October 15, 2019

SPECIFICATION SHEET: AFDUST 2016v1 Platform

Description: Nonpoint area fugitive dust (afdust) emissions, for simulating 2016 and future year U.S. air quality

1. EXECUTIVE SUMMARY

The area fugitive dust (afdust) sector consists of fugitive dust particulate matter (PM) emissions from the 2014 National Emissions Inventory (NEI) version 2 nonpoint source category. Categories included in the afdust sector are paved roads, unpaved roads and airstrips, construction (residential, industrial/commercial/institutional, road and total), agriculture production, and mining and quarrying. For the 2016v1 platform, emissions from paved roads are projected from 2014 to 2016 based on county total VMT, but emissions from all other sources, including unpaved roads, are held constant. Base and future year inventories were processed with the Sparse Matrix Operating Kernel Environment (SMOKE) v4.7. SMOKE creates emissions in a format that can be input into air quality models. After SMOKE processing, afdust emissions are reduced using a gridded transport fraction file that accounts for the impact of the roughness of the landscape on the emissions. Emissions are further reduced at specific hours

based on snow cover and precipitation. National and state-level emission summaries for key pollutants are provided.

2. INTRODUCTION

This document details the approach and data sources used for developing 2016v1 emissions for the nonpoint area fugitive dust (afdust) sector. For states within the Mid-Atlantic Regional Air Management Association (MARAMA), the version 1 (v1) platform uses a partial projection of afdust emissions from the 2014NEIv2, including paved road emissions and construction dust, are projection from the 2014NEIv2 to 2016, while most other afdust categories are held constant. For non-MARAMA states, only paved road emissions are projected from the 2014NEIv2 to 2016 while emissions from all other afdust categories are held constant. This section includes background information on the sector in general. The projection method is described in Section 3.

The afdust sector contains PM_{10} and $PM_{2.5}$ emission estimates for nonpoint SCCs identified by EPA as dust sources. Categories included in the afdust sector are paved roads, unpaved roads and airstrips, construction (residential, industrial/commercial/institutional, road and total), agriculture production, and mining and quarrying. It does not include fugitive dust from grain elevators, coal handling at coal mines, or vehicular traffic on paved or unpaved roads at industrial facilities because these are treated as point sources so they are properly located spatially.

Table 1 is a listing of the Source Classification Codes (SCCs) in the afdust sector.

Table 1. Afdust SCCs in the 2016v1 platform

SCC	Tier 1 description	Tier 2 description	Tier 3 description	Tier 4 description
2275085000	Mobile Sources	Aircraft	Unpaved Airstrips	Total
2294000000	Mobile Sources	Paved Roads	All Paved Roads	Total: Fugitives
2294000002	Mobile Sources	Paved Roads	All Paved Roads	Total: Sanding/Salting - Fugitives
2296000000	Mobile Sources	Unpaved Roads	All Unpaved Roads	Total: Fugitives
2311000000	Industrial Processes	Construction: SIC 15 - 17	All Processes	Total
2311010000	Industrial Processes	Construction: SIC 15 - 17	Residential	Total
2311010070	Industrial Processes	Construction: SIC 15 - 17	Residential	Vehicle Traffic
2311020000	Industrial Processes	Construction: SIC 15 - 17	Industrial/Commercial/ Institutional	Total

SCC	Tier 1 description	Tier 2 description	Tier 3 description	Tier 4 description
2311030000	Industrial Processes	Construction: SIC 15 - 17	Road Construction	Total
2325000000	Industrial Processes	Mining and Quarrying: SIC 14	All Processes	Total
2325060000	Industrial Processes	Mining and Quarrying: SIC 10	Lead Ore Mining and Milling	Total
2801000000	Miscellaneous Area Sources	Ag. Production - Crops	Agriculture - Crops	Total
2801000003	Miscellaneous Area Sources	Ag. Production - Crops	Agriculture - Crops	Tilling
2801000005	Miscellaneous Area Sources	Ag. Production - Crops	Agriculture - Crops	Harvesting
2801000007	Miscellaneous Area Sources	Ag. Production - Crops	Agriculture - Crops	Loading
2801000008	Miscellaneous Area Sources	Ag. Production - Crops	Agriculture - Crops	Transport
2805001000	Miscellaneous Area Sources	Ag. Production - Livestock	Beef cattle - finishing operations on feedlots (drylots)	Dust Kicked-up by Hooves (use 28-05-020, -001, -002, or -003 for Waste
2805001100	Miscellaneous Area Sources	Ag. Production - Livestock	Beef cattle - finishing operations on feedlots (drylots)	Confinement
2805001200	Miscellaneous Area Sources	Agriculture Production – Livestock	Beef cattle - finishing operations on feedlots (drylots)	Manure handling and storage
2805001300	Miscellaneous Area Sources	Agriculture Production – Livestock	Beef cattle - finishing operations on feedlots (drylots)	Land application of manure
2805002000	Miscellaneous Area Sources	Ag. Production - Livestock	Beef cattle production composite	Not Elsewhere Classified
2805003100	Miscellaneous Area Sources	Ag. Production - Livestock	Beef cattle - finishing operations on pasture/range	Confinement
2805007100	Miscellaneous Area Sources	Ag. Production - Livestock	Poultry production - layers with dry manure management systems	Confinement
2805007300	Miscellaneous Area Sources	Ag. Production - Livestock	Poultry production - layers with dry manure management systems	Land application of manure

