The 2002 National Emission Inventory Shakeout:

The First Step in Development of EPA's 2002 Emissions and Air Quality Modeling Platform

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Shakeout Background

- 2002 National Emissions Inventory (NEI), V.1
- Modeling sector comparisons to latest version of the 2001 modeling platform**
- Emissions processed through the Sparse Matrix Operator Kernel Emissions (SMOKE), V2.1
- Community Multiscale Air Quality (CMAQ) model, V4.5 used to estimate concentrations for both 2001 and 2002 emissions
- Same 2001 meteorology and CB04 chemistry

** Same emissions and air quality results as the PM NAAQS Final

Why Perform an Emissions Inventory Shakeout?

1) Identify potentially large differences in AQM predictions of pollutant concentrations between 2001 and 2002 platforms caused by large changes in the emissions
2) Update some of the SMOKE ancillary input data: e.g., SCCs in SMOKE cross-reference files

Why Perform a Shakeout? Explain large AQM differences (cont.)

- Ensure large emissions changes not result of potential inventory errors not caught by QA/QC process
- Inspect SMOKE ancillary input files for potential inconsistencies in application to 2001 and 2002 emissions:
  - Country-state-county FIPS
  - Inventory species
  - Spatial and temporal allocation

Shakeout Methodology

- “Isolate” large differences to particular emissions inventory sectors
- Run “mixed” 2001/2002 SMOKE/CMAQ runs with 2002 emissions for one or two sectors, and 2001 emissions for all other sectors
- Retain all other inputs from latest 2001 modeling platform
- While 2002 platform is multi-pollutant, shakeout restricted to criteria air pollutants (CAPs)
- Determined by availability of inputs, expected impact

AQM Shakeout Sectors

2001 sector(s)	2002 sector(s)	Shakeout Run	SMOKE sector	Sector Description
oarea & ag	nonpt & ag	nonpt & ag	area	NEI non-point inventory excluding: 1) non-point fires, 2) fugitive dust
ptnonipm & pfdust	ptnonipm	ptnonipm	point	Non-EGU point sources –EGUs determined through IPM source matching
nonroad	nonroad & alm	nonroad & alm	area	Nonroad mobile emissions including aircraft, locomotives, and commercial marine
fire	ptfire	ptfire	area (2001), area & point/fire (2002)	2001: Subset of NEI non-point containing open/ag/Rx burning & wildfires; 2002: Day-specific, point source wildfires and Rx burning

Shakeout Emissions

- state-(SCC)/tier-pollutant comparisons for all sectors
- state-Facility-pollutant comparison ranks for ptnonipm and ptipm sectors
- Large differences were then fed back to emissions inventory developers for investigation

Shakeout Sector Results: Emissions

- Much higher fertilizer application NH3 emissions in numerous states in 2002
  - RPO-funded CMU model → accepted as improvement over 2001
- Catastrophic releases (tire fires) in 2002
  - removed these sparsely-reported 2002-specific emissions
- Erroneous surface coating emissions in Georgia
  - corrected in Version 2 of the NEI

Shakeout Sector Results: Emissions Example: Top 3 EGU Facilities in KS

Rank	NH_3 [tons/yr]	Year
1	13	2001
2	10	2001
3	6	2001
1	2,786	2002
2	684	2002
3	305	2002

