



Development of the 2016 Nationwide Oil and Gas Emissions Inventory: Data Collection, Emissions Estimation, and Spatial, Speciation, and Temporal Modeling Surrogates

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Overview of the Presentation

- Introduction/Background Information
- Project Goals
- Data Sources
- Project Tasks
- Notes





Introduction/ Background Information

- Oil and gas exploration and production sources can vary significantly by year
- Typically, oil and gas emissions are annual county-level estimates (some states provide point source emissions)
 - For air quality modeling, these county-level estimates need to be allocated to grid cells that are often smaller than a county
 - Additionally, annual emissions need to be temporally allocated to hourly values for air quality modeling



Project Goals

- Develop a special year 2016 nationwide oil and gas emissions inventory
- Develop year 2016 gridded spatial allocation factors for oil and gas sources
 - Develop 2-km and 4-km shapefiles
 - Develop 4-km spatial surrogate files for 23 surrogates
 - Update hierarchy for gap-filling of spatial surrogates
- Develop monthly temporal profiles for year 2016
- Develop hazardous air pollutant (HAP) Augmentation profiles for year 2016
- Update Speciation Cross References for year 2016



Data Sources

- Drilling Info (DI) Desktop
 - 3rd-party vendor compiling oil and gas data from state databases
 - In accordance with the EPA's licensing agreement, well-level data is proprietary, but derived products, such as aggregation at the county level, are acceptable for public dissemination and use in the Tool.
 - Provides data in a standardized format for individual well locations, production information, drilling information, and well completion information
 - Most states were updated through 2016



Data Sources

- States
 - Illinois, Kansas, Pennsylvania, Texas, and West Virginia
 - Mostly production data, some exploration data and basin factor updates
- Oil and Gas Commission Websites
 - Alaska, Arizona, Idaho, Illinois, Indiana, Kansas, Kentucky, Louisiana, Maryland, Michigan, Mississippi, Missouri, Nevada, New York, Oregon, Pennsylvania, and Tennessee
 - Information retrieved varied, but included well locations, production data, and exploration data



Data Sources

- RigData – Used by permission
 - State-level feet drilled allocated to the county-level using county proportion of spuds to the state totals of spuds
- Energy Information Agency (EIA)
 - State-level production for: Illinois and Tennessee
 - Allocated to counties using county proportion of active wells to state totals.



Data Attributes Compiled

Associated Gas Production	Condensate Production – Gas Wells	Spud Counts – CBM Wells*
Coalbed Methane (CBM) Production*	Feet Drilled	Spud Counts – Gas Wells
CBM Well Counts*	Natural Gas Production	Spud Counts – Oil Wells
Completions – All Wells	Natural Gas Well Counts	Total Exploratory Wells
Completions – CBM Wells*	Oil Production	Total Production Wells
Completions – Gas Wells	Oil Well Counts	Total Wells
Completions – Oil Wells	Produced Water – All Wells	Unconventional Well Completions*
Condensate Production – CBM Wells*	Spud Counts – All Wells	

* = No CBM wells or hydraulically-fractured wells in Alaska

Estimating 2016 Emissions

- Summed data attributes to the county level and entered into the 2014 Oil and Gas Estimation (O&G) Tool:
 - Production and Exploration Modules modified to 2016

EPA Oil and Gas - Production Activities

EPA Oil and Gas Tool, 2016 NEI Version 1.0 - Production Activities Module

Welcome to the U.S. Environmental Protection Agency (EPA) Oil and Gas Tool - Production Activities Module. This Module allows the User to generate county-level emission estimates of criteria and hazardous air pollutants (CAPs and HAPs) for oil and gas source categories related to production activities. When finished, data can be exported to Emission Inventory System (EIS) Staging tables.

To begin, first link to the EIS Staging tables in the nonpoint_bridge_tool.accdb database. When finished, please click the "BEGIN" button below to make your geographic and source category selections.

