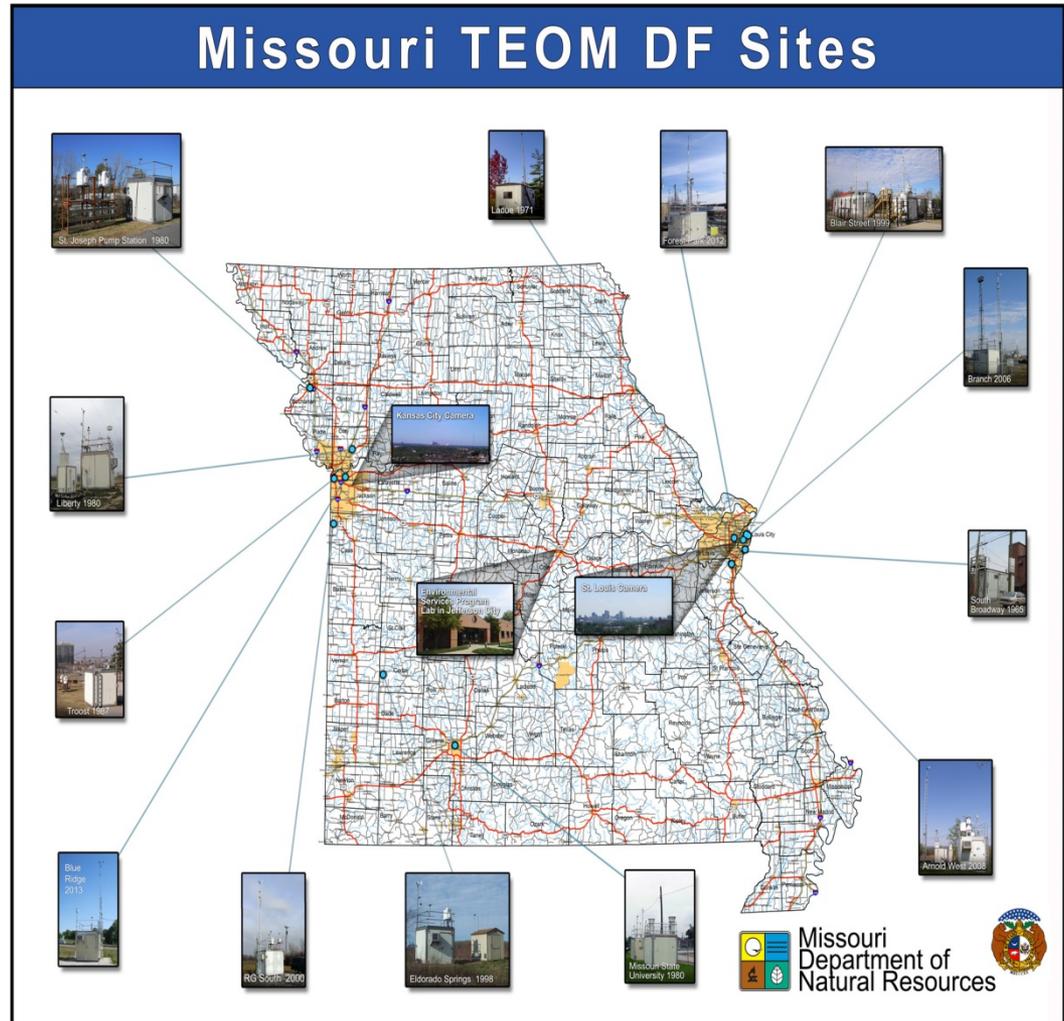


# A PM 2.5 Episode in Missouri

February 12-14, 2014



# General Outline

- Definitions
  - Inversion/stability
  - PM2.5 National Ambient Air Quality Standard (NAAQS)
- Affected Sites/Elevated Values
  - St. Louis Aerial/Ground Photos
  - Site Tables
  - Site Trends

