Advances in characterizing emissions

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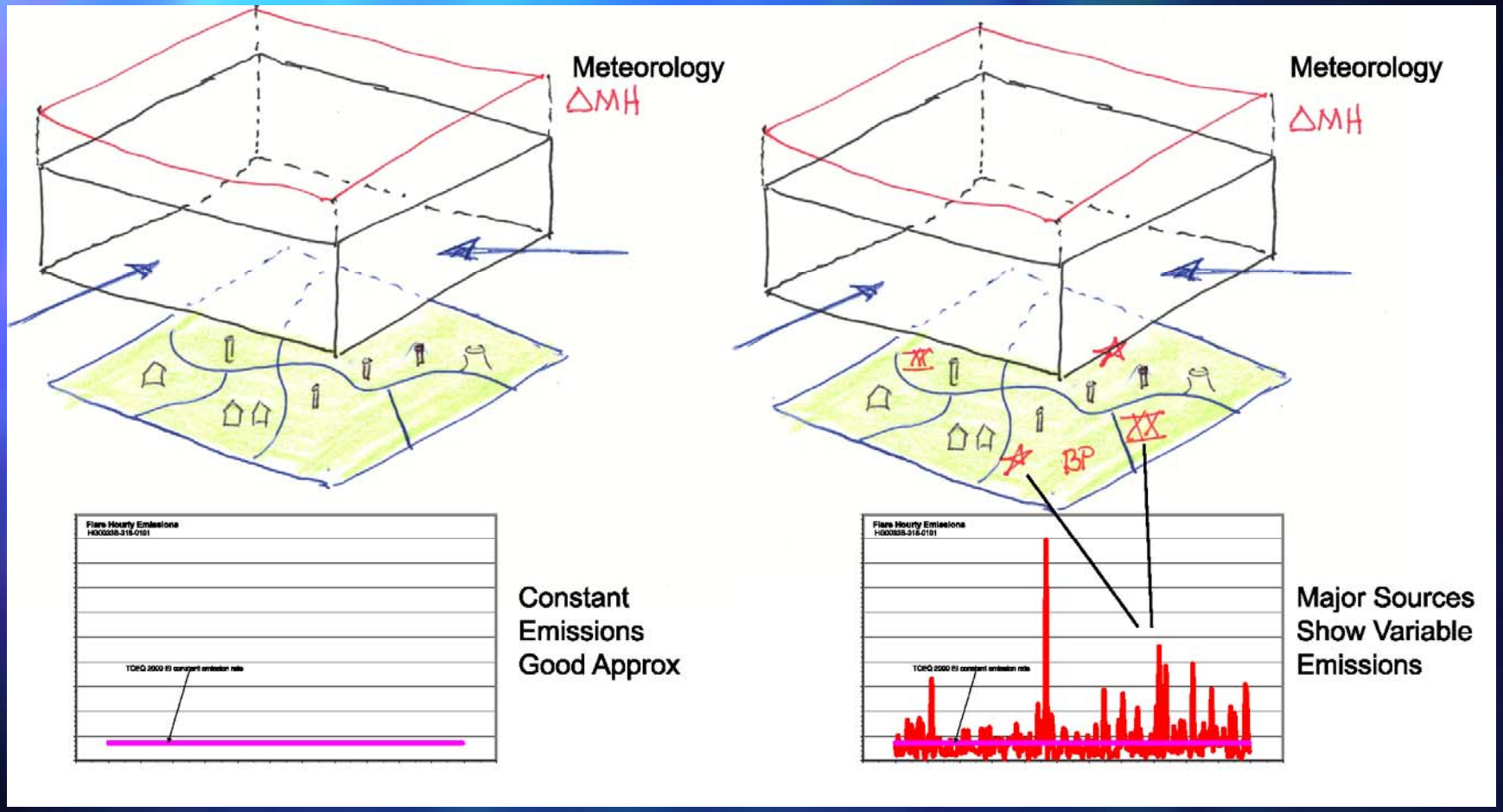
Emission inventory issues

- Emission variability from point sources (Project H13)
- Biogenic emissions (Project H12 8HRB)
- Emissions from oil and gas production and pipeline activities
- Lack of a region specific PM and PM precursor inventory

Point source emission variability: Conceptual issue

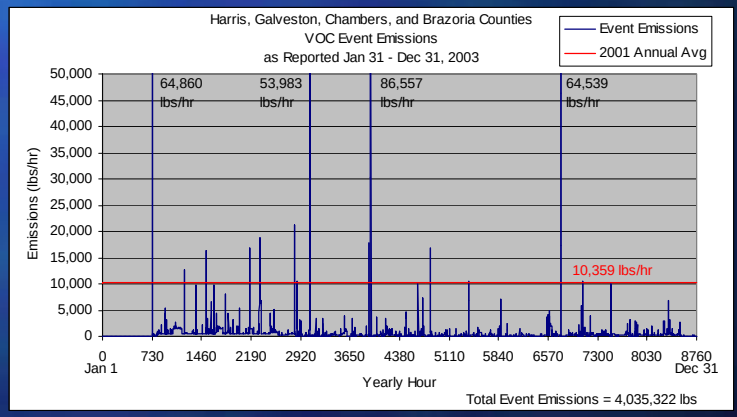


In most of US, industrial emissions are relatively constant or are small enough that meteorology is cause of “worst conditions”

In Houston, both meteorology and ***emissions*** are cause of “worst conditions”

