TOOLS OF THE TRADE:
Making the most of onboard weather forecasting

by

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During our circumnavigation in the early 1990s, my partner, Evans Starzinger, and I planned our routes based on the historical pilot chart winds and then took whatever weather came our way once at sea. We gathered what little weather information we could from our high frequency radio while on passage, but it rarely did more than confirm the conditions we were already experiencing. Since that time, the amount and quality of weather information available has increased radically, along with the ways to communicate it to a sailboat while underway. During our six-year, high latitude voyage aboard our Van de Stadt Samoa 47, *Hawk*, we have made use of just about every source of weather information available to a boat at sea. We regularly rely on five different sources of weather information while on passage including weatherfaxes, "grib" files, and shore-based weather routers. But to make the best use of this wealth of information takes practice, a good general knowledge of weather, and an understanding of the strengths and shortcomings of each weather source.

WEATHER INFORMATION

We use weather information in three ways aboard the boat: to pick a departure window, to modify our route while on passage, and to make decisions about what sails to carry for the next six to twelve hours. Before weather information became accessible on board, we used shore-based weather sources to pick our departure window, the pilot charts to determine our route, and after that relied on "deck level forecasting" to determine our next six to twelve hours of weather. Wind direction, barometric pressure, the trend in pressure and wind direction, cloud cover, swell, humidity, and temperature all helped us to determine whether we were under the influence of a low or high pressure system and what weather to expect in the short term. We rarely modified our route underway based on weather considerations because we rarely had access to the information that would let us make those decisions. Today we still use shore-based sources in addition to our onboard weather information to find a departure window, but now we can also get up-to-date (though not always very accurate) forecasts every four to six hours while on passage. We use these to modify our overall routing strategy if the weather is behaving differently than normal, and to make smaller changes to our route in response to specific weather systems. We base our sail handling decisions on these forecasts but still use our deck level forecasting skills to check the accuracy of the information we have received.

To make all these decisions, we currently use five different external sources of weather information (see Table 1). Four can be accessed through a high-frequency radio transceiver; of these, three are virtually free. Comparing these sources gives us a much better map of the weather systems

and their likely movement than we could get from any one source. This combined information also allows us to keep track of our position relative to the weather systems by monitoring our true wind direction and any wind shifts, as well as the barometric pressure and its trend.

Weatherfax. Most countries disseminate various types of weather information by weatherfax several times per day. These include synoptic charts and satellite images as well as 12- and 24-hour prognoses (with some providing up to 3- to 5-day prognoses). These can be received via a dedicated weatherfax machine or through a high-frequency radio receiver attached to a laptop computer via a sound cable. While most people download faxes through their SSB transeiver, an inexpensive short-wave receiver like the SONY all-band receiver we carry on *Hawk*, can also be used. These receivers represent the lowest hardware cost of any of the weather options and allow access to several different types of weather information. The laptop must be loaded with a software program such as Meteofax or Xaxero to receive and read the charts. Once the system has been set up, the faxes themselves can be downloaded without charge. Weatherfaxes provide an inexpensive and low effort way to get weather information aboard; however, reception is dependent upon radio prorogation.

The same information that gets broadcast as weather faxes is often available on the country's weather website. When looking for a departure window, we will access this website at an Internet café for several weeks prior to leaving to get a feel for local weather conditions and how systems normally track. We will look at satellite images, synoptic charts, and prognoses to see if systems tend to develop as forecast. At sea, we will download faxes in relatively calm conditions, but don't tend to rely on them when it gets too rough. Weatherfaxes offer general guidance with respect to the specific conditions we can expect in the next six to twelve hours. But they're much more important for picking out the major weather features that could affect us in a few days' time or for determining current weather trends, like the track of low pressure systems through the forecast area.

Ham/SSB high seas forecasts and marine nets. Most countries transmit voice forecasts for offshore waters over the SSB frequencies several times per day. These include a synopsis and forecast by sea area. In addition, someone in almost every ocean runs a weather net for yachts crossing that ocean. Herb Hilgenberg, better known as Southbound II, has for more than a decade run such a net in the North Atlantic and handles as many as 80 boats at a time. While the quality of the weather advice depends upon the experience and skill of the person running the net, simply listening to these nets provides a wealth of useful information. Any boat equipped with a high-frequency radio can participate, and any boat carrying an inexpensive short-wave receiver like the SONY all-band receiver can listen in.