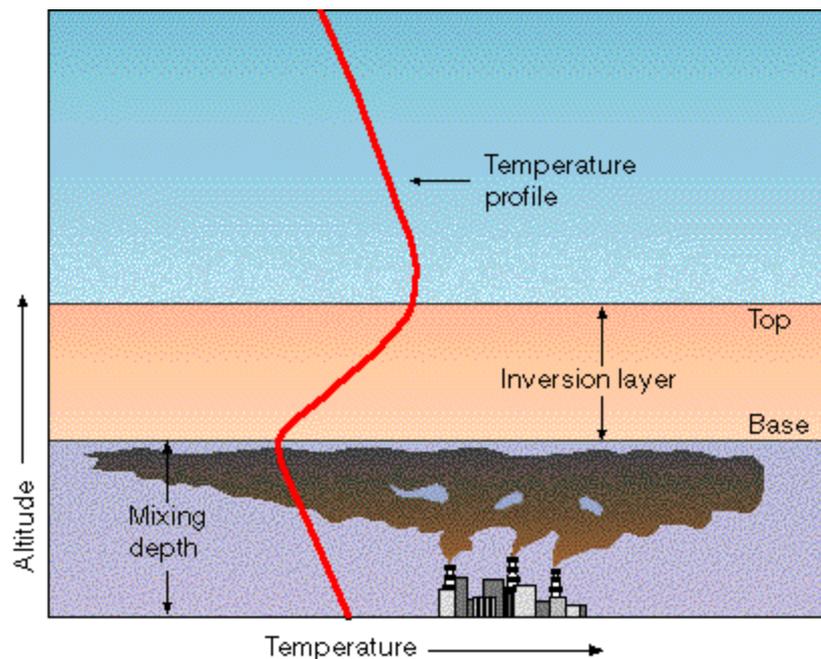
# General Outline Cont...

- **Influencing Factors/Observations**
  - National Weather Service (NWS) Area Forecast Discussions (AFD)
  - Surface Analyses
  - NWS Sounding Network
  - Storm Prediction Center (SPC) Mesoanalyses
  
- **Conclusions**
  - STL Winter Summary
  - Similar Analog Weather Events

# Inversion/Stability

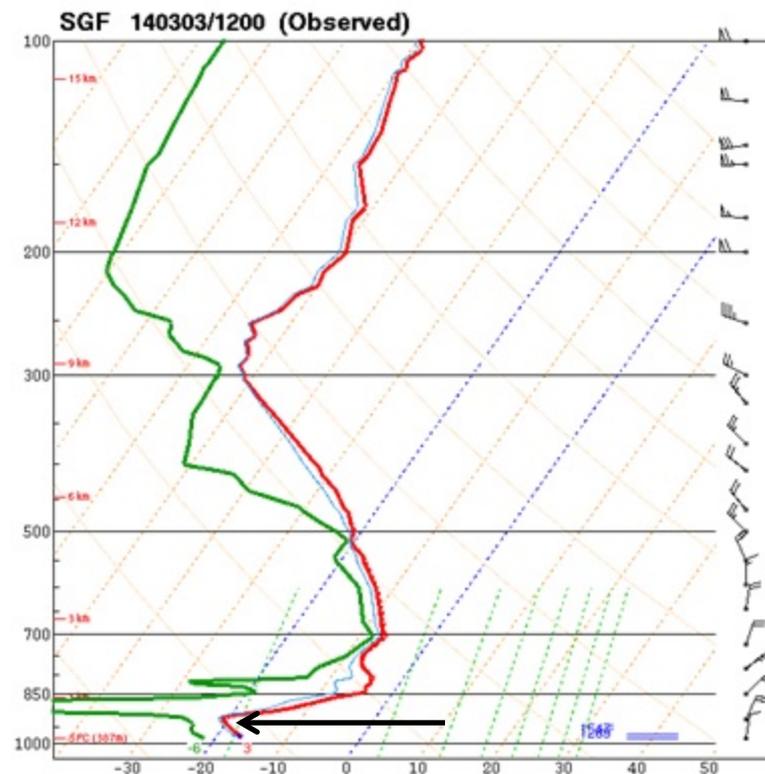
- A condition, in which the air temperature may actually increase with height (Ahrens, 2003).
  - → *Stable* Atmosphere = Reduced mixing of atmospheric properties
- Typically occur in the early morning hours, especially under clear skies (difference in cooling rates)
- Only increase in heating can neutralize or weaken the inversion (less stable).

