

Modeling to Support BART

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BART Determination Process

- Step 1: Identify BART-eligible sources *[States]*
- **Step 2: Determine which BART-eligible sources are subject to BART** *[States/LADCO/MACTEC]*
 - Sources which are *reasonably anticipated to cause or contribute to visibility impairment in any Class I area*
- Step 3: For sources subject to BART, conduct engineering analysis of emissions control alternatives *[MACTEC]*
- Step 4: Perform cumulative air quality analysis (assess degree of visibility improvement due to emission reductions from all sources subject to BART) *[LADCO]*
- Step 5: Based on engineering analysis and air quality analysis, establish BART emission limitations. *[States/MACTEC?]*

Determining which BART-eligible sources are subject to BART

USEPA BART Proposal (May 5, 2004):

1. Assume all BART-eligible sources cause or contribute to visibility impairment in a Class I area
2. Demonstrate (via modeling) that all BART-eligible sources do not cause or contribute to visibility impairment in any Class I area
3. Consider individual contributions of each BART-eligible source
 - a. Preferred Option: **Refined** CALPUFF modeling
 - b. Alternative Options: **Screening** CALPUFF modeling, look-up tables (based on CALPUFF), source ranking, and Q/d method

How are we determining which BART-eligible sources are subject to BART?

- EGUs (no action at this time)
 - USEPA BART Proposal (May 5, 2004): *“we believe the IAQR, as proposed, is clearly better than BART for those affected EGUs in the affected States which we propose to cover under the IAQR. We thus expect that the final IAQR would satisfy the BART requirements for affected EGUs...”*
- Non-EGUs (handful of facilities under review)
 - Screening (Q/d): 25 non-EGU sources (facilities) have Q/d > 10 in at least one Class I area (MACTEC will address 23 of these sources)
 - **Modeling (CALPUFF and CAMx)**

***CALPUFF Modeling to
Support BART Analysis***

CALPUFF BART Modeling

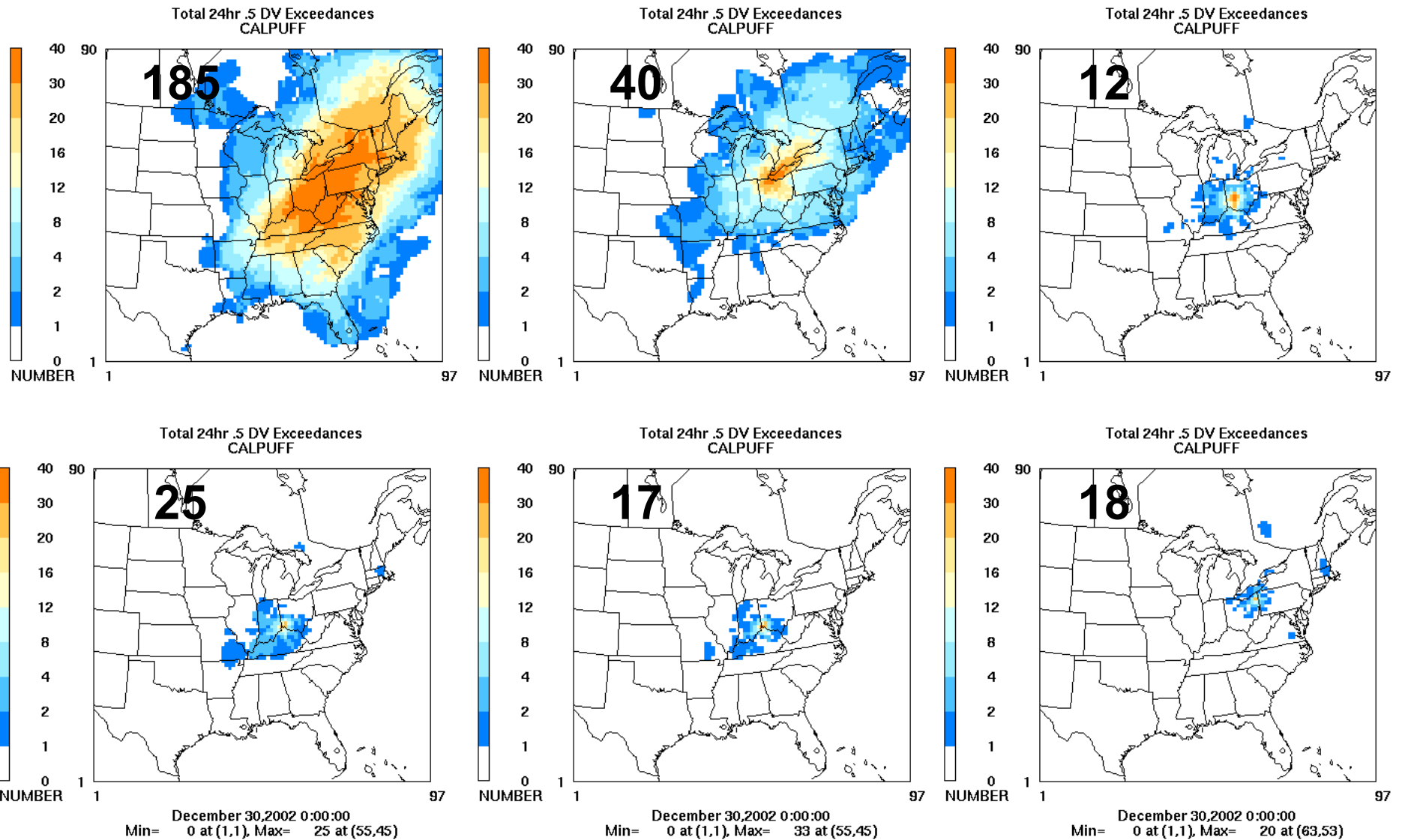
- Annual 2002 Simulations using latest version of CALPUFF (incl. POSTUTIL and CALPOST)
- Meteorological input data is hourly and from an annual 2002 MM5 simulation
- Grid is consistent with photochemical model grid: 97 X 90 x 16 (36km grid cells) over Eastern U.S.
- Selected top 25 Q/D non-EGU sources (Q/D > 10)
- Multiple facility emissions and stack parameters were averaged; some States used more realistic values in place of average values
- Annual average emissions were used; some States used 2-month averaged emissions

