Panel 3 – Training

Moderator: Ms. Melissa Bailey, *Director, Air Traffic Services, Aircraft Owners and Pilots Association*

Rapporteurs: Mr. Floyd Hauth, *Office of the Federal Coordinator for Meteorology (Science and Technology Corporation)*

Dr. Wayne Estabrooks, *Assistant Federal Coordinator for United States Navy/United States Marine Corps Meteorological Affairs*

Synopsis

The following summarizes the major issues from this session:

- Implementation of technology (i.e. full use of new or revised products) is not maximized without proper training.
- Not only must pilots be trained in weather, but forecasters should also be trained in how pilots operate in order to best support their needs with finer scale (mission scale) weather products. It was also pointed out that general aviation product requirement and training needs are very different from the needs of commercial and military users.
- Products and training should be tailored to the unique needs of different users.
- PIREPs (and training in PIREPs) were identified as a problem area that needs to be addressed. Without a robust PIREP system in place, verifying (and improving) forecasts is difficult.
- The range and breadth of training issues require action across the spectrum of providers and users of weather information for aviation operations. These include pilots, controllers, dispatchers, and aviation support elements of the FAA, NOAA/NWS, NASA, the DOD, and the civil sector.
- A synopsis of the aviation forum, including its issues and recommendations, should be briefed to the National Aviation Weather Program Council.

- A Joint Action Group should be established to develop a comprehensive training concept for aviation weather support and guide its implementation.
- Pilot training programs should be at three levels: weather theory, state of the atmosphere, and impact of weather on flight.

Training was seen as a fundamental aspect of aviation weather that crossed all other facets of aviation weather. It is an area in which a small investment can pay huge dividends in safety and efficiency of operations. Much effort in a variety of organizations (both public and private) has been dedicated to maximizing training benefits for military, commercial, and general aviation purposes. A variety of media are used for training to maximize its utility. These efforts are indispensable and complement one another well. A number of interagency efforts (such as COMET) are underway and continue to improve training capabilities. However, some gaps exist and there are several opportunities for improvement.

1. Lt Col Ron Dunic, Directorate of Weather, U.S. Air Force. Air Force weather relies heavily on both officer and enlisted personnel to provide operational support. Historically, Air Force Weather qualification and upgrade training was conducted at the local level. In the 1990's, due to downsizing, the divestiture of the Air Weather Service, and manning shortages, Air Force Weather developed a reengineering plan to better provide timely, accurate, and relevant weather support. The most experienced forecasters are assigned to USAF and Army field locations. This plan also employs regionally focused hubs responsible for analysis and forecasting, which also serve as a training ground for forecaster apprentices. Currently there are four hubs in the continental U.S. The enlisted career track was revised, with an emphasis on improved training. Air Force Weather trains using an integrated building block approach of schoolhouse, formal on-the-job training, and correspondence courses. Airmen first attend a 19-week course at Keesler Air Force base. Forecaster Apprentices receive 2-3 years of intensive supervised qualification and upgrade training in a hub. Apprentices train on core tasks using Qualification Training Packages. Airmen must also complete a 15-volume Career Development Course, which is scheduled to begin in Oct 01. After graduation, airmen are assigned to field-level units to provide direct support to the war-fighter. Weather Officer training was also improved, with new weather officers entering Air Force Weather after earning a meteorology degree or completing the Basic Meteorology Program. Officers attend an initial (weather officer) skills course at Keesler Air Force Base before their first assignment. The entire officer career track was also revised to improve mission support, and better train the weather officers. On the other hand, aircrews receive weather training during pilot training and periodic updates through refresher courses held at their operational locations.

2. Leroy Spayd, Science & Technology Core, National Weather Service. The National Weather Service maintains a robust training program to train weather personnel. For all National Weather service job areas, subject matter expert meetings were held to define potential training needs. NWS has a system in place to prioritize the 288 training units that were identified. An interagency team of experts defined a complete set of job-based training requirements for weather Service, Air Force, and navy forecasters. The highest

priority training requirements were defined by NWS field users support service areas identified in the "National Aviation Weather Initiatives" document: ceiling and visibility, convective hazards, en-route & terminal winds/temperature, in-flight icing, turbulence, and volcanic ash & other airborne hazards. Learning materials available include NWS/Cooperative Program for Operational Meteorology, Education and training (COMET) modules. These are now available for access via the World Wide Web. Inconsistent funding for interagency sponsored training modules/materials continues to be an issue/problem.

3. Hooper Harris, Flight Technologies and Procedures Division, Federal Aviation Administration. Rather than rely on a single source of information, weather requires the user to open a vast toolbox of products. Each product must be understood on its own merits, weaknesses, and limitations, and its relationship to other products. Weather information requires a high level of correlation on the part of the user to develop a full picture. However, there is a limit to what can be done. Training requirements exist for pilots, flight instructors, ground instructors, dispatchers, air traffic controllers, flight engineers, and flight navigators. Training guidance exists in both government and industry sources. Government sources include the Aeronautical Information Manual, current Advisory Circulars (AC's), and emerