

# **Ozone and PM<sub>2.5</sub> Forecasting**

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**Louisville, Jefferson County, Kentucky**

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**November 14, 2007**

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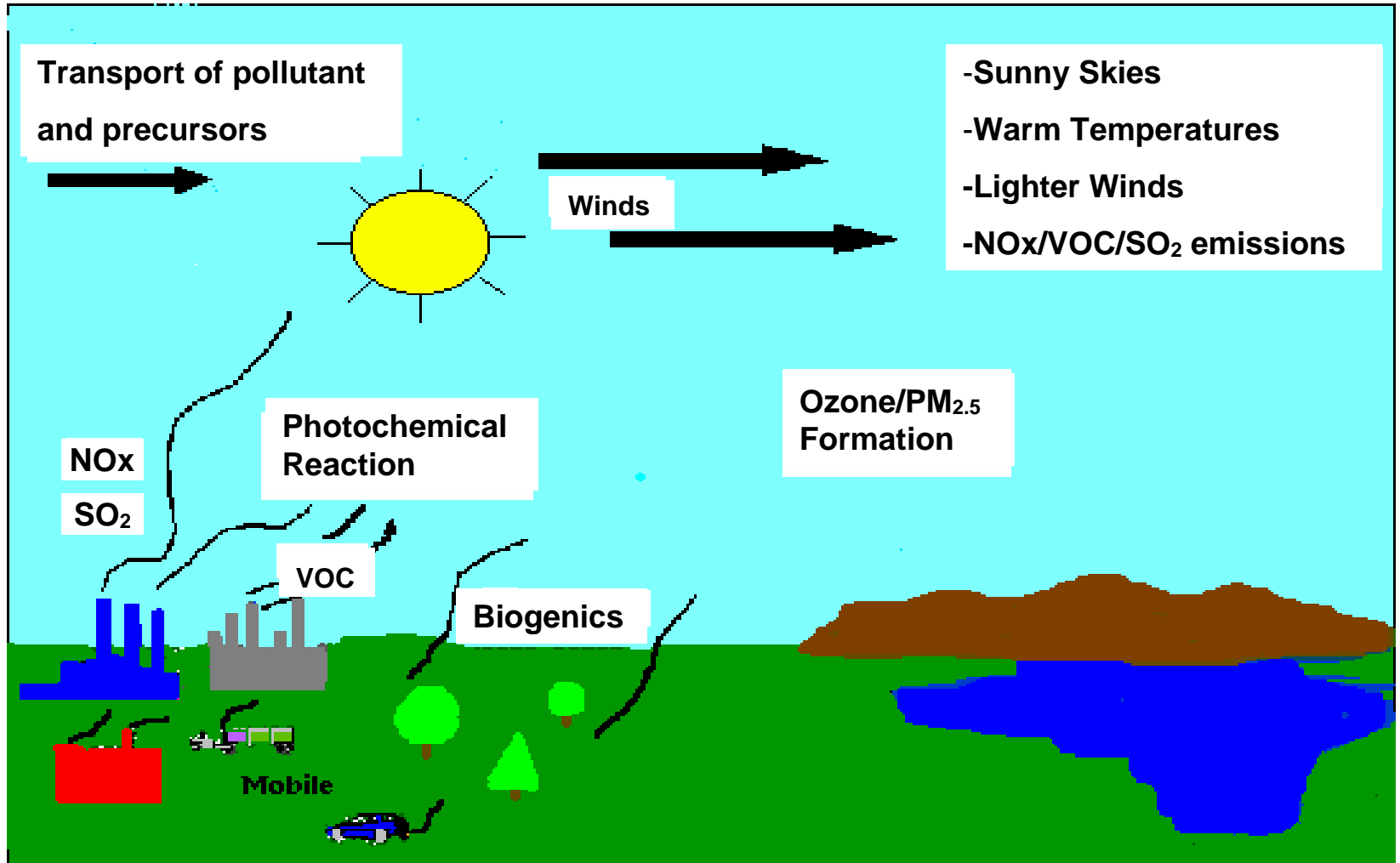
## **Ozone /PM<sub>2.5</sub> Forecasting Team**

- **Forecasting team consists of Indiana Department of Environmental Management-Office of Air Quality staff and County/Local Agency staff from Jefferson County, Evansville and Indianapolis.**
- **IDEM-OAQ staff have Atmospheric Science degrees from Purdue**
- **IDEM has been involved in air quality forecasting since 1995 (1-hour ozone standard of 125 parts per billion (ppb) only)**
- **IDEM is also involved with the Lake Michigan Air Director's Consortium (LADCO) forecasting for the Lake Michigan area**
- **County and Local Agency involvement is key for more accurate forecasting in providing invaluable historical and statistical analysis to aid in forecasting as well as review of forecasting tools to come up with more area-specific forecasting.**

# **Meteorological Parameters for Ozone /PM<sub>2.5</sub> Development**

- **Meteorological parameters that are conducive for ozone and/or fine particles (PM<sub>2.5</sub>) development and transport include:**
  - **Hot temperatures (for ozone)**
  - **Stagnant conditions at the surface/lower atmosphere**
  - **Ridging in the upper atmosphere**
  - **Wind directions and lower wind speeds**
  - **Humidity/water vapor**
  - **Clouds**
  - **Rain**
  - **Atmospheric pressure**
  - **Tropical weather systems**

# Ozone and PM<sub>2.5</sub> Formation



# **Forecasting Tools Used for Ozone /PM<sub>2.5</sub> Forecasting**

- **Text forecasts from National Weather Service (NWS)**
- **Surface and upper air maps**
- **Numerical forecasts for different cities**
- **Previous day's ozone and PM<sub>2.5</sub> concentrations**
- **Back trajectories from National Oceanic and Atmospheric Administration (NOAA)**
- **Ozone forecasting model results from NOAA/EPA joint venture and University of Louisville (Dr. Cobourn)**
- **PM<sub>2.5</sub> forecasting model results from National Weather Service**

# Example NWS Text Forecast for Louisville (taken from 10/31/07)

**Today:** Mostly sunny, with a high near 70. South wind between 7 and 13 mph, with gusts as high as 24 mph.

**Tonight:** Mostly cloudy, with a low around 45. Southwest wind 7 to 11 mph becoming north. Winds could gust as high as 20 mph.