CALPUFF BART Modeling

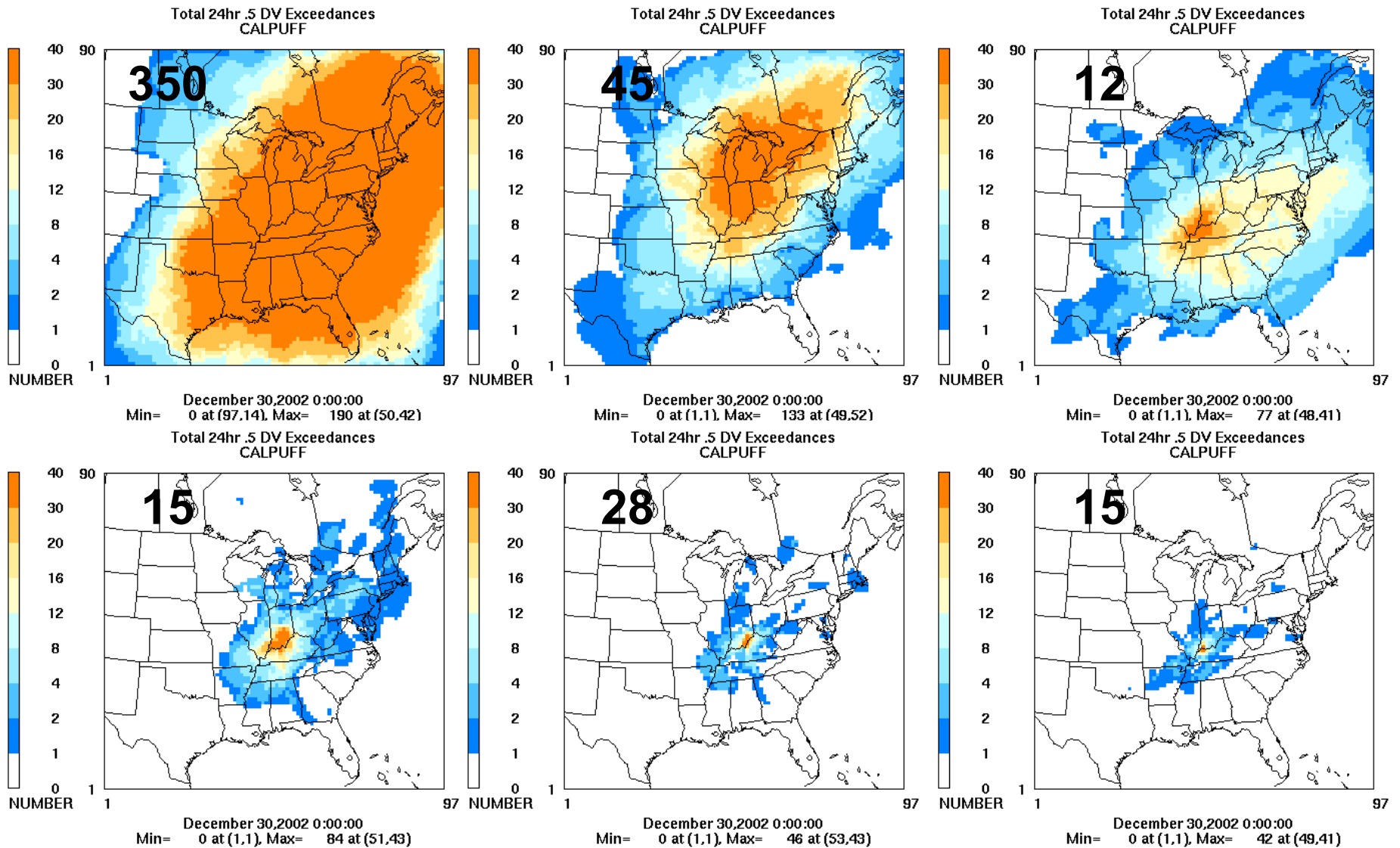
- Results show the **number of times** each grid cell exceeds the 24hr average .5 DV degradation over “background” visibility
- Results are the combined visibility degradation from sulfate and nitrate
- These are not “refined” modeling runs; these runs were facility total actual emissions (screening runs)

Non-EGU CALPUFF Simulations

Ohio Sources (6)



Non-EGU CALPUFF Simulations Indiana Sources (6)



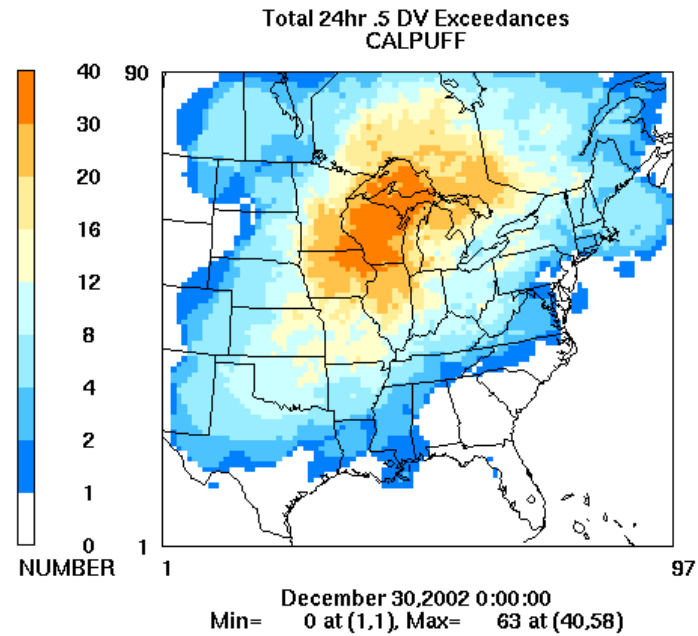
CALPUFF Sensitivity

- Sensitivity simulation for visibility calculation parameter BCKNH3
- Background ammonia concentrations (same value for entire domain for entire year)
- Important parameter in CALPUFF estimation of PM2.5 nitrate

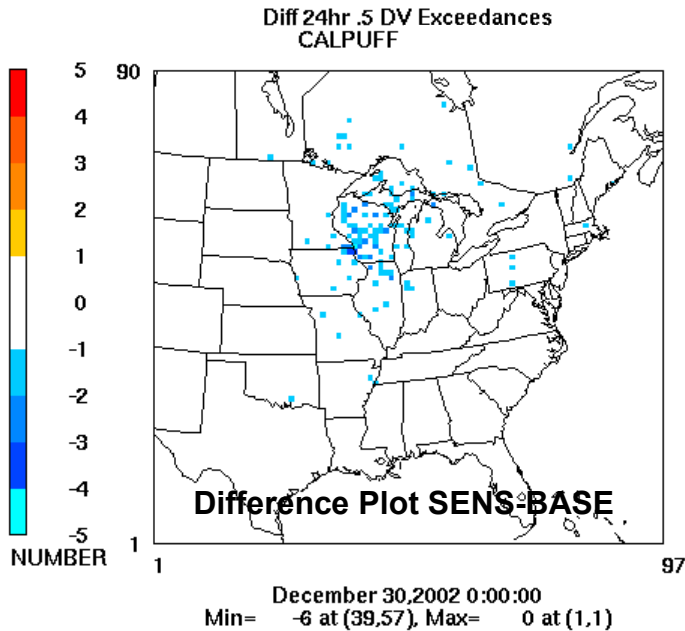
CALPUFF Sensitivity:

BCKNH3 = 1.0 (basecase/default)

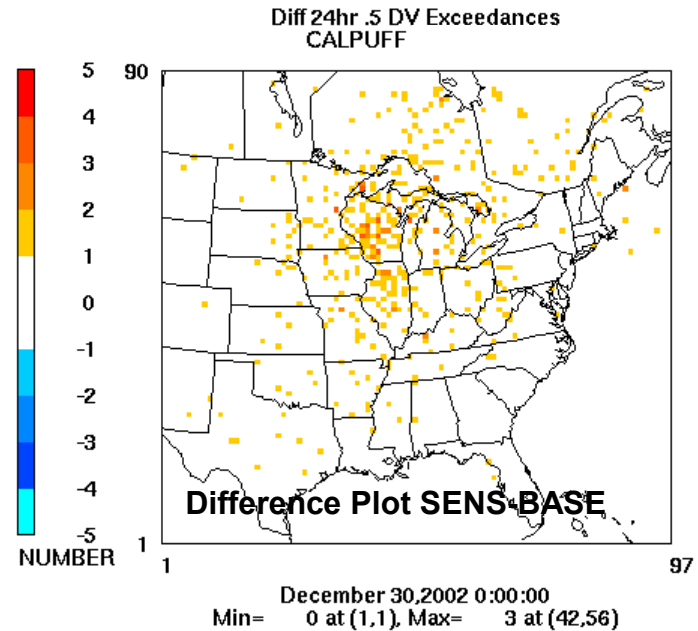
BCKNH3 = 0.5 and 1.5



Ammonia Conc SENS (NH3=0.5)



