Daily Forecast Operations

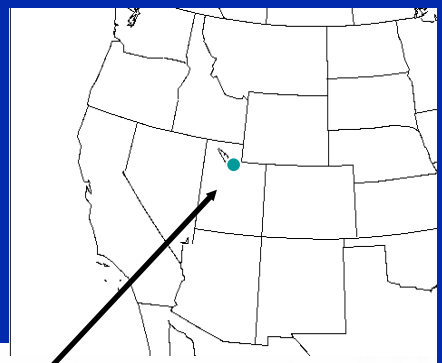
Nine steps to produce an accurate air quality forecast - a suggested method

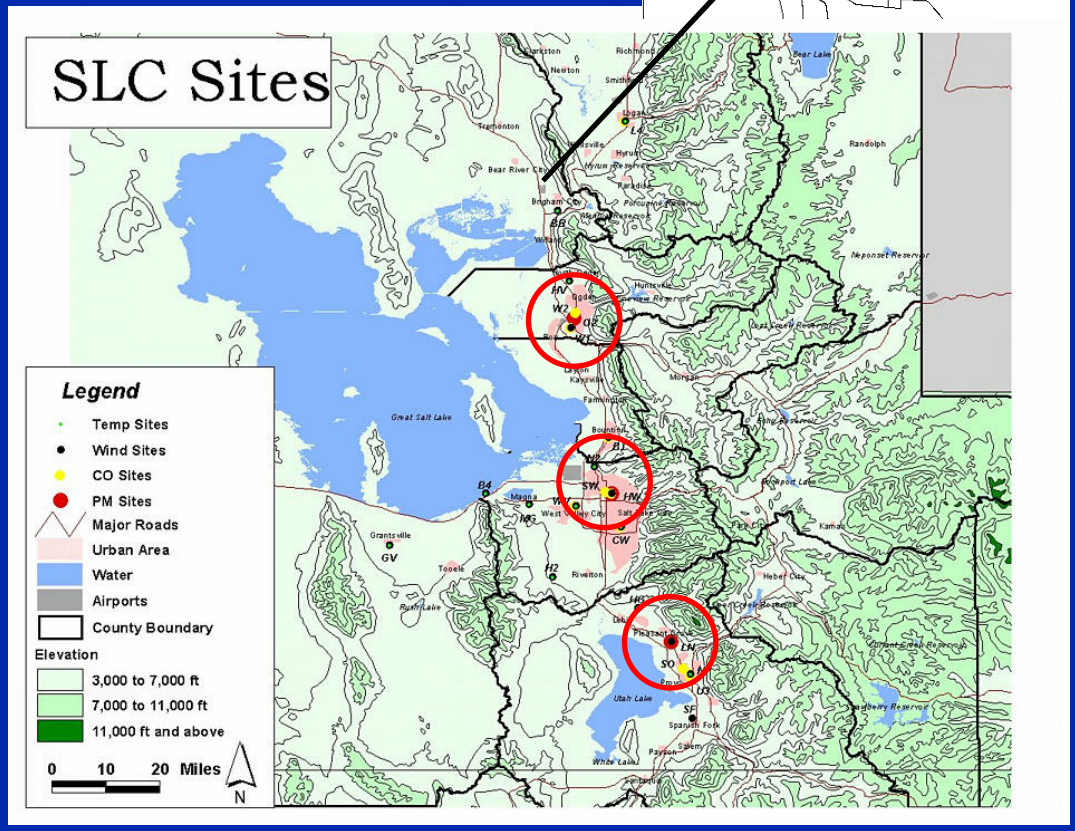
1. Review yesterday's forecast
2. Review the latest air quality data
3. Review the weather
4. Develop a conceptual forecast
5. Run forecast tools
6. Produce a final forecast
7. Document the forecast
8. Distribute the forecast
9. Monitor air quality and meteorology

