

# **Regional Photochemical Modeling for the Ozark Isoprene Experiment (OZIE)**

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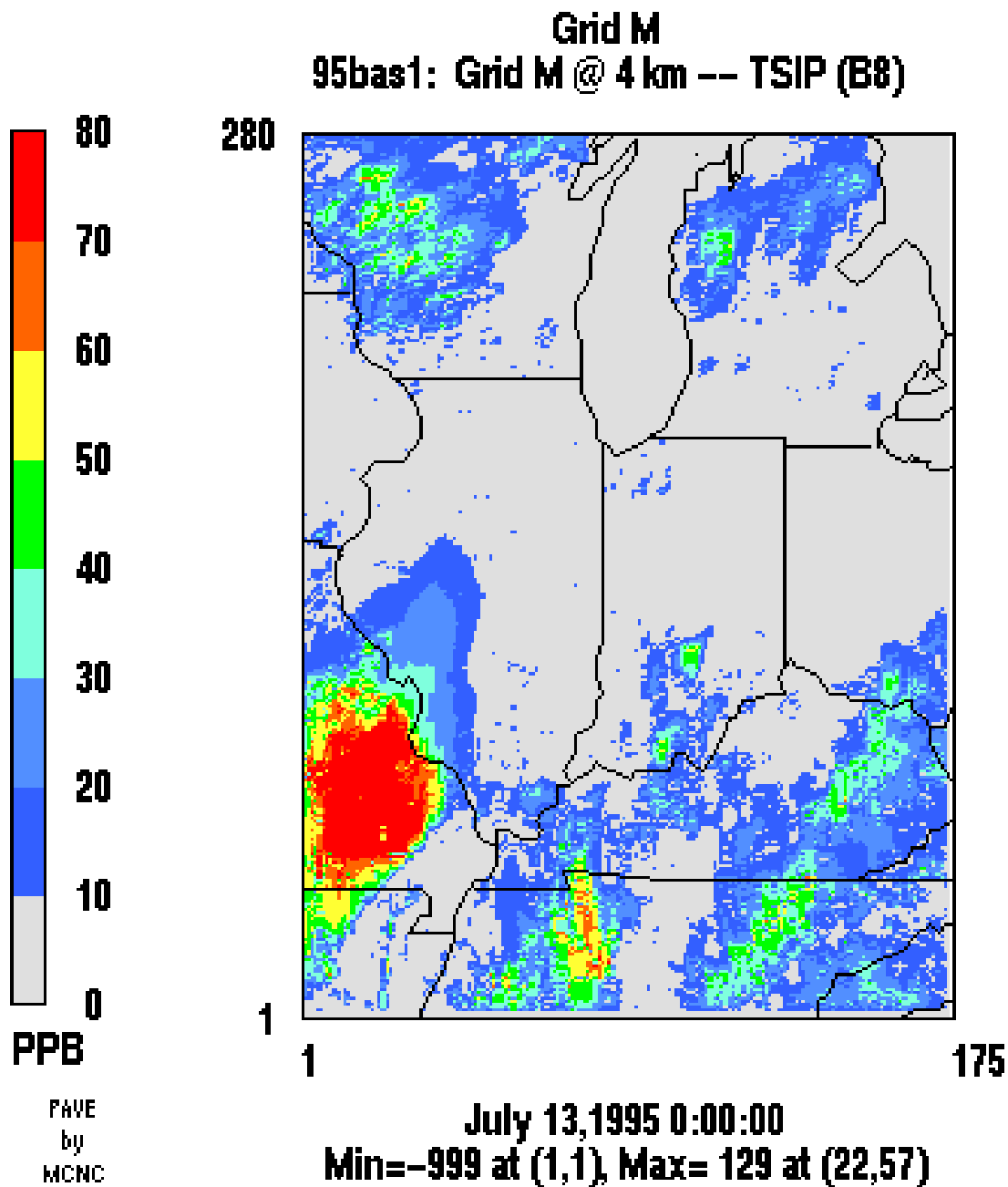
## **Motivation for OZIE...**

- ...biogenic hydrocarbons are important for ozone attainment modeling (National Academy of Sciences, 1991);**
- ...abnormally high (>250 ppbC) isoprene concentrations are being modeled over the Ozark Plateau; and,**
- ...southern Missouri has the highest density of oaks (high isoprene emitters) in the United States.**



