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Reconciliation and Comparison of Regional and Global Emission Inventories

16th Annual International Emissions Inventory Conference
"Emission Inventories: Integration, Analysis, Communication“
Session 8. Global/International Issues

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Presentation Outline

- Background
- Regional and Global Emission Inventories
- Comparison of Inventories
- Conclusions and Recommendations

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Acknowledgement

Terry Keating

Office of Air & Radiation, US. EPA

Co-Chair of Task Force on Hemispheric Transport of Air Pollution

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Background

- Once thought of as a local issue, air pollution is now recognized as a complex problem subject to local, regional, hemispheric, and global influences

- Task Force on the Hemispheric Transport of Air Pollution has been organized to assess the evidence for intercontinental transport of air pollutants in the Northern Hemisphere and the implications for future international cooperation to abate air pollution

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Background

- Lack of high quality and officially-recognized emissions estimates for many parts of the world
- Global Emissions Inventory Activity (GEIA) has attempted to make global gridded emissions estimates

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Project Objective

- To better understand the intercontinental flow of air pollutants, it is important to compare, evaluate, and where possible resolve the spatial and temporal differences between emissions inventories developed at different scales

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Project Objective

- Compare emission estimates contained among various regional and international emission inventories, centering on emissions in the continental United States

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Emission Inventories -- Purpose of Use

- Regulatory
  - Nationally-developed inventories
  - Identify, track, and remedy air quality problems in metro areas
- Research
  - Global-scale inventories
  - Overall framework for intergovernmental efforts

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Expanded Purpose

- International collaborations and resolutions require emission inventories to be reviewed and prepared with more scientific appraisal
- Created the need for data to be more complete, accurate, timely, transparent, and affordable
- Elevated level of responsibility on inventory developers to maintain the metadata and calculate the uncertainty on multiple levels of aggregation

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Regional and Global Emission Inventories

- EDGARv32 Fast Track 2000
- EDGARv32 1990 and 1995
- U.S. National Emissions Inventory 2002
- EPA's ICAP trans-Pacific emissions inventory 1999/2001
- Canadian National Pollutant Release Inventory 2002
- Mexican National Emissions Inventory 1999

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Availability and Format

- Each data set was publicly available via FTP or other web access
- Common denominators for comparison
  - All data converted to 1^{o} x 1^{o} grid
  - CO, NOx, SO2, NMVOC
  - Annual emissions
  - Categorized by EDGAR source codes

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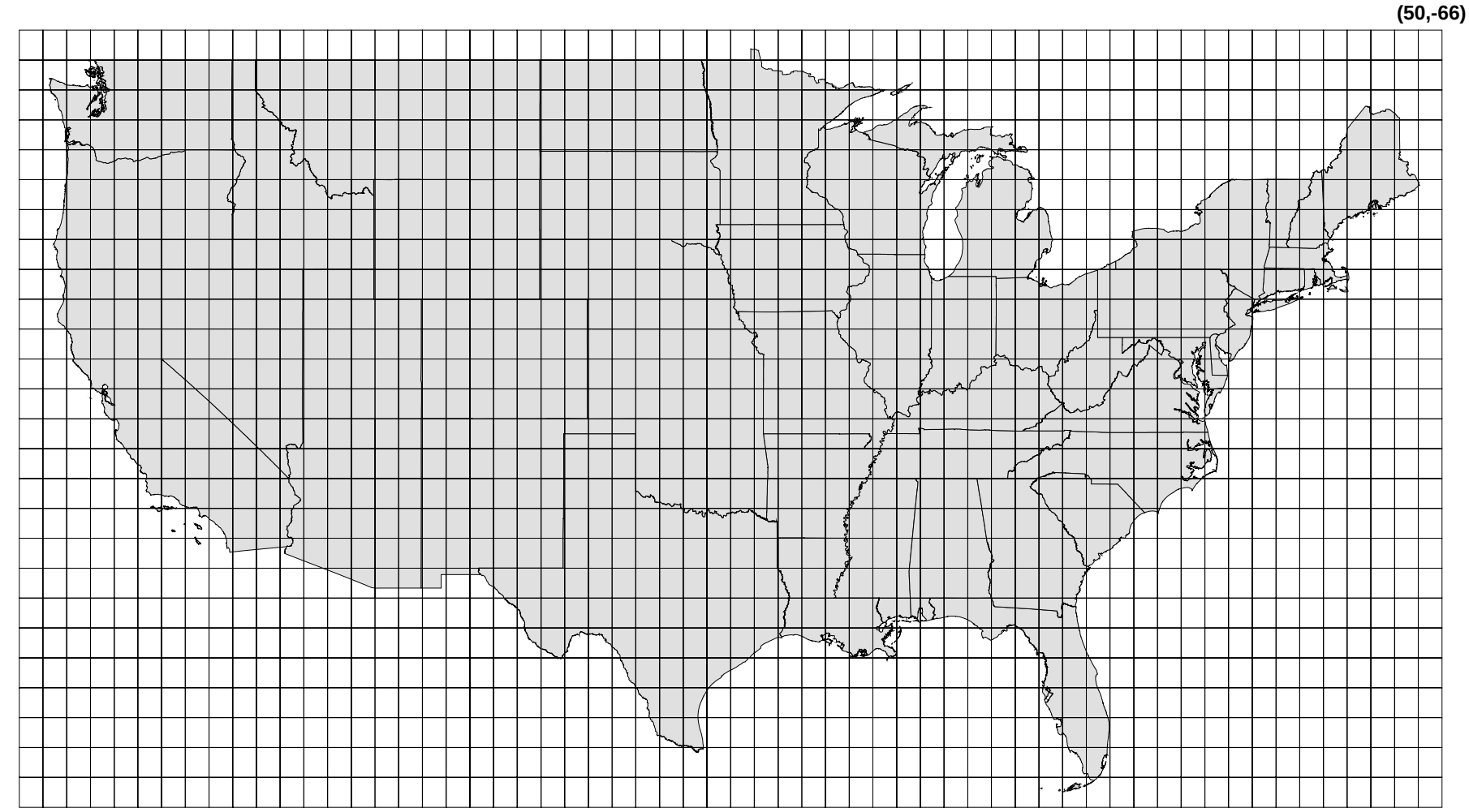
Comparison Domain



EDGAR Source Category Codes (IPCC-Based)

- Fossil fuel (EDGAR category 'F');
- Biofuel (EDGAR category 'B');
- Industrial processes (EDGAR category 'I');
- Agriculture (EDGAR category 'L');
- Biomass burning (EDGAR category 'L');
- Waste handling (EDGAR category 'W');
- Production and use of halocarbons and other fluorinated gases (EDGAR category 'H'); and
- Other (EDGAR category 'F').