Daily Forecast Operations

Example Forecast

- Salt Lake City, UT
- Today
  (February 7, 2002)
- Tomorrow
  (February 8, 2002)





Step 1: Review Yesterday's Forecast (1 of 3)

- Did the forecast for yesterday verify? If the forecast missed by more than 15 $\mu g/m^3$, a retrospective study is recommended.
- Did it verify for the right reasons? For example, you forecasted for low $PM_{2.5}$ because of predicted rain, but low $PM_{2.5}$ occurred with no rain.
- Did all monitors report data yesterday?
- Are there any bad data points?
- If the forecast didn't verify, does that affect the forecast you plan to issue today?

Step 1: Review Yesterday's Forecast (2 of 3)

- Verification for yesterday
  - Same-day $PM_{2.5}$ forecast issued on 2/6/02: 66 $\mu g/m^3$
  - Observed 24-hr $PM_{2.5}$ averages on 2/6/02:
    - Hawthorne: 46 $\mu g/m^3$
    - Linden: 32 $\mu g/m^3$
    - Ogden: 46 $\mu g/m^3$
- $PM_{2.5}$ forecast for today (2/7/02) from yesterday: 58 $\mu g/m^3$

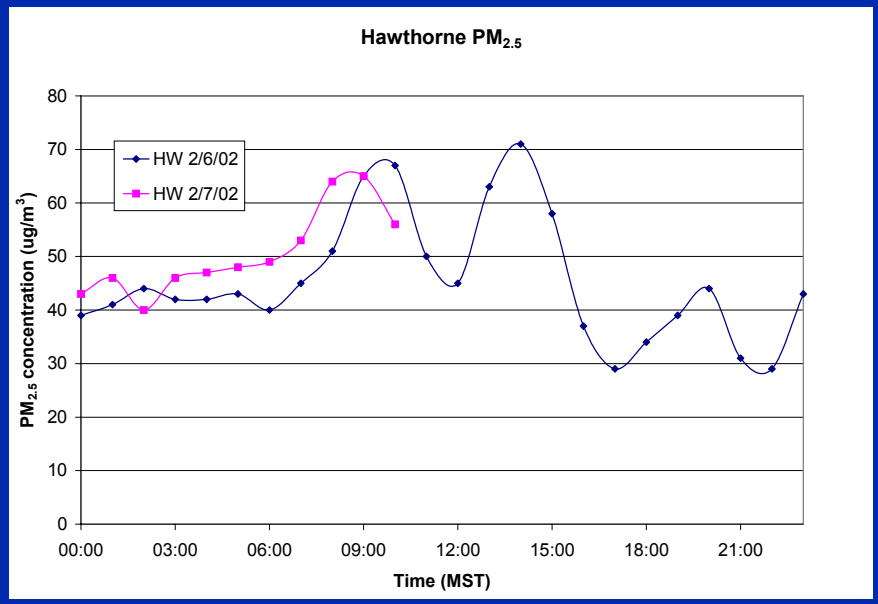
Step 1: Review Yesterday's Forecast (3 of 3)