[LINK TO EIS STAGING TABLES](#)

[BEGIN \(go to DASHBOARD VIEW\)](#)

[CLICK FOR A LIST OF UPDATES TO THIS VERSION OF THE TOOL](#)



EPA Oil and Gas - Exploration Activities

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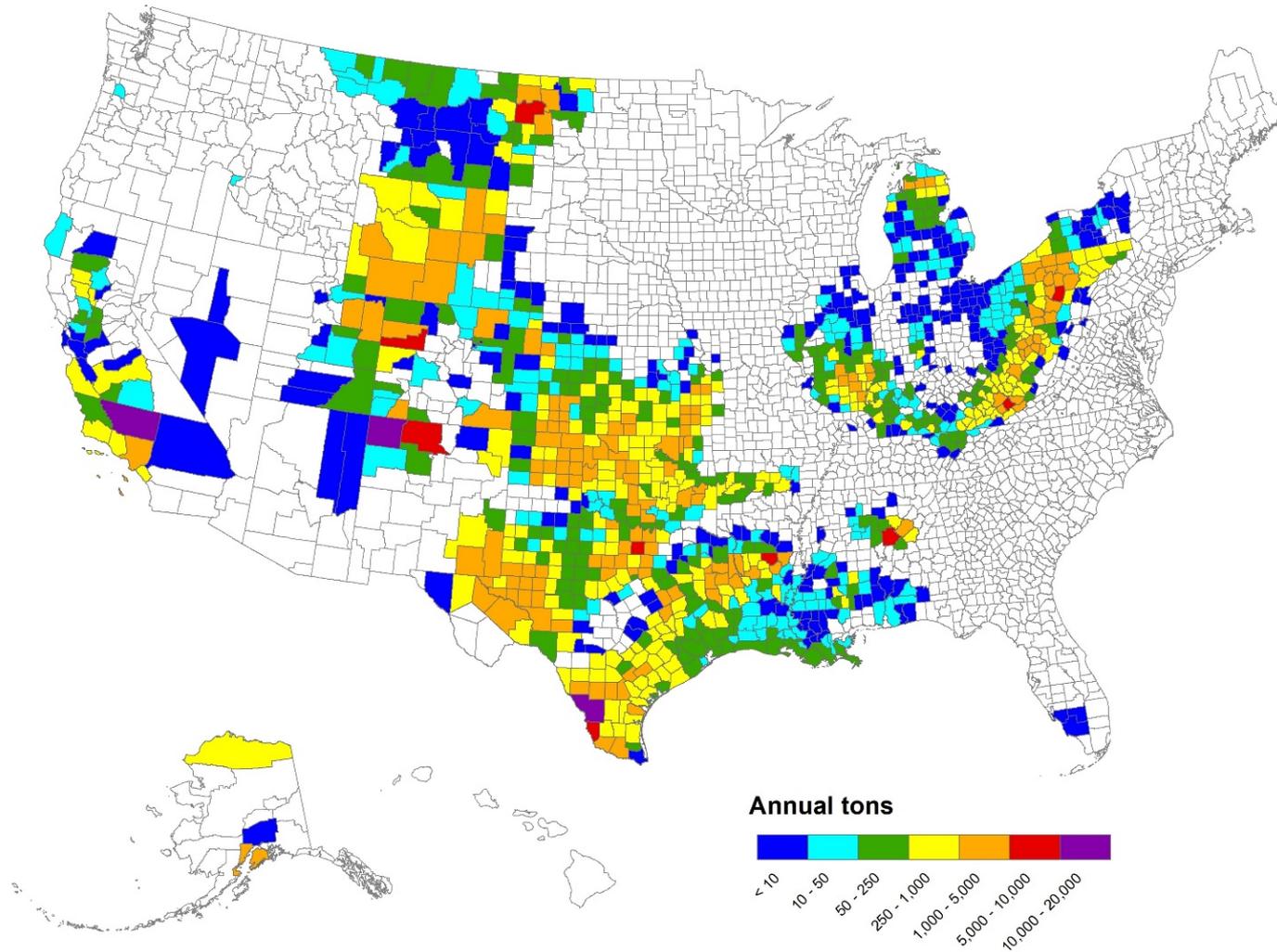
[BEGIN \(go to DASHBOARD VIEW\)](#)

[CLICK FOR A LIST OF UPDATES TO THIS VERSION OF THE TOOL](#)