Emission variability from point sources

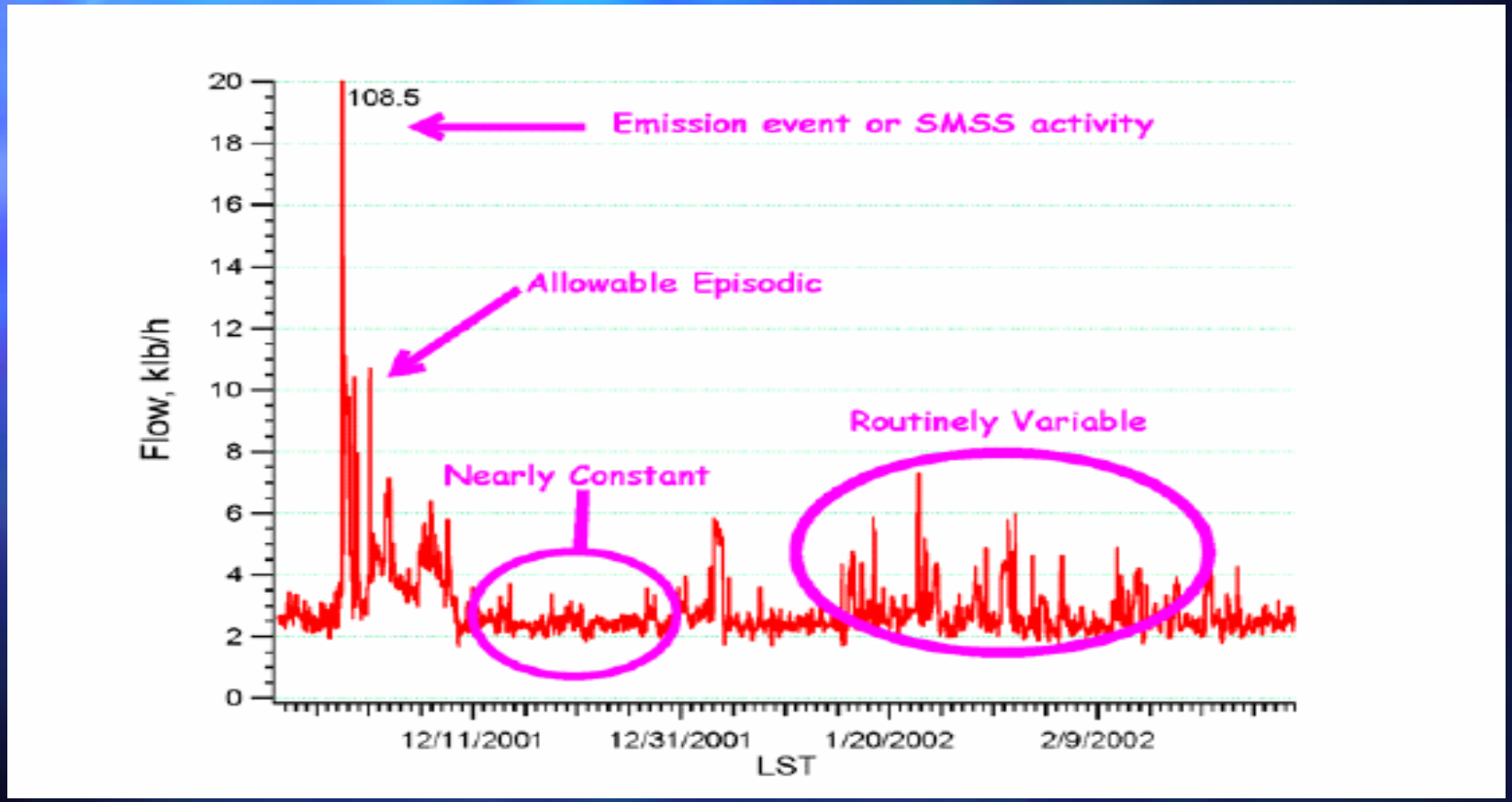
- Since TexAQS was conducted in summer of 2000, primary focus has been on characterizing emission variability of HRVOCs from facilities along the Gulf Coast