Typically, the net operator will open with an overall synopsis and forecast for the reporting area, and will then check in with each boat, asking the crew to report their current position and conditions including wind speed, direction and wave heights before giving them a localized forecast for the next twenty-four hours. To track this information, we use a piece of graph paper marked with latitude and longitude that covers most of the reporting area. During the overview, we mark the position of the major weather features and their forecast directions and speeds. Then we mark the actual wind speeds and directions at the positions reported by the vessels checking in with the net, as well as our own wind speed and direction. If the wind speeds and directions don't correspond well with the major features in the forecast, it's often because systems have moved more quickly or more slowly than predicted, and by shifting the major features slightly we can align them with what's been reported and get a

better sense of the actual situation and our likely weather over the next twenty-four hours. Using the same sheet for three or four days running, with different color markers, gives a good feel for the speed and direction of major weather systems. Thus, this window into the actual weather conditions around us allows us to build our own synoptic chart of the current situation and forecast what will happen over the next period.

Our homemade weather chart has proven more accurate than any available weather chart on many occasions. In conjunction with weather faxes, this chart also helps us to identify unusual weather patterns that may make us modify our overall route. When leaving the Virgin Islands for Ireland we had planned to sail the typical route due north to 40 degrees and then turn west to avoid the large windless area created by the Azores high. Once we got underway, the weather map we created from the weather net showed deep lows tracking between 35 and 40°N and good 20-25 knot winds across the middle of the Atlantic. Based on this overall weather pattern, we were able to save several hundred miles by sailing the rhumb line straight to Ireland with favorable winds.

On passages between the tropical and temperate latitudes, boats a couple hundred miles to weather of us can give us warning of bad weather we may be able to avoid by slowing down. On passage from Fiji to New Zealand, some boats about 300 miles in front of us reported on the radio net that they had 50 knots of wind, waterspouts and lightning. Though we still had perfect sailing conditions, we reduced sail and slowed the boat down for two days to let the whole mess pass under us. We have done this on several different occasions and feel strongly that this is the most effective action a normal cruising boat can take once underway.

We follow the nets daily on passage and often tune in for the high seas broadcast as well. Even in the worst weather, we can listen to what's going on even if we can't update our synoptic chart.

Inmarsat-C forecasts. Inmarsat-C provides professionally prepared broadcasts meant for commercial traffic, similar to the Navtext forecasts available coastally. These include a synopsis of the major weather features and a forecast by sea area disseminated four times daily. Inmarsat C provides worldwide coverage independent of radio propagation but requires an investment of about $3,000 in hardware and can only be accessed via a laptop computer. The forecasts themselves are free and are transmitted to the unit via an external antenna. They are then stored in a "black box" until downloaded. The unit must be on to receive the forecasts, and it draws a couple of amps per hour. However, forecasting schedules are available, so we can turn the unit on an hour or so before the forecast is due and turn it off when we have received and downloaded the transmission.

Forecasts cover the following 24 hours with a 12-24 hour prognosis – useful for deciding what sail to carry for the next watch but less useful in determining overall routing or avoidance tactics for systems several days away. Again, by diagramming the synopsis on a piece of paper marked with latitude and longitude and tracing the situation over several days, we can gain a good feel for how systems are moving. By placing our position on this chart and taking into account our own barometric pressure, wind direction and speed, we can usually figure out where we are in relation to these systems and get a better idea of what weather we're likely to experience over the next few days.

We get Inmarsat-C forecasts once or twice a day on passage when weather information is limited from other sources, particularly in the high latitudes where radio propagation tends to be problematic. During a gale in the high latitudes, the only forecasts we're likely to get will be Inmarsat-C. Because the forecast gets stored until we download it on the computer, we're not on someone else's schedule to get this weather information but can pick the quietest time to set up the computer and check the forecast.

Grib files. The most compact format for downloading weather information directly from the Internet is called a grib (gridded binary) file. These are special-request files that access NOAA weather databases to provide tailored information to the user. They offer almost unlimited flexibility in selecting weather information, with the user specifying the reporting area, the type of information required, and the forecast period. The information that can be downloaded includes wind speeds and directions displayed as wind arrows, surface pressure, 500-millibar charts, and wave heights, all at 12-hour intervals for up to 15 days (though accuracy declines markedly after the first 24-48 hours). To download them on the boat requires some way to access the Internet from onboard, a laptop computer, and software to read the grib files.

Grib files can be downloaded from several different sites on the Internet including www.globalmarinenet.net, www.navcenter.com, www.raymarine.com, and www.saildocs.com. Each of these sites includes an explanation of how grib files work and how to access them through that site, and provides software for reading the grib files once downloaded. Most cruisers use their high-frequency radio and a Pactor modem to access the gribs through Saildocs as part of their onboard e-mail service. We use a satellite phone to download gribs and read them using MaxSea software. While downloading costs nothing more than the radio time or phone time (using Iridium it costs us about a dollar for five days of weather maps), there may be a small annual fee for accessing the sites to download the files.

