



**Federal Aviation
Administration**

General Aviation Pilot's Guide to Preflight Weather Planning, Weather Self-Briefings, and Weather Decision Making



General Aviation Pilot's Guide

Preflight Planning, Weather Self-Briefings, and Weather Decision Making

Forward	ii
Introduction	1
I Preflight Weather Planning	2
Perceive – Understanding Weather Information.....	2
Process – Analyzing Weather Information	5
Perform – Using Data and Analysis to Make A Weather Plan...	12
II Inflight Weather Decision-Making	15
Perceive – Obtaining Information During the Flight.....	15
Process – (Honestly) Evaluating Inflight Conditions.....	18
Perform – Using All Available Weather Resources.....	22
III Post-Flight Weather Review	26
IV Resources	27
Appendix 1 – Weather Products & Providers Chart.....	28
Appendix 2 – Items for Standard Briefing.....	29
Appendix 3 – Automated Weather Systems (definitions).....	30
Appendix 4 – Aviation Weather Analysis Forms.....	31
Appendix 5 –Developing Personal Weather Minimums.....	32

Forward

This guide was developed with assistance and contributions from a number of weather experts, aviation researchers, air traffic controllers, and general aviation pilots. Special thanks are due to Dr. William Knecht and Dr. Dennis Beringer of the FAA's Civil Aviation Medical Institute (CAMI); Dr. Michael Crognale, Department of Psychology and Biomedical Engineering, University of Nevada/Reno; Dr. Douglas Wiegmann; Dr. B.L. Beard and Colleen Geven of the NASA Ames Research Center; Paul Fiduccia of the Small Aircraft Manufacturers Association; Lawrence Cole, Human Factors Research and Engineering Scientific and Technical Advisor, FAA; Ron Galbraith, FAA Air Traffic Controller, Denver ARTCC; Michael Lenz, FAA General Aviation Certification and Operations Branch, and Dr. William K. Krebs, Human Factors Research and Engineering Scientific and Technical Advisor, FAA.

Introduction



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 probably thought the same thing -- that is, until they found themselves in weather conditions they did not expect and could not safely handle.

Given the broad availability of weather information, why do general aviation (GA) pilots continue to find themselves surprised and trapped by adverse weather conditions? Although there are many factors involved, interviews with pilots suggest that some find it difficult to screen out non-essential data, focus on key facts, and then correctly evaluate the risk resulting from a given set of circumstances.



This guide describes how to use the **Perceive – Process – Perform** risk management framework as a guide for your preflight weather planning and inflight weather decision-making. The basic steps are:

- Perceive** weather hazards that could adversely affect your flight.
- Process** this information to determine whether the hazards create risk, which is the potential impact of a hazard that is not controlled or eliminated.
- **Perform** by acting to eliminate the hazard or mitigate the risk.

Let's see how the 3-P model can help you make better weather decisions.

Preflight Weather Planning

Perceive – Understanding Weather Information



When you plan a trip in a general aviation (GA) airplane, you might find yourself telling friends and family that you are first going to “see” if weather conditions are suitable. In other words, your first major preflight task is to *perceive* the flight environment by collecting information about current and forecast conditions along

the route you intend to take, and then using the information to develop a good mental picture of the situation you can expect to encounter during the flight.

Because there are many sources of weather information today, the first challenge is simply knowing where and how to look for the weather information you need.

For many GA pilots, the FAA Flight Service Station (FSS) remains the single most widely used source of comprehensive weather information. Like other weather providers, the FSS bundles, or “packages,” weather products derived from National Weather Service (NWS) data and other flight planning information into a convenient, user-friendly package that is intended to offer the pilot not only specific details, but also a big picture view of the flight environment. In this respect, you might think of the FSS as “one-stop shopping” for GA weather information. As you learned in ground school, the FSS offers four basic briefing packages: outlook (for flights more than six hours away), standard (for most flights), abbreviated (to update specific weather items after receiving a standard briefing) and TIBS (telephone information briefing service), which provides recorded weather information. The specific weather information packaged into a standard briefing includes weather synopsis, sky conditions (clouds), visibility, weather conditions at the departure, en route, and destination point. Also included are adverse conditions, altimeter settings, cloud tops, dewpoint, icing conditions, surface winds, winds aloft, temperature, thunderstorm activity, precipitation, precipitation intensity, visibility obscuration, pilot reports (PIREPs), AIRMETs, SIGMETs, Convective SIGMETs, and Notices to Airmen (NOTAMs), including any temporary flight restrictions (TFRs).



Although a Flight Service weather briefing is still the single most comprehensive source of weather data for GA flying, it can be difficult to absorb all the information conveyed in a telephone briefing. Pictures are priceless when it comes to displaying complex, dynamic information like cloud cover and precipitation. For this reason, pilots may find it helpful to begin the preflight planning process by looking at weather products from a range of providers. The goal of this self-briefing process is to develop an overall mental picture of current and forecast weather conditions, and to identify areas that require closer investigation with the help of an FSS briefer.

Here is one approach to conducting your initial self-briefing process:



Television/Internet Sources. For long-range weather planning, many pilots start with televised or online weather, such as The Weather Channel (TWC) on television or Internet. TWC is not an FAA-approved source of weather information, but its television and Internet offerings provide both tactical and strategic summaries and forecasts (up to 10 per day). TWC provides compact, easy-to-use information that can be a useful supplement to approved sources. For example, one TWC Internet page includes a weather map with color-coding for Instrument Flight Rules (IFR) and Marginal Visual Flight Rules (MVFR) conditions at airports around the country (<http://www.weather.com/maps/aviation.html>). This and other TWC features can give you a very useful first snapshot of weather conditions you will need to evaluate more closely. The National Weather Service's **Aviation Weather Center** (<http://aviationweather.gov/>) is another useful source of initial weather information. A look at the Airmet and Sigmet watch boxes can quickly give you an idea of areas of marginal or instrument weather.



Direct User Access Terminal System (DUATS). Next, get a printed version of the FSS briefing package by obtaining a standard briefing for your route on DUATS. Free and accessible to all pilots via the Internet at www.duat.com, this resource provides weather information in an FAA-approved format and records the transaction as an official weather briefing. You might want to print out selected portions of the DUATS computer briefing for closer study and easy reference when you speak to a Flight Service briefer.



Flight Service Station Briefing. Once you have formed a basic mental picture of the weather conditions for your trip, it is time to call the FSS. If the weather situation and mission

are both simple, ask for an abbreviated briefing. If not, ask for a standard briefing. Armed with what you already know from your self-briefing process, you will find that it is much easier to absorb information from the briefer.



Here are a few additional guidelines for getting weather data from the FSS:

- ✓ **DO** be sure to get the right FSS. When you dial the standard number, 1-800-WX-BRIEF from a cell phone, this number will connect you to the FSS associated with your cell phone's area code – not necessarily to the FSS nearest to your present position. If you are using a cell phone outside your normal calling area, check the *Airport/Facility Directory* to find the specific telephone number for the FSS you need to reach.
- ✓ **DO** know what you need, so you can request the right briefing “package” (outlook, standard, or abbreviated).
- ✓ **DO** use the standard flight plan form to provide the background the briefer needs to obtain the right information for you. Review the form before you call, and develop an estimate for items such as altitude, route, and estimated time en route so you can be sure of getting what you need to know.
- ✓ **DO** be honest – with yourself and with the briefer -- about any limitations in pilot skill or aircraft capability.
- ✓ **DO** let the FSS specialist know if you are new to the area or unfamiliar with the typical weather patterns, including seasonal characteristics. If you are unfamiliar with the area, be sure to have a VFR or IFR navigation chart available while you listen to help sharpen your mental picture of where the weather hazards may be in relation to your departure, proposed route of flight, and destination.
- ✓ **DON'T** hesitate to ask questions or to say that you don't understand something you have seen or heard. Aviation Safety Reporting System (ASRS), or “NASA” reports show that sometimes less experienced pilots choose not to be assertive because it makes them feel uncomfortable. The reality is that meteorological conditions are complex and constantly changing.

