



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF AIR QUALITY PLANNING AND STANDARDS
HEALTH AND ENVIRONMENTAL IMPACTS DIVISION
RESEARCH TRIANGLE PARK, NC 27711

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TO: *National Emission Standards for Hazardous Air Pollutants for Coal- and Oil-fired Electric Utility Steam Generating Units* docket

FROM: Zachary Pekar (EPA OAQPS)

SUBJECT: Clarification and Updating of Mercury Deposition Maps Provided in the *Technical Support Document: National-Scale Mercury Risk Assessment Supporting the Appropriate and Necessary Finding for Coal- and Oil-Fired Electric Generating Units (Mercury Risk TSD)*

Overview

During the Science Advisory Board (SAB) review of the Mercury Risk TSD held on June 15-17th, questions were raised by Panel members regarding patterns of mercury deposition reflected in Figures 2-1 through 2-4 of the TSD. These figures were intended to show annual total mercury (Hg) deposition per unit area (in units of $\mu\text{g}/\text{m}^2$) by watershed.¹ However, the patterns reflected in the figures did not comport with generalized expectations given the Panel's prior experience in studying patterns of total and Electric Generating Unit (U.S. EGU) – sourced Hg deposition within the U.S..

Questions raised by the Panel resulted in EPA staff reviewing the four figures in question subsequent to the SAB meeting, including the underlying data and spatial interpolation used in generating those figures. That review has resulted in our identifying that the original Figures 2-1 through 2-4 actually displayed intermediate calculations that had not been adjusted by the waterbody-specific surface areas (i.e., these figures reflected an intermediate calculation and not the intended value of *$\mu\text{g mercury deposited per square-meter by watershed}$*). This explains why the spatial patterns of Hg deposition presented in Figures 2-1 through 2-4 of the TSD did not match the expectations of Panel members and specifically why some of the larger watersheds had the highest deposition estimates. We have now updated Figures 2-1 through 2-4 (presented below) to correctly reflect total annual Hg deposition per square-meter by watershed. It is important to emphasize that because the risk estimates are based on proportional relationships between total and US EGU-sourced Hg deposition (i.e., application of a unitless ratio) at the watershed-level, they are not in any way affected by the choice of units reflected in the deposition maps.² However we felt it important to update the maps to reflect Hg deposition in terms of $\mu\text{g}/\text{m}^2$ by watershed to aid review and interpretation of spatial patterns reflected in those

¹ As discussed in Section 1.3 of the Mercury Risk TSD, Hydrologic Unit Code 12 scale watersheds (HUC12s) were used as the basis for generating risk estimates in the analysis.

² As noted in Section 1.3 of the Mercury Risk TSD, proportionality between changes in Hg deposition and changes in fish tissue methylmercury levels (which translate into risk) is used in projecting future risk for the 2016 scenario and is also used to apportion risk between total and US EGU-sourced Hg. This proportionality assumption (which is implemented using unitless ratios calculated using Hg deposition estimates) is based on Mercury Maps modeling.

maps.

The remainder of this memo is organized as follows. First we provide additional clarification on the nature of the Hg deposition estimates provided in the original Figures 2-1 through 2-4. Then we provide updated Figures 2-1 through 2-4 based on Hg deposition normalized by unit surface area.

Clarification of Hg Deposition Estimates Provided in Original Figures 2-1 through 2-4

Figure M-1 shows the underlying CMAQ deposition data from which the watershed-level values reflected in Figure 2-1 of the Mercury Risk TSD are derived. The CMAQ data are expressed in $\mu\text{g}/\text{m}^2$, with all grid cells being 12km squares.

