



Development of Agricultural Equipment Allocation Factors for EPA's MOVES Model

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Geographic Allocation Factors for Agricultural Equipment

- Purpose
 - Review of MOVES Nonroad Equipment Spatial Allocation Factors for 2016 Modeling Platform
 - Agricultural and Construction Equipment
- Background
 - NONROAD Model Developed from National Equipment Populations
 - Surrogate Data Used to Allocate Equipment Populations to States/Counties
 - NONROAD only allocates from state to county level

(Equipment Population)_{county} =

(Calculated Equipment Population)_{state} x Surrogate_{county} / Calculated Surrogate_{state}



Ag. Equipment Geographic Allocation Factors (cont'd.)

- Motor Vehicle Emission Simulator (MOVES) Incorporates Nonroad Model Functionality
 - Geographic Allocation Factors for Agricultural Equipment
 - Total Acres of Crops Harvested
 - 2002 County-Level Bureau of Census
- Identify/Analyze Potential Alternatives
 - County-Level
 - Recentness
 - Better Indicator of Agricultural Equipment Population and Use?
- 2002 NONROAD Model Review – Agriculture Sector Employment



Ag. Equipment Geographic Allocation Factors (cont'd.)

- Spatial/Temporal Allocation Study for LADCO
 - Based on Year 2002 Diesel Fuel Consumption Estimates
 - Midwest Region Bottom-Up (Major Crop-Specific)
- Spatial Allocations - Diesel Consumption for Major Crops
 - Corn, hay, oats, sugar beets, soybeans, wheat
 - Per planted acre diesel consumption by crop estimates from USDA surveys
 - 2002 Planted Acreage by county from USDA
- Temporal Allocations – Diesel Consumption for Major Crops in Each Week
 - Equipment use operations by crop type (Planting, Cultivation, Harvesting, and Post-Harvesting)
 - Sum across operations and sum across crops by State



Agriculture Sector Fuel Expenditures Data

- Farm Production Fuel Expenditure Data Available from USDA for Target Year (2016)

Region	State	2016 Farm Production Expenditures: Fuel (million \$)
Atlantic	North Carolina	290
	Other States	1,100
South	Arkansas	400
	Florida	230
	Georgia	250
	Other States	600
Midwest	Illinois	480
	Indiana	300
	Iowa	660
	Minnesota	530
	Missouri	340
	Wisconsin	330
	Other States	580
Plains	Kansas	450
	Nebraska	550
	Texas	790
	Other States	980
West	California	1,120
	Washington	230
	Other States	1,090
United States		11,300