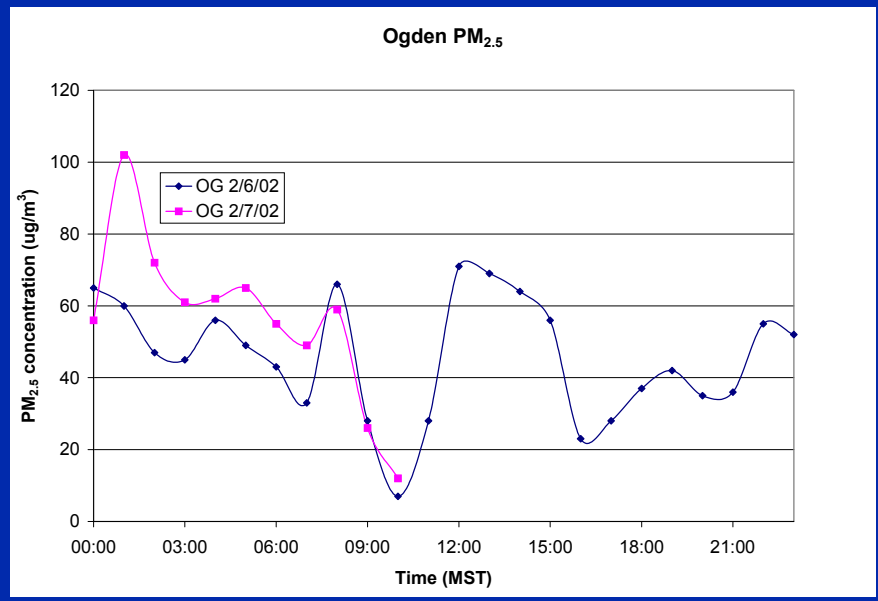
Discussion issued on 2/6/02:

Strong subsidence from an upper-level ridge of high pressure is resulting in a strong surface temperature inversion. A surface high pressure system centered over northern Utah is keeping winds light. These conditions, combined with high carryover $PM_{2.5}$ concentrations from yesterday, will allow $PM_{2.5}$ levels to reach Unhealthy today. Tomorrow (2/7/02), although the ridge weakens slightly as a weak trough approaches from the west, we do not expect the inversion to break until very late in the day. However, with slightly stronger winds expected tomorrow compared to today, PM levels should reach the **high end of Unhealthy for Sensitive Groups**.

Step 2: Review the Latest Air Quality Data

- Are all sites reporting data today?
- How does yesterday's air quality compare with today's?
- Consider the meteorology when reviewing the morning air quality.





Hourly $PM_{2.5}$ values from today and yesterday

Step 3: Review the Weather (1 of 4)

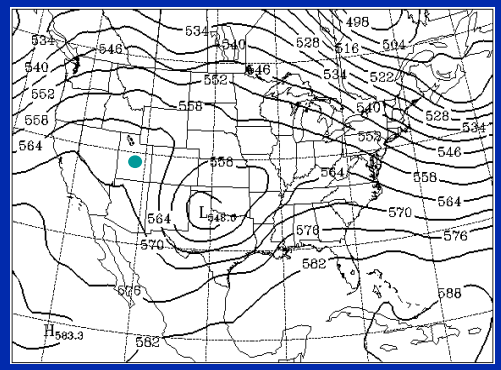
- What is the general synoptic pattern?
  - Ridges and troughs
  - Upper-level warming and cooling
  - Surface and aloft winds
- Is the large-scale pattern changing?
- Are these changes going to influence local weather and air quality?
- What are the local meteorological conditions?
- If weather forecasts are predicting conditions conducive to good air quality, consider skipping to Step 6, Produce a Final Forecast

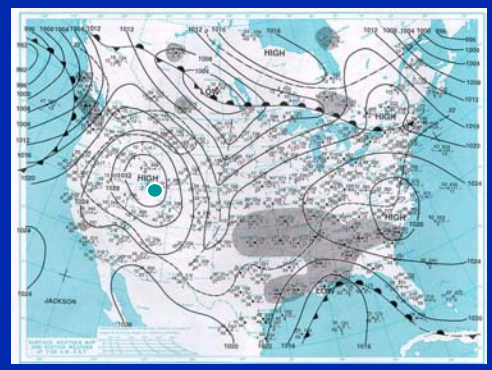
Step 3: Review the Weather (2 of 4)