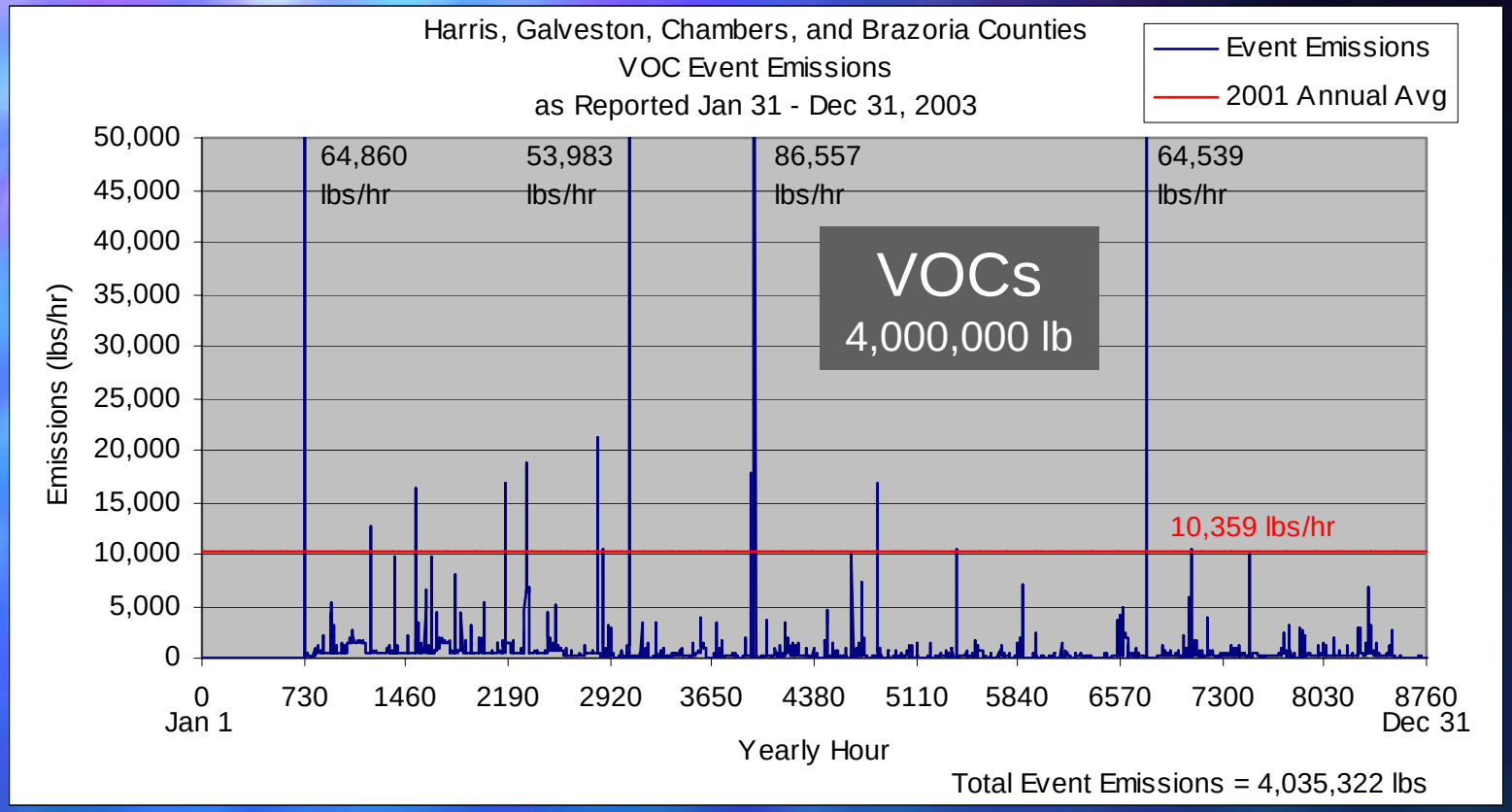


Contributions of Project H13

- Characterization of frequency, magnitude, duration and composition of emission events
- Development of new tools for incorporating variable emissions into SIP planning

Emission variability and its impact on ozone formation in the Houston Galveston Area





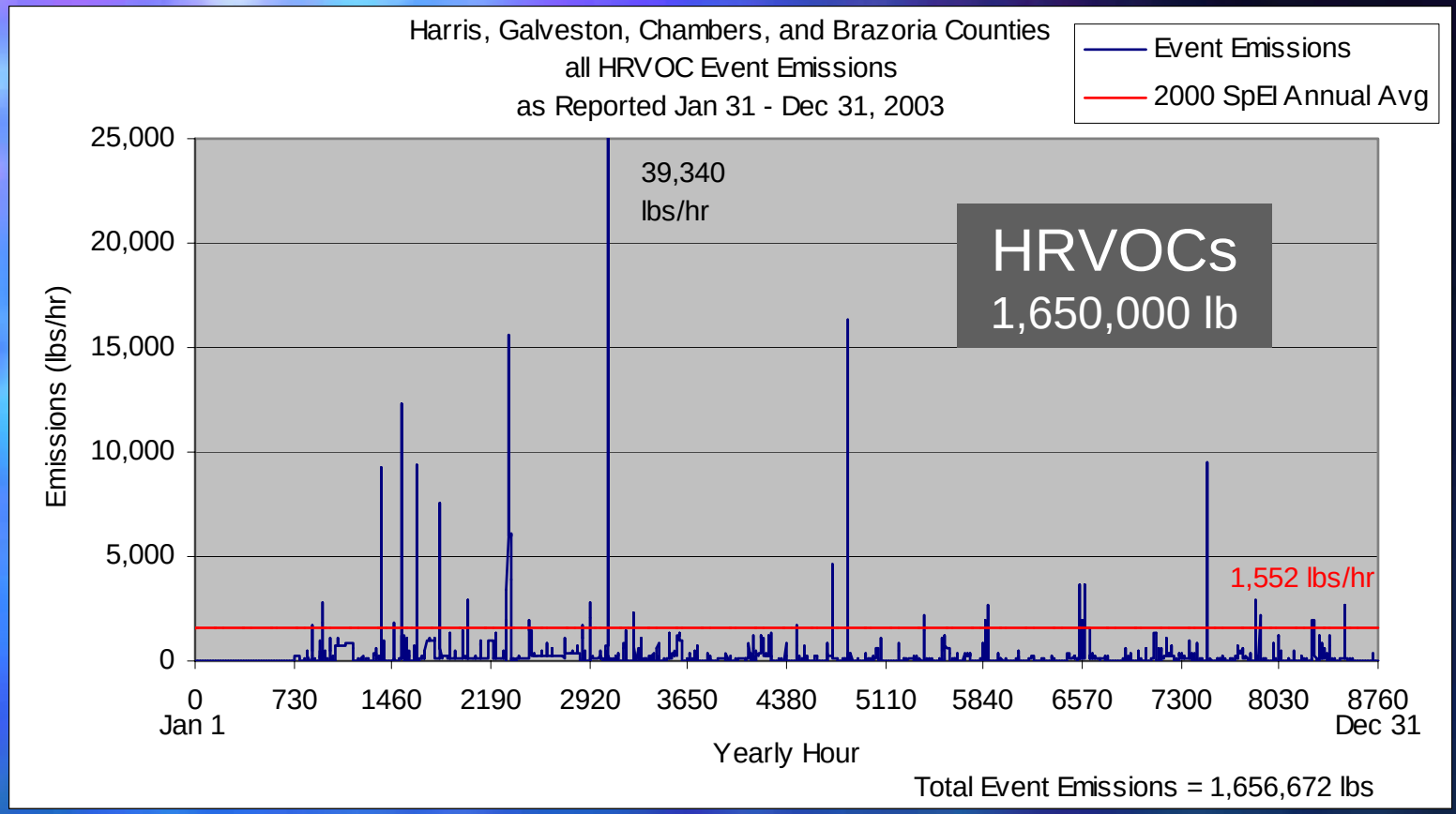
hej1

- Total mass of over 4 millions pounds (2000 tons) contributes 4% to the 45,000 tons of VOC emitted over a single year from point sources in the four counties.
- 14 times (18 hours) during the eleven-month period, event emissions exceed the annual average for all facilities in the region.

