The Front

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Hazards Behind Surface Analysis

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Pilot weather briefings represented the lion's share of daily duties for me, a young forecaster with the Air Force. My mission was to provide weather forecasts for flights anywhere in the world, often on very short notice.

The surface chart was a significant resource in my tool box of weather information. The chart was hand plotted and analyzed. Forecasters devoted a great deal of detailed scrutiny to delineate the features of concern to pilots.

I walked the pilot through a description of the radar chart and explained the invisible features depicted on the latest satellite image. The jet stream chart, with a prominent fat red line, always grabbed the pilot's attention.

Despite the value of in-flight charts, the briefing always started with the surface map, the biggest and most prominent chart in the middle of the map display.

Cold fronts were colored in a heavy blue marker, warm fronts were red and occluded fronts purple.

Most pilots had a basic understanding of the actual weather mechanics associated with fronts and pressure systems. Most were savvy enough to just wander in, take a glance at the big chart on the wall and have a pretty good idea where the weather

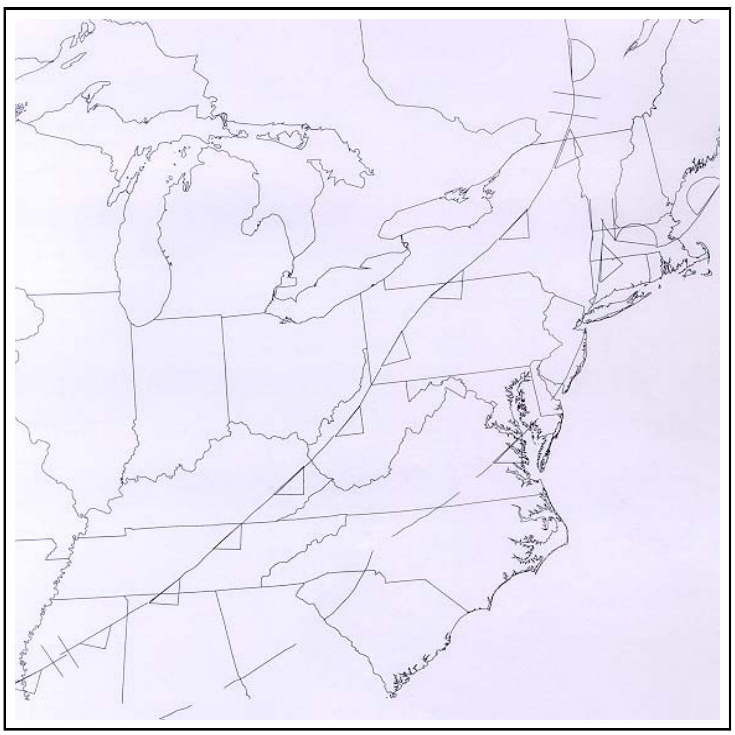

Figure 1: *Computer generated frontal analysis for the eastern*

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The Front

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Mission Statement

To enhance aviation safety by increasing the pilot's knowledge of weather systems and processes and National Weather Service products and services.

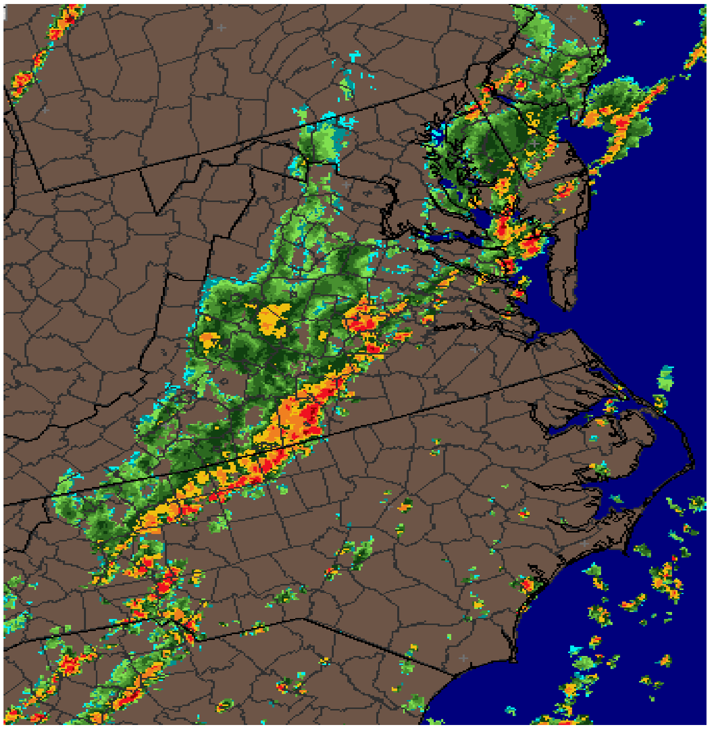

Figure 2: *what many pilots might expect in the summer, abundant convection from central Virginia back into western North Carolina.*

was likely to be unfavorable for flying and where it might be "clear and a million."

The days of face-to-face briefings by Weather Service folks like those of the Air Force are over. Pilot weather briefings are now almost exclusively handled by experienced Federal Aviation Administration (FAA) briefing specialists.

The Internet has automated pilots' visualization of features and data in the weather briefing process. This is good preparation but not a substitute for a thorough preflight briefing from the FAA Flight Service Station (FSS).

Most of the information available from the Internet is computer generated, convenient and pleasing to the eye; however, it is not always the most accurate or up-to-date information available. The computer generate surface chart may lack significant detail an experience analyst could add.

Hand analysis reveals small-scale features that may be significant to pilots. Squall lines and wind shifts associated with thunderstorm outflow boundaries are masked or "smoothed" out in a computer generated analysis. Pilots using the Internet to "self brief" ahead of any formal flight planning may be unaware that the surface analysis they are viewing is not adequately depicting these small-scale dangers.

A computer generated frontal analysis for a recent late summer day is shown in Figure 1 (Page 1). A frontal system stretches from eastern New Jersey into the Carolinas. The main cold front is depicted from western New York and Pennsylvania southward into the Gulf states.

The concurrent radar image in Figure 2 shows what many pilots expect in the summer, abundant convection in this region of low pressure from central Virginia back to western North Carolina.

A close look at the radar shows that most of the convection is along and near the computer-depicted trough over the Carolinas. Little or no weather is associated with the *main* front farther to the west.

NWS forecasters look for small-scale details to provide answers by employing a practice known as "meso analysis." Figure 3 shows what one of these analyses adds to the total weather picture. Convection is actually causing significant disruptions in the pressure and wind fields, making the frontal analysis complex. The front fragments some-

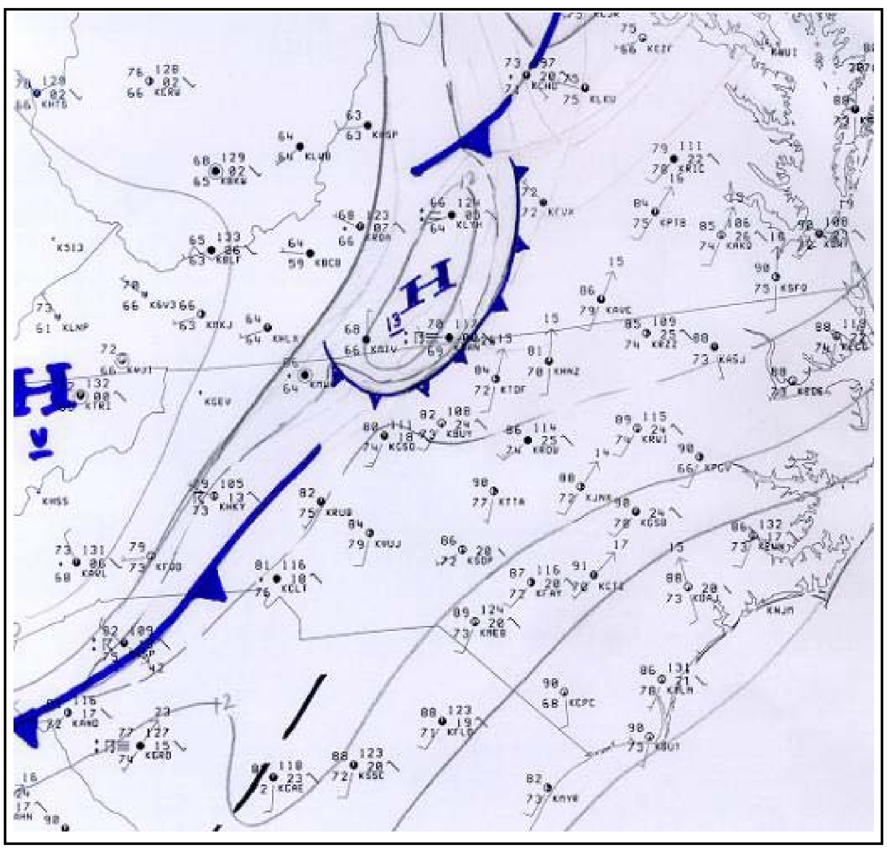

Figure 3: *Convection is actually causing significant disruptions in the pressure and wind fields, making the frontal analysis complex.*

where in central Virginia and become hard to find until a discernible wind shift and pressure trough reappear over northern South Carolina.

The most significant feature, a squall line, stretches from extreme southern Virginia to northern North Carolina. The squall line has created a gust front and spread a cold pool of air in its wake. This stable pool of air is known as a meso high.

Bottom Line

What does it all mean? In addition to the gusty winds and heavy precipitation associated with the thunderstorms, the meso high suggests the presence of turbulence and low level wind shear displaced from the parent line of storms. A feature this complex and dangerous to air safety has no chance of showing up on a computer generated analysis.

Training and experience would lead most pilots to focus on the "main" cold front farther in western Pennsylvania and to look for active showers and thunderstorms; however, in this case, just a few thunderstorms exist there.

This is just one example of how a computer-generated chart could mask important features. Computers can fail to analyze such essential elements as coastal fronts, dry lines, sea breeze fronts, lee side troughs and other features.

Weather is the result of big features like highs and lows modulated by small-scale events

An FSS briefing is a good start by calling on professionals to supply these details.

Pilots who pre-brief on the Internet need to make it routine practice to examine many types of real-time data, knowing that the pretty pictures may mask dangers.

Understanding where hazardous weather could be lurking on an otherwise benign looking weather chart, enhance situational awareness of weather systems and prepare pilots to handle or avoid hazardous conditions once they are air borne. ✈

The Graphical Area Forecast: A New Solution to an Old Problem

By Ron Olson, AWC Warning Coordination Meteorologist

The format and update frequency of NWS AIRMETs (WA), SIGMETs (WS), and Area Forecasts (FA) text products has changed little in 30 years. Pilots and dispatchers often try to form graphical images from these text products. However, the "picture" is not always what it should be. Limitations associated with text formatted, and maximum character restrictions by FAA systems, force Aviation Weather Center (AWC) forecasters to describe complex weather situations using broad-brush terminology, resulting in more pessimistic forecasts than intended. When faced with large weather hazard areas extending over periods of six hours or more, aircraft must be dispatched into these areas where the forecasted weather conditions are lurking *somewhere* inside. Graphical products may play a significant role in solving this problem.

