ACQUIRING WEATHER INFORMATION FOR FROST CONTROL DECISIONS

J. DAVID MARTSOLF[1]
University of Florida
Horticultural Sciences Department
P.O. Box 110690
Gainesville, FL 32611-0690

C. TERRY MORROW
University of Florida
Office of Academic Technology
Gainesville, FL 32611

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Abstract. **An experience with acquisition of weather information on the World Wide Web (WWW) is described. Comparison of the verifications from two automated weather stations with the forecasts are included, with a recommendation that data from privately owned weather stations be made available on line for it permits the observations to be utilized in real time from more than one location. Temperature forecasts were acquired from several sources on the WWW on the morning of 26 Feb., 2002. Tables revealed what seemed to be an error of 1 d, but, in reality it was a difference in the manner in which the forecasts were displayed.**

This paper describes experiences in the search for frost warnings on the World Wide Web (WWW). The presentations on the WWW are in a rapid state of change. So are the methods which bring such information to a decision making process. The philosophy of dealing with the information has not changed (Martsolf, 1997, 1999 and 2001). This paper documents its use in evaluating frost forecasts available on the WWW. The focus of the paper is how forecasts vary one from another, but also on the comparison of forecasts with automated weather station (AWS) data.

Materials and Methods

Computer Systems. The main system on which most of the information was collected that serves as the foundation of this paper is located in Fifield Hall on the main campus of the University of Florida (UF) in Gainesville. It is connected to a local area network and through it to the campus network which in turn provides access to the WWW. Some of the data were collected on a similar but somewhat newer system, located in Turlington Hall, also on the main UF campus. In both cases, some of the observations were made with personal computers at the authors' homes, one in Gainesville and the other in Alachua, Florida. In one of these cases, the link was via 56K Baud modem over conventional telephone lines. In the other, a cable modem was used. The three faster links to WWW proved to be a more efficient way to acquire weather forecasts, but the slower 56K Baud link was adequate.

Climate Prediction Center. The MRF forecast model outputs for temperature and precipitation were found at: (http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/cdus/prcp_temp_tables/mrffox.txt).

This site included a text table of the model outputs for temperature and probability of precipitation, clouds and wind speed. It contained outputs for only ten locations in Florida, and Gainesville is not one of them. The Florida sites were all together, but some scrolling through the large table to find the sites was necessary, a time consuming process. Since these data were collected, the site has moved as indicated in the discussion section.

FAWN. The Florida Federal-State Frost Warning Service provided frost warnings from 1935 through 1 Apr. 1996. In 1997 a frost in South Florida caught horticulturists by surprise and resulted in the resurrection of FAWN, the Florida Automated Weather Network (http://fawn.ifas.ufl.edu/). Temperature observations at the Alachua station in FAWN (FAWN, 2001) were used to verify the documented forecasts.

Private Automated Weather Station. The private AWS used for comparison in this study is a Davis VantagePRO wireless weather station. This station monitors outside temperature, outside relative humidity, rainfall, wind speed, wind direction, inside temperature, inside relative humidity, and barometric pressure. The VantagePRO transits to a display unit located in the owner's home adjacent to a small planting of citrus and vegetables. This planting is located in Alachua, FL. The transmitter sends an update to the receiver on a 30 sec interval. The receiver/display unit is connected to a computer using a serial connection. The data are archived on the computer each 30 min. At the same interval, the data are also sent using FTP protocol to a WWW site: (http://plaza.ufl.edu/ctm/weather/test/Current_Vantage_Pro.htm). Data, as shown on the WWW site, are publicly accessible.

The new forecast product from the Jacksonville National Weather Service office. The URL is http://www.srh.noaa.gov/jax/cgi-bin/master.pl?suite=gfe. The product is animated in time and presents the forecasts of temperature, humidity, wind, and probability of precipitation in a graphical format that is easy to read and hard to misinterpret in regard to the time for which the forecast is made. The forecasts are not for the minimums and maximums, however, but rather for a particular time of day, of which 7 AM was assumed to be close to the minimum in this case. A later interrogation of the URL presented above sometimes results in a message that the page is not currently available. If one goes to the homepage, i.e. the address clipped back to "jax," one will find a list of products on the left hand side of the home page one of which is the "Graphical Forecast."