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Comparison of Inventories

- Focus on comparing U.S. EPA's National Emissions Inventories (NEI) with the EDGARv32 inventories

- Objective of qualitatively and quantitatively reconciling the two allowing the science of international transport to benefit from the results

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Comparison Classes

- Total anthropogenic sources
- Elevated sources
  - Most prevalent anthropogenic source types contributing to short term regional and intercontinental transport

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All Anthropogenic Sources Summary Statistics

Inventory	Pollutant	Annual Emissions (Gg) Total	Maximum	Average
EDGAR32 1990	SO2	2.346E+03	4.690E+01	2.867E+00
	NOx	1.997E+03	8.140E+01	2.374E+00
	NMVOC	1.984E+03	1.110E+02	2.365E+00
	CO	9.298E+03	5.230E+02	1.108E+01
EDGAR32 1995	SO2	1.926E+03	5.860E+01	2.354E+00
	NOx	1.899E+03	8.450E+01	2.258E+00
	NMVOC	2.038E+03	1.180E+02	2.429E+00
	CO	9.349E+03	5.460E+02	1.114E+01
ICAP 1999	SO2	1.585E+03	3.985E+01	1.854E+00
	NOx	2.048E+03	3.427E+01	2.374E+00
	NMVOC	1.677E+03	2.942E+01	1.945E+00
	CO	1.005E+04	1.999E+02	1.165E+01
EDGAR 32FT2000	SO2	1.757E+03	5.170E+01	2.047E+00
	NOx	1.807E+03	8.240E+01	2.086E+00
	NMVOC	1.958E+03	1.080E+02	2.258E+00
	CO	7.927E+03	4.620E+02	9.175E+00
NEI 2002	SO2	1.343E+03	3.414E+01	1.566E+00
	NOx	1.892E+03	2.954E+01	2.185E+00
	NMVOC	1.501E+03	2.174E+01	1.732E+00
	CO	8.657E+03	1.291E+02	1.002E+01

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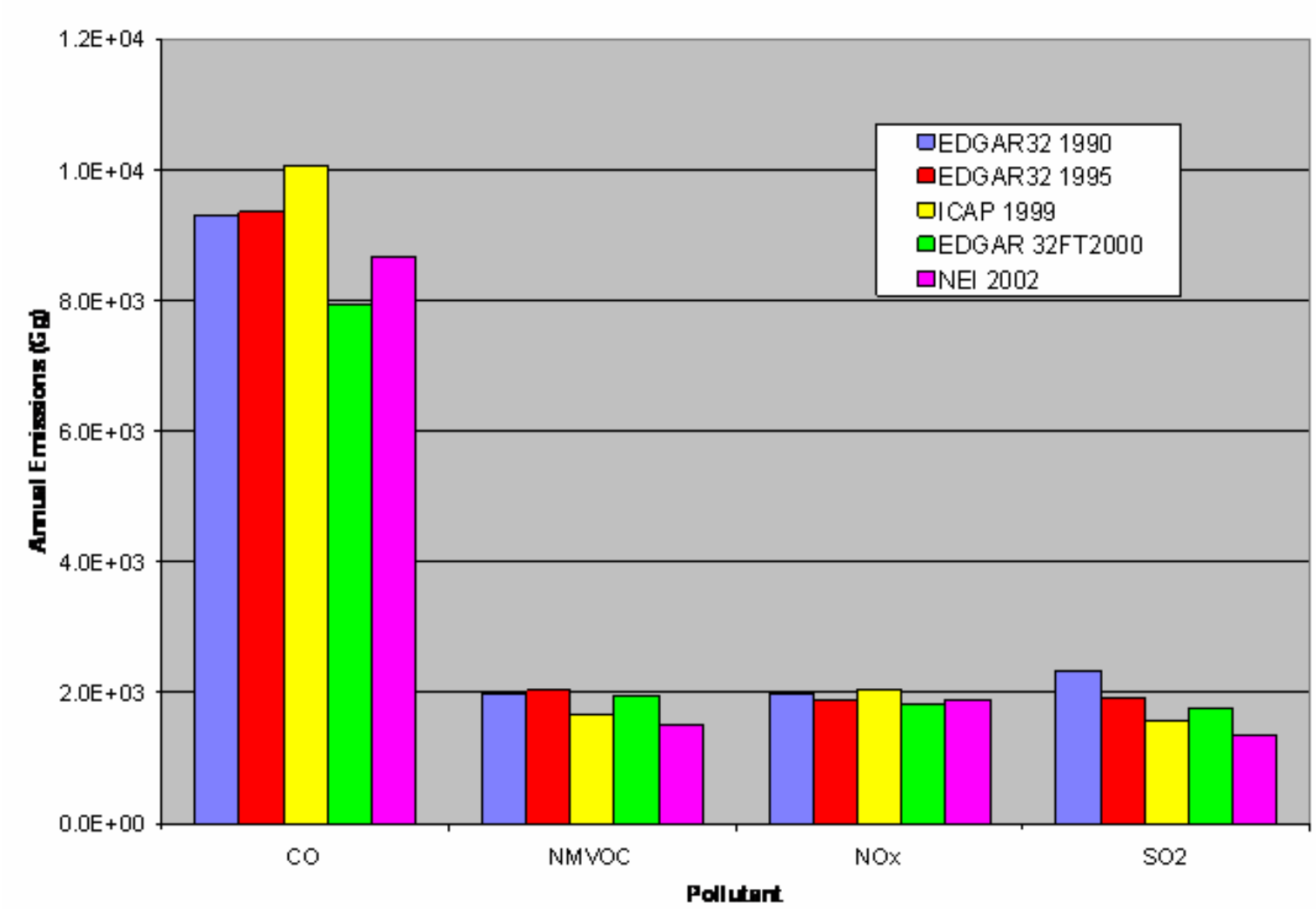
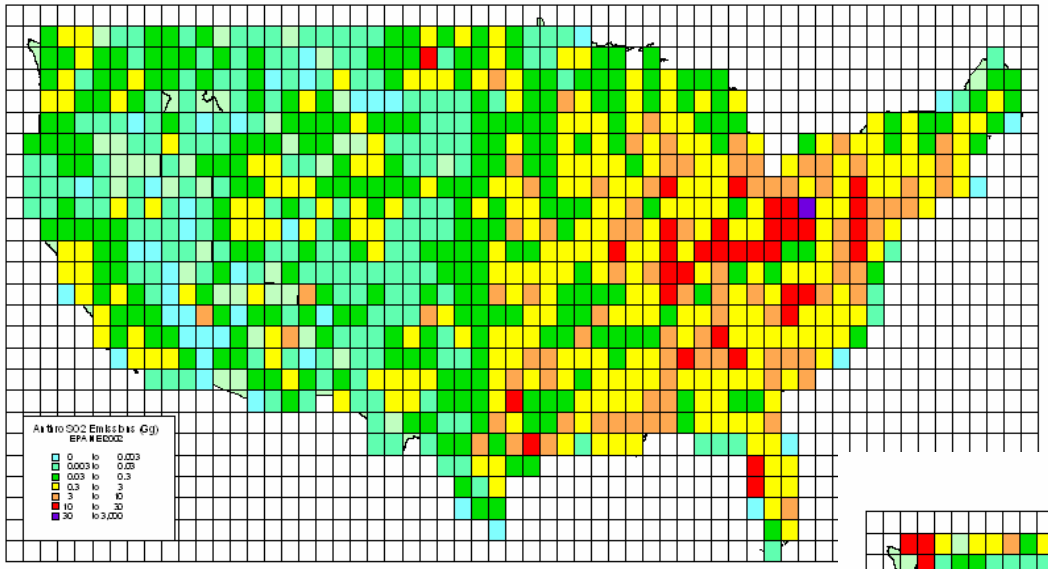
Annual All Anthropogenic Emission Comparison (Gg)