Recognizing this reality, expert pilots reduce the ambiguity of the weather information by taking the time to address uncertainties about that particular, unique flight. If you find yourself hesitating, remember that the FSS weather briefers are there to provide service to pilots. The only questions they cannot answer are the ones that you don't ask.

Process – Analyzing Weather Information

Obtaining weather information is only the first step. The critical next step is to study and evaluate the information to understand what it means for your circumstances.

The knowledge tests for most pilot certificates include questions on weather theory and use of weather products in aviation. However, it takes continuous study and experience to develop a solid understanding of how to evaluate and apply weather data to the process of planning and safely completing a specific flight in a GA airplane. You can learn a lot from reading books and articles on aviation weather, and there are many excellent weather textbooks available to assist you in the continuous (even lifelong) process of learning about weather. The wealth of information provided in weather textbooks, though, can be overwhelming and it is easy to lose sight of the overall picture. You might find it helpful to approach the task of practical, real world weather analysis with several basic concepts in mind.

What creates weather? Most pilots can recite the textbook answer -- “uneven heating of the earth’s surface” – but what does that mean when you are trying to evaluate weather conditions for your trip? Let’s take a look.

The three basic elements of weather are *temperature* (warm or cold); *wind* (a vector with speed and direction); and *moisture* (or humidity). Temperature differences (e.g., uneven heating) support the development of low pressure systems, which can affect wide areas. Surface low pressure systems usually have fronts associated with them, with “front” being the zone between two air masses that contain different combinations of the three basic elements (temperature, wind, and moisture). The illustration shows the “classic”



northern hemisphere low pressure system with the associated cold and warm fronts. Remembering that air circulates counterclockwise around a low pressure system in the Northern Hemisphere will help you visualize the overall temperature, wind, and moisture patterns in a given area. Because weather is associated with fronts, which are in turn associated with low pressure systems,

you can get some idea of possible conditions just by looking to see where the low pressure systems are in relation to your route.

What can weather do to you? Temperature, wind, and moisture combine to varying degrees to create conditions that affect pilots. The range of possible combinations is nearly infinite, but weather really affects pilots in just three ways. Specifically, the three basic weather elements can:

- *Reduce visibility* (e.g., temperature and moisture interact to create clouds, fog, haze, etc.)
- *Create turbulence* (e.g., gusty crosswinds, thunderstorms, wind shear, mountain waves)
- *Reduce aircraft performance* (e.g., high density altitude, icing)

How do you evaluate weather data? Given these effects, one approach to practical weather analysis is to review the data you have collected in terms of how current and forecast conditions will affect visibility, turbulence, and aircraft performance for this specific flight.

Suppose you want to make a flight from Cincinnati Municipal Airport (KLUK) to Ohio State University Airport in Columbus, Ohio (KCMH). You want to depart KLUK around 1830Z and fly VFR at 5,500 MSL. Your estimated time enroute (ETE) is approximately one hour. Your weather briefing includes the following information:



METARs:

KLUK 261410Z 07003KT 3SM -RA BR OVC015 21/20 A3001
 KDAY 261423Z 14005KT 3SM HZ BKN050 22/19 A3003
 KCMH 261351Z 19005KT 3SM HZ FEW080 BKN100 OVC130 22/17 A3002

TAFs

KLUK 261405Z 261412 00000KT 3SM BR BKN015
 TEMPO 1416 2SM -SHRA BR
 FM1600 14004KT 5SM BR OVC035
 TEMPO 1618 2SM -SHRA BR BKN015
 FM1800 16004KT P6SM BKN040
 FM0200 00000KT 5SM BR BKN025
 TEMPO 0912 2SM BR BKN018

KDAY 261303Z 261312 06003KT 5SM BR SCT050 OVC100
 TEMPO 1315 2SM -RA BR BKN050

FM1500 15006KT P6SM BKN050
 TEMPO 1519 4SM -SHRA BR BKN025
 FM1900 16007KT P6SM BKN035
 FM0200 14005KT 5SM BR BKN035
 FM0600 14004KT 2SM BR BKN012

KCMH 261406Z 261412 19004KT 4SM HZ SCT050 BKN120
 FM1800 17006KT P6SM BKN040
 TEMPO 1922 4SM -SHRA BR
 FM0200 15005KT 5SM BR BKN035
 FM0700 14004KT 2SM BR BKN012

WINDS ALOFT

3000 6000 9000 12000 15000 18000 21000 24000 27000
 CMH 1910 2108+15 2807+10 2712+05 2922-07 2936-17 294532 294540 313851
 CVG 2310 2607+16 2811+11 2716+06 3019-05 2929-16 293430 293240 293652

Remember that you have the option of getting this information in “plain English” format if you prefer not to decode. Whichever format you select, the first step is to look at your weather data in terms of three specific ways that weather can affect your flight: turbulence, visibility, and aircraft performance. Organize the information into tables such as the one below, (see Appendix 4 for blank forms). This kind of format allows you to see and make “apples-to-apples” comparisons more easily. The column headings in the top row – arranged to match the order in which the briefing information is presented -- can help you quickly identify the specific weather hazard(s) you might face on this trip. (Note: You may also find it helpful to convert Zulu (UTC) times to local time as well.)

Using the KLUK-KCMH trip as example:

CURRENT CONDITIONS

		Turbulence	Ceiling & Visibility			Visibility & Performance	Trends
Place	Time	Wind	Visibility	Weather	Ceiling	Temp/Dewpt	Altimeter
KLUK	1410Z	07003KT	3SM	RA, BR	OVC015	21/20	A3001
KDAY	1432Z	14005KT	3SM	HZ	BKN050	22/19	A3003
KCMH	1351Z	19005KT	3SM	HZ	FEW080, OVC130	22/17	A3002

FORECAST CONDITIONS

		Turbulence	Ceiling & Visibility		
Place	Time	Wind	Visibility	Weather	Ceiling
KLUK	FM1800Z	16004KT	P6 SM		BKN040
KDAY	TEMPO 1519Z	--	4SM	-SHRA	BKN025
	FM1900Z	16007KT	P6 SM	--	BKN035
KCMH	FM1800Z	17006KT	P6 SM	--	BKN040
	TEMPO 1922Z	--	4SM	-SHRA, BR	--

WINDS ALOFT

		Turbulence	Visibility & Performance
Place	Altitude	Wind	Temp
CVG	6000	260/07	16 C
CMH	6000	210/08	15 C

1. *Ceiling & Visibility.* Next, look at the weather data elements that report ceiling and visibility. To make your go / no-go decision, ask yourself the following questions:

VFR Flight	IFR Flight
<p><i>Ceiling:</i> How much room do I have between the reported / forecast ceilings and the terrain along my route of flight?</p> <p>Does this information suggest any need to change my planned altitude?</p> <p>If I have to fly lower to stay out of the clouds, will terrain be a factor?</p> <ul style="list-style-type: none"> ○ Specifically, how much ground clearance will I have between the ceiling and terrain over the route of flight? ○ Do I have reliable ceiling information about those portions of the route which are between weather reporting stations? <p>Are the reported and forecast ceilings above my personal minimums? (<i>Note: personal minimums for a typical 50-100 hour/year private pilot should be at least basic VFR (3,000 feet) for daytime flight, raised to 4,000 feet for night flight in non-mountainous terrain and at least 5,000 feet for VFR night flight in mountainous terrain.</i>)</p>	<p><i>Ceiling</i> Is the forecast ceiling for my estimated time of arrival high enough to make the approach?</p>
<p><i>Visibility:</i> What visibility can I expect for each phase of flight (departure, enroute, destination)?</p>	<p><i>Visibility:</i> What visibility can I expect for each phase of flight (departure, enroute, destination)?</p>

<p>Given the speed of the aircraft, expected light conditions, terrain, and ceilings, are the reported and forecast visibility conditions sufficient for this trip? Are they above my personal minimums? <i>(Note: personal visibility minimums for a typical GA pilot should be at least basic VFR (5 miles) for daytime flight, and at least 7 miles for night VFR.)</i></p> <p>Are there conditions that could reduce visibility during the planned flight? (Hint: look for indications such as a small and/or decreasing temperature/dewpoint spread).</p>	<p>Will I have enough visibility to legally make an instrument approach at the destination?</p> <p>Do current or forecast ceiling and visibility conditions require me to select and file an alternate? (Hint: Remember the 1-2-3 rule.)</p> <p>How do reported and forecast conditions for ceiling and visibility compare with my personal minimums for IFR? <i>(Note: Reasonable personal landing minimums for a typical GA instrument pilot might be set at 800 feet for an ILS and 1,000 feet for GPS or other non-precision approach.)</i></p>
--	---

In the case of the proposed VFR flight from KLUK to KCMH, current visibility at your departure and destination airports is marginal, and the small temperature/dewpoint spread should trigger a mental red flag for potentially reduced visibility. The forecasts call for conditions to improve at your departure airport, KLUK, by the time you plan to launch (1830Z). Note, however, that you could encounter marginal conditions, including light rain showers, en route and also at your destination (KCMH). Since the forecast ceilings will probably not allow you to fly VFR at the planned altitude (5,500 MSL), this part of the analysis tells you that terrain and obstacle avoidance planning (discussed in the next section) will be necessary for this flight if you choose to depart at the originally scheduled time.



2. *Aircraft Performance.* Next, carefully review items such as temperature for possible adverse weather impact on performance. In the sample VFR flight from KLUK to KCMN, temperatures on the surface and at your planned altitude are moderate. If, however, the temperatures are high, you need to know and plan for the effects of high density altitude, especially on takeoff, climb, and landing. If, on the other hand,

temperatures are low and you plan on flying in the clouds, you should pay special attention to known or forecast icing and freezing levels. Questions to ask:

VFR Flight	IFR Flight
<p>Given temperature, altitude, density altitude, and aircraft loading, what is the expected aircraft performance?</p> <ul style="list-style-type: none"> ○ Takeoff distance ○ Time & distance to climb ○ Cruise performance ○ Landing distance <p>Are these performance values sufficient for the runways to be used and the terrain to be crossed on this flight? (Remember that it is always good practice to add a 50% to 100% safety margin to the “book numbers” you derive from the charts in the aircraft’s approved flight manual (AFM)).</p>	
	<p><i>Icing.</i> What is the forecast freezing level for this flight?</p> <p>Are there any pilot reports (PIREPS) for my route, or points on the route, that support or rebut the icing forecast?</p> <p>Where are the cloud bases and cloud tops?</p>



3. *Turbulence:* Review wind conditions for departure, enroute, and destination, and also develop a mental picture of vertical wind profiles so as to select the optimum altitude(s) for cruise flight along the route. For the sample flight from KLUK to KCMH, the chart format allows you to see quickly that you will encounter light southerly surface winds at your departure and destination airports.

Winds aloft will also be light, but from a westerly direction. There are no indications for wind shear or convective activity (thunderstorms), so you can conclude that turbulence is not likely to be a hazard for this particular flight.

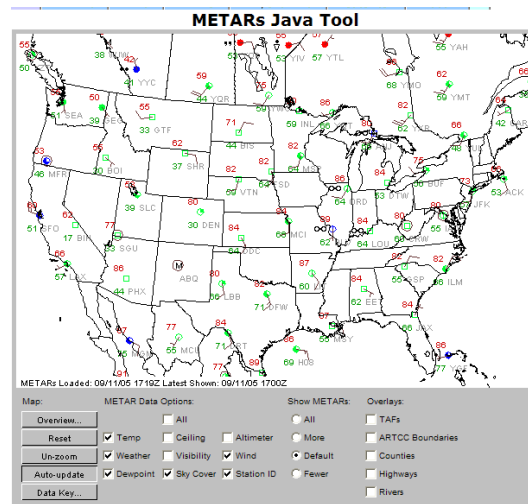
VFR Flight	IFR Flight
<p>Are the wind conditions at the departure and destination airports within the gust and crosswind capabilities of both the pilot and aircraft? (<i>Note: For most GA pilots, personal minimums in this category might be for a maximum gust of 5 knots and maximum crosswind component 5 knots below the maximum demonstrated crosswind component.</i>)</p> <p>What is the maneuvering speed (V_A) for this aircraft at the expected weight?</p>	
	<p><i>Thunderstorms.</i> Does the forecast include convective activity at any point</p>

along my proposed route?

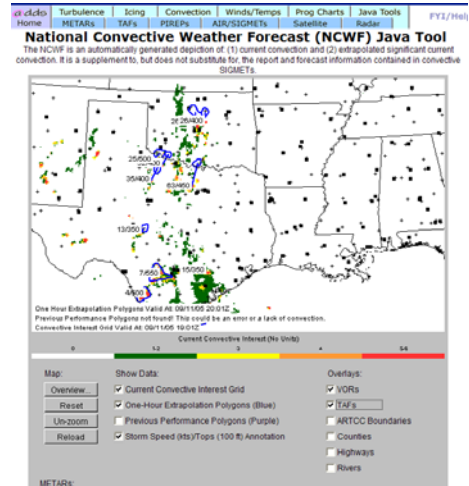
There is another resource that can help you process weather data and better understand its potential impact on your flight. Take a look at the weather information and resources available online via the Aviation Digital Data Service (ADDS), a joint effort of NOAA Forecast Systems Laboratory, NCAR Research Applications Program (RAP), and the National Centers for Environmental Prediction (NCEP) Aviation Weather Center (AWC). Available at <http://adds.aviationweather.noaa.gov>, ADDS combines information from National Weather Service (NWS) aviation observations and forecasts and makes them available on the Internet along with visualization tools to help pilots use this information for practical flight planning. For example:



- For METARs, TAFs, AIRMETS, and SIGMETs, the ADDS java tool can zoom in on specific parts of the country.
- For pilot reports (PIREPs), the ADDS Java tool can zoom in on a specific part of the country and specify the type of hazard reported (icing, turbulence, sky and weather). The tool also allows you to limit data to specified altitudes and time periods. Map overlays including counties, highways, VORs, and Air Route Traffic Control Boundaries are available.

