

6. Biogenic Sources

6.1 Introduction and scope

Biogenic source emission estimates have been calculated for particulate matter precursors for use in the 2005 Periodic PM₁₀ Inventory. These biogenic source emission estimates are for Maricopa County and the approximately 3,000 square-mile portion of the PM₁₀ nonattainment area within Maricopa County and a small portion of Pinal County. The biogenic emissions were estimated using the Model of Emissions of Gases and Aerosols from Nature (MEGAN). MEGAN is a state-of-the-art model, developed by Dr. Alex Guenther and ENVIRON International Corporation (Guenther, 2006a and b). MAG contracted with ENVIRON and Dr. Guenther in 2005 to develop a more reliable and accurate biogenic emissions model. Dr. Guenther performed field studies in June 2006 to measure vegetation emission rates within Maricopa County. During 2006, Dr. Guenther also collected data on desert plant emission rates in Clark County, Nevada. Due to the incorporation of emission rates that are more characteristic of plants located in the desert southwest, the MEGAN estimates represent a substantial improvement over previous biogenic emission estimates for Maricopa County. Among the chemical species included in MEGAN, only nitric oxide (NO) is attributable to PM formation. Therefore, only NO_x emissions are included in the inventory.

6.2 MEGAN input files

To calculate biogenic emissions using MEGAN, seven gridded input files were prepared:

- User domain file: this file describes the user's domain such as the number of grid cells, grid cell size, and latitude and longitude coordinates of grid cells
- Solar radiation and temperature file
- Monthly Leaf Area Index (LAI) file
- Plant Functional Type (PFT) file
- Emission Factor (EF) file
- Wind speed and humidity
- Soil moisture

Since MEGAN requires that all input data files be provided for grid cells defined in the user domain file, gridded meteorological data (e.g., temperature, solar radiation, wind speed and humidity, and soil moisture) generated by the Penn State/NCAR Mesoscale Meteorological Model 5 (MM5) for MAG 8-hour ozone modeling were provided to MAG by ENVIRON. The MM5 meteorological data files were reformatted for MEGAN input. LAI, PFT and EF files for Maricopa County developed by Dr. Guenther were extracted from the MEGAN database using the MEGAN driving variables processor.

6.3 Emission estimation

Since MM5-generated meteorological data for all days in 2005 were not available, NO emission estimates from MEGAN for May 31 to June 7, 2002 for the MAG 8-hour ozone modeling area were employed to derive 2005 daily average NO emissions for the PM₁₀ nonattainment area and Maricopa County. The PM₁₀ nonattainment area, Maricopa County, and 8-hour ozone modeling area are delineated in Figure 6.3–1.

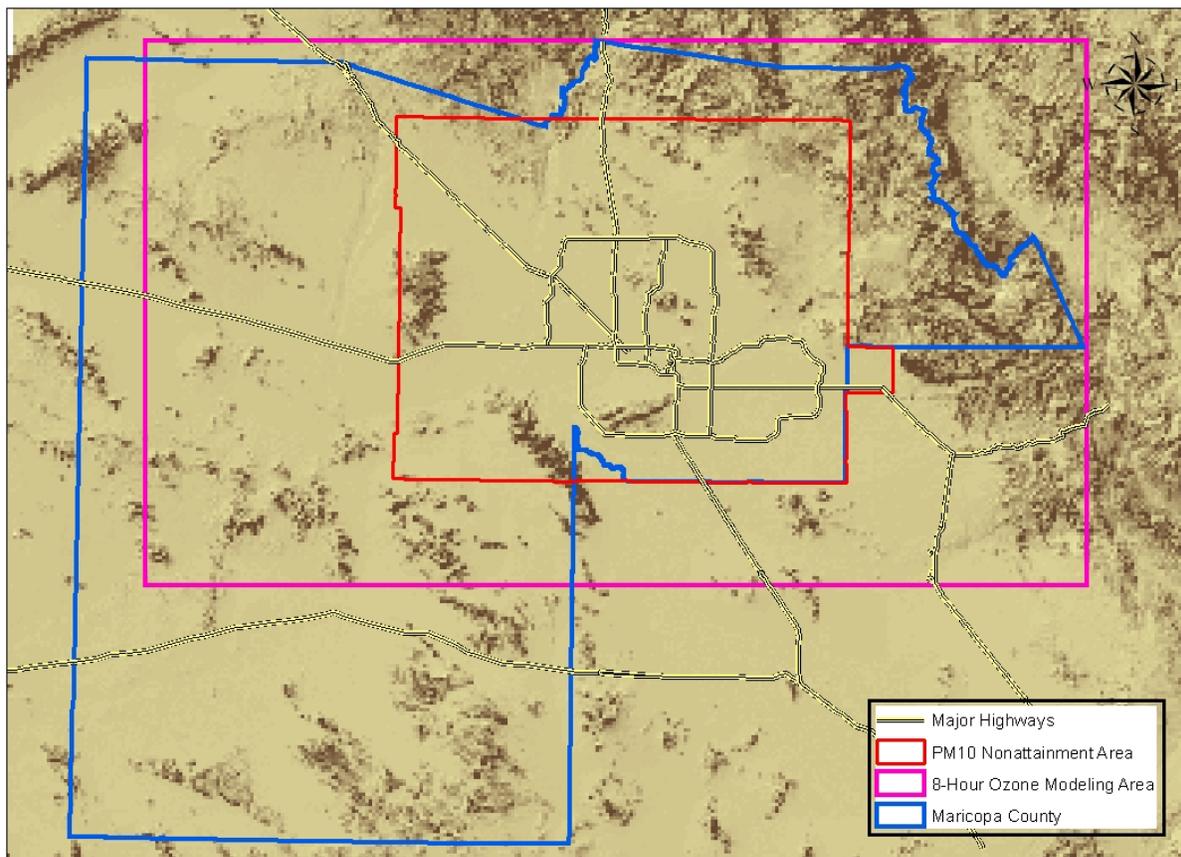


Figure 6.3–1. Boundaries of PM₁₀ Nonattainment Area, 8-Hour Ozone Modeling Area and Maricopa County

The daily average NO emissions for the 8-hour ozone modeling area within Maricopa County and PM₁₀ nonattainment area were extracted from NO emissions for the 8-hour ozone modeling area using GIS. The extracted daily NO emissions for May 31 to June 7, 2002 for the Maricopa County portion of the 8-hour ozone modeling area and PM₁₀ nonattainment area are provided in Tables 6.3-1 and Table 6.3-2, respectively.

However, the emissions developed for the 8-hour ozone modeling area do not cover 7,295 square kilometers of the western and southern areas of Maricopa County. To obtain NO emissions for all of Maricopa County, emissions per square kilometer were calculated using MEGAN NO emission estimates for a 1,600 square kilometer area in the southwest corner of the 8-hour ozone modeling area. This relatively remote and largely unpopulated area was assumed to be representative of vegetation in the portion of Maricopa County that was not modeled for 8-hour ozone. The average NO emissions per square kilometer for the 1,600 square kilometer area, 0.3505 kg/km²-day, was multiplied by 7,295 square kilometers. The result, 2,557 kg/day, was

added to NO emissions estimated for the 8-hour ozone modeling area within Maricopa County to obtain total biogenic NO emissions for all of Maricopa County.

Table 6.3–1. Daily NO emissions in the 8-hour ozone modeling area (Maricopa County).

Date	NO (kg/day)
5/31/2002	6,414
6/1/2002	5,921
6/2/2002	5,197
6/3/2002	4,742
6/4/2002	4,926
6/5/2002	5,655
6/6/2002	6,536
6/7/2002	6,182
Average	5,697

Table 6.3–2. Daily NO emissions in the PM₁₀ nonattainment area.

Date	NO (kg/day)
5/31/2002	2,920
6/1/2002	2,707
6/2/2002	2,371
6/3/2002	2,169
6/4/2002	2,262
6/5/2002	2,598
6/6/2002	2,993
6/7/2002	2,829
Average	2,606

6.4 Summary of biogenic source emissions

Annual and typical daily NO_x biogenic emissions for Maricopa County and the PM₁₀ nonattainment area are summarized in Tables 6.4–1.

Table 6.4–1. Annual and typical daily NO_x biogenic emissions.

Geographic area	Annual emissions (metric tons/yr)	Annual emissions (tons/yr)	Season-day emissions (kg/day)	Average daily emissions (lbs/day)
Maricopa County	3,013	3,321	8,254	18,197
PM ₁₀ NAA	951	1,048	2,606	5,745

6.5 References

- Guenther, A., 2006a. User's Guide to Processing Driving Variables for Model of Emissions of Gases and Aerosols from Nature (MEGAN), August 14, 2006.
- Guenther, A., 2006b. User's Guide to the Model of Emissions of Gases and Aerosols from Nature (MEGAN) Version MEGAN-VBA-2.0, August 28, 2006.
- ENVIRON International Corp., Final Report, Maricopa Association of Governments 2006 Biogenics Study, September 11, 2006.