Use of GIS Data for Allocating Aircraft, Commercial Marine Vessel, and Rail Emissions to the County Level

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Problem

- In developing a national emissions inventory, it is sometimes possible to estimate emissions at the national level, but very difficult to dissaggregate these national estimates accurately to the county level.

Overview of Presentation

- In this presentation, we will discuss improvements made in the 1999 NTI in spatially allocating emission for
  - Aircraft
  - Commercial Marine Vessels
  - Locomotive Sources

Overview of 1996 Aircraft Emission Estimating and Spatial Allocation Methods

- National aircraft-specific activity data were obtained from the FAA's *Airport Activity Statistics of Certified Route Air Carriers, 12 Months Ending December 31, 1996.*

- To estimate emissions of criteria pollutants, these activity data were applied to the FAA's Aircraft Engine Emissions Database (AEED)- version 2.1.

1996 Aircraft Methods (cont)

- General aviation and air taxi emission estimates were calculated using FAA LTO data from *Air Traffic Activity - Fiscal Year 1996*, and EPA State Implementation Plan (SIP) guidance.
- All aircraft criteria estimates were speciated into individual Hazardous Air Pollutants (HAP) based on guidance provided by Office of Transportation and Air Quality (OTAQ).

1996 Aircraft Methods (cont)

- Aircraft emissions were assigned to 600 FAA towered airports that submitted FAA Form 5010 Applications. Emissions were allocated to individual airports based on airport LTO data for each aircraft type (i.e., air carriers. general aviation, and air taxis).

Overview of 1999 Aircraft Emission Estimating and Spatial Allocation Methods

- National aircraft-specific LTO data for 1999 were obtained from the FAA's *Airport Activity Statistics of Certified Route Air Carriers, 12 Months Ending December 31, 1999.*

- FAA's Emissions Dispersion and Modeling System (EDMS),

1999 Aircraft Methods (cont)

- For general aviation and air taxis, LTO data were obtained from the FAA's *Air Traffic Activity - Fiscal Year 1999* and criteria emissions were estimating used the same approach used in the 1996 inventory.
- The criteria estimates were speciated into individual HAPs based on guidance provided by OTAQ.

1996 Aircraft Methods (cont)

- Aircraft emissions were spatially assigned to over 2000 individual airports based on airport LTO data for each aircraft type (i.e., air carriers. general aviation, and air taxis). These airport GIS data were obtained from the Department of Transportation's *National Transportation Atlas Databases*.