Agriculture Sector Fuel Expenditures Data

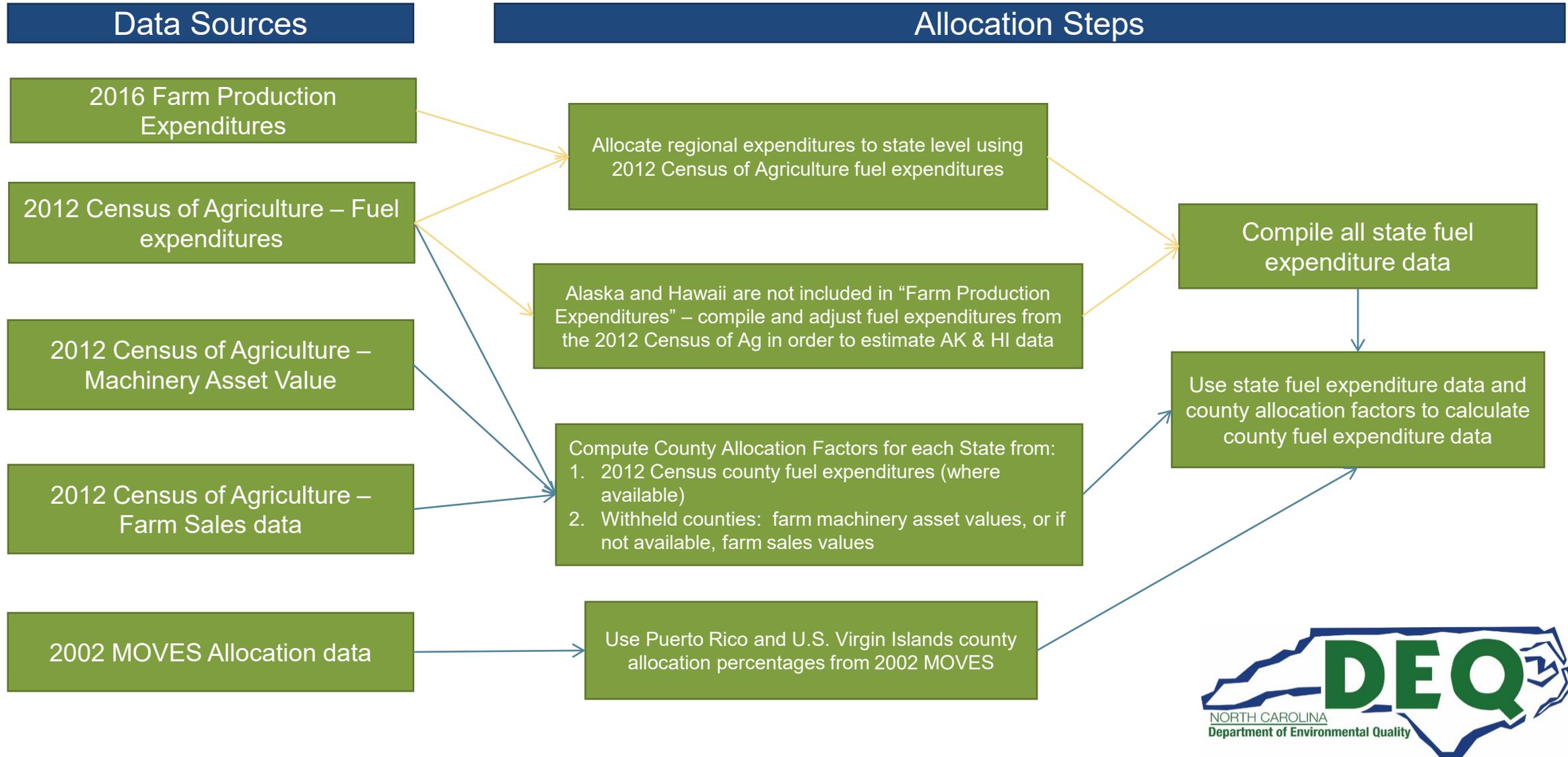
- Data Compilation
 - Regional/State Fuel Expenditures Data from 2016 “Farm Production Expenditures”
 - Exceptions: Alaska and Hawaii; Puerto Rico and U.S. Virgin Islands
 - Allocate Regional Data to Remaining States Based on 2012 Census of Agriculture “Gasoline, Fuels, and Oils” Purchased
 - Allocate State Fuel Expenditures to Counties Using 2012 Census of Agriculture Fuels Purchased in Each County
 - Exceptions: Counties with Withheld Data
 - Farm machinery asset value
 - Farm sales

Variable	Correlation Coefficient*
Farm Tractor Inventory	0.80
Farm Trucks Inventory	0.83
Farm Machinery Value	0.87

* relative to farm fuel expenditures



Agriculture Sector Fuel Expenditures Data



Agriculture Sector Fuel Expenditures Data

State Name	Crop Acreage-Based	Fuel Expenditures-Based		Fuel % -
	2002 MOVES	2000	2016	Crop %
Alabama	0.66%	1.28%	1.14%	0.62%
Alaska	0.01%	0.03%	0.03%	0.02%
Arizona	0.29%	1.15%	1.11%	0.86%
Arkansas	2.46%	2.82%	3.53%	0.36%
California	2.80%	8.14%	9.89%	5.35%
Colorado	1.44%	2.12%	1.60%	0.68%
Connecticut	0.04%	0.20%	0.22%	0.15%
Delaware	0.14%	0.32%	0.18%	0.17%
District of Columbia	0.00%	0.00%	0.00%	0.00%
Florida	0.76%	2.00%	2.03%	1.24%
Georgia	1.07%	2.04%	2.21%	0.97%
Hawaii	0.04%	0.22%	0.22%	0.18%
Idaho	1.42%	1.87%	1.78%	0.45%
Illinois	7.45%	4.15%	4.24%	-3.31%
Indiana	3.94%	2.54%	2.65%	-1.41%
Iowa	7.93%	5.16%	5.83%	-2.77%
Kansas	6.27%	4.91%	3.97%	-1.36%
Kentucky	1.64%	1.79%	1.56%	0.15%
Louisiana	1.10%	1.33%	1.49%	0.23%
Maine	0.13%	0.25%	0.24%	0.11%
Maryland	0.42%	0.65%	0.51%	0.22%
Massachusetts	0.05%	0.22%	0.18%	0.17%