Slide 7

hej1 The figure fonts could at least be made BOLD
And some of the most important "notes" could
be colored RED, like total emissions values

The inserted
Harvey Jeffries, 1/11/2004



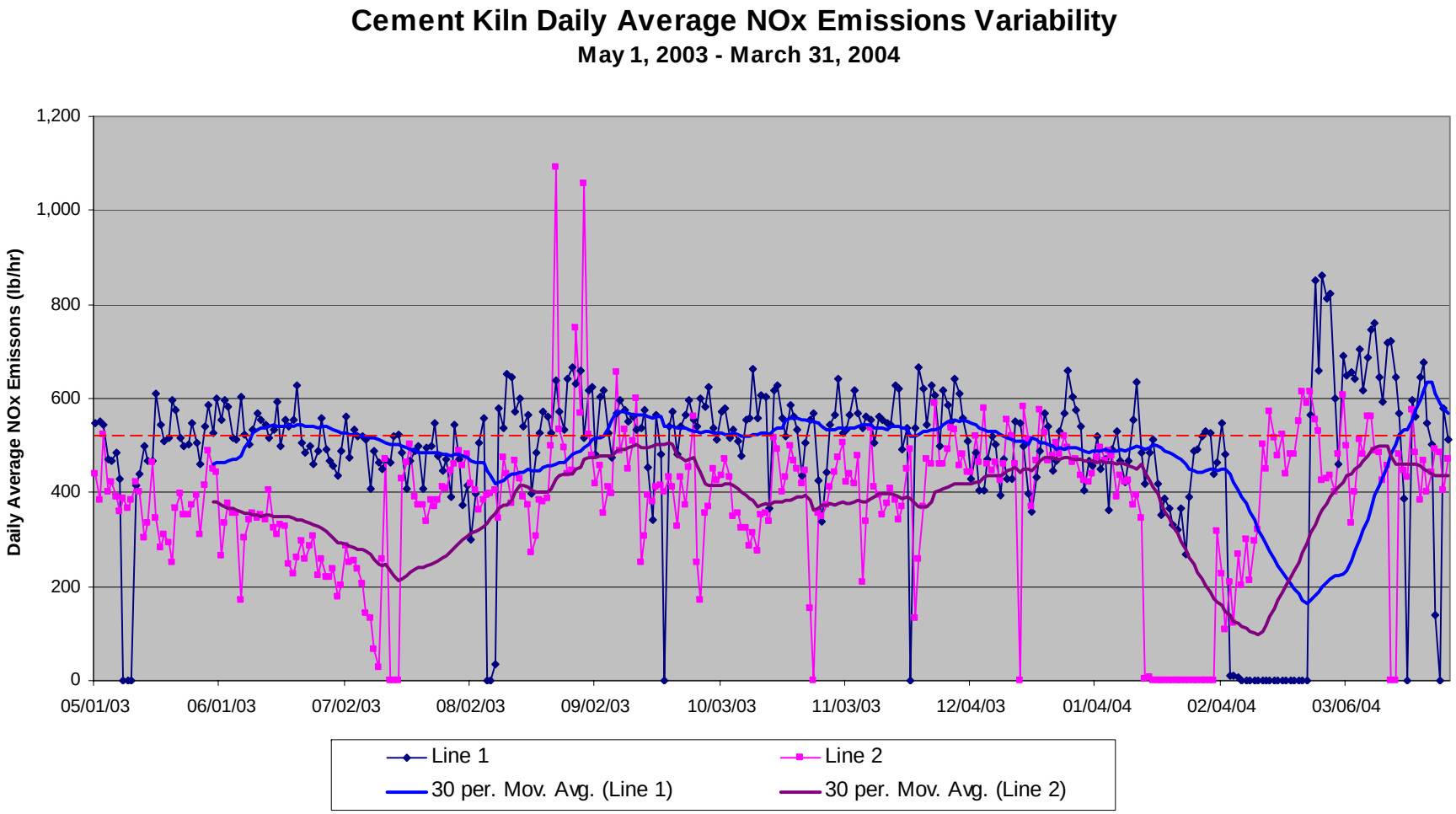
- Total mass of over 1.6 millions pounds (830 tons) is ~12% of the 6800 tons of HRVOC emitted over a single year from point sources in the four counties.
- 29 times (115 hours) during the eleven-month period, event emissions exceed the annual average.

Conceptual model

- Events with emissions of more than 1000 pounds of HRVOCs occur several times per week, on average
- Many are relatively short (well under one hour in duration)
- Among the HRVOCs, ethene and propene dominate
- Events occur primarily in Harris and Brazoria counties at chemical manufacturing facilities

(Murphy and Allen, Atmospheric Environment, in press)

Emission variability from point sources not confined to Houston chemical mfg. facilities