## Inversion Effect



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## Inversion Example



# St. Louis Aerial Camera



# St. Louis Ground Perspective



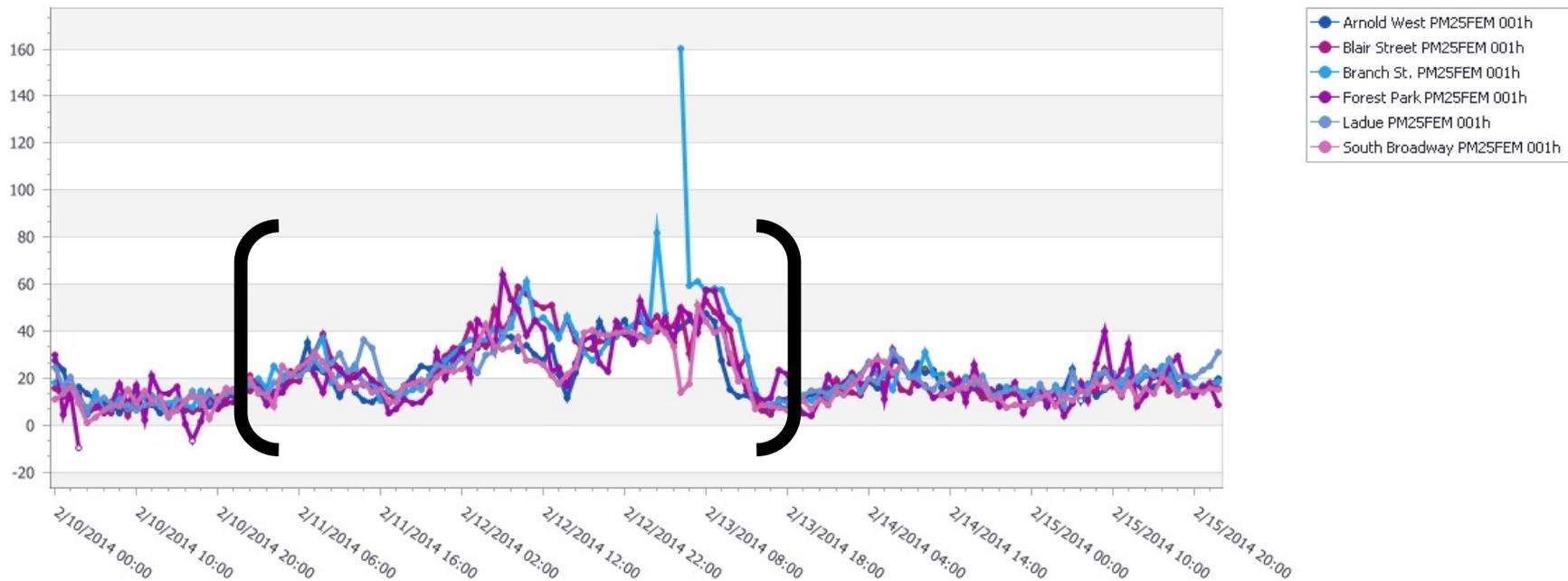
# Notes About the Following Data

- The DF site tables...**DAILY** averages...  
from 2-10-14 through 2-15-14
  - A **red** cell = Reached NAAQS Standard ( $35 \mu\text{g}/\text{m}^3$  for a 24 hour average)
  - \* = Not a whole 24-hour average, but still has more than 75% of data
- The DF site trends...**HOURLY** averages...  
from 2-10-14 through 2-15-14.
  - Extreme maxima/minima points skew plots.
  - Gaps in data (Instrument checks, power failures, etc).

# Saint Louis PM25 DF Site Table

	2/10/14	2/11/14	2/12/14	2/13/14	2/14/14	2/15/14
Arnold West	10.7	18.5	32.2	24.4	17.5	16.6
Blair Street	9.9	19.4	<b>41.3</b>	28.7	16.2 *	16.3
Branch Street	11.6	20.1	<b>39.0</b>	<b>39.3 *</b>	9.5 *	17.9
Forest Park	9.5 *	17.3	<b>35.0</b>	29.5	17.0	17.5
Ladue	11.6	21.6	<b>X</b>	<b>X</b>	18.2	19.6
South Broadway	10.3	18.3	31.5	22.9	16.8 *	14.4

