

# **CMAQ Modeling for the CRPAQS winter 2000-2001 PM Episode: Model Sensitivities**

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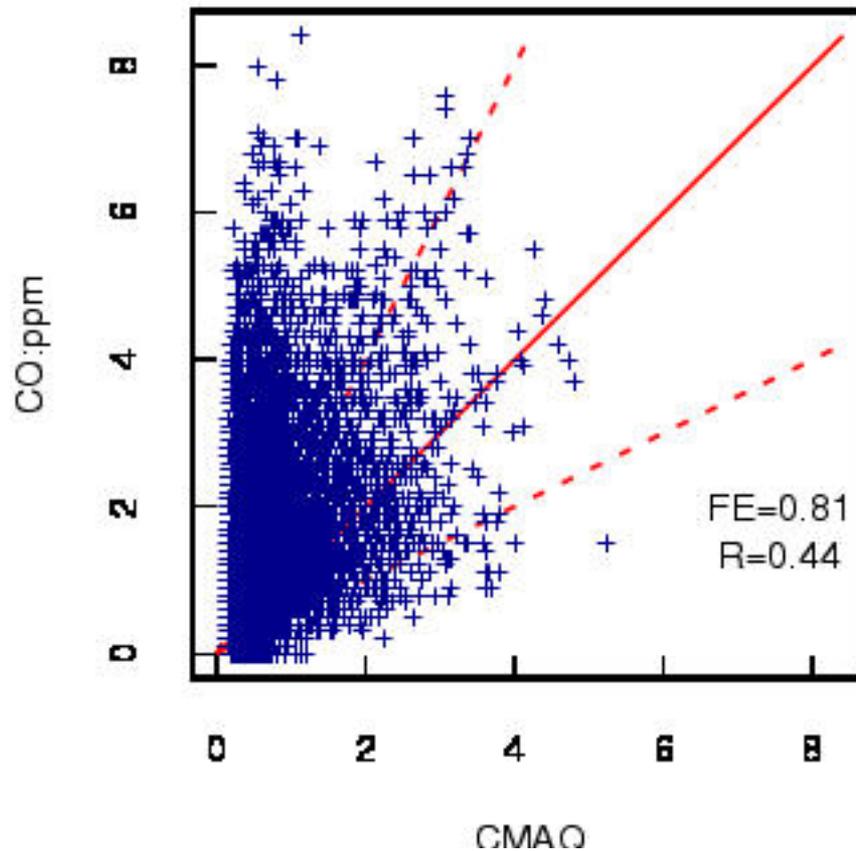
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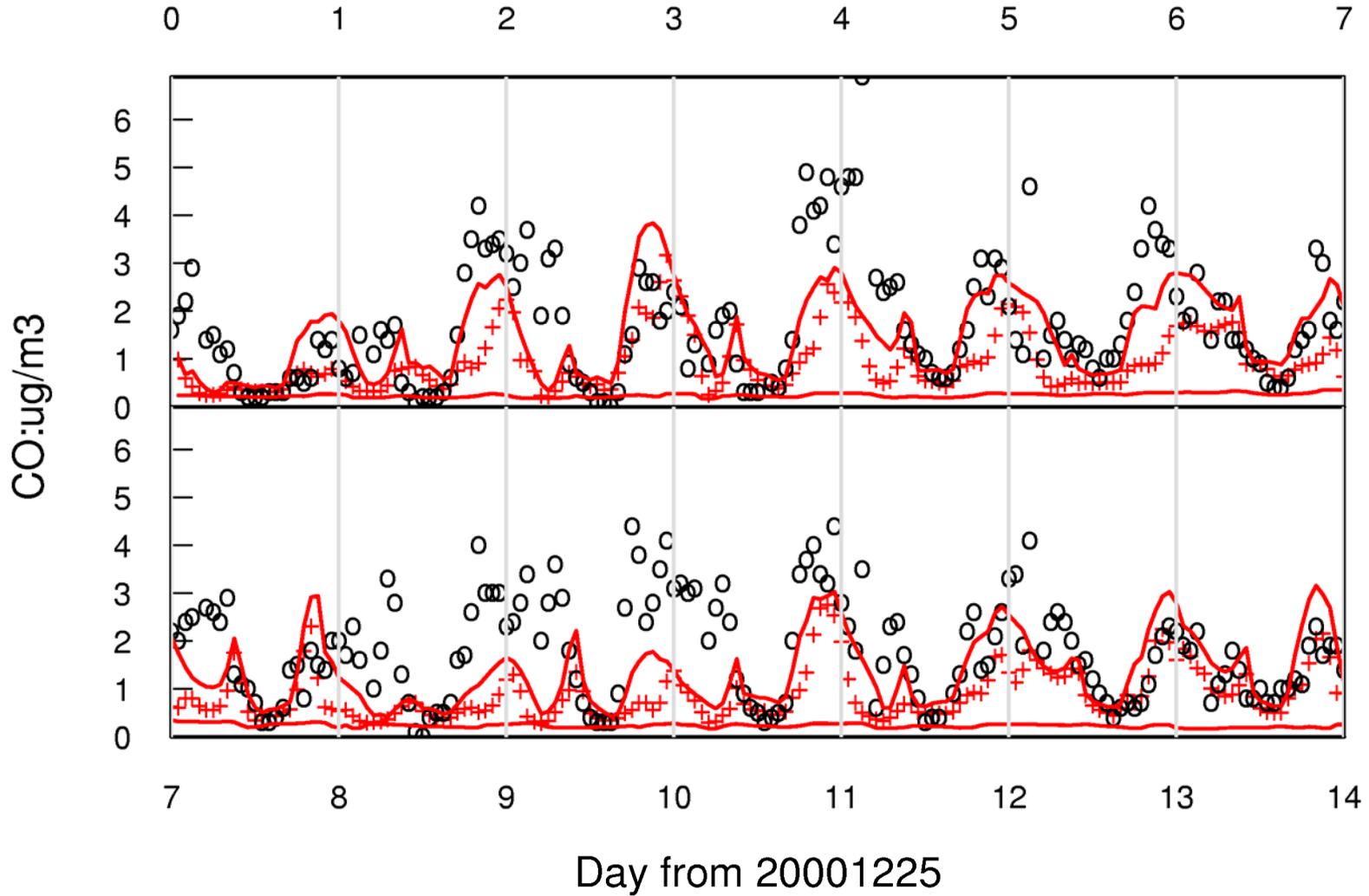
# Outline

- Precursor performance issue: CO
- Angiola model performance at surface and aloft
- Preliminary precursor limitations
- Synthesis