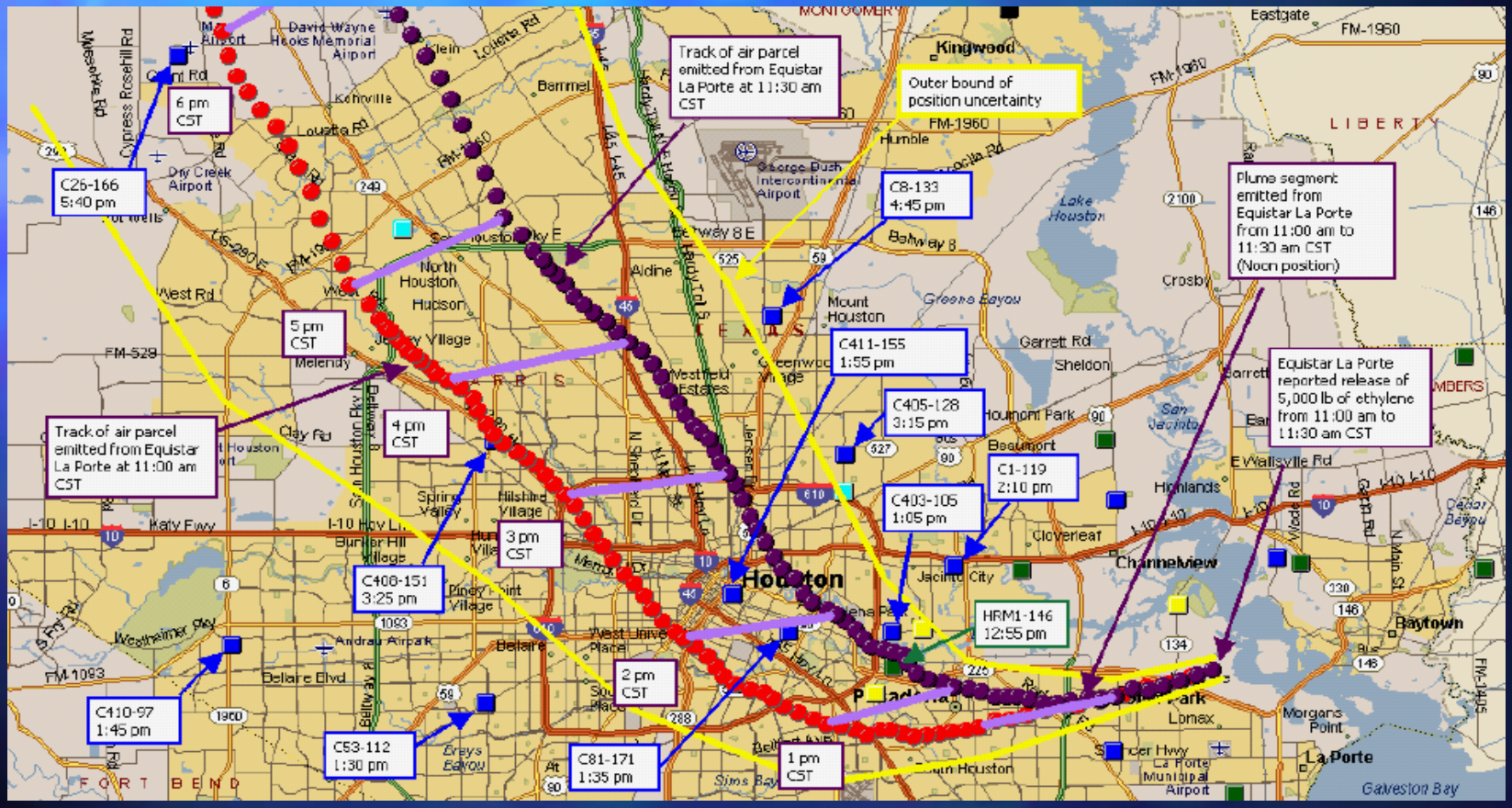


What are the consequences of emission variability for ozone formation?

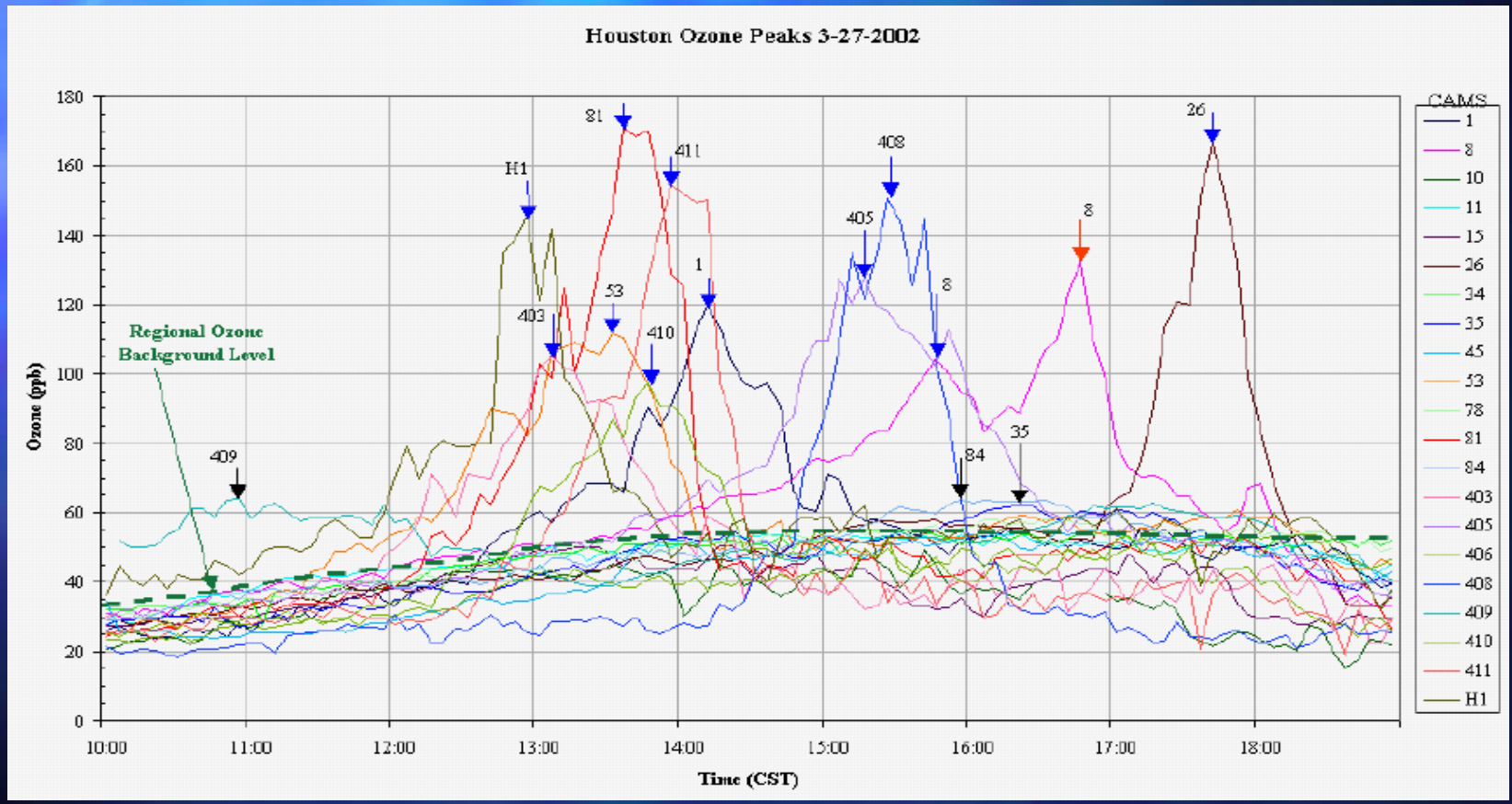
- Example of worst case scenario: Monitoring data from a 6700 lb, 30 minute ethylene release at LaPorte
- New modeling tools for emission events
- Analyses for many other events at:

  http://www.tceq.state.tx.us/compliance/monitoring/air/monops/sigevents05.html

10,000+ lb ethylene release at LaPorte, (6700 lb between 11 and 11:25 AM) 3/27/2002