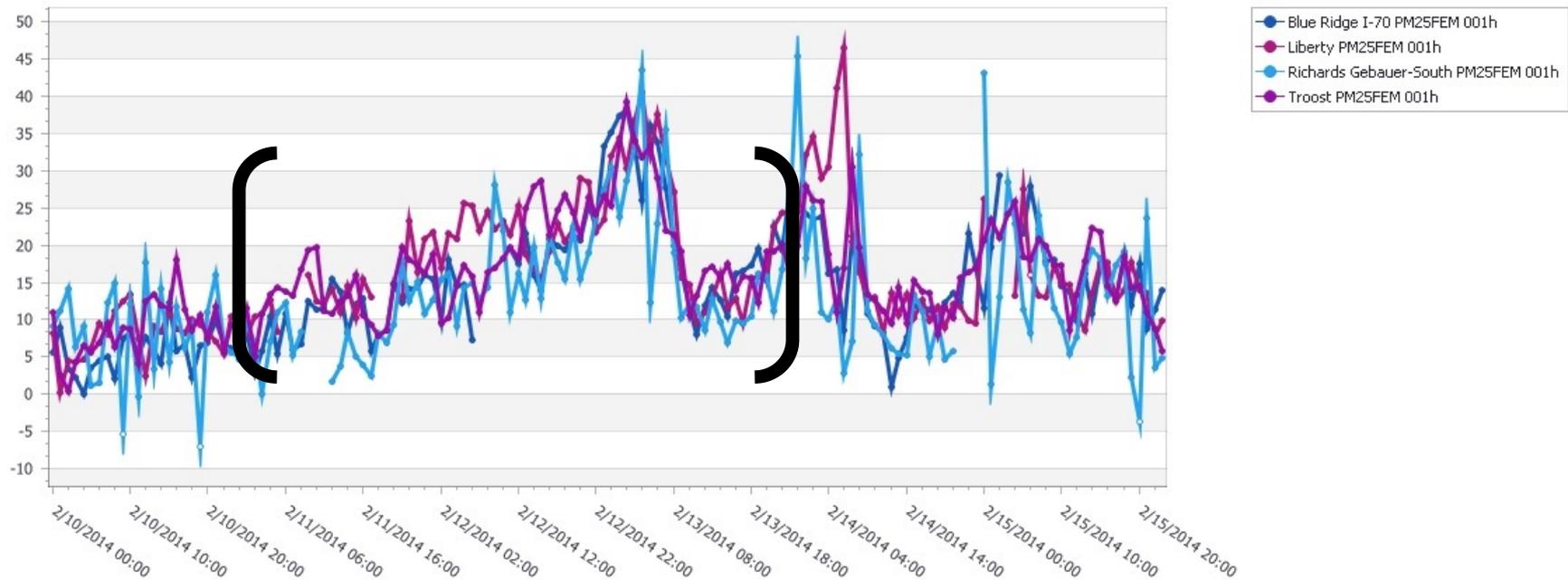
# St. Louis PM25 Trend



# KC, MO PM25 DF Site Table

	2/10/14	2/11/14	2/12/14	2/13/14	2/14/14	2/15/14
Blue Ridge	5.7	9.8	18.3 *	21.9	14.2	16.4 *
Liberty	7.9	12.9 *	22.1	22.3	18.5	15.0 *
RG South	7.7	7.7 *	16.9	18.2	12.4 *	14.2
Troost	8.7	13.2	20.0	21.3	16.2	17.1

