On board Weather Forecasting

by Batt, BoM

A question asked of me from time to time is - *How has vessel-board weather forecasting changed over the years?* It's a complex answer but the simplest answer is – *It has changed for the better over the years. The degree of change has varied greatly from one boat to the next. Essentially it's a function of how much money boat owners have been prepared to fork out for technology!* Before I go on to elaborate, let's take a peek at a much potted history of the art and science of meteorology. This may help us to understand where I'm coming from?

It's safe for us to assume that our very early ancestors acquired weather wisdom by observing weather sequences and noting the foreshadowed effects of certain atmospheric conditions on objects animate or inanimate. We can further assume that the knowledge thus acquired was communicated to their descendants and that it was handed down, with additions and amplifications, from generation to generation. We find in the earliest writings and in the Scriptures expressions of weather wisdom, many of which have appeared over the years as "weather folklore". Thus by assumption and deduction we know that humankind has always employed, inherited and acquired weather wisdom in the daily affairs of life both on land and sea.

The wisdom thus acquired has been perpetuated in the form of trite sayings or proverbs. Many of these sayings are polished gems of weather folklore, others have lost their potency by transfer to places in the world where dissimilar climatic conditions exist and a large proportion have been born of fancy or superstition.

Seafarers have long been renowned for their use of weather folklore to assist them in their weather forecasting endeavours. Some examples are below:

"Mackerel scales and mare's tails,
Make lofty ship's carry low sails"
(Refers to high level cloud signaling the approach of a cold front and thus stronger winds. We know that some cold fronts move through cloud free and some move through as very weak features and as such not a lot of wind. High level jet stream winds can also produce high level cloud without a cold front being anywhere near your area and light winds being experienced at the surface)

"Red sky at night sailor's delight,
Red sky in the morning sailor's warning"
(Probably the one that has stood the test of time in different parts of the world. It refers to the passage of a cold front and has more potency in temperate to high latitudes than low latitudes).

These sayings probably worked quite well in the UK and some European waters. But once these seafarers started to move further a field, they would have (and still do) discovered that these sayings became a very much hit and miss affair. Early meteorology was very much an art.

In order to set some perspective to such a complex topic, I've set up a time-line of some major meteorological discoveries/events (discoverer in brackets) below:

1593 Invention of the thermometer (Galileo)
1632 Trade winds resulted from the Earth's rotation (Bacon)
1643 Invention of the mercury barometer (Torricelli)
1686 Global wind belts explained (Halley)
1735 Understanding of the Trade winds improved (Hadley)
1756 Trade winds better explained (Kant)
1783 First meteorological measurements from a balloon (Cesar)
1788 First instrumented weather observations taken in Australia (Dawes)
1805 Beaufort Scale first appeared (Beaufort)
1805 Classification of clouds (Howard)
1816 Weather maps first appeared (Brandes)
1828 Equatorial Trough (Doldrums) explained (von Humboldt)
1837 Invention of the telegraph (Morse)
1841 Apparent turning due to Earth's rotation- Coriolis "force" (Coriolis)
1844 Invention of the aneroid barometer (Vidie)
1848-1860 First wind charts for the oceans (Maury)
1852 UK Met Office established
1856 Relationship between pressure and winds (Buys Ballot)
1856 Global wind circulation (Ferrel)
1859 First intensive study of the Australian climate (Jevons)
1861 First storm warning system for shipping established in UK (Fitzroy)
1870's Birth of synoptic meteorology (Koppen)
1876 First world wind charts (Coffin)
1877 First weather map to appear in an Aus newspaper (Russell)
1878 Idea of the cold front first conceived (Ley)
1884 First long range forecast of the monsoons (Blanford)
1901 First long distance wireless transmissions (Marconi/Tesla)
1908 Australian Bureau of Meteorology (BoM) established
1921 Polar front theory of weather (Bjerknes)
1922 First attempt at Numerical Weather Forecasting (Richardson)
1949 First successful numerical forecast (Charney)
1950 Laboratory model of the global circulations (Fultz)
1955 Numerical Weather Prediction became operational as electronic computers came onto the scene
1960 First weather satellite launched
1968 First computer appeared in the BoM
1969 First operational numerical analysis performed in Australia (BoM)
1976 First numerical weather forecasts produced for the Southern Hemisphere (BoM)

1977 First Japanese geostationary meteorological satellite launched

During the 1970s and 80s, meteorology worldwide grew in “leaps and bounds” to become the science that it is today. Much of this growth thanks to computers.

This brings me back to the answer to the question that was posed in the opening paragraph, namely, *vessel-board weather forecasting has changed for the better over the years. The degree of change has varied greatly from one vessel to the next. Essentially it’s a function of how much money boat owners have been prepared to fork out for technology and of course a person's knowledge!*

OK to start with, in the early days of sail, before the telegraph and the radio. Mariners had no way of obtaining observations from other vessels at sea or locations. The shipping company owner would have paid top money in order to obtain the best captain. These captains then had no choice but to adopt single station weather forecasting techniques (SSWFT): observing the clouds and other signs around them and then using their local knowledge and folklore: in order to derive their own forecast.

Once the telegraph, radio, robust weather forecast systems and knowledge came along, then it depended on how much money the owner could spend on receiving systems and with time, onshore human weather routers in order to receive weather bulletins, maps (via radio facsimile) and forecasts at sea. Up until recent times, this was the domain of commercial shipping. The owners had the big money required to buy these systems. Over the last twenty years or so however, there has been a move to sophisticated systems (radio transceivers, satellite, computers and associated software) on cruising and racing yachts as the price of these electronic marvels has kept decreasing.

Nevertheless, there are still a plethora of craft that put to sea almost daily with only a radio onboard in order to receive broadcast weather forecasts and warnings. The skippers of these craft have to resort to a blend of the “official forecast" and SSWFT.

For those mariners without any means of obtaining outside weather information then they have to adopt SSWFT in much the same way as the early seafarers had to.
You will now ask – What is single station weather forecasting?

SSWFT is essentially the regular keeping of weather observations. These observations should be performed at least every three hours. Observations should include the following:

wind direction and speed

cloud types

barometric pressure (actual)

barometric tendency and

sea and swell conditions.

By logging the above variables and noting any trends, one should be able to build a picture of what is going on around them. In particular it is the observation of cloud, followed by the barometric tendency that will give you an indication of any impending significant changes.

One should become very familiar with the various cloud forms. There are many good weather books and cloud charts that will help you. When you are happy with this aspect (it takes time) then you can start to concentrate on cloud sequences or trends. It is the sequence or trend that is very important for forecasting. An example of a *must know* cloud trend (outside of the tropics) is that associated with the passage of a cold front.

It goes like this, 20 to 36 hours before the arrival of the cold front you will generally observe high-level clouds, 6 to 12 hours beforehand middle level cloud will be observed, and marking the leading edge of the front at the surface will be low-level clouds. But remember that from the point of view of cloud and weather, each cold front will be different, and that some cold fronts are cloud free.

The aneroid barometer is your main instrument at sea that will sense significant changes. It is the tendency (rise or fall over a time interval) of the pressure that is most important and not the instantaneous value. For example, a pressure rise or fall of say 6hPa or more, over a 3 hour period will indicate that, either strong winds or greater are currently being observed, or they are just around the corner. The greater the pressure change over a three hour period, the stronger the winds.

SSWFT is good out to about 24hours, after which the accuracy drops off very quickly.

Boat owners, skippers and navigators should strive to spend as much money as they can to ensure that they have excellent weather knowledge, skills and information retrieval systems.

Good on board weather forecasting.