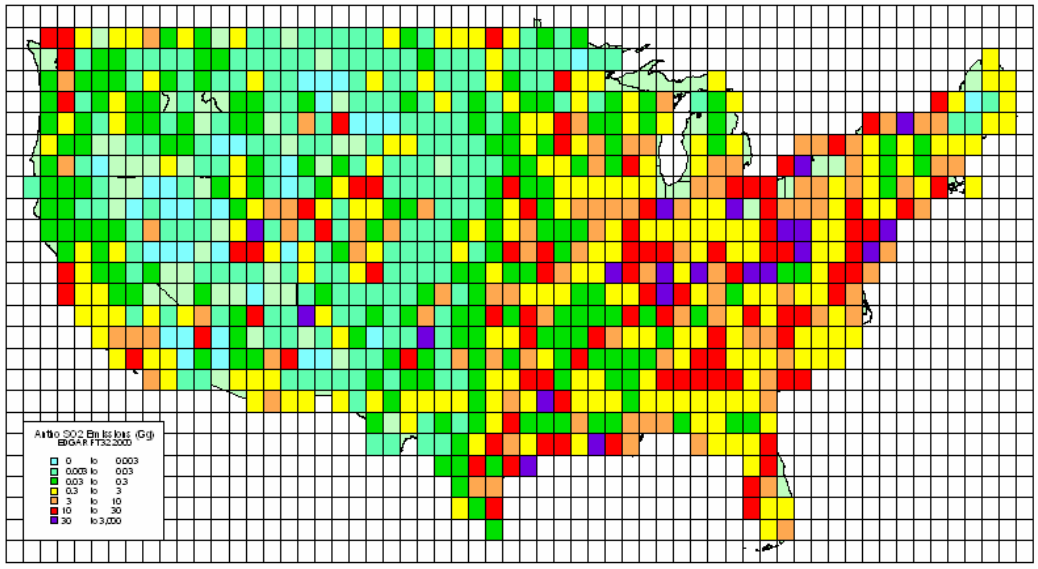


Annual SO2 Emissions (Gg)



← U.S. NEI 2002

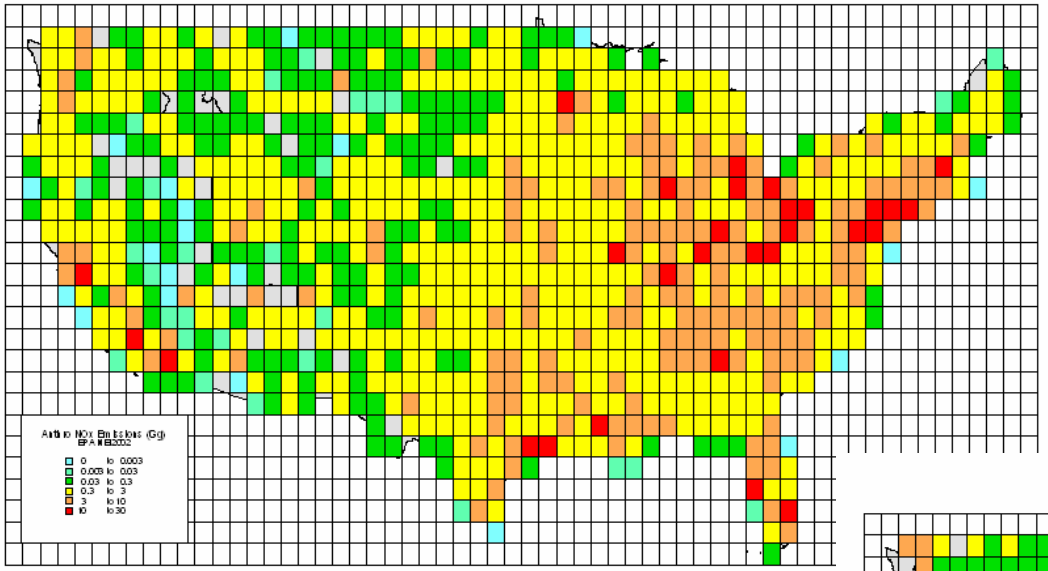
EDGARv32 FT 2000 →



Annual Emissions (Gg)