**Thursday:** Mostly cloudy, then gradually becoming sunny, with a high near 61. North wind between 8 and 10 mph.

**Thursday Night:** Mostly clear, with a low around 39. North wind between 4 and 7 mph becoming calm.

**Friday:** Sunny, with a high near 62. Calm wind becoming northeast around 6 mph.

**Friday Night:** Partly cloudy, with a low around 42.

**Saturday:** Mostly sunny, with a high near 62.

**Saturday Night:** Partly cloudy, with a low around 41.

**Sunday:** Mostly sunny, with a high near 61.

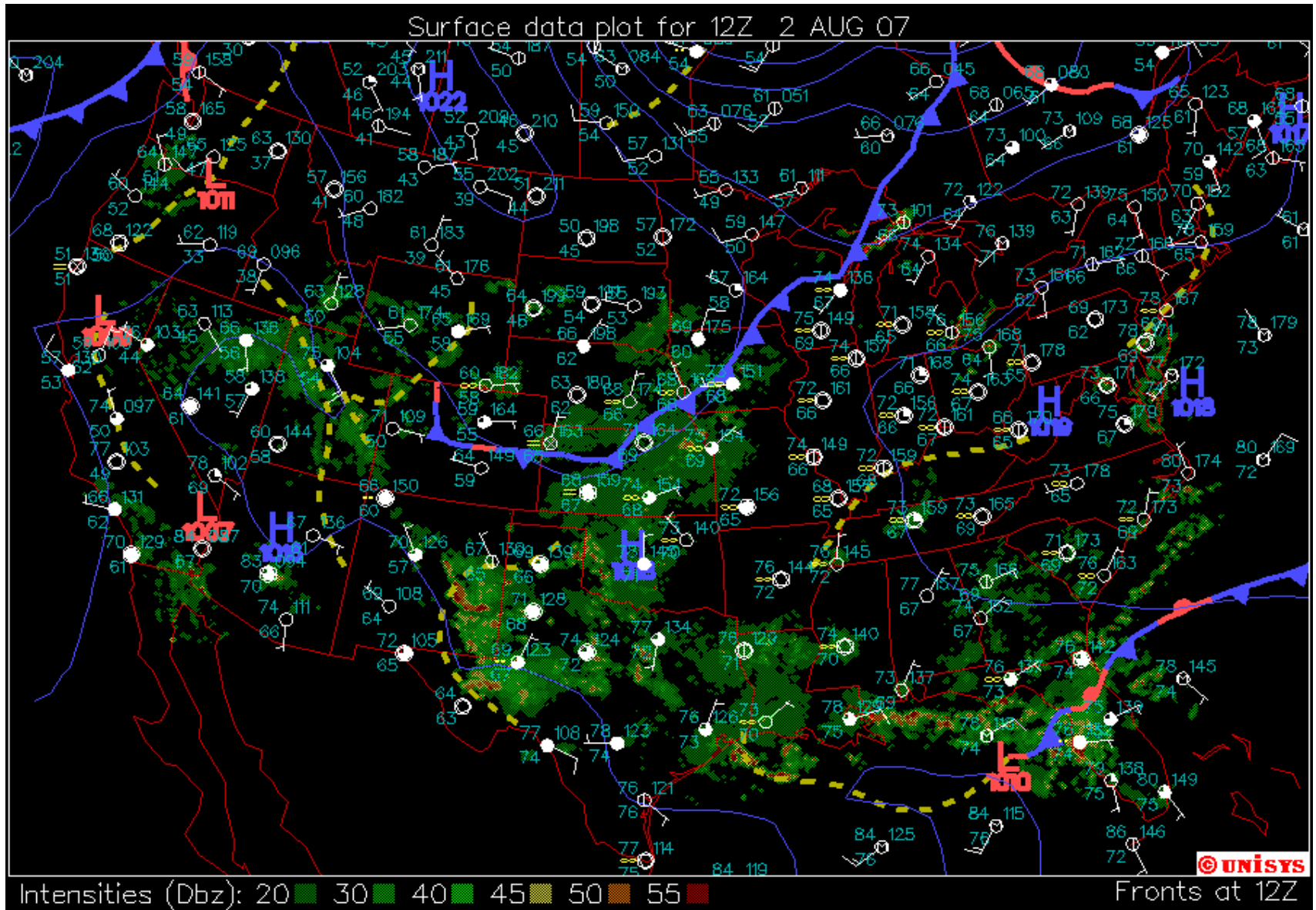
**Sunday Night:** Partly cloudy, with a low around 44.

**Monday:** Mostly sunny, with a high near 66.

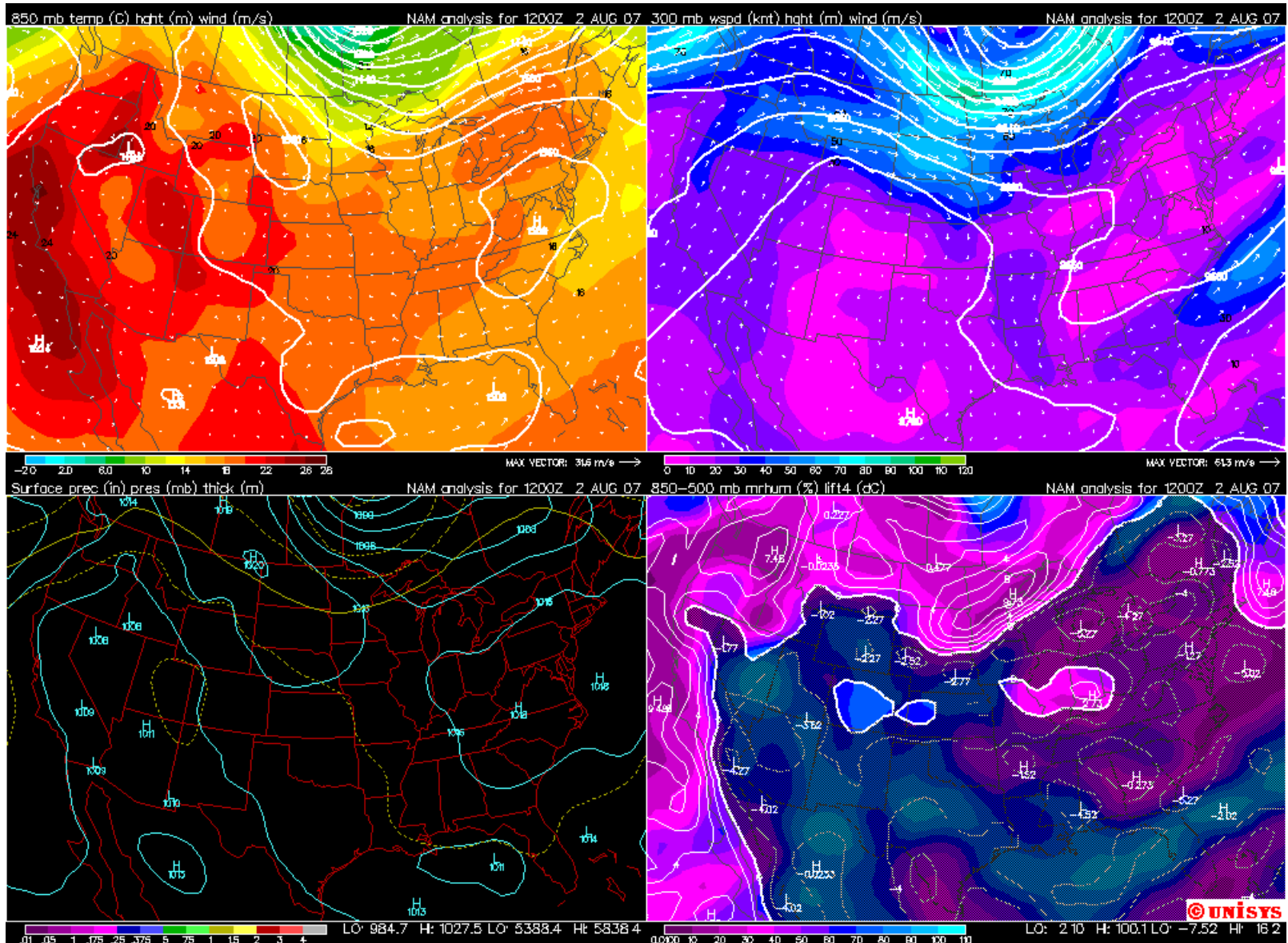
**Monday Night:** A 20 percent chance of showers. Mostly cloudy, with a low around 46.