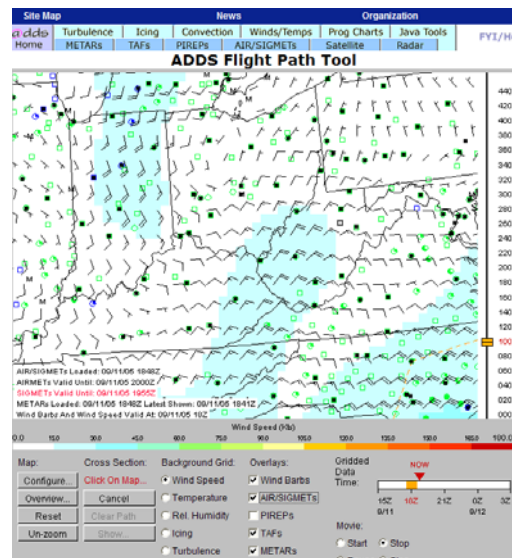


- For the National Convective Weather Forecast (NCWF), the latest convection diagnostic is shown together with the one hour forecast. The java tool allows the user to toggle the height and speed of the forecasted thunderstorm, as well as the one-hour forecast from the previous hour to help the user understand how well the NCWF is performing.



- ADDS also includes a Flight Path Tool that helps pilots visualize high resolution weather products together with winds aloft and pilot reports.

Although some of the other ADDS tools (e.g., icing potential and maximum turbulence potential) are only authorized for operational use by meteorologists and dispatchers, these products can still help you develop a mental picture of vertical and horizontal “weather hazard areas” for your flight.



Perform – Using Data and Analysis to Make a Weather Plan

Research indicates that pilots sometimes continue VFR flight into Instrument Meteorological Conditions (IMC) because they either do not fully appreciate the risk arising from flight into adverse weather; they have unrealistic levels of confidence in their own ability to handle the situation; and/or they are unwilling to change their goals for a specific flight. Safe weather decision-making requires you to be aware of your own limitations and recognize that narrow escapes in the past must not be interpreted as a guarantee that you will survive your next attempt to fly into adverse weather. In fact, narrow escapes may give you unwarranted confidence in your ability to cope with adverse weather.

At this point in your preflight weather planning, therefore, you need to perform an honest evaluation of whether pilot skill and/or aircraft capability are up to the challenge posed by this particular set of weather conditions. It is also important

to consider whether the combined “pilot-aircraft team” is sufficient. For example, you may be a very experienced, proficient, and current pilot, but your weather flying ability is still limited if you are flying a 1980s-model Cessna 172 with no weather avoidance gear. On the other hand, you may have a new Cirrus SR-22 with GPS, weather datalink, stormscope, and ice protection, but if you as the pilot do not have much flying experience (especially in weather), you must not count on the airplane’s capability to fully compensate for your own lack of experience. You must also ensure that you are fully proficient in the use of onboard equipment, and that it is functioning properly.

One way to “self-check” your decision (regardless of your experience) is to ask yourself if the flight has any chance of appearing in the next day’s newspaper. If the result of the evaluation process leaves you in any doubt, then you need to develop safe alternatives. In the KLUK-KCMH trip described above, for example, the weather analysis indicated that low ceilings and marginal visibility are likely to exist for this flight, making the planned flight altitude (5,500 MSL) unworkable.

To fly safely, you should consider a **terrain avoidance plan** for any flight that involves:

- Weather forecast to be at or below marginal VFR conditions (MVFR – ceiling 3,000 or less and visibility 5 miles or less)
- A temperature/dewpoint spread of 4° C. or less;
- Any expected precipitation; or
- Operating at night.

A terrain avoidance plan requires you to know the minimum safe altitude for each segment of a VFR flight. All VFR sectional charts include a maximum elevation figure (MEF) in each quadrangle. The MEF is determined locating the highest obstacle (natural or man-made) in each quadrangle, and rounding up by 100 to 300 feet. Charts for IFR navigation include a Minimum Enroute Altitude (MEA), a Minimum Obstruction Clearance Altitude (MOCA); an Off Route Obstruction Clearance Altitude (OROCA) that guarantees a 1,000-foot obstacle clearance in non-mountainous terrain and a 2,000 foot obstacle clearance in mountainous terrain. In addition to these sources, many GPS navigators (both panel-mount and handheld) include a feature showing the Minimum Safe Altitude (MSA), Enroute Safe Altitude (ESA), or Minimum Enroute Altitude (MEA) relative to the aircraft’s position. If you have access to such equipment, be sure you understand how to access and interpret the information about safe altitudes. The Air Safety Foundation’s [Terrain Avoidance Plan](http://www.aopa.org/asf/publications/tap.pdf) (<http://www.aopa.org/asf/publications/tap.pdf>) is another helpful resource.





It is especially important to remember that external factors can often influence a pilot's decision to launch in marginal weather or press on into deteriorating conditions. No matter what the purpose of your trip, there is almost always pressure to launch and pressure to continue. Even the small investment in making the trip to the airport can create pressure to "make it count" by launching the flight anyway. Factors such as family events, and business meetings create pressure as well. In fact, a number of GA weather accidents have been associated with external or social pressures, such as the pilot's reluctance to appear "cowardly" or to disappoint passengers eager to make or continue a trip. In the case of VFR into IMC accidents, for instance, pilots have felt pressured to reach the destination when passengers are onboard, or when family, friends, and business associates are waiting at the destination. In addition to the social pressures for completing a flight, other stresses can have a negative impact on your decision-making. Traffic that makes you late, an argument with your spouse or your boss, lack of sleep, and illness can all act as "mental static" that distorts good judgment.

Unfortunately, most pilots tend to downplay the influence that social pressures and life stresses have on them, and thus do not fully appreciate the subtle effects that others may have on their decision-making processes. For this reason, your weather planning should include preflighting your passengers as well as your aircraft. If you jointly plan for weather contingencies and brief your passengers before you board the aircraft, you as the pilot will be less vulnerable later on to the insidious pressure to continue regardless of deteriorating weather conditions. Suggestions:

- ✓ **DO** take the time to develop a personal minimums checklist that will help you make the toughest go / no-go and continue / divert decisions in advance. Use the worksheet at Appendix 5 to establish personal minimums appropriate for your particular experience, training, and flying profile.
- ✓ **DO** be aware that the presence of others can influence your decision-making and your willingness to take risks.
- ✓ **DO** communicate to your passengers that safety is your top priority.
- ✓ **DO** establish "weather checkpoints" along the route at which you will reevaluate conditions. If possible, have your passengers assist by tracking progress and conditions at each weather checkpoint.

- ✓ **DO** use your pre-established personal minimums to determine exactly what conditions will trigger a diversion at any given weather checkpoint. Let your passengers know what these conditions are.
- ✓ **DO** decide specifically what you will do if you have to divert at any particular point, and inform your passengers of these “weather escape” plans. Preflight is the time to make alternative arrangements (e.g., hotel and rental car reservations) in the event that weather conditions degrade.
- ✓ **DO** advise anyone meeting you at your destination that your plans are flexible and that you will call them when you arrive.
- ✓ **DO** bear in mind that one of the most powerful – and effective – safety tools at your disposal is waiting out bad weather. Bad weather normally does not last long, and being able to wait a day can often make the difference between a flight with high weather risk and a flight that you can make safely.

Inflight Decision-Making

Perceive – Obtaining Information During the Flight



Often weather is not forecast to be severe enough to cancel the trip, so pilots often choose to take off and evaluate the weather as they go. Even so, interviews with GA pilots indicate that there still is an enormous “information gap” with respect to en route weather data. A small number of GA pilots have access to sophisticated equipment to keep abreast of the weather while en route. The majority, however, still depend on using visual recognition, automated weather information from ATIS or ASOS/AWOS, and radio calls to Flight Watch (Enroute Flight Advisory Service – EFAS) or ATC and to supplement and update weather information obtained during the preflight briefing. In fact, a 2005 survey on how GA pilots actually use weather information reveals that even on a “challenging” four-hour flight, the average pilot spends only about seven minutes getting inflight updates. Pilots who responded to the survey reported using mostly ATIS, ASOS/AWOS, and Flight Watch, in that order of preference.