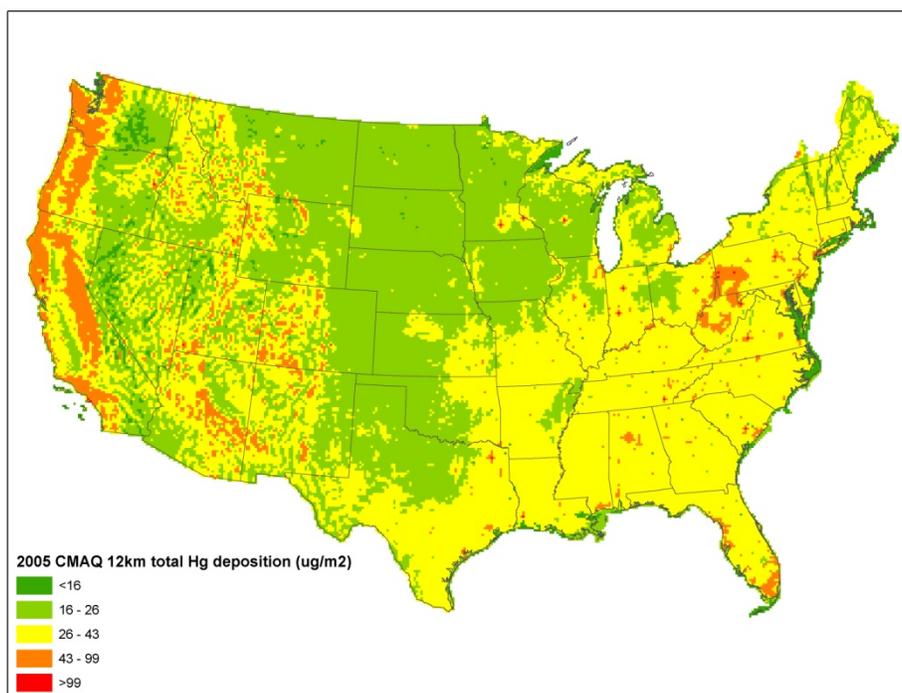


Figure M-1. Total mercury deposition ($\mu\text{g}/\text{m}^2$) by 12 km CMAQ grid cell (2005)

To allocate these values to the watershed level, the following calculations were performed. For each watershed (i.e., HUC) that a CMAQ grid cell intersects, the amount of that grid cell (in terms of area) lying within the watershed was calculated and used to create a ratio used to apportion the total value for the grid cell into the watersheds that it intersects. The value for each watershed is then the sum of the apportioned values for all grid cells with which it intersects. That is,

$$\text{Watershed}_i \text{ deposition} = \sum_j \text{CMAQ}_j \text{ deposition} * \frac{\text{HUC}_{12_{ij}} \text{ area}}{\text{CMAQ}_j \text{ area}}$$

where j indicates all CMAQ grid cells that intersect watershed i and HUC_{ij} area is the amount of overlap between the watershed and grid cell. Applying this formula for all watersheds leads to

the map in Figure M-2, which matches Figure 2-1 in the Mercury Risk TSD.

Presenting the maps reflecting the above calculation, however, ignores the differences in sizes of watersheds. Because larger watersheds intersect a larger number of grid cells, larger watersheds are apportioned more of the deposition. As a result, Figure M-2 most clearly shows the relative sizes of watersheds rather than the average deposition across the watersheds.

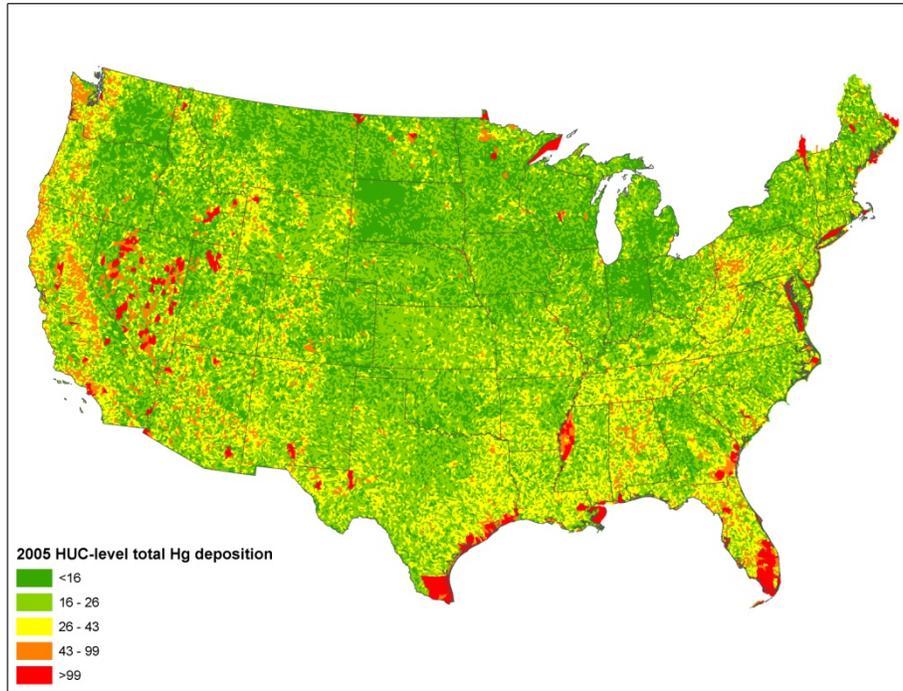


Figure M2. Original mercury deposition map (2005) (without adjustment for watershed surface area) – corresponds to Figure 2-1 in Mercury Risk TSD