Grib files are raw data plucked from the NOAA databases without human intervention. Providers of gribs caution that they have not been quality controlled and require interpretation by the user. But we have found them to be as accurate as what we get through weather routers. Like the pilot charts, information is reported on a latitude/longitude grid, 5 degrees on an edge (though that can be reduced to a half a degree on an edge in a custom request). That means they can miss compact, intense systems like meteorological bombs and small tropical depressions. Like many things on the computer, the graphics are so compelling it becomes easy to believe what you're seeing is what you will get over the next five days. However, their accuracy varies as does any forecasting tool, and we have learned to be very skeptical of anything they show beyond 48 hours. On the other hand, they have often given us several days' warning of large, well-established, intense high and low pressure systems, giving us time to maneuver as these approached.

When looking for a weather window, we download gribs every few days for several weeks. As with the weatherfaxes, we're trying to get a feel for how systems move and for how accurate the forecasts seem to be. Gribs give us a long enough forecasting horizon – up to 10 days – that we can identify a potential weather window earlier than with any other weather source. More than half the time the weather window won't actually materialize, but when it does we're ready to take advantage of it. At sea, we usually download gribs only in settled weather and only once a week or so, just to be sure there's no large weather feature on its way that might radically affect our strategy, like a deep low pressure system or a large, windless high.

Shore-based weather routers. These professional forecasters provide tailored forecasts to the crews of boats at sea including recommendations on what route to take to avoid bad weather or find good winds. This service comes at a price – from $100 to $1,000 or more for a passage. Most weather routers have built a business serving racing crews willing to pay for any edge to win offshore races. Given the wealth of weather information now available to the navigator while offshore, a shore-side weather router is worth paying for in two situations: if you have little experience interpreting weather data and want a second opinion, or if you are making a passage through an area where other sources of weather information are very limited. To access a weather router, the boat needs to be equipped with some means of long-distance communication. This includes voice or e-mail communications over a high-frequency transceiver or satellite phone.

Weather routers provide a synopsis of the major weather features and forecasts of wind strength, direction, and wave height at six-hour intervals for periods of three to five days. They will also make routing suggestions and give recommended waypoints to be reached in a specific period of time. As with the grib files, we find the accuracy of the forecasts generally declines rapidly after 48 hours, and we have occasionally had forecasts that fell apart after six or eight hours. Also like the grib files, the weather routers are best at picking out large, stable features that might have a big impact on our sailing like deep low pressure systems or widespread areas of stable high pressure. Routers are, after all, accessing the same sources of data and the same models as the grib files; their value added is the interpretation they bring and the cross-checking they can do against other weather sources to give you as accurate a forecast as possible.

Getting good advice from a weather router depends upon several things. First, the router needs to be a trained meteorologist with a proven record working with cruising boats, not just the big racing boats who can manage much higher speeds and can more easily position themselves with respect to the weather. Second, the router needs to understand your boat's average speeds upwind and downwind so his or her recommendations accurately reflect your daily averages in different conditions. Be realistic in making your estimates. *Hawk* is a relatively fast and capable boat, but we sail a lot slower (particularly close hauled) when short-handed on passage than when day sailing – because the waves are much bigger and we are much more tired. Third, you should clarify your preferences with respect to wind speeds and directions. We don't mind running downwind in winds of 35 or 40 knots, but we'll do almost anything to avoid going upwind into the same conditions. Finally, be clear what information you will find useful and ask for additional information if they are not providing it. We always ask for the center barometric pressure of highs and lows and the pressure they expect us to see as fronts pass through. This allows us to place ourselves relative to large weather features and more accurately predict when frontal systems will pass over us. We also like to know how confident the router is in the forecast and we will treat a high confidence forecast quite differently than an uncertain one. Some routers are willing to provide this information and some are not.

Besides providing forecasts while underway meant to tell you what conditions to expect in the short- and long-term, weather routers will put together specific departure packages. These include forecast wind speeds and directions, a recommendation for when to leave and what route to take, and on the US east coast, recommendations for routing through the Gulf Stream. This would be worthwhile for someone who has not yet developed forecasting skills, especially on a short passage (under five days) where a good weather router should be able to find a weather window

that will last for the length of a passage. More experienced cruisers have access to the same weather resources as routers do while ashore, so they can usually find a good departure window on their own.

WEATHER ROUTING CONCLUSIONS

After using all these sources of weather information for the last six years on *Hawk*, we have come to several conclusions.