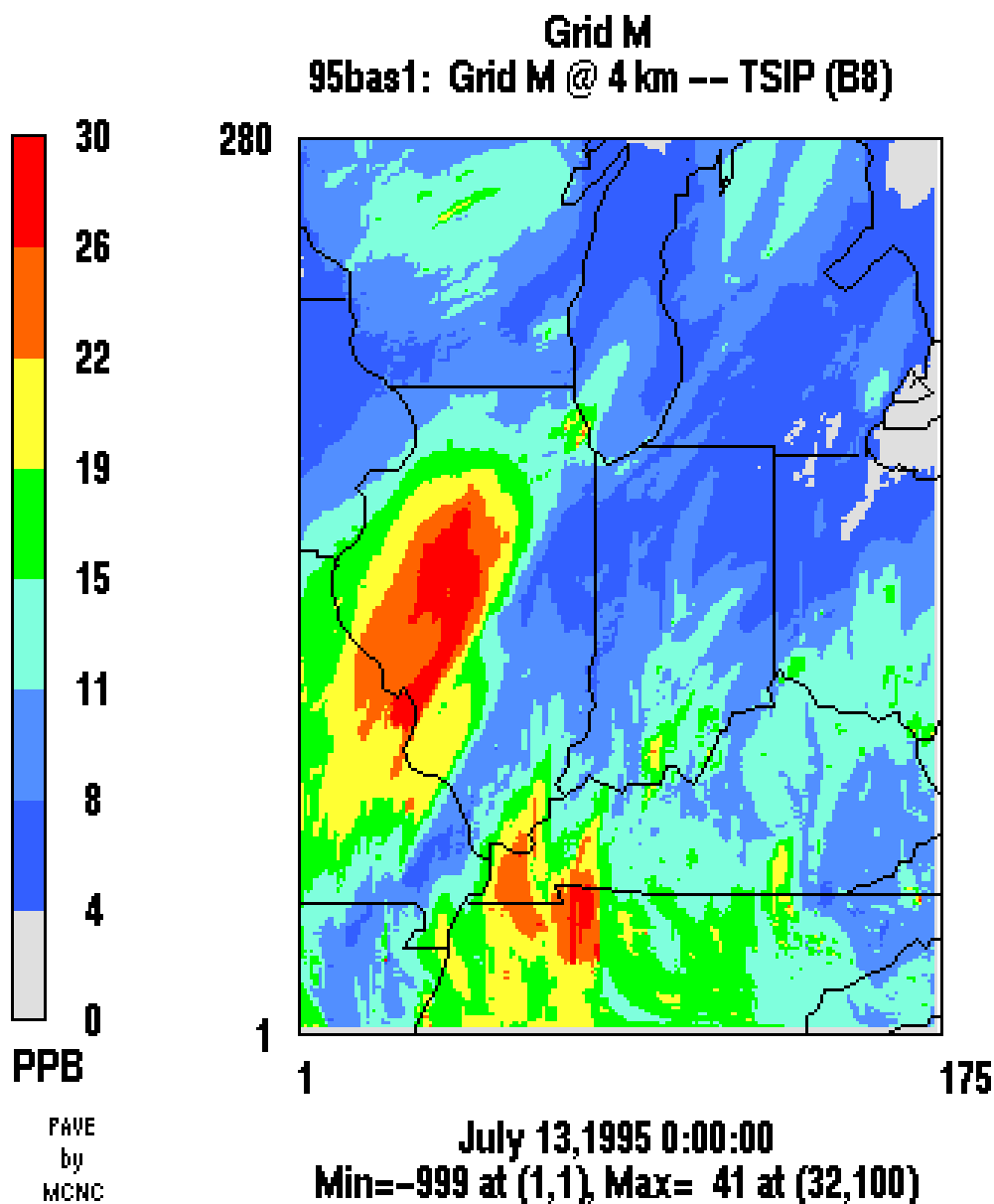
# Urban Airshed Model (UAM) Layer 1 (~50 m deep), 4 km Grid