Aviation users understand this problem and are actively lobbying the government for new, official graphical products as well as new and creative dissemination methods. At both the 2001 and 2002 Friends/Partners in Aviation Weather (FPAW) forums, user group representatives requested new graphical weather products from senior FAA and NWS managers. The FPAW forum is held annually to discuss common aviation weather interests and concerns. Forum members include:

- Airline Dispatchers Federation
- Aircraft Owners and Pilots Association
- AOPA Air Safety Foundation

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KZLC GAMET VALID 220600/221200 KKCI-
SALT LAKE CITY FIR BLW FL450..OR ID MT WY NV UT
SECN I
SFC WSPD: MT..18/21 40 KT BOUNDED BY 50N FCA TO 30NNW HVR TO 40NE
BIL TO 50E LWT TO 50SW BIL TO 30NW HLN TO 50N FCA
SFC VIS: MT..BLW 3 SM BR BOUNDED BY 40NW YQL TO 50S YYN TO 40NW
BIS TO 50NNE DPR TO 50WNW DPR TO 30W BIL TO 50ESE YXC TO 40NW YQL
SIGWX: MT WY NV UT CO..OCNL TSRA 120/FL350 BOUNDED BY 70NNW ISN
TO 50NW PIR TO 30SE LBF TO 40SW AKO TO 20WSW CYS TO 50SW INW TO
30SSW ELY TO 30NW BOY TO 30W GGW TO 70NNW ISN
MT OBSC: ID MT WY..BOUNDED BY 30SW YQL TO 60S BIL TO 30NNE LMD TO
20SW MLP TO 40SE YXC TO 30SW YQL
SIG CLD: MT..OVC CIG BLW 010/080 BOUNDED BY 50SW YXH TO 60ESE HVR
TO 50W MLS TO 20W BIL TO 40SSW YQL TO 50SW YXH. ID UT..21/00 BKN
CIG BLW 010/060 BOUNDED BY MLD 20E SLC TO DTA TO BVL TO 50WSW MLD
TO MLD. 18/21 OR ID MT OCNL TCU 100/FL250 BOUNDED BY 80NNW DNJ TO
50NW DLN TO DBS TO 30NW TWF TO 30SSE BKE TO 80NNW DNJ
ICE: ID MT WY..MOD RIME ICGIC 090/FL180 BOUNDED BY YXC TO 70SSW
YYN TO 50WSW ISN TO 90SSW MLS TO BIL TO 50E JAC TO 20N PIH TO 40N
DNJ TO YXC
TURB: OR ID MT WY..MOD FL250/FL400 BOUNDED BY 50SW YXC TO 40SE
HVR TO 50N RAP TO 30NNE DDY TO JAC TO 50NNW TWF TO 20N DSD TO
140SW ONP TO 50SW TOU TO 40SSE YDC TO 50SW YXC
MTW: UT WY..MOD FL150/FL330 BOUNDED BY 30SE MLD TO 40W OCS TO JNC
OT 40S HVE TO 50SE DTA TO 30SE MLD
LLWS: MT..+/- 15 KT BOUNDED BY 40SW YQL TO 40NE HVR TO 60E LWT TO
50SW LWT TO 40SW YQL
SIGMET APPLICABLE: FOXTROT 1
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***Figure 1**: GAMET Section I - Hazards*

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SECN II
PSYS: 18 L 1004 MB 70SW ISN MOV ENE 15 KT H 1017 MOV ESE 15 KT
WRMFNT 70SW ISN-ANW-PWE MOV ENE 15KT CDFNT 70SW ISN-50NE OCS-40SE
ILC MOVG E 20 KT.
CLD: NV UT..21/00 OVC LYR 120/FL250 BOUNDED BY 50NE BVL TO 40W BCE
TO EED TO HEC TO 40NW BTY TO 50NW FMG TO 60E BAM TO 50NE BVL
MVIS: WA OR ID MT..VIS 3-5 SM BR BOUNDED BY 20SSE YQL TO 30NW GTF
TO 20WNW DLN TO 30NNE DNJ TO 20WSW PDT OT 50SSW YDC TO 40S YXC TO
20SSE YQL
FZLVL: 090 40WNW FCA-50SSW YXH-50ENE HVR-30NE MLS-30S DIK 120
50WSW BAM-50E PIH-40WNW DDY 150 40SE ILC-20SW BCE 150 30S ILC-25SW
BCE
VA: MT..BISON N 4224 W 11530 ERUPTED VA CLD TOP FL330
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***Figure 2**: GAMET Section II - Other required information*

- Air Line Pilots Association
- Air Transport Association
- National Business Aviation Association
- Small Aircraft Manufacturers Association

The FAA and NWS listened, and have worked with industry to develop a new set of operational graphical products called the Graphical Forecast for Aviation (GFA). The GFA represents the first major shift away from operational text-based products to operational graphical products. The GFA will eventually replace the Area Forecast product; however, the text product won't vanish immediately.

At the September 2003 meeting of the FPAW GFA Working Group, it was agreed that the U.S. should adopt the International Civil Aviation Organization GAMET area forecast as the text format to continue when the GFA becomes operational. The GAMET is a highly structured form of data suitable for automated processing. The GAMET encapsulates all of the required information currently contained in both the AIRMET and Area Forecast products. It is for that reason that the FPAW GFA Working Group concluded that the GAMET will also replace the AIRMET when the GFA and GAMET become operational. A new GAMET will be automatically generated whenever the GFA is updated.