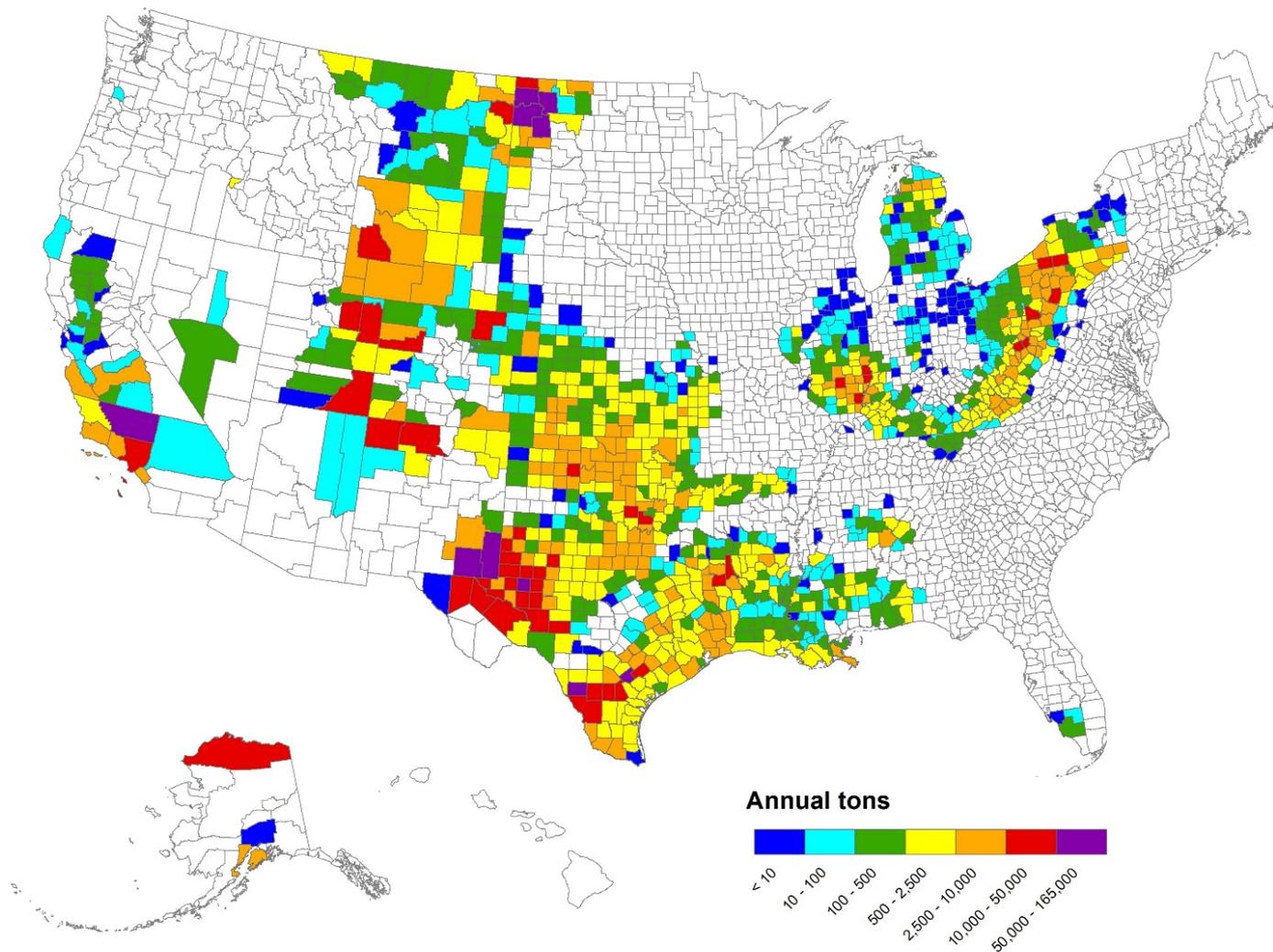


Year 2016 Oil and Natural Gas Emissions - NO_x





Year 2016 Oil and Natural Gas Emissions - VOC





Data Summary

- For the 2016 Oil and Gas Tool, over one million oil, gas, and CBM wells compiled into an Access[®] database.
- Coverage:
 - 34 states (same as 2014 Tool)
 - 1,150 counties
 - 2014 NEI: 1,158 counties