SCC	Tier 1 description	Tier 2 description	Tier 3 description	Tier 4 description
2805008100	Miscellaneous Area Sources	Ag. Production - Livestock	Poultry production - layers with wet manure management systems	Confinement
2805008200	Miscellaneous Area Sources	Ag. Production - Livestock	Poultry production - layers with wet manure management systems	Manure handling and storage
2805008300	Miscellaneous Area Sources	Ag. Production - Livestock	Poultry production - layers with wet manure management systems	Land application of manure
2805009100	Miscellaneous Area Sources	Ag. Production - Livestock	Poultry production - broilers	Confinement
2805009200	Miscellaneous Area Sources	Ag. Production - Livestock	Poultry production - broilers	Manure handling and storage
2805009300	Miscellaneous Area Sources	Ag. Production - Livestock	Poultry production - broilers	Land application of manure
2805010100	Miscellaneous Area Sources	Ag. Production - Livestock	Poultry production - turkeys	Confinement
2805010200	Miscellaneous Area Sources	Ag. Production - Livestock	Poultry production - turkeys	Manure handling and storage
2805010300	Miscellaneous Area Sources	Ag. Production - Livestock	Poultry production - turkeys	Land application of manure
2805018000	Miscellaneous Area Sources	Ag. Production - Livestock	Dairy cattle composite	Not Elsewhere Classified
2805019100	Miscellaneous Area Sources	Ag. Production - Livestock	Dairy cattle - flush dairy	Confinement
2805019200	Miscellaneous Area Sources	Ag. Production - Livestock	Dairy cattle - flush dairy	Manure handling and storage
2805019300	Miscellaneous Area Sources	Ag. Production - Livestock	Dairy cattle - flush dairy	Land application of manure
2805020002	Miscellaneous Area Sources	Ag. Production - Livestock	Cattle and Calves Waste Emissions	Beef Cows
2805021100	Miscellaneous Area Sources	Ag. Production - Livestock	Dairy cattle - scrape dairy	Confinement
2805021200	Miscellaneous Area Sources	Ag. Production - Livestock	Dairy cattle - scrape dairy	Manure handling and storage
2805021300	Miscellaneous Area Sources	Ag. Production - Livestock	Dairy cattle - scrape dairy	Land application of manure
2805022100	Miscellaneous Area Sources	Ag. Production - Livestock	Dairy cattle - deep pit dairy	Confinement
2805022200	Miscellaneous Area Sources	Ag. Production - Livestock	Dairy cattle - deep pit dairy	Manure handling and storage
2805022300	Miscellaneous Area Sources	Ag. Production - Livestock	Dairy cattle - deep pit dairy	Land application of manure

SCC	Tier 1 description	Tier 2 description	Tier 3 description	Tier 4 description
2805023100	Miscellaneous Area Sources	Ag. Production - Livestock	Dairy cattle - drylot/pasture dairy	Confinement
2805023200	Miscellaneous Area Sources	Ag. Production - Livestock	Dairy cattle - drylot/pasture dairy	Manure handling and storage
2805023300	Miscellaneous Area Sources	Ag. Production - Livestock	Dairy cattle - drylot/pasture dairy	Land application of manure
2805025000	Miscellaneous Area Sources	Ag. Production - Livestock	Swine production composite	Not Elsewhere Classified (see also 28-05-039, -047, -053)
2805030000	Miscellaneous Area Sources	Ag. Production - Livestock	Poultry Waste Emissions	Not Elsewhere Classified (see also 28-05-007, -008, -009)
2805030007	Miscellaneous Area Sources	Ag. Production - Livestock	Poultry Waste Emissions	Ducks
2805030008	Miscellaneous Area Sources	Ag. Production - Livestock	Poultry Waste Emissions	Geese
2805035000	Miscellaneous Area Sources	Ag. Production - Livestock	Horses and Ponies Waste Emissions	Not Elsewhere Classified
2805039100	Miscellaneous Area Sources	Ag. Production - Livestock	Swine production - operations with lagoons (unspecified animal age)	Confinement
2805039200	Miscellaneous Area Sources	Ag. Production - Livestock	Swine production - operations with lagoons (unspecified animal age)	Manure handling and storage
2805039300	Miscellaneous Area Sources	Ag. Production - Livestock	Swine production - operations with lagoons (unspecified animal age)	Land application of manure
2805040000	Miscellaneous Area Sources	Ag. Production - Livestock	Sheep and Lambs Waste Emissions	Total
2805045000	Miscellaneous Area Sources	Ag. Production – Livestock	Goats Waste Emissions	Not Elsewhere Classified
2805047100	Miscellaneous Area Sources	Ag. Production – Livestock	Swine production - deep-pit house operations (unspecified animal age)	Confinement
2805047300	Miscellaneous Area Sources	Ag. Production – Livestock	Swine production - deep-pit house operations (unspecified animal age)	Land application of manure
2805053100	Miscellaneous Area Sources	Ag. Production – Livestock	Swine production - outdoor operations (unspecified animal age)	Confinement

The afdust sector is separated from other nonpoint sectors to allow for the application of a "transport fraction," and meteorological/precipitation reductions. These adjustments are

applied using a script that applies land use-based gridded transport fractions based on landscape roughness, followed by another script that zeroes out emissions for days on which at least 0.01 inches of precipitation occurs or there is snow cover on the ground. The land use data used to reduce the NEI emissions determines the amount of emissions that are subject to transport. This methodology is discussed in Pouliot, et al., 2010, and in "Fugitive Dust Modeling for the 2008 Emissions Modeling Platform" (Adelman, 2012). Both the transport fraction and meteorological adjustments are based on the gridded resolution of the platform (i.e., 12km grid cells); therefore, different emissions will result if the process were applied to different grid resolutions. A limitation of the transport fraction approach is the lack of monthly variability that would be expected with seasonal changes in vegetative cover. While wind speed and direction are not accounted for in the emissions processing, the hourly variability due to soil moisture, snow cover and precipitation is accounted for in the subsequent meteorological adjustment.

For the data compiled into the 2014NEIv2, meteorological adjustments are applied to paved and unpaved road SCCs but not transport adjustments. For the 2014NEIv1, the meteorological adjustments were inadvertently not applied. This created a large difference between the 2014NEIv1 and 2014NEIv2 dust emissions which did not impact the modeling platform because the modeling platform applies meteorological adjustments and transport adjustments based on unadjusted NEI values (for both v1 and v2).   Thus, for the 2014NEIv2, the meteorological adjustments that were applied (to paved and unpaved road SCCs) had to be backed out so that the entire sector could be processed consistently in SMOKE and the same grid-specific transport fractions and meteorological adjustments could be applied sector-wide. Because it was determined that some counties in 2014NEIv2 did not have the adjustment applied, their emissions were used as-is. Thus, the FF10 that is run through SMOKE consists of 100% unadjusted emissions, and after SMOKE all afdust sources have both transport and meteorological adjustments applied. The total impacts of the transport fraction and meteorological adjustments for 2016v1 are shown in Table 2. Note that while totals from AK, HI, PR, and VI are included at the bottom of Table 2, they exist in a separate domain.