500-mb heights

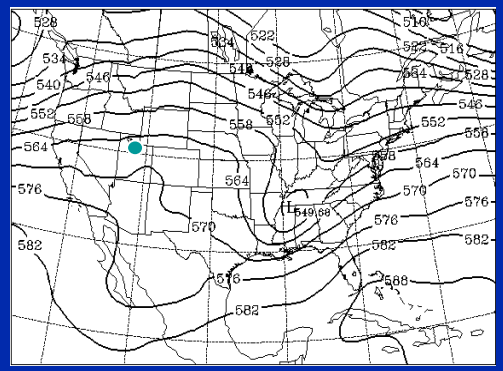
Surface analysis

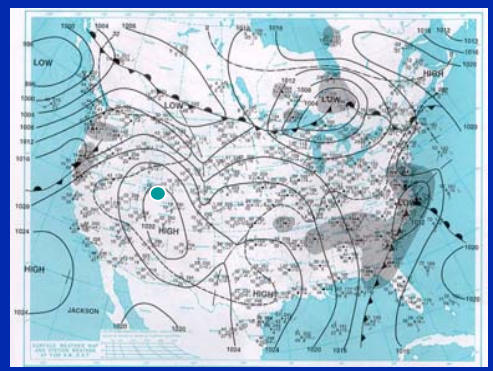
Yesterday:
2/6/02 0500 MST



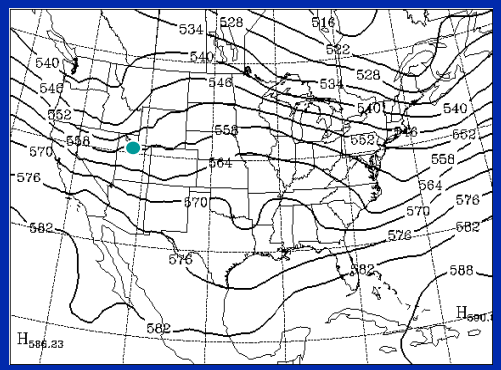


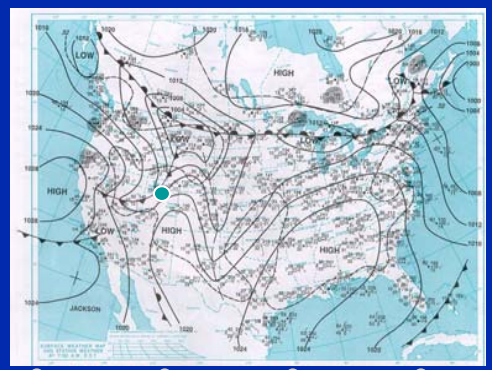
Today:
2/7/02 0500 MST





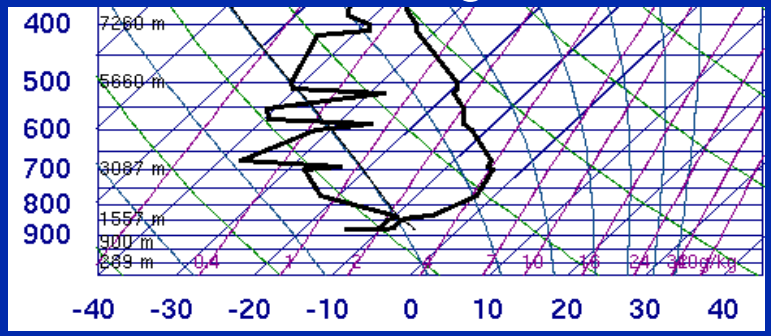