Updating weather information while enroute is critical for most GA flights, because they travel relatively slowly and at low altitudes – which means that GA pilots and their aircraft operate in (rather than above) most weather. At typical GA aircraft speeds, making a 200-mile trip can leave a two- to three-hour weather information gap between the preflight briefing and the actual flight.

Let's take a closer look at inflight weather data sources.

Visual Updates. One of the most important things you can do, both before departure and during the flight, is to look outside. Use your eyes to survey the weather and literally see whether the conditions around you match the conditions that were reported or forecast. Sometimes there are local deviations in weather conditions (isolated cells, fog, etc.) that may not be immediately known to the FSS specialist or that may not appear on weather-product depictions, especially if there is no weather-reporting capability at your departure point. Even if you looked at radar during your preflight briefing process, remember that graphical radar information such as NEXRAD data can be as old as 12 minutes or more just by the time you see it on a display, and older still by the time you are ready to depart. Weather can change very rapidly.

Once you have launched on a flight, the task of perceiving weather becomes very literal: except in aircraft equipped with weather avoidance equipment, it is largely up to the pilot to physically see what the weather is doing. Common sense suggests that see-and-avoid applies as much to hazardous weather avoidance as to preventing midair collisions. However, the reality is different. Research indicates that pilots involved in VFR-into-IMC accidents often venture into reduced visibility conditions because they lack experience in interpreting real-time weather. Some researchers have found that pilots, particularly those with less experience, do not trust what their eyes are telling them and proceed “blindly” ahead. There are also some very real limitations on the human visual system, which we will discuss in the next section.

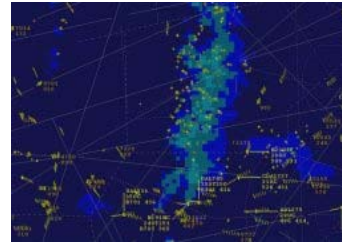


ATIS/ASOS/AWOS. Many pilots primarily use ATIS and ASOS/AWOS broadcasts to update weather information after takeoff. A 2005 survey conducted by the FAA's Civil Aviation Medical Institute (CAMI) revealed that with respect to weather information used once the flight was airborne, ATIS and ASOS/AWOS were the top two of four most frequently used sources. Pilots responding to the survey rated ATIS as above average and reportedly used it 75% of the time. ASOS/AWOS was second at 49%. Although presumably most pilots who reported using these sources tuned in near the destination – i.e., updated weather only in preparation for landing – pilots who wish to keep a continuous watch on nearby weather conditions along the route can benefit from this information as well. Since ATIS and ASOS/AWOS frequencies are printed on aeronautical charts, pilots can update and validate preflight information about enroute weather conditions simply by listening to broadcasts from airports along the route of flight.

Enroute Flight Advisory Service (EFAS, or Flight Watch). Available on 122.0 in the continental United States from 5,000 AGL to 17,500 MSL (124.67 at higher

altitudes), EFAS, addressed as Flight Watch, is a service specifically designed to provide en route aircraft with timely and meaningful weather advisories pertinent to the type of flight intended, route of flight, and altitude. In conjunction with this service, EFAS is also a central collection and distribution point for pilot reported weather information. You should not hesitate to use this resource. If you are in contact with ATC, request permission to leave the frequency to contact EFAS. When you contact Flight Watch, provide your aircraft identification and the name of the VOR nearest to your position. The specialist needs to know your approximate location to select the most appropriate transmitter/receiver outlet for communication coverage. Charts depicting the location of the flight service stations and outlets they use are contained in the Airport/Facility Directory (A/FD). Aeronautical charts also include these frequencies, and most Flight Service Stations can also be reached at any altitude on 122.2 MHz. Calling EFAS shortly after the beginning of the hour will ensure that you receive the most current METARs and other reports.

Air Traffic Control (ATC). ATC is another possible resource for inflight weather information. ATC's primary mission is to prevent collisions between aircraft and organize the flow of air traffic, so VFR pilots should be aware that assistance to VFR flights is an additional service provided at the controller's discretion. If traffic volume, frequency congestion, radar quality, controller workload, and higher priority duties are too great, ATC may decline to provide VFR services. Remember that adverse weather impacts ATC system workload as well. If you ask for general information on the present location of weather, the controller will try to give you a rough idea. If you need detailed information on what to expect along your route, however, ATC will ask you to contact Flight Watch (EFAS).



Datalink and Weather Avoidance Equipment. Radar and lightening detectors, which are also known as “stormscopes” or “sferics devices,” have been available in some GA aircraft for many years. These devices can contribute significantly to weather awareness in the cockpit. An increasing number of GA aircraft are now being equipped with weather datalink equipment, which generally uses satellites to transmit weather data such as METARs, TAFs, and NEXRAD radar to the cockpit, where it is often shown as an overlay on the multifunction display (MFD). Handheld weather datalink devices are also poised to become a popular source of en route weather information.

With respect to datalink, there are several basic methods for transferring weather data from a weather data provider's network to an aircraft:

- **Request/Reply** - In these systems, the pilot must decide what is needed and then request the specific information and coverage area. This request must then be sent from the aircraft to the satellite, from the satellite to the ground,

processed by the ground system and transmitted back to the airplane. Transmission time can require as long as 10 or 15 minutes. Since weather can change very rapidly, this delay can significantly reduce utility of the data.

- **Narrowcast** - Some providers offer “narrowcast,” which automatically sends data directly to the aircraft according to the pilot’s pre-established preferences for products, update rate, resolution, coverage area, and other parameters.
- **Broadcast** - Broadcast systems continuously send available weather products to every user in the area through a satellite network and a system of interconnected ground stations. Satellite broadcast systems use high-powered geo-synchronous satellites to deliver large amounts of data in a very short time.

One of the most important, and critical, things to know about datalink is that regardless of the transmission method, it does not provide “real-time” information.

Process – (Honestly) Evaluating and Updating Inflight Conditions

Just as you did in the preflight weather process, you need to periodically update, evaluate, and analyze the information you have gathered on inflight weather conditions.

Visual Updates. Seeing is believing – or so we are conditioned to think. Although you should certainly use your eyes during the flight to perceive the weather, you need to be aware that much of our visual perception is influenced by prior knowledge of the visual world. To a surprisingly great degree, our prior visual experience determines our ability to “see” things. Pilots learn in ground school about various sensory illusions. In the narrow runway illusion, for instance, the aircraft appears to be at a greater height over the runway because we have learned through previous experience what a typical runway should look like at a given altitude. The human brain prefers to adjust the apparent height of the aircraft rather than adjust the concept of what a runway should look like.



Similarly, scientists who study human vision have determined that weather transitions are sometimes too subtle for the limits of the visual system. Like other sensory organs, the eye responds best to changes. It adapts to circumstances that do not change, or those that change in a gradual or subtle way, by reducing its response. Just as the skin becomes so acclimated to the “feel” of clothing that

it is generally not even noticed, the eye can become so accustomed to progressive small changes in light, color, and motion that it no longer “sees” an accurate picture. In deteriorating weather conditions, the reduction in visibility and contrast occurs quite gradually, and it may be quite some time before the pilot senses that the weather conditions have deteriorated significantly. In essence, you have to learn how to look past the visual illusion and see what is really there. We will discuss techniques for “learning to see” in the next section.

