FORECASTING TECHNIQUES

A Method for Presenting Medium-Range Forecasts

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1. Introduction

Medium-range forecasts (3–8 days) have become a staple of most weather presentations on television, in newspapers and on radio. But the information contained in these forecasts often sadly misrepresents the type of knowledge that the medium-range forecaster possesses. Certainly, forecasters trade very useful weather information about the medium range among themselves, secure in their mutual knowledge of the limitations imposed by atmospheric predictability. Little effort, though, is made to communicate to the lay public the different nature of the forecast problem in this longer time scale.

Few would disagree that the medium-range forecast guidance available to the meteorologist has improved during this decade. The development of the European Center for Medium-Range Weather Forecast (ECMWF) and the implementation of the Medium-Range Forecast Model (MRF) by the National Meteorological Center (NMC) have made more sophisticated forecast products available to the operational forecaster. Bengtsson (1985), in his summary of experiences at ECMWF, presents data which show that four-day forecasts for the 500 mb geopotential are as accurate now as the one-day forecasts produced in the early 1950s. He goes on to demonstrate, however, that model skill varies markedly with season, weather regime, spatial scale, altitude and even geographical location. Wintertime medium-range predictions show greater objective skill than summertime forecasts. Blocking patterns tend to be more predictable than transitional flow regimes. Bengtsson also notes that 500 mb model predictions with subjective usefulness can generally be made up to day 6 and 7, while 1000 mb forecasts show less skill. Planetary waves are more accurately forecast than shorter waves. The knowledge of these and other model limitations is only the first step in the preparation of an effective medium-range forecast. Ultimately, the best medium-range prediction is one that is placed in a format that allows for the limitations cited by Bengtsson. The widespread practice in all media of placing medium-range forecasts in a

similar format as the one- to two-day predictions has limited the potential of extended forecasts and is proving a disservice to the public.

It has been shown that the format in which we couch our forecasts plays a significant role in how others interpret the information being relayed (Abrams, 1971). Since the medium-range forecast is a challenge different from the shorter one- and two-day predictions, it is essential that a different style of presentation, a variety of new terms, and an adaptation of graphics be considered to enhance the credibility of this valuable weather information. Since September 1983, meteorologists at The Pennsylvania State University have been experimenting with a unique format in presenting medium-range forecasts to the general public. This article presents the elements of the format and emphasizes the philosophy behind this type of forecast.

2. Background

The conduit for our format for medium-range forecasting is a program called "Weather World" seen each weeknight on Public Broadcasting stations in Pennsylvania. "Weather World" is a 15 minute weather magazine show with three components: first, an analysis of current conditions plus the one- and two-day forecasts; second, a special weather segment including such elements as climatology, travel weather or the medium-range forecast; and finally, a feature portion connecting the weather with the world around us. The medium-range predictions are presented twice each week. These forecasts have been made over 200 times during the past two years by the authors of this article. The extended forecast, as it is called, is typically presented in a two and one-half minute segment. Forecasts are prepared at the Penn State Weather Observatory on Monday and Friday afternoons for presentation on that evening's television show. A large number of data sources are available to the forecaster. These sources include

- satellite pictures and loops received on telephone lines from the Washington Satellite Field Service Station;

- NMC MRF forecasts of 500 mb heights, 1000–500 mb thickness, and sealevel pressure for the Northern Hemisphere from 72 to 168 h from the previous 00Z run of the model;
- ECMWF model forecasts of 500 mb heights, 1000–500 mb thickness, and sealevel pressure for the Northern Hemisphere from 24 to 120 h from the previous day's 12Z run;
- any desired charts from the digital facsimile circuit (DIFAX);
- teleconnections charts (O'Connor, 1969);
- other products derived through manipulating grid fields (e.g., 500 mb height changes) from the numerical models using a minicomputer system in the observatory (Cahir et al., 1981).

