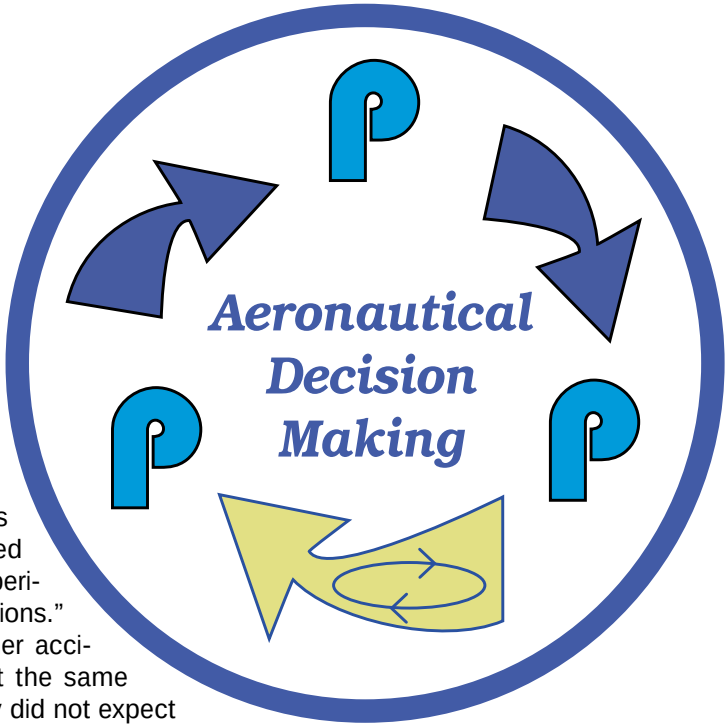
Weather Decision-Making for GA Pilots

by Susan Parson



Aviation has come a long way since the Wright brothers first flew at Kitty Hawk. One thing that has unfortunately not changed as much is the role that weather plays in fatal airplane accidents. Even after a century of flight, weather is still the factor most likely to result in accidents with fatalities.

From the safe perspective of the pilot's lounge, it is easy to second-guess an accident pilot's decisions. Many pilots have had the experience of hearing about a weather-related accident and thinking themselves immune from a similar experience, because "I would never have tried to fly in those conditions." Interviews with pilots who narrowly escaped aviation weather accidents indicate that many of the unfortunate pilots thought the same thing — that is, until they found themselves in conditions they did not expect and could not handle.

Given the broad availability of weather information, why do pilots continue to be surprised and trapped by adverse weather conditions? Ironically, the very abundance of weather information might be part of the answer. With many weather providers and weather products, it can be very difficult for pilots to screen out non-essential data, focus on key facts, and then correctly evaluate the risk resulting from a given set of circumstances.

This article describes how to use the FAA Aviation Safety Program's **P**erceive – **P**rocess – **P**erform decision-making framework as a guide for your preflight weather planning and in-flight weather decision-making. The basic steps are:

—**Perceive** weather hazards that could adversely affect your flight by obtaining all the information you need for good situational awareness.

—**Process** this information to determine whether, and how, the hazards create risk to the safety of your flight.

— **Perform** by acting to mitigate the risk and evaluate the outcome of your action.

Preflight Decision-Making

Perceive

When you plan a trip in a general aviation (GA) airplane, you might find yourself telling passengers that you are first going to "see" if weather conditions are suitable. In other words, your first preflight weather task is to *perceive* the flight environment by collecting information about current and forecast conditions along the intended route. Flight Service and DUATS are the approved sources of aviation weather information, but there are many other resources that can help you get the maximum benefit from your weather briefing. A few suggestions:

✔ *Prepare*. If you have a basic idea of current and forecast conditions and weather systems before you call the Automated Flight Service Station (AFSS) or access DUATS, it will help you better absorb information and identify areas that require closer investigation or discussion with the briefer. Many pilots start by getting the big picture with televised or online weather, and then go to the National Weather Service's Aviation Weather Center <http://aviationweather.gov/> and Aviation Digital Data Service (ADDS) <http://adds.aviationweather.noaa.gov/> for aviation-specific information. ADDS also offers interactive tools that can help you better visualize weather conditions.