## Peak 1-Hour Isoprene



# Urban Airshed Model (UAM) Layer 1, 4 km Grid

## Peak 1-Hour Formaldehyde

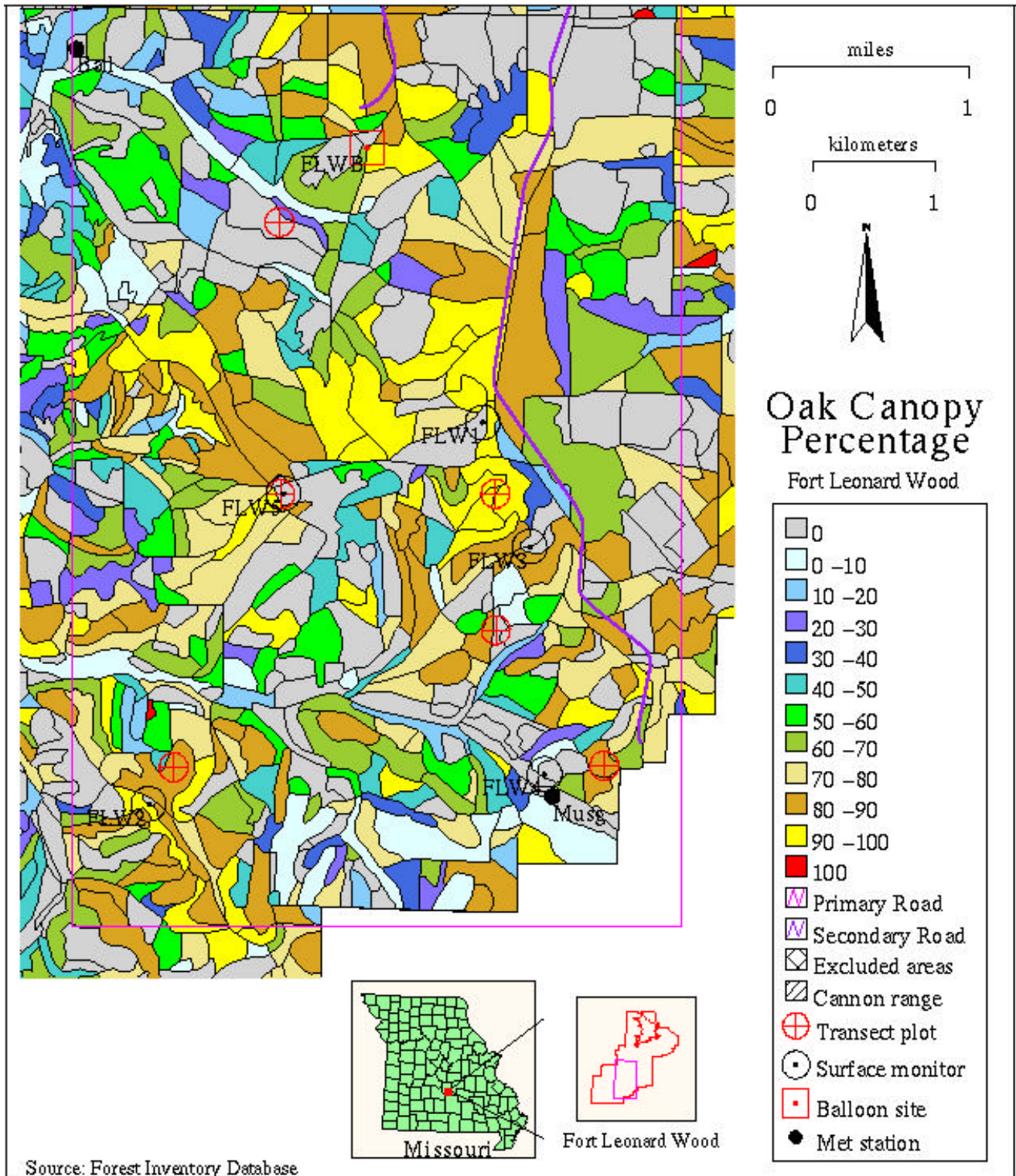


# Ozark Isoprene Experiment (OZIE) Study Locations

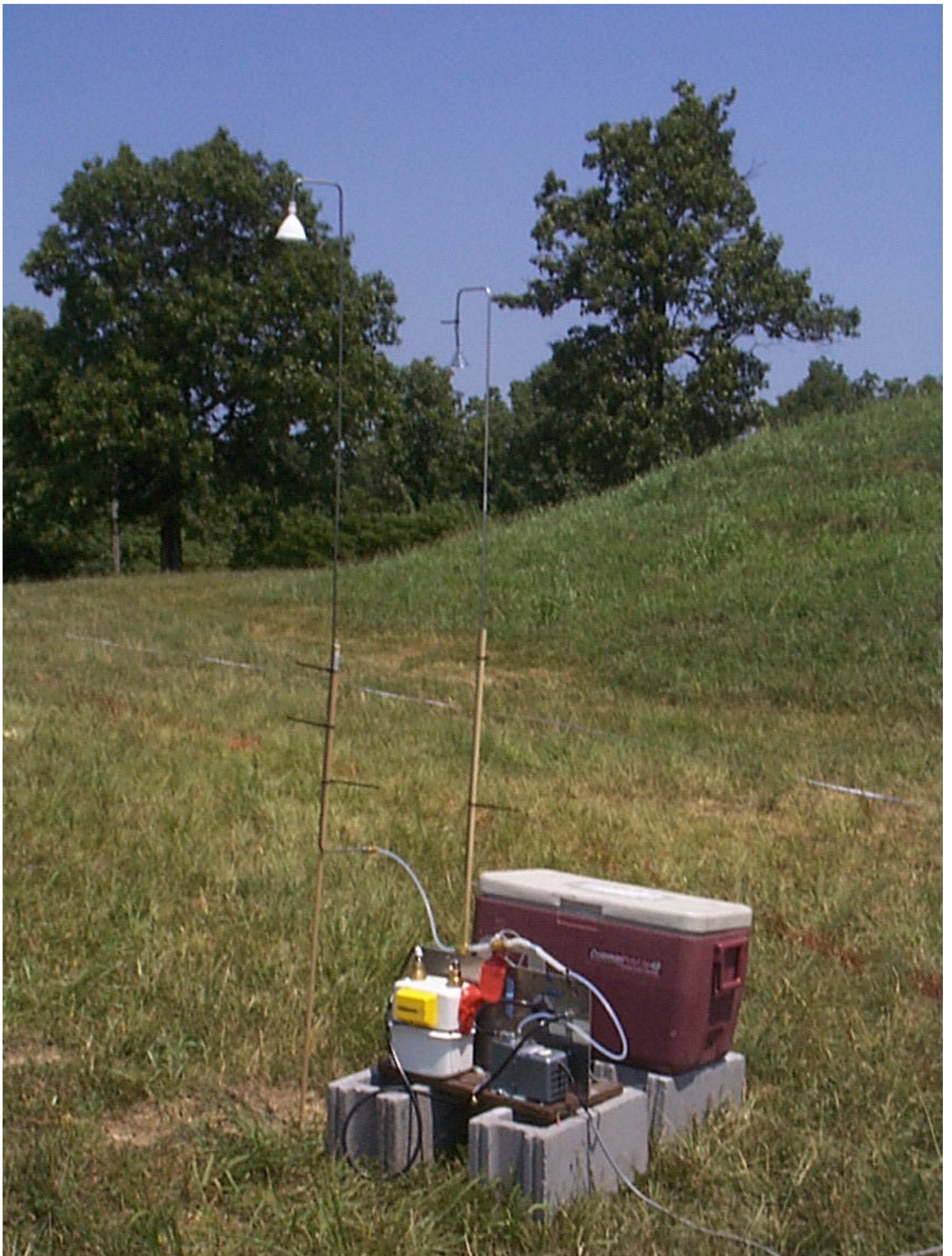


- |          |                 |
|----------|-----------------|
| Missouri | County boundary |
| Illinois | Study locations |
| Indiana  |                 |

# Ft. Leonard Wood measurement sites















## Summary of Surface Isoprene

Site	n	Mean	Range
Giant City, IL (7% oak, 8-24Jul)	41	32 ppbC	3-77 ppbC
Morgan-Monroe, IL (8% oak, 8-24Jul)	23	32 ppbC	12-76 ppbC
Ft. Leonard Wood, MO (34% oak, 9-20Jul)	69	54 ppbC	9-179 ppbC
Willow Springs, MO (36% oak, 21Jul)	16	75 ppbC	41-136 ppbC
Sinkin Creek, MO (53% oak, 22Jul)	17	75 ppbC	33-121 ppbC



# Photochemical Model used to Compare to OZIE Measurements

Model:	Models-3/Community Multiscale Air Quality Modeling (CMAQ) System
Domain:	Eastern North America 36 km horizontal resolution 21 vertical layers (layer 1 = ~38 m)
Chemistry:	CBIV w/ Carter isoprene
Meteorology:	MM5v2.10 <sup>+</sup>
Biogenic Emissions:	BEIS2.2
Simulation date:	12 July 1995* *similar to 18-21 July 1998