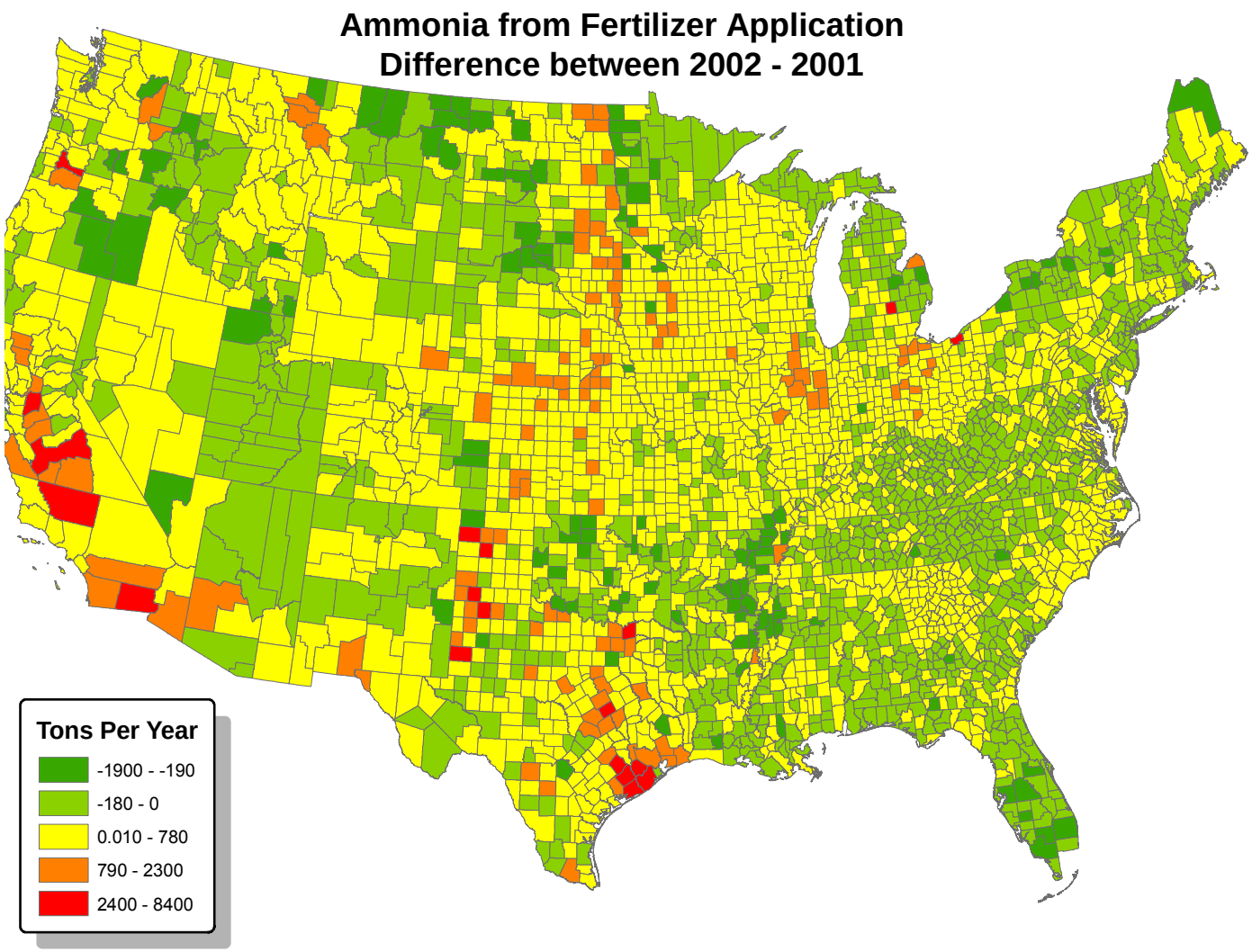
►Yielded problem with NH_3 EGU emissions in some states

►fixed in V2 of the 2002 NEI

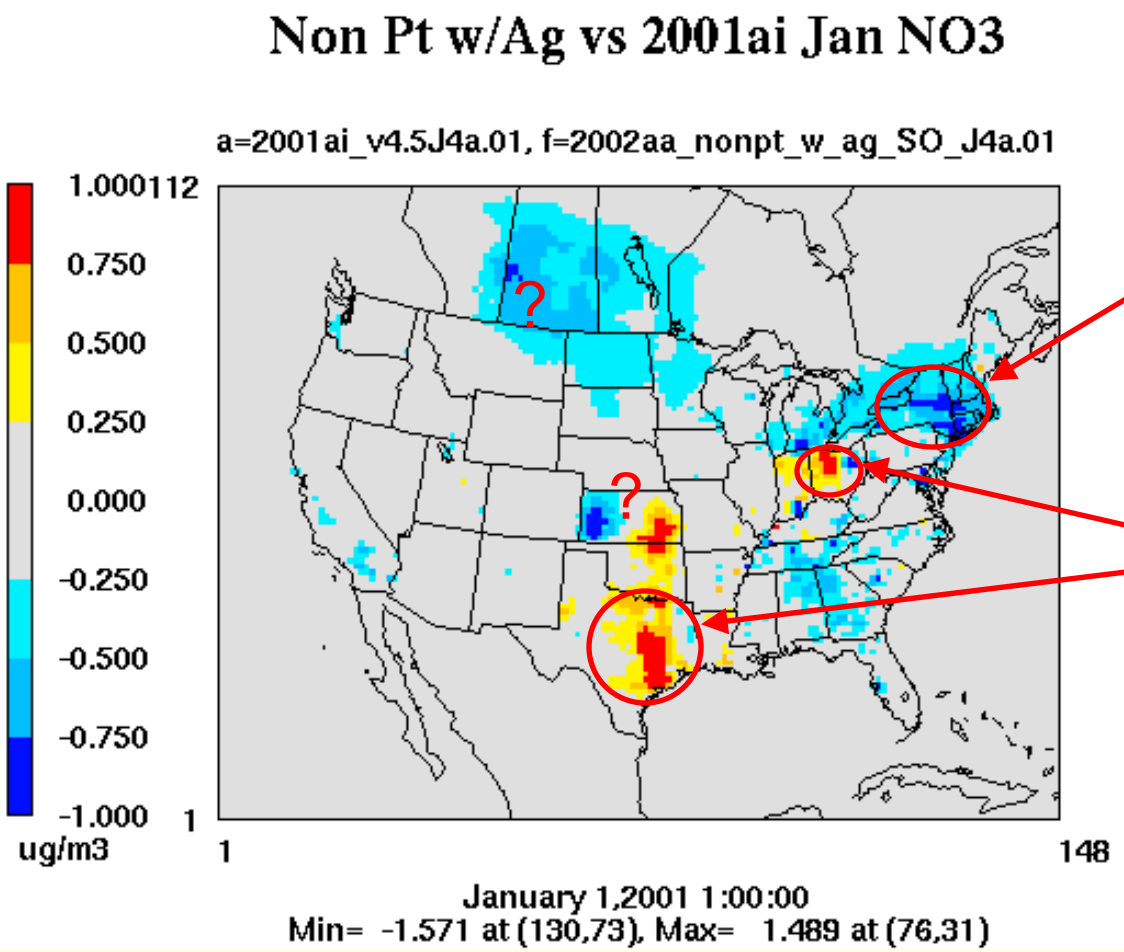
Shakeout Sector Results: Emissions-Other 2002-related issues