Figure 1 illustrates the impact of each step of the adjustment, using the 2014v7.0 platform afdust sector as an example. The reductions due to the transport fraction adjustments alone are shown at the top of Figure 1. The reductions due to the precipitation adjustments alone are shown in the middle of Figure 1. The cumulative emission reductions after both transport fraction and meteorological adjustments are shown at the bottom of Figure 1. The top plot shows how the transport fraction has a larger reduction effect in the east, where forested areas are more effective at reducing PM transport than in many western areas. The middle plot

shows how the meteorological impacts of precipitation, along with snow cover in the north, further reduce the dust emissions.
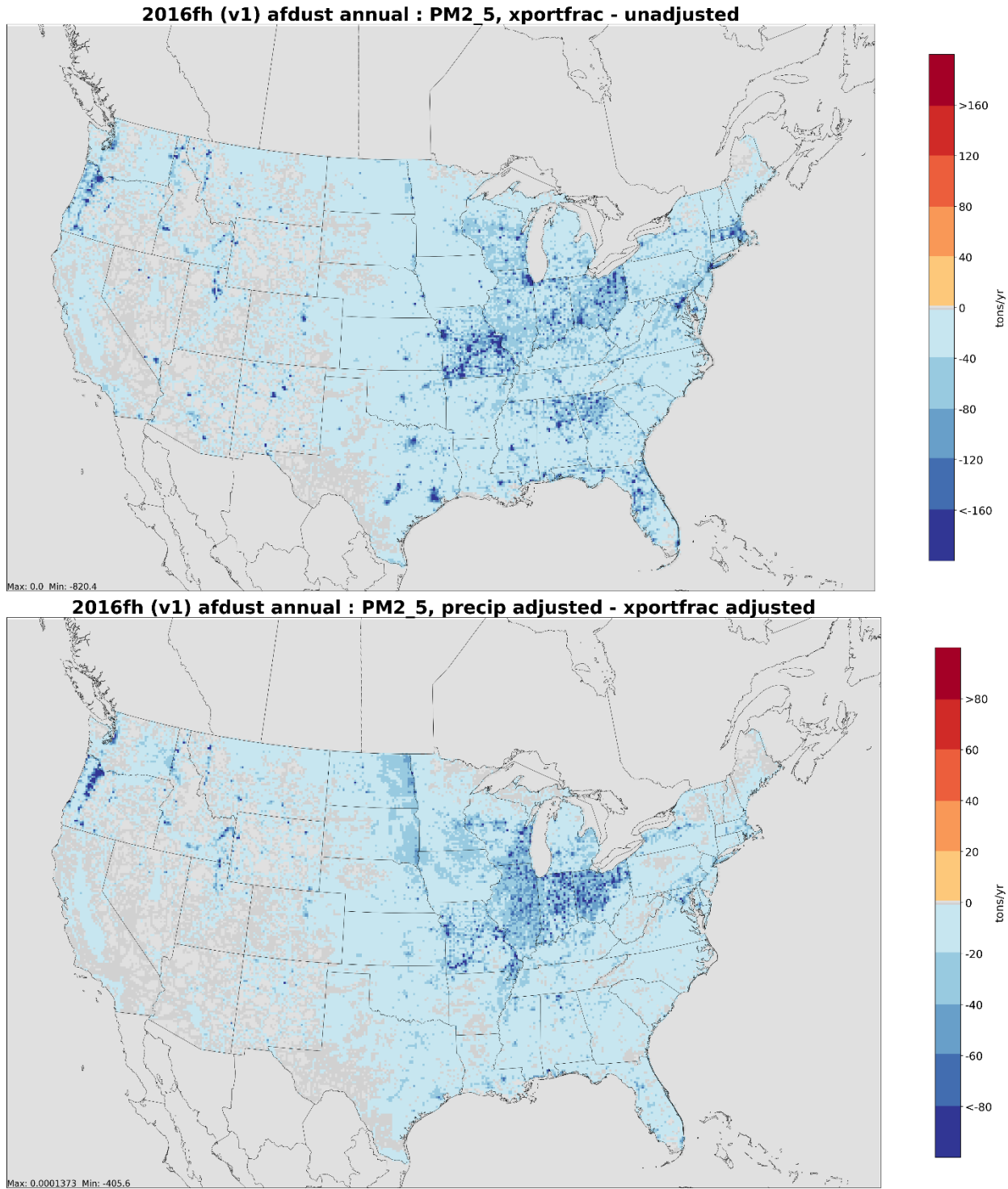
Table 2. Total impact of fugitive dust adjustments to unadjusted 2016 v1 inventory
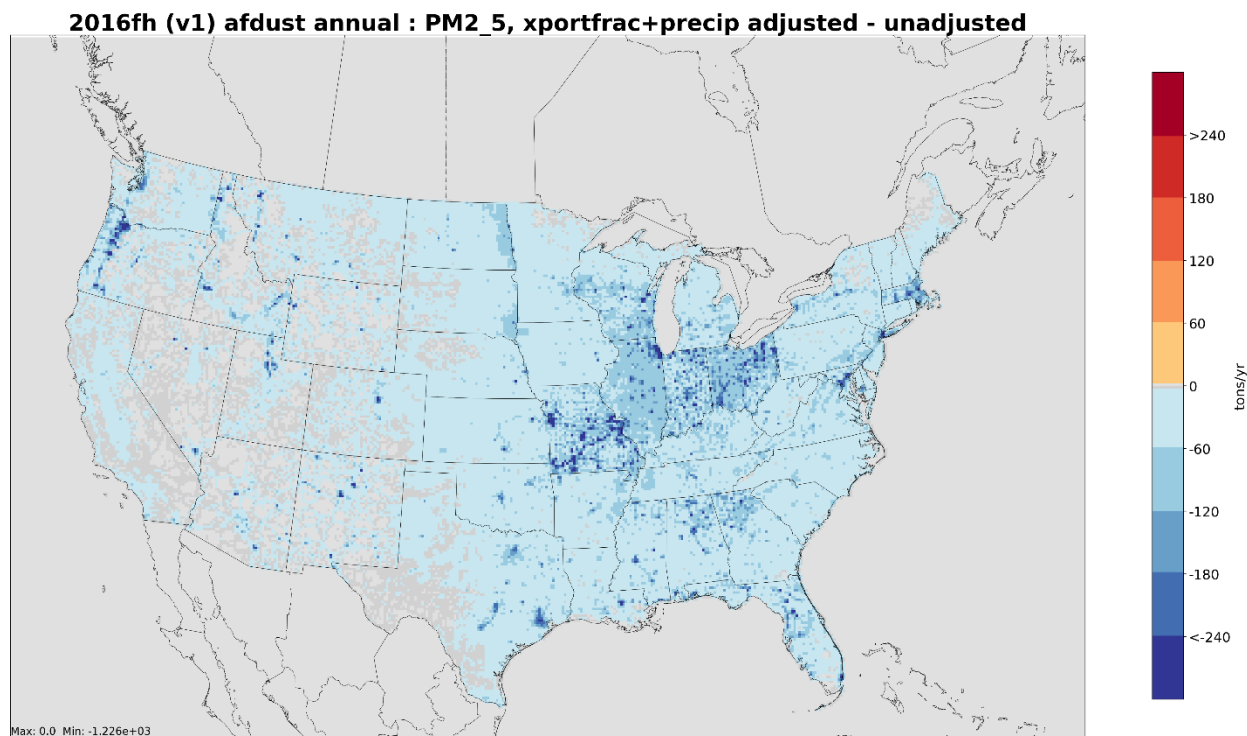
State	Unadjusted PM$_{10}$	Unadjusted PM$_{2.5}$	Change in PM$_{10}$	Change in PM$_{2.5}$	PM$_{10}$ Reduction	PM$_{2.5}$ Reduction
Alabama	535,218	63,682	-372,853	-44,336	70%	70%
Arizona	264,628	32,808	-96,814	-11,809	37%	36%
Arkansas	321,488	49,397	-211,050	-31,802	66%	64%
California	314,917	41,395	-134,347	-17,059	43%	41%
Colorado	242,327	36,848	-121,263	-17,718	50%	48%
Connecticut	23,740	3,385	-17,548	-2,510	74%	74%
Delaware	14,566	2,502	-8,843	-1,533	61%	61%
District of Columbia	2,619	378	-1,627	-236	62%	62%
Florida	721,379	82,397	-412,621	-46,899	57%	57%
Georgia	557,354	66,609	-389,482	-46,272	70%	69%
Idaho	454,301	55,978	-241,373	-28,363	53%	51%
Illinois	997,748	143,992	-619,594	-88,735	62%	62%
Indiana	718,027	84,663	-498,442	-58,430	69%	69%
Iowa	387,029	60,253	-222,941	-34,557	58%	57%
Kansas	613,183	99,486	-277,007	-44,234	45%	44%
Kentucky	312,872	42,952	-233,163	-31,762	75%	74%
Louisiana	266,812	35,788	-172,875	-22,923	65%	64%
Maine	38,345	5,963	-31,893	-4,978	83%	83%
Maryland	105,892	16,672	-68,246	-10,824	64%	65%
Massachusetts	148,284	18,297	-112,998	-13,852	76%	76%
Michigan	390,994	48,838	-286,999	-35,560	73%	73%
Minnesota	405,052	61,723	-250,646	-37,609	62%	61%
Mississippi	434,575	53,546	-299,888	-36,494	69%	68%
Missouri	1,604,501	185,103	-1,084,830	-124,078	68%	67%
Montana	432,844	62,062	-236,341	-32,695	55%	53%
Nebraska	349,373	55,303	-165,083	-25,739	47%	47%
Nevada	161,820	23,360	-54,899	-7,953	34%	34%
New Hampshire	22,330	4,607	-18,436	-3,803	83%	83%
New Jersey	40,336	9,118	-26,776	-6,035	66%	66%
New Mexico	490,617	54,236	-200,695	-22,038	41%	41%
New York	264,041	44,137	-196,162	-32,785	74%	74%