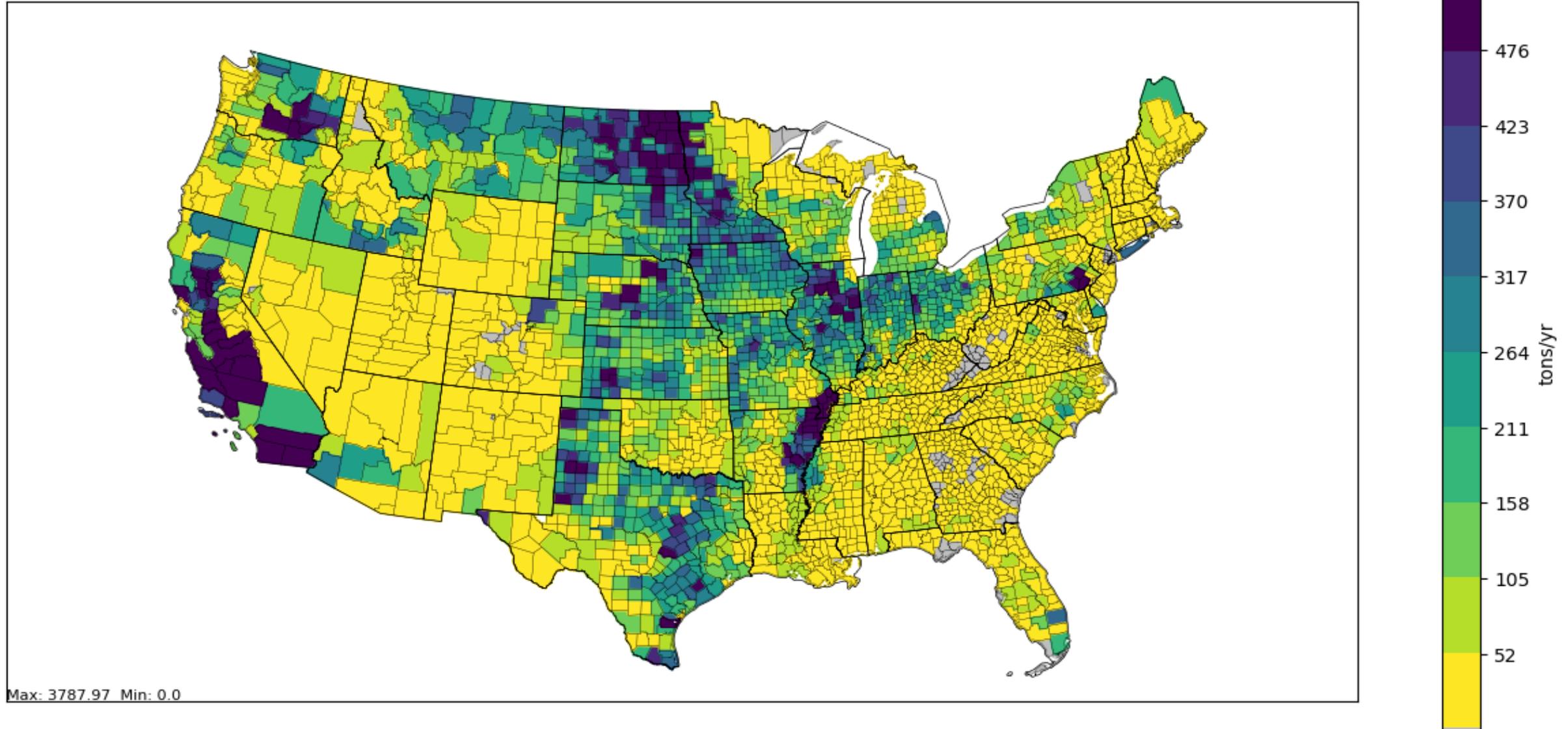
Agriculture Sector Fuel Expenditures Data