- “non-traditional” source categories in 2002 point inventory
  - some 10-digit SCCs: sector/SCC summaries require updated QA/summary procedures
  - Agriculture NH_3 emissions from animal (farm) waste
  - aircraft emissions at airports sometimes reported as point sources using SCC related to jet engines
  - nonroad mobile ski resort emissions (very small)

Results: Non-point and Ag Shakeout



Results: Non-point and Ag Shakeout



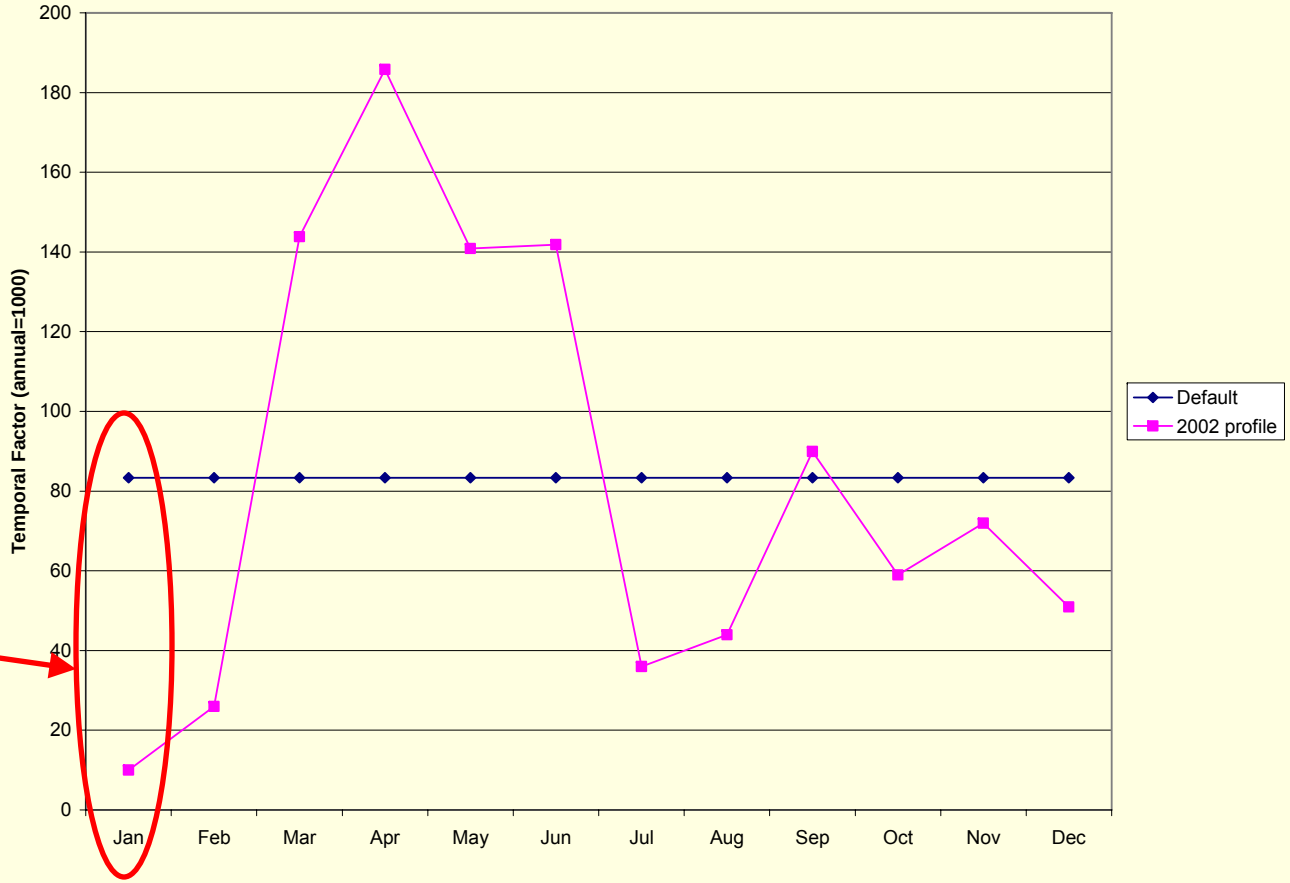
NY: ERROR-stationary residential combustion emissions