✔ *Review.* Using the standard flight plan form, develop an estimate for altitude, route, and estimated time en route so you can get the most appropriate information from the AFSS briefer or DUATS.

✔ *Be honest* – with yourself and with the briefer – about any limitations in pilot skill or aircraft capability. If you are new to the area or unfamiliar with the typical weather patterns, including seasonal characteristics, speak up.

✔ *Ask questions* – what you don't know can hurt you. The worse the weather, the more data you need, and you should definitely seek a "live" briefing from an FSS specialist before you head for the airplane. If you are flying in instrument metereological conditions (IMC) or marginal visual flight rules (MVFR) that could deteriorate, be sure to get information on which direction (north, south, east, west) to turn for better weather, and how far (or how long) you would have to fly to reach it. Also, don't forget to

check the pilot reports (PIREPs) – fresh information from someone who has actually experienced the weather conditions can add substantially to your weather picture.

Process

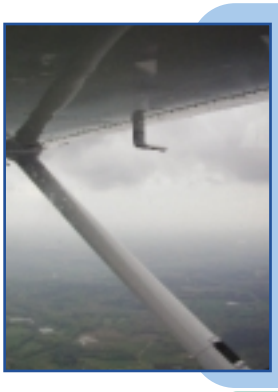
Fuel in your tanks is useless unless it is processed through the engine. Similarly, weather information in your hands is worth little, unless it is processed through your brain. Weather is certainly complex, but the good news is that you don't have to have a degree in meteorology to effectively and accurately analyze the weather information that you just obtained. Here's a simple way to start processing your weather briefing data.

As you might remember from ground school, the three basic elements of weather are: *temperature* (warm or cold); *wind* (a vector with speed and direction); and *moisture* (or humidity). These three weather elements combine in various ways to create conditions that affect pilots.

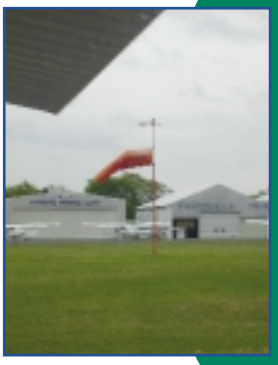
While the range of possible combinations is nearly infinite, weather really affects pilots in just three ways. Specifically, the basic weather elements can. (See below)

Consequently, you need to analyze your weather briefing data in terms of how current and forecast conditions will create any of these hazards for your flight. Use any method that works for you, but you might find it helpful to jot information from METARs and TAFs into a format like the tables on the next page. The columns match the order in which the weather data is presented, with labels along the top for the three major weather impacts. Make rows to record conditions for departure, en route, and arrival phases of flight. This method can help you make "apples to apples" comparisons, and to see at a glance whether, and how, the three weather impact conditions will be present for each phase of your flight. You might make a similar analysis of winds aloft.

Once you identify the weather issues for your flight, the final part of processing your information is to evaluate whether the pilot-aircraft team is up to the challenge. For example, you may be a very experienced, proficient, and current pilot, but your weather flying ability will be limited if you are flying a 1980s-model aircraft with no weather avoidance gear. On the other hand, you may have a new technically advanced aircraft with moving map GPS, weather datalink, and autopilot — but if you do not have much weather flying experience, never count on the airplane's capability to compensate for your own lack of experience. It also helps to compare conditions to your personal minimums (see May/June 2006 issue of the *FAA Aviation News*).



Reduce ceiling & visibility (clouds, fog, rain)



Create turbulence (wind, thunderstorms)

Reduce aircraft performance (ice, density altitude)

Perform

The third step, making a preflight weather plan, is a strategic, "big picture" exercise that should include:

✔ *Escape Options:* Is there good weather within your aircraft's range and endurance capability? What direction do you turn, and how long will it take to get there? In bad weather, can you identify an acceptable alternative airport for each 25-30 nm segment of your route?