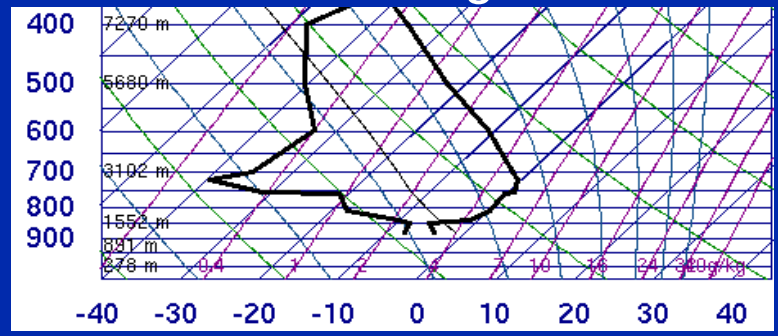
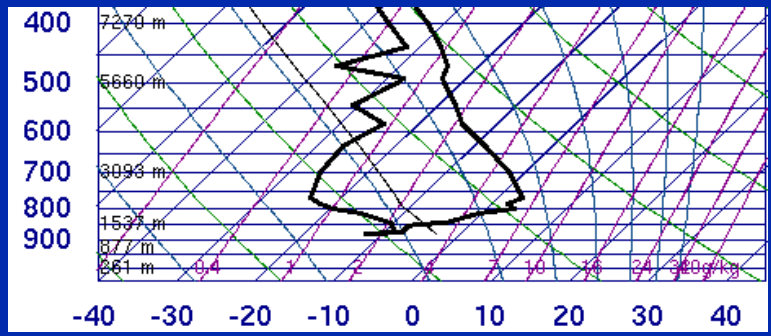
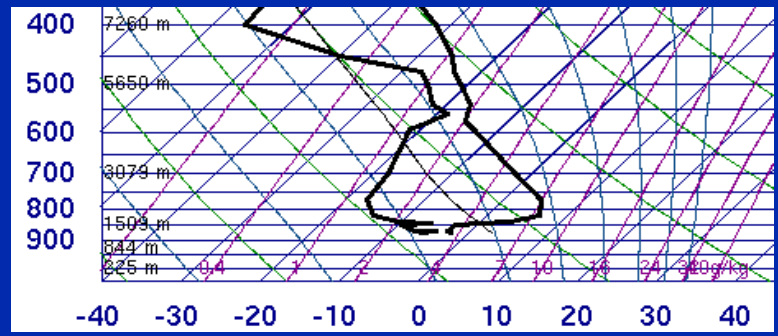
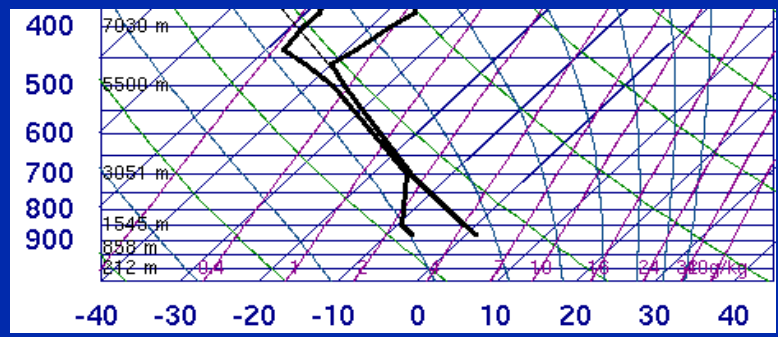
Tomorrow:
2/8/02 0500 MST





Step 3: Review the Weather (3 of 4)

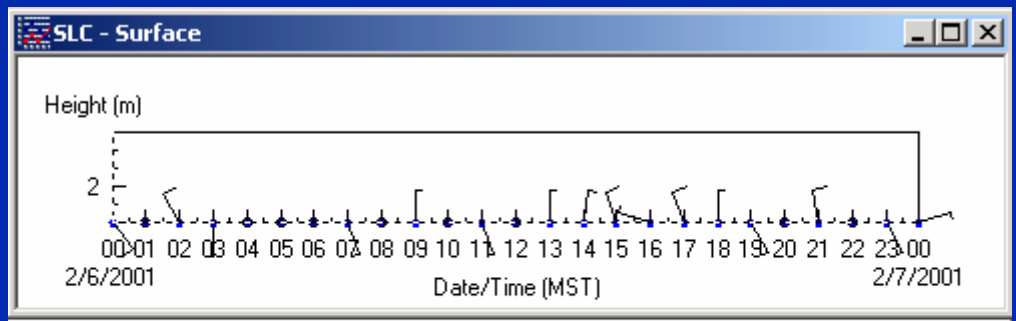
Soundings in Salt Lake City, February 6-8, 2002.