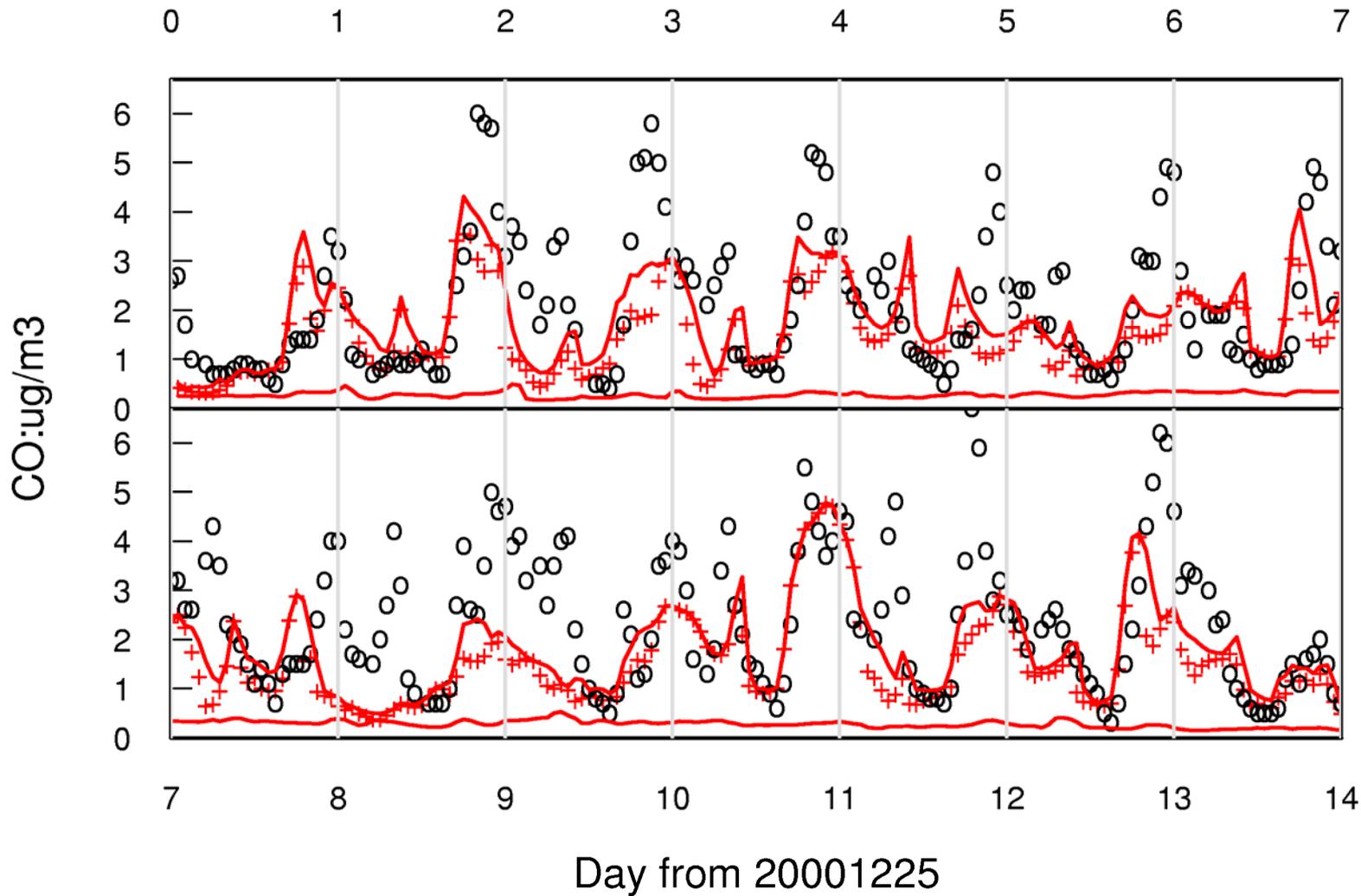
# CO: All Sites



BAC:125:28



FSF:109:66



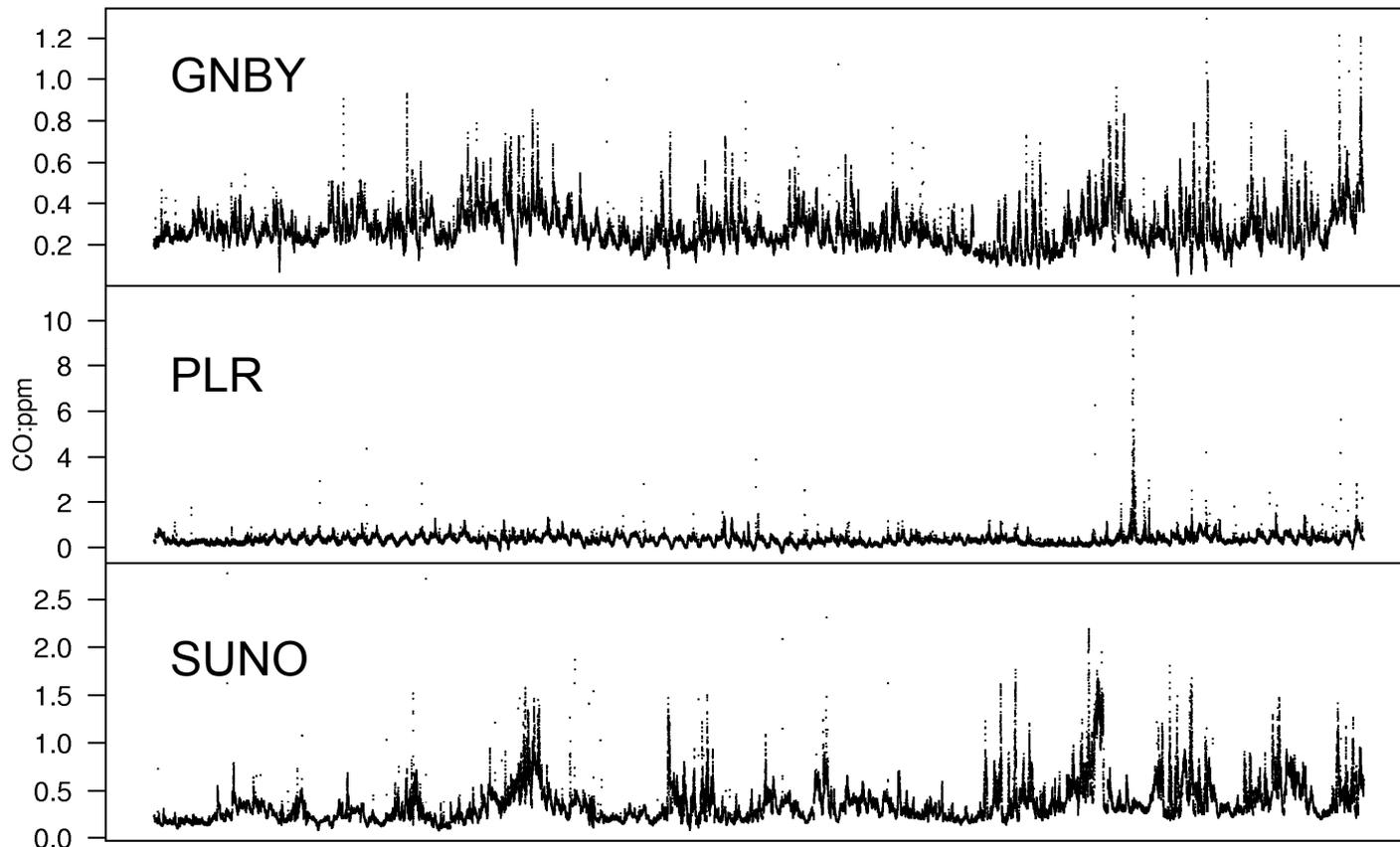
# CO Performance

- General expectation: Since CO is an inert gas, models should be able to predict its concentrations accurately (if inputs such as emissions and meteorology are accurate)
- CMAQ generally under-predicts CO for the CRPAQS episode modeled
  - CO inventory wrong?
  - Meteorology wrong?