These products are combined subjectively and translated into the graphics that are used for the "on-air" presentation. Each presentation begins with satellite imagery, either an infrared picture of the west coast of North America and the Pacific Ocean during the cold season or a visible picture of the eastern half of North America, Atlantic Ocean and Caribbean Sea during the summer. These images are chosen to focus on weather systems that are controlling the large-scale midtropospheric flow. Next, a mercator projection map of the western section of the Northern Hemisphere (140°–20°E longitude) is used as the base for the current and forecast jet stream locations (Fig. 1). A map of the United States is then presented for the forecast period. The map includes the likely storm tracks, areas with significant temperature anomalies, and times of expected frontal passage for the forecast region (Fig. 2). In general, these forecast maps are designed to show the evolution of important weather features in the three- to six-day range. However, these forecasts can extend up to eight days in certain highly predictable regimes. As air time and the forecast permits, a temperature and precipitation trend for the forecast period

FIG. 1. Representation of the Northern Hemisphere jet stream as it appears on the extended forecast segment of "Weather World."

FIG. 2. Forecast of important weather systems as shown in a typical extended forecast on "Weather World." As is conventional in U.S. media weather presentation, temperature change references are in Fahrenheit degrees. References to below and above relate to seasonal normals.

is then shown as a summary of the extended outlook for the area.

3. Forecast philosophy

There are three specific characteristics of these medium-range forecasts that define the philosophy of the presentation: first, the differentiation through format and style from the traditional one- to two-day forecast; second, the formulation of only the information that the weather situation dictates; and last, the relaying of medium-range forecasts using a language that distinguishes it from the shorter range forecasts.

a. Differentiation from one- to two-day forecasts

It is important that the vastly different character of the information available in the medium-range be made evident to the public in every possible way. On "Weather World," this separation is accomplished three ways: the extended forecast is set apart from the shorter-range forecast by a 15 to 30 sec break, a different meteorologist prepares and presents the on-air medium-range outlook, and the graphics used are unlike those that appear in the local short-range prediction. We feel these elements influence the viewers to have different expectations for the medium-range forecast, expectations more consistent with the body of information that the meteorologist typically has at his disposal.

b. Formulating only pertinent information

The given weather pattern is frequently the arbiter of what useful information is available. That is, the meteorologist must be careful to relay only the weather information that is inherent in the pattern. This is in stark contrast to the neatly packaged one- to two-day

predictions with specific compartments of weather information (tonight, tomorrow, etc., each with specific temperatures, sky conditions and risks of precipitation). In the medium-range outlook, it may be that there is a great deal to say about temperature and very little assurance about precipitation, or vice versa. There may be just one or two facts that can be discerned with confidence about weather during the extended forecast period. In short, when constructing a medium-range prediction, the meteorologist should not let the format decide what is said; instead, the type of weather pattern should be the decisive factor. The challenge for the medium-range forecaster is to feel comfortable with letting the weather pattern dictate the content of the forecast each time.

c. Relaying the medium-range forecast using a language that distinguishes it from shorter-range prediction

Since the nature of the information is different, the graphics and words used to describe these forecasts should correspond to this distinction. The following are three cases of typical medium-range forecasts accompanied by a commentary and a revised forecast that amplifies our philosophy of medium-range forecasting. While the typical format forecasts are patterned after traditional three- to five-day predictions, the suggested revision demonstrates that in some cases, useful forecast information can be relayed beyond the fifth day.

1) CASE ONE

Typical format—Sunny and cold on Wednesday. Increasing cloudiness Thursday. On Friday, cloudy and not as cold, chance of rain or snow.

Unanswered questions—Is Friday's storm going to be a major event or is it just another brush with winter snow? How long will it last? Just how likely is it to be snow? Will the storm really come on Friday?

Commentary—Normally, a forecaster knows a fair bit about the potential of a storm and even the likely precipitation amounts (i.e., Is this one of the big storms for the winter?). Certainly, this should be communicated. A forecaster also knows whether a storm will be a fast mover or has the potential to stall and cause several days of inclement weather. The forecaster usually has some leaning toward rain or snow based upon the likely storm track. Often, the forecaster's expected weather scenario extends beyond the formulated forecast period, and, in those cases, the typical structure can limit the value of the information available.