**Tuesday:** A 20 percent chance of showers. Mostly cloudy, with a high near 57.

# Surface map from August 2, 2007



# Upper Air Maps from August 2, 2007

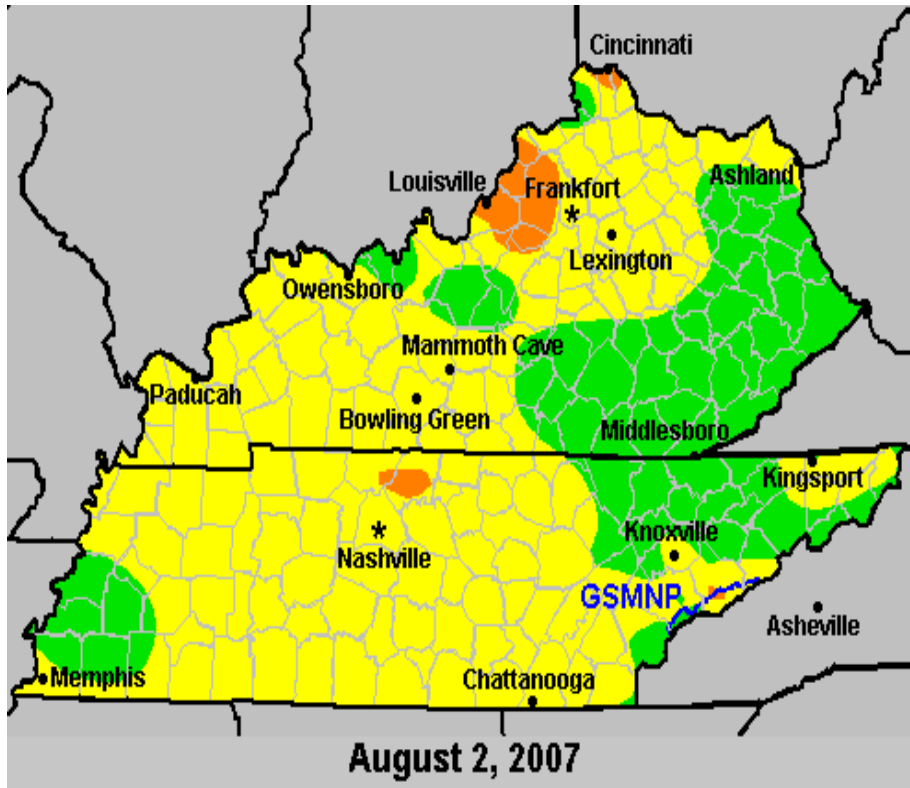


# Numerical Forecast for Louisville for August 2, 2007

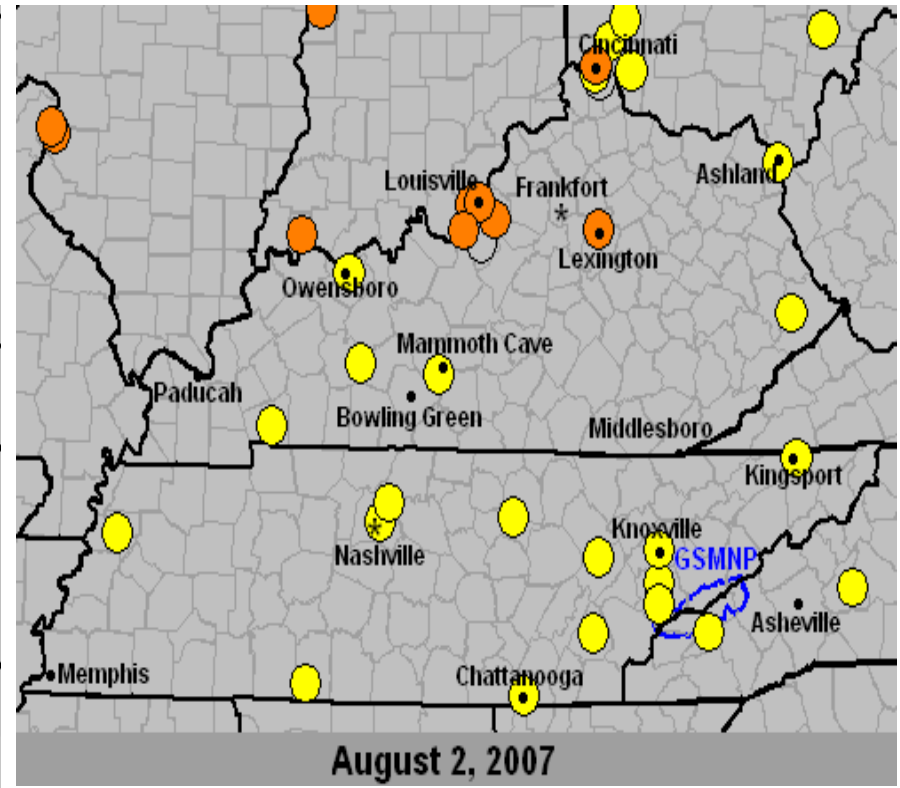
- GFS MOS FORECASTS
- KSDF GFS MOS GUIDANCE 8/02/2007 0600 UTC
- DT /AUG 2 /                    AUG 3 /                    AUG 4 /
- HR 12 15 18 21 00 03 06 09 12 15 18 21 00 03 06 09 12 15 18 00 06
- X/N 97 73 96 74 94
- TMP 75 88 95 95 91 85 79 76 77 90 94 94 91 84 79 76 77 86 91 89 77
- DPT 66 66 63 62 63 66 68 68 68 68 64 63 64 67 68 68 69 68 65 66 69
- CLD CL CL FW SC SC FW CL CL SC CL SC SC FW CL FW CL FW FW SC BK FW
- WDR 11 23 25 23 24 20 21 22 25 26 28 26 27 24 31 03 24 22 25 26 18
- WSP 02 02 05 06 06 03 03 02 02 03 05 06 06 03 02 01 02 03 05 07 04
- P06 0 1 0 8 3 0 3 8 16 6 13
- P12 1 8 8 8 26
- Q06 0 0 0 0 0 0 0 0 0 0 0
- Q12 0 0 0 0 0
- T06 3/ 0 2/ 1 4/ 0 5/ 0 6/ 0 17/ 2 9/ 0 12/ 0 10/ 0 12/ 0
- T12 4/ 1 9/ 0 22/ 2 14/ 0 27/ 2
- CIG 8
- VIS 5 7 7 7 7 7 6 7 7 7 7 7 7 7 7 7 6 7 6 7 7
  