TX, NW Ohio: supported by increased NH_3 emissions (previous slide)

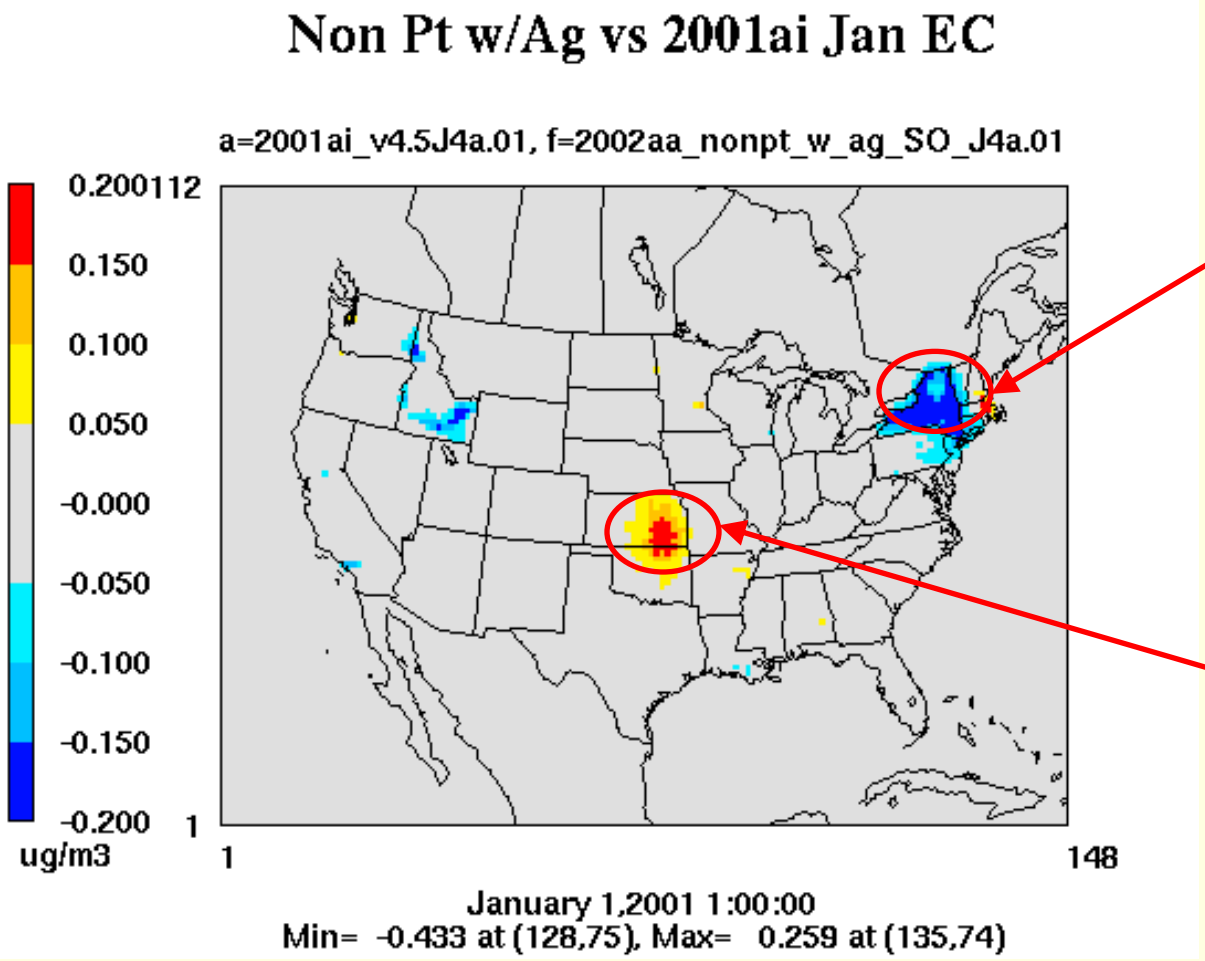
Results: Non-point and Ag Shakeout

Fertilizer Application Monthly Temporal Profile Used in 2001 (default) vs. 2002

January 2002 monthly factor ~85% LESS than 2001; Supported by diminished nitrate differences in Saskatchewan in July