First, don't overestimate what you'll get from weather forecasting. Weather routing will not prevent you from ever getting into heavy weather. For the average cruising boat weather information is much more useful for picking a departure window and determining what sails to carry for the next watch than for avoiding storms and areas of light wind on passage. In the tropics, the weather patterns (trade winds, tropical waves and inter-tropical convergence zone) tend to be hundreds to thousands of miles long, so there is little chance to run around the end/edge of the weather. In the temperate and high latitudes, a slow front will be moving at 10 knots (240 miles/day) and a fast one at 30 knots (720 miles/day). We only rarely get more than two days' accurate warning of the direction and speed of an approaching system, even using weather routers. Forecasters are better at identifying stable high pressure systems with large expanses of light air four or five days in advance, however, these systems tend to be many hundreds or even thousands of miles across. In the tropics or the temperate latitudes, then, a crew aboard a typical cruising boat capable of sailing 120-150 miles per day will not be able to do much to position the boat in the time available. To really take advantage of weather routing, a boat needs to be able to make good 300 miles per day.

Second, the most cost effective way to receive weather on board is to carry an all-band receiver. This will give you access to the high seas broadcasts, marine nets, and, in conjunction with a laptop computer, weatherfaxes. If you already carry a high-frequency transceiver and Pactor modem, for a minimal investment you can have access to all of these plus grib files, and you can also use a shore-based weather router. For those traveling where radio propagation may be an issue, the Inmarsat-C offers a bulletproof way of ensuring access to short-term weather forecasts, and a satellite phone will provide access to gribs and weather routers.

Third, your responsibility does not end with a forecast. Even a weather router is limited to virtual information; you are the only one who knows exactly what you are experiencing real time. You still have to reconcile the weather predicted in the forecasts with the barometer, wind direction, sea state, and sky to come to your own conclusion about what the next twelve to twenty-four hours will bring. Each source of weather information can be viewed as a single aide to navigation – to figure out exactly where you are on the weather chart, you need to reconcile those with the evidence of the actual sea and wind conditions.

Fourth, all this weather analysis is difficult once in heavy weather. It is not fun, and often not productive, to sit in the nav station and stare at a computer screen when you are tired, wet and seasick. The laptop needs to be protected from saltwater and prevented from flying across the cabin. We have learned to extract as much weather information as possible when in nice weather and not to count on getting much more, except possibly the Inmarsat-C situation update or a high seas or marine net broadcast, when in bad weather.

Prior to GPS, cruising skippers spent most of their time simply trying to figure out where they were, but with GPS this is a one-second push button exercise. The prudent navigator will invest their 'spare' time in analyzing the weather to determine the safest and fastest possible route. No amount of weather information or analysis will allow you to avoid all bad weather, but the value of bypassing one bad storm or several days becalmed certainly offsets, for us, the time and effort invested in understanding what's going on around us.

TABLE 1. Comparison of different types of shipboard weather information

TYPE	HARDWARE REQUIRED	COST PER FORECAST	PROS	CONS
SSB/Weatherfax	• Need hf radio receiver and some sort of fax software with a laptop computer, OR • Dedicated fax receiver and thermal paper	• Weather faxes free, many per day	• Can get up to five-day forecasts • Wide range of information available including satellite pictures, synoptic charts and prognoses	• Propagation unreliable, but transmitters tend to be more powerful than for the ham nets
Ham/SSB Nets	• High-frequency radio receiver	• Free to listen • May be small donation to participate	• Actual weather info from boat reports • Routing suggestions	• Radio propagation unreliable • Quality of information varies depending on skill and experience of person running net
Grib files off Internet	• Satellite phone OR hf radio transceiver and modem • Laptop computer • MaxSea, Raytech, or other software to analyze grib files	• Free off hf radio • About 6 minutes/$10 for a chart or 2 minutes/$3 for a 5-day grib file over Iridium phone	• Can get five-day forecasts • No propagation issues with Iridium • Complete range of information available	• Expensive • Grib data is raw output from a computer weather model, which has not had any human quality control – requires interpretation
Inmarsat C	• Special Inmarsat C receiver (~$3,000) • Laptop computer	• Twice daily weather free in most areas	• No problems with propagation • Information of national weather service quality	• Relatively short outlook – 12-24 hours on Inmarsat
Shore-based weather router	• Some sort of communication equipment – laptop with SatC or satellite phone OR high-frequency radio transceiver	• Costs from $100 to +$1000 for a passage	• Typically trained meteorologists, but get resumes to make sure • Detailed, individual forecasts with generally excellent weather information	• Expensive • Routing advice sometimes suffers from limited experience with cruising boats