CURRENT CONDITIONS (METARs)

Weather Impact		Turbulence	Ceiling & Visibility			Visibility & Performance	Trends
Place	**Time**	**Wind**	**Visibility**	**Weather**	**Ceiling**	**Temp/Dewpt**	**Altimeter**
Dep							
ENR							
Dest							

FORECAST CONDITIONS (TAFs)

Weather Impact		Turbulence	Ceiling & Visibility		
Place	**Time**	**Wind**	**Visibility**	**Weather**	**Ceiling**
Dep					
ENR					
Dest					

✔ *Reserve Fuel:* Knowing where to find VFR weather will help only if you have enough fuel to reach it. More fuel means access to more alternatives. It also spares you the worry (and distraction) of fearing fuel exhaustion when weather has already increased your cockpit workload.

✔ *Terrain Avoidance*: Always know how low you can go without hitting terrain and/or obstacles. Make a specific terrain avoidance plan for any flight that involves MVFR conditions, a temperature/dewpoint spread of 4° C. or less, any expected precipitation, or operating at night.

✔ *Passenger Plan*: Pressures such as the pilot's reluctance to appear "cowardly" or to disappoint passengers can be very powerful, so your weather planning should include preflighting your passengers. Suggestions:

❍ Share personal weather minimums with your passengers, and state up front that you will delay or divert if conditions exceed these values.

❍ Let passenger know what you will do if you have to divert at any particular point. Preflight is the time to think through alternative arrangements (e.g., hotel, rental car) in the event that weather conditions worsen.

❍ Advise anyone meeting you at your destination that you will call when you arrive, and that you will delay or divert if weather becomes a problem.

❍ Remember that waiting it out is one of the most effective safety tools. A single day can often make the difference between risky and routine.

En Route Weather Decision Making

Perceive

When weather is not severe enough to cancel the trip, many pilots choose to take off and take a look. If you make such a decision, safety requires staying alert to weather changes. At typical GA aircraft speeds, a 200-mile trip can leave a two to three hour weather information gap between the preflight briefing and the actual flight — and weather can change a lot. Use these sources of information before you take-off:

✔ *Visual Updates*. Use your eyes to see whether the conditions around you match the conditions that were re-

ported or forecast. If not, you need to start getting more information.

✔ *ATIS/ASOS/AWOS*. Listen to ATIS and ASOS/AWOS broadcasts as you fly. If conditions are worse than forecast, it's time to seek more information.

✔ *Enroute Flight Advisory Service (EFAS, or Flight Watch)*. Available on 122.0 MHz in the continental United States from 5,000 feet AGL to 17,500 feet MSL (124.67 MHz at higher altitudes), call Flight Watch for en route weather advisories pertinent to the type of flight, route of flight, and altitude.

✔ *Air Traffic Control (ATC)*. If you are not already on an IFR flight plan, monitoring ATC frequencies (available on aeronautical charts) along the way can tell you a lot. For instance, are other GA aircraft along your route deviating for weather? Having the ATC frequency tuned also makes it easier to request information and assistance.

✔ *Datalink and Weather Avoidance Equipment*. Datalink is an increasingly popular method of getting inflight weather information. Datalink uses satellites to transmit METARs, TAFs, NEXRAD, and other information to the cockpit for display on the multifunction display (MFD) or a handheld unit.

Process

In order to properly evaluate and interpret en route weather information, you need to be aware of limitations such as:

✔ *Visual Limitations*. Research has determined that weather transitions are sometimes too subtle for the visual system. The human eye responds best to changes, including motion and light (e.g., flashing strobe). In deteriorating weather conditions, reductions in visibility and contrast can occur so gradually that the pilot does not notice until there is a significant reduction in visibility.

✔ *ATIS/ASOS/AWOS*. Inflight weather information obtained from ATIS and ASOS/AWOS broadcasts can contribute useful pieces to the en route weather picture, but remember that it is only a "snapshot" of a limited area in the airport vicinity.