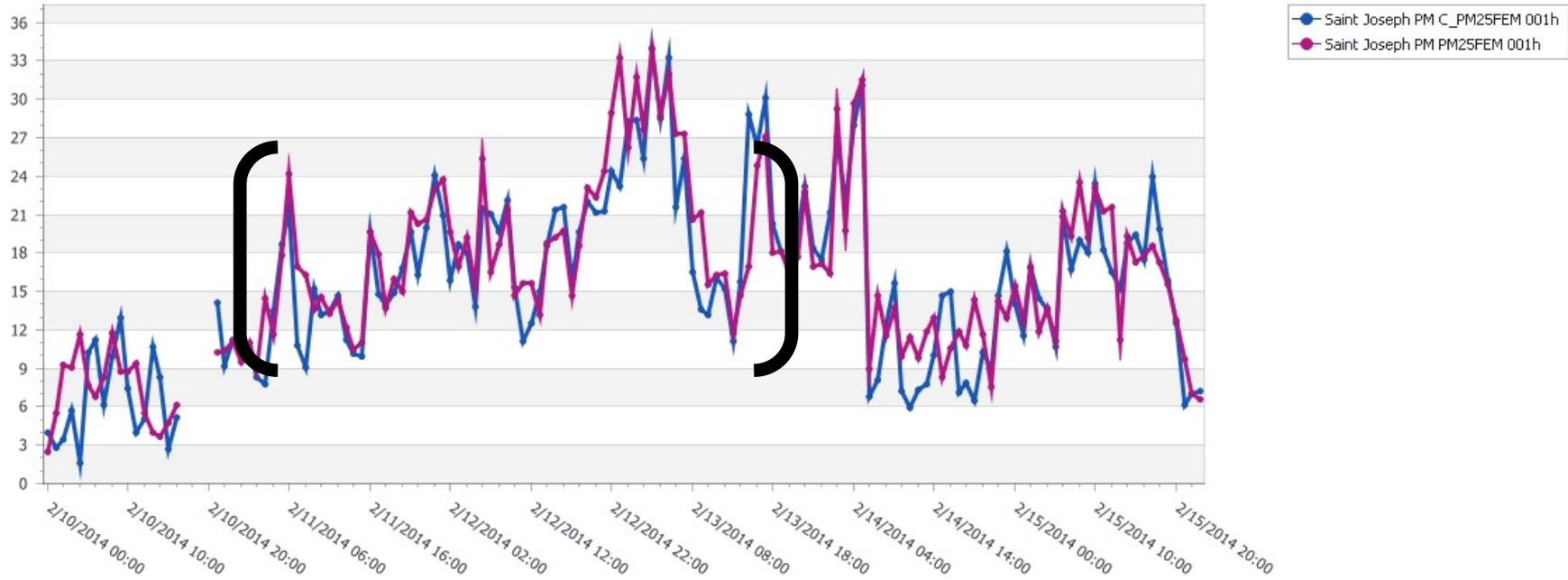
# Kansas City PM25 Trend



# Other Locations PM25 DF Site Table

	2/10/14	2/11/14	2/12/14	2/13/14	2/14/14	2/15/14
St. Joe Primary	7.8 *	15.2	20.1	22.1	14.6	16.0
St. Joe Collocate	7.3 *	13.9	19.1	22.0	13.8	15.7
El Dorado Springs	9.5	7.7	16.0 *	19.4	13.5	14.0 *
Missouri State	23.0	18.5 *	26.0 *	27.6	17.3	14.6

# Northwest MO PM25 Trend



# Southwest MO PM25 Trend



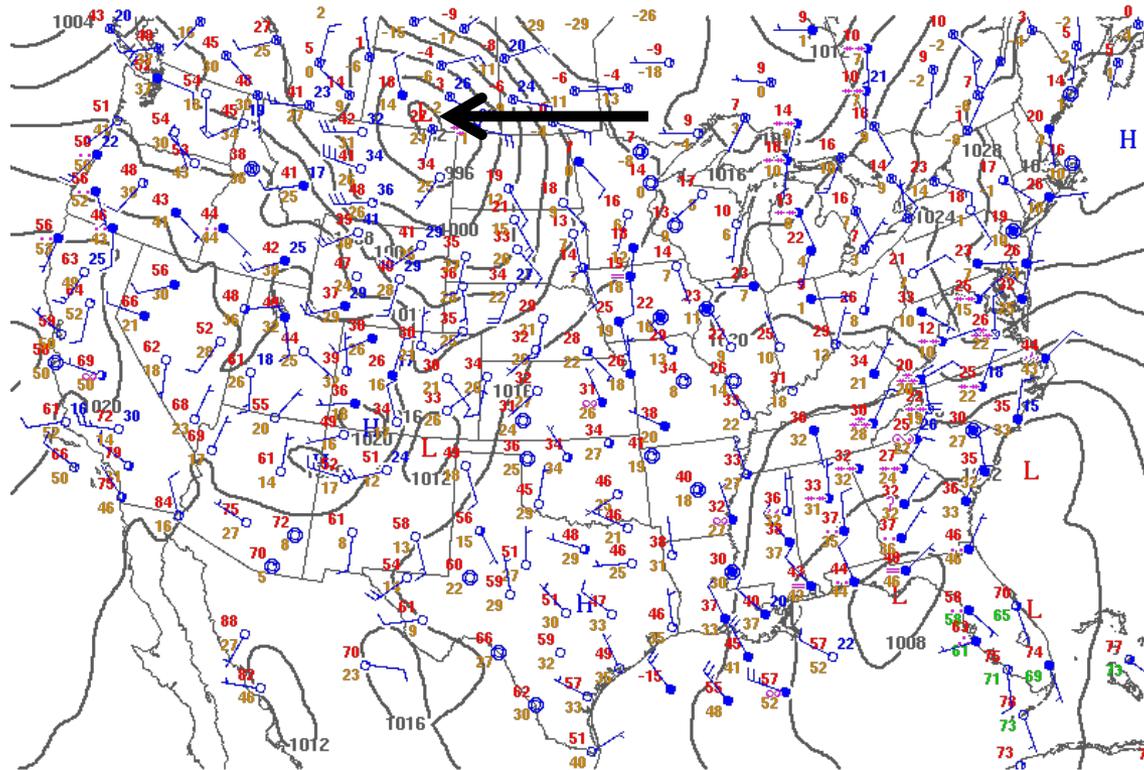
# AFD Highlights/Summary (Thurs AM)