The Weather Channel. The URL is: http://www.weather.com/weather/local/ onto which an identifier for the zip code or the city is added to identify the particular area of interest. There is currently a series of forecasts for the coming 10 d with the Max/Min indicated for each of the days and the key is in the sequence. At the time the data for this paper were collected, the forecast was arranged in the configuration of a table but with the column containing the maximum temperature to the left of that for the minimum.

AWS WeatherBug. The WeatherBug software may be obtained by visiting: http://ww2.weatherbug.com/aws. When installed, either as a free version including advertisements or as an ad-free version supported by a rather minimal charge, the display is but a single click on an icon which is the current temperature (or the temperature the last time the computer was linked to the Internet Service Provider (ISP)). The forecast for today and tomorrow comes up on the initial screen, and subsequent days are available by clicking on the "Forecast" button. In other words the WeatherBug software takes the place of the Browser in the communications process.

Methods. Data were collected by interrogating various WWW sites where forecasts were known to be displayed. The data were then compiled in a MS PowerPoint Presentation. For this paper some of the data from the presentation have been arranged in Tables 1, 2, and 3.

Results

Three tables have been organized to show the data collected by saving the images found at three WWW sites so that they might be compared. At the time the data were collected, between 8:30 and 9:30 AM on 26 Feb. 2002, the data were consumed in the format presented on the website. The tables are a major simplification in each case and in particular of the case covered by Table 1. It has been noted during the preparation of this paper that the www.weather.com site has changed the format of its 10-day forecast so that the Max/Min temperature forecast for a particular day are more clearly the maximum for the day and likely the minimum for the following morning.

Both authors have downloaded the AWS WeatherBug software and are able to access the forecast shown there conveniently. The screen saved in the data set revealed only the forecast that comes up on the initial screen and not the more detailed forecast that is available if one triggers an additional display. The initial screen displayed on Tuesday morning, Feb. 26, 2002, declared the Low for Tuesday to be 40 °F and the Low for Wednesday to be 22 °F.

The minimum temperatures recorded at the FAWN site called Alachua was 18.8 °F. at 7 AM on 28 Feb. 2002, and the personal AWS belonging to the second author reported 21.8 °F

Table 1. The minimum temperature forecast (°F) for Tallahassee (TLH) and Orlando (MCO) as it was recorded from the Climate Prediction Center on the Tuesday morning of 26 Feb. 2002.

Location	Wednesday	Thursday	Friday
TLH	27	16	31
MCO	48	31	42

Table 2. The temperature forecast (°F) for Gainesville as it was recorded from Weather.com on the Tuesday morning of 26 Feb. 2002, has been reduced to the following table. Only values of interest are included.

Day	Hi	Lo
Tuesday	73	37
Wednesday	50	25
Thursday	57	34
Friday	63	51

at 5:56 AM. The Alachua site in FAWN is a few miles North of the Morrow AWS. However, the settings are quite different with the former in a relatively flat pasture, and the latter on a slope to a small pond with numerous large live oak and pine trees.

Discussion

What appeared to be a major difference in when the coldest night of the freeze would arrive turned out to be a difference in the way the forecasts are presented on the WWW. Table 1 is configured in the conventional style. The rule is and has been to check the accuracy of the forecasts by verification. If several forecasts are compared differences are expected. Location influences the minimum temperature appreciably when winds are calm and skies are clear. The recommendation is and has been to collect sufficient observations to develop a typical difference between the area on which the forecast is focused and the area of interest to the user of the forecast. To do this it is necessary to determine both the time and the location for which the online forecast is intended. That turned out to be more problematic than was anticipated.

A new style is apparent. Notice that the maximum temperature precedes the minimum in Tables 2 and 3. But what is more apparent are the large differences in the minimum temperatures recorded in Table 1 versus those in Tables 2 and 3. Some interpolation is required in the Table 1 to arrive at values that are equivalent in those for the Gainesville location in Tables 2 and 3. Recognition that Gainesville is sufficiently close to halfway between Tallahassee and Orlando permits one to see that a minimum of about 23 °F might be expected for Thursday. However, the lowest temperatures from the other two sources are expected for Wednesday. At first, this difference seemed to be an error. It turns out, however, that the forecasts were quite similar and what is different is the style of the presentation.

The source from which Table 1 was built is not one that is recommended for the typical viewer, however. Rather the source was used to view what was likely to be driving most of the forecasts, a commonly used model output from the National Weather Service. The WWW Site was maintained by the

Table 3. The temperature forecast (°F) for Gainesville as it was recorded from AccuWeather on the Tuesday morning of 26 Feb. 2002, has been reduced to the following table.