State Name	Crop Acreage-Based	Fuel Expenditures-Based		Fuel % -
	2002 MOVES	2000	2016	Crop %
Michigan	2.26%	2.20%	2.49%	-0.06%
Minnesota	6.41%	4.87%	4.68%	-1.54%
Mississippi	1.37%	1.83%	1.82%	0.47%
Missouri	4.34%	3.04%	3.00%	-1.30%
Montana	2.89%	2.04%	1.58%	-0.85%
Nebraska	5.73%	5.25%	4.85%	-0.47%
Nevada	0.18%	0.28%	0.28%	0.10%
New Hampshire	0.03%	0.09%	0.08%	0.05%
New Jersey	0.15%	0.38%	0.32%	0.23%
New Mexico	0.28%	0.88%	0.77%	0.60%
New York	1.27%	1.74%	1.82%	0.47%
North Carolina	1.42%	2.73%	2.56%	1.31%
North Dakota	6.58%	2.69%	3.48%	-3.89%
Ohio	3.32%	2.50%	2.63%	-0.82%
Oklahoma	2.55%	2.49%	2.27%	-0.06%
Oregon	1.03%	1.32%	1.36%	0.29%
Pennsylvania	1.35%	1.90%	1.82%	0.55%
Rhode Island	0.01%	0.03%	0.03%	0.02%
South Carolina	0.45%	0.81%	0.85%	0.36%
South Dakota	4.46%	2.54%	2.90%	-1.92%
Tennessee	1.44%	1.50%	1.15%	0.06%
Texas	5.86%	7.63%	6.97%	1.77%
Utah	0.32%	0.72%	0.56%	0.41%
Vermont	0.15%	0.22%	0.25%	0.07%
Virginia	0.87%	1.35%	1.11%	0.48%
Washington	1.62%	1.94%	2.03%	0.32%
West Virginia	0.21%	0.32%	0.24%	0.11%
Wisconsin	2.95%	2.91%	2.91%	-0.04%
Wyoming	0.43%	0.62%	0.59%	0.19%



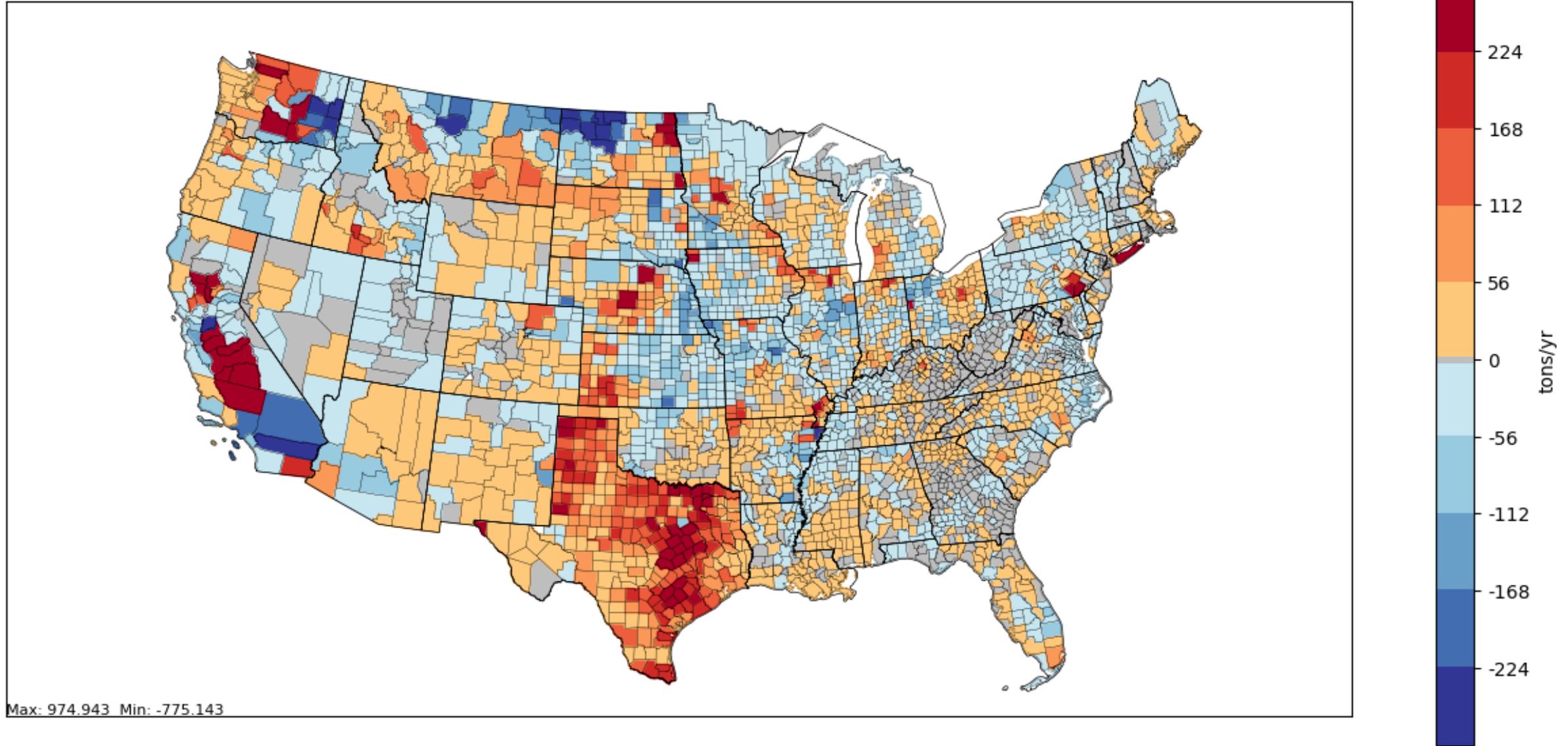
2016 Platform Agricultural Sector NOx Emissions