- OBV BR N N N N N N N N N N N N N N N HZ N HZ N N

# AIRNOW 8-Hour Ozone and 24-hour PM<sub>2.5</sub> for August 2, 2007

Ozone

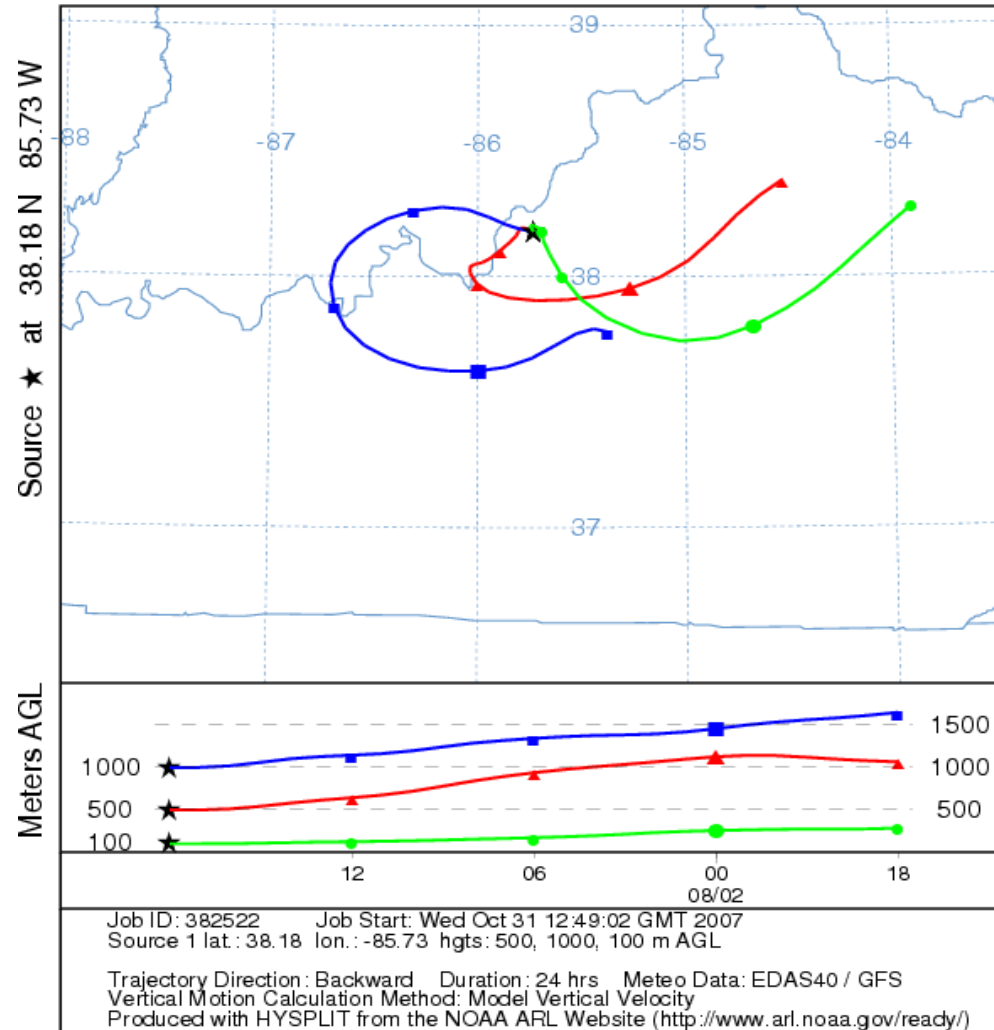


PM<sub>2.5</sub>



# Back Trajectory for August 2, 2007

NOAA HYSPLIT MODEL  
Backward trajectories ending at 18 UTC 02 Aug 07  
EDAS Meteorological Data



