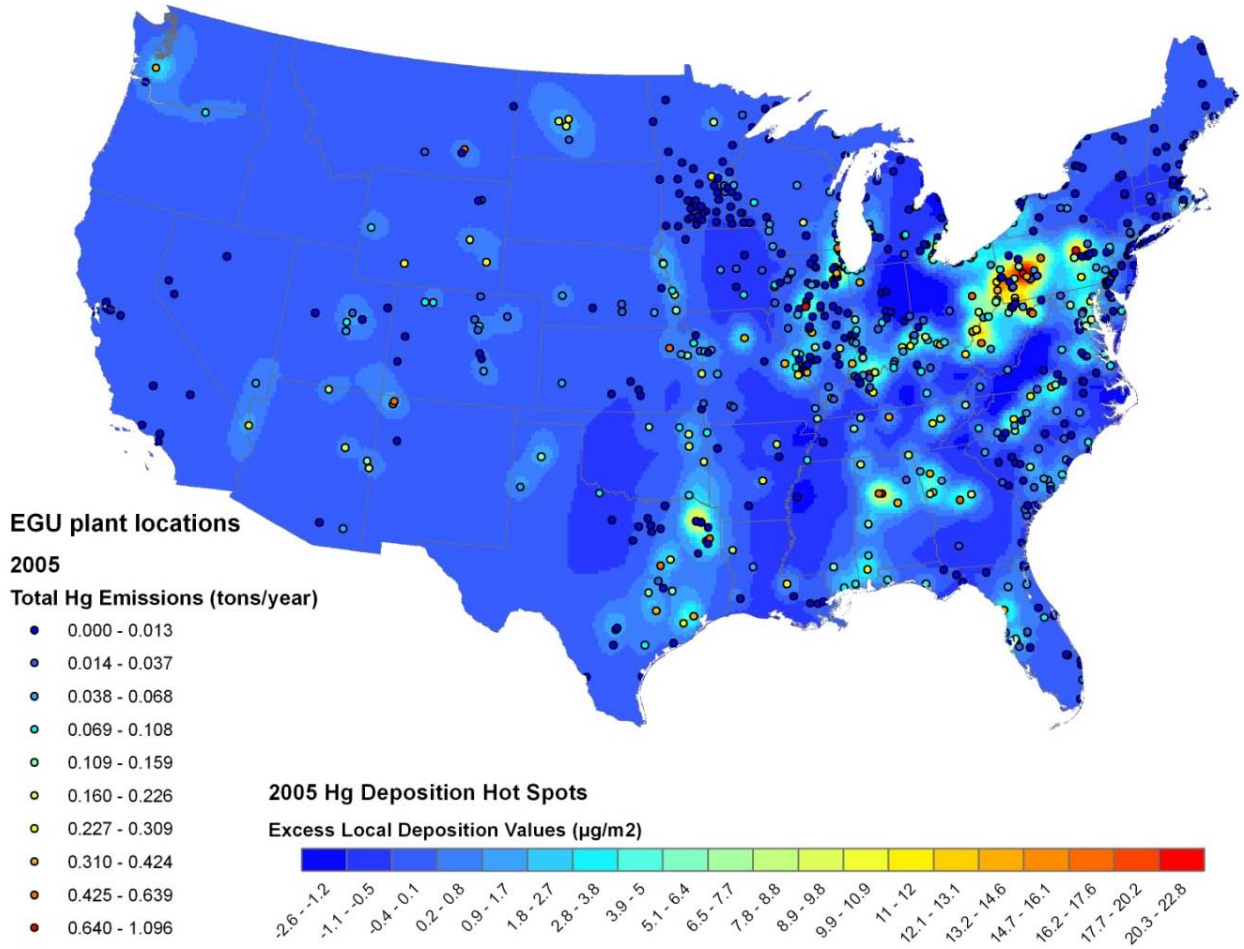

Figure 2. Excess Local Deposition in 2016 (Base Case)