# Investigating CO Data

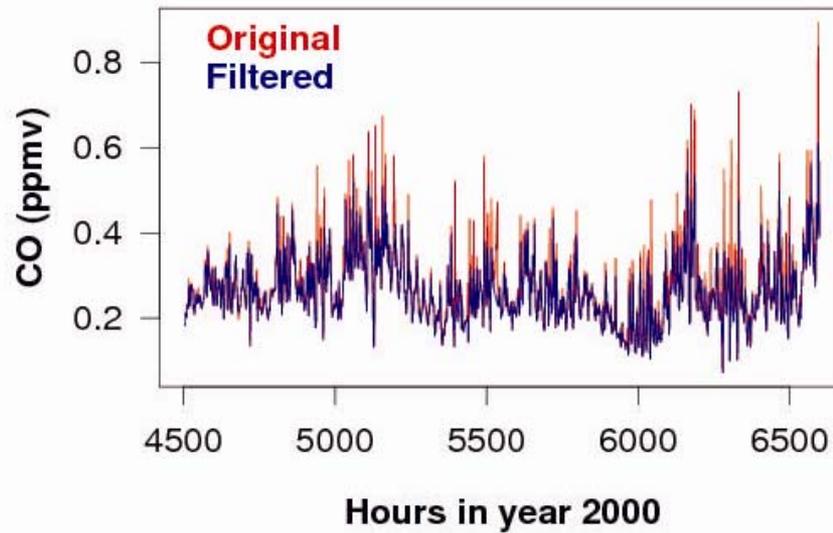
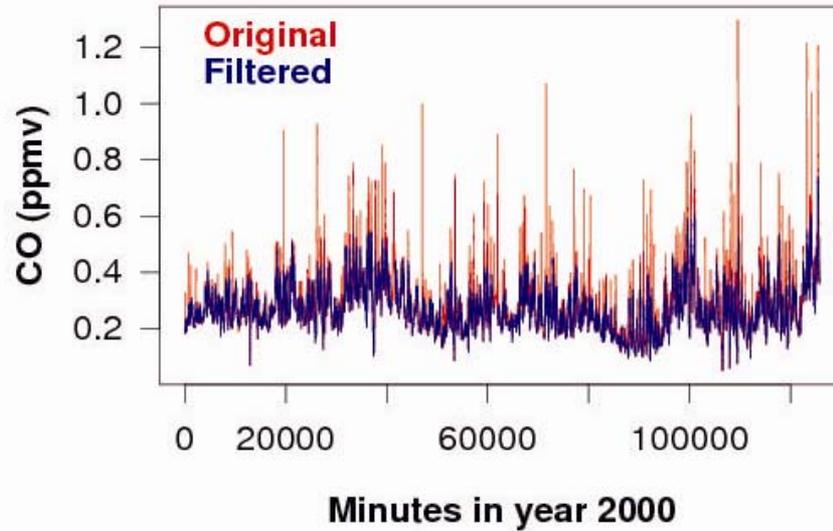
- We looked at monitoring sites to see if they were overly influenced by roadways, etc.
  - Not a trivial exercise
- We looked for high-resolution data
  - No such data for Winter 2000-2001 in CCAQS database
  - Found 1-minute data for Parlier, Granite Bay, and Sunol for Summer 2000
  - Summer 1-minute data has significant noise
    - Used FFT and preserved low frequencies up to twice a day to mimic general emission pattern

# Summer 1-Minute CO Data

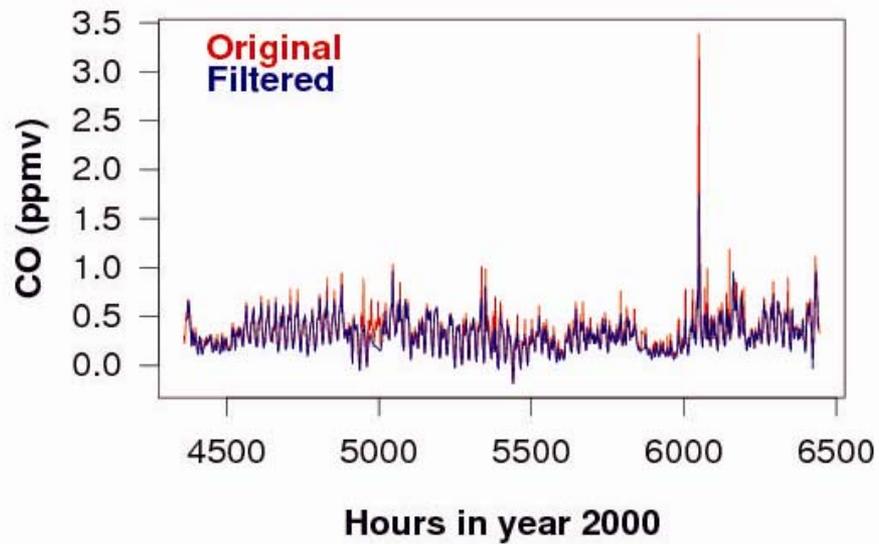
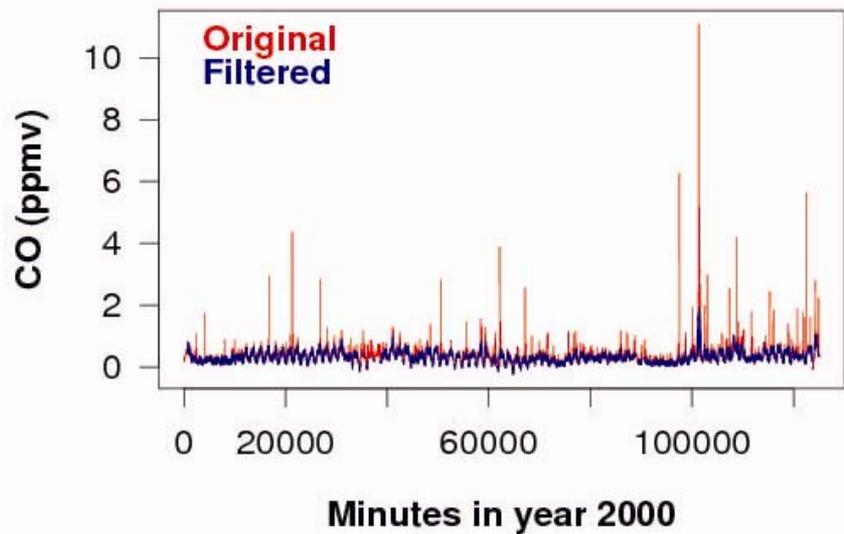


Summer 2000

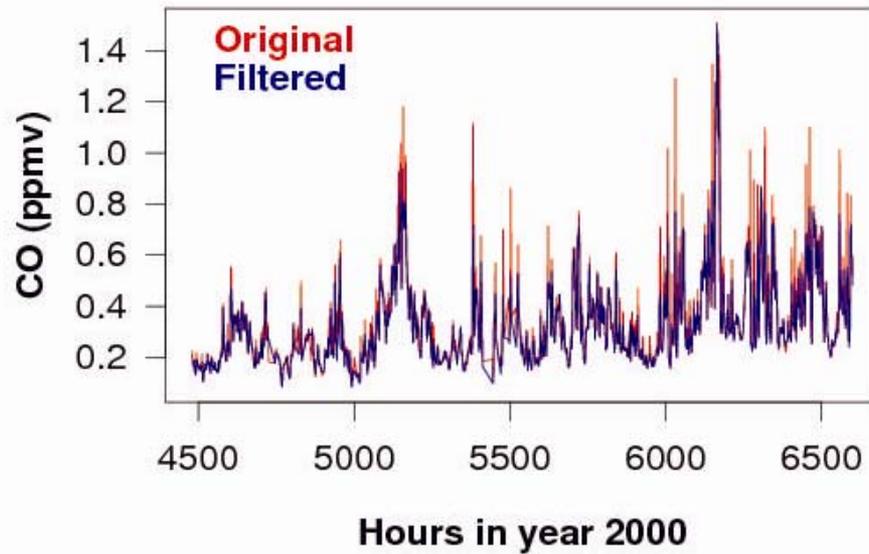
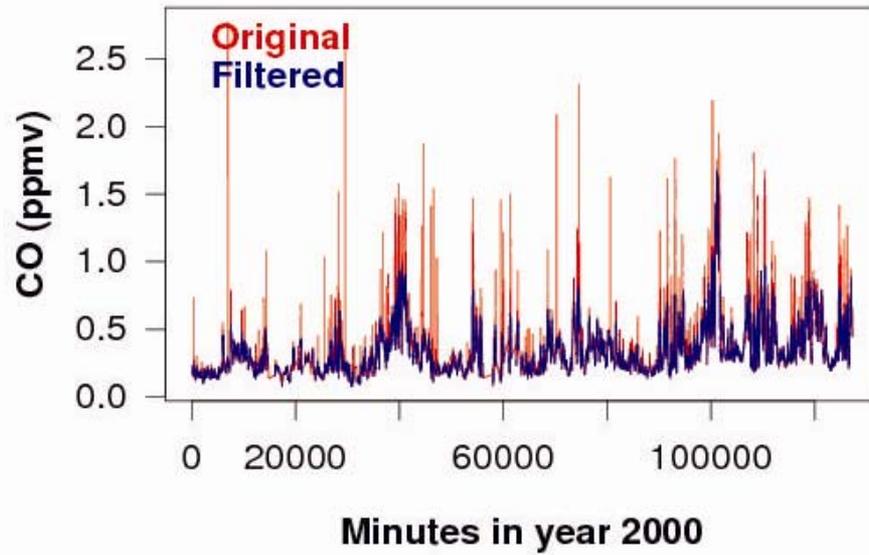
### CO data at GNBV