- Weak High Pressure (Light/Calm Winds)
  - Build/Sustain Episode
  
- Mostly clear skies (chilly surface temps)
  
- Warm Air Advection (Clipper system)
  - Helps to dissipate episode

# More to Keep in Mind

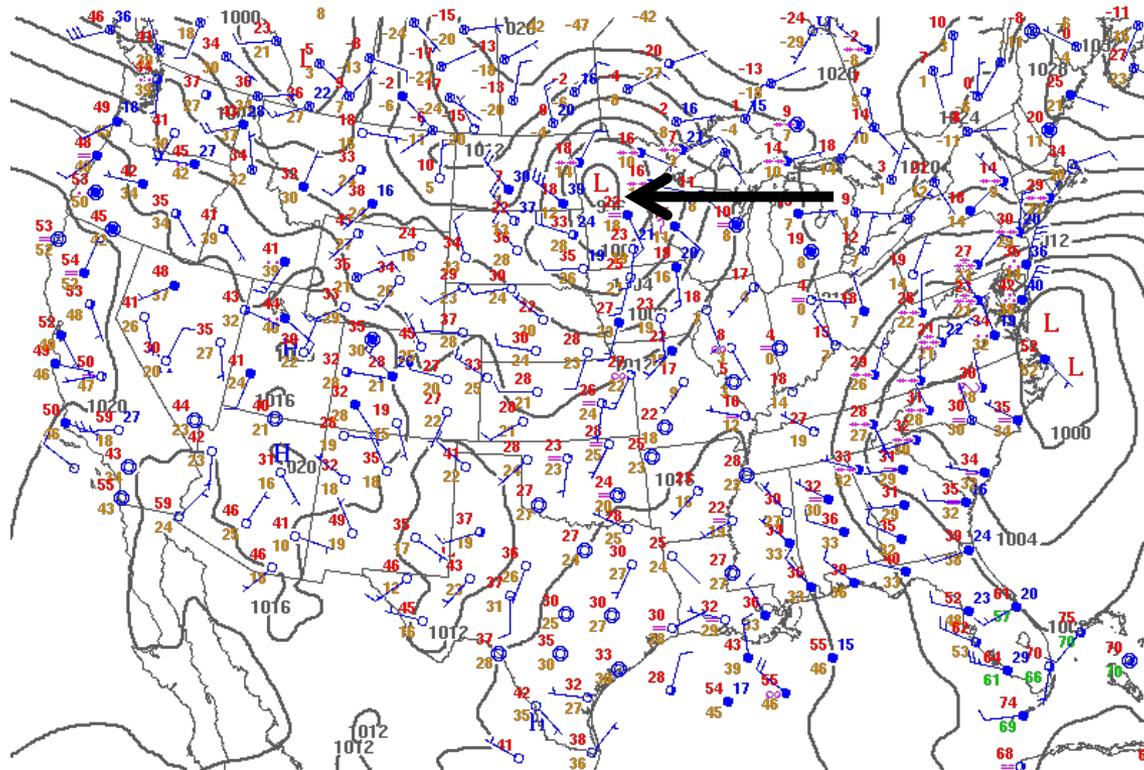
- Time of year
  - Could sustain...
  