When the values in Figure M-2 are normalized to account for the differences in watershed sizes, they appear as in Figure M-3, which shows the average deposition in $\mu\text{g}/\text{m}^2$ across watersheds.

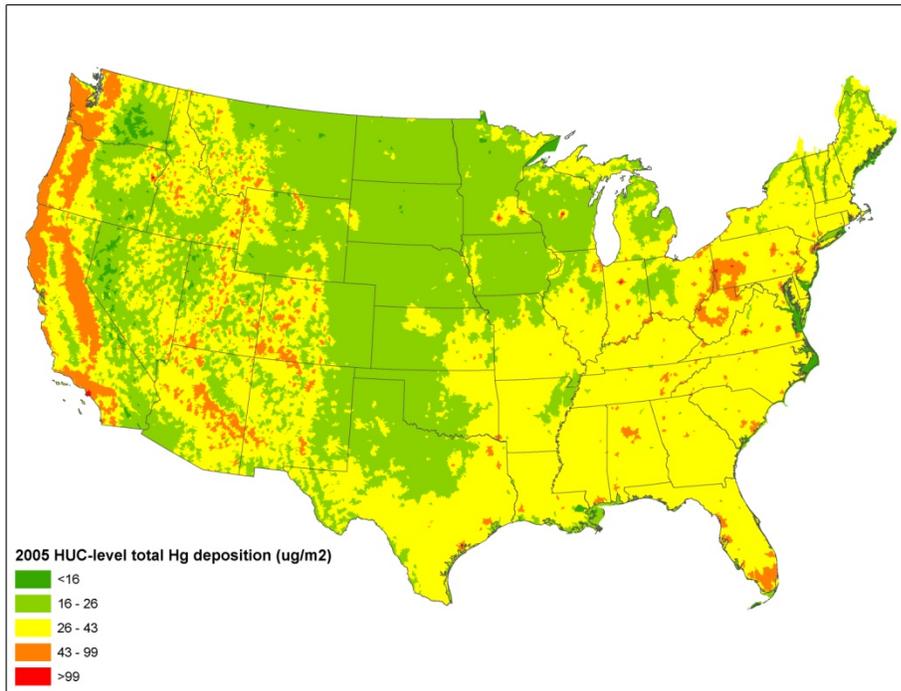


Figure M-3. Total mercury deposition ($\mu\text{g}/\text{m}^2$) by watershed (2005)

It can be seen that after the watershed values are adjusted to account for differences in sizes, the distribution of values is consistent with what is seen in the underlying CMAQ data (i.e., the pattern reflected in Figure M-3 matches that in Figure M-1). Figure M-3 reflects the units intended for presentation in the Mercury Risk TSD (i.e., annual mercury deposition per square-meter by watershed). The pattern of total annual mercury deposition reflected in Figure M-3 is likely more in-line with what SAB Panel members expected to see in Figure 2-1 of the Mercury Risk TSD.

Updated Figures 2-1 through 2-4 for the Mercury Risk TSD

Updated versions of Figures 2-1 through 2-4 of the Mercury Risk TSD, presenting total and US EGU-sourced (for 2005 and 2016) annual deposition normalized by surface area (i.e., units of $\mu\text{g}/\text{m}^2$ per watershed) are presented below as Figures M-4 through M-7.