### CO data at PLR



### CO data at SUNO



# CO Implications

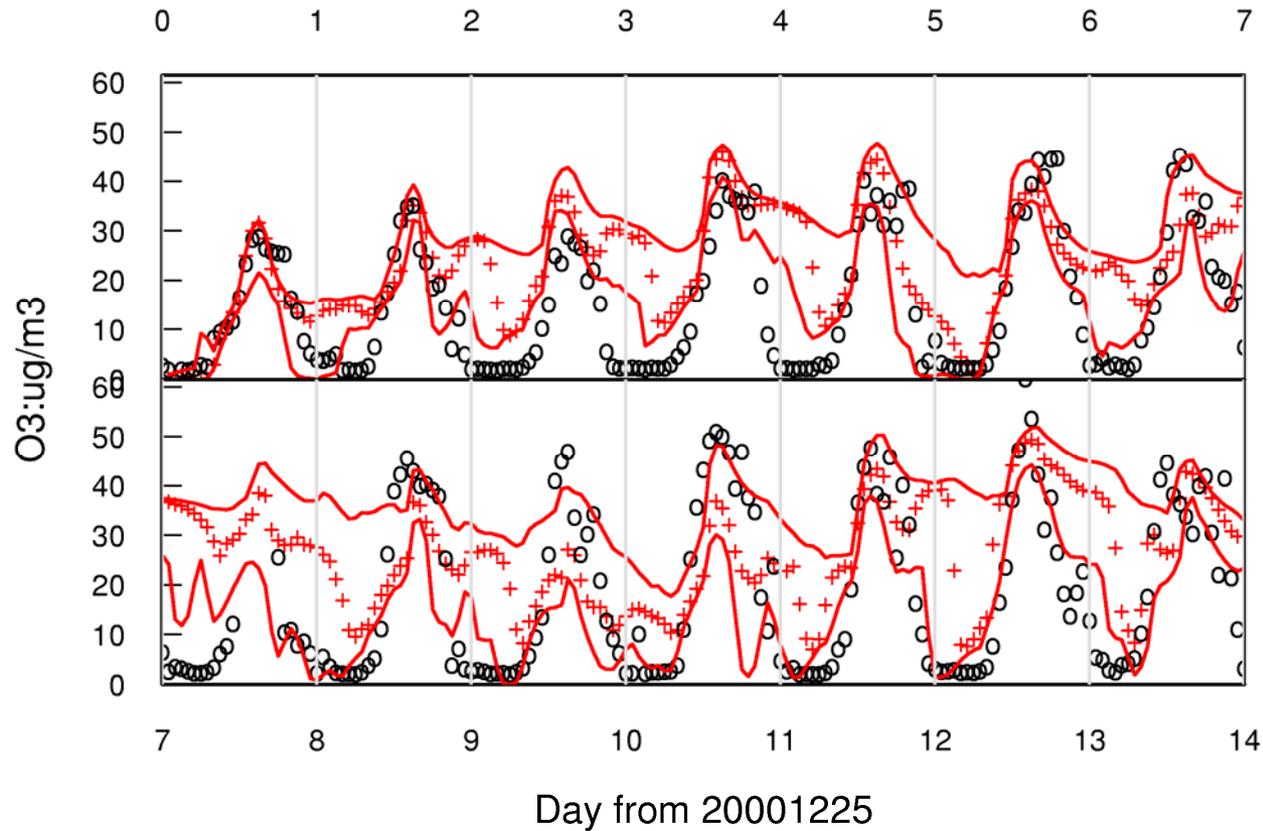
- Analysis was for summer and we did not find any high-resolution CO data for winter
- If the findings hold true for winter, model performance for CO may be better than shown previously
- Care should be taken when pollutant ratios involving CO is used to reconcile summer (and perhaps winter) emission inventories
- This much noise seen in high-resolution data for other pollutants?

# Angiola Model Performance

- Modeling results are for a hybrid meteorology (UCD winds in lower layers and MM5 in upper layers)
- We show:
  - Surface
    - O<sub>3</sub>, NO, NO<sub>2</sub>, Nitrate
  - Aloft
    - O<sub>3</sub>, NO, Nitrate