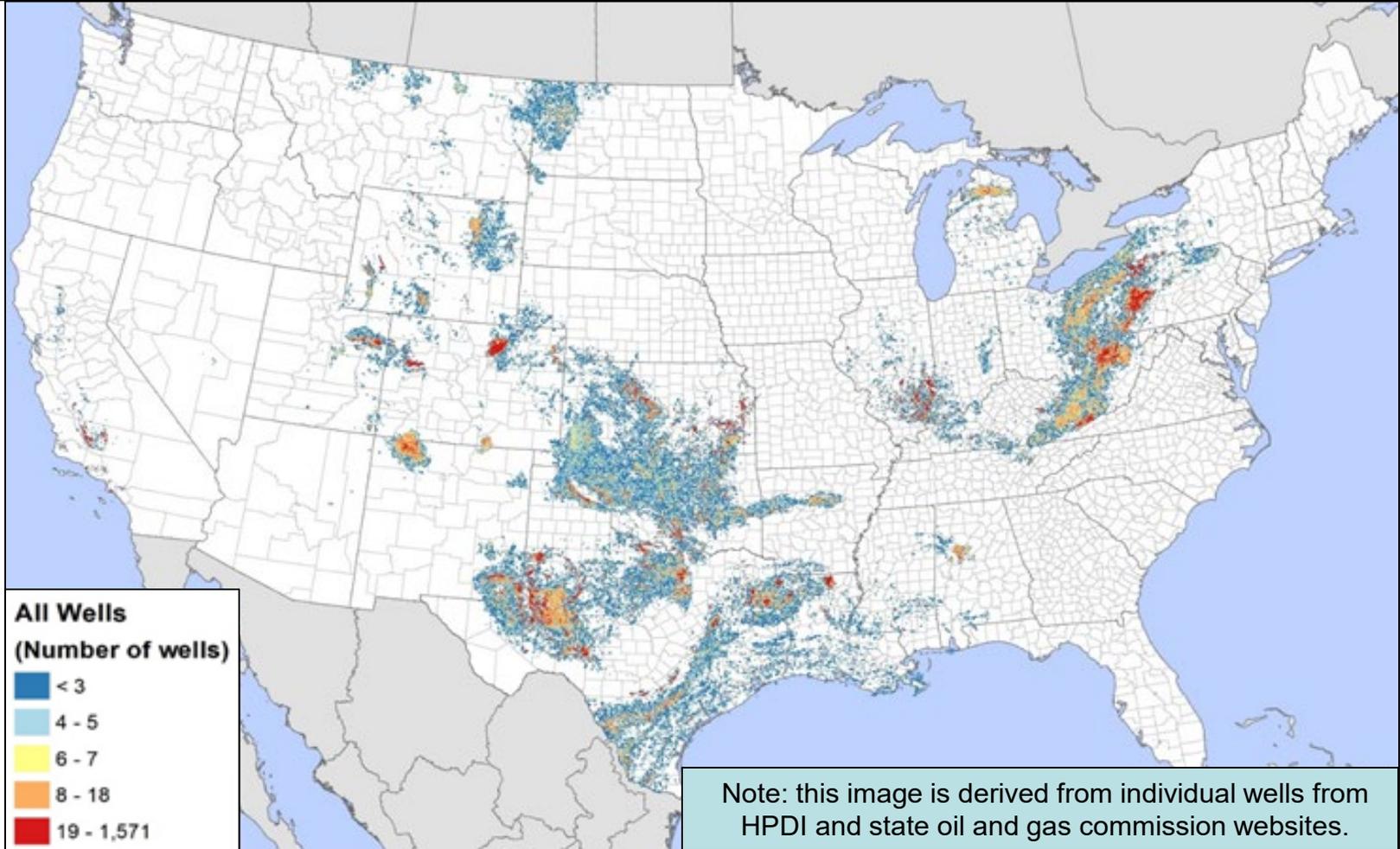


Developing Spatial Surrogates

- Assigned each well and corresponding data attribute to both 2-km and 4-km grid cells
- By default, each well and attribute summed to the 2-km grid cell.
 - If less than 3 wells were in the 2-km grid cell, then the wells were summed to a 4-km grid cell to preserve the proprietary data resolution.
- Merged together data using 2-km cells with the coarser on 4-km grid cells