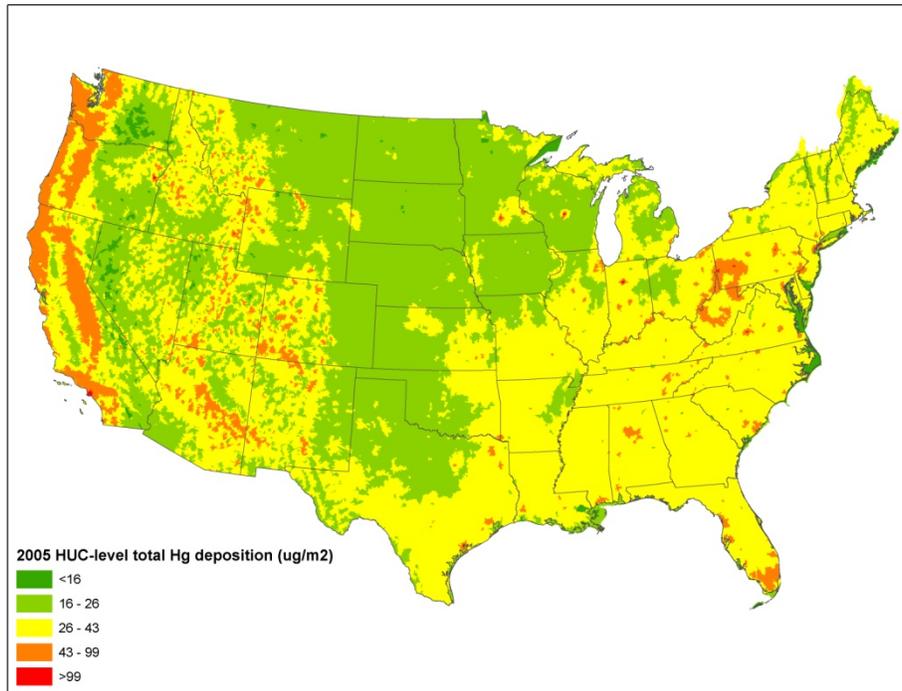


Figure M-4. Total mercury deposition ($\mu\text{g}/\text{m}^2$) by watershed (2005) (updates Figure 2-1 in the Mercury Risk TSD)

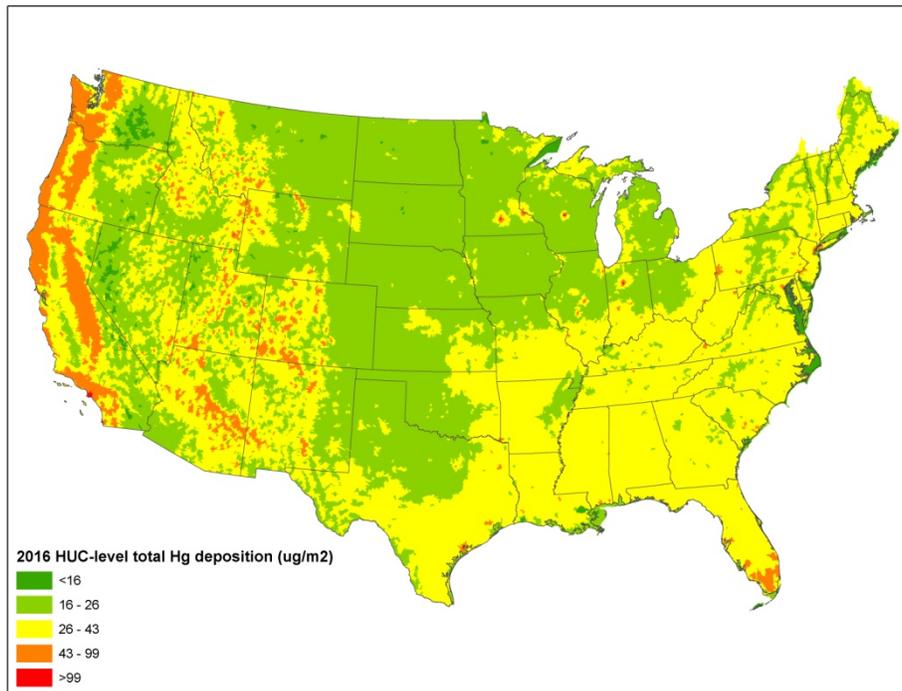


Figure M-5. Total mercury deposition ($\mu\text{g}/\text{m}^2$) by watershed (2016) (updates Figure 2-2 in the Mercury Risk TSD)