# University of Louisville – Dr. W. Geoffrey Cobourn’s

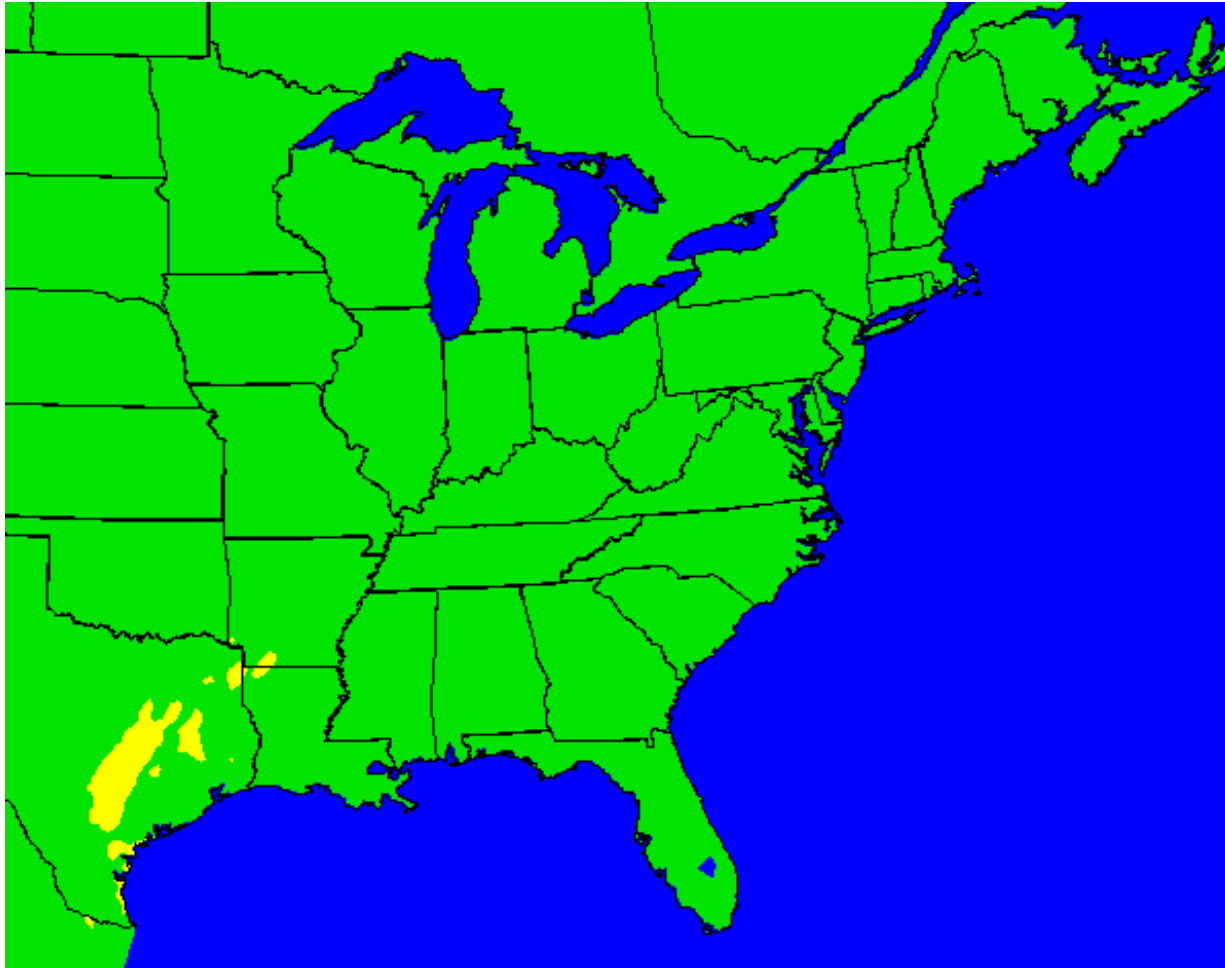
## 8-Hour Ozone Prediction Model

Month <b>AUG</b>	Day <b>2</b>	Day of Week <b>Thursday</b>	Year <b>2007</b>
WIND SPEED (mph) <b>CALM (0-3)</b>		MAX TEMP (F) <b>mid 90s</b>	
CLOUDS <b>CLEAR</b>		MIN TEMP (F) <b>low 70s</b>	
Thunderstorm Probability <b>NO CHANCE (0-10%)</b>		<b>Standard HiLo Hybrid</b>	
<b>8-hr peak: 97 (ppb)</b>		Selected Model <b>Hi_Lo</b> Air Quality <b>Unhealthy for Sensitive Groups</b>	

Air Quality	Good	Moderate	Unhealthy for Sensitive Groups	Unhealthy	Very Unhealthy
8-hr peak (ppb)	0 – 64	65 – 84	85 – 104	105 – 124	125+
AQI	0 – 50	51 – 100	101 – 150	151 – 200	200+

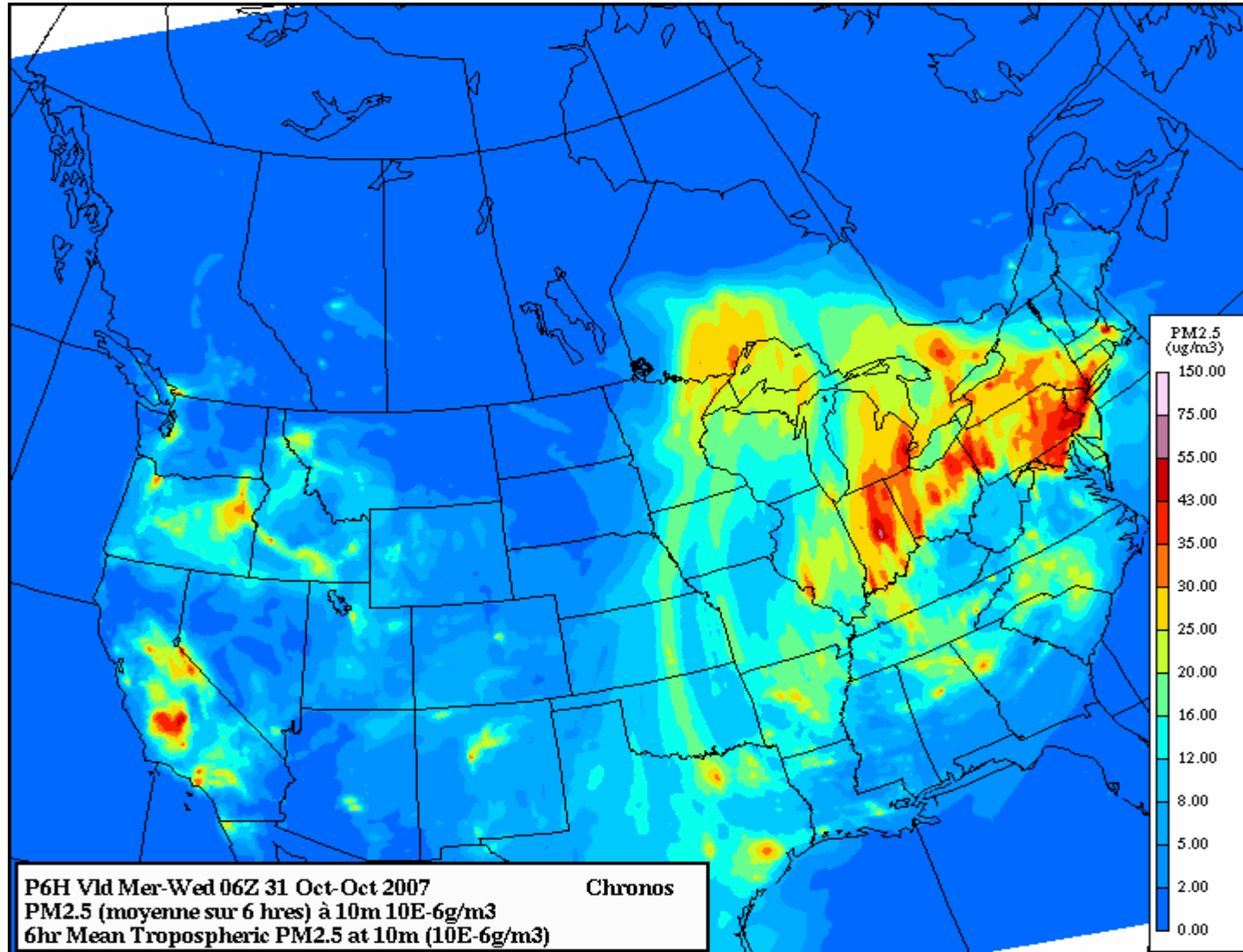
# NOAA-EPA Predicted Ozone Model for 10/31/07