Certain weather conditions also make it particularly difficult to perceive accurately with the eye. For instance, a phenomenon called “flat light” can create very hazardous operating circumstances. Flat light is a condition in which all available light is highly diffused, and information normally available from directional light sources is lost. The result is that there are no shadows, which means that the eye can no longer judge distance, depth features, or textures on the surface with any precision. Flat light is especially dangerous because it can occur with high reported visibility. It is common in areas below an overcast, and on reflective surfaces such as snow or water. It can also occur when blowing snow or sand create flat light conditions accompanied by “white-out,” which is reduced visibility in all directions due to small particles of snow, ice or sand that diffuse the light.

ATIS/ASOS/AWOS. Inflight weather information obtained from ATIS and ASOS/AWOS broadcasts can contribute useful pieces to the en route weather picture, but it is important to understand that this information is only a weather “snapshot” of a limited area. ATIS and ASOS/AWOS broadcasts are primarily intended to provide information on conditions in the airport vicinity. The information reported is derived from an array of sensors. While these systems are designed to be as accurate as possible and are increasingly sophisticated, you need to understand that the automated system is actually monitoring only a very small area on the airfield and that it reports only what it can “see.” For example, sensors that measure visibility are actually measuring a section of air less than 24 inches wide. Even a dense fog on a portion of the airfield will go undetected by the system unless the fog actually obscures the sensors. The system will not “see” an approaching thunderstorm until it is almost directly over the automated site’s ceiling instruments.



EFAS. Assuming that you do find or suspect deteriorating conditions while en route, be sure to contact the En route Flight Advisory Service (EFAS), also known as Flight Watch, for additional information. EFAS can be an immensely helpful resource, but interpreting and applying the information you receive while you are also flying the aircraft – especially if you are in adverse or deteriorating conditions with no autopilot – can be very challenging. The key is understanding where the weather is in relation to your position and flight path, where it is going, and how fast it is moving. To process the data accurately, it is helpful to have an

aeronautical chart with your route clearly marked readily available before you call Flight Watch. Even if you are operating in familiar airspace, having a chart at hand will help you visualize where the weather conditions are in relation to your current position and intended route of flight, and determine whether (and where) you need to deviate from the original plan.

Another useful tool is the Inflight Advisory Plotting Chart (figure 7-1-2 in Chapter 7 of the Aeronautical Information Manual (AIM)). This chart includes the location and identifier for VORs and other locations used to describe hazardous weather areas. Consider keeping copies of this chart in your flight bag for easy reference whenever you call EFAS.



ATC. As noted earlier, Air Traffic Control (ATC) can also be a valuable source of inflight weather information. It is, however, critical for GA pilots to understand what ATC can and cannot provide, and how to communicate clearly – especially when trying to avoid convective (thunderstorm) activity or icing conditions.

In a Terminal Radar Approach Control (TRACON) facility, the controller's primary tool is radar. Modern radar has evolved from the simple display of reflected energy known as echoes or returns ("primary" radar) to a complex amalgam of data from a network of transponders, computer systems, and radars. Radar can provide valuable information for weather avoidance and flight planning. It does, however, have limitations. Specifically, radar sees only those entities that reflect energy. These include precipitation, the density of which may be determined by the strength of the return. What ATC radar sees is dependent upon the kind of equipment in use. Older radars will only depict primary radar returns, and controllers using these units often use a device known as circular polarization (CP) to reduce the magnitude of precipitation returns so that they can see aircraft targets more clearly. In these cases, the weather information displayed will be reduced and understated.

Terminal ATC facilities equipped with the latest radar systems can measure precipitation intensity and display it to the controller in six levels of intensity. In increasing order of magnitude these are:

- Level 1 - Light precipitation
- Level 2 - Light to moderate rain
- Level 3 - Moderate to heavy rain
- Level 4 - Heavy rain
- Level 5 - Very heavy rain; hail possible
- Level 6 - Very heavy rain and hail; large hail possible.

Radar does not detect or "see" turbulence, but its existence may sometimes be implied by the intensity of a precipitation return: the stronger the return, the more likely the presence of turbulence. Additionally, icing does not show directly, but

may be inferred by the presence of moisture, clouds, and precipitation at temperatures at or below freezing.



Another critical element in interpreting weather information from ATC is having a thorough understanding of pilot-controller communications. In recent years, there have been several GA accidents in which the effectiveness of information provided by ATC was diminished by the fact that pilots and controllers used terms that each interpreted in a different way. For example, description of weather radar echoes sometimes varies with the type of facility that provides the information (i.e., terminal versus en route). Guidance issued to ATC (ATC Order 7110.65, paragraph 2-6-4) instructs controllers to issue information on observed weather areas, but does not provide guidance on use of the term “level” with respect to precipitation echo intensity. Similarly, the current version of the Aeronautical Information Manual (AIM) does not mention precipitation echo levels or contain any discussion of what information controllers may provide, and some pilots may not be aware that radar weather echo intensity levels are addressed in the “R” section of the AIM’s Pilot/Controller Glossary.

The next section will provide specific communications guidelines and suggested phraseology, but the key point to remember in your mental processing of en route information from ATC is to *never make assumptions*. Be specific, and don’t hesitate to ask questions to clarify points you do not understand.

Datalink and Weather Avoidance Equipment. Most traditional weather avoidance devices (e.g., radar, stormscopes) require a certain amount of training and expertise to master. Detailed discussion of interpreting these devices is beyond the scope of this guide, but suffice it to say that pilots who fly with this equipment should be sure to invest the time required for correct usage and interpretation.



The emergence of datalink systems in the GA aircraft cockpit holds enormous promise for improving GA pilots’ weather awareness, and these systems do so without some of the limitations of other sources of inflight weather data. In processing this information, however, it is vital to remember that the quality of the information you receive through datalink depends heavily upon features discussed in the previous section, such as update rate, resolution, and coverage area. When flying an aircraft that has datalink equipment, safe and accurate interpretation of the information you receive depends on your understanding of each of these parameters.

As stated earlier, one of the most important, and critical, things to know and remember about datalink is that it does not provide real-time information. Although weather and other navigation displays can give pilots an unprecedented

quantity of high quality weather data, their use is safe and appropriate only for *strategic* decision making (attempting to avoid the hazard altogether). **Datalink is not accurate enough or current enough to be safely used for tactical decision making** (negotiating a path through a weather hazard area, such as a broken line of thunderstorms).

Be aware that onboard weather equipment can inappropriately influence your decision to continue a flight. Some studies have found that pilots with onboard weather information and NEXRAD displays had better assessments of weather conditions than those having only “out the window” visual weather information. However, NEXRAD also increased risk-taking behavior, with the highest resolution displays encouraging pilots to continue flights with the expectation that they could fly around or between significant weather features. Not so!

Perform – Using All Available Weather Resources

So how do you make the most of the various inflight weather resources at your disposal, and minimize the limitations of each? As part of the FAA/Industry Training Standards (FITS) program for training in technically advanced aircraft, the FAA and the GA community jointly developed a [Personal and Weather Risk Assessment Guide](#) that offers tips and worksheets that you can use to develop your own specific and standardized procedures for weather decision-making.

Here are a few additional tips:



Visual Updates. We have already discussed the limits of the human visual system, and how adaptation can reduce the eye’s ability to perceive gradually deteriorating conditions.