Ammonia Conc SENS (NH3=1.5)



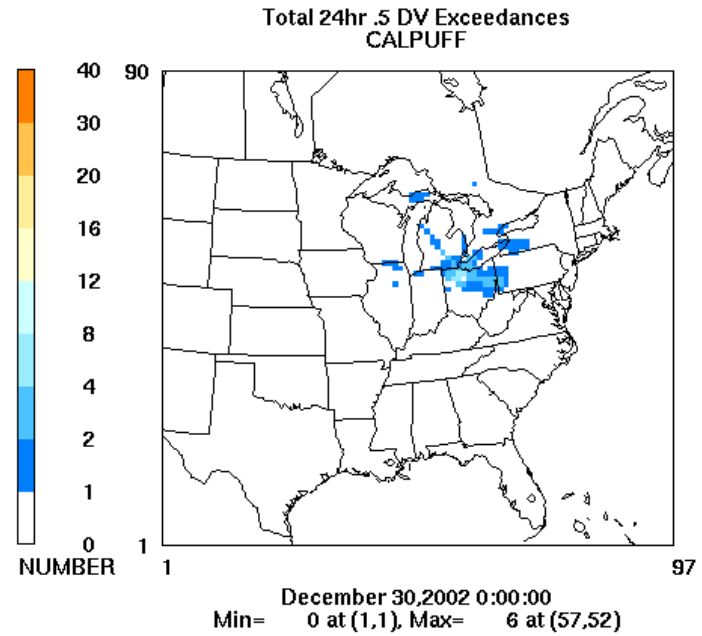
CALPUFF Sensitivity

- Sensitivity simulation for visibility calculation parameter RHMAX
 - fRH value based on daily RH and the fRH curve
 - Not consistent with monthly fRH values used for regional haze analysis
 - fRH curve capped at RHMAX=90 for basecase

CALPUFF Sensitivity:

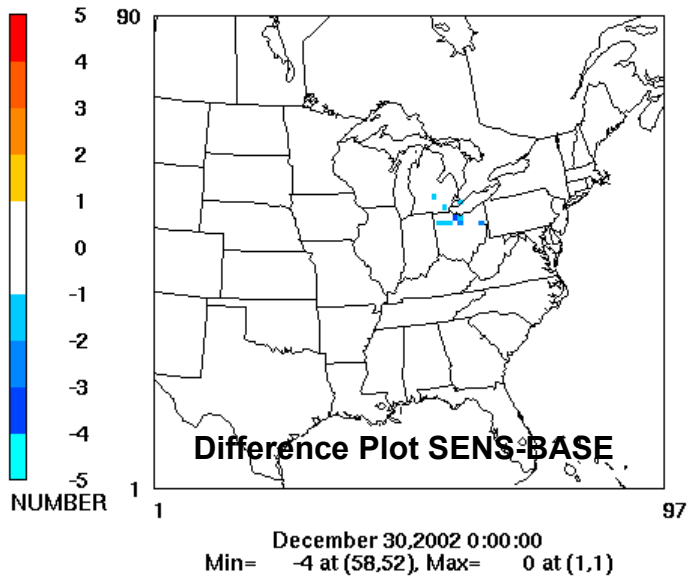
RHMAX = 90 (basecase)

RHMAX = 85 and 95 (default)



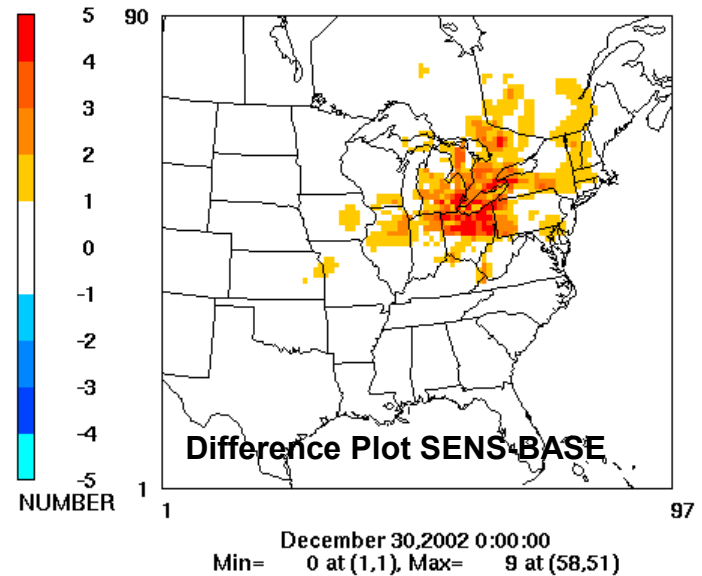
RHMAX SENS [85-90]

Diff 24hr .5 DV Exceedances
CALPUFF ()



RHMAX SENS [95-90]

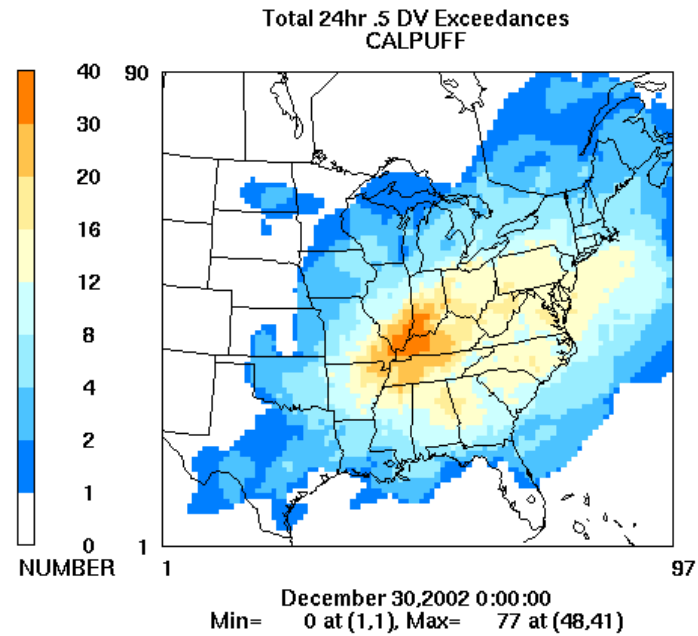
Diff 24hr .5 DV Exceedances
CALPUFF ()



CALPUFF Sensitivity:

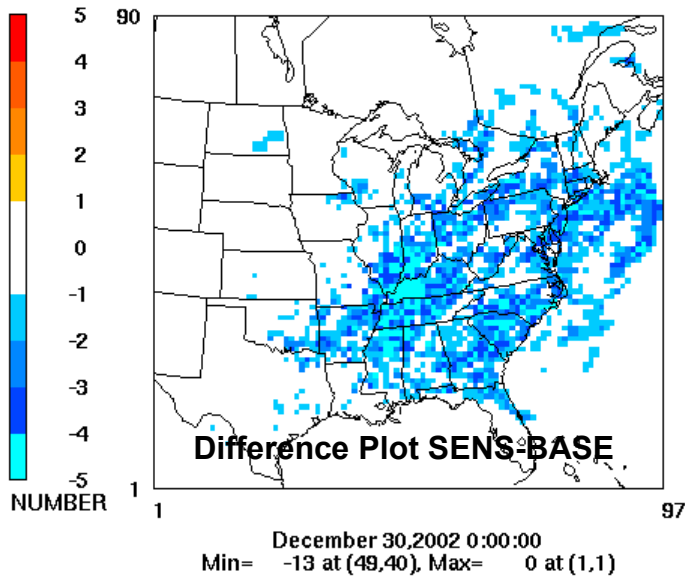
RHMAX = 90 (basecase)