GFA Hazard Elements

- Strong surface wind (30 knots or greater)
- Surface visibility (IFR)
- Significant weather (thunderstorms, sand/dust storms)
- Mountain obscuration
- Significant clouds (IFR ceilings, TCU)
- Icing
- Turbulence
- Mountain waves
- Low level wind shear
- Non-convective SIGMETs

Other Required Elements

- Location of pressure centers, fronts and movements
- Other clouds below 18,000 feet
- Surface visibility (MVFR)
- Freezing level
- Location of volcanic eruption

The GFA is a suite of seven "snapshot" forecasts issued every three hours, valid at standard forecast intervals out to 24 hours (0, 3, 6, 9, 12, 18, and 24). By definition, snapshots delineate weather areas precisely in time and space. Conversely, a text product often indicates the most conservative or worst weather condition. GFA users can see the movement, development, and dissipation of weather areas by examining GFA snapshots in a time sequence. The area of the GFA

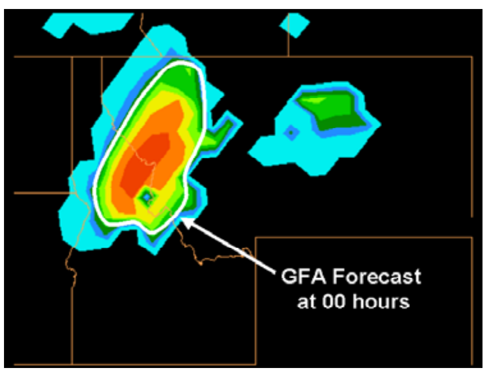

***Figure 3A:** The GFA forecast depicts the precise area for 00 hour forecast.*

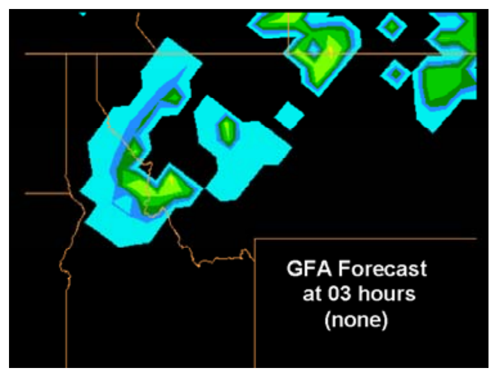

***Figure 3B:** The GFA forecast depicts the precise area for the 03 hour forecast.*

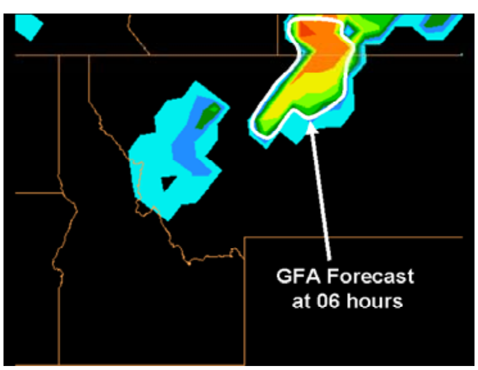

***Figure 3C:** The GFA forecast depicts the precise area for the 06 hour forecast.*

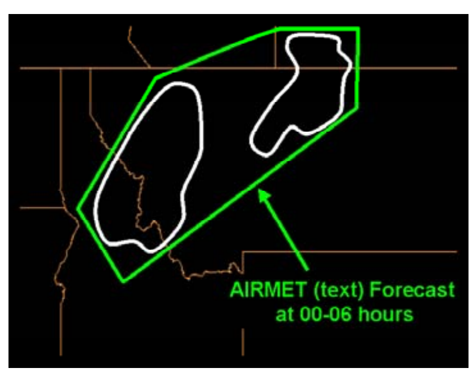

***Figure 4:** The AIRMET Text product covers the largest possible area for the 6 hour forecast period.*

Figure 5: *GFA experimental visibility (with obstruction) from the Jan-Feb 2003 demonstration.*

extends over the contiguous 48 United States and adjacent coastal waters. The vertical dimension extends from the surface to 45,000 feet (FL450).

State-of-the-art icing guidance is shown in Figures 3A-C. GFA icing forecast areas are indicated by the solid white lines. In Figure 3A, a mature icing area is forecast over northern Idaho and northwest Montana based on automated icing guidance. In Figure 3B, this mature area has diminished and a new area is developing over north central Montana along the Canadian border; however, the icing is not significant at this point and no GFA icing is forecasted.

In Figure 3C, the new area has continued to develop and a new GFA forecast icing area is depicted. In each case, the precise icing forecast area is delineated.

Figure 4 shows the area delineated by the traditional AIRMET text for this period. For illustration, the precise GFA forecasts are shown inside the AIRMET area. The AIRMET product is a temporal and spatial smear that offers no precise information about where the icing is at a given time.

Demonstrations

During January and February 2003, the AWC demonstrated the GFA product for the first time. A forecast generation process was conceived and thoroughly tested for efficacy during the demonstration period. The location of the demonstration was carefully chosen and the area was intentionally limited to accommodate known software and hardware limitations at the AWC. The area, extending from the coastal plain from Texas through South Carolina and southward over Florida and the Gulf of Mexico, was chosen for its typically benign winter weather. The number of weather elements and forecast periods was limited for reasons stated above. The vertical domain extended from the surface to 10,000 feet. Figure 5 shows a turbulence forecast from this demonstration.