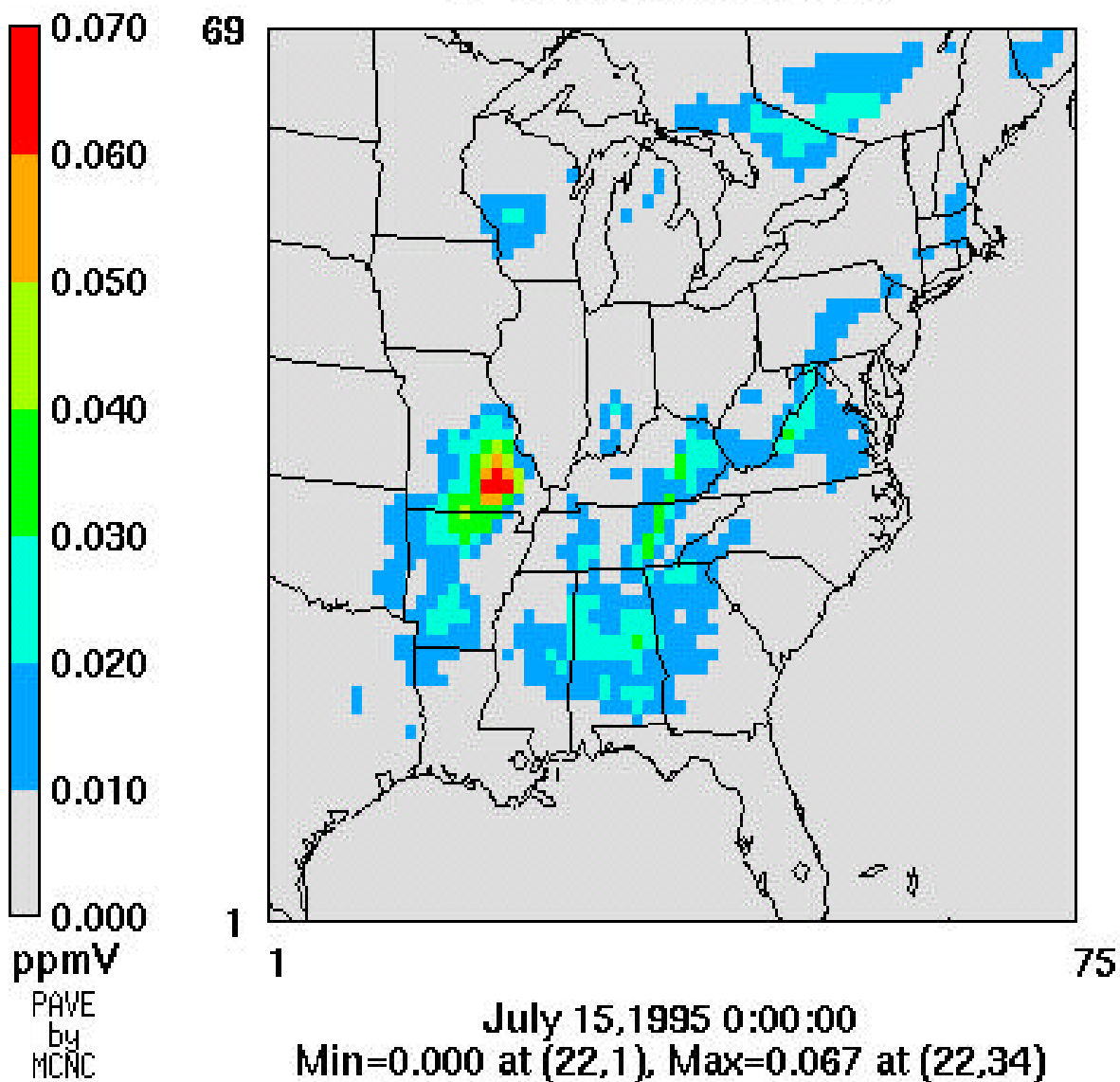




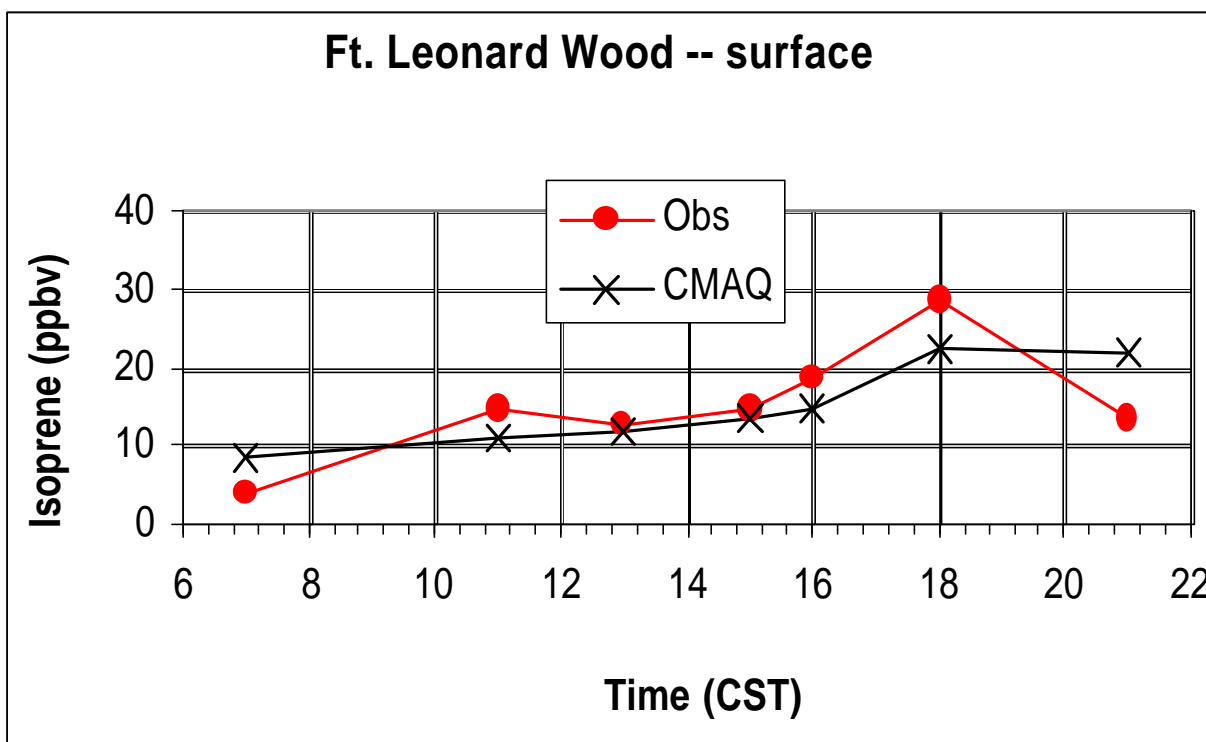
# CMAQ Prediction of Isoprene in Layer 1. Grid = 36 km, Layer 1 = 0-35 m.