State	Unadjusted PM$_{10}$	Unadjusted PM$_{2.5}$	Change in PM$_{10}$	Change in PM$_{2.5}$	PM$_{10}$ Reduction	PM$_{2.5}$ Reduction
North Carolina	206,465	30,017	-141,501	-20,610	69%	69%
North Dakota	473,241	82,478	-249,646	-43,138	53%	52%
Ohio	931,847	116,560	-638,127	-79,098	68%	68%
Oklahoma	450,904	67,915	-232,046	-33,983	51%	50%
Oregon	659,099	73,832	-456,949	-49,830	69%	67%
Pennsylvania	242,608	37,707	-179,647	-27,959	74%	74%
Rhode Island	4,935	785	-3,503	-556	71%	71%
South Carolina	164,477	22,016	-110,278	-14,795	67%	67%
South Dakota	339,195	63,248	-169,300	-31,302	50%	49%
Tennessee	295,092	43,414	-204,746	-29,995	69%	69%
Texas	1,264,131	180,314	-636,591	-87,931	50%	49%
Utah	209,800	26,453	-111,587	-13,771	53%	52%
Vermont	22,437	3,275	-18,644	-2,699	83%	82%
Virginia	286,237	37,007	-211,882	-27,348	74%	74%
Washington	242,907	41,851	-135,713	-23,281	56%	56%
West Virginia	123,003	15,127	-105,093	-12,911	85%	85%
Wisconsin	690,830	89,899	-486,508	-62,683	70%	70%
Wyoming	240,156	29,140	-123,388	-14,561	51%	50%
Domain Total (CONUS)	**18,484,575**	**2,506,516**	**-11,280,883**	**-1,500,070**	**61%**	**60%**
Alaska	112,025	11,562	-101,822	-10,508	91%	91%
Hawaii	109,120	11,438	-73,612	-7,673	67%	67%
Puerto Rico	5,889	1,313	-4,355	-984	74%	75%
Virgin Islands	3,493	467	-1,477	-195	42%	42%

Figure 1. Impact of adjustments to fugitive dust emissions due to transport fraction, precipitation, and cumulative

2016fh (v1) afdust annual : PM2_5, xportfrac - unadjusted

2016fh (v1) afdust annual : PM2_5, precip adjusted - xportfrac adjusted

2016fh (v1) afdust annual : PM2_5, xportfrac+precip adjusted - unadjusted

3. INVENTORY DEVELOPMENT METHODS

The starting point for the afdust emissions is the 2014 National Emissions Inventory version 2. The methodologies to estimate emissions for each SCC in Table 1 are described in the 2014 NEI version 2 Technical Support Document[1].

MARAMA States

The MARAMA states include Connecticut, Delaware, the District of Columbia (DC), Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, Vermont, Virginia, and West Virginia. MARAMA submitted county-specific projection factors for their states to project afdust emissions from the 2014NEI2 to 2016 for paved roads (SCC 2294000000), residential construction dust (SCC 2311010000), industrial/commercial/institutional construction dust (SCC 2311020000), road construction dust (SCC 2311030000), dust from mining and quarrying (SCC 2325000000), agricultural crop tilling dust (SCC 2801000003), and agricultural dust kick-up from from beef cattle hooves (SCC 2805001000). Other afdust emissions, including unpaved road dust emissions, were held constant at 2014NEIv2 values.

---

[1] https://www.epa.gov/air-emissions-inventories/2014-national-emissions-inventory-nei-technical-support-document-tsd

Non-MARAMA States

For non-MARAMA states' paved roads (SCC 2294000000), the 2014NEIv2 paved road emissions in afdust were projected to year 2016 based on differences in county total VMT between 2014 and 2016:

*2016 afdust paved roads = 2014 afdust paved roads * (2016 county total VMT) / (2014 county total VMT)*

The development of the 2016 VMT is described in the onroad documentation.

All emissions other than those for paved roads are held constant in the 2016v1 inventory, including unpaved roads for these states.

4. ANCILLARY DATA

Spatial Allocation

Spatial allocation of afdust emissions to the national 12km domain used for air quality modeling is accomplished using spatial surrogates, and afdust emissions for the national 36km domain are aggregated from the gridded 12km emissions. Spatial surrogates map county polygons to the uniformly spaced grid cells of a modeling domain. The afdust sector uses the total road miles surrogate to allocate emissions from paved roads, and surrogates based on National Land Cover Data (NLCD) land use to allocate other sources. A report summarizing total emissions by spatial surrogate at the national level is provided in Table 3. Reports summarizing total emissions by spatial surrogate at the state and county level are included in the emissions modeling workgroup reports package.

Table 3. 2016fh afdust emissions by spatial surrogate, Continental US (no transport or meteorological adjustments applied)

Srg	Description	PM10	PM2.5
240	Total Road Miles	1,274,035	294,379
304	NLCD Open + Low	10,592,071	1,053,145
306	NLCD Med + High	345,333	43,633
308	NLCD Low + Med + High	1,194,025	123,524
310	NLCD Total Agriculture	5,014,173	988,012

The meteorological adjustments applied to afdust emissions are particularly sensitive to changes in grid resolution and meteorology. So that afdust emissions can be consistent

between resolutions, afdust emissions for the national 36km domain are aggregated from the gridded 12km emissions, rather than processed separately using 36km meteorology. The exception is for Southeast Alaska, which is partially inside the 36US3 modeling domain but is outside the 12km domains. For Southeast Alaska only, we process afdust emissions using 36km surrogates and meteorology as a separate sector called "afdust_ak", which is a supplement to afdust 36km emissions for the Continental US which were aggregated from 12km resolution.

Application of a transport fraction to reduce afdust emissions is applied with a gridded file called the XPORTFRAC file. Formerly, XPORTFRAC files were developed based on BELD3 land use. For the v1 platform, XPORTFRAC files are now developed using land use data from the MCIP GRIDCRO2D file. GRIDCRO2D files contain several LUFRAC variables, which represent different types of land use. Each land use type is grouped into a general category, each of which has a distinct transportable fraction, as shown in Table 4. For example, in areas that are 100% forest, afdust emissions are multiplied by 0.05 (95% reduction). In areas that are 50% urban and 50% shrubland, emissions are multiplied by 0.60 (average of 0.40 and 0.80; 40% reduction). Figure 2 displays the resulting gridded transport fractions for the 12US2 modeling domain that were applied in the spatial allocation steps of the emissions modeling. A value of 1

Table 4. Transportable fractions for different land use categories

Category	Transport fraction
Agricultural	0.75
DevLowIntensity	0.70
DevMedIntensity	0.40
DevHiIntensity	0.10
Grasses	0.75
Water	1.00
Forest	0.05
Urban	0.40
Shrubland	0.80

Figure 2. Gridded transport fractions for the 12US2 modeling domain using GRIDCRO2D land use
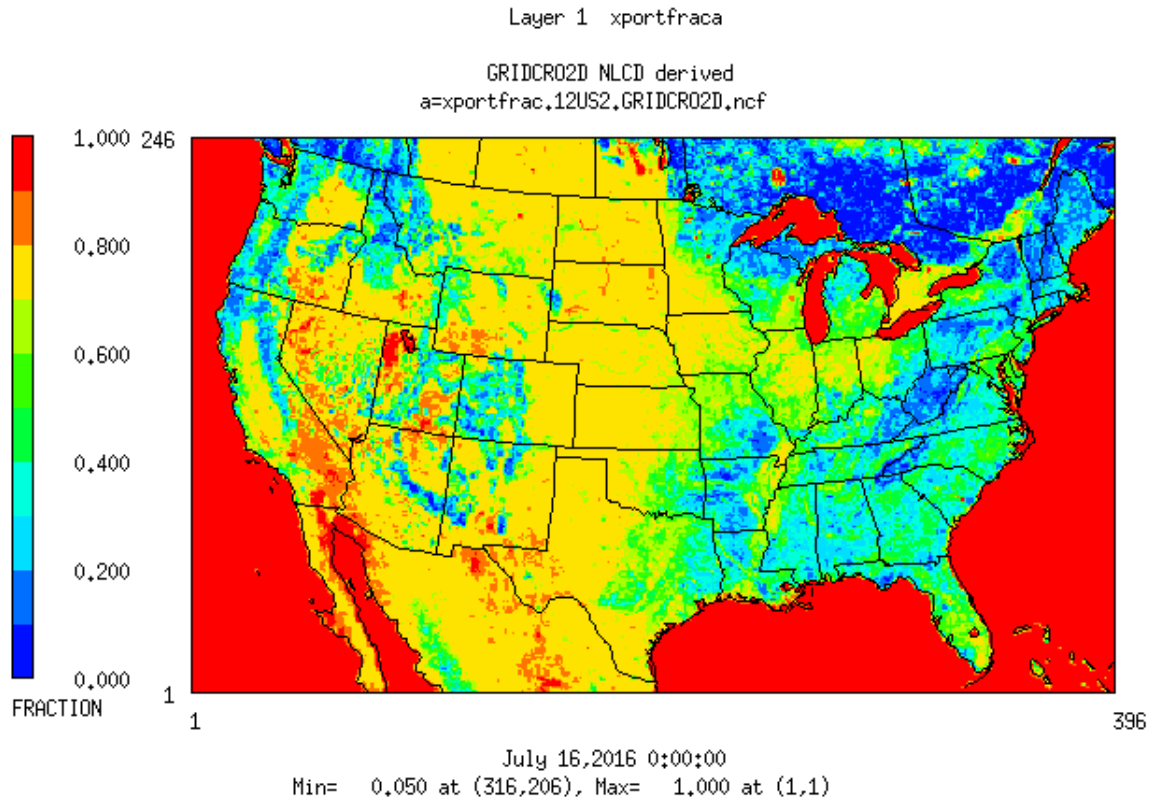
Temporal Allocation

Reports summarizing total emissions according to the monthly, day-of-week, and hour-of-day temporal profile assignments were developed at the state and county level. A national-level summary is provided in Table 5.

Table 5. 2016fh afdust emissions grouped by temporal profile assignment (no transport or meteorological adjustments applied)

Monthly profile	Weekly profile	Diurnal profile	PM10	PM2.5
22	18	26	1,561,518	169,545
22	18	27	3,921,938	781,758
262	7	26	171	29
262	20021	2013[1]	12,079,710	1,370,220
1560	7	26	228	89
1560	7	27	1,636	338
1570	7	26	1	0
Ag[2]	7	26	22,875	3,925
Ag[2]	7	27	1,079,860	204,383

[1] Separate diurnal profiles for weekdays (2013wd) and weekends (2013we).

[2] Includes multiple monthly profiles, which vary by state and by ag emissions category.

Chemical Speciation

The afdust sector only includes PM10 and PM2.5 emissions. Seven different PM2.5 profiles are used for the afdust sector due to the varied nature of the emissions that comprise the sector. Reports summarizing total PM2.5 emissions according to PM2.5 speciation profile were developed at the state and county level.

5. EMISSIONS PROJECTION METHODS

MARAMA States

MARAMA submitted projection factors for their states to project 2016 afdust emissions to future years 2023 and 2028. These county-specific projection factors impacted paved roads (SCC 2294000000), residential construction dust (SCC 2311010000), industrial/commercial/institutional construction dust (SCC 2311020000), road construction dust (SCC 2311030000), dust from mining and quarrying (SCC 2325000000), agricultural crop tilling dust (SCC 2801000003), and agricultural dust kick-up from beef cattle hooves (SCC 2805001000). Other afdust emissions, including unpaved road dust emissions, were held constant in future year projections.

Non-MARAMA States

For paved roads (SCC 2294000000), the 2016 afdust emissions were projected to future years 2023 and 2028 based on differences in county total VMT:

Future year afdust paved roads = 2016 afdust paved roads * (Future year county total VMT) / (2016 county total VMT)

The VMT projections are described in the onroad document.

All emissions other than paved roads are held constant in future year projections.

6. EMISSIONS PROCESSING REQUIREMENTS

Afdust emissions are processed for air quality modeling using the Sparse Matrix Operator Kernel Emissions (SMOKE[2]) modeling system version 4.7 modeling system. Gridded emissions output from SMOKE do not have any transport fraction or meteorological adjustments applied, and so SMOKE outputs are considered "unadjusted" emissions. For this sector, extra steps are needed outside of SMOKE to apply those adjustments.

---

[2] http://www.smoke-model.org/index.cfm

First, the transport fraction, represented as a gridded file called the XPORTFRAC (see Section 4, Spatial Allocation), is applied to the emissions using a Fortran program called "mult" that multiplies an emissions file by a gridded set of fractions. Output files from this step are placed in the same premerged/afdust directory, but with "xportfrac" in the file name.

Second, meteorological adjustments are applied to the xportfrac-adjusted emissions, in which emissions are zeroed out whenever there is snow cover or falling precipitation. Output files from this step are assigned a new sector name: "afdust_adj". Only the afdust_adj emissions, and not the unadjusted afdust emissions, should be included in the final sector merge or any downstream modeling.

Afdust emissions are processed through SMOKE using representative days: one file for each day of the week per month, plus holidays. Transport fractions are not time-dependent, and are also applied on a representative day basis. Meteorological adjustments are time-dependent, and so emissions with meteorological adjustments are generated separately for every day of the year.

This is a 2-D sector in which all emissions are output to a single layer gridded emissions file.

7. EMISSIONS SUMMARIES

National and state unadjusted afdust totals by pollutant for the v1 platform cases are provided here in Table 6 – Table 8, along with some example plots. Additional plots and maps are available online through the LADCO website[3] and the Intermountain West Data Warehouse[4].

Descriptions of the emissions platform cases shown in the tables and plots below are as follows:

2014fd = 2014NEIv2 and 2014 NATA

2016fe = 2016 alpha platform (grown from 2014NEIv2)

2016ff, 2023ff, and 2028ff = 2016, 2023, and 2028 cases from the 2016 beta platform

2016fh, 2023fh, and 2028fh = 2016, 2023, and 2028 cases from the 2016 v1 platform

Table 6. Comparison of national total annual CAPS unadjusted afdust emissions (tons/yr)

Pollutant	2014fd	2016fe	2016ff	2016fh	2023ff	2023fh	2028ff	2028fh
PM10	18,609,657	18,609,657	18,663,254	18,667,930	18,753,210	18,804,710	18,791,296	18,867,130
PM2.5	2,517,877	2,517,877	2,530,184	2,530,265	2,550,512	2,557,970	2,558,876	2,570,714

---

[3] https://www.ladco.org/technical/modeling-results/2016-inventory-collaborative/
[4] http://views.cira.colostate.edu/iwdw/eibrowser2016

Table 7. Comparison of state total annual Primary PM10 unadjusted afdust emissions (tons/yr)

State	2014fd	2016fe	2016ff	2016fh	2023ff	2023fh	2028ff	2028fh
Alabama	528,781	528,781	530,994	530,994	533,335	534,253	533,698	535,415
Alaska	111,865	111,865	112,052	112,052	112,312	112,330	112,469	112,497
Arizona	263,614	263,614	264,215	264,215	265,871	266,189	266,665	267,318
Arkansas	320,563	320,563	321,503	321,503	322,737	323,151	323,079	323,819
California	312,537	312,537	313,897	313,897	319,392	321,209	322,177	325,419
Colorado	241,417	241,417	242,584	242,584	244,162	244,305	245,094	245,329
Connecticut	23,465	23,465	23,432	23,661	23,710	24,299	23,914	24,658
Delaware	14,370	14,370	14,754	14,572	15,148	15,279	15,212	15,718
D.C.	2,568	2,568	2,588	2,630	2,610	2,802	2,601	2,857
Florida	711,690	711,690	715,197	715,197	719,072	720,211	720,397	722,599
Georgia	549,708	549,708	552,994	552,994	556,489	556,489	559,254	559,254
Hawaii	108,186	108,186	108,303	108,303	108,497	108,567	108,585	108,713
Idaho	449,496	449,496	452,564	452,564	458,164	458,605	461,597	462,206
Illinois	998,531	998,531	998,531	998,531	999,213	999,532	999,243	999,841
Indiana	711,183	711,183	713,044	713,044	715,073	715,905	715,366	716,918
Iowa	386,614	386,614	387,616	387,616	388,508	388,828	388,679	389,244
Kansas	613,261	613,261	614,019	614,019	615,349	615,722	615,790	616,432
Kentucky	310,944	310,944	311,552	311,552	312,847	313,355	313,114	314,109
Louisiana	265,725	265,725	265,899	265,899	267,273	267,622	267,784	268,402
Maine	37,803	37,803	38,122	38,171	38,593	38,709	38,654	38,806
Maryland	104,047	104,047	105,110	106,436	106,887	112,850	107,489	115,439
Massachusetts	146,920	146,920	150,390	147,090	150,994	148,587	151,413	149,373
Michigan	387,396	387,396	388,501	388,501	389,566	390,072	389,499	390,490
Minnesota	404,487	404,487	404,992	404,992	406,363	406,765	406,703	407,478
Mississippi	431,598	431,598	432,177	432,177	433,268	433,683	433,451	434,216
Missouri	1,590,321	1,590,321	1,592,353	1,592,353	1,595,288	1,596,263	1,596,115	1,597,850
Montana	431,833	431,833	432,151	432,151	433,179	433,232	433,838	433,889
Nebraska	348,666	348,666	349,245	349,245	350,023	350,175	350,355	350,598
Nevada	160,293	160,293	162,333	162,333	164,564	164,579	166,197	166,209
New Hampshire	21,673	21,673	22,239	22,165	23,746	23,799	24,912	25,015
New Jersey	39,690	39,690	40,771	39,982	41,693	40,868	42,372	41,535
New Mexico	484,805	484,805	486,558	486,558	488,402	488,735	489,375	489,914
New York	266,456	266,456	262,033	263,082	265,012	268,214	264,195	268,257
North Carolina	201,958	201,958	203,960	206,050	206,227	221,777	207,813	229,387
North Dakota	476,225	476,225	475,565	475,565	476,270	476,400	476,655	476,827
Ohio	924,347	924,347	926,792	926,792	930,603	930,603	932,347	932,347
Oklahoma	449,725	449,725	450,375	450,375	452,009	452,361	452,715	453,318
Oregon	653,001	653,001	653,875	653,875	655,359	655,522	656,282	656,538
Pennsylvania	240,126	240,126	240,224	242,548	241,963	250,219	241,743	250,931
Rhode Island	4,793	4,793	4,849	4,938	4,924	5,318	4,918	5,356
South Carolina	161,472	161,472	163,488	163,488	164,926	165,426	165,262	166,210
South Dakota	341,201	341,201	341,386	341,386	341,882	341,967	342,128	342,255
Tennessee	292,579	292,579	294,599	294,599	296,873	297,654	297,539	298,989
Texas	1,255,165	1,255,165	1,261,816	1,261,816	1,270,256	1,271,874	1,274,353	1,277,188

State	2014fd	2016fe	2016ff	2016fh	2023ff	2023fh	2028ff	2028fh
Utah	207,301	207,301	208,700	208,700	210,140	210,323	210,996	211,280
Vermont	22,105	22,105	22,199	22,341	22,394	22,589	22,441	22,717
Virginia	283,229	283,229	283,555	284,830	285,119	288,422	285,556	289,575
Washington	240,697	240,697	242,998	242,998	247,491	248,361	250,089	251,588
West Virginia	121,931	121,931	121,952	122,356	122,328	123,485	122,368	123,809
Wisconsin	686,669	686,669	687,663	687,663	689,605	689,605	690,795	690,795
Wyoming	238,688	238,688	238,605	238,605	239,306	239,331	239,788	239,791
Puerto Rico	5,860	5,860	5,860	5,860	6,093	6,174	6,119	6,284
Virgin Islands	3,464	3,464	3,464	3,464	3,490	3,503	3,490	3,515
Tribal Data	18,613	18,613	18,613	18,613	18,613	18,613	18,613	18,613

Table 8. Comparison of state total annual Primary PM2.5 unadjusted afdust emissions (tons/yr)

State	2014fd	2016fe	2016ff	2016fh	2023ff	2023fh	2028ff	2028fh
Alabama	62,688	62,688	63,229	63,229	63,800	64,024	63,887	64,307
Alaska	11,518	11,518	11,564	11,564	11,629	11,634	11,668	11,675
Arizona	32,630	32,630	32,775	32,775	33,166	33,242	33,354	33,509
Arkansas	49,285	49,285	49,509	49,509	49,805	49,903	49,888	50,063
California	41,064	41,064	41,268	41,268	42,093	42,365	42,511	42,997
Colorado	36,656	36,656	36,934	36,934	37,314	37,348	37,538	37,595
Connecticut	3,337	3,337	3,329	3,371	3,398	3,477	3,448	3,545
Delaware	2,456	2,456	2,551	2,494	2,649	2,626	2,665	2,716
D.C.	368	368	373	378	379	398	377	402
Florida	80,865	80,865	81,722	81,722	82,669	82,947	82,991	83,530
Georgia	65,362	65,362	66,147	66,147	66,989	66,989	67,655	67,655
Hawaii	11,324	11,324	11,353	11,353	11,402	11,419	11,424	11,456
Idaho	55,752	55,752	55,927	55,927	56,246	56,272	56,442	56,477
Illinois	144,503	144,503	144,503	144,503	144,671	144,750	144,679	144,827
Indiana	83,739	83,739	84,194	84,194	84,689	84,892	84,759	85,139
Iowa	60,224	60,224	60,464	60,464	60,677	60,752	60,717	60,851
Kansas	99,656	99,656	99,843	99,843	100,170	100,261	100,278	100,436
Kentucky	42,709	42,709	42,855	42,855	43,163	43,284	43,225	43,463
Louisiana	35,685	35,685	35,729	35,729	36,061	36,146	36,184	36,334
Maine	5,853	5,853	5,931	5,941	6,046	6,069	6,061	6,091
Maryland	16,323	16,323	16,584	16,716	17,020	17,616	17,167	17,963
Massachusetts	18,147	18,147	18,998	18,148	19,146	18,374	19,249	18,506
Michigan	48,344	48,344	48,612	48,612	48,872	48,996	48,856	49,098
Minnesota	61,739	61,739	61,864	61,864	62,201	62,301	62,285	62,476
Mississippi	53,207	53,207	53,348	53,348	53,615	53,716	53,660	53,846
Missouri	183,479	183,479	183,981	183,981	184,705	184,946	184,909	185,337
Montana	62,061	62,061	62,137	62,137	62,386	62,398	62,545	62,557
Nebraska	55,257	55,257	55,396	55,396	55,582	55,618	55,662	55,719
Nevada	22,915	22,915	23,423	23,423	23,978	23,982	24,385	24,389
New Hampshire	4,454	4,454	4,593	4,569	4,963	4,951	5,249	5,241
New Jersey	8,963	8,963	9,233	9,034	9,464	9,257	9,633	9,424

State	2014fd	2016fe	2016ff	2016fh	2023ff	2023fh	2028ff	2028fh
New Mexico	53,401	53,401	53,821	53,821	54,265	54,344	54,499	54,627
New York	44,879	44,879	43,794	43,956	44,526	44,946	44,327	44,844
North Carolina	29,221	29,221	29,716	29,974	30,275	32,447	30,666	33,701
North Dakota	83,206	83,206	83,045	83,045	83,218	83,249	83,313	83,354
Ohio	115,548	115,548	116,153	116,153	117,093	117,093	117,523	117,523
Oklahoma	67,833	67,833	67,989	67,989	68,380	68,465	68,549	68,694
Oregon	73,129	73,129	73,343	73,343	73,707	73,747	73,932	73,996
Pennsylvania	37,377	37,377	37,397	37,698	37,819	38,770	37,764	38,828
Rhode Island	760	760	773	783	792	832	790	835
South Carolina	21,416	21,416	21,907	21,907	22,258	22,379	22,340	22,570
South Dakota	63,674	63,674	63,718	63,718	63,837	63,857	63,895	63,925
Tennessee	42,944	42,944	43,403	43,403	43,923	44,098	44,076	44,402
Texas	178,633	178,633	180,237	180,237	182,268	182,658	183,249	183,937
Utah	26,003	26,003	26,353	26,353	26,713	26,758	26,927	26,998
Vermont	3,211	3,211	3,234	3,265	3,280	3,317	3,292	3,346
Virginia	36,615	36,615	36,673	36,874	37,042	37,490	37,144	37,670
Washington	41,318	41,318	41,894	41,894	43,017	43,234	43,666	44,041
West Virginia	15,005	15,005	15,006	15,066	15,095	15,244	15,104	15,284
Wisconsin	89,454	89,454	89,694	89,694	90,167	90,167	90,457	90,457
Wyoming	29,029	29,029	29,010	29,010	29,173	29,178	29,285	29,284
Puerto Rico	1,305	1,305	1,305	1,305	1,363	1,383	1,370	1,411
Virgin Islands	464	464	464	464	470	473	470	476
Tribal Data	2,885	2,885	2,885	2,885	2,885	2,885	2,885	2,885

Figure 3. Gridded Annual PM2.5 for adjusted afdust

2016fh_16j afdust_adj 12US1 annual : PM2_5
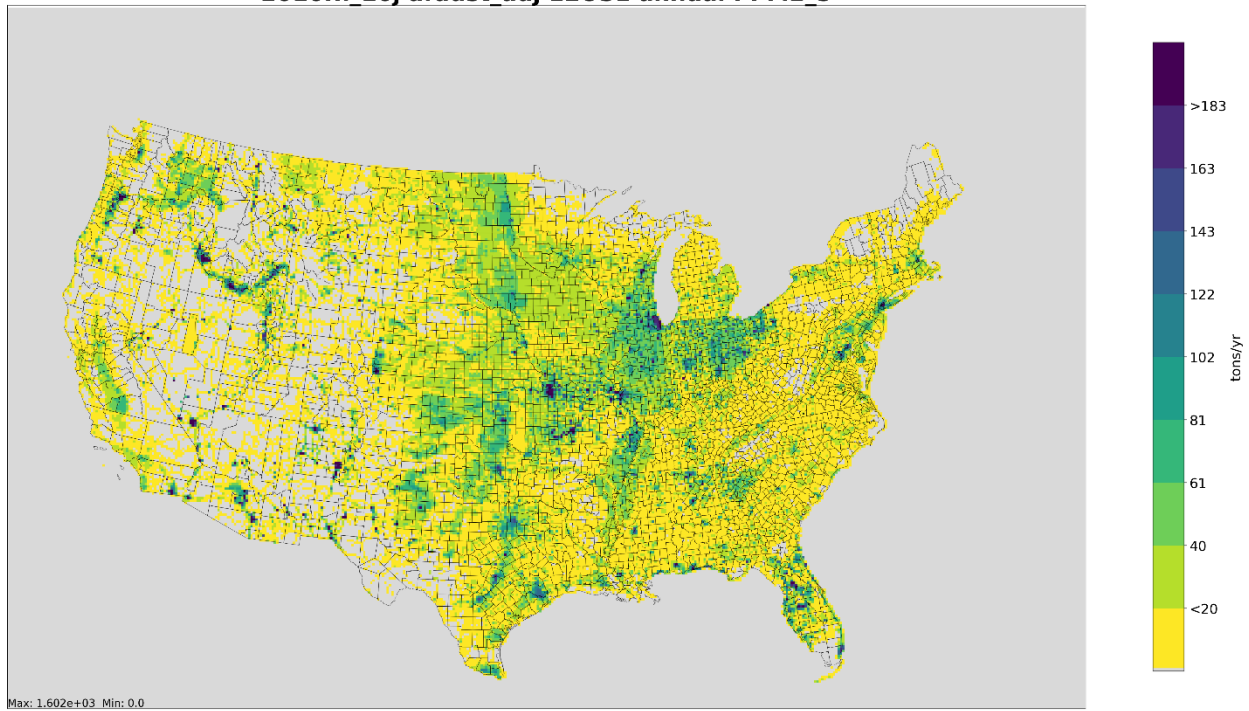
Figure 4. Gridded Annual PM10 for adjusted afdust

2016fh_16j afdust_adj 12US1 annual : PM10