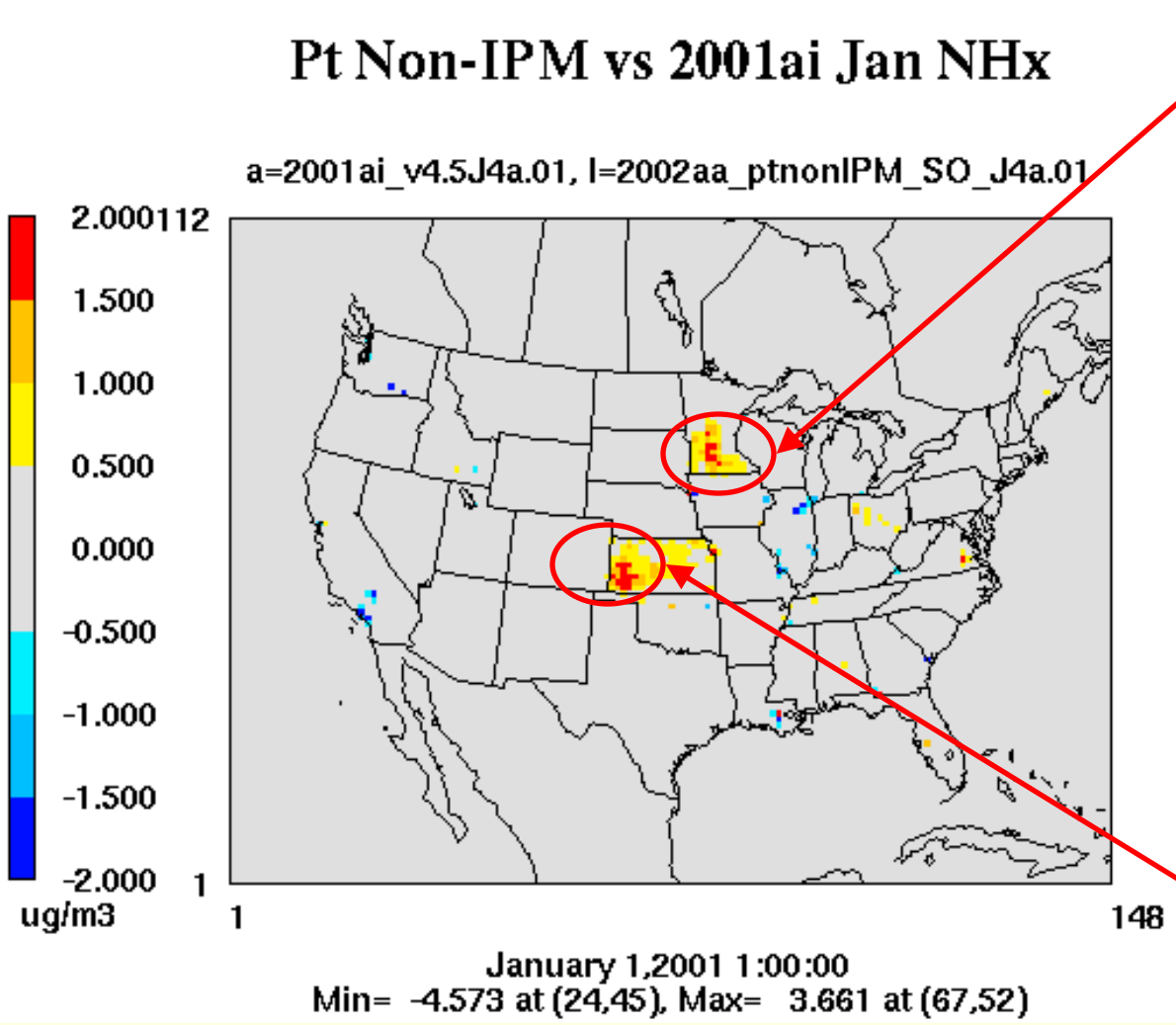
Results: Non-point and Ag Shakeout



NY: (same) ERROR- stationary residential combustion emissions

KS: (same) area as increased NO_3 concentrations

Results: PtnonIPM Shakeout



MN: The “answer”! ….

KS and MN reported farms in 2002 point inventory;
these are in the non-point inventory in 2001: hence shakeout really not apples-to-apples here as these sources have changed inventories!