## Layer 1 ISOPe

e=CCTM\_s1kCONC.s2j



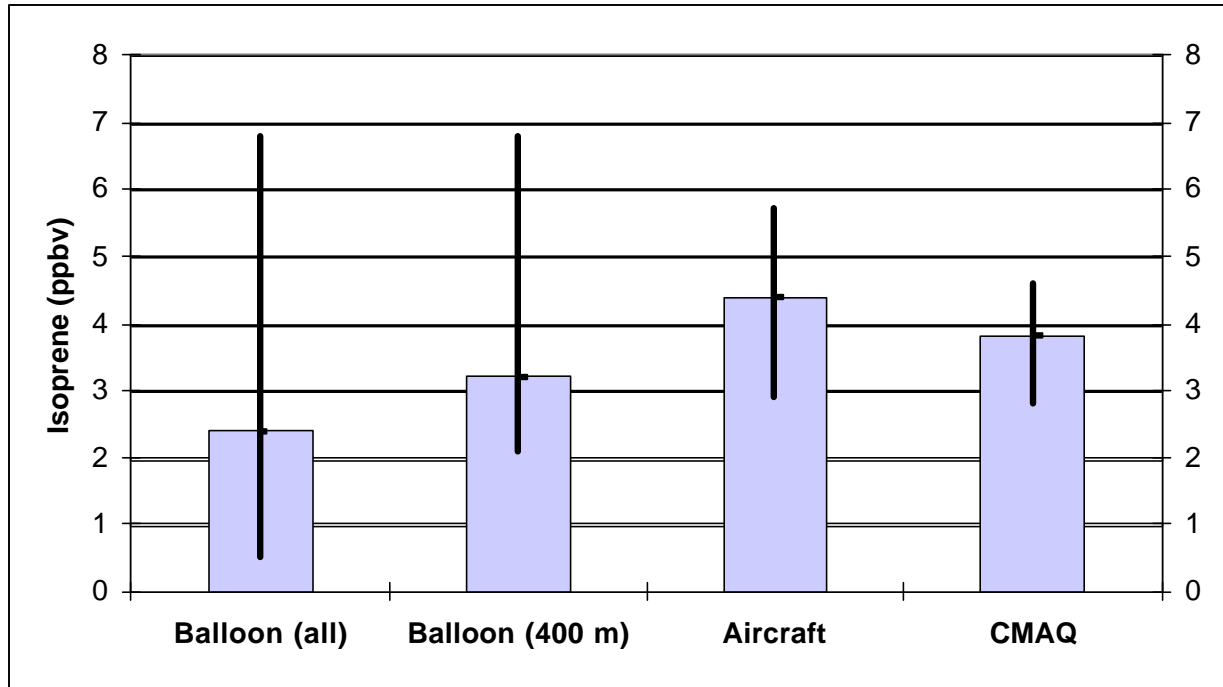
## Comparison of Near Surface Observed and Modeled Isoprene at FLW, Missouri



Obs: Average of 5 surface sites, 18-21Jul98

Model: Layer 1, 36-km grid centered over FLWood, 12Jul95,

## Comparison of Observed and Modeled Aloft Isoprene Concentrations at FLW



Aircraft obs: 450-900 m (agl), July 18-21, 18-20 GMT.

Balloon obs: 15/5 flights, 400-1000/400 m (agl).

CMAQ: model layers 8-11, 18-19 GMT, 12 July 1995,  
36-km grid cell centered on Ft. Leonard Wood.