- <http://www.airnow.gov/index.cfm?action=airnow.national>

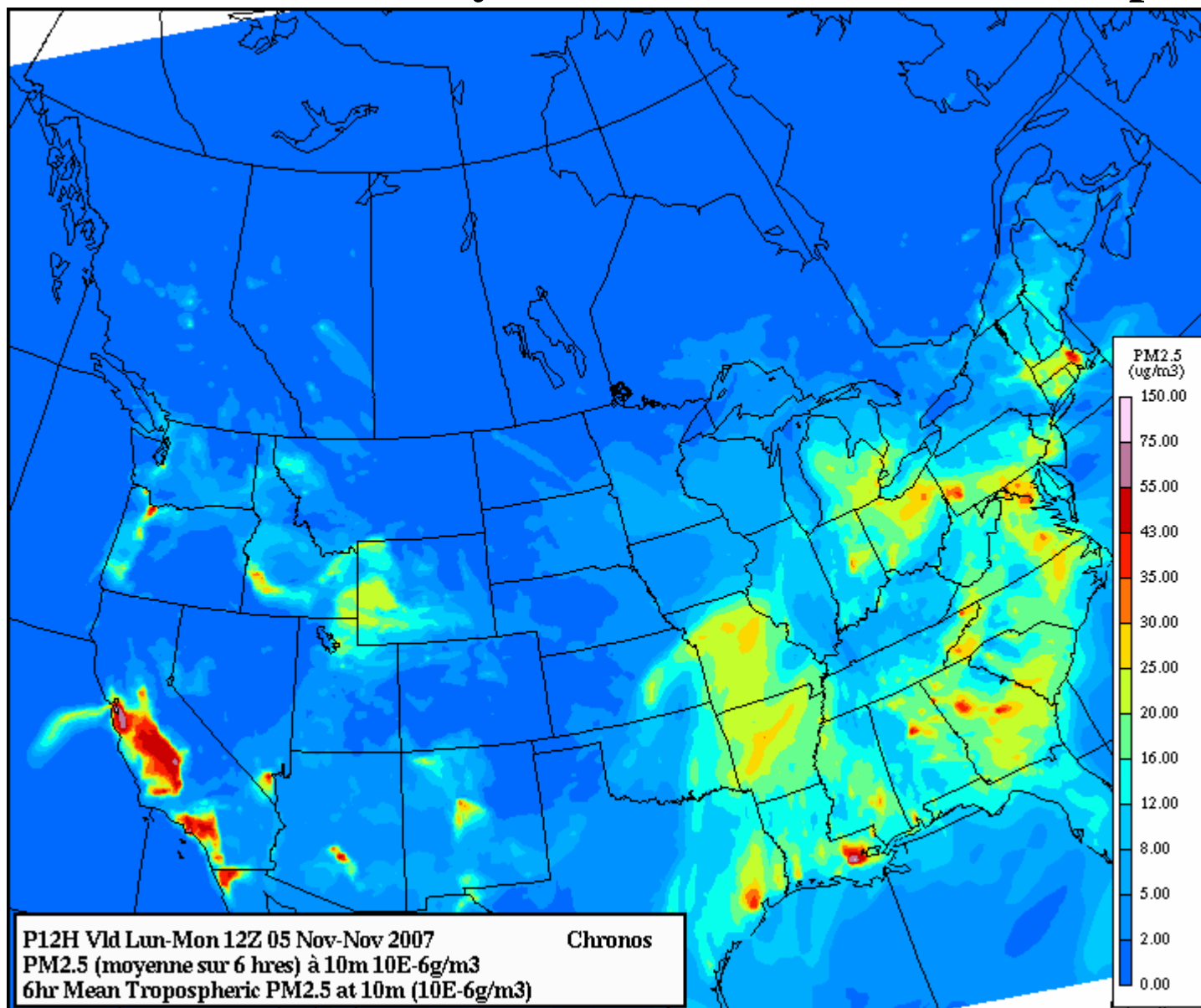


# CHRONOS PM<sub>2.5</sub> Model Forecasts for 10/31/07

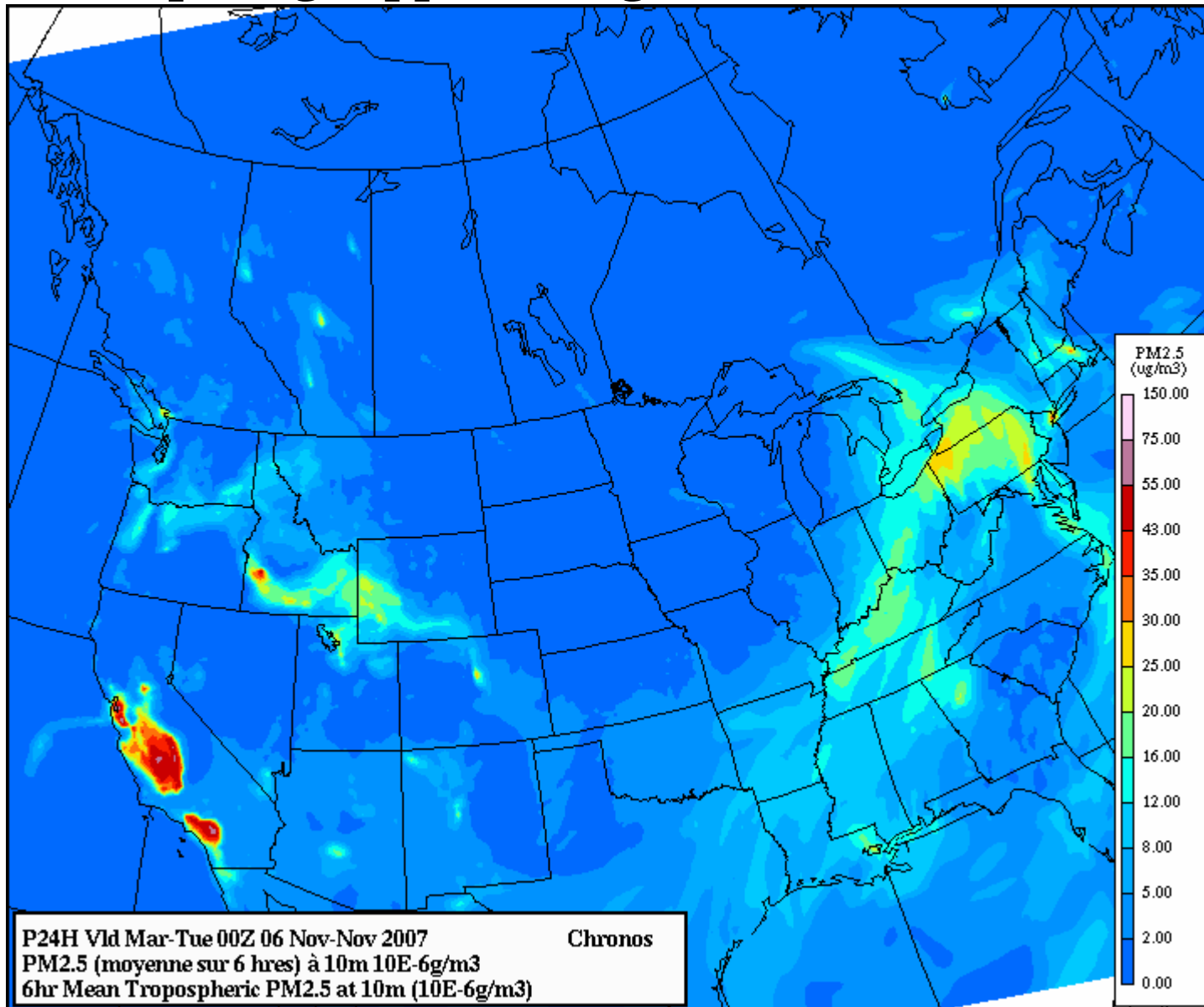
[http://www.msc-smc.ec.gc.ca/aq\\_smog/chronos\\_e.cfm](http://www.msc-smc.ec.gc.ca/aq_smog/chronos_e.cfm)