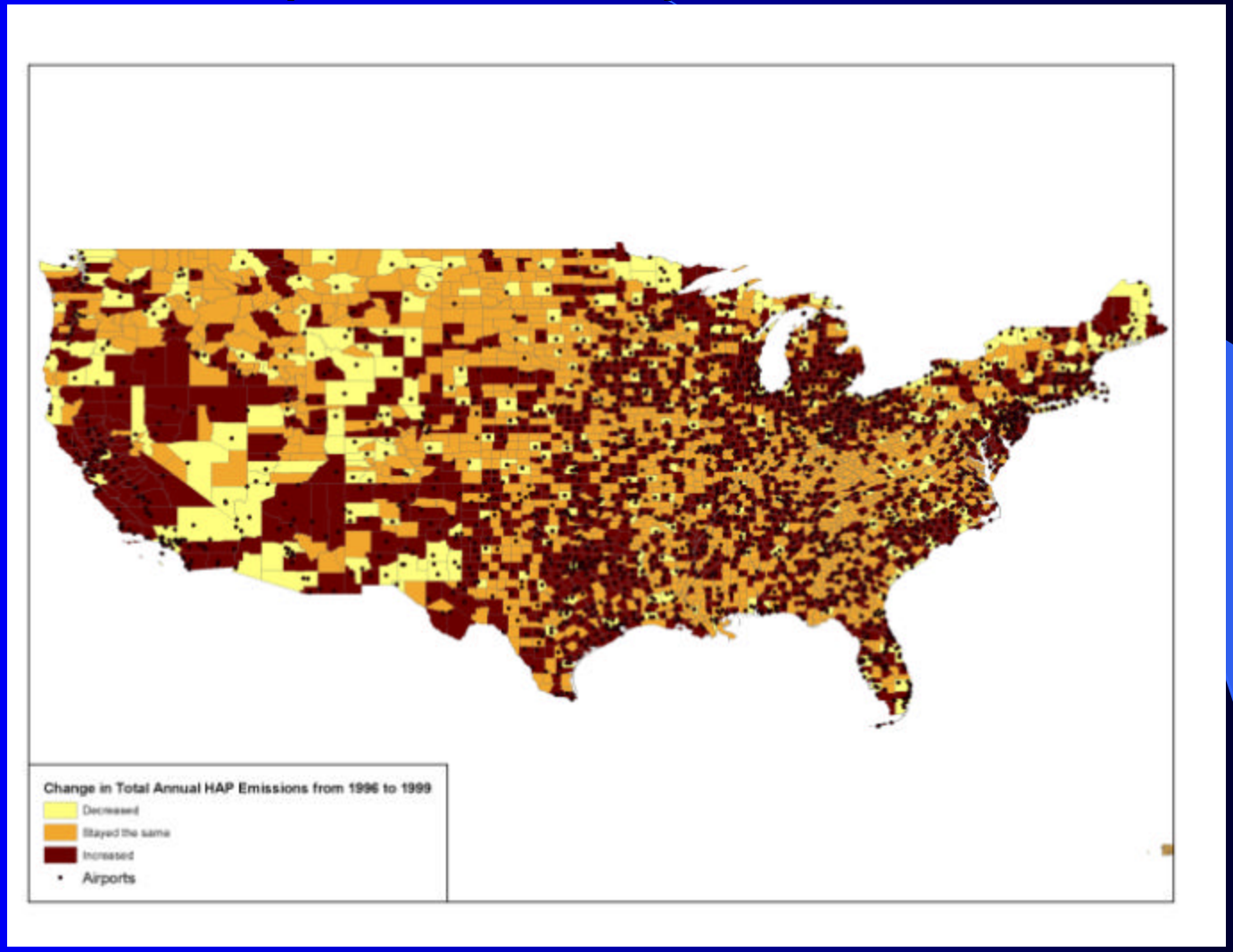
Comparison of 1996 and 1999 Aircraft Inventories

- The inclusion of 1,400 smaller municipal airports provided a more accurate method of allocating general aviation and air taxi emission estimates. Most of the counties that show increases are due to the inclusion of these smaller municipal airports.

Aircraft Comparison (cont)

- The approach used for the 1996 inventory to allocate commercial air carriers was similar to that used in the 1999 inventory. Counties that show decreased emissions are due to the improved spatial allocation of general aviation and air taxi emission estimates.

Comparison Map - Aircraft



Overview of 1996 CMV Emission Estimating and Spatial Allocation Methods

- National CMV criteria emissions for 1996 were provided by OTAQ staff who were involved in the EPA's recent marine diesel engine rule making.

- Estimates for steam-powered vessels were calculated using Department of Energy (DOE) bunkered fuel data obtained from *Fuel Oil and Kerosene Sales, 1996* and emission factors from EPA SIP guidance.

1996 CMV Methods (cont)

- The criteria emission estimates were speciated into individual HAPs based on guidance provided by OTAQ.
- These national emission estimates were assigned to the top 150 ports, based on the amount of cargo handled as estimated in the U.S. Army Corps of Engineers' *Waterborne Commerce of the United States, Calendar Year 1996, Part 5- Waterways and Harbors National Summaries.*

Overview of 1999 CMV Emission Estimating and Spatial Allocation Methods

- National CMVs criteria emissions for 1999 were obtained from the EPA's *Draft Regulatory Impact analysis: Control of Emissions from Compression Ignition Marine Engines* which was developed in support of recent marine diesel engine rule making.

- Emission estimates from steam-powered vessels were calculated based on DOE bunkered fuel data obtained from *Fuel Oil and Kerosene Sales, 1999* and emission factors from the EPA's SIP guidance.