RHMAX = 85 and 95 (default)



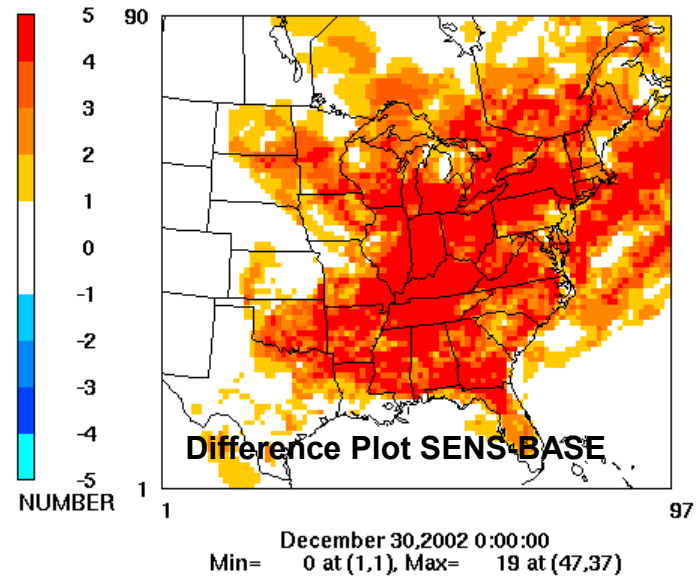
RHMAX SENS [85-90]

Diff 24hr .5 DV Exceedances
CALPUFF (



RHMAX SENS [95-90]

Diff 24hr .5 DV Exceedances
CALPUFF (



Conclusions

- Multiple CALPUFF runs and annual CALMET files seem to be a large burden for standard State office Windows systems
- Visibility results very sensitive to RHMAX value
- Visibility results minimally impacted by the background ammonia concentration values selected in these sensitivity runs
- More investigation of the results are needed to ensure some $>.5$ DV changes were not due to winter sulfate and summer nitrate

***CAMx4 Particulate Source
Apportionment (Sulfate)***

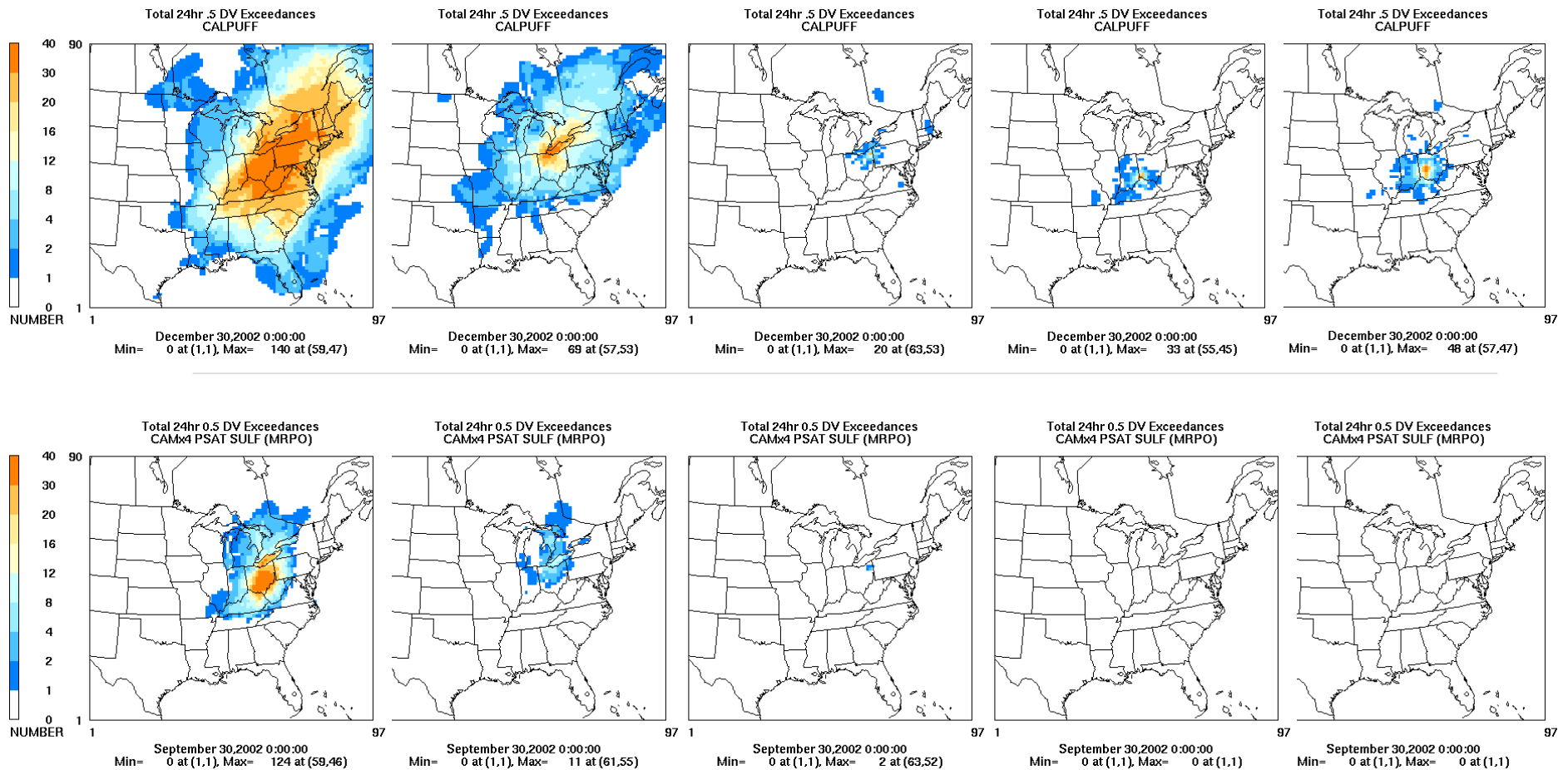
CAMx4 PSAT

- Applied CAMx4 PSAT sulfate for top 25 *non-EGU* BART facilities in the MRPO
- Applied sulfate PSAT to April-Sept 2002
- These results do not show the impact from nitrate
- We assume that visibility degradation is dominated by summer sulfate
- Model simulations took ~3.5 hrs/episode day (21 regions * 3 groups) compared to ~1.15 hrs/episode day for a regular model run (1 region * 1 group)

