Weather Maps and the Plotting Model for Surface Observations

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In 1990, Canada issued a stamp (Scott 1287) to commemorate 150 years of continuous weather observations in Toronto. Indeed, the original Toronto Weather Observatory is considered the forerunner of the modern Canadian weather service.

The stamp shows clouds, a rainbow and a weather observation displayed in a special format known as the surface plotting model. To the author's knowledge, this is the only stamp on which shows weather information in this form, though a few others do include random weather symbols. What information is included in the plotting model? We will refer to the stamp to answer this question.

The core of the plotting model is a central small circle which defines the location of the observing station on the map, and also presents the total amount of clouds covering the sky. This amount is commonly expressed in tenths, or in eighths (also known as "oktas") of the celestial dome. The circle contains a sort of "pie chart" which specifies the total cloud amount. In the example, the right half of the circle is completely shaded (5/10 covered), and the horizontal line segment in the left half is for another 1/10, giving 6/10 of the sky which is covered by clouds. An empty circle would represent a clear sky, while a ~~black~~ completely-filled circle would represent the other extreme, an overcast sky.

The temperature (26C) is found above and to the left of the station circle, while the dew point (14C) lies below it and to its left. These values are typical of an average summer day in many parts of Canada.

In meteorology, as in common usage, the wind is named for the direction *from* which it blows. This direction is represented by a shaft leading to the station. The example shows a south-southwesterly wind (blowing from about 210 degrees). The wind speed is represented by barbs at the end of the shaft; a full barb means 10 knots (nautical miles per hour, abbreviated kt), while a half barb means 5 knots. The two full barbs of the example define a wind speed of 20 kt. A wind of 50 kt would be represented by a small black triangle (a "pennant") on the shaft. Any wind speed, to the nearest 5 kt, is then built up from these three basic speed elements. If the wind shaft is absent, then the wind is calm.

The current weather is represented by a special symbol immediately to the left of the station circle. There are many such symbols, for the various possibilities (rain, snow, drizzle, fog, showers, thunderstorm, freezing rain, etc). In our example, the open triangle topped by a dot means that a rain shower is occurring at the time of the observation. To the left of the current weather symbol is found the code for the prevailing visibility at the station. This code value is an integer between zero and 89. The value of 70 on the stamp represents 13 statute miles. For code values from zero through 48, on can obtain the visibility in miles by dividing by 16 (e.g. code 24 represents 1.5 miles). For values above 48, this trick does not work, and the meteorologist must memorize the equivalent values, or refer to a table to get them.

Pressure is an important weather variable. Lines of equal pressure (isobars) on the weather map define patterns including low and high pressure centres. The station pressure is converted by a special technique to an equivalent value at mean seal level (MSL) to allow the comparison of pressure data from stations at different altitudes. This MSL pressure is plotted in truncated form above and to the right of the station circle. It is measured in millibars (mb), or in modern terminology, hectopascals (hPa). Typical values range from 960 to 1040 mb, though extremes on both ends of this range are not uncommon. The pressure is plotted in tenths of a mb, but the leading '9' or '10' is dropped, to save space. Hence, 985.3 mb would be plotted as 853. In the example, the MSL pressure is 1012.7 mb. Any plotted pressure value could start with a '9' or a '10' in theory; in practice, there is no confusion, since the correct value is always clear from surrounding stations and recent history.

Pressure changes are very important in meteorology. The pressure tendency (the MSL pressure change during the three hours before the observation) is plotted below the MSL pressure, in tenths of a mb. A small graphical symbol showing how the pressure has changed is included with the numerical value. In the example, the pressure changed by 0.7 mb, and in three hours it first fell and then was steady.

Cloud information is of course included in the plotting model. Three general classes of clouds are considered: low (e.g. stratocumulus and convective clouds such as cumulonimbus), middle (e.g. altocumulus) and high (the various cirrus clouds). A low cloud symbol is found immediately below the station circle. These symbols generally bear some resemblance to the actual cloud. In the example, a towering cumulus cloud is indicated. This is a common summer cloud which grows vertically from an ordinary cumulus, and is often associated with rain showers. This is in fact the cloud pictured on the stamp. To the right of the low cloud symbol is plotted the amount, in oktas, of the low cloud which is covering the sky. In the example, we see that the towering cumulus is covering 3/8 (or, if you wish, about 4/10) of the sky. A value of 9 is also permitted. This would mean that the sky is completely obscured, usually by heavy precipitation.

The base height of the low cloud is presented, again as a code, with possible values zero through 9. Each code value corresponds to a certain range of cloud base heights, but meteorologists commonly use a mnemonic rather than memorize all the values. The trick is to take the code value and square it. The result then gives, roughly, the low cloud base height in hundreds of feet. In the example, this works out to 4,900 feet. The actual definition for code 7 is low cloud bases between 1,500 and 2,000 m (4,921 to 6,560 feet). The estimated value is close to the lower limit of the full range. If middle cloud is present, it is defined by a symbol immediately above the station circle. High cloud, if present, is in turn found as a symbol above the middle cloud symbol. The middle cloud of the example is altocumulus which is being formed by the spreading out of the convective clouds. No high cloud is present. No direct information about the the amount of middle and/or high cloud is found in the plotting model, but the the amount of the two together can be inferred by subtracting the low cloud amount from the total cloud amount. In the example, this is 6/10 - 4/10 = 2/10. We conclude that the altocumulus is covering 2/10 of the sky.

The surface weather map is a powerful tool for summarizing a large amount of information through the plotting model. The meteorologist can quickly assimilate this information once he is familiar with its details. Moreover, the plotting model is an international standard, so that weather maps from any country can be immediately understood in any other country. I hope you have enjoyed this brief tour through the intricacies of the surface plotting model.