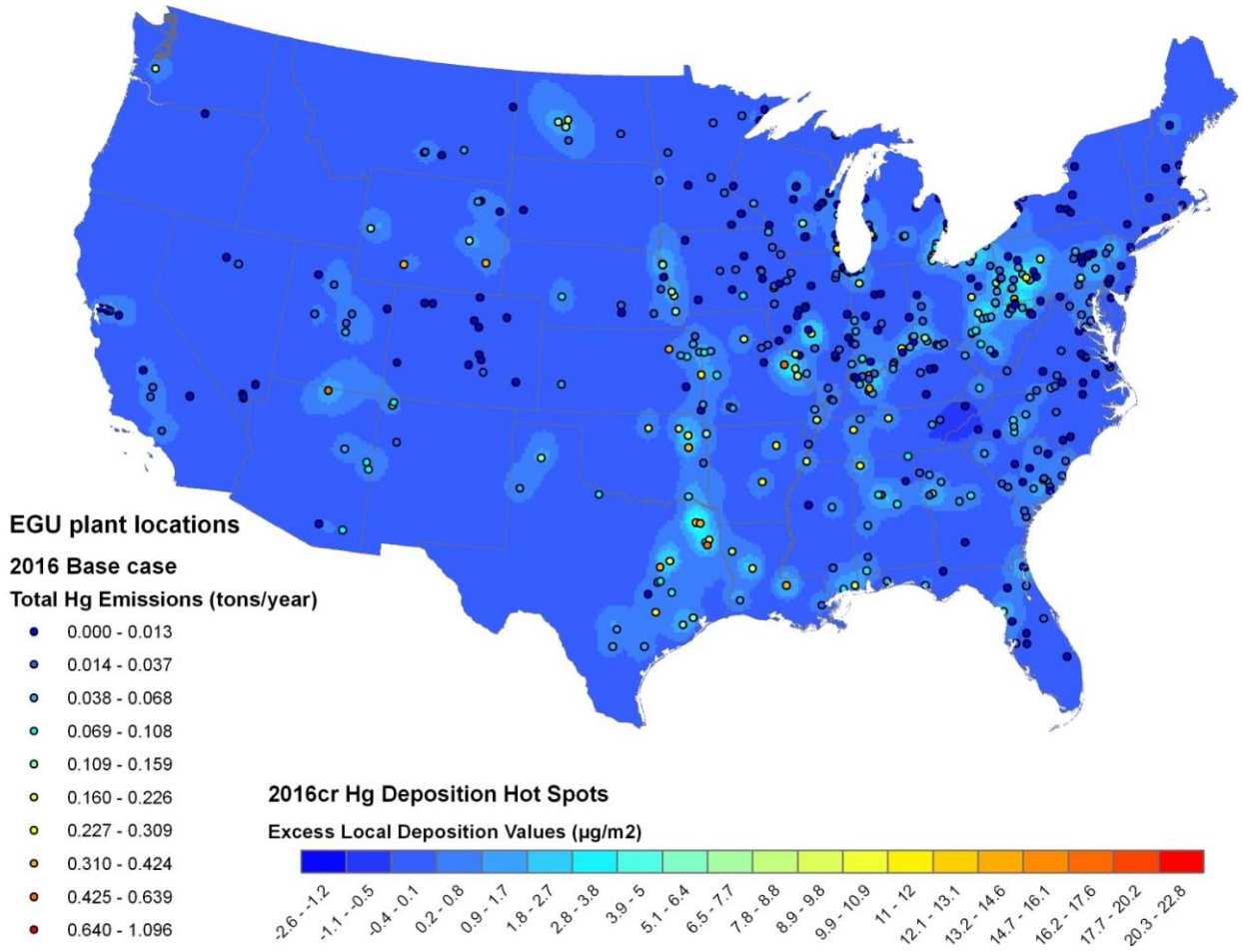

Table 1. Excess local deposition of Hg based on CMAQ modeled Hg deposition

Category of Results	50km-Radius-Average Excess Local EGU-Attributable Deposition values (µg/m^2)	
	Mean Across EGUs (percent of regional average deposition)	
	2005 Scenario	2016 Scenario
All U.S. EGU sites with Hg emissions >0 (672 sites)	1.65 (119%)	0.38 (98%)
Top ten percent U.S. EGU in Hg emissions (67 sites)	4.89 (352%)	1.18 (302%)

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