CAMx4 PSAT

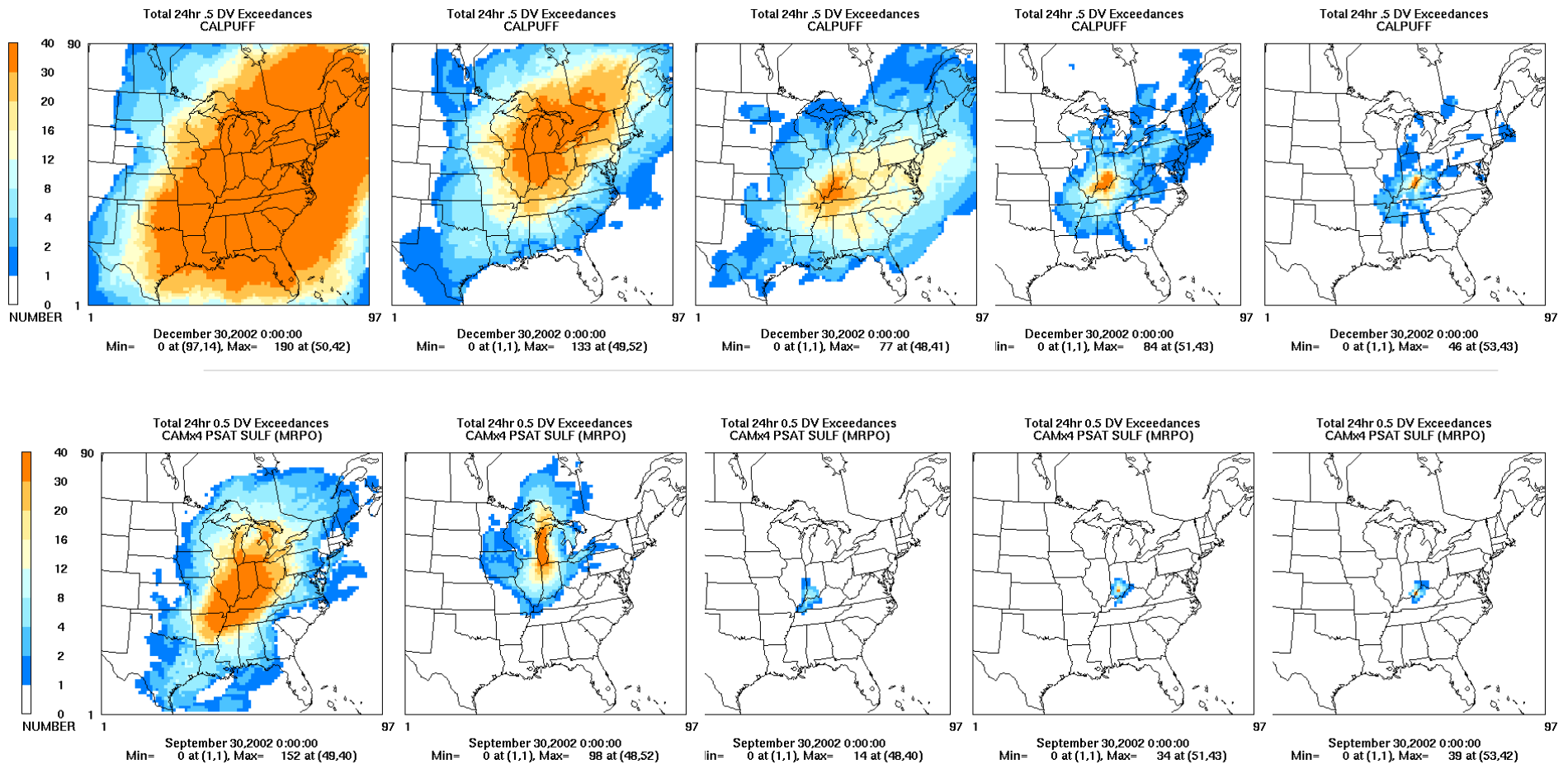
- Results for each facility are shown similar to CALPUFF results: counts of $> .5$ DV change over natural background conditions
- fRH values derived using daily average relative humidity in the grid cell as predicted by MM5 and calculated using the exact same look-up table that is used in CALPOST; the maximum daily average RH is 90
- This is the first attempt to apply PSAT to track many individual facility emissions

Total 24hr avg .5 DV Exceedances CALPUFF (top) CAMx4 PSAT (bottom)



**CALPUFF includes sulfate+nitrate and CAMx4 includes sulfate*

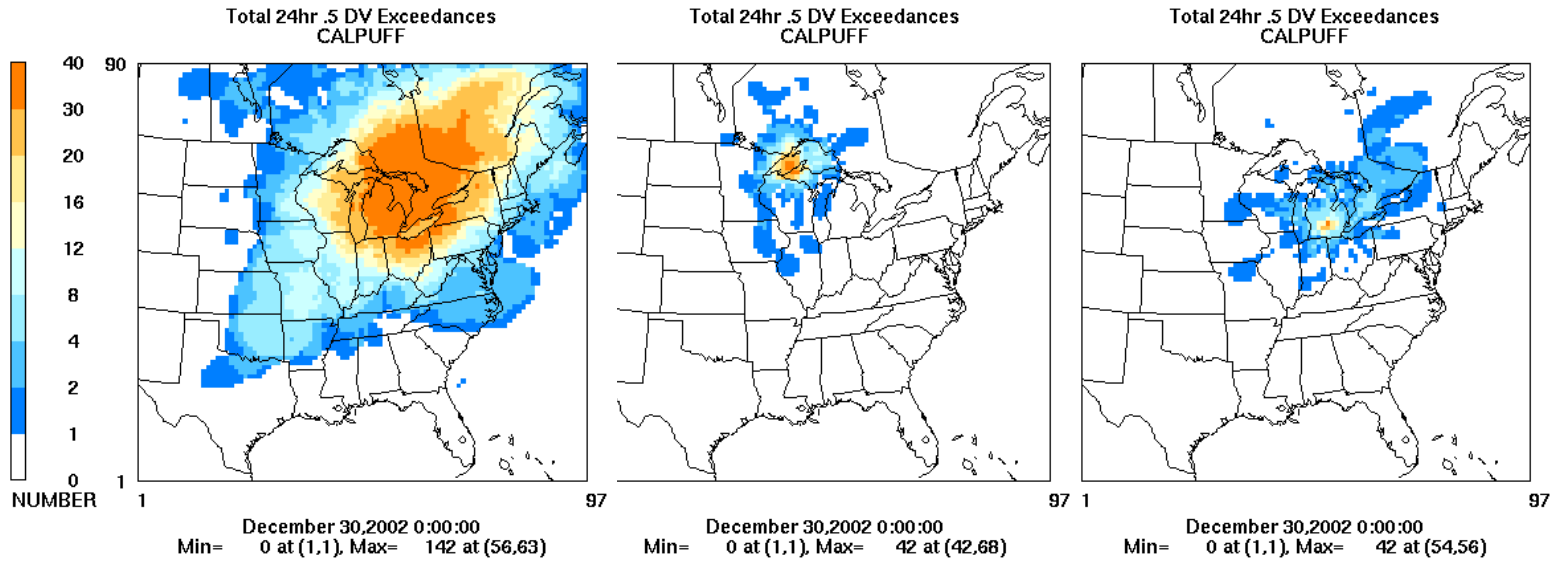
Total 24hr avg .5 DV Exceedances CALPUFF (top) CAMx4 PSAT (bottom)