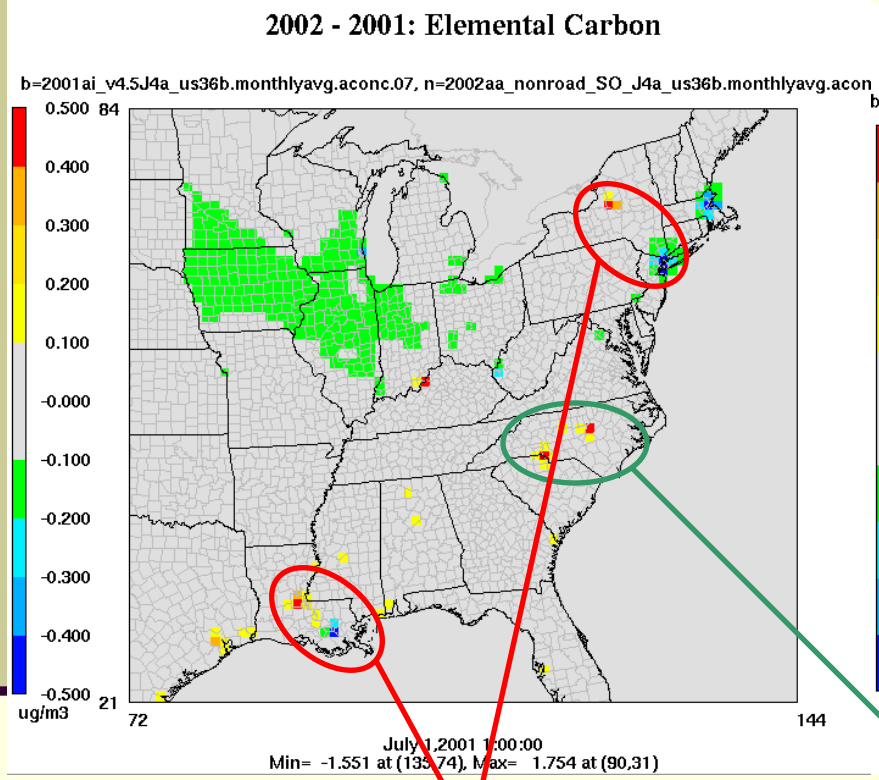
KS: (same) area as DECREASED NO_3 concentrations from non-point & ag shakeout

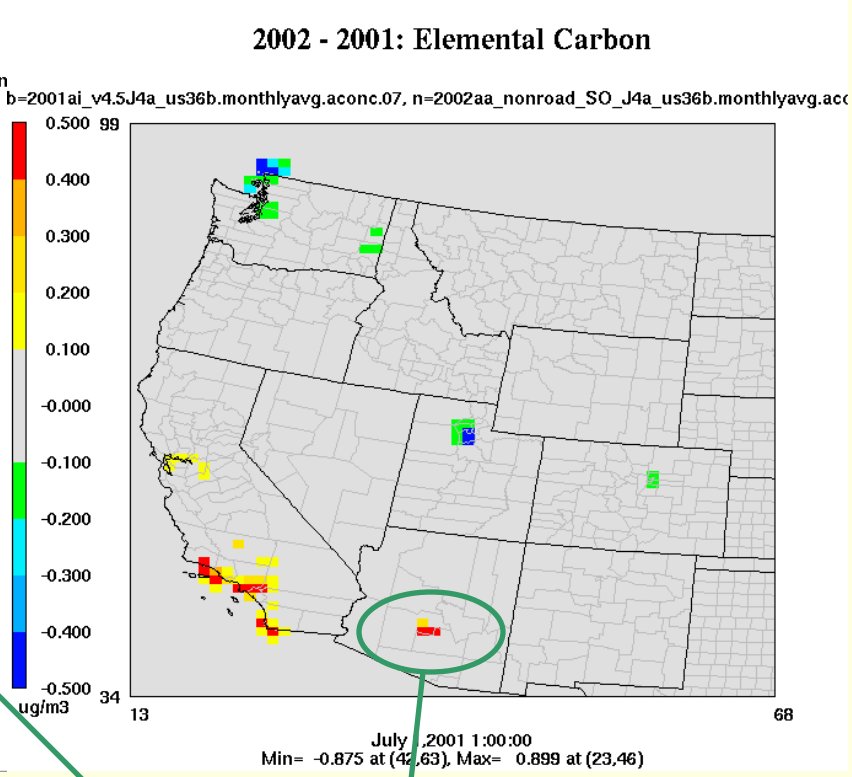
Select SCC Tier Emissions Comparisons

SCC Tier	Description	sector	st	NH_3 2001	NH_3 2002	NH_3 Delta	$PM_{2.5}$ 2001	$PM_{2.5}$ 2002	$PM_{2.5}$ Delta
302	Ind. Procs; Food & Ag	ptnonipm	KS	2	57,611	57,609	454	396	-59
2801	Ag Production – Crops	ag	KS	37,290	63,994	26,704	0	0	0
2801	Ag Production – Crops	nonpt	KS	0	11,436	11,436	4,672	75,108	70,436
2805	Ag Production – Livestock	ag	KS	96,168	33,381	-62,787	0	0	0
302	Ind. Procs; Food & Ag	ptnonipm	MN	0	25,934	25,934	858	646	-212
2805	Ag Production – Livestock	ag	MN	101,460	72,405	-29,055	0	0	0