- Northwesterly Upper-Level Flow
  - Fairly Active Weather

# Wednesday Night Surface Analysis



140213/0000 Surface OA Pressure and Obs  
Weather, Temp, Dript, Gusts

# Thursday Morning SFC Analysis

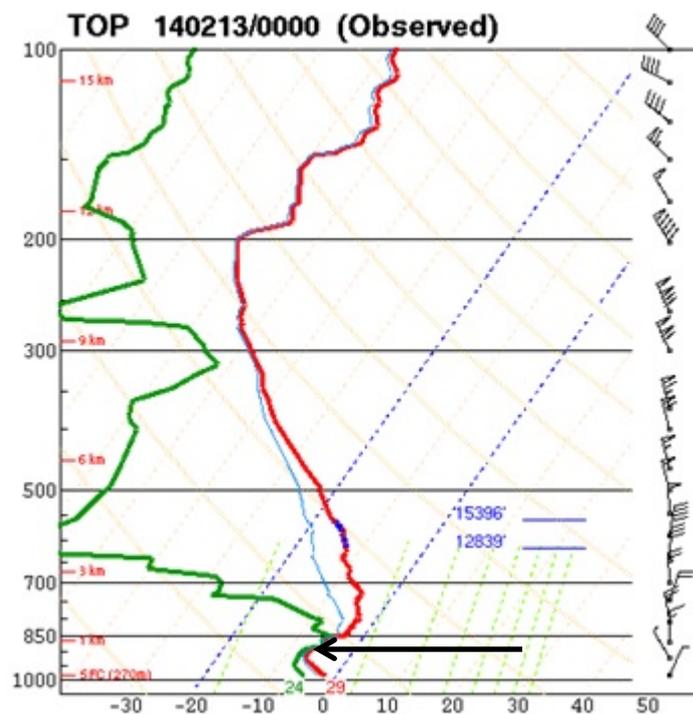


140213/1200 Surface OA Pressure and Obs  
Weather, Temp, Dpvt, Gusts

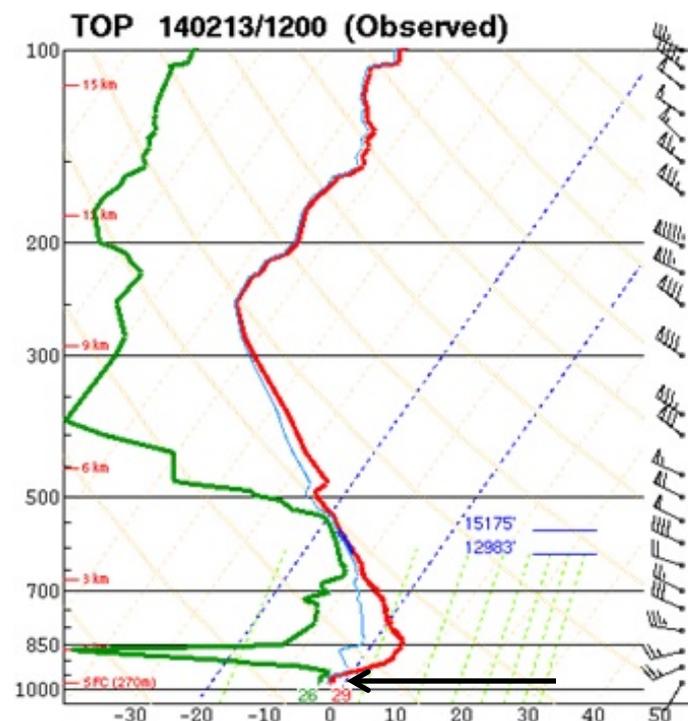
# NWS Radiosonde Network

- Launch every morning and evening
- Not every NWS office
- A “Point” observation
- <http://www.spc.noaa.gov/exper/soundings/>

**Topeka, KS Sonde Wednesday PM**

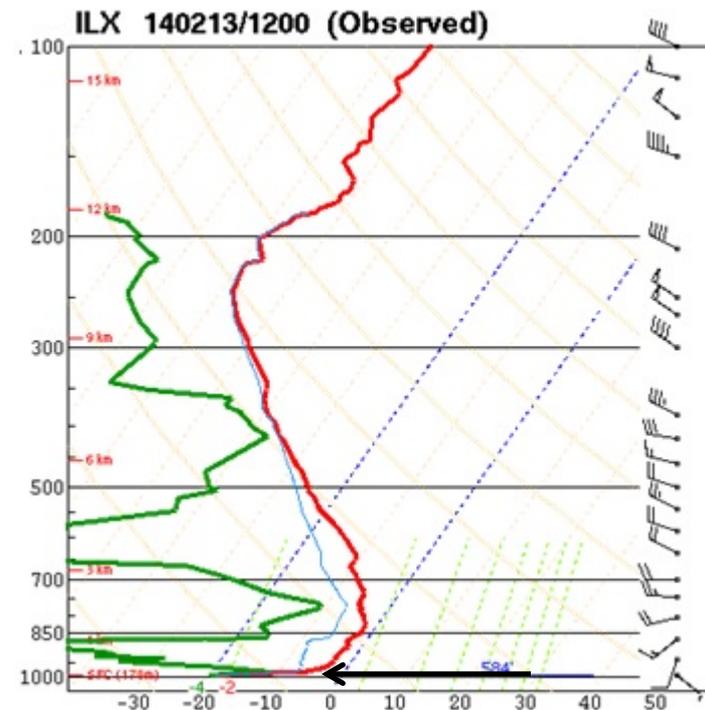
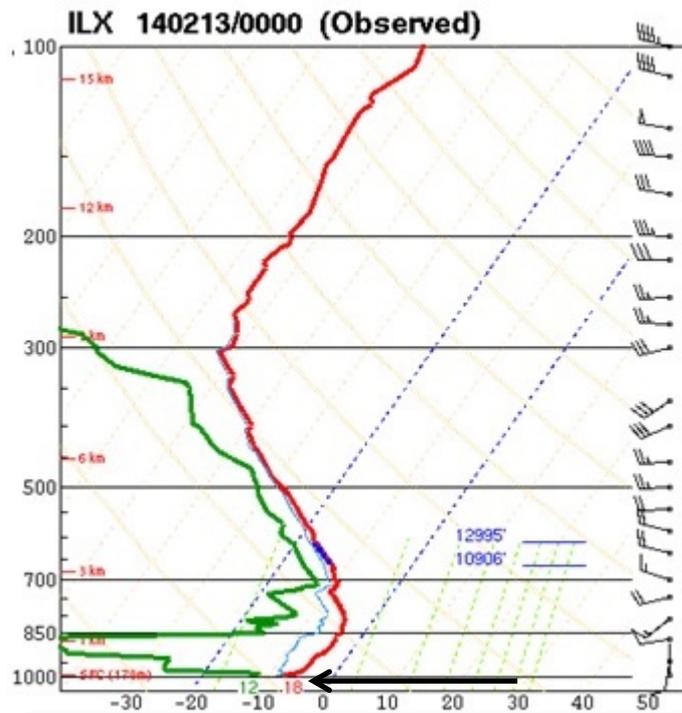