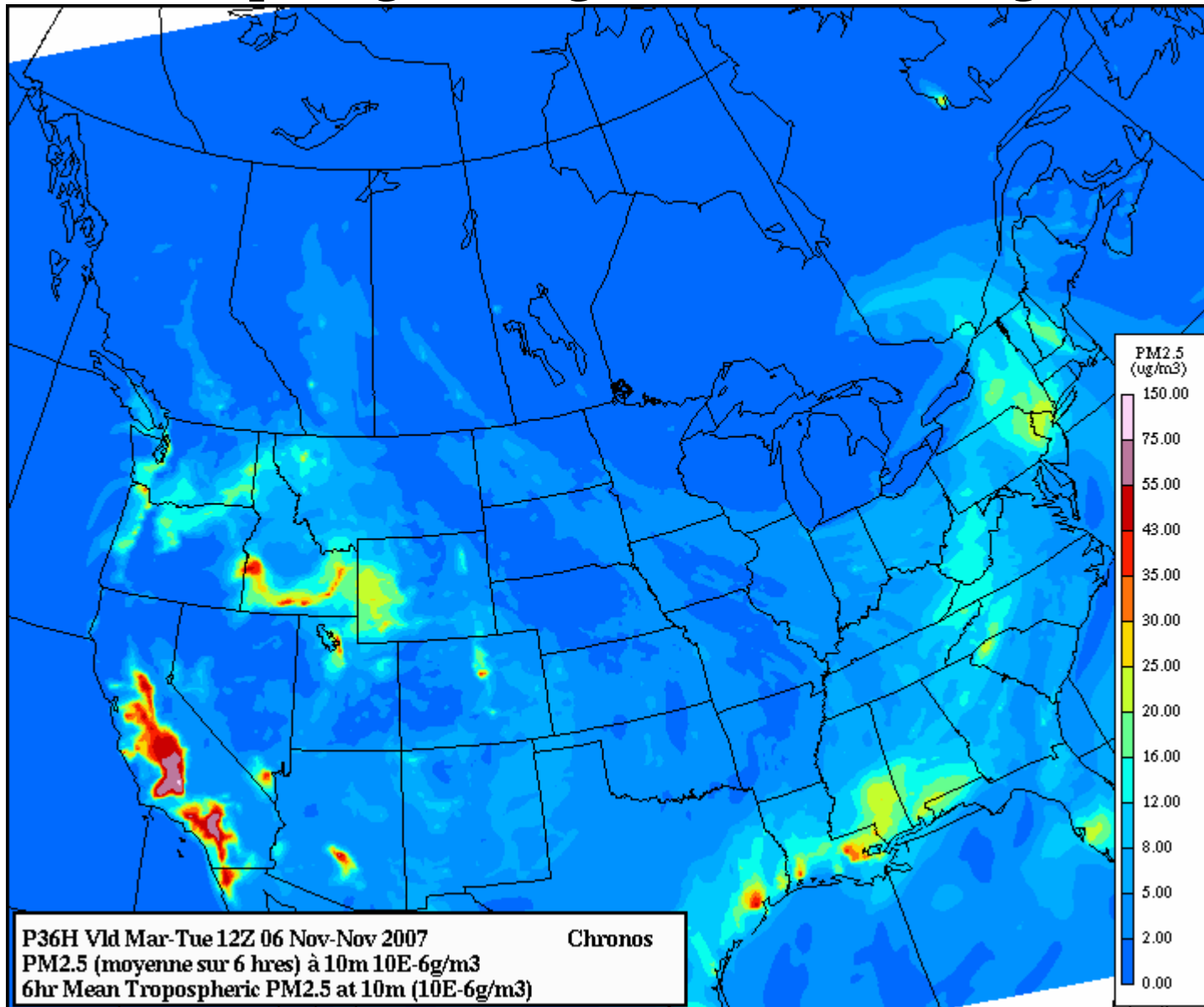
# Series of PM<sub>2.5</sub> daily concentrations forecast maps



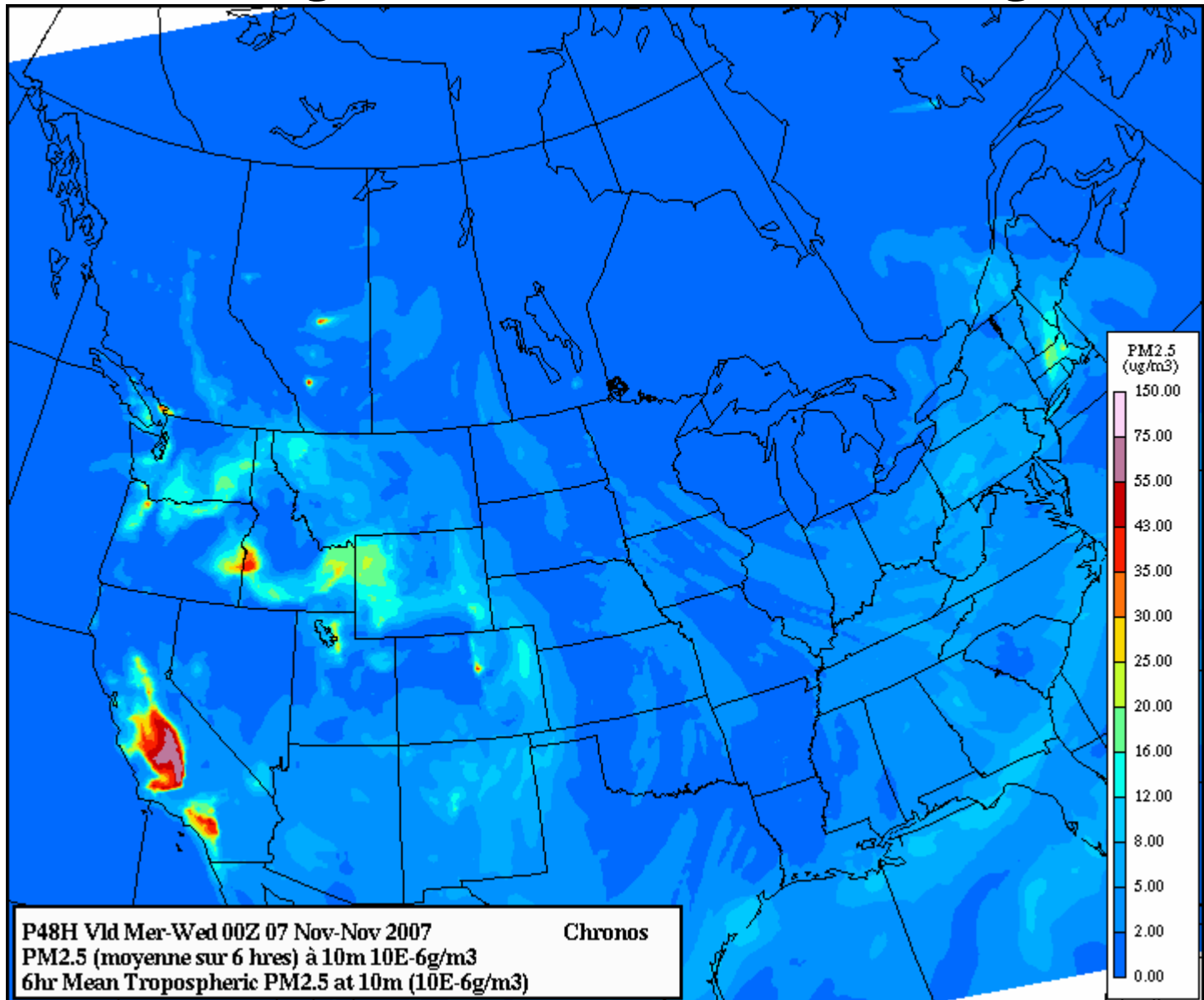
# Frontal passage approaching area with PM<sub>2.5</sub> clean out