A more challenging test is planned by the NWS and FAA at the AWC for the winter of 2003-2004. This will be the first demonstration of the final proposed GFA

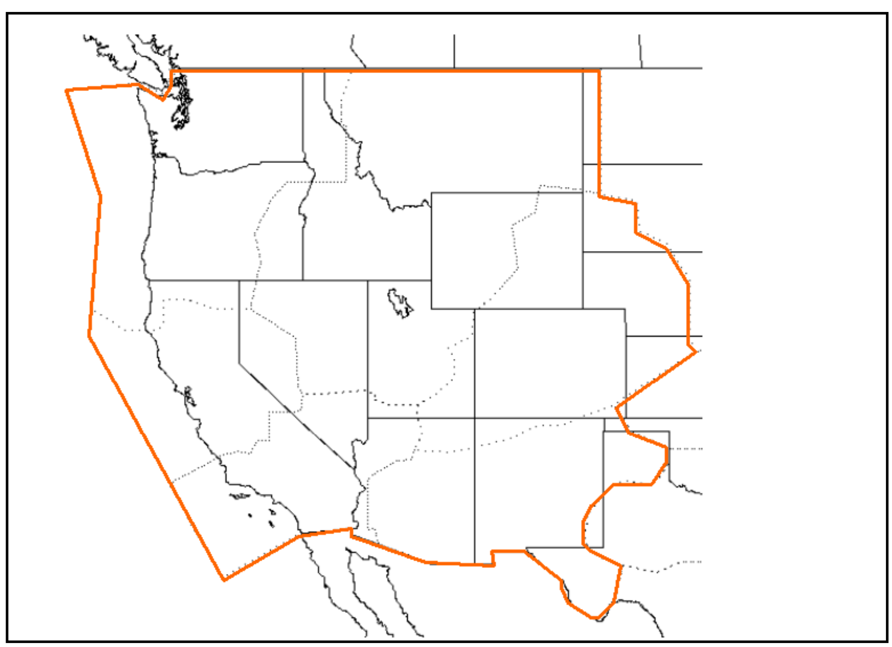

Figure 6: *Proposed GFA demonstration area during Winter of 2003-2004.*

requirements. Forecasters will generate the GFA forecasts over the complex weather regimes that make up the western 48 U.S. (Figure 6). The automated GAMET text formatter will not be tested during this demonstration. Instead, GAMET text forecasts will be generated manually after the fact.

En-route aviation weather forecasts are changing for the better. They will help aviators better understand hazards and to deal with them effectively and safely. ✈

High Altitude Weather Charts for Low Altitude Pilots

By Michael Graf, Assistant Program Manager
Aviation Services Branch, NWS Headquarters

The 500 millibar (500mb) chart has been used for years as a rough guess to locate large weather features like fronts and areas of high and low pressure. The upper level wind pattern at about 18,500 feet displayed by the 500mb chart offers hints of improving or worsening weather conditions when combined with other weather charts.

This article will touch on basic weather pattern rules of thumb derived from the 500mb chart, and how this information can aid low altitude pilots during flight planning. Also discussed are some strengths and weaknesses of long-range planning with the 500mb chart.

A typical 500mb chart is shown in Figure 1. Study points A-F on the map for a quick review of 500mb labeling.

A. Before using any graphic, always check the date and time usually found at the bottom and/or top of the chart. This example shows the date/time at the top and bottom of the chart as "030926/1800V000." Breaking the date/time down:

- Year is 03.
- Month is 09.
- Day is 26.
- Analysis time is 1800 UTC.
- The three digit value to the right of the "V" is the valid time.
- The value 000 refers to the initial chart produced, in this case, by the 1800 UTC computer run. Any other number would indicate it was a forecast. A number 012 indicates the forecast for 12 hours after the computer run. 006 would be the forecast for six hours after the computer run.

B. At the top or bottom, the label "500 MB HGT" tells you this is the 500mb chart.

C. ETA stands for the model being used. Usually you'll see the ETA or Global Forecast System (GFS). The GFS is the model used for looking beyond 4 days.

D. The black solid "contour lines" represent points of equal pressure like the lines of equal height on a topography map.

E. Pressure contours are normally labeled every 60 meters. At altitude, wind flows roughly parallel to the pressure contours. The value 576 is labeled across southern Illinois. Add a zero to the end of this number to get the height in meters above MSL for the 500mb surface, or 5760 meters.

F. The colored areas denote where the atmosphere has higher energy moving through it. This energy is called vorticity and if it could be seen, would look much like rapids do in a river of water. The x's in the vorticity mark where it is at a peak. Weather tends to worsen in areas of higher vorticity depending on the influence of other factors such as moisture availability and local topography.

G. Wind direction and speed over central Kansas is from about 300 degrees at 50 knots and over central New Mexico from about 020 degrees at 15 knots.