	Morning	Evening
Yesterday		
Today		
Tomorrow	No data available	

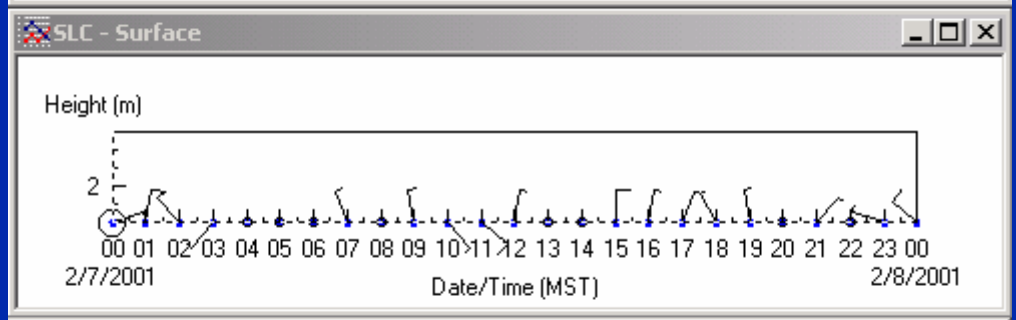
Step 3: Review the Weather (4 of 4)

Hourly surface winds in Salt Lake City, February 6-8, 2002.

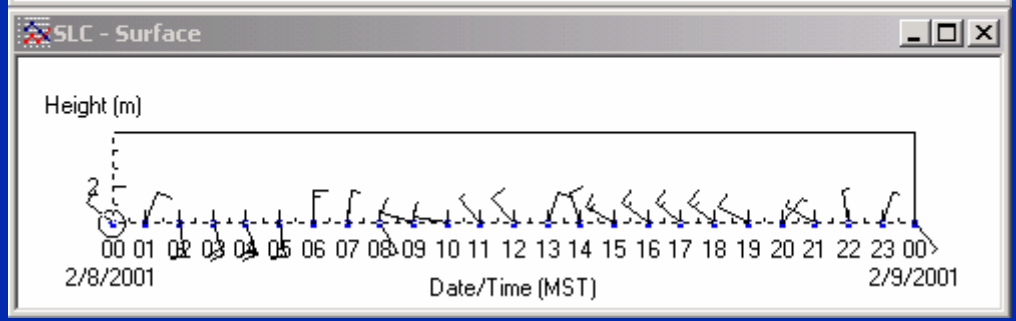
Yesterday



Today



Tomorrow



Step 4: Develop a Conceptual Forecast (1 of 2)

- Use your conceptual understanding to fill in the following air quality forecast worksheet.
- The worksheet is designed to capture important processes that influence air quality.

	$PM_{2.5}$ (ug/m^3)	500 mb pattern	Surface pattern	Winds	Inversion/ Mixing	Carryover	Clouds/ fog	Transport/ Recirculation
Yesterday								
Today								
Tomorrow								

Step 4: Develop a Conceptual Forecast (2 of 2)

Example forecast worksheet for $PM_{2.5}$

	$PM_{2.5}$ (ug/m^3)	500 mb pattern	Surface pattern	Winds	Inversion/ Mixing	Carryover	Clouds/ fog	Transport/ Recirculation
Yesterday	46	Ridge	High pressure	Light and variable	Strong inversion	Yes	Mix	No
Today	70	Weak ridge	High pressure	Light and variable	Strong inversion	Yes	Mix	No
Tomorrow	35	Weak trough	Cold front/ trough	Moderate west-northwest	No inversion	Yes	Mix	No

Step 5: Run Forecast Tools

- Gather and review forecast and observational data needed to run the forecast tool(s).
- Run the tool(s).
- Tweak input values to estimate the impact of uncertainties in the weather forecasts.
- Save inputs and outputs for future verification.

Step 5: Run Forecast Tools – Example

About AQCast
Forecasts
Ozone
PM 2.5
PM 10
Query Database
AQCast Key
Comments

AQCast

Region	Pollutant	Averaging Time	Issue Date	Model Intialization Time (GMT)	Forecasted Max Average	
					Today	Tomorrow
					Forecast $PM_{2.5}$ (ug/m^3)	Forecast $PM_{2.5}$ (ug/m^3)
Salt Lake	$PM_{2.5}$	24	2/6/2002	12	45	37
Salt Lake	$PM_{2.5}$	24	2/7/2002	12	42	18

Conduct Another Query

Key: Good | Moderate | Unhealthy for Sensitive Groups | Unhealthy | Very Unhealthy | Hazardous

www.sonomatech.com/aqcast

Regression forecasting tool output for Salt Lake City, Utah.

Step 6: Produce a Final Forecast

- Review output from forecast tools and the conceptual forecast.
- Do the forecasts from different tools agree?
  - If so, you may choose to use the average or the high or low values, or some value in between depending on your program objectives.
  - If not, check inputs for each tool.

$PM_{2.5}$ Forecast ($\mu g/m^3$)	Conceptual	Tool	Final
Today	70	42	65
Tomorrow	35	18	25

Step 7: Document the Forecast

Document forecast rationale

- What happened yesterday
- What's expected today and tomorrow and why.

Salt Lake City Forecast Discussion issued February 7, 2002

The ridge of high pressure that has been over the Salt Lake region for the last several days is finally weakening as a trough approaches from the west. Despite the demise of the ridge, a strong inversion is expected to remain in place throughout the day today. With the exception of moderate easterly winds associated with the drainage from the mountains, winds should be light and variable. The combination of the strong inversion, light winds, and carryover $PM_{2.5}$ from yesterday, will allow $PM_{2.5}$ levels to reach Unhealthy today. Tomorrow, the trough is expected to move over the area by morning, but the more vigorous portion of the system is not expected until afternoon. This means that the poor air quality conditions won't improve until the afternoon when the inversion breaks. So, with high $PM_{2.5}$ concentrations in the early morning hours and low $PM_{2.5}$ concentrations in the afternoon, we expect the 24-hour average $PM_{2.5}$ levels to be Moderate.

Step 8: Distribute the Forecast

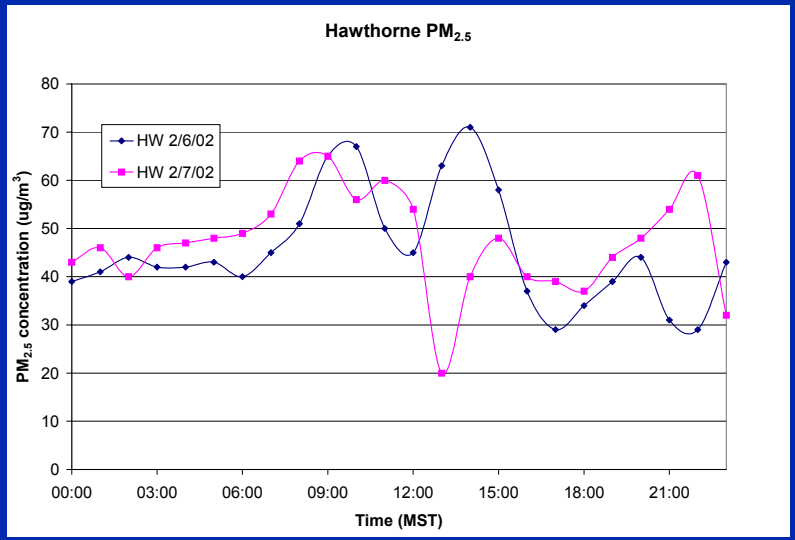
- Ensure forecast distribution before the deadline by planning a daily timeline.
- Distribution
  - Internal (technical details)
  - Public (generalized and health-oriented)
    - E-mail
    - Fax
    - Internet
    - Phone
    - Pager