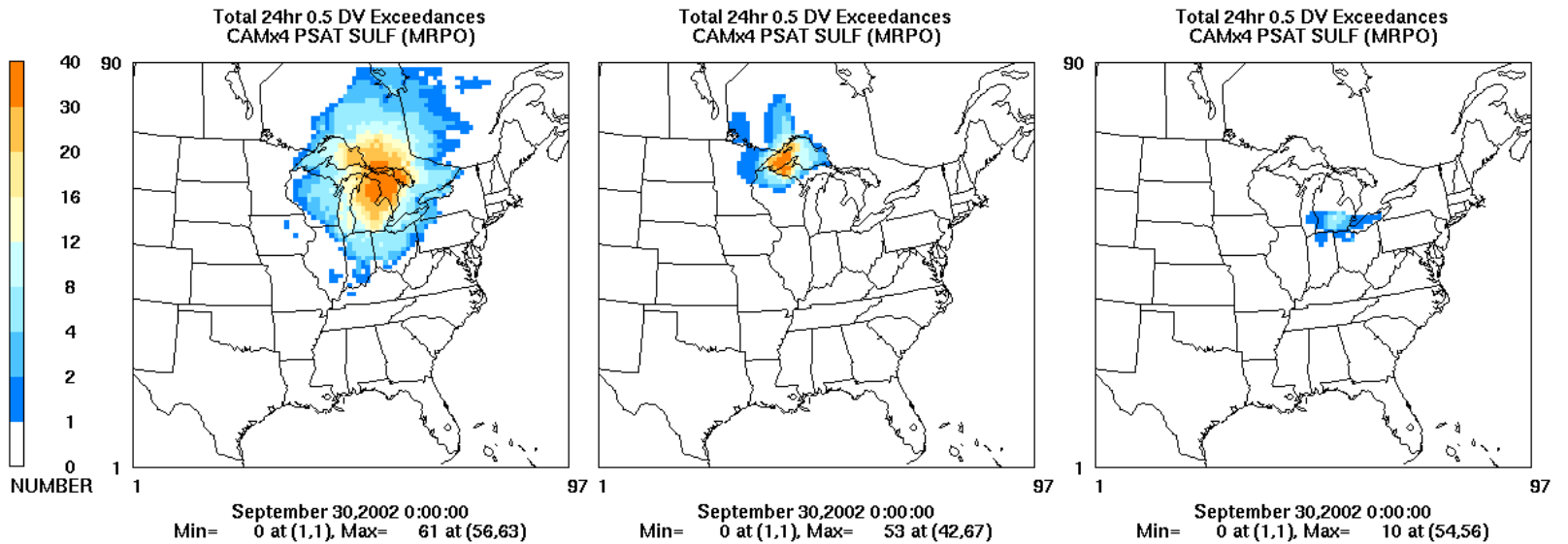
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Total 24hr avg .5 DV Exceedances CALPUFF (top) CAMx4 PSAT (bottom)

**CALPUFF
Results →**



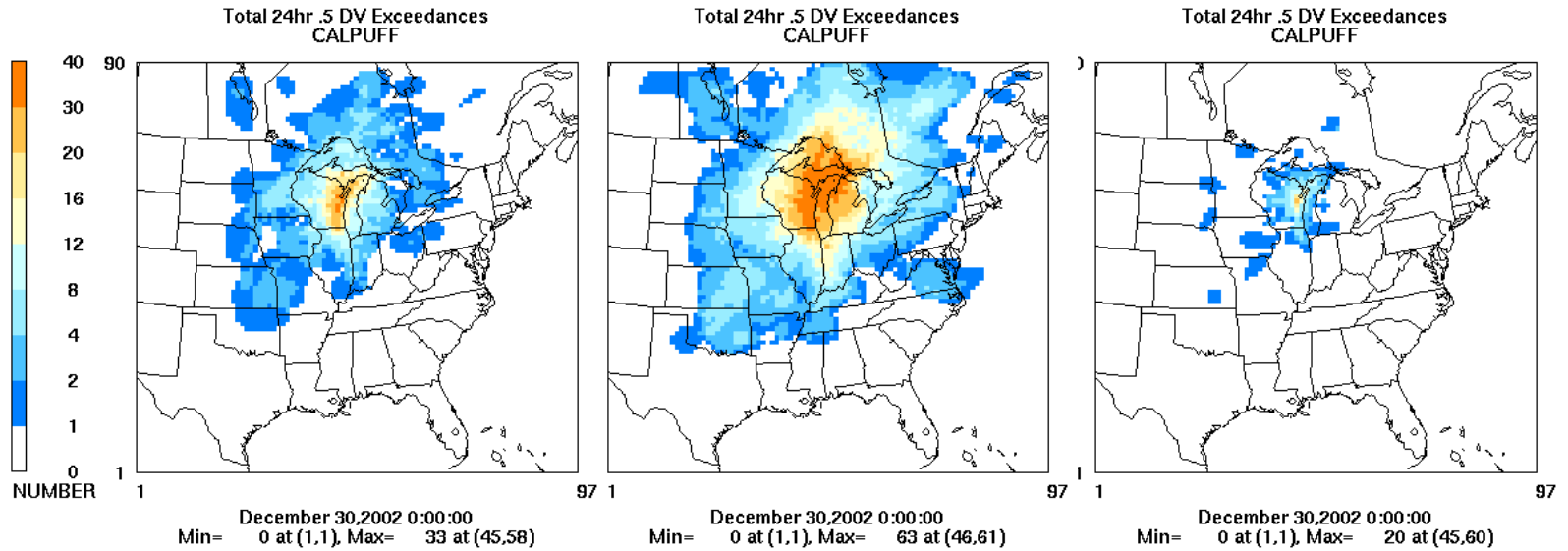
**CAMx4
PSAT
Results →**



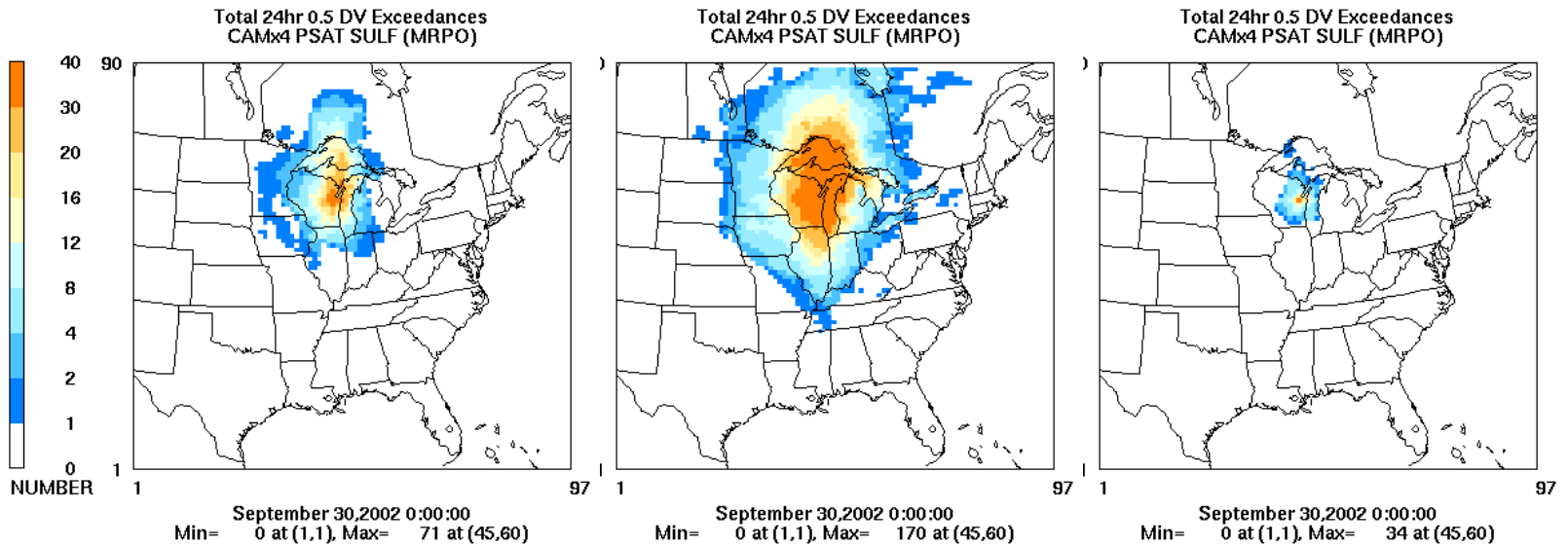
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**CALPUFF
Results →**