To ensure that your eyes do not play tricks:

- ✓ **DO** make a conscious effort to periodically reevaluate the weather and estimate visibility while en route. As suggested in the previous section, one way to accomplish this objective is to monitor en route weather sources and then perform a mental cross-check. If, for example, your route takes you near an airport with ATIS or ASOS/AWOS, first try to evaluate the basic weather conditions based on what you see. Then listen to the ATIS or ASOS/AWOS and compare the official report to your own evaluation of conditions, as well as with any previous reports you have seen from this location. This technique

will help you establish a continuous weather assessment habit. It will also help you calibrate your perceptions and learn when to trust what you see.

- ✓ **DO** be vigilant in your assessment of weather conditions, and plan periodic assessments of weather into your flight plan. For every flight, make it a habit to designate specific fixes (e.g., airports) on or near your flight path as “weather check” checkpoints and tune in to the ATIS or ASOS/AWOS broadcasts. Another good option for monitoring weather if you are flying VFR is to listen to the nearest ARTCC, TRACON, or EFAS frequency, which will help you develop and maintain a mental picture of the weather conditions in your area.

ATIS/ASOS/AWOS. To make the most of ATIS/ASOS/AWOS information obtained en route:

- ✓ **DO** listen to several successive broadcasts and compare the various elements.
- ✓ **DO** check ATIS or ASOS/AWOS frequencies at airports for which you got METAR and TAF information during your preflight weather briefing, so you can compare the current information to the preflight METAR and TAF data. This analysis will help you spot trends, as well as give you an idea of how accurate the forecast was. Significant differences between the information you received during the preflight and the inflight data you get from ATIS or ASOS/AWOS broadcasts should raise a red flag of weather caution.

EFAS. To maximize the use of this resource, here are a few guidelines:

- ✓ **DO** request permission to leave an ATC frequency to contact EFAS if you see or suspect deteriorating weather. Provide your aircraft identification and the name of the VOR nearest to your position.
- ✓ **DO** make a specific request. Do you need updated weather at your destination, or information about possible convective activity along your route? If you are asking about hazardous conditions along your route, be sure to let the specialist know your present position.
- ✓ **DO** have an aeronautical chart with your route marked readily available before you call Flight Watch. Even if you are operating in familiar airspace, having a chart at hand will help you visualize where the weather conditions are in relation to your current position and intended route of flight.
- ✓ **DO** be a good aviation citizen. Contribute to the system and help your fellow GA pilots by making pilot reports (PIREPS) when you call Flight Watch. Don't worry about format; simply offer the information you have and the specialist will put it into the appropriate format for distribution. To learn more about

making good PIREPS, take the [Air Safety Foundation's free online "Skyspotter" course](http://www.aopa.org/asf/online_courses/skyspotter/) (http://www.aopa.org/asf/online_courses/skyspotter/).

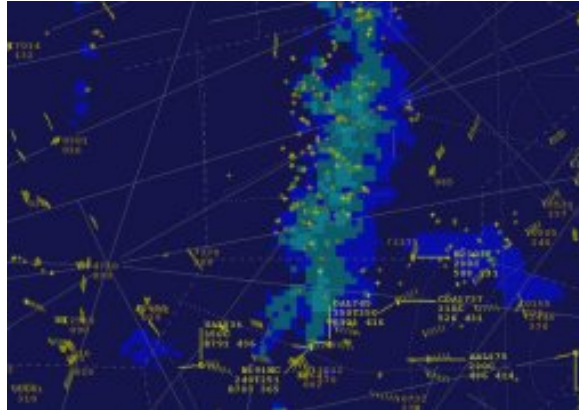
ATC. If you are facing weather, be aware that the ATC system in your area is likely to be busier than usual. If you need ATC's help, ask sooner rather than later. The range of options available to both you and ATC will narrow as you fly closer to the weather. Radar cannot "see" clouds, so the controller will not be able to determine whether your course will take you into IFR conditions. Remember that even if ATC issues radar vectors, navigational guidance information issued to a VFR flight is *advisory* in nature and the job of flying the aircraft safely remains with the pilot. Radar vectors do not constitute authorization for the pilot to violate regulations.



Here are a few guidelines for requesting and using ATC's help with inflight weather information and weather avoidance:

- ✓ **DO** be sensitive to ATC communications workload, but keep controllers advised of your weather conditions and be sure to tell them if you think you will enter IMC.
- ✓ **DO** ask for PIREPs. Recent PIREPs can augment information provided by radar and give you a better understanding of the weather conditions in your area. You should assist others by offering PIREPs as well.
- ✓ **DO** invest the time to learn how to communicate with ATC in a precise and professional way. ATC is required to use standardized words with precise meanings designed to improve understanding and eliminate ambiguity. By using the same approach, pilots can understand and communicate more efficiently with controllers. There are many resources available to help you learn (e.g., the Pilot/Controller Glossary in the AIM). Remember that how you communicate says a lot to a controller about your competency as a pilot, and determines to a great extent how you will be handled. Efficient communication also saves valuable time for everyone.
- ✓ **DO** know the general geographical boundaries of the approach control facilities along your route of flight as well as the appropriate frequencies to use in contacting them.

- ✓ **DO** be aware that ARTCC (Center) weather radar displays do not provide real-time information, and suggested vectors may not keep you clear of all weather.
- ✓ **DON'T** hesitate to ask questions if you do not understand.
- ✓ **DON'T** make assumptions about what the controller knows about your flight:
 - Not all controllers are pilots, and some may not be aware that you do not have onboard weather avoidance equipment.
 - If you are handed off to another controller while on a suggested vector for weather avoidance, confirm that the next controller knows you are requesting weather avoidance assistance. For example, your initial call might be: “Center, N2817S, level 5,000, 020 heading for weather avoidance.”
 - Never assume that “cleared direct when able” means that flying a direct course at that time will keep you clear of weather. To ATC, “direct when able” means to fly direct when you are able to navigate directly to the fix. If you have any doubt, ASK whether a direct course will keep you clear of areas with moderate and heavy radar returns indicative of thunderstorm activity.
 - Words such as “showers” and “precipitation” can be very misleading. Some pilots mistakenly assume that these words indicate areas of rain with no thunderheads present. Do not proceed into areas of “showers” or “precipitation” without clarifying the level of precipitation or a descriptor such as “light,” “moderate,” or “heavy.” The difference between Level 1 precipitation and Level 4 precipitation can be fatal to a GA pilot.
- ✓ **DON'T** terminate VFR flight following or other services and leave an ATC frequency without informing the controller that you are doing so.



Post-Flight Weather Review



When you land after a challenging flight in the weather, you may want nothing more than to go home and unwind. The immediate postflight period, however, is one of the best opportunities to increase your weather knowledge and understanding. Studies show that pilots sometimes fly into bad weather simply because they lack relevant experience, and thus did not recognize that certain weather “cues” might create a safety hazard to the flight. Make it a point to learn something from

every weather encounter. At the end of a flight involving weather, take a few minutes to mentally review the flight you just completed and reflect on what you learned from this experience. To guide your postflight weather review:

- ✓ 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 briefing?
- ✓ 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 enroute weather information provided the best (or most useful, most accurate, most relevant) data for this flight?

Another way to develop your weather experience and judgment is simply to observe the weather every day. When you look out the window or go outside, take a look at the clouds. What are they doing? Why are they shaped as they are? Why is their altitude changing? This simple habit will help you develop the ability to “read” clouds, and understand how shape, color, thickness, and altitude can be valuable weather indicators. As your cloud-reading skill develops, start trying to correlate the temperature, dewpoint, humidity, and time of day to the types of clouds that have formed. Take note of the wind and try to visualize how the wind wraps around the tree or whips around the corner of a building. This exercise will help you become more aware of wind at critical points in your 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.