**Topeka, KS Sonde Thursday AM**



**Springfield, IL Sonde Wednesday PM**

**Springfield, IL Sonde Thursday AM**

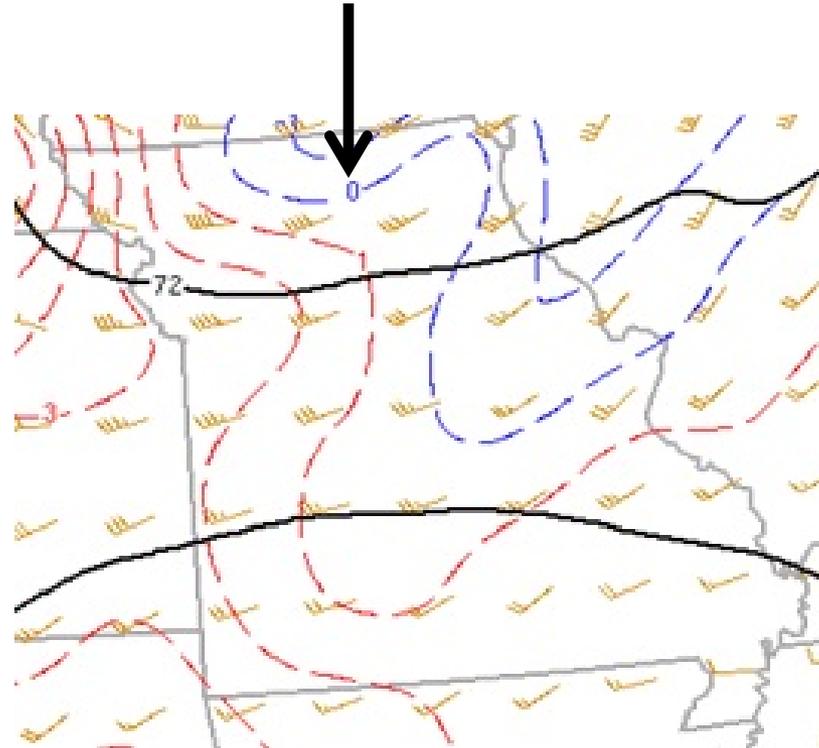


# SPC Mesoanalysis

- <http://www.spc.noaa.gov/exper/mesoanalysis/>
- A blend
  - Surface observations (ASOS, NWS offices)
  - High Resolution (40km) Forecast model
  - **Not an actual forecast!!**



# Just Above the Sfc-Air Interface (Half km)



# St. Louis Winter Summary

- December 1, 2013 through February 28, 2014
  - Max temperature was  $\leq 32^{\circ}\text{F}$  = 32 days
  - 10<sup>th</sup> snowiest winter (27.2")
  - 19<sup>th</sup> coldest winter (29.5°F, tied with 3 other years)

# Conclusions

- Perfect MET Ingredients
  - Weak high pressure sustains
  - Clipper/warm air weakens the episode
- Still, why now???
- Numerous days, similar weather setups (early March)