Still investigating the RPO-submitted PM for crop burning (SCC=2801500170); for most counties, this SCC does NOT contain both NH_3 and $PM_{2.5}$

Results: Nonroad Shakeout





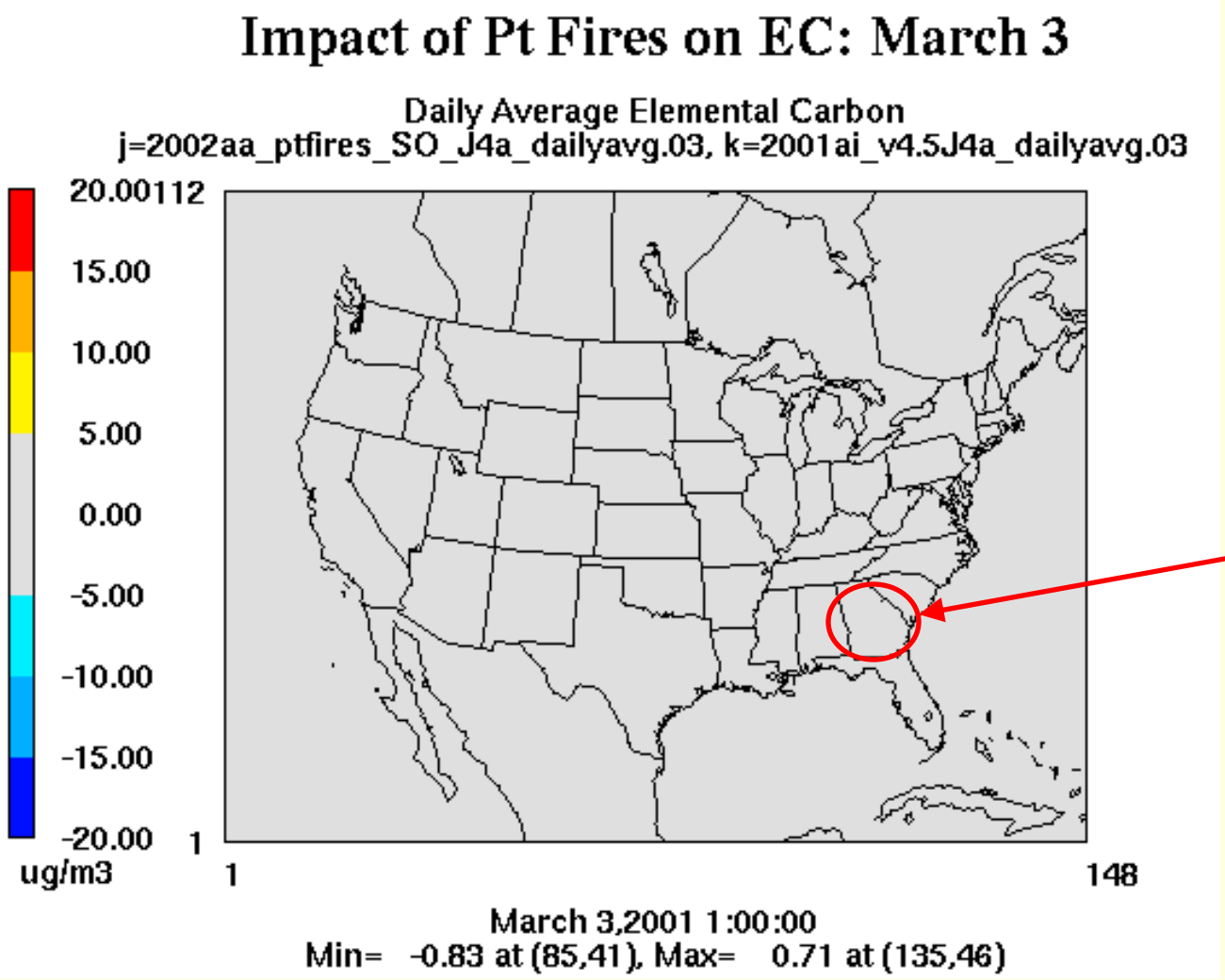
misallocated ports in 2002 V1, fixed much earlier for 2001, and fixed for subsequent versions of the 2002 NEI ALM sector