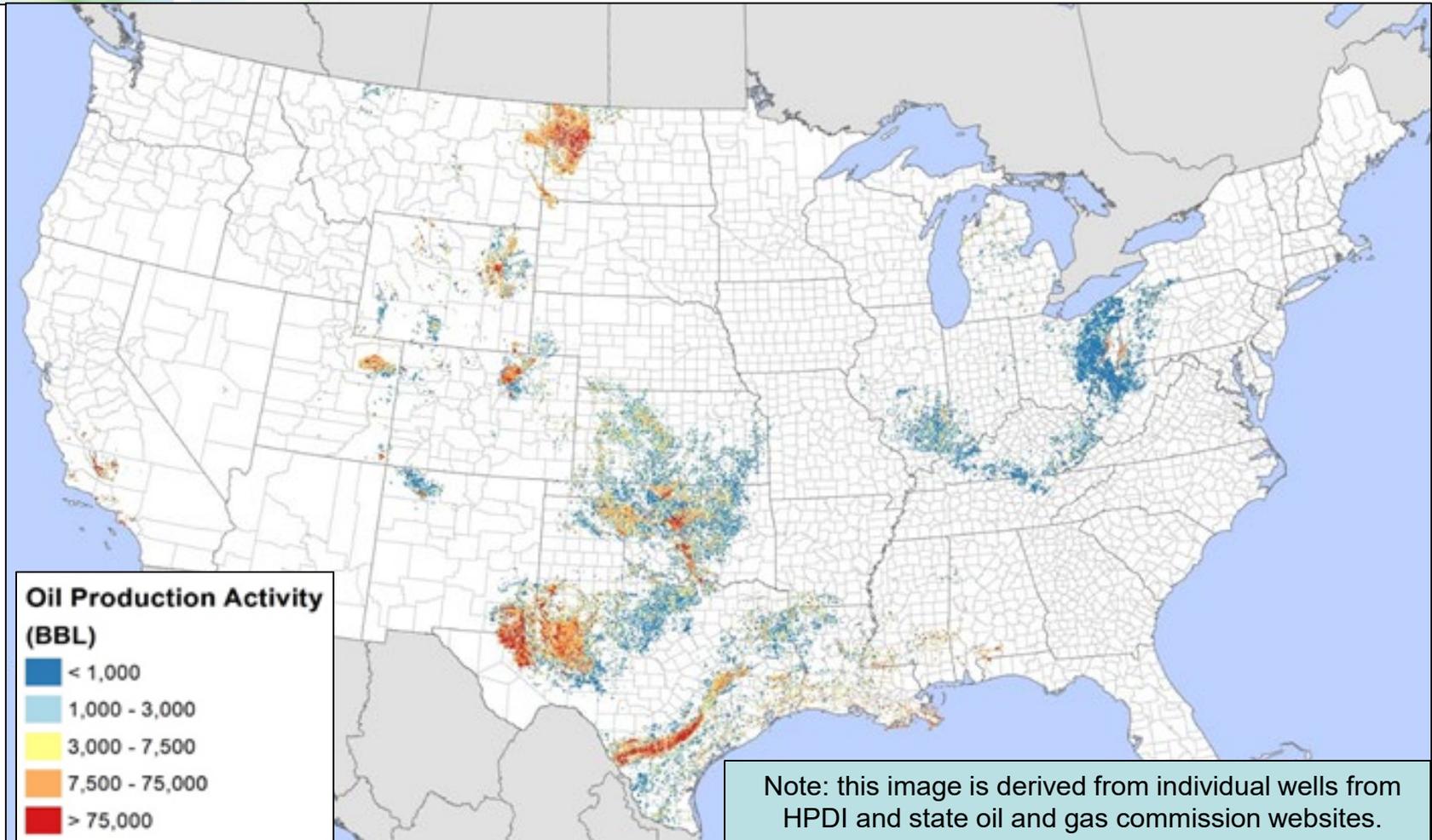


Oil, Gas, and CBM Wells - 2016

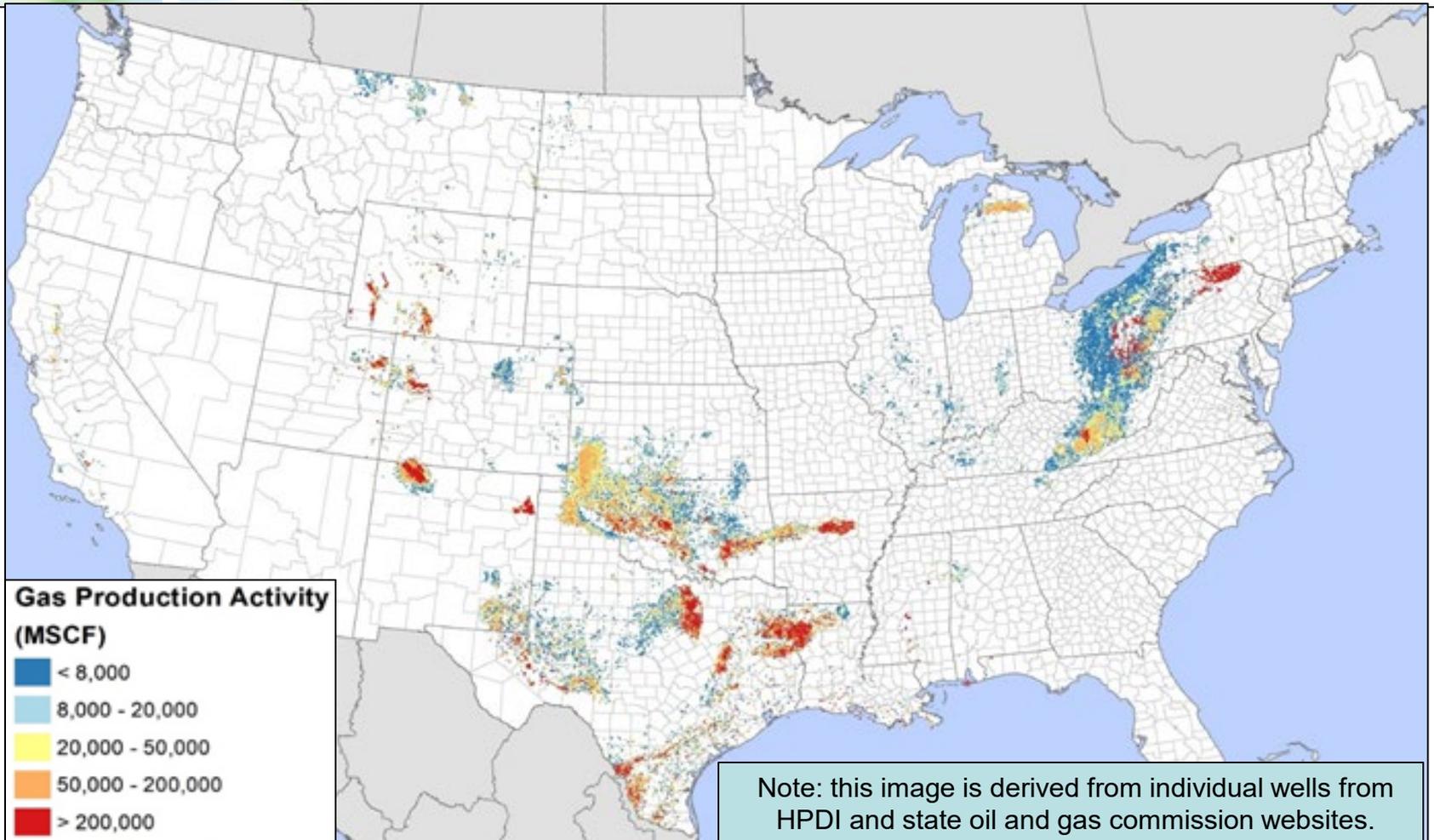




Oil Production, 2016

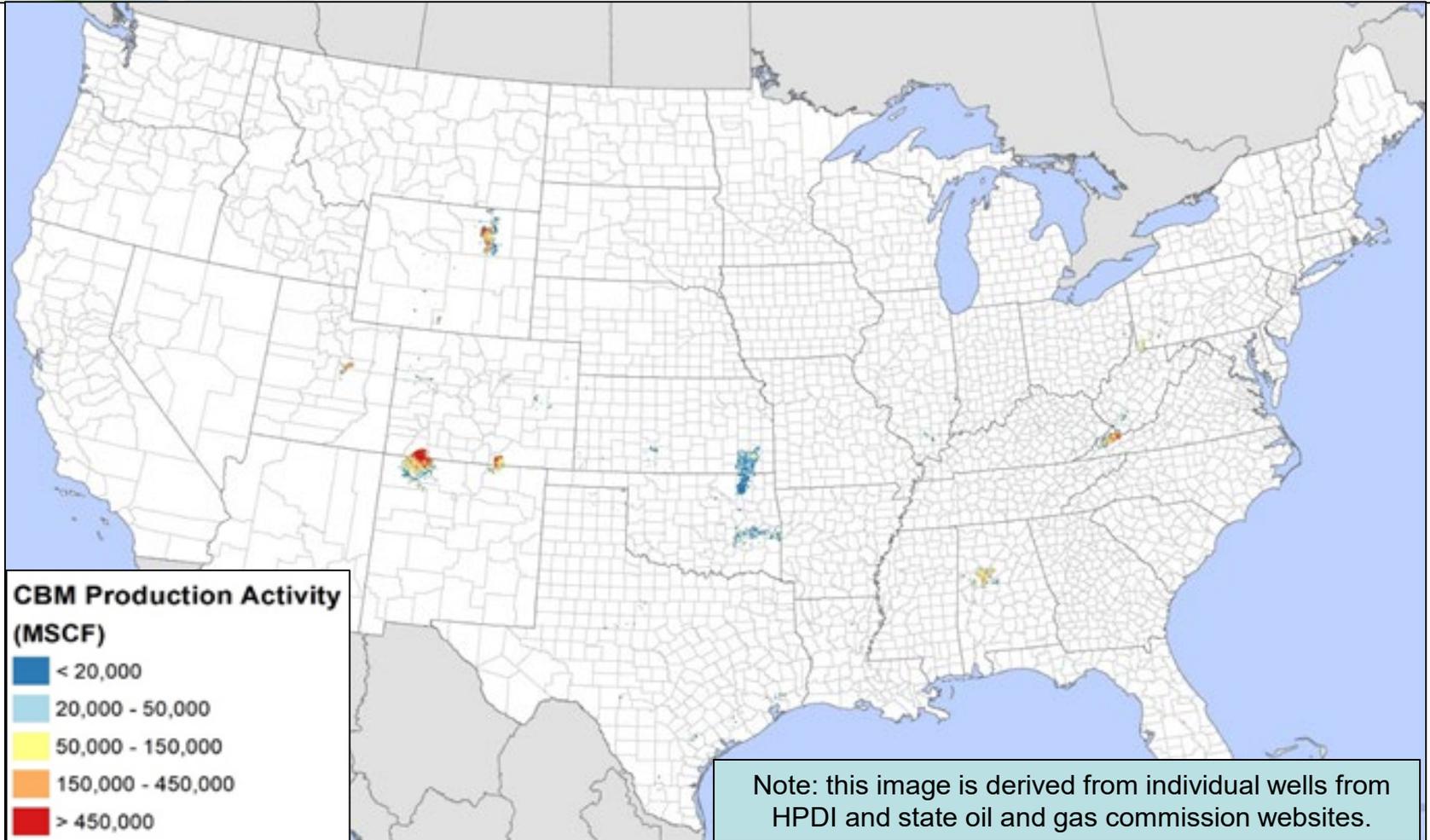


Gas Production, 2016





CBM Production, 2016





Surrogate Development – 4-km files

- Using GIS software, assign wells to 4-km grid cell
- Sum attribute activity data to the 4-km grid cell level
- Used Spatial Allocator¹ to develop federal information processing system (FIPS)-grid cell fractions for each surrogate

¹ Latest Spatial Allocator is posted at: <https://www.cmascenter.org/sa-tools/>



Each Spatial Surrogate has a Hierarchy for Gap-filling

Oil Production (primary surrogate)

↓
Oil Well Counts

↓
Total Producing Wells

↓
Completions Oil Wells

↓
Spud Oil Wells

↓
Total Wells

↓
Rural Land Area

Gap-filling is used when an attribute is not available in a county – this keeps emissions from being dropped