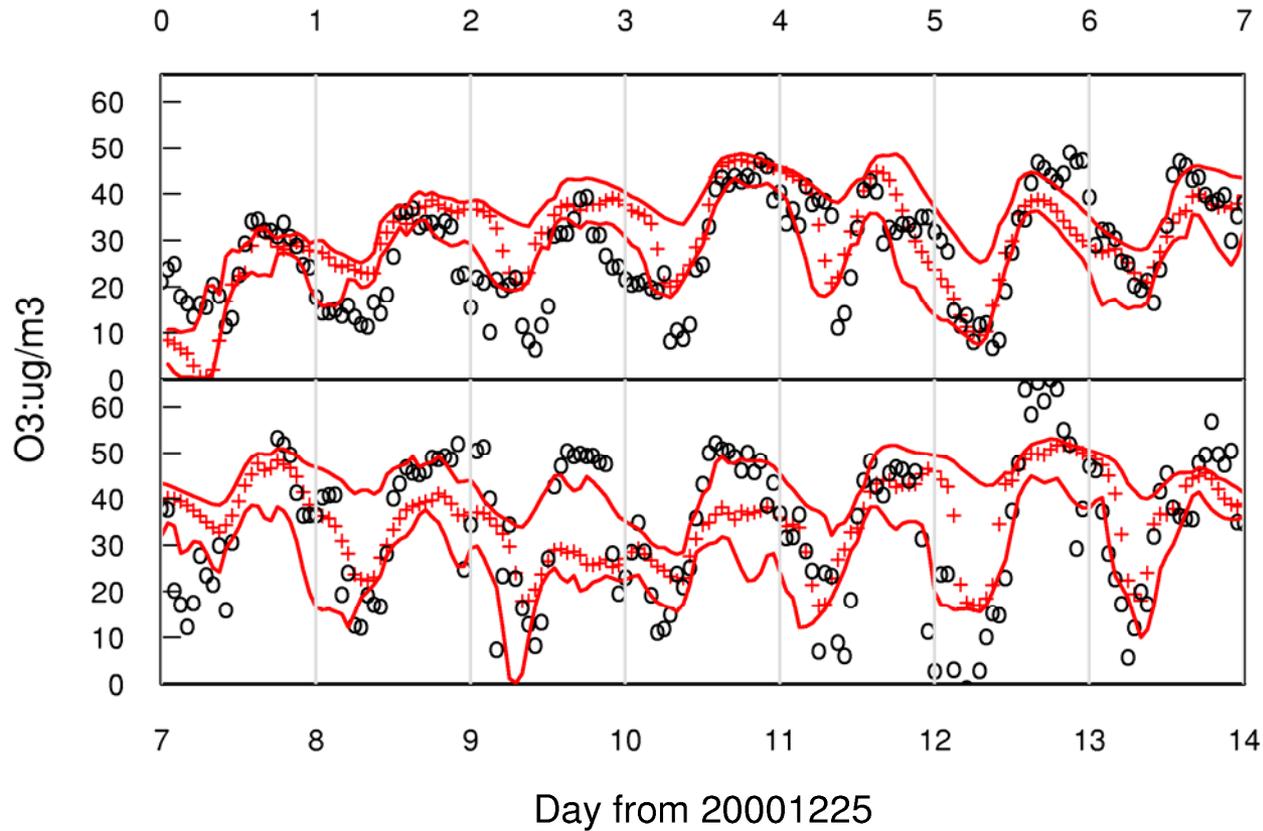
# Surface O<sub>3</sub>

ANGI:114:44



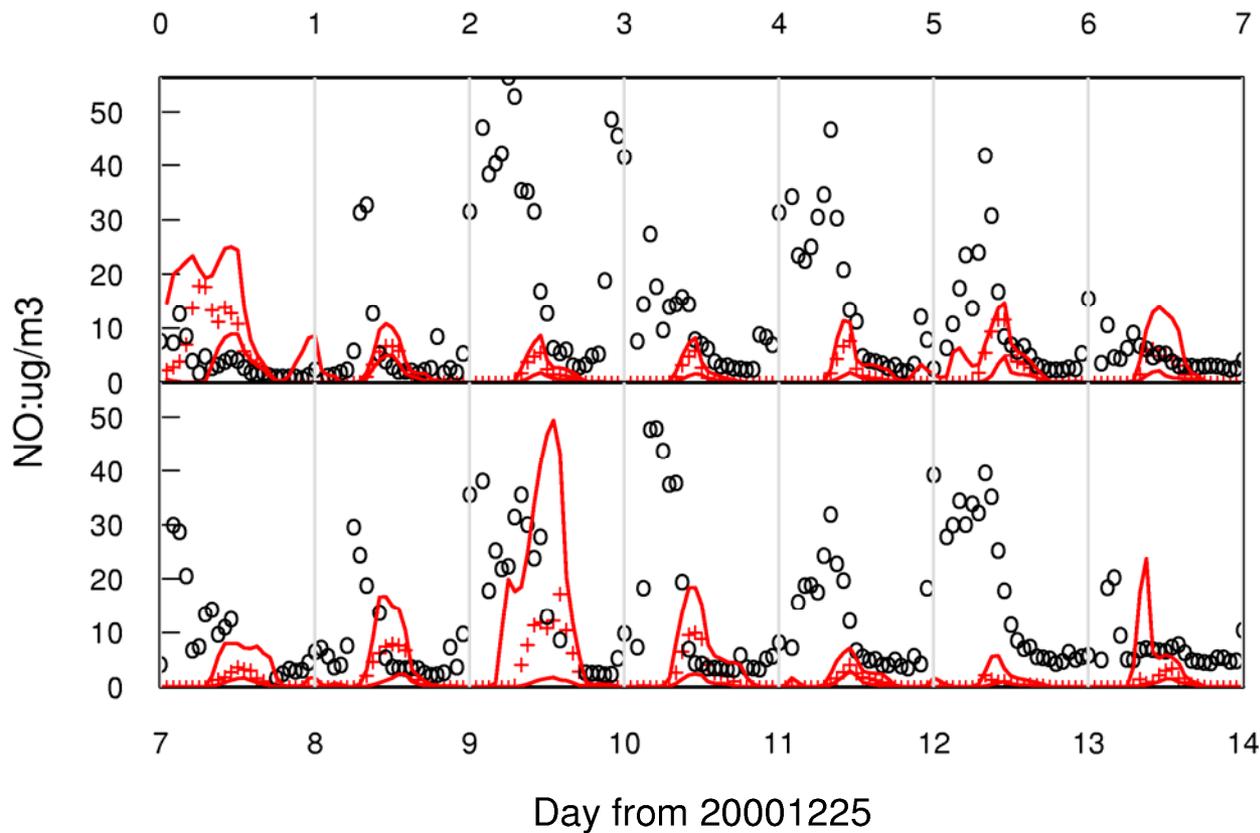
# Aloft O<sub>3</sub>

ANGI100:114:44



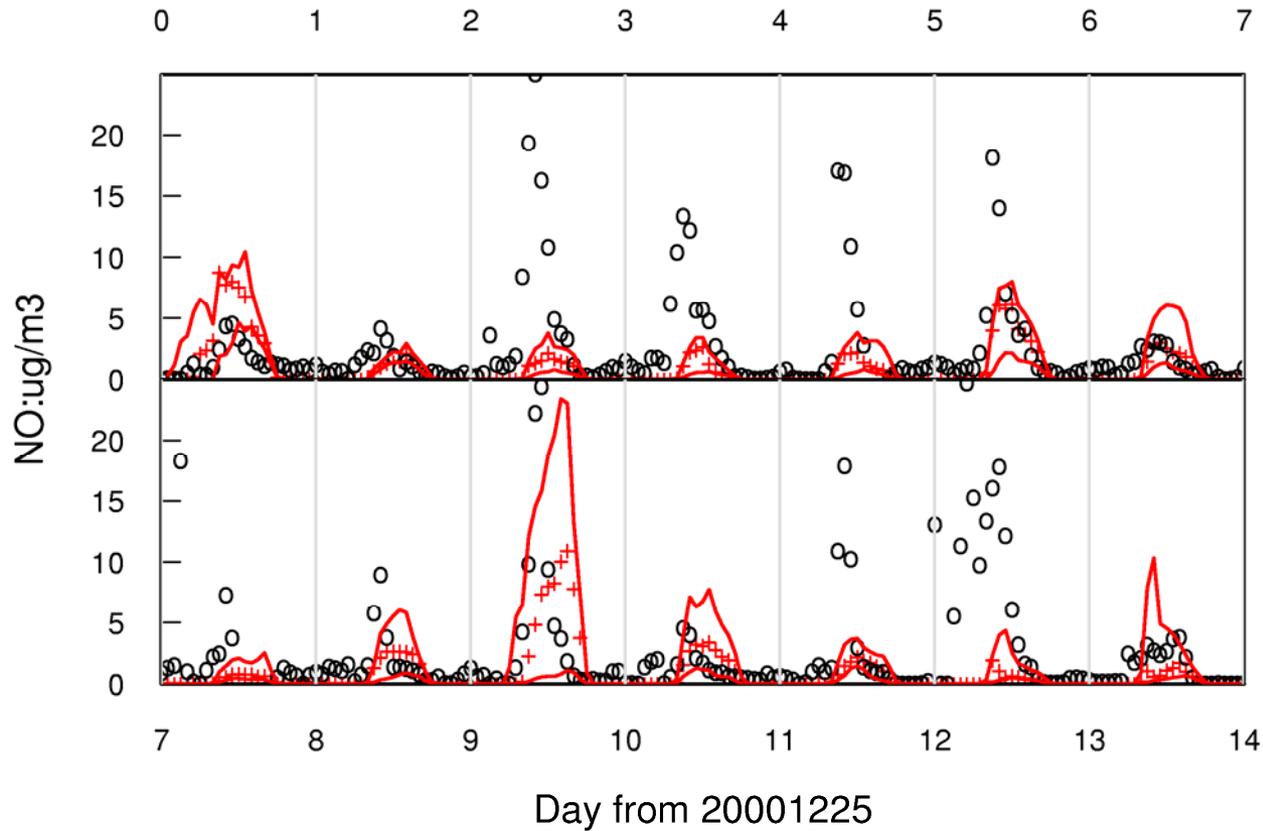
# Surface NO

ANGI:114:44



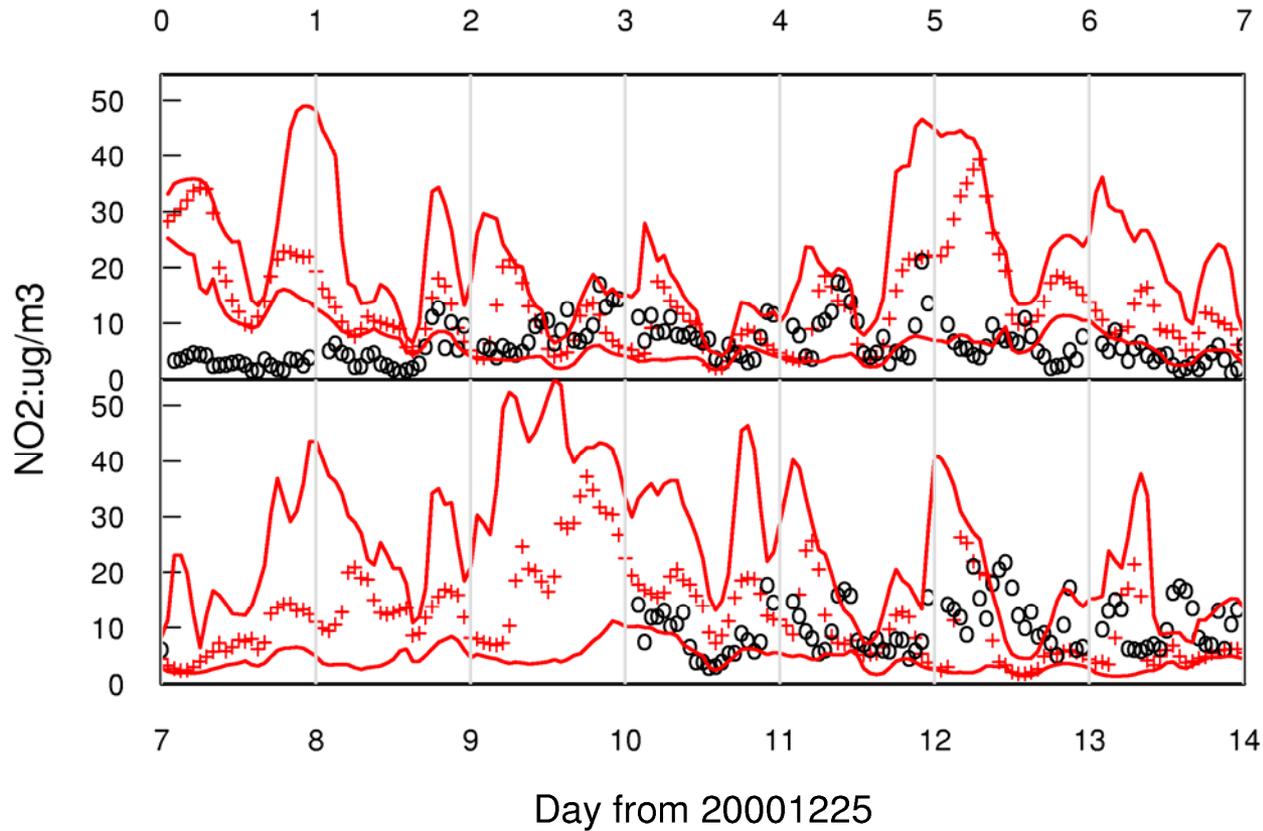
# Aloft NO

ANGI100:114:44



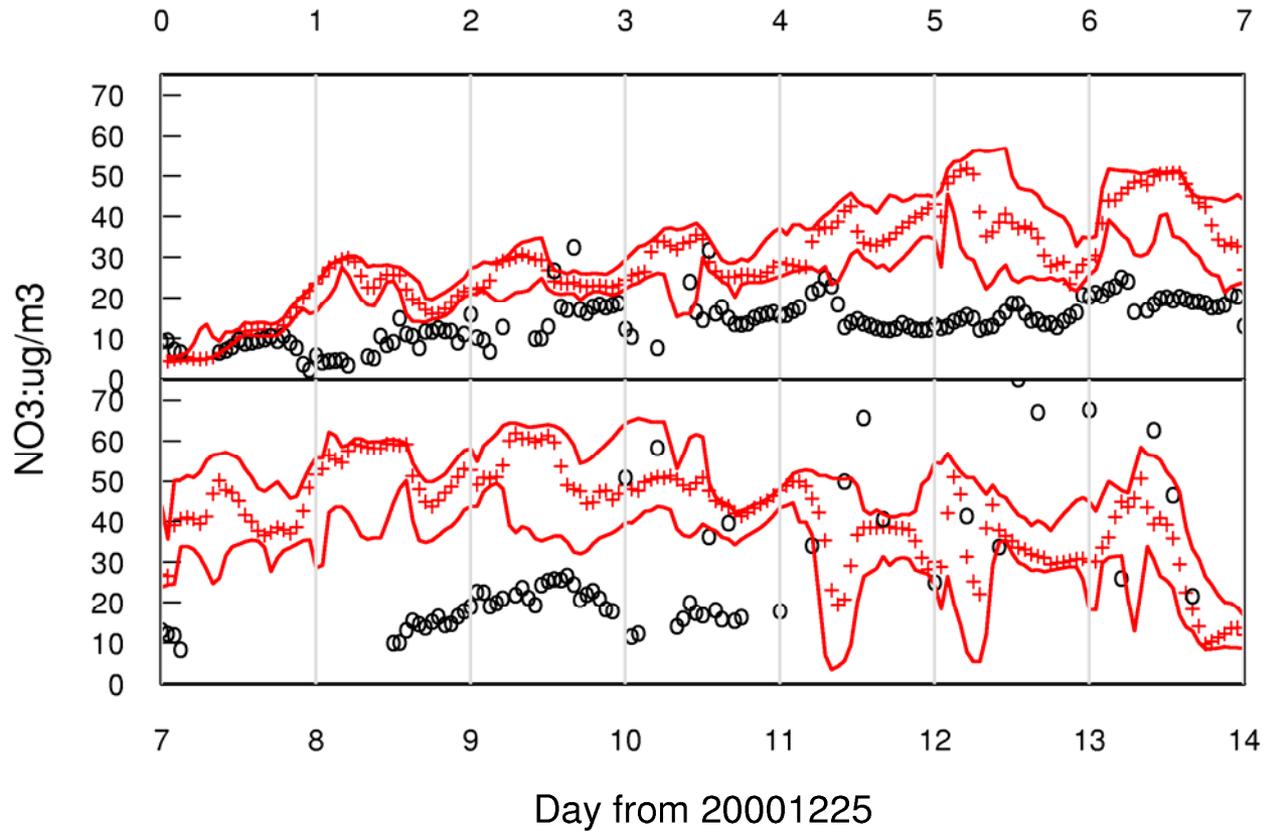
# Surface NO<sub>2</sub>

ANGI:114:44



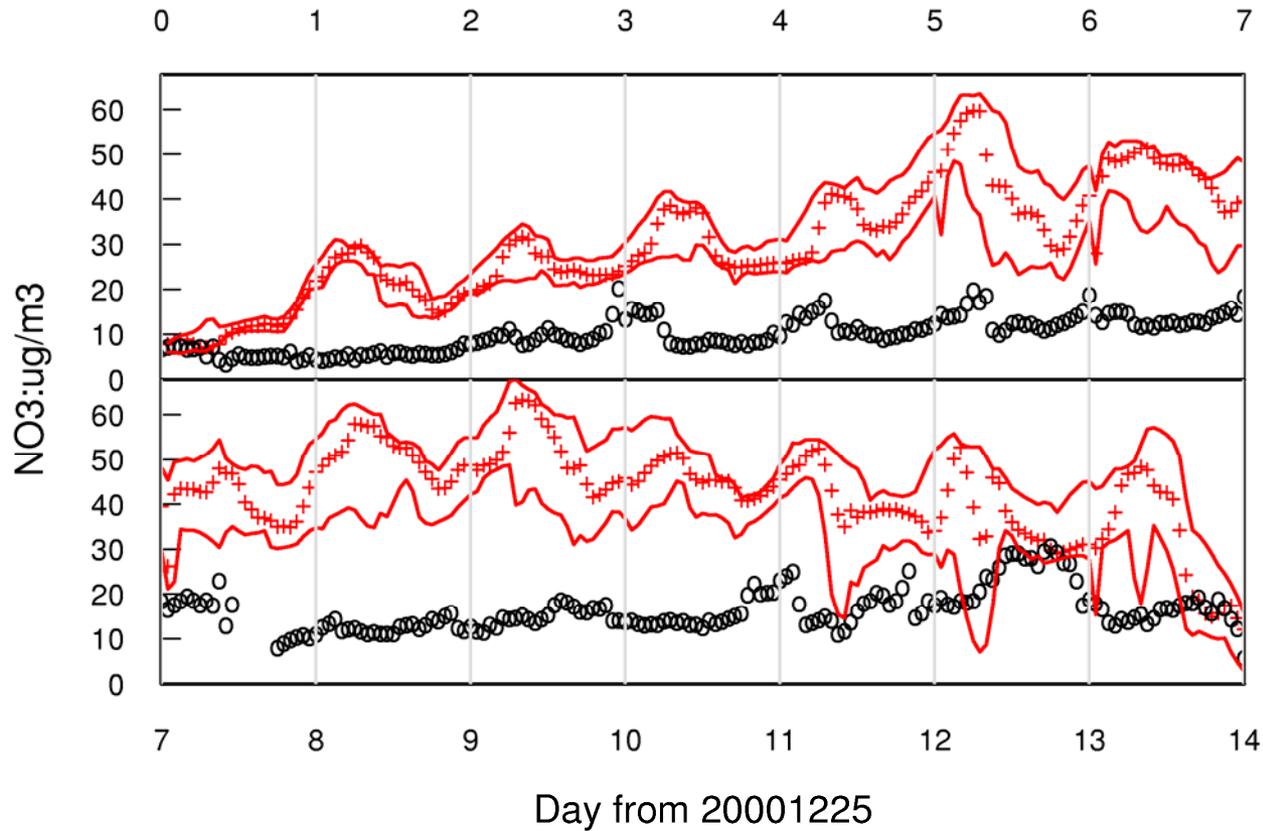
# Surface Nitrate

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# Aloft Nitrate

ANGI100:114:44



# Angiola Summary

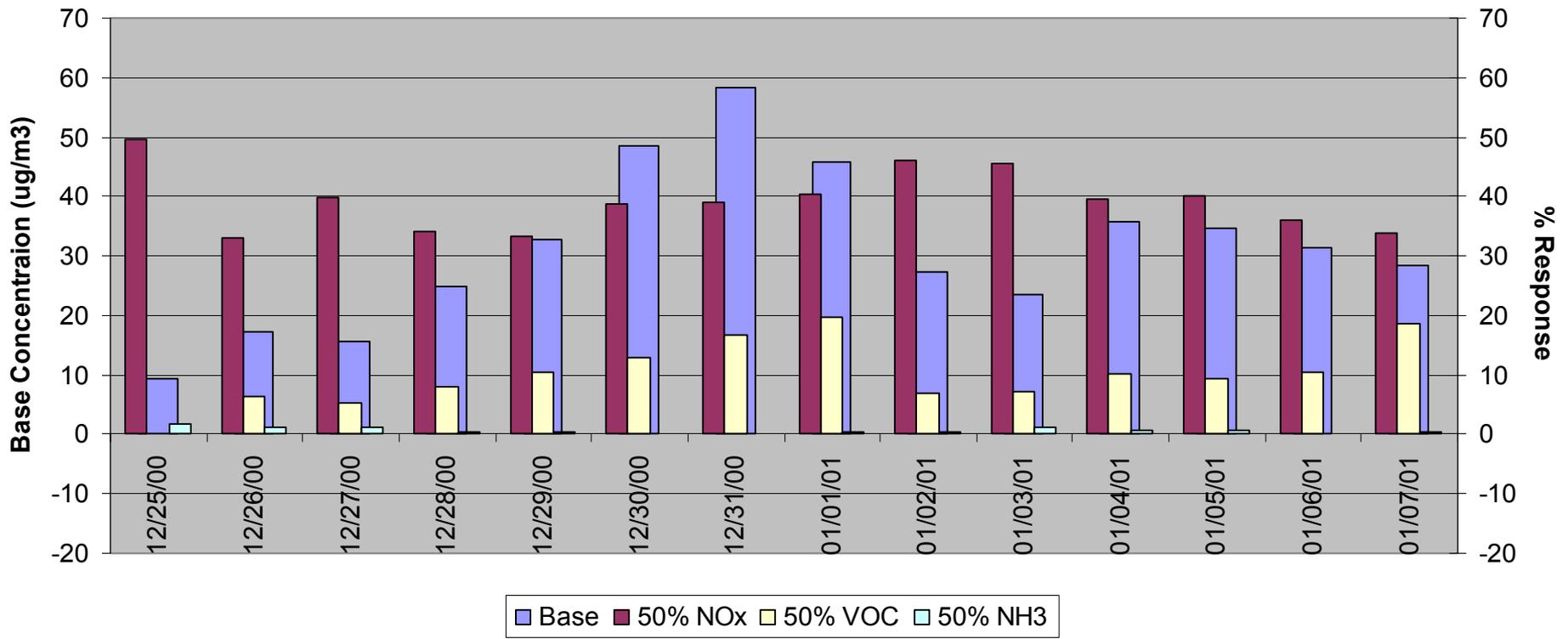
- O<sub>3</sub> performance is satisfactory
- NO performance is poor at both surface and aloft
  - Missing local NO source(s)?
- Over-prediction of NO<sub>2</sub> at the surface.
- Nitrate over-prediction aloft
- Lack of NO did seem to have affected O<sub>3</sub> or nitrate formation (because there is enough NO<sub>2</sub>?)
- Roughly half of the nitrate is formed during night time

# Precursor Sensitivities

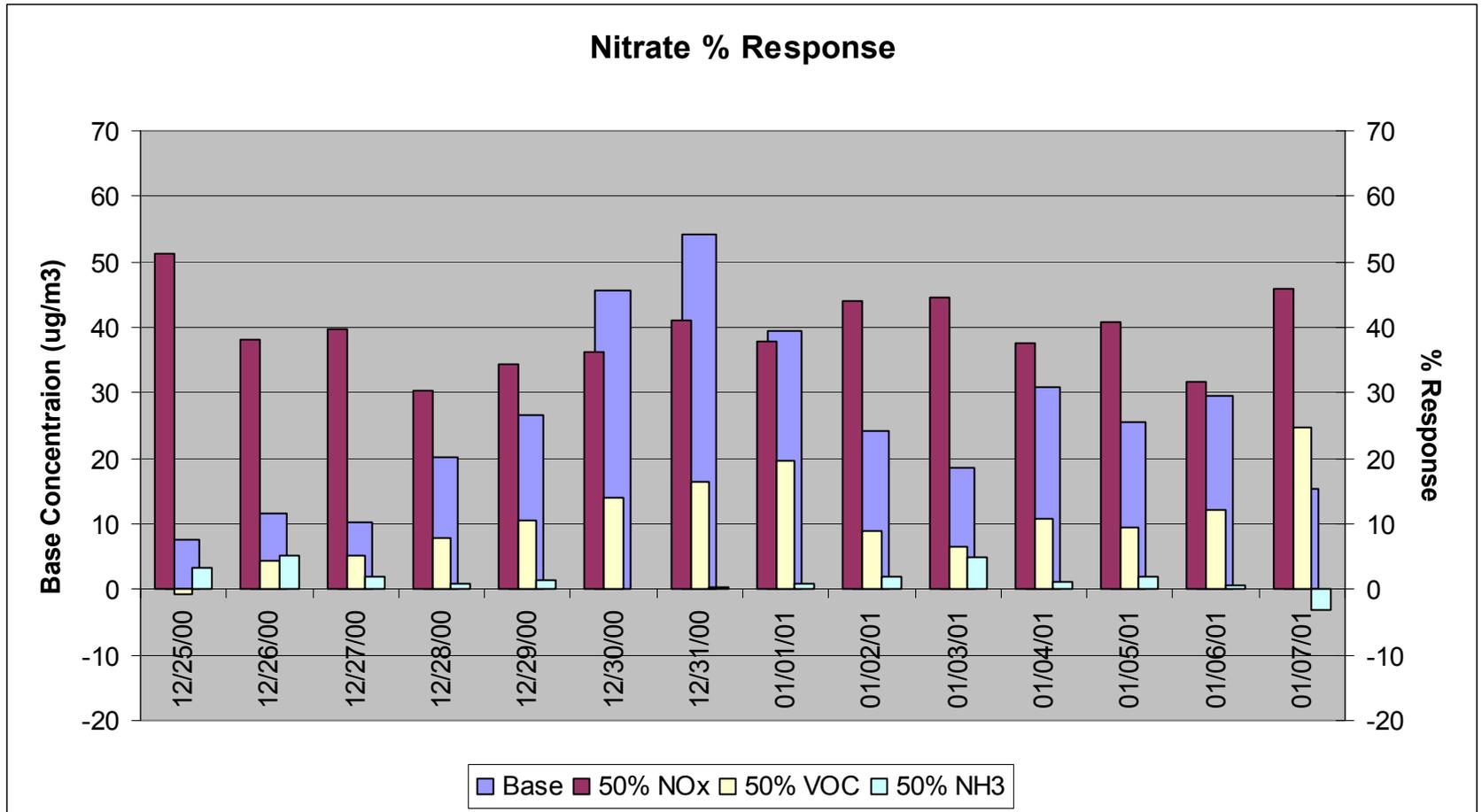
- We conducted domain-wide 50% emission reductions of VOC, NO<sub>x</sub>, and NH<sub>3</sub>
- Nitrate concentrations are:
  - most sensitive to NO<sub>x</sub> reductions
  - not very sensitive to VOC reductions
  - least sensitive to NH<sub>3</sub> reductions

# Angiola

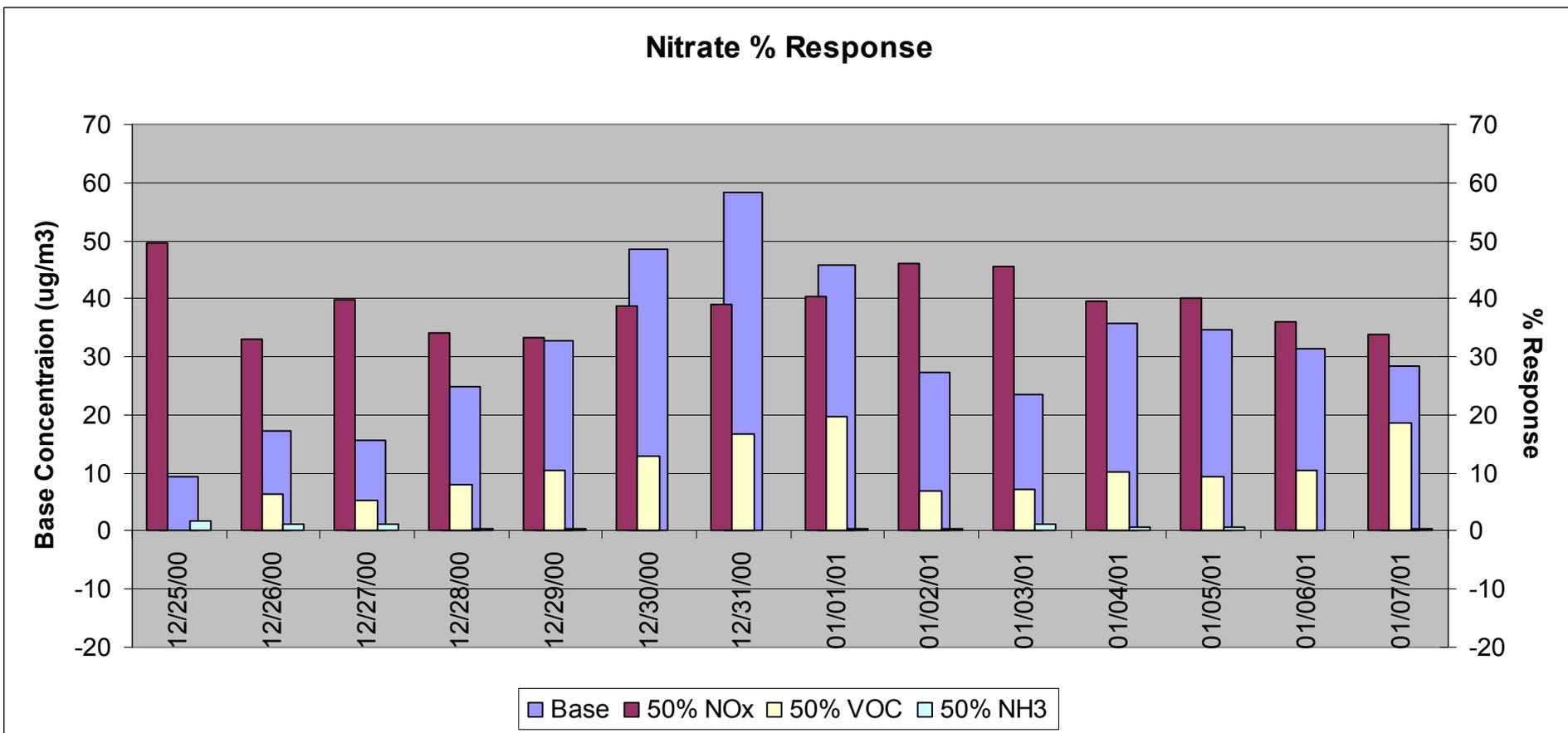
Nitrate % Response



# Bakersfield



# Fresno



# Synthesis

- There seems to be ~35 ppb of O<sub>3</sub> background (based on aloft measurements at Angiola)
- During winter, the photochemical activity is very limited. Anthropogenic VOCs are less reactive compared to biogenics
- Ground level ozone concentrations may be due to a mixture of vertical mixing during the day and some photochemical activity
- Nitrate formation during the day is due to photochemical activity near surface and that during night is due to N<sub>2</sub>O<sub>5</sub> formation aloft (50:50 ?)
- This is consistent with modeled nitrate formation being most sensitive to NO<sub>x</sub>