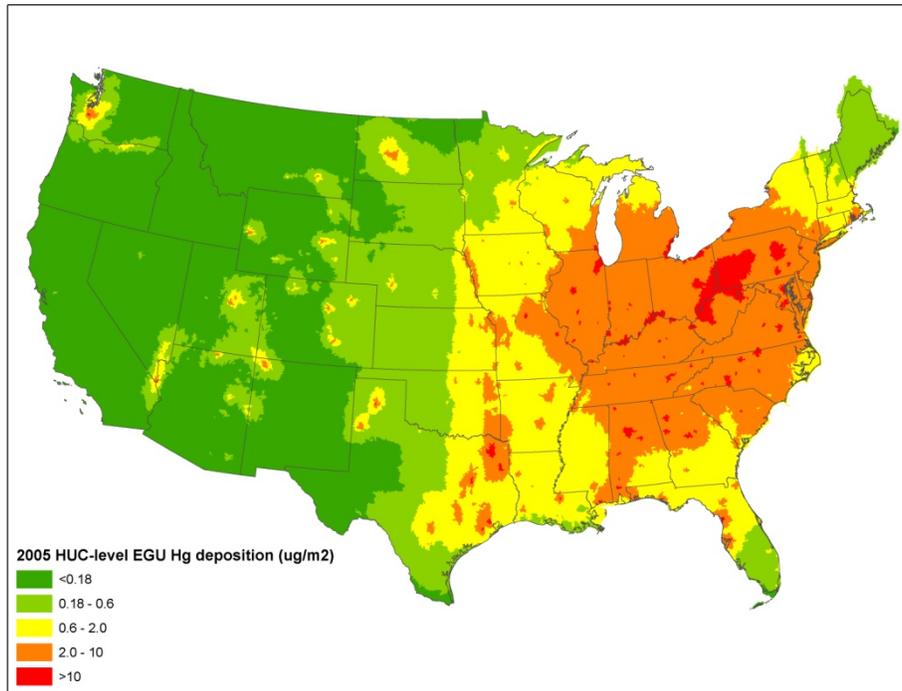


Figure M-6. U.S. EGU-attributable mercury deposition ($\mu\text{g}/\text{m}^2$) by watershed (2005)
 (updates Figure 2-3 in the Mercury Risk TSD)

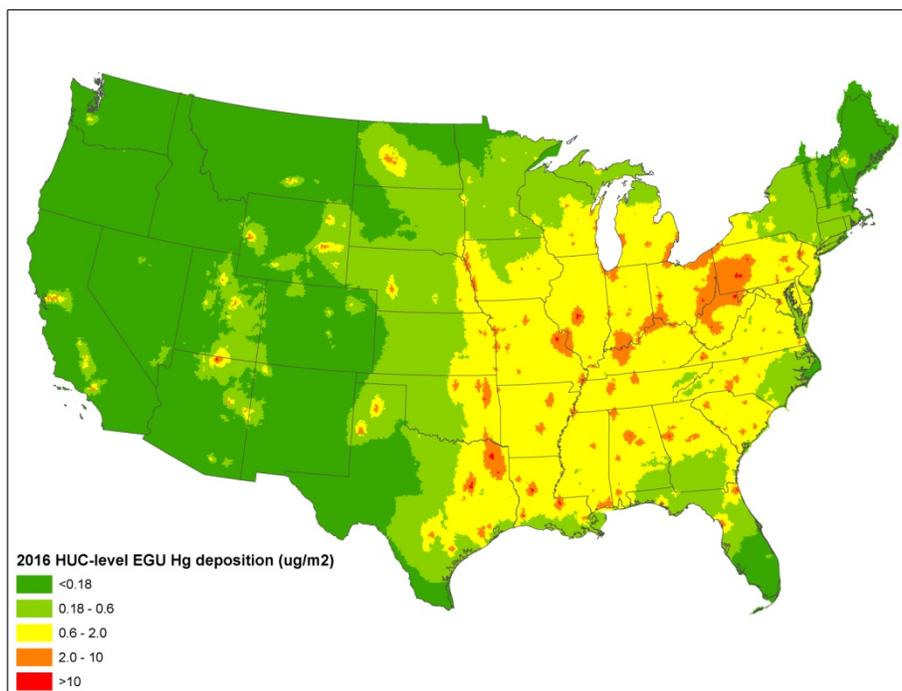


Figure M-7. U.S. EGU-attributable mercury deposition ($\mu\text{g}/\text{m}^2$) by watershed (2016)
 (updates Figure 2-4 in the Mercury Risk TSD)