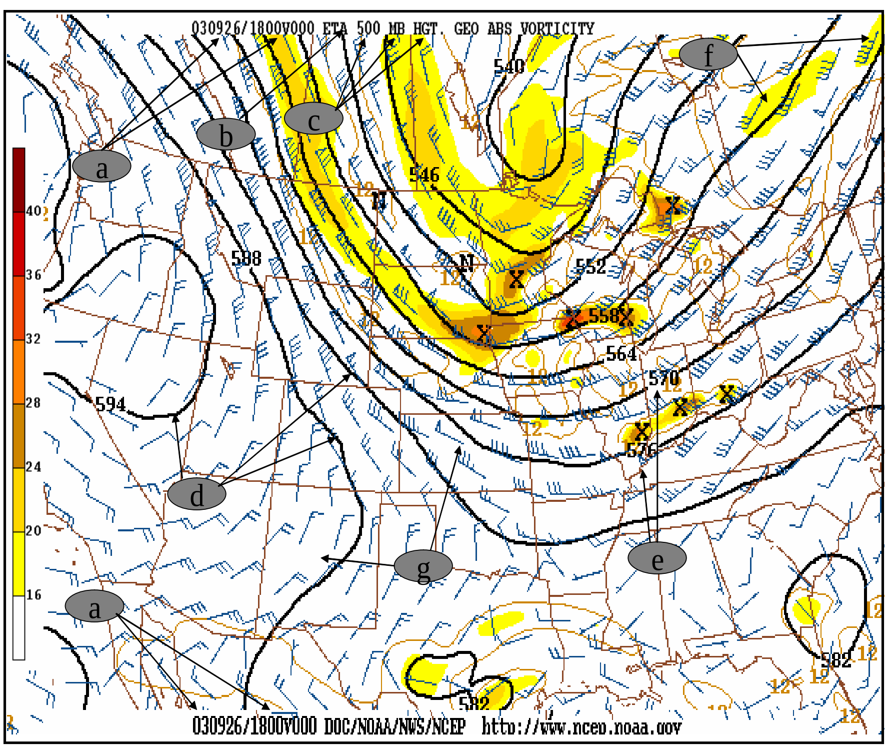

Figure 1: Example 500 millibar chart from the NWS and a brief review of labels.

So how can the wind flow at 500mb establish a connection to low altitude weather? A method known as pattern recognition is a useful tool. Pattern recognition occurs when a pilot relates wind patterns and wind directions to local weather conditions. Pattern recognition can be a simple and effective tool that enhances situational awareness.

Experienced pilots intuitively use pattern recognition. For example, local pilots know during the winter season areas downwind of the Great Lakes, like Buffalo, can experience lake effect clouds and precipitation. They know low level wind flow at about "3000-5000 feet" and especially from around 240 degrees can cause localized heavy snow bands, IFR conditions and icing. Locals know this because they see these hazards repeated with this particular wind pattern.

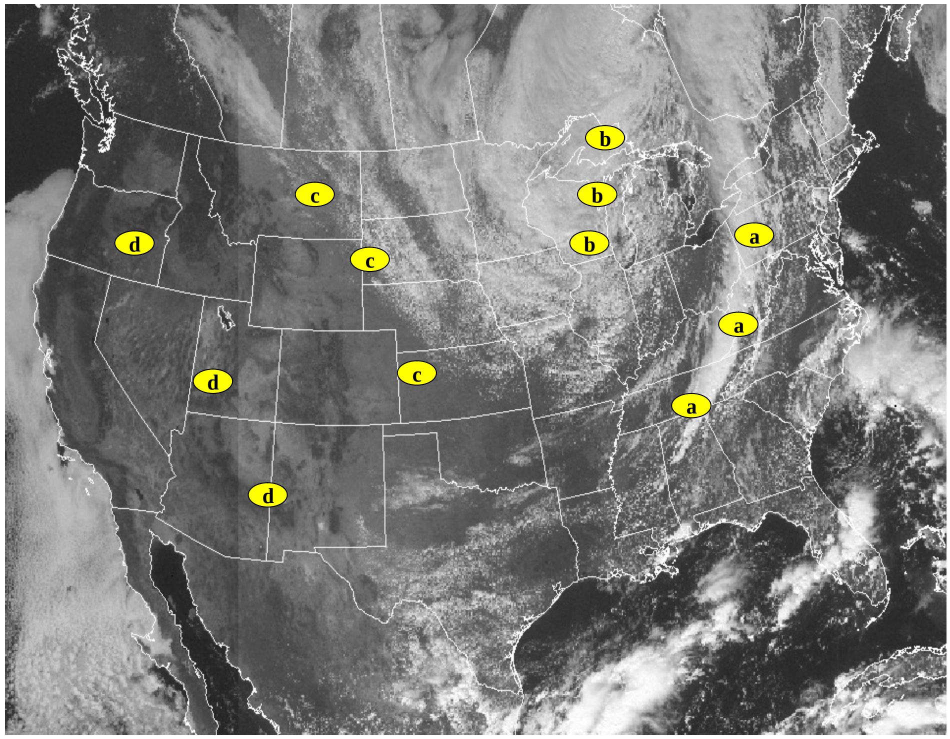

Figure 2: Visible satellite picture from the Aviation Weather Center.

Now consider a pilot flying near Pittsburgh Pa. during the winter. That same wind pattern from the southwest is usually good weather for Pittsburgh and points east. But swing that 5000 foot wind around to 340 degrees and persistent MVFR and IFR conditions can occur, depending on terrain influences. So pattern recognition in the low levels is a useful tool in anticipating possible weather hazards. But below we'll step up to a much larger scale of pattern recognition, and that involves the 500 millibar chart.

Before going further, it's important to understand 500mb pattern recognition is not recommended for making localized weather decisions like the lake effect example above. Instead, view the 500mb chart as a method to get the really big weather picture for determining placement of fronts and areas of high and low pressure. Knowing the location of these features, one can infer where ceiling/ visibilities and hazards could be a problem, and aids in the overall flight planning process.

The following charts and examples will layout some simple but effective pattern recognition features. Figures 2-4 include a visible satellite picture, surface map and a 500mb chart, each valid for the same day and time. We'll use all three maps to highlight four examples of pattern recognition at 500millibars that tend to repeat themselves across mid-latitudes.