Suggested revisions—Sunny and cold Wednesday. Clouding up Thursday. As a weak, fast-moving disturbance passes just to our south Friday, there will likely be a few hours of light snow. A more northerly track, though, could bring some light rain instead. In any

case, Friday's storm will be minor and the weekend should be generally dry and chilly.

2) CASE TWO

Typical format—Mostly sunny, continued cold Monday. Partly cloudy, breezy and milder Tuesday and Wednesday.

Unanswered questions—How long will the milder weather last? Is this the end of a long siege of wintry weather? Will the mild weather be followed by rain?

Commentary—When there is a major realignment of the long-wave pattern, the forecaster can see this coming. This type of information can be included in the prediction. The shift to a distinctly different upper air pattern means a completely new storm track, and this determines the next risk of precipitation. Frequently, the forecaster can determine approximately how long the warming trend will last before a front approaches with the risk of rain. Occasionally, the meteorologist can distinguish the timing of the next change.

Suggested revision—After a sunny, cold day Monday, there will be a big change in the weather pattern. The rest of the week will be milder with some sun and clouds. A cool front should bring scattered showers at the end of the week, but once it warms up, there is no sign of colder weather to follow.

3) CASE THREE

Typical format—Rather cloudy throughout the period with the chance of showers each day.

Unanswered questions—Will it rain for three days? Are large amounts of rain possible? Might there be some dry times?

Commentary—This forecast is typical of many that are issued when there is great uncertainty in the medium-range outlook. This forecast relays very little useful information since there is probably little useful information to give. The user of this forecast should be informed of the difficulty of making this prediction. It should be made clear that in this type of weather situation, there is little detail to be offered. In short, medium-range forecasters must, despite pressures to the contrary, be prepared to say "I don't know." Certainly, there are few times when nothing at all is known. Even in the most puzzling of weather patterns a few facts can be stated. But, in the final analysis, the forecasts issued in this case must communicate the level of uncertainty. Overall, the expression of uncertainties in medium-range prediction should be communicated through careful choice of words rather than the numerical value of confidence. What medium-range forecasts do not need is another number to clutter the presentation.

Suggested revision—No temperature extremes are expected throughout the period, but a frontal zone will

be near the region during this time. The exact position of the front is uncertain, so very little can be said at this time about the timing and amount of rain, but cloudiness will be prevalent.

It should be noted that, at times, some forecasters preparing medium-range outlooks have attempted revisions of this kind. However, it is the consistent presentation of medium-range predictions in a revised format that will best signal to the public the type of information available.

4. Recommendations

Medium-range forecasts must have a distinguishing quality. To some extent, these qualities depend on the communication medium. A brief discussion which gives context to the forecast is essential. In addition, innovative graphics and new phraseology must be employed to lead to more effective medium-range predictions.

Generally, radio and print formats are sufficiently flexible to permit easy implementation of forecast discussions and improved wording. A commercial television weathercast has the potential to be the best possible medium for an improved extended forecast, but severe time constraints pose a great challenge. Nevertheless, television weathercasters should take steps to be certain that medium-range forecasts are truly serving the user. The traditional "Five-Day Forecast Board" is an inadequate tool for communicating medium-

range forecast information. Better is the use of regional or national graphics that focus on the weather systems that shape the trends in the medium-range forecast period.

The format of one- and two-day forecasts have, by default, become the standard format for presentation of most forecast information. Today, trends in operational forecasting suggest that greater emphasis will be placed not only on medium-range (3–8 day) forecasts but also on nowcasts (0–12 hours). The development of techniques of communication compatible with these new kinds of forecast information will be a key factor in the success of these forecasts. With the decade to come holding promises for better, more sophisticated meteorological tools for the forecaster, the forecasting community must remember that ultimately the quality of these predictions will depend on our skill as communicators.

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