1999 CMV Methods (cont)

- These criteria emission estimates were speciated into individual HAPs based on guidance provided by OTAQ.
- The national emission estimates were disaggregated into port level emissions and underway emissions.
- The port estimates continued to be assigned to the top 150 ports, as was done in the 1996 inventory.

1999 CMV Methods (cont)

- Underway emissions were allocated to shipping lanes based on traffic volume data. The shipping lanes data used in the 1999 inventory were obtained from the Bureau of Transportation Statistics' *National Transportation Atlas Databases - National Waterway Network.*

Comparison of 1996 and 1999 CMV Inventories

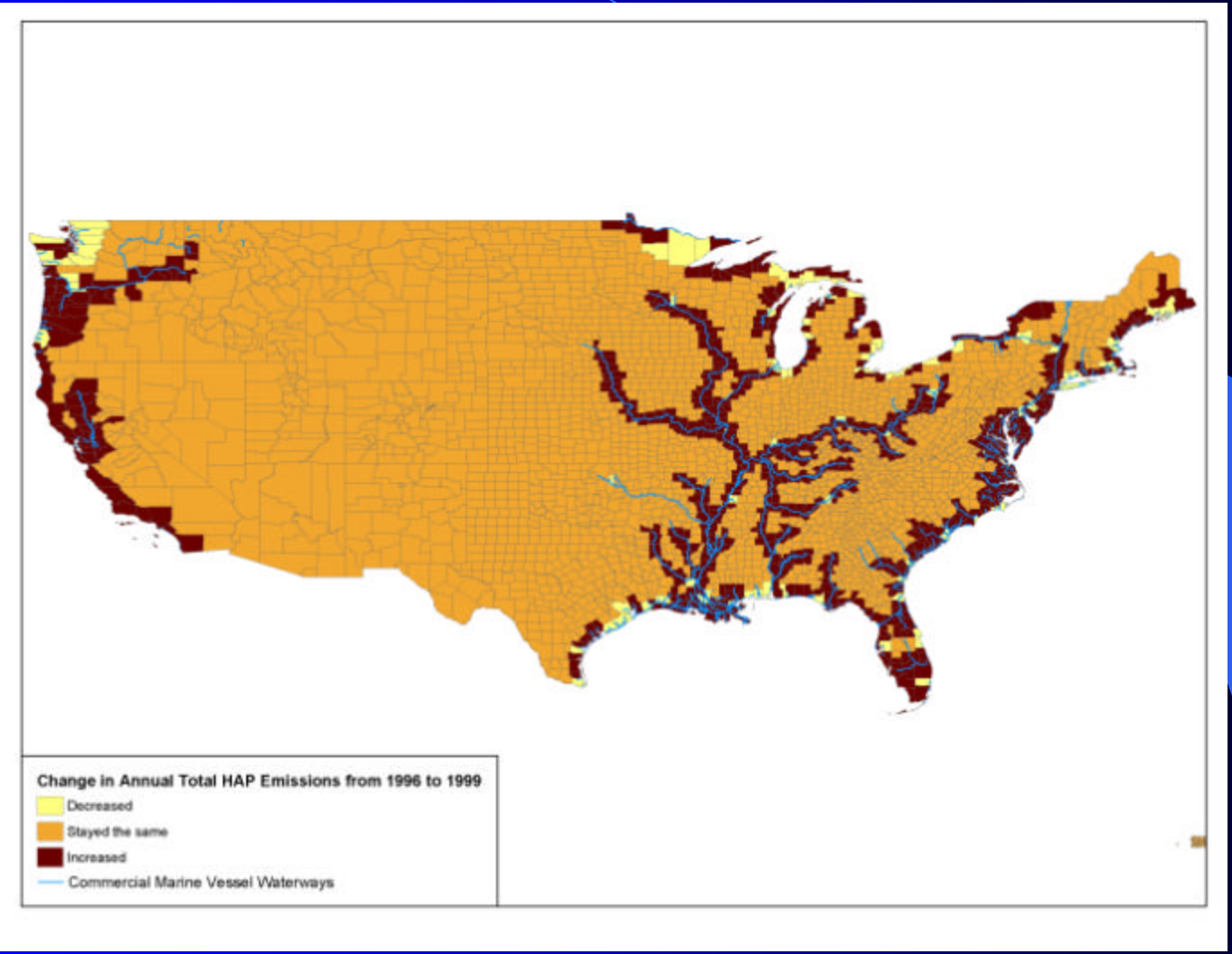
- In the approach used in the 1996 inventory, CMV emissions were only attributed to counties with commercial ports. Emissions declined in individual ports due to the fact that underway emissions were removed from port emission estimates and more accurately assigned to shipping lanes.