The first example across the eastern portion of the country is "a." Area "a" depicts a cold front extending from western New York, south westward through central Tennessee. The satellite picture gives an idea of the location because of the obvious line of clouds, and the surface chart, Figure 3, refines the location of the cold front. However review the pattern at 500 millibars in figure 4 and pay attention to the southwest orientation of the black height lines and consider the following:

- The more perpendicular the 500mb winds are to the actual front on the surface chart, the faster the front tends to move. Fast moving cold fronts have clouds and precipitation at, or ahead of, the front. The likelihood of thunderstorms and damaging winds is higher with fast moving fronts. Expect clearing quickly after frontal passage, except areas downwind of moisture sources or areas with elevated topography.

- In the example shown, 500mb winds in the east are almost parallel to the cold front not perpendicular, indicating a slow moving cold front. With south to southwesterly flow at 500 millibars, these fronts can also have extensive areas of IFR and MVFR behind them. Be careful, especially in elevated areas, clearing after a cold frontal passage may take longer than expected. These frontal systems usually bring widespread rain and IFR conditions during the winter and repetitive thunderstorms in the summer.

- Greater icing coverage and severity is more likely with southwest to south flow at 500mb and when the freezing level is low.
- Turbulence also increases with the wind pattern in Example a, especially near, or around, the frontal boundary.
- A southwest wind flow at 500 milli-

bars usually means deteriorating weather is on the way all along the area marked by "a".

Area "b" on Figure 4 is another mid-latitudes scenario which most often occurs in fall, spring and winter. At 500mb this is called an upper level low. Change is the keyword with these types of systems because ceilings and visibilities will usually be all over the place, especially during the day.

In example "b," clouds over the Great Lakes region make it hard to sort out what's happening below. Figure 3 helps by showing an area of low pressure nearby, along with a cyclonic/counter clockwise wind field. These patterns usually mean clouds and weather, but it is still hard to pinpoint troublesome areas. So if you see the 500mb pattern typified in example "b", consider the following rules of thumb.

- Weather will be highly variable depending on the amount of moisture available.

- In some instances, clear skies may dominate at night but daytime sunshine can often lead to convection around the upper low. In area "b," the satellite image is showing plenty of moisture with mainly MVFR conditions and a smattering of IFR. Topography plays a huge role in this equation. If the topography is increasing or low level winds are rising, conditions over area "b" will worsen. Conversely areas with down-slope winds would tend to be MVFR or better.

- Icing is often a player, if it's cold enough, even in the strato-cumulus clouds,.

- Again, in mountainous areas, these upper level lows usually create unstable conditions that lead to showers and thunderstorms. The result is rapid changes in ceilings and visibilities.

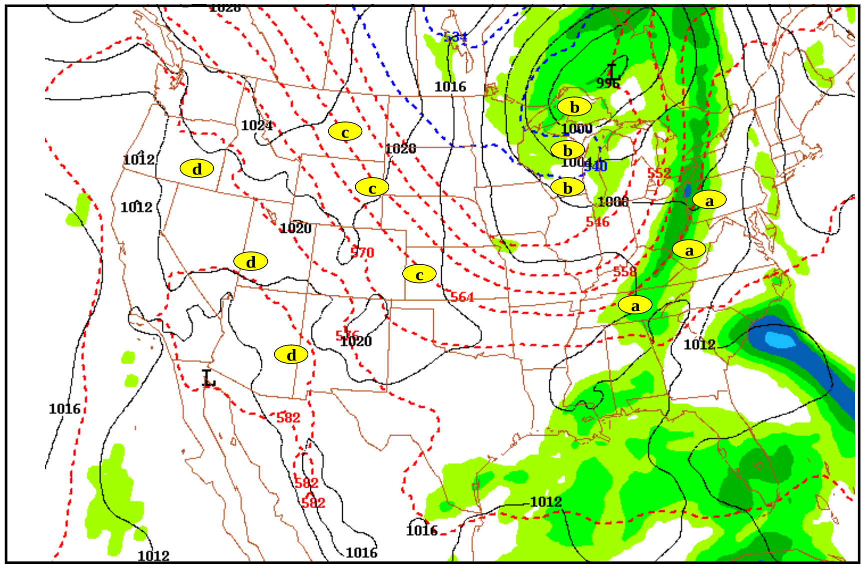

Figure 3: NWS Surface chart: Solid black lines are isobars or lines of equal pressure are the contour lines that help place frontal boundaries (western Pennsylvania). The dash lines are lines of thickness which help deliniate different airmasses (western Pennsylvania and southwest through Kentucky). The blue line to the north (Wisconsin) is the 540 line and is used widely to deliniate rain versus snow. The shaded green is depicting areas of precipitation.

Example "c" is referred to as the "backside of a trof" or northwest flow at 500mb. These areas usually have more favorable weather. High pressure normally builds into the region, and behind the trof improving ceiling and visibilities usually follow. Looking at the satellite picture, cloud cover is scattered to non-existent during the afternoon for area "c."

The surface chart shows a front stretching from Arkansas back to Montana, but really no weather. This pattern at 500mb is common and an easy one to recognize. Some things to watch for however:

- Though improving weather is expected, sometimes there is enough instability either from afternoon heating, or enough instability in the atmosphere, that thunderstorms can pop up. These tend to be fast movers containing damaging winds because the 500mb winds are often very strong.

- Good or improving weather is expected, but sometimes the conditions that lead to good weather cause problems. Case in point, it's been cloudy all day and a front finally drags through. The temperature/dewpoint spread has been close all day because of the cloud cover. You see that the "back edge" of the trough at 500mb is moving across your area. The winds die down and the skies clear. Conditions are now perfect for temperatures to drop quickly. The temperature falls to the dewpoint and fog develops with IFR consequences.

- High winds can develop under this pattern. The strong upper level winds can translate down to the surface and create conditions conducive for moderate or worse, mechanical turbulence, or even mountain wave turbulence, depending on the orientation of the topography.

- Low-level winds can be forced to ascend due to rising elevation. This may cause problems with clouds and precipitation. For example the upslope areas across eastern Colorado can be susceptible to these conditions with a north-through-east wind component in the low levels.

Area “d” is typified as “big bubble, no trouble,” the nickname for high pressure building into a region. The satellite image shows little if any clouds. The surface chart has high pressure written all over area “d.” And at 500mb, most of the West is under this high pressure ridge with light winds aloft. Despite the benign pattern below, trouble can arise from several factors:

- Fog can be a problem late at night and in the morning, with enough moisture. these areas of fog tend to be localized and repeat themselves each night until the pattern or air mass changes.

- Elevated areas should be watch for convection. although under high pressure, enough instability can exist that daytime heating in the higher elevations to foster isolated thunderstorms.

- Isolated thunderstorms over deserts can lead to localized dust storms from downburst winds.

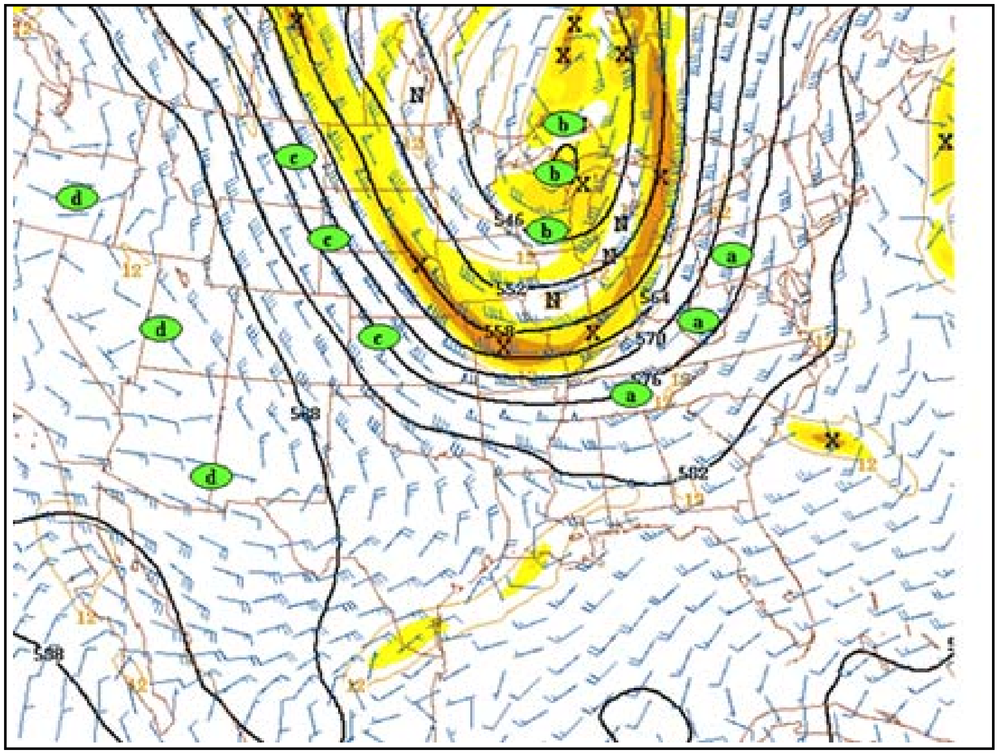

Figure 4: 500 Millibar chart: Pictured are four examples of pattern recognition. You can use "a through d" off a 500 millibar chart. Watch for these patterns to continuosly repeat themselves through the year. Check the associated suface weather and hazards whenever you see them.

These examples are only a few of the many different patterns seen at 500mb, but they occur often enough to recognize easily. Being familar with these patterns helps long-range planning.

For example, the National Weather Service “NWS” runs several numerical models, forecasting from a few hours to as long as 16 days into the future. Unfortunately, model accuracy tends to worsen the further out in time they go. Keeping that thought in mind, a key to effectively using the longer range models is to look for consistency and trends.

For example, go to the NWS home page: **http://weather.gov**. Click on numerical model “to the left” then click on GFS 4-Panel chart with the most recent valid time. Scroll down and click on a time frame. The 500 millibar chart is on the top right. Along the same lines is the 850 chart or 5000 ft level at the bottom right.

Using this page, you can see the vast array of data forecasters use. If your plan is for a trip two weeks in the future, look at the 500 millibar pattern. If you keep checking the 500MB chart for the same date every few days, the 500MB pattern may change a lot, a little, or somewhere in between.

If the 500mb pattern changes only slightly, you can slowly increase your confidence factor in the forecast, or the use of a particular pattern recognition tool, such as the 4 examples here.

If the trend keeps changing, be cautious and consider all options till the trend becomes more consistent, especially if you notice pattern a,b or even c developing. Most important, do not pin down a long range forecast to exact ceilings and visibilities. Remember to use 15, 10, 5 or even 3 day 500mb forecasts only as a rough trend.

Because the placement of pattern “a” on day ten may end up being a pattern “c” by day three. Remember each pattern has its own weather challenges and your flight planning needs to reflect this.

Using this high altitude chart and remembering some patterns tips presented here will aid low level flight planning and decision making. The key is to look at the charts frequently and pay attention to associated weather. This process may add a few minutes to the planning cycle but will eventually aid in making the connection from low level hazards to high level weather patterns.

Remember, the value of the 500mb chart is for seeing the big picture. Use it in coordination with other charts such as satellite and surface maps for the best possible planning forecast. ✈