Appendix N. Comparison of Projected PM2.5 Concentrations Using 36 km vs 12 km Modeling

The air quality modeling performed for the PM NAAQS RIA included CMAQ model runs with a horizontal grid resolution of approximately 36 x 36 km (as fully described in Chapter 4). Ambient measurements indicate that $PM_{2.5}$ species, especially directly emitted species like crustal material and carbon (elemental and primary organic carbon) can exhibit large spatial gradients in urban areas. The magnitude and extent of these gradients depends on the type and distribution of local emissions sources within the urban area. Being able to adequately represent in our modeling the large observed gradients is important when trying to assess the impacts of changes in emissions at such sources on monitors in the general vicinity of the source. It is likely that 36 km resolution will understate the impacts of controls on primary emissions from local sources since this relatively coarse resolution smoothes out the emissions from such sources. In view of this issue, we initiated a sensitivity analysis to explore the difference in annual PM2.5 design values calculated using 36 km modeling versus modeling at a 12 x 12 km resolution. We chose to use 12 km modeling for this analysis because of the availability of meteorological data and other inputs at this resolution that are consistent with our 36 km modeling platform. These 12 km inputs cover an Eastern U.S. modeling domain that extends from east Texas to Maine. This domain is shown in Figure 1 (figure is provided on the last page of this appendix).

Ideally, we would want to perform the grid resolution comparison modeling using an control scenario that focused on the effectiveness of local source control measures. However, due to the large computational requirements for 12 km modeling and the time constraints for completing the analysis, we elected to use the 2015 base case scenario since this was one of the initial scenarios developed for the PM NAAQS analysis. The emissions reductions in this base case run are derived mostly from national control programs (e.g., onroad and nonroad engine rules) and regional programs (i.e., CAIR), and thus, the effects of grid resolution are likely to be less than if we analyzed a scenario reflecting more local controls.

The 2015 base case 12 km run was performed in a similar manner to the corresponding 36 km run and the CMAQ outputs were post-processed using the same SMAT technique to project $PM_{2.5}$ design values (as described in Chapter 4). Table 1 shows the 36 km and 12 km modeling results for counties in the Eastern U.S. 12 km modeling domain and with projected annual design values at or above 14 $\mu g/m^3$, which covers the range of annual concentrations of interest for the PM NAAQS analysis.

Table 1. Projected Annual $PM_{2.5}$ Design Values in Eastern US Based on 36 km and 12 km CMAQ Modeling: 2015 Base Case

State	County	Annual DV @ 36 km	Annual DV @ 12 km	Difference (12 km - 36 km)
Alabama	Jefferson Co	16.11	16.15	0.04
Georgia	Clayton Co	14.20	14.61	0.41
Georgia	DeKalb Co	13.95	14.06	0.11
Georgia	Floyd Co	14.43	14.31	-0.12
Georgia	Fulton Co	15.88	16.41	0.53
Illinois	Cook Co	15.50	15.41	-0.09
Illinois	Madison Co	15.26	15.18	-0.08
Illinois	St. Clair Co	14.71	14.61	-0.10
Michigan	Wayne Co	17.57	17.22	-0.35
New York	New York Co	14.10	14.45	0.35
Ohio	Cuyahoga Co	15.55	15.51	-0.04
Ohio	Hamilton Co	14.41	14.64	0.23
Ohio	Jefferson Co	14.20	14.28	0.08
Ohio	Scioto Co	15.63	15.49	-0.14
Pennsylvania	Allegheny Co	16.48	16.42	-0.06
Tennessee	Knox Co	13.88	14.08	0.20

The data in Table 1 indicate that the predicted annual DV for $PM_{2.5}$ is higher in some counties and lower in others across these modeling resolutions. In both runs, the same eight counties are projected to exceed the 1997 annual standard of 15 $\mu g/m^3$. The 12 km concentrations in six of these eight counties are lower than in the 36 km run. On average, the 12 km concentrations are lower by 0.02 $\mu g/m^3$ in the eight nonattainment counties, but the range is -0.35 to + 0.53 $\mu g/m^3$. Excluding the data for Fulton County in the calculation, since this appears to be somewhat of an outlier across these counties, on average the 12 km concentrations in the nonattainment counties are 0.10 $\mu g/m^3$ lower than in the 36 km modeling. However, in counties with concentrations between 14 and 15 $\mu g/m^3$, the concentrations tend to be higher in the 12 km run.

The results of this limited sensitivity analysis indicate that grid resolution can be an important factor in modeling to project future year concentrations. The sensitivity results shown here reflect the national, regional nature of control programs that are part of the 2015 base case scenario. As indicated above, we would expect the differences between the use of 36 km and 12 km modeling to be greater than found in this limited sensitivity analysis if the control scenario used in the comparison emphasized more local controls.

Figure 1. The 12 km modeling domain (area within the box shown in this figure).