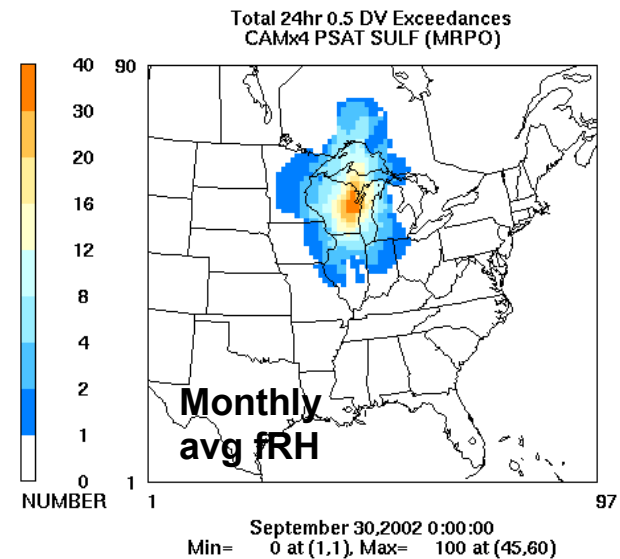
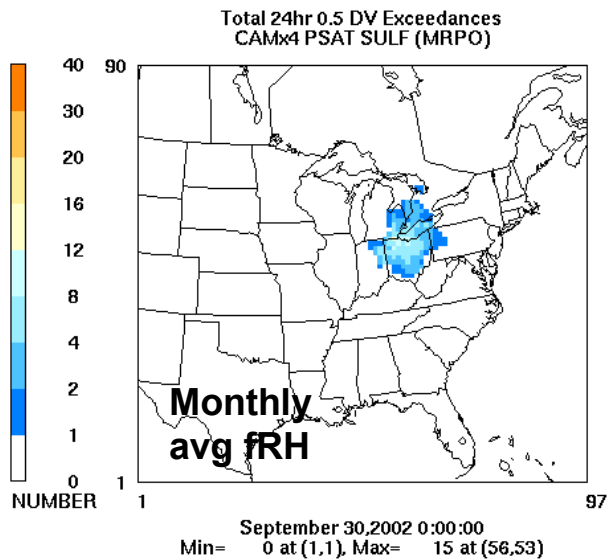
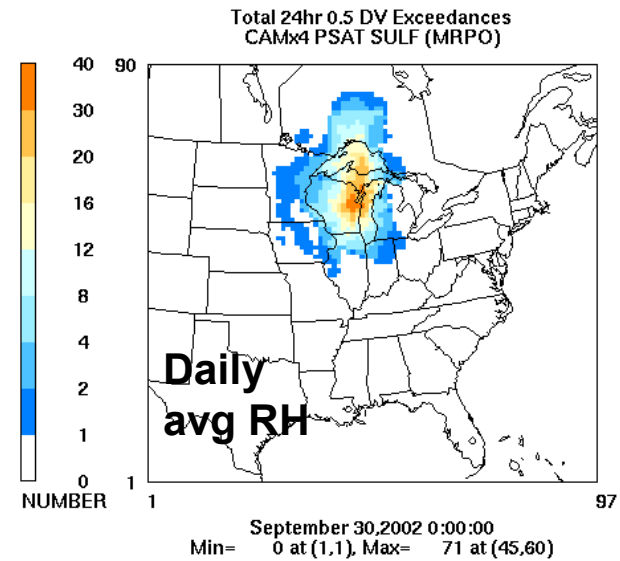
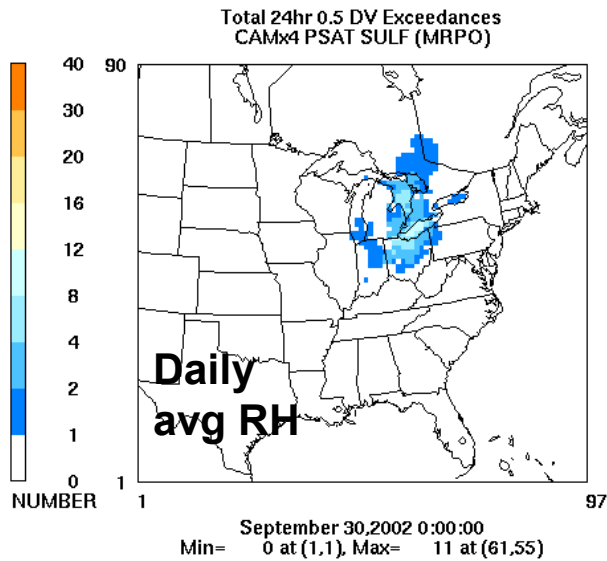
**CAMx4
PSAT
Results →**



**CALPUFF includes sulfate+nitrate and CAMx4 includes sulfate*

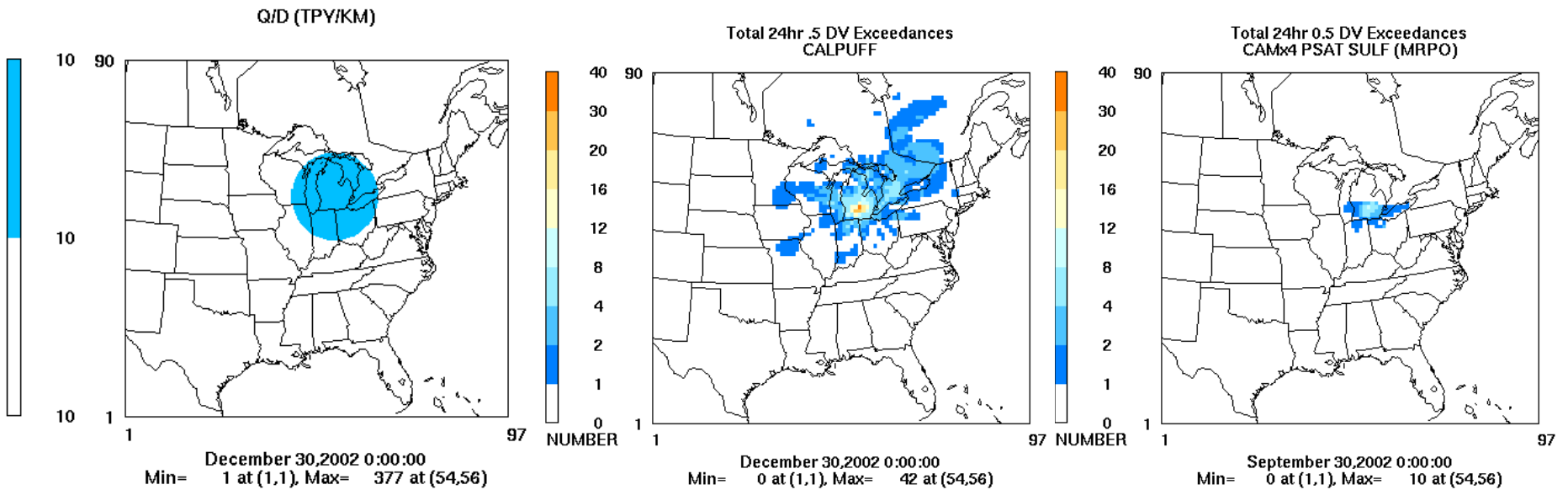
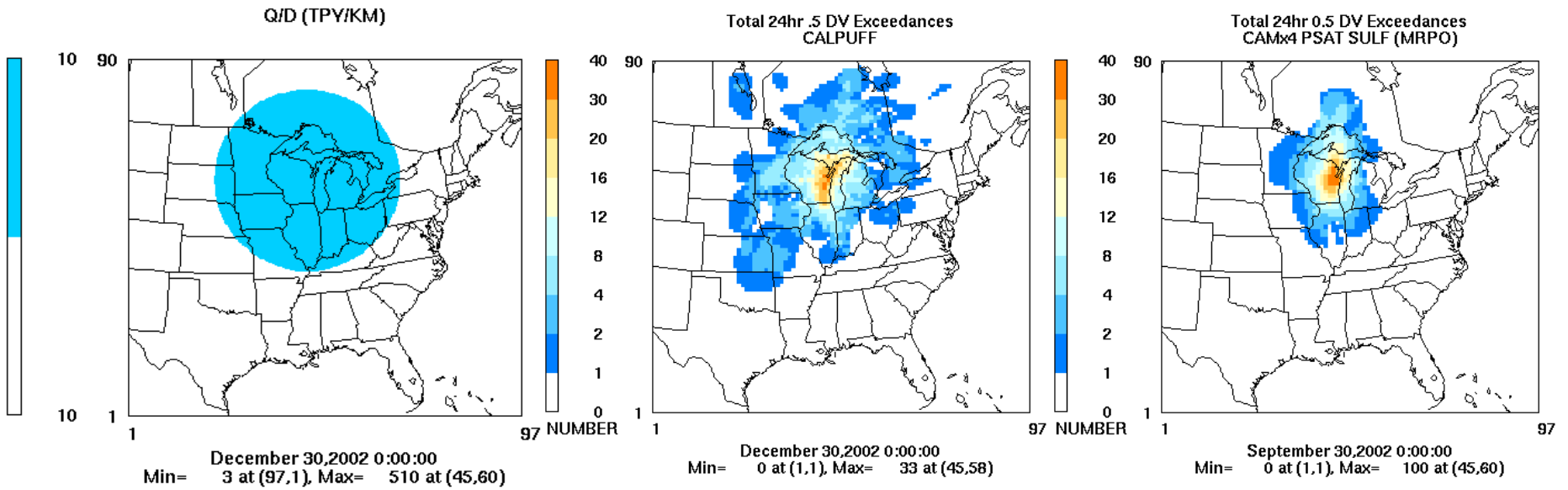
PSAT Results:

fRH calc from 24-hr RH v monthly gridded fRH values



Q/D Method v. CALPUFF Results v. CAMx4 PSAT

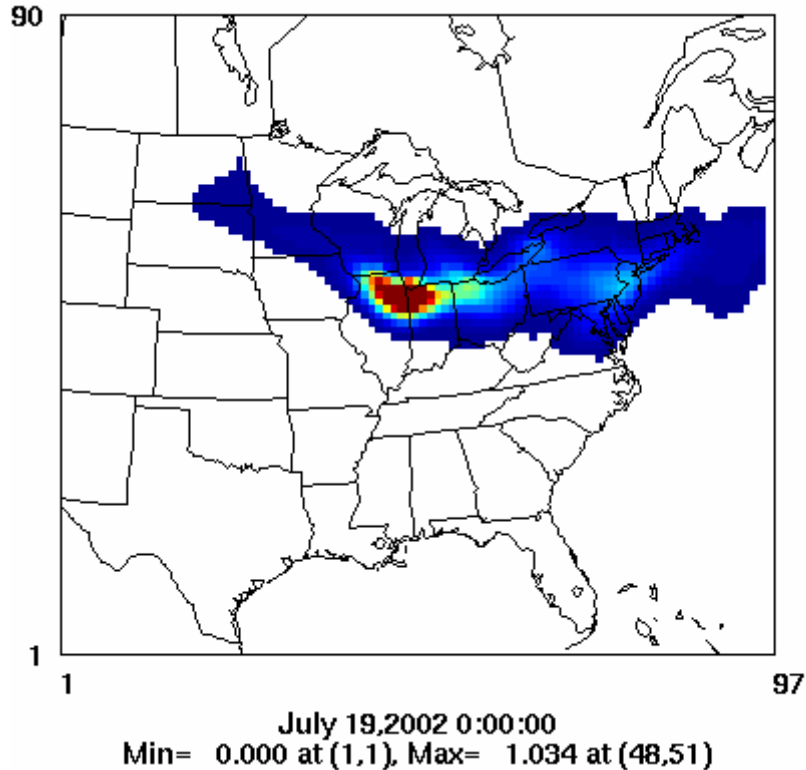
*(sulfate only)



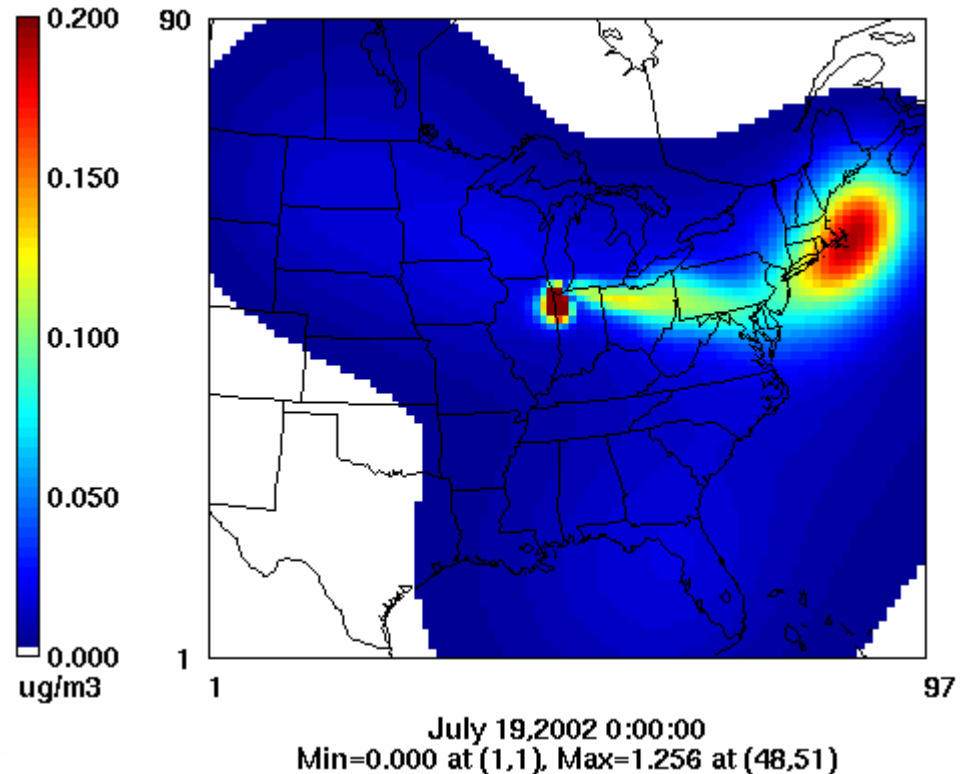
July 19, 2002 24-Hour SO₄ Concentrations

CALPUFF much higher concentrations away from source. Why secondary CALPUFF SO₄ peak over Cape Cod?

CAMx PSAT



CALPUFF



Conclusions

- Similar spatial patterns for all methods; CAMx4 PSAT results do not show visibility degradation as far downwind as CALPUFF
- Need to consider nitrate PSAT runs for better comparison although visibility degradation is expected to be dominated by summer sulfate
- The screening tools agree fairly well: CALPUFF and Q/D
- The screening tools agree fairly well with the CAMx PSAT results for certain facilities but not all of them
- Impacts to visibility appear over-stated in CALPUFF; probably not under-stated

Extra Thanks to...

- Mike Majewski
- Mark Derf
- Joe Scire
- Mike Koerber
- Gary Wilson
- Ralph Morris
- Greg Yarwood