Chapter 1

What is Weather Analysis?

The first step in preparing a weather forecast is the gathering and analysis of weather data. This step provides you as the forecaster with a three-dimensional picture of what is going on within the atmosphere and a sense of why the atmosphere is doing what it is doing. Before exploring the various aspects of operational weather analysis, we need to ask the question: What is weather analysis?

Definition of Weather Analysis

The dictionary defines “analysis” as a detailed examination of something. It is a process that breaks the object of the analysis into parts so that each part can be examined in detail. This process determines its nature, function, and other characteristics. In operational weather analysis the object is the atmosphere, specifically, the troposphere, where day-to-day weather occurs. The parts that we need to examine are the various weather parameters that are typically used to describe the atmosphere: temperature, humidity, wind speed and direction, atmospheric pressure, clouds, precipitation, etc. We generally do our analysis at one specific time in order to get a glimpse of what is happening in the atmosphere at that moment. However, analysis over time is often useful to provide a better picture of how things are changing.

Examination of atmospheric components can be carried out in two ways: (1) isopleths of each component are drawn in order to visualize the pattern associated with that particular component; and (2) time series or sequential maps of a component are examined to determine changes over time. Drawing of isopleths, whether done manually or by computer, is a fairly mechanical process that will be described in Chapter 3. Keep in mind that drawing isopleths or time series is only Step 1 in the analysis process.

The second, and more important, step in meteorological analysis is the interpretation of the patterns found in Step 1. Examination of these patterns should address questions such as:

a. What physical processes do these patterns and time changes indicate?
b. Is there evidence of weather systems?

c. Do these weather systems fit any of the standard meteorological analysis models?

The interpretation carried out in Step 2 must be integrated over space and time to provide an understanding of what is occurring in the troposphere and to explain why things are occurring. This part of the process requires a thorough understanding of how the atmosphere works. This background information is usually obtained through a series of atmospheric science courses at the introductory and intermediate level. The process of putting the components back together to form a complete picture of the atmosphere is called synthesis.

Thus operational weather analysis consists of two parts: *analysis* (in the formal sense of the term, i.e., breaking something into its component parts for examination), and *synthesis* (or bringing the components back together to achieve complete understanding of the whole).

Computer Analysis

As noted in the previous section, computer programs have been designed to draw isopleths on charts based on observational data or gridded data fields. The isopleths produced by these programs are usually referred to as *objective analyses* (OA). However, these “analyses” only satisfy Step 1 of the weather analysis process described above, i.e., the drawing of isopleths.

Djuric (1994) suggests that computer-produced weather maps be referred to as “computer charts” while the term “analysis” be reserved for computer charts that have been annotated by meteorologists in order to highlight or add interpretive information such as analysis model information. In a strict sense, a true “analysis” cannot be put on paper (or a computer screen) but is a mental visualization of what data or isopleths are telling you as a meteorologist. You can enhance a computer chart with interpretive information or composite interpretive information from several charts onto one chart to aid in the integration process. (This latter chart is usually referred to as a *composite chart*.) In any case, we will adapt the Djuric’s suggestion and refer to computer-produced isopleths as *computer charts* while reserving the term *weather analysis* for the overall interpretation of these charts.

Atmospheric Models

One way that a meteorologist interprets data and patterns is through *atmospheric analysis models*. An analysis model is an idealized representation of a weather system that helps you as a meteorologist visualize that system, its associated weather, and its evolution. It provides a distribution in space and time of the typical three-dimensional system structure. By comparing data or isopleths patterns to analysis models, you can get a better sense of what is happening and why. An analysis model gives an analyst a sense or feel for the logical distribution of weather parameters in both space and time.

As a meteorologist you should also realize that there will be differences between an analysis model and observed data patterns. Analysis models help the analyst make sense of the vast array of available data, and also help fill-in-the-gaps where data may be missing or no observations are available. Atmospheric analysis models will be explored in more depth in Chapter 6.

The term “model” is often used to refer to numerical weather prediction (NWP) or computer forecast models. In order to avoid confusion, we will be specific when referring to models by using a more complete phrase such as “analysis model” or “computer forecast model.”

Become a Sherlock Holmes

As a meteorological analyst you must be a Sherlock Holmes. Mr. Holmes used his powers of observation to note numerous details about the cases that he investigated. He then combined this information with his vast database (to use current terminology) of facts and deductive reasoning to solve the case.

In weather analysis and forecasting, you examine a wide variety of weather data throughout the troposphere by integrating several observing systems during the weather analysis process. You then blend all this information into a three-dimensional image of what is producing the current weather by correlating what is observed with your meteorological background, e.g., your knowledge of atmospheric analysis models and physical processes that occur in the atmosphere. If you are also preparing a forecast, you next combine this initial analysis with the computer forecasts to get a sense of how things are likely to change over the next 24 to 36 hours.

A thorough analysis of the current state of the atmosphere and near-term changes takes time, usually at least an hour on a simple day, often longer if the situation is complex. Today's analysis is usually easier if you have followed the weather charts over the last several days and have noted the movement of and changes in both upper level and surface systems.

In the old days a forecaster could walk into a weather office and flip through a set of charts that were hanging on the wall and get a sense of how the flow patterns have changed over the last 3 to 4 days. If the Internet is your primary source of weather date, this procedure is difficult to follow today. Most Internet sites have the latest charts but it is not east to find a chart 12 or 24 hours old. This lack of "old" charts reduces a forecaster's ability to compare charts over time and see how weather features have changed over the last 24 to 36 hours.

Please realize that a lot of what is discussed in this book is based on analysis of observed data. However, most of the concepts and methods can also be applied to prognostic fields from computer forecast models.

Latter chapters of this book will explore in detail many of the ideas introduced in this chapter. As you read through these chapters, keep in mind the real meaning of the word, analysis.

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