Day	Hi	Lo
Tuesday	73	40
Wednesday	52	21
Thursday	57	26

National Climate Center. The model outputs are available to forecasters through a several services.

In this case, Table 1 indicates the model expects the coldest temperatures to occur on Thursday whereas the commercial forecasts (Tables 2 and 3) were pointing to Wednesday as the day in which the coldest temperatures would occur.

In Tables 2 and 3 it may appear at first glance that the coldest temperatures are designated for Wednesday. It is easy at this point to conclude that there are small differences in the expected minimum temperatures, but a rather large difference in the timing. With the expected freeze imminent it was hard to understand how there could be a full day's error in the timing. What turned out to be true was that there was not an error in timing but rather a difference in the way the data are displayed.

At this point in the exercise the new display on the National Weather site for Jacksonville, which displays a temperature forecast for Alachua County in not only a graphical formatted but one that is automated, seemed a Godsend. It is practically impossible to misread the forecast by one day in this new display. A screen was saved of the particular image that projected the minimum temperature for the particular mornings, clearly showing that the one for Thursday morning for Alachua County was 22 °F. At the time the image was first viewed it seemed to be the only forecast obtained [with the model output from the CPC] that had the timing of the coldest morning correctly identified. The JAX NWS seemed to be the only site in agreement with the CPC model outputs on timing, i.e., the only site that had the coldest temperatures forecasted for Thursday morning. Later the difference in display convention would become apparent and even make sense.

The explanation for the timing differences is explained by referring to Fig. 1. On a typical frost morning the minimum temperature occurs at sunrise, i.e., when the sun interrupts the radiant cooling of the surface. So the minimum temperature for a particular date, one that denotes the 24-hour period from midnight to midnight, often occurs in the morning just before sunrise and the maximum then occurs later, an hour or so after 12 o'clock noon. Apparently the consumers of information have complained about this situation which seem confusing to them and so the other sites visited
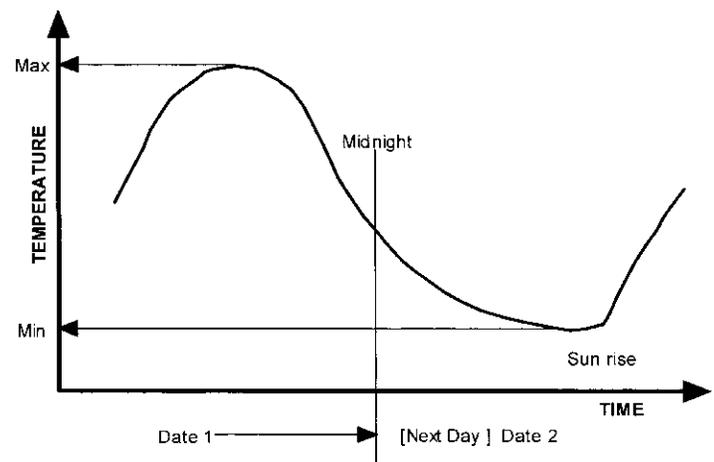

Fig. 1. A trace of time versus temperature typical of most frost situations provided to illustrate the confusion that can occur when the practice of associating the minimum temperature [Min] with the night of Date 1 rather than as it typical of climatological records in which it is recorded for Date 2, the next day.

are now showing the maximum for the day, in which most of their viewers are awake, and then indicates the minimum as coming that night, when their clients are again asleep. The rationale, if there is one, rests on the greater likelihood that if you know it is going to get cold Wednesday night, as they are suggesting in this case, you will do something about it on Wednesday. There is a possibility that an indication that the minimum temperature for Thursday will be 22 °F would find some waiting until Thursday to move their tender plants indoors, which in this case, given that they get up after sunrise, would be too late.

The way that we consume weather information and in particular from the WWW is in a rapid state of change. The convention has changed in the way that the forecasts are presented so that the consumer is alerted to the maximum for a particular day which often occurs a few hours after the noon hour, and the minimum of that day during what they point to as the night. The minimum on frost nights and indeed on most nights occurs just before sunrise of the following day. However, in the way the forecasts are now displayed that minimum temperature is attached to the previous day. This system has merit in that it alerts one in time to do something about the process on the right day.

Literature Cited

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