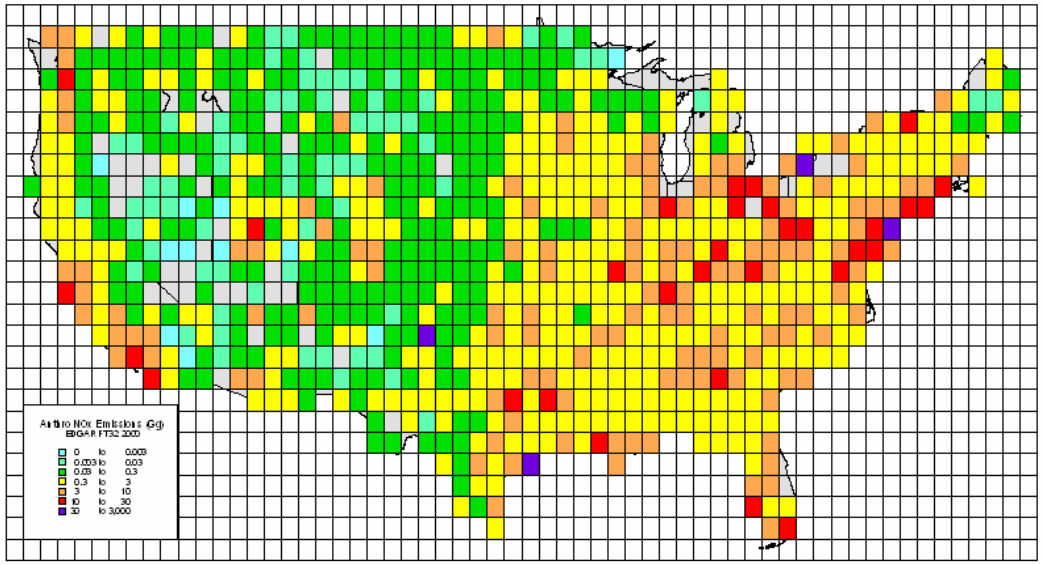
30	to	3,000
10	to	30
3	to	10
0.3	to	3
0.03	to	0.3
0.003	to	0.03
0	to	0.003

Annual NOx Emissions (Gg)



← U.S. NEI 2002

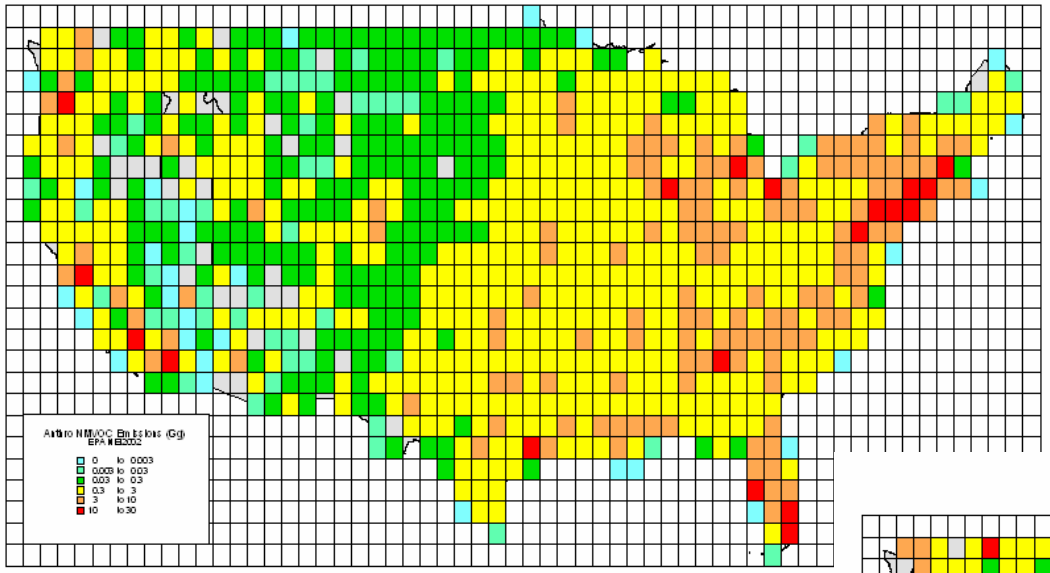
EDGARv32 FT 2000 →



Annual Emissions (Gg)

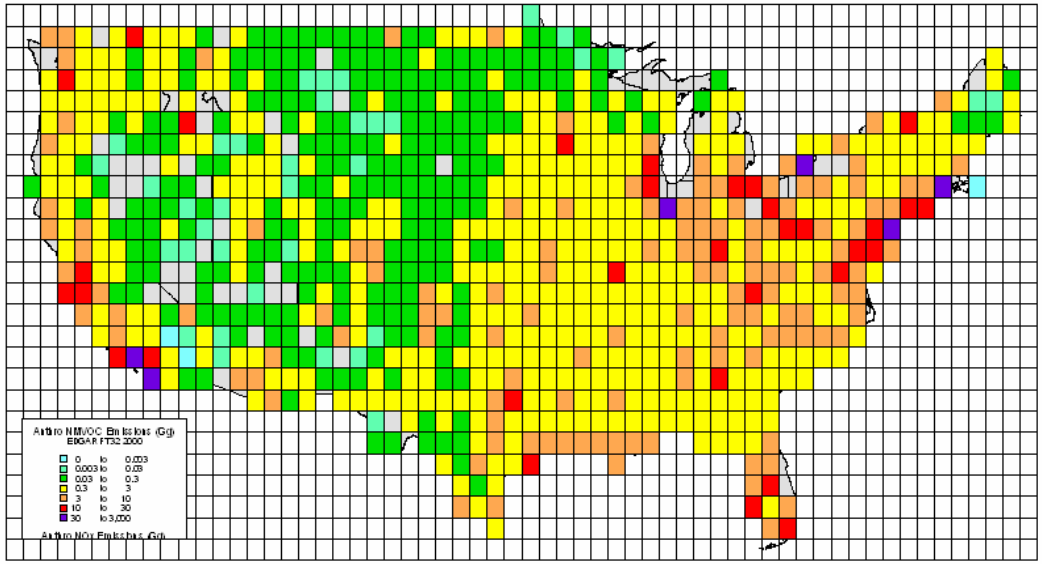
30	to	3,000
10	to	30
3	to	10
0.3	to	3
0.03	to	0.3
0.003	to	0.03
0	to	0.003

Annual NMVOC Emissions (Gg)



