

Chapter 12

Practical Atmospheric Analysis

With the ready availability of computer forecast models and statistical forecast data, it is very easy to prepare a forecast without ever looking at actual observations, i.e., without ever "looking out the window." This trend places the forecaster's emphasis on theory and statistics, but does not develop the analytical skills so necessary to a good short term forecast.

Beyond 12 hours from issue time, the influence of current and past observations on a forecast is negligible. However, in the short term, that is, particularly in the "nowcast" time frame out to about 6 hours, current observations and recent trends should have a strong influence on the forecast. Any meteorologist worth his/her salt as a forecaster should be able to make a 6 to 12 hour forecast without using computer forecast model output or statistical forecast guidance.

The purpose of this chapter is to explore, from a conceptual perspective, those things that a forecaster should look at to determine what is currently happening and what will likely happen in the near future. As mentioned in Chapter 1, you must be a Sherlock Holmes. He used his powers of observation to note numerous details about a situation and then combined this information with his vast knowledge-base of facts and deductive reasoning to solve the case.

The meteorological analysis process requires three things:

- A solid background in meteorological analysis models, atmospheric physical processes, and the wide variety of weather phenomena that are found in the atmosphere.
- An ability to recognize atmospheric models and physical processes in data and computer forecast model output, that is, an ability to bridge the gap between idealization and real world data.
- A knowledge of your local forecast area and phenomena that are common or unique to that area.

Solid Meteorological Background

It is beyond the scope of this e-book to discuss in detail all meteorological phenomena that a forecaster should be familiar with and have at his/her fingertips to assist in the analysis

process. As a result, listed below are the compilation of tools, physical processes, and analysis models that you need to have in your mental database. Some of these topics were addressed in earlier chapters of this e-book; many are addressed in a good introductory atmospheric science course.

Operational Toolbox Applications:

- Ability to read the information on a weather chart including weather symbols.
- Ability to construct isolines on a weather chart.
- Ability to use a thermodynamic diagram.

Physical Processes: (an understanding of how the process works and recognition of causative factors on a weather chart)

- Energy transfer mechanisms of conduction, convection and radiation.
- Impact of atmospheric radiation effects on surface temperature including the influence of:
 - Clouds
 - Atmospheric water vapor
 - Albedo and solar angle
 - Long and short wave radiation
- Moisture variables
- Saturation
- How to saturate air
 - Adding water
 - Cooling the air
 - Mixing warm humid air with cooler air
- Formation of fog, dew, frost
- Lifting mechanisms
 - Orographic
 - Frontal
 - Low level convergence
 - Local convection
- Adiabatic lift
- Stability
- Development of local winds
 - Foehn/chinook
 - Santa Ana
 - Katabatic
 - Sea-land breeze
 - Valley-mountain breeze
- Precipitation type
 - Rain-snow

- o Freezing rain
- o Ice pellets
- o Freezing drizzle

Atmospheric Analysis Models:

- General Concepts:
 - o Pressure gradients
 - o Geostrophic-gradient winds
 - o Cloud types
- Synoptic Models (and associated weather):
 - o Ridges and troughs
 - o Cyclones and anticyclones
 - o Jet stream
 - o Rossby waves
 - o Air masses
 - o Fronts
 - o Mid-latitude cyclones
 - o Conveyor belts
- Mesoscale Models:
 - o Drylines
 - o Thunderstorm
 - Development (ingredient approach)
 - Types
 - o Mesoscale convective systems
 - o Tornadoes
 - o Hurricanes

How many of these can you discuss without referring to a textbook or other reference source? How many can you recognize in operational weather data? There may be a few things that were inadvertently left off the list.

Model Recognition in Real Data

The ability to recognize specific weather phenomena in a set of data or output fields from the computer forecast model is difficult to describe. It involves mentally correlating what you see with that vast mental database described in the previous section. It is a learned skill that takes practice and the development of deductive reasoning.

Some phenomena are easier to recognize than others. It is the more subtle situations that can be challenging. Let's illustrate this with an example. Figure 12-1 is a surface weather chart for a situation that occurred in early winter. Assume that you are on a midnight shift in Norfolk, VA. A strong cold front passed

At chart time, 06 UTC, the cold front extends across Alabama, Georgia and South Carolina with a band of clouds along the front. Temperatures in Norfolk have fallen to 20°F and winds are blowing briskly from the north northwest. Skies everywhere north of the front, in the cold air, are clear, except for Norfolk, where a deck of low stratus clouds prevail. The cold air is expected to dominate the weather for another 24 hours as the high pressure center from Canada settles into New England.

Your task is to issue a forecast for the "today" period. Ideally the cold air and clear skies would imply an abundance of sunshine with chilly afternoon temperatures. However, what about those stratus clouds over head? Take a moment before reading the next paragraph and study the chart in Figure 12-1. Answer the following questions: Why are there clouds over Norfolk? What effect will these clouds have on the Norfolk "today" forecast? What would your forecast be for Norfolk for today?

Even though the phenomenon does not occur very often over Chesapeake Bay, this is an example of lake-effect snow. The cold winds are blowing along the length of the bay and are picking up moisture in the same manner as winds associated with lake-effect snows over the Great Lakes. As these winds pass from the bay onto the coast around Norfolk, they slow, converge, and produce the low stratus deck. This example is based on a real event experienced by the author. The forecast put out that morning was "cloudy with snow flurries." Norfolk received 2 inches of snow flurries that day.

The key in this case is recognizing that a lake-effect snow phenomenon is occurring over a smaller water body. The physical processes are the same. Did you figure out what going on?

Local Forecast Area

If you work in a particular area for an extended period of time, you soon realize that certain weather events are common in your area while other types of weather are relatively rare. This may involve such weather events as fog (more common in some areas than in others), flash flooding (usually a repetitive event for specific areas), or sea-land breezes (for shoreline areas). Often there are local forecast schemes to help in preparation of forecasts of these events. If you work in a forecast office, check for some type of local forecast guidance information. Also, review local climatology to get a sense of month-to-month changes at that locale.

Concluding Remarks

This chapter has described a variety of factors that need to be part of the weather analysis process. Weather analysis is the first step in preparing a forecast and should be a critical step in your forecast routine. Even if you are not making an "official forecast," a daily review of the latest weather data, easily accessible on-line, will build your experience level in weather analysis.

It's been said that weather forecasting is both art and science. The science is easy enough to identify in the computer forecast models, the hydrodynamic equations, and thermodynamic processes. The art side of weather forecasting is more elusive. It is related to the background, experience, and mental database of weather facts that you accumulate over time, particularly during your daily analysis of current weather. These daily reviews enhance and expand that mental database that you need to be a good forecaster.

If you remember nothing else from this e-book, remember to:

Look out the Window!

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