- Some port emissions also declined in the 1999 inventory due to the inclusion of data developed by local authorities using local port data, such as the Houston/Galveston shipping channel.

CMV Comparison (Cont)

- Because the 1999 emission inventory method is able to account for underway emissions, all counties with shipping lanes now have emissions attributed them.

Comparison Map - CMV



Overview of 1996 Railroad Emission Estimating and Spatial Allocation Methods

- The national locomotive criteria emission estimates were provided by OTAQ staff involved in the EPA's recent locomotive rule making.
- Criteria emissions were speciated into individual HAPs based on guidance provided by OTAQ.
- The national railroad emissions were spatially allocated to individual counties based on population data obtained from U.S. Department of Commerce's *Estimates of Population of Counties: Annual Time Series.*

Overview of 1999 Railroad Emission Estimating and Spatial Allocation Methods

- National locomotive fuel data were obtained from the Association of American Railroads' *Railroad Facts*.
- These fuel data were applied to emission factors obtained from the EPA's *Emission Factors for Locomotives* which was developed in support of recent locomotive rule making.
- These criteria emission estimates were speciated into individual HAPs based on guidance provided by OTAQ.

1999 Rail Methods (cont)

- The national railroad emissions were allocated to the volume of rail traffic per track length as provided in the Bureau of Transportation Statistics' *National Transportation Atlas Databases - National Railway Network.*