Monthly Temporal Profile Development

- Developed monthly temporal profiles for 53 O&G source classification codes (SCCs) for all O&G counties.
- The majority of the attribute data is at the monthly level
 - Sum attribute activity data to the monthly timeframe
 - Divide summed monthly activity data by the summed annual activity to calculate monthly temporal factors

FIPS	SCC	J	F	M	A	M	J	J	A	S	O	N	D
48113	2310000550	0.13	0.12	0.12	0.10	0.12	0.11	0.09	0.05	0.04	0.04	0.04	0.04



HAP Augmentation

- Using the emissions from the O&G Tool, develop HAP augmentation factors (HAP/VOC) and (HAP/PM10-PRI) based tool emissions ratios*

- Ratios are source and county-specific

<u>Profile Name (200 Chars)</u>	<u>EIS Input Pollutant Code</u>	<u>EIS Output Pollutant Code</u>	<u>Multiplication Factor</u>
ONG_TOOL_01003_2310000550	VOC	100414	0.000483217
ONG_TOOL_01003_2310000550	VOC	108883	0.000682004
ONG_TOOL_01003_2310000550	VOC	1330207	0.000538298
ONG_TOOL_01003_2310000550	VOC	71432	0.001850922
ONG_TOOL_01003_2310021010	VOC	100414	0.000608641
ONG_TOOL_01003_2310021010	VOC	108883	0.003888618
ONG_TOOL_01003_2310021010	VOC	1330207	0.002320454
ONG_TOOL_01003_2310021010	VOC	50000	0
ONG_TOOL_01003_2310021010	VOC	71432	0.003091868
ONG_TOOL_01003_2310021400	VOC	100414	0.05949311
ONG_TOOL_01003_2310021400	VOC	107028	2.82011E-05
ONG_TOOL_01003_2310021400	VOC	108883	0.3371329
ONG_TOOL_01003_2310021400	VOC	110543	0.002764812
ONG_TOOL_01003_2310021400	VOC	1330207	0.3470432
ONG_TOOL_01003_2310021400	VOC	50000	0.000115201
ONG_TOOL_01003_2310021400	VOC	71432	0.3371309
ONG_TOOL_01003_2310021400	VOC	75070	2.4911E-05
ONG_TOOL_01003_2310021400	VOC	91203	9.36964E-07
ONG_TOOL_01003_2310021603	VOC	100414	0.000583465
ONG_TOOL_01003_2310021603	VOC	108883	3.21691E-05
ONG_TOOL_01003_2310021603	VOC	1330207	0.000493859



Update Speciation Cross Reference

- Oil and gas SCCs don't distinguish flared portion of process. For example, SCC 2310021400 (gas well dehydrators) consists of process, reboiler, and/or flaring emissions
 - This SCC may use a combination of three different speciation profiles
 - Reboiler Profile= 0003
 - Flaring Profile = FLR99
 - Venting Profile = 8949 (default), but region-specific profiles are available (e.g., Piceance Basin, Uinta Basin, etc.)
 - O&G Tool generates information on how much VOC is from process, flare and reboiler, by basin.
 - From that output, compute weight fractions by county and SCC profile for speciation assignment file (used for emissions modeling)



Update Speciation Cross Reference (cont.)

- Region-specific profiles (county or basin; 599 records)
 - California
 - Colorado
 - Montana
 - New Mexico
 - Texas
 - Utah
 - Wyoming

- For the U.S. National Emissions Inventory, state-submitted emissions are included rather than O&G Tool emissions
- Additional Support: Oklahoma (OK)
 - Provided a list of wells by American Petroleum Institute (API) number that were to be submitted in their point sources submittal
 - Wells were matched, and the corresponding activity data were removed using the point sources subtraction step.
 - OK DEQ submitted point source O&G emissions along with nonpoint emissions from which point source activity had been subtracted

- Additional Support: Pennsylvania (PA)
 - Provided year 2016 unconventional wells and emissions inventory for select sources
 - Wells were matched by API number, and the corresponding activity data were removed using the point sources subtraction step.
 - EPA prepared county-level emissions for unconventional wells (from PA data) and for conventional wells (from O&G Tool data)



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