✔ *EFAS*. Interpreting EFAS information while you are also flying the aircraft — especially in adverse conditions with no autopilot — can be very challenging. Keep a chart at hand so that you can quickly visualize location of weather relative to your position and route, and determine whether (and where) you need to deviate.

✔ *Air Traffic Control (ATC)*. Be aware that radar "sees" only those entities that reflect energy. Precipitation density is indicated by the strength of the return and, while radar does not detect turbulence, an intense precipitation return may imply its existence. Similarly, icing does not show directly, but may be inferred by the presence of moisture, clouds, and precipitation at temperatures at or below freezing.

✔ *Datalink and Weather Avoidance Equipment*. Today's cockpit weather displays give pilots an unprecedented quantity of weather data, but datalink is not a silver bullet. The quality of the information depends heavily upon update rate, resolution, and coverage area. Accurate analysis of datalink information depends on your understanding each of these parameters.

Perform

Your preflight weather plan is a strategic tool. Use en route weather data and analysis to make tactical ("right now") weather decisions based on what you actually find in the air. Suggestions:

✔ *Take action*. Act immediately if you see or suspect deteriorating weather. For example, head for the nearest airport if you see developments such as:

- ❍ Clouds forming beneath your altitude,
- ❍ Gray or black areas ahead,
- ❍ Hard rain or moderate turbulence,
- ❍ Clouds forming above that require you to descend; or
- ❍ Conditions below your pre-established personal minimums.

It is always easier to reevaluate conditions and make a new plan from the safety of an airport.

✔ *Don't delay*. If you need help from ATC in avoiding or escaping weather, ask sooner rather than later. Remember that navigational guidance information issued to a VFR flight is *advisory* in nature. Suggested headings do not authorize you to violate regulations, and they are not guaranteed to keep you clear of all weather.

✔ *Never assume*. Don't make assumptions about what the controller knows about your flight.

- ❍ If you are handed off while on a suggested heading for weather avoidance, confirm that the next controller knows you are requesting this assistance.

- ❍ Remember that to ATC, "cleared direct when able" means to fly direct when you are able to navigate directly to the fix. It does *not* mean that you are now clear of weather. Always ask whether a direct course will keep you clear of radar returns indicative of thunderstorm activity.

✔ *Help other pilots.* When ever your workload permits, contribute to the system by making PIREPs yourself. If you aren't certain about how to give PIREPs, take a look at the AOPA Air Safety Foundation's free online "Skyspotter" course (http://www.aopa.org/asf/ online_courses /skyspotter/), which includes a handy PIREP form that you can put on your kneeboard. If you don't have a form

handy, don't let that stop you from contributing — tell the FSS specialist or controller what you see so that other pilots can benefit from your experience.

Post-Flight Weather Review

When you land after a challenging flight in the weather, you probably want nothing more than to go home and unwind. The immediate post flight period, however, is one of the best opportunities to increase your weather knowledge and understanding. Make it a point to learn something about weather from every flight. Take a few minutes to review and reflect by considering these questions:

✔What weather conditions/hazards existed, and how did they impact this flight?

Turbulence / Winds _____
Ceilings / Visibility _____
Aircraft Performance _____

✔How did the conditions encountered during this flight compare with the information obtained in the preflight and/or en route briefings?

✔Which source(s) of preflight weather information provided the best (or most useful, most accurate, most relevant) data for this flight?

✔Which source(s) of en route weather information provided the best (or most useful, most accurate, most relevant) data for this flight?

Weather is a fact of life for pilots. Developing your weather knowledge and expertise is well worth the time and effort you put into it, because weather wisdom will help keep you, and your passengers, safe in the skies.

Note: For more information, please go to:
http://www.faa.gov/pilots/safety/media/ga_weather_decision_making.pdf

Susan Parson is a Special Assistant in Flight Standards' General Aviation and Commercial Division and is an active GA plot and a NAFI Master CFI.