# Frontal passage through entire forecasting area

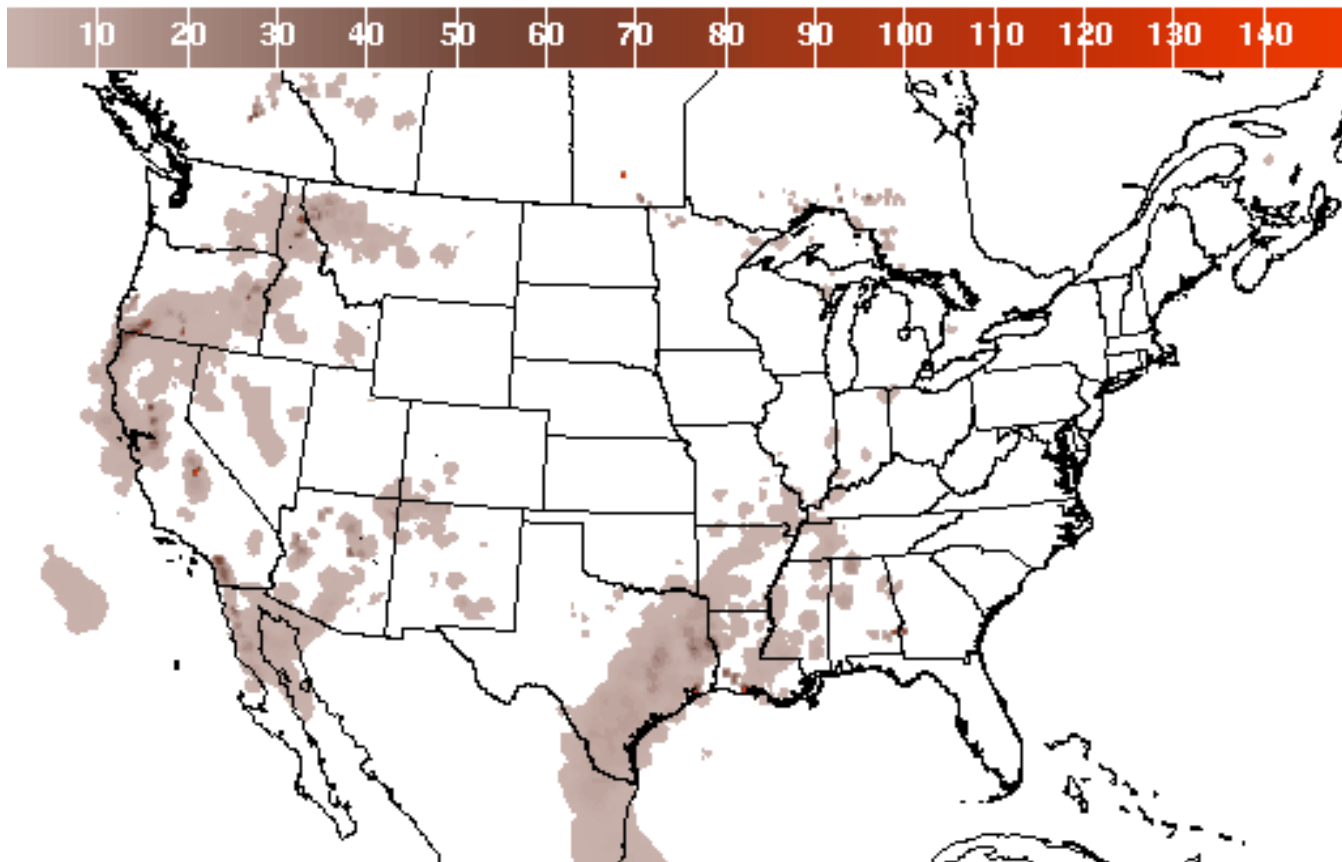


# Reinforcing shot of clean air in forecasting area



# NOAA/NWS Surface Smoke Concentration (10/31/07)

<http://www.weather.gov/aq/sectors/conus.php>



1Hr Surface Smoke (micrograms/m<sup>3</sup>) Wed Oct 31 2007 7PM EDT  
(Wed Oct 31 2007 23Z)



**National Digital Guidance Database**

6z model run      Graphic created-Oct 30 8:36AM EDT

## Ozone Standard

- **Current Ozone 8-hour Standard: 0.08 parts per million (85 parts per billion)**
- **Proposed Ozone 8-hour Standard: 70 to 75 parts per billion**

## PM<sub>2.5</sub> Standards

- **Current PM<sub>2.5</sub> Annual Standard: 15 micrograms per cubic meter**
- **Current PM<sub>2.5</sub> 24-hour Standard: 35 micrograms per cubic meter (old standard of 65 ug/m<sup>3</sup>)**

## Forecasting Challenges for Ozone/PM<sub>2.5</sub>

1. **Appears to be different atmospheric chemistry due to lower NO<sub>x</sub> emissions resulting from the NO<sub>x</sub> SIP Call in 2004**
2. **Highest ozone impacts found directly downwind from urban area.**
3. **Tougher to judge the 8-hour averages with lower 1-hour peaks**
4. **Transport of PM<sub>2.5</sub>**
5. **Local emissions impacts on PM<sub>2.5</sub>**
6. **Need to understand how humidity affects PM<sub>2.5</sub> development**