← U.S. NEI 2002

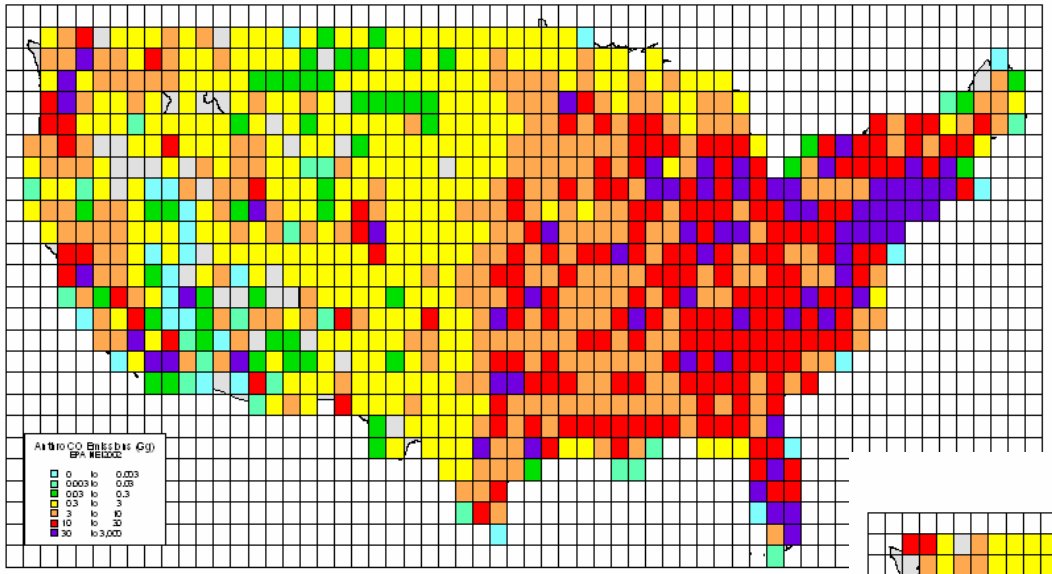
EDGARv32 FT 2000 →



Annual Emissions (Gg)

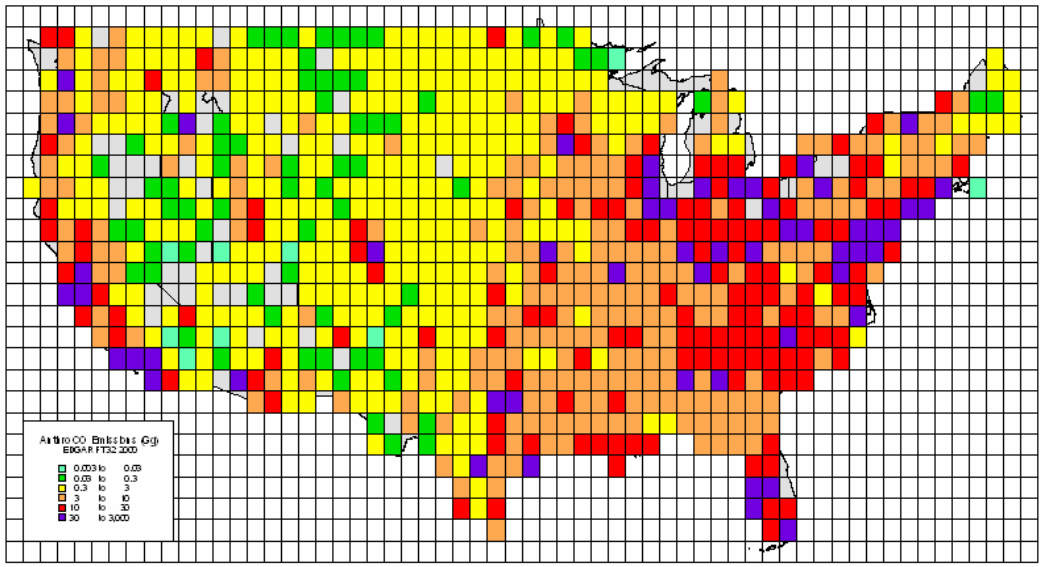
30	to	3,000
10	to	30
3	to	10
0.3	to	3
0.03	to	0.3
0.003	to	0.03
0	to	0.003

Annual CO Emissions (Gg)



← U.S. NEI 2002

EDGARv32 FT 2000 →



Annual Emissions (Gg)

30	to	3,000
10	to	30
3	to	10
0.3	to	3
0.03	to	0.3
0.003	to	0.03
0	to	0.003

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Elevated Sources

- Low level sectors, like transportation categories, have a significant impact on air pollution concentrations in localized geographic areas

- Elevated source emissions is where our focus centers for short term regional and international transport
  - Essential that emissions be characterized with the greatest possible certainty
  - Temporal and spatial influence

Elevated Source List

(EDGAR Codes)

- Fossil Fuel Use (non-mobile)
- Fossil Fuel Production and Transmission
- Industrial Processes
- Biomass Burning

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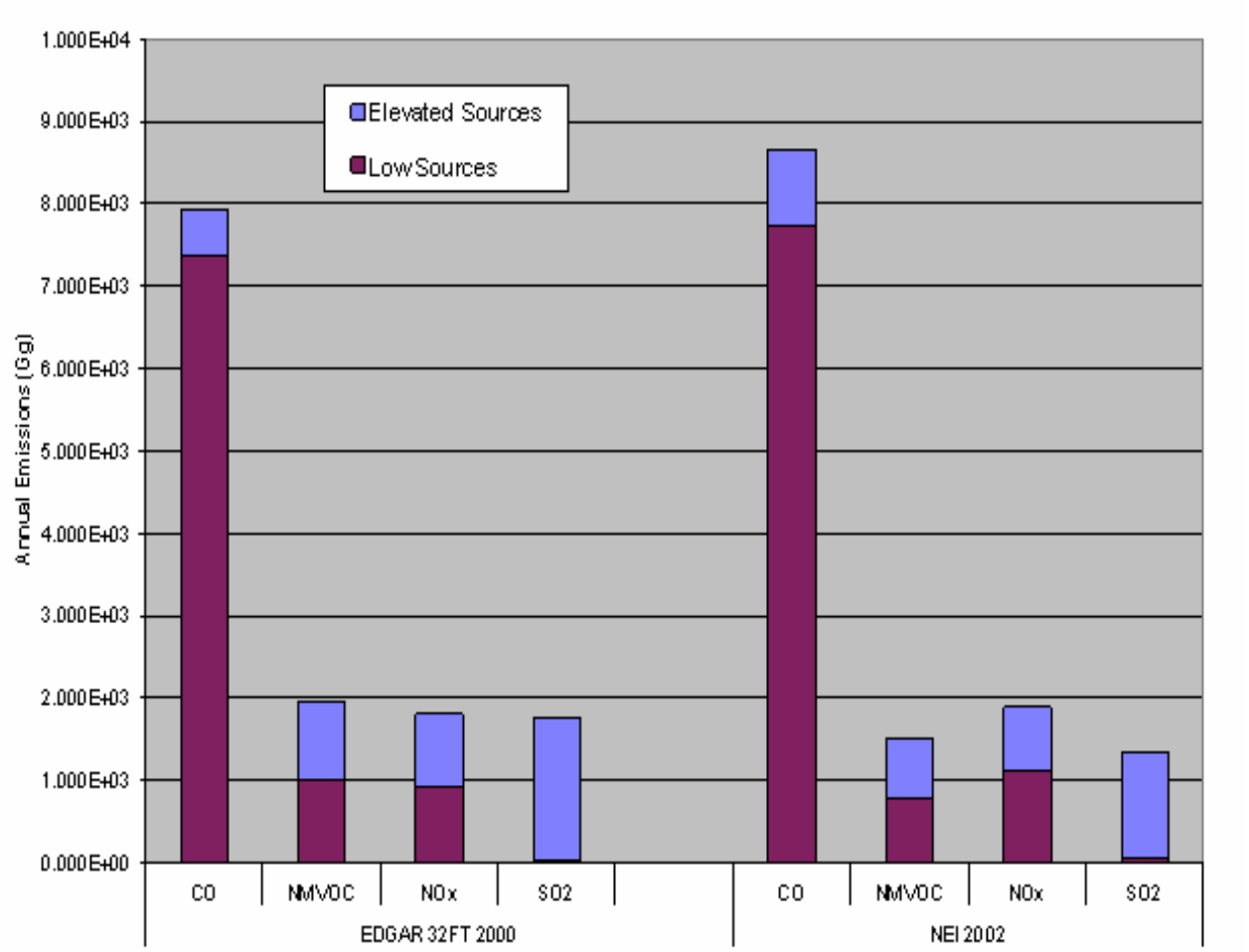
Elevated Source Contribution