Short term ozone enhancements of up to 100 ppb



Modeling tools for events: Subdomain modeling

- Episodic emissions can result in significant ozone formation but vary in magnitude and location
- Computationally demanding to represent full range of possible events in a conventional modeling simulation
- Alternative approach is to identify sensitive sub-domains from full CAMx simulation, evaluate ozone formation due to many episodic emission snapshots in sensitive sub-domains using computationally efficient sub-domain model, identify most significant snapshots (scenarios), evaluate most significant scenarios in full CAMx model
- Using this approach, sub-domain modeling is a screening tool. Final evaluations are still done in full CAMx simulation

Results of event modeling

- Emission events, sometimes impact peak ozone concentrations; when they do, a variety of air quality models suggest that the relationship of the event emission mass to the increase in peak ozone concentration is linear, up to at a mass release of at least 5000 lb
- The magnitude of the impact (increase in peak ozone per pound of event emission) depends on the location of the release, time of the release, and other emissions – values range between 1 and 4 ppb per 1000 lb of release
- Under worst case conditions, emission events are roughly additive for 2-3 hour periods (i.e., a 1000 pound total release over 2-3 hours can have up to the same impact as a 1000 pound release over 1 hour)
- The time windows during which peak ozone concentrations are most sensitive to event emissions is relatively narrow
- Statistics on the frequency of event emissions and the frequency of conditions conducive to event emissions impacting peak ozone can be used in attainment demonstrations

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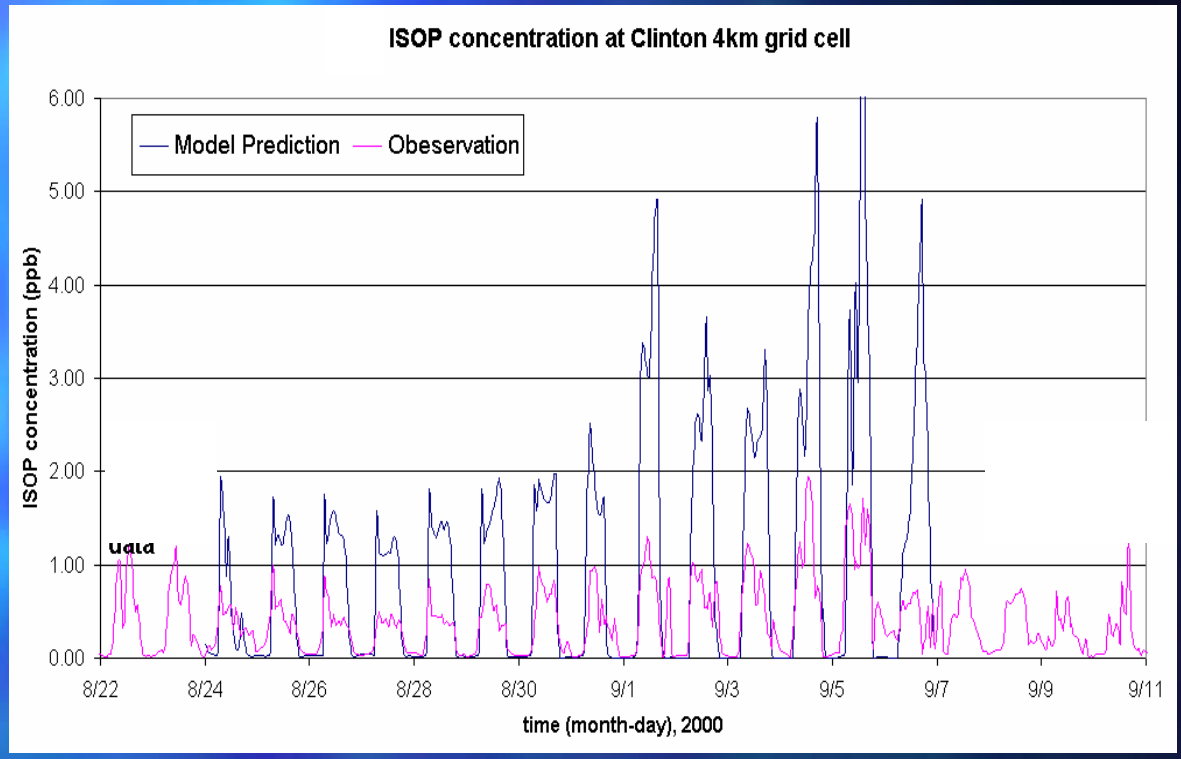
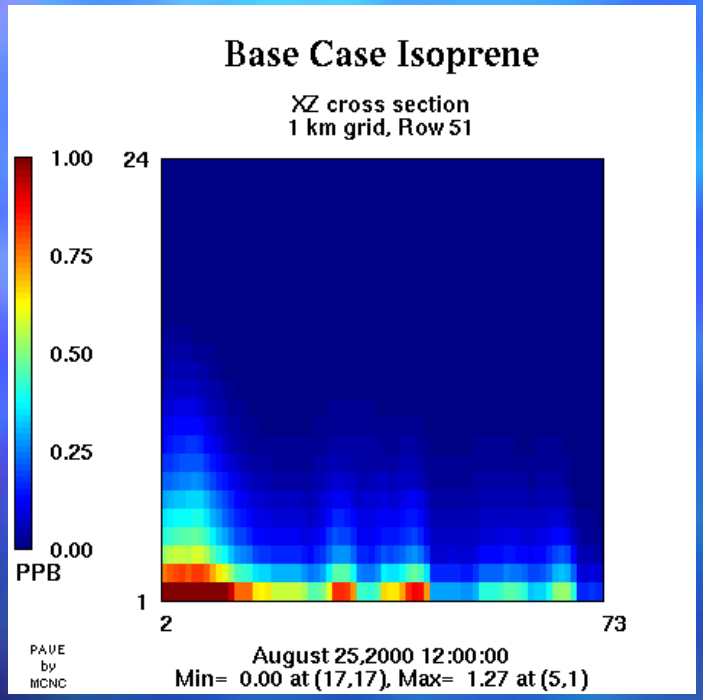
Comparison of modeled isoprene concentrations to ground data and aircraft data in Houston (TexAQS 2000)