Resources

Appendix 1 Weather Products and Weather Providers Chart

Appendix 2 Items for Standard Briefing

Appendix 3 How to Obtain a Good Weather Briefing (P-Pamphlet)

Appendix 4 Automated Weather Observing Systems

Appendix 5 Aviation Weather Analysis Forms

Appendix 6 Personal & Weather Risk Assessment Guide

Appendix 1 Weather Products and Weather Providers

The table below lists some of the most common weather products and providers:

Source	AC (Severe Wx Outlook)	AIRMET / SIGMET	charts, Convective outlook	charts, Prog.	charts, Radar (NEXRAD)	charts, Radar summary	charts, Surface analysis	Center Weather Advisory (ATC)	charts, Weather depiction	FA (18-hr area forecast)	FD (winds/temps aloft forecast)	FD (winds/temps aloft forecast)	METAR	PIREP	Satellite	SD (hourly radar)	TAFs	TWEB	WWW, AWWW
Format: T = text; G = Graphic. Text may be written or spoken.																			
<i>Preflight</i>	T	T	G	G	G	G	G	T	G	T	T	G	T	T	G	T	T	T	T
Commercial vendor	Search Internet for "commercial weather products."																		
Public NWS or NOAA site		X	X	X	X		X			X		X	X	X	X	X	X	X	X
DUATS	X	X						X	X	X	X		X	X	X	X	X		X
FSS (automated TIBS)	Short automated briefing, origin & radius, advisories & summary, ceil, vis, w. easy link to FS Specialist																		
FSS (standard)	Verbal synopsis of all available information																		
FSS (abbreviated)	Short, verbal synopsis, based on all available information																		
FSS (outlook)	Short, verbal forecast based on all available information																		
The Weather Channel					X								X		X				
<i>En route</i>																			
cockpit avionics	products vary																		
EFAS	Verbal synopsis, based on all available information																		
HIWAS		X						X						X					X
TWEB	Short automated synopsis, origin & radius, wx advisories, ceil, vis, winds, radar, PIREPS, alerts																		
<i>Both</i>																			
ASOS	ASOS, ATIS, AWOS are similar to METAR, incl. Place, Time, Wind direction/speed, Visibility, Ceiling, Temp/Dewpoint, Altimeter																		
ATIS																			
AWOS																			
CWA	Short, verbal synopsis, based on all available information																		
LLWAS	Airport-specific wind-shear alerts																		

(NO

NOTE: Products directly accessible to the user are marked with an "X."

- ASOS Automated Surface Observing System
- ATIS Automated Terminal Information Service
- AWOS Automated Weather Observing System
- CWA Center Weather Advisory
- DUATS Direct User Access Terminal System
- EFAS En route Flight Advisory System
- FSS Flight Service Station
- HIWAS Hazardous Inflight Weather Advisory System
- LLWAS Low Level Wind Shear Alert System
- NOAA National Oceanic and Atmospheric Association
- NWS National Weather Service
- TIBS Telephone Information Broadcast Service
- TWEB Transcribed Weather Broadcast

Appendix 2

Items for Standard Briefing

- ✓ Type of Flight (VFR or IFR)
- ✓ Aircraft identification
- ✓ Aircraft Type / Special Equipment
- ✓ True Airspeed
- ✓ Departure Point
- ✓ Proposed Departure Time
- ✓ Cruising Altitude
- ✓ Route of Flight
- ✓ Destination
- ✓ Estimated Time En Route
- ✓ Remarks (e.g., “no weather avoidance equipment on board”)
- ✓ Fuel
- ✓ Alternate Airports
- ✓ Pilot’s Name

Appendix 3

Automated Weather Observing Systems

AWOS- Automated Weather Observing System.

ASOS- Automated Surface Observing System.

AWOS-3 reports all the items in a METAR – time of observation, wind, visibility, sky coverage/ceiling, temperature, dew point and altimeter setting. The designator "**A02**" in the remarks portion of the observation indicates the station has a precipitation discriminator which determines the difference between liquid and freezing/frozen precipitation.

ASOS reports the same data as AWOS-3 **plus** precipitation type and intensity like the AWOS-3 sites with the A02 capabilities.

AWOS-2 reports the same METAR items as an AWOS-3 except it **does not report sky coverage/ceiling information.**

AWOS-1 reports the time of observation, wind, temperature, dew point and altimeter setting. **It does not report visibility or sky coverage information.**

AWOS-A reports **only** the time of observation and altimeter setting.

The prefix "AUTO" indicates the data is derived from an automated system. A certified weather observer may provide augmented weather and obstruction to visibility information in the remarks of the report at AWOS locations.

The "AUTO" prefix disappears when the report has been augmented by human observers.

Appendix 4 Aviation Weather Analysis Forms

CURRENT CONDITIONS (from METARs)

		Turbulence	Ceiling & Visibility			Visibility & Performance	Trends
Place	Time	Wind	Visibility	Weather	Ceiling	Temp/Dewpt	Altimeter

FORECAST CONDITIONS (from TAFs)

		Turbulence	Ceiling & Visibility		
Place	Time	Wind	Visibility	Weather	Ceiling

WINDS ALOFT

		Turbulence	Visibility & Performance
Place	Altitude	Wind	Temp

Appendix 5 Developing Personal Weather Minimums

Note: This worksheet was adapted from the FAA/Industry Training Standards (FITS) Personal and Weather Risk Assessment Guide (October 2003). For the entire document, please go to: www.faa.gov/education_research/training/fits/guidance/media/Pers%20Wx%20Risk%20Assessment%20Guide-V1.0.pdf.

Certification, Training, and Experience Summary

Certification	Certificate level (e.g., private, commercial, ATP)	
	Ratings (e.g., instrument, multiengine)	
	Endorsements (e.g., complex, high performance, high altitude)	
Training	Flight review (e.g., certificate, rating, Wings Program)	
	Instrument Proficiency Check	
	Time since checkout in airplane 1	
	Time since checkout in airplane 2	
	Time since checkout in airplane 3	
	Variation in equipment used (e.g., GPS navigators)	
Experience	Total flying time	
	Years flying	
	Hours in previous 12 months	
	Hours in this airplane (or identical model) in last 12 months	
	Landing in last 12 months	
	Night hours in last 12 months	
	Night landings in last 12 months	
	Hours flown in high density altitude in last 12 months	
	Hours flown in mountainous terrain in last 12 months	
	Crosswind landings in last 12 months	
	IFR hours in last 12 months	
	IMC hours (actual conditions) in last 12 months	
	Approaches (actual or simulated) in last 12 months	

Personal Minimums

Weather Condition	VFR Pilot (100-200 hours)	IFR Pilot (300-500 hours)	My Personal Minimums
Ceiling & Visibility			
Ceiling – DAY VFR	3,000 feet	2,000 feet	
Ceiling – NIGHT VFR	5,000 feet	3,000 feet	
Ceiling – IFR APPROACH	n/a	Minimums + 500	
Visibility – DAY VFR	5 miles	3 miles	
Visibility – NIGHT VFR	7 miles	5 miles	
Visibility – IFR APPROACH	n/a	Minimums + ½ mile	
Turbulence (Wind)			
Surface Wind Speed	15 knots	15 knots	
Surface Wind Gusts	5 knots	5 knots	
Crosswind Component	7 knots	7 knots	
Mountain Flying			
Overwater Flying	Consult instructor or mentor		
Icing Conditions			
	n/a	Consult instructor or mentor	