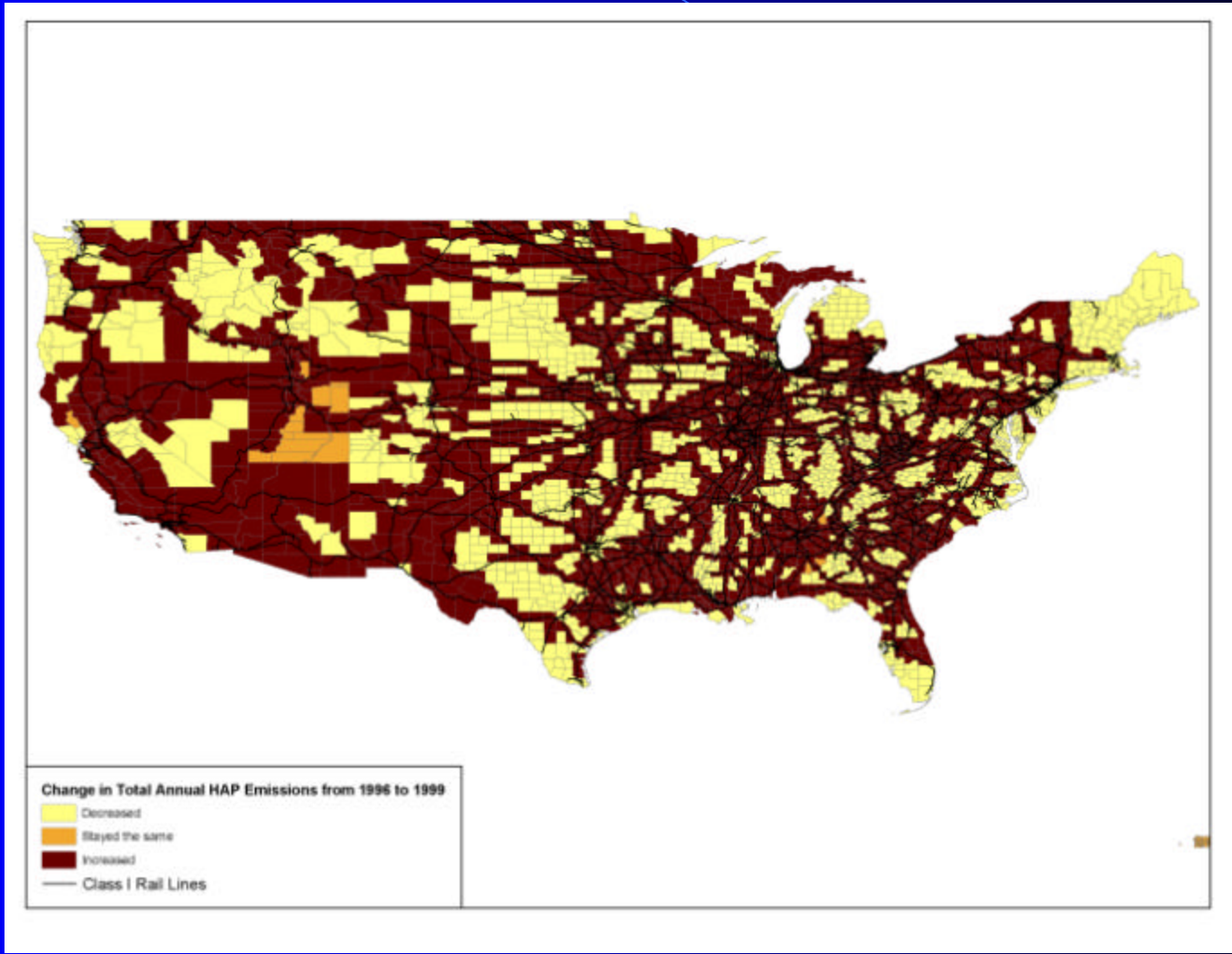
Comparison of 1996 and 1999 Railroad Inventories

- The use of GIS rail data allowed for the reallocation of locomotive emissions from over 600 counties that had emissions erroneously assigned to them in the 1996 NTI.
- For the most part, emission increased in counties that had Class I railroads, this was particularly noticeable for counties that were sparsely populated in the 1996 census data.

Rail Comparison (cont)

- One significant problem that was encountered in this approach was that the states without Class I rail operations had no locomotive emissions attributed to them even though they may have considerable Class II/III, passenger, commuter, or yard operations.

Comparison Map -Rail



Proposed Future Improvements

- **Aircraft**

  Continuing to incorporate state and local emission estimates into the NEI that have been developed based on accurate local airport activity data and use of the latest version of EDMS.

- Currently, all aircraft-specific data must be entered into EDMS manually. The next version of EDMS is planned to allow batch downloading of FAA aircraft-specific data, which will make direct estimation of airport-specific emissions possible.

Improvements (cont)

- Military aircraft emissions continue to be difficult to estimate both at the national and local levels. Currently, OTAQ and the Emission Factor and Inventory Group (EFIG) are reviewing plans to revise military aircraft methodologies.

- **CMV**

  Continue to include local inventory studies that use the latest emission factors incorporated in the background documents for recent marine diesel rule making.

Improvements (cont)

- **Railroad**
  In the next version of the 1999 inventory, the national locomotive emissions will be disaggregated into the following categories and spatial methods to allocate emissions for each railroad operation will be tailored to the operation.

  •Class I
  •Class II/III
  •Passenger
  •Commuter
  •Yard

Conclusions

- The use of GIS data allowed for relatively easy spatial allocation of national level emission estimates to individual counties.
- For some source categories, such as Class I railroads, these GIS techniques are particularly useful.

Conclusions (cont)

- Though these GIS methods represent a significant improvement in how emissions for these source categories can be spatially allocated, these techniques do not diminish the need for emission estimates developed using local activity data and the latest emission factors or models.