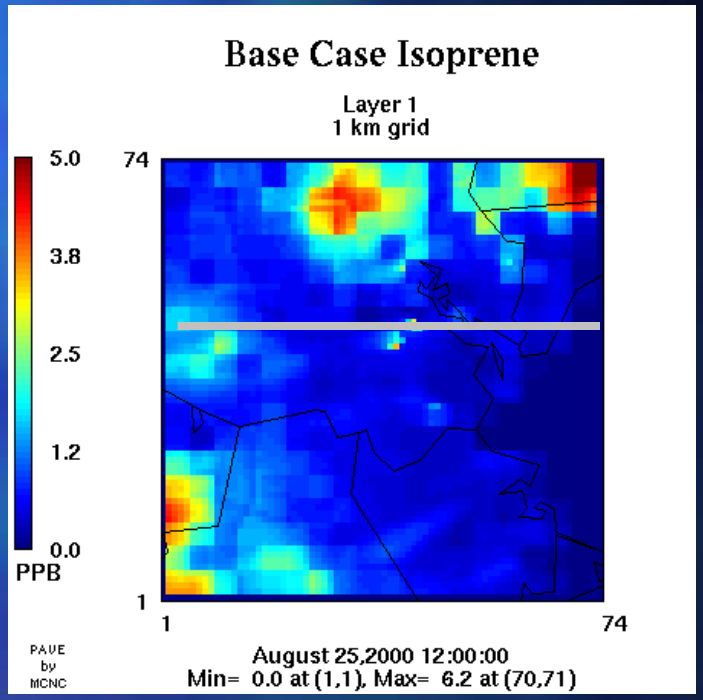


- Ground data at all sites systematically a factor of 2-3 lower than predicted values
- Aircraft data (canisters and PTRMS) generally consistent with modeled concentrations

Song, et al, JAWMA, under review

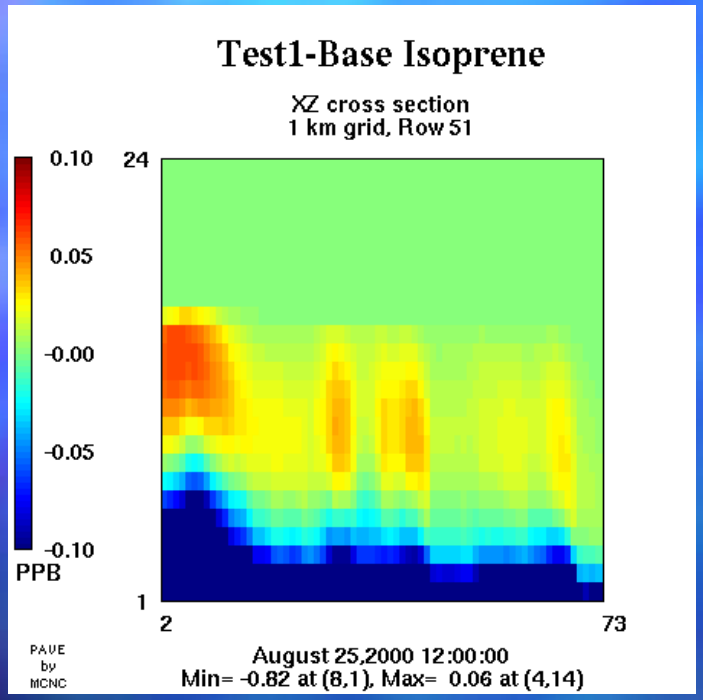
Vertical structure of modeled isoprene concentrations

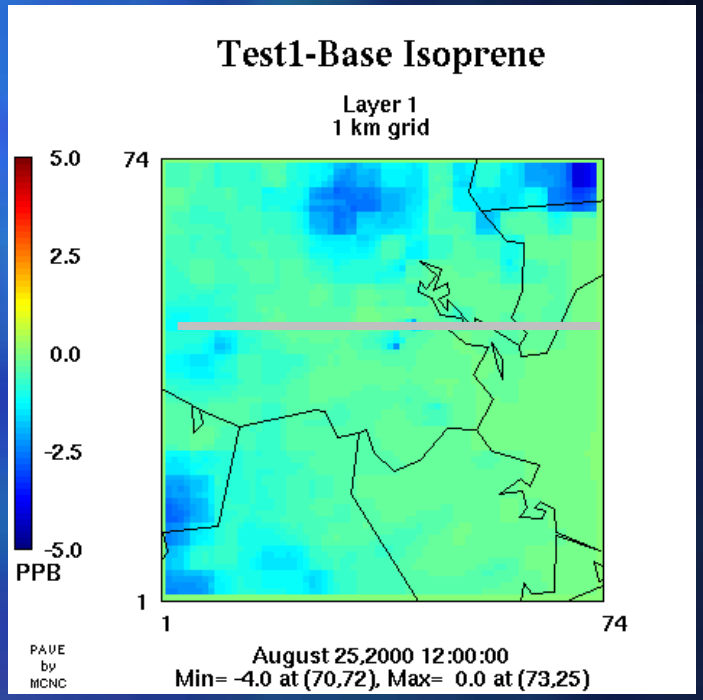




- Model predicts very little isoprene above 200 m AGL

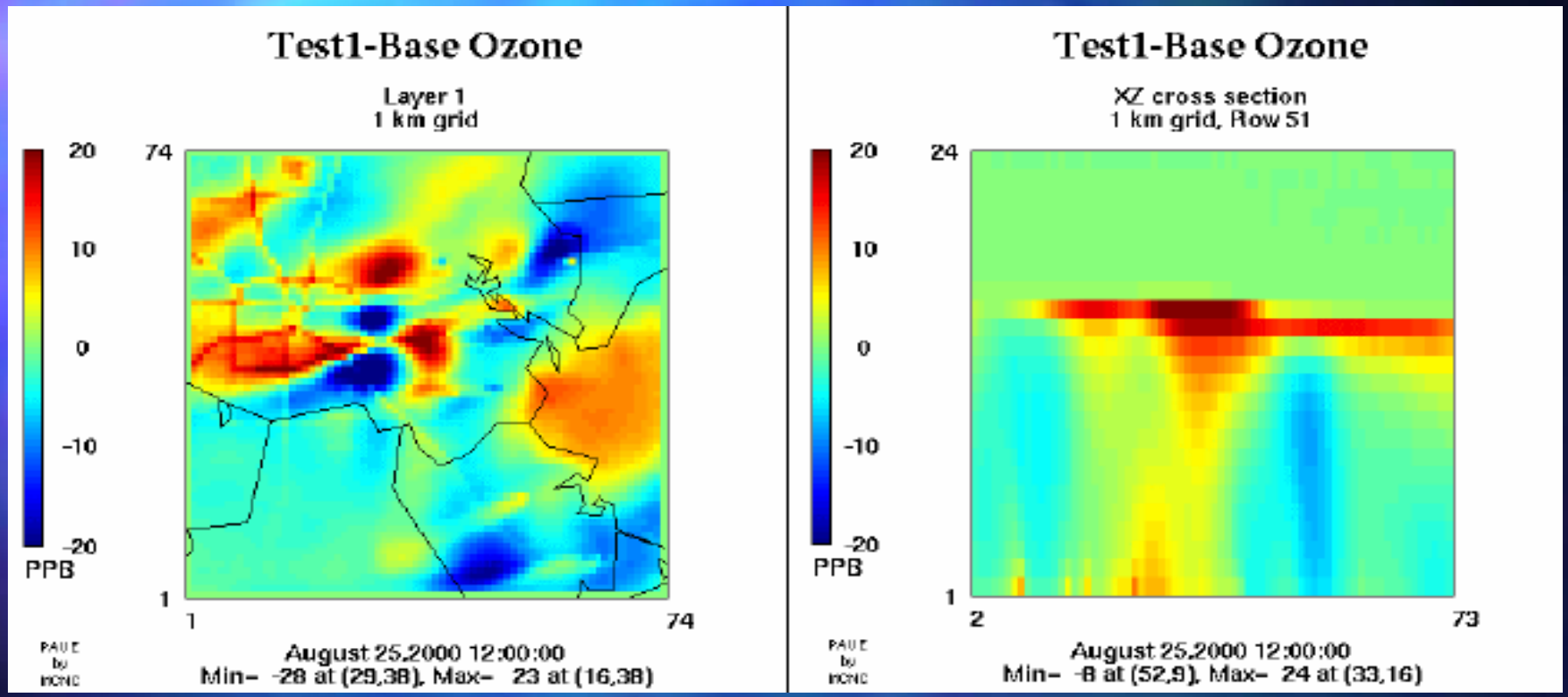
Implications for isoprene concentrations of changing vertical mixing parameters in model





- Increase vertical mixing parameters and calculate difference in isoprene concentrations between test case and base case

Implications for ozone formation of changing vertical mixing parameters in model



- Changing vertical mixing parameters can change ozone concentrations by +/- 20 ppb

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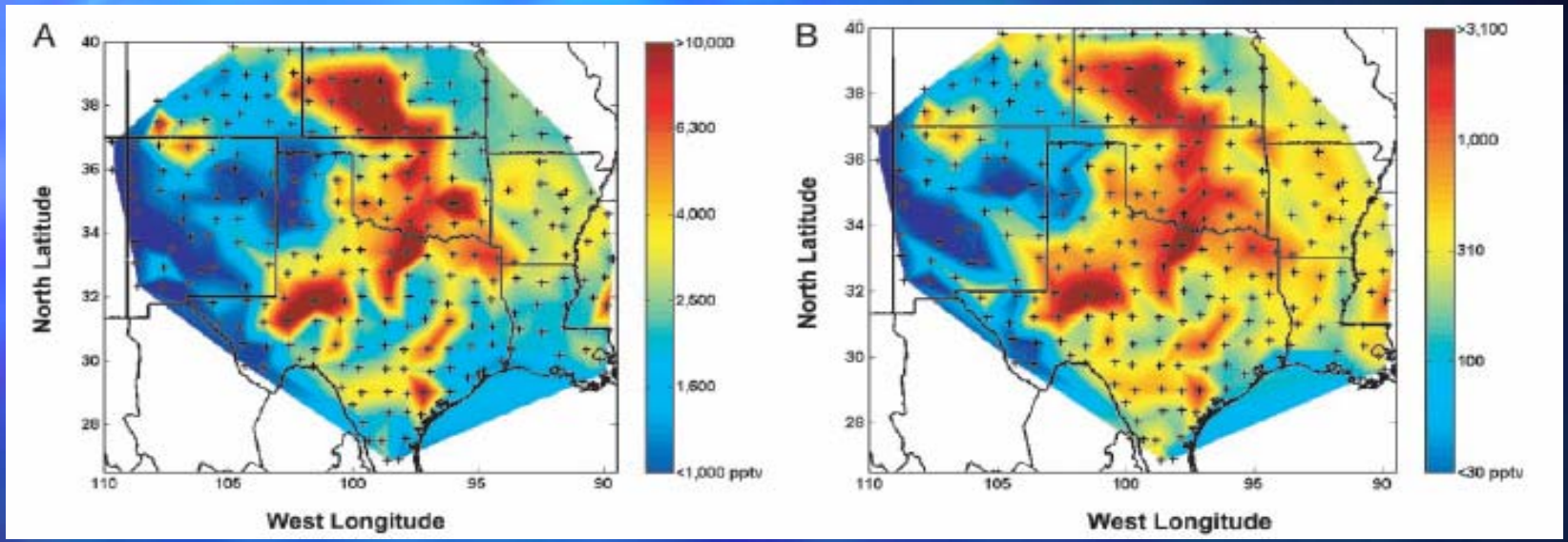
Emissions for oil and gas production and pipelines underestimated?



- Ethane (left) and n-butane (right) mixing ratios

Katzenstein et al. 2003 ***PNAS*** 100 (21): 11975.

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