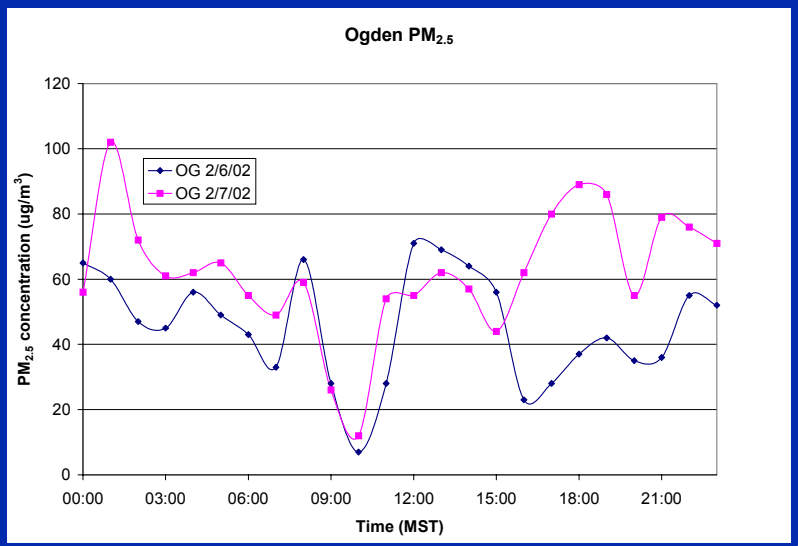
Step 9: Monitor Air Quality and Meteorology (1 of 2)

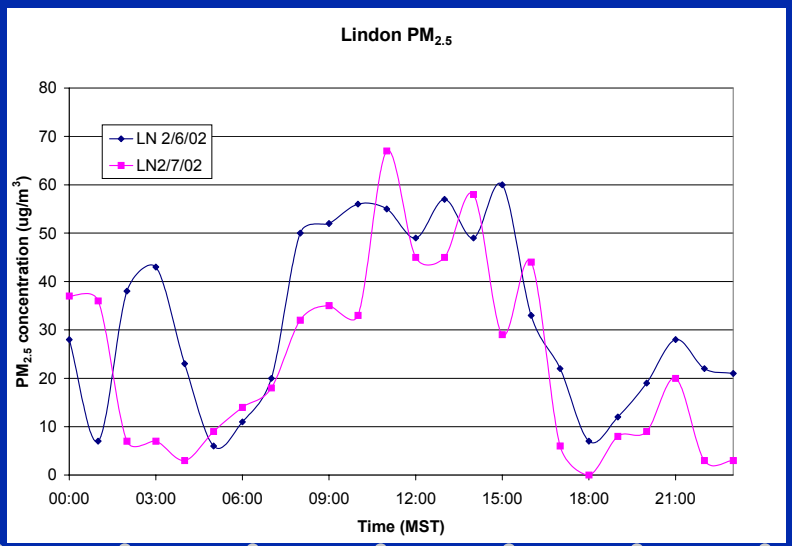
- Monitor the air quality and meteorology throughout the day for unexpected changes.
- Update the forecast if meteorology or air quality is different than expected.
- Ensure that incoming data are reasonable given the meteorological/ air quality conditions.

Step 9: Monitor Air Quality and Meteorology (2 of 2)

- Hawthorne and Linden trending is similar to yesterday.
- Ogden is higher or the same as yesterday at almost every hour.
- Forecast for higher $PM_{2.5}$ concentrations today is on track.







Summary

Following a predetermined daily forecasting protocol helps produce a consistent, timely, and accurate forecast.

- Next step – Contest
- Questions