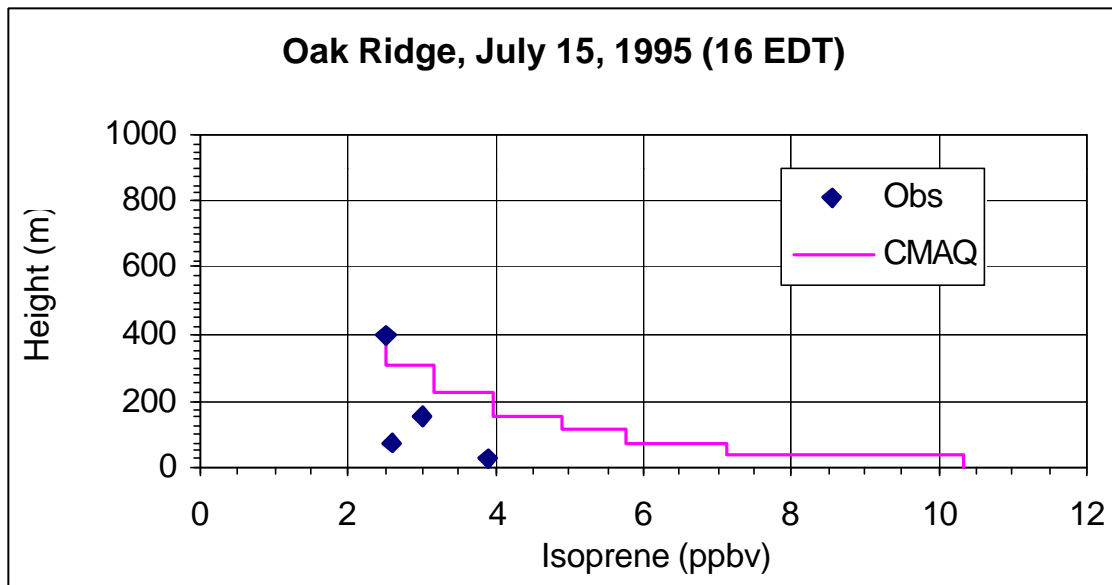
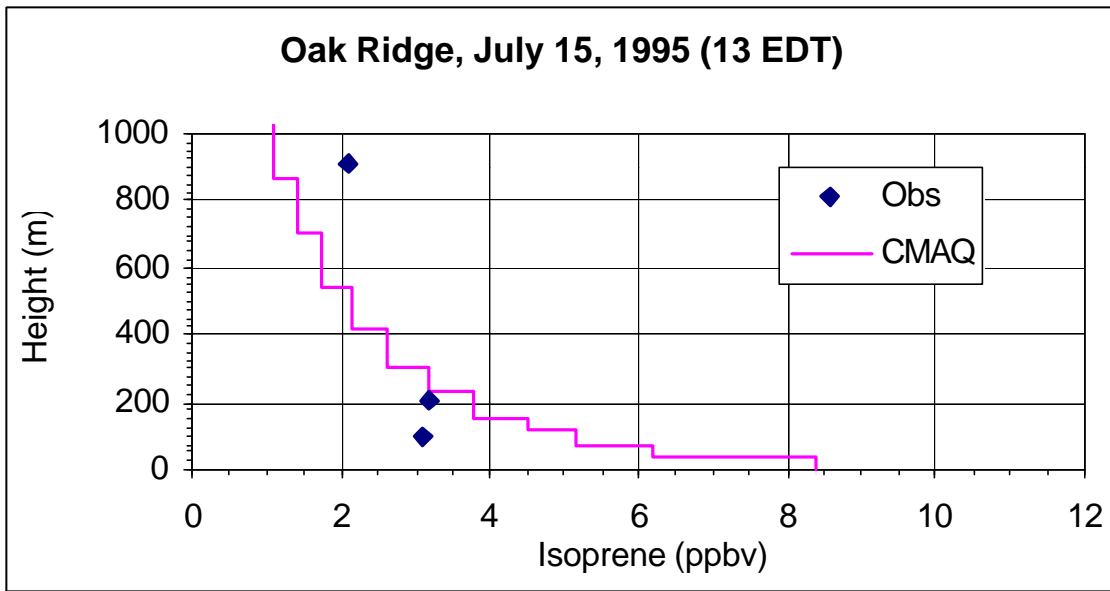
## Comparison of Tethersonde Measurements and CMAQ Predictions of Isoprene (ppbv) for Willow Springs and Sinkin Creek

Willow Springs	Obs (n=9)	CMAQ (18-22 GMT)	Sinkin Creek	Obs (n=7)	CMAQ (16-20 GMT)
Isop (ppbv)	2.4	8.5	Isop (ppbv)	3.2	12.6
Temp. (°C)	33.8	34.3	Temp (°C)	31.9	33.0
PAR ( $\mu\text{mol m}^{-2}\text{s}^{-1}$ )	1150	1683	PAR ( $\mu\text{mol m}^{-2}\text{s}^{-1}$ )	1300	1873