Kept: state-reported aircraft in 2002

Results: Ptfire Shakeout

- Most challenging from a QA perspective because the format and content are so different in 2002:
  - day-specific
  - discretely located
  - wildfire & Rx burning containing new information to improve spatial –particularly vertical- distribution of each fire: acres burned, fuel loading & heat content
- Expected, and did, find more localized and temporally-refined peaks and minimums in predicted air quality concentrations

Results: Ptfire Shakeout



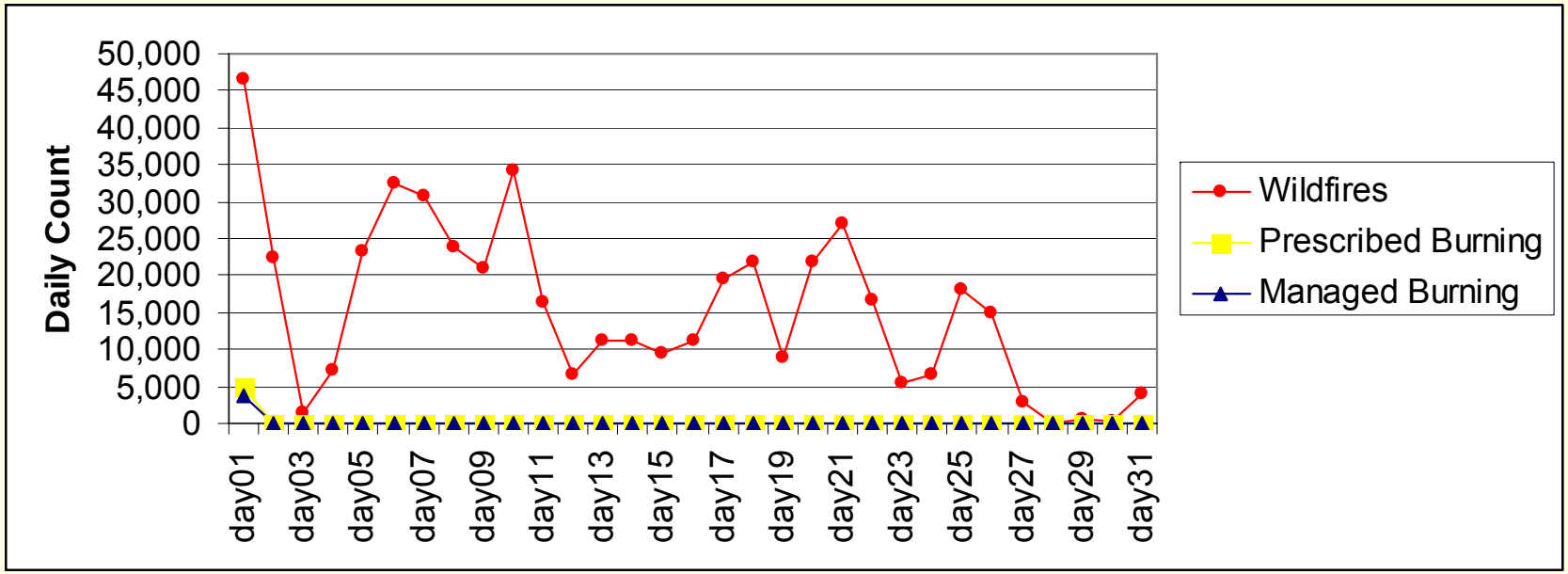
Daily Impacts, Feb 28th - March 3rd

Differences in Ptfire Shakeout EC (elemental carbon) concentrations

Investigate Georgia Fires in March

Results: Ptfire Shakeout

March Fire Counts in Georgia 2002 Ptfire Inventory



Found that all Prescribed (and managed) burning emissions in Georgia were assigned to the first day of each month, and were being placed at the county centroids

These fires were therefore reformatted into the SMOKE area format and modeled as “nonptfire” sector, with monthly temporal factors

Conclusions

- 2002 Shakeout was a successful part of the development of the 2002 Emissions Modeling Platform:
  - Helped us identify inventory errors in the first version of the 2002 NEI, which were corrected in subsequent versions;
  - We became more familiar with certain characteristics of the inventory that relate to the ancillary files used for processing/summarizing emissions;
  - Inventory fixes sometimes get lost (ports) in new base years

Conclusions (cont.)

- We also caught some inventory errors as part of the emissions shakeout that were not evident in the modeled concentrations (and vice versa)
- More point data, more state-reported data = potentially large changes in AQM estimated concentrations
- Serendipitous discovery of SMOKE and inventory errors in ptfire shakeout
- Result is an improved inventory, and greater understanding of the characteristics of the 2002 emissions data

Disclaimer

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