Nonroad agriculture 2016v1 including state CA/TX NOX



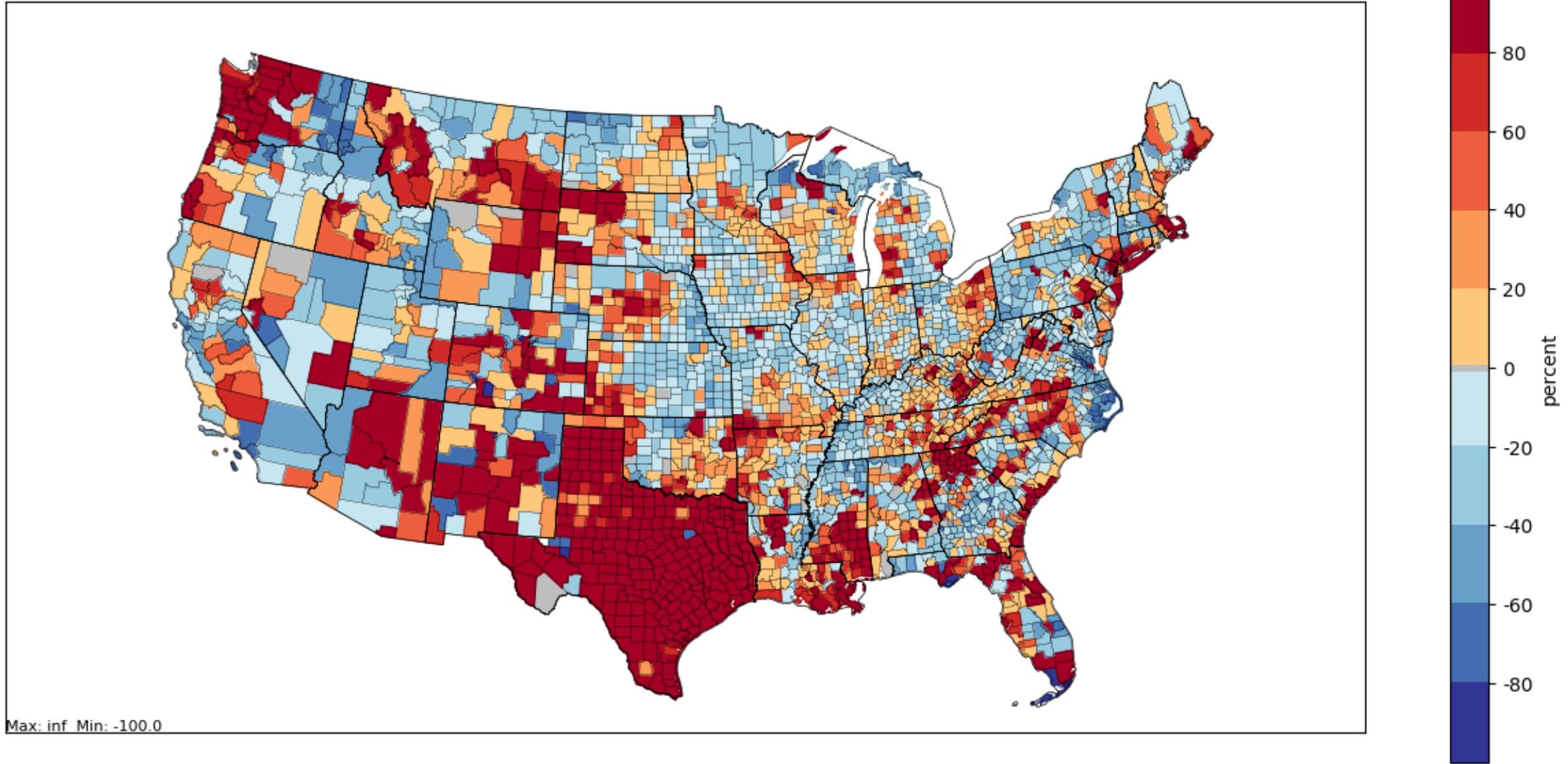
2016 Platform Agricultural Sector NOx Emissions

Nonroad agriculture 2016v1 - 2016b including state CA/TX NOX



2016 Platform Agricultural Sector NOx Emissions

Nonroad total 2016v1 - 2016b % including state CA/TX NOX



Acknowledgements

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