- Major component of three of the four analyzed pollutants for our domain

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Elevated Sources Summary Statistics

Inventory	Pollutant	Annual Emissions (Gg)		
		Total	Maximum	Average
EDGAR 32FT2000	SO2	1.728E+03	4.841E+01	2.131E+00
	NOx	8.896E+02	4.717E+01	1.097E+00
	NMVOC	9.345E+02	5.246E+01	1.155E+00
	CO	5.508E+02	3.594E+01	6.808E-01
NEI 2002	SO2	1.274E+03	3.364E+01	1.484E+00
	NOx	7.608E+02	1.084E+01	8.786E-01
	NMVOC	7.062E+02	1.142E+01	8.154E-01
	CO	9.270E+02	2.599E+01	1.073E+00

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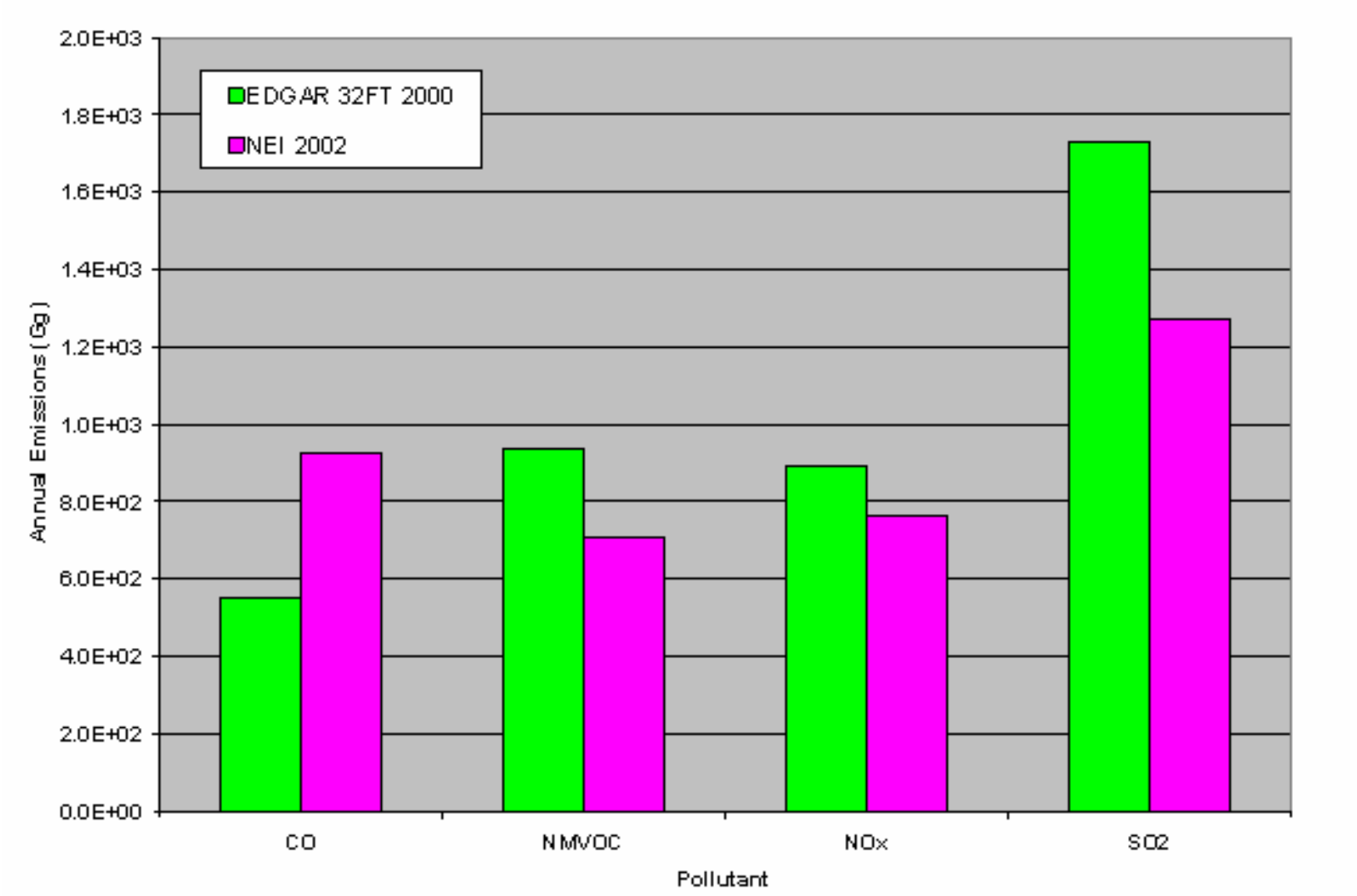
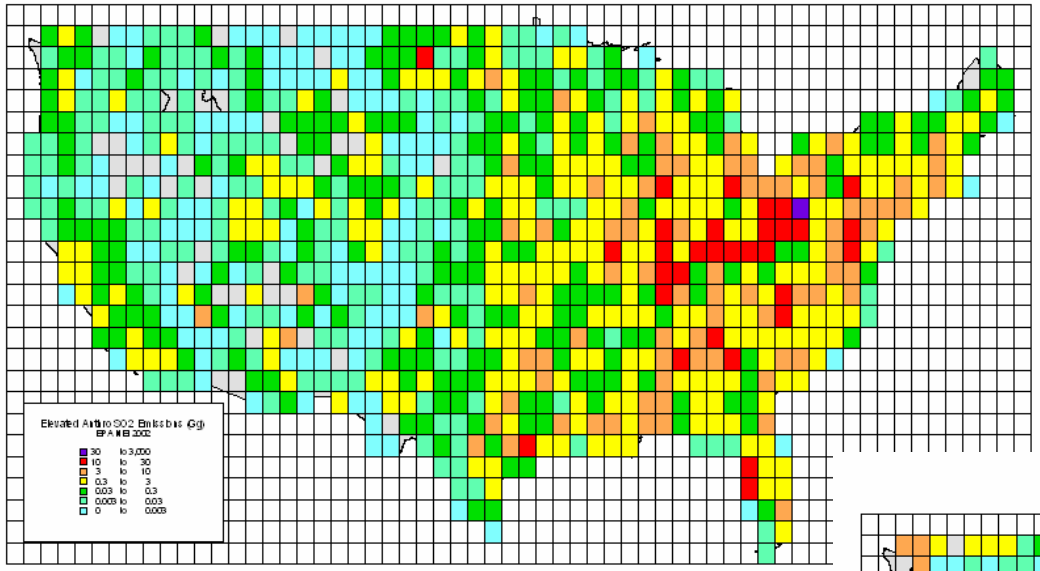
Annual Elevated Source Emission Comparison (Gg)



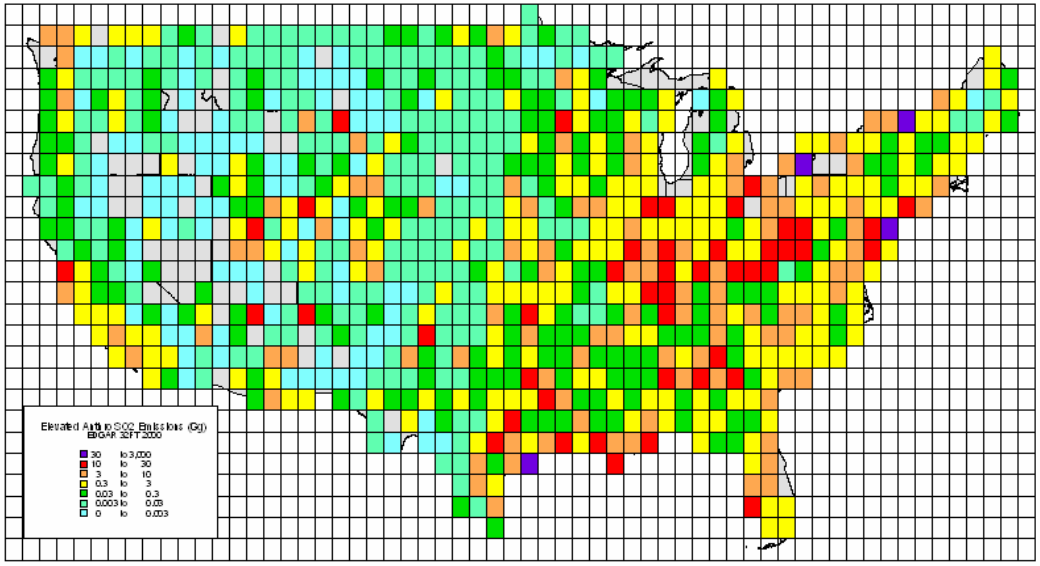
Annual SO2 Emissions (Gg)

Elevated Sources



← U.S. NEI 2002

EDGARv32 FT 2000 →

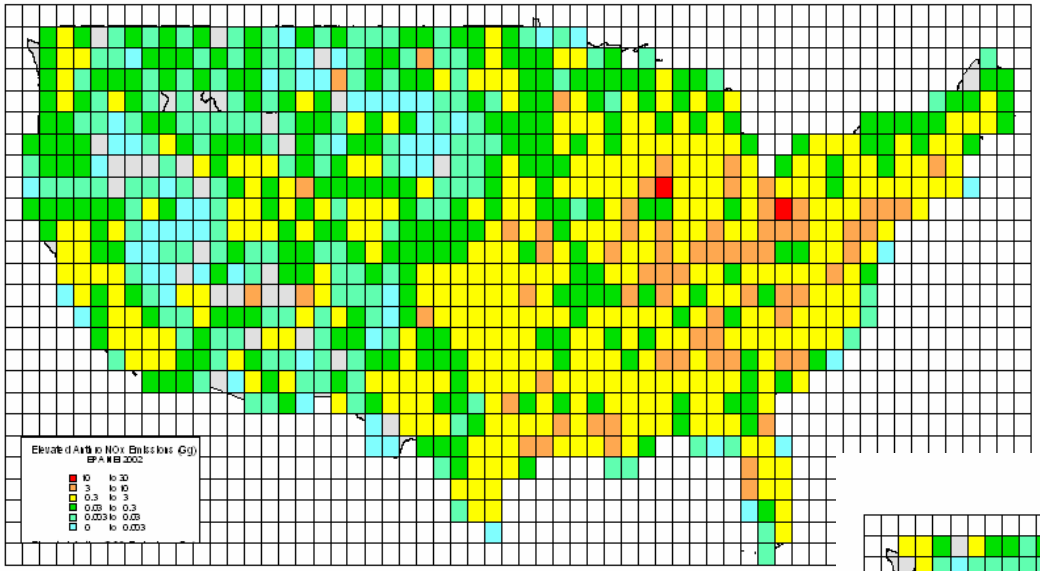


Annual Emissions (Gg)

30	to	3,000
10	to	30
3	to	10
0.3	to	3
0.03	to	0.3
0.003	to	0.03
0	to	0.003

Annual NOx Emissions (Gg)

Elevated Sources



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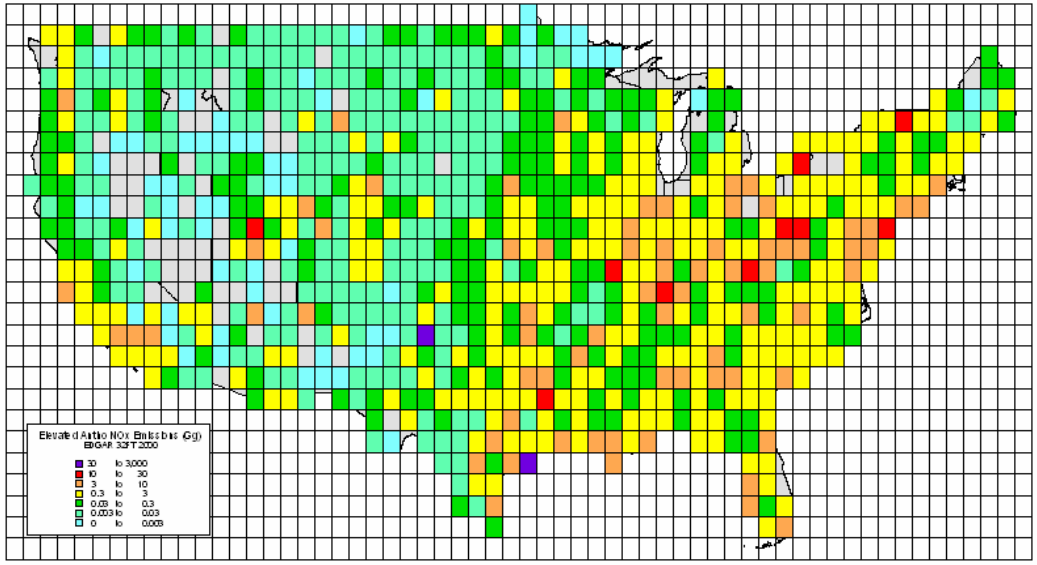
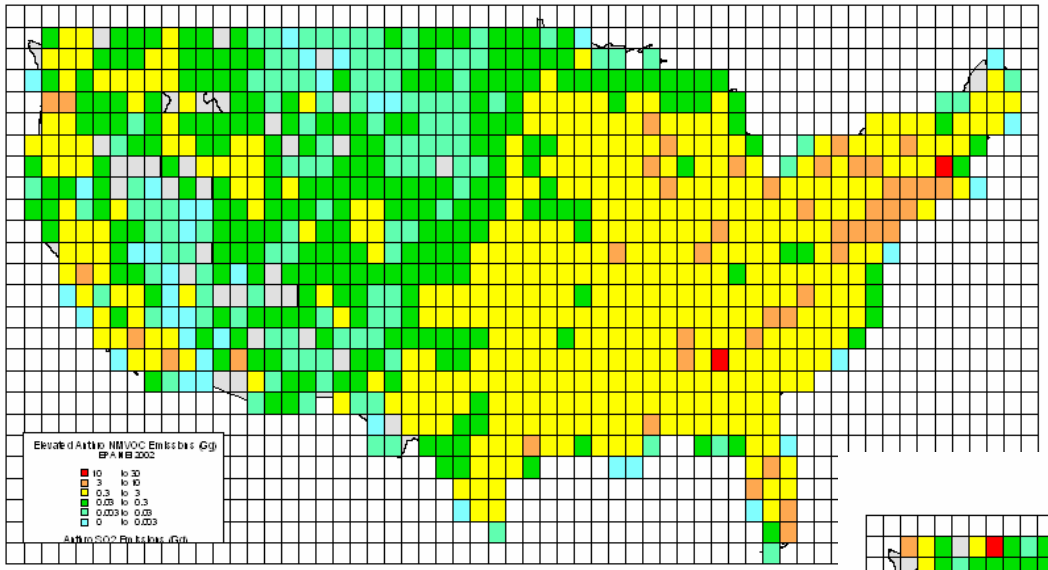


Annual Emissions (Gg)

30	to	3,000
10	to	30
3	to	10
0.3	to	3
0.03	to	0.3
0.003	to	0.03
0	to	0.003

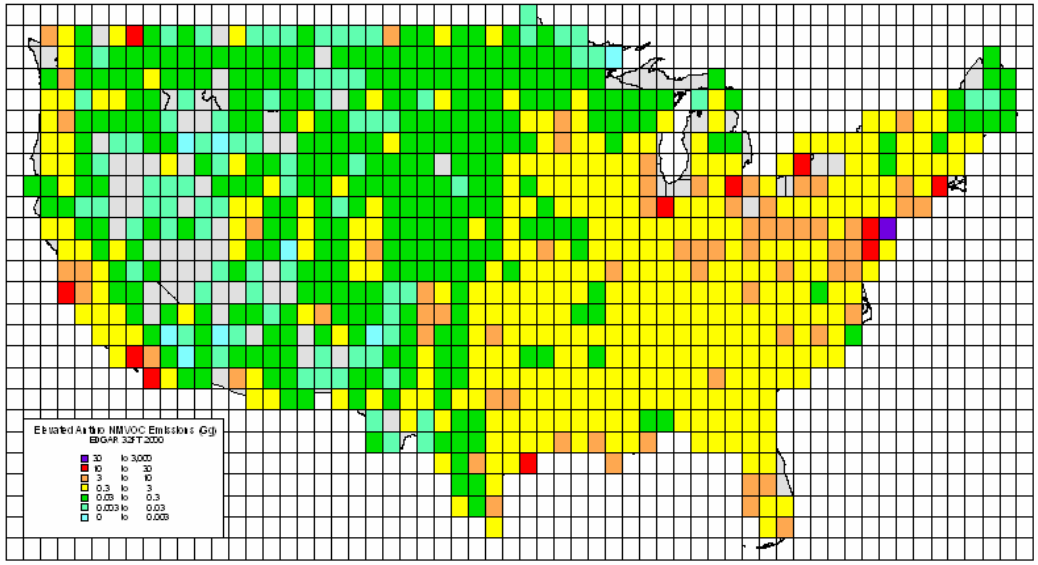
Annual NMVOC Emissions (Gg)

Elevated Sources



← U.S. NEI 2002

EDGARv32 FT 2000 →



Annual Emissions (Gg)

30	to	3,000
10	to	30
3	to	10
0.3	to	3
0.03	to	0.3
0.003	to	0.03
0	to	0.003

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Conclusions

- We have identified notable differences in the estimates of annual emissions among analyzed data for both total and elevated source anthropogenic inventories
  - Good spatial correlation
  - Regional and national gradations of emissions as a result of applied abatement programs is still not replicated accurately

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Conclusions

- The participation of multiple countries in international collaborations and resolutions has created the need for emissions data to be made even more complete, accurate, timely, transparent, and affordable to science bodies in need of their use

- Our objective as scientists working to attend to these collaborations is to compare emission estimates contained among various regional and international inventories and to reconcile differences based on the alternate methods of emission inventory preparation

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Recommendations

- Our long term goal as inventory data developers and users should be the advancement of an emissions inventory that is universally available to all who want to access its information, is of high-resolution and source and facility specific, is comprehensive with respect to pollutants and sources, is well documented and easily duplicated, and is based on comparable, state of science methodologies and factors

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