Tethersonde: ~200 m agl

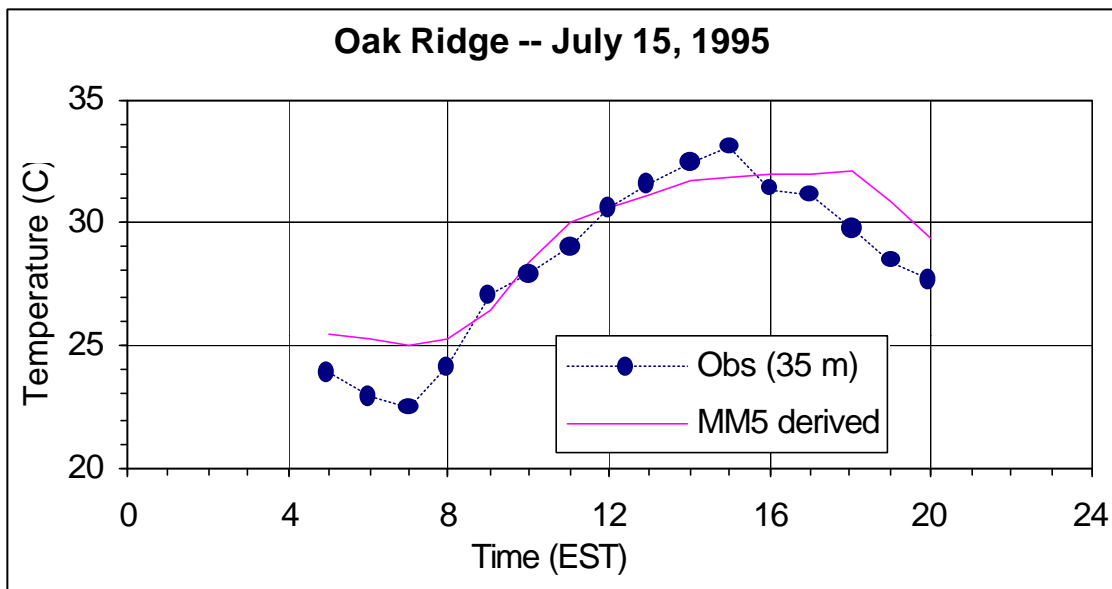
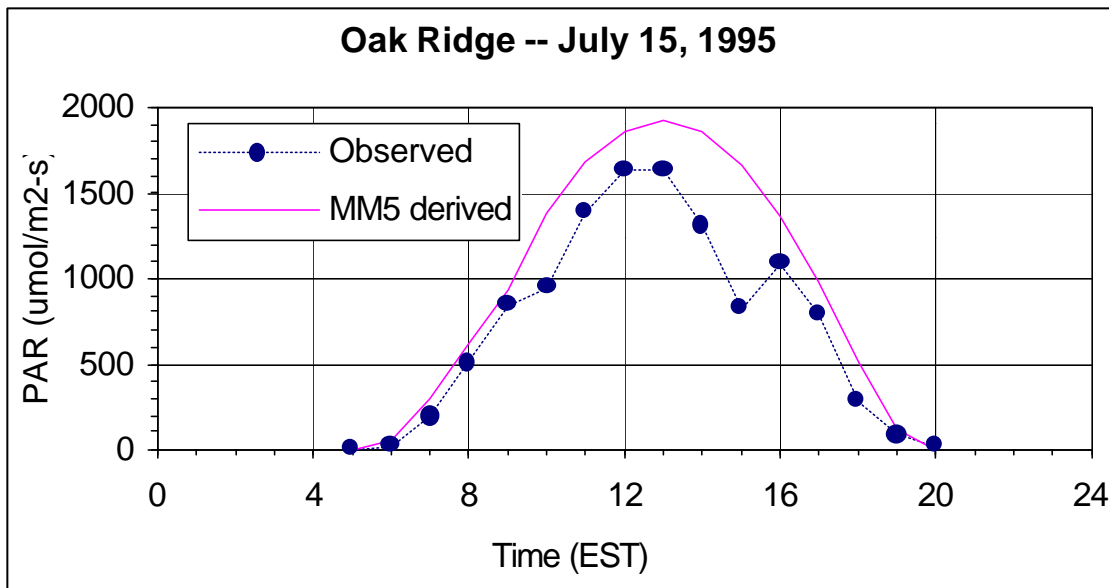
CMAQ: model layer 5 (150-220 m, 12 July 1995)

# Tethersonde Measurements and CMAQ Predictions for Oak Ridge, TN



CMAQ: 36-km grid

# Comparison of Observed and Modeled Meteorology





# Summary

⇒ Relatively high isoprene concentrations (~75 ppbC) were measured at the surface sites in Missouri. CMAQ results are comparable, but UAM (4 km) results are more than x2 higher than observations.

⇒ Above Willow Springs and Sinkin Creek, CMAQ overestimated by >x3. This may be due partially to poor treatment of meteorology.

⇒ Above Ft. Leonard Wood, CMAQ and observed isoprene compared favorably (w/in the range observed by the aircraft and the balloon). UAM (4 km) is ~x2 higher.



# Summary

(continued)

⇒ CMAQ comparisons have neither disproved nor confirmed abnormally high isoprene predictions. However, preliminary UAM comparisons clearly show overestimates. Possible model problems include meteorology, vertical diffusion, and chemistry.

⇒ Caveats:

- (1) July 1995 simulation v. July 1998 obs.
- (2) Coarse grid resolution in the CMAQ model.
- (3) Representativeness of measurement footprint.



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[www.epa.gov/asmdnerl/biogen.html](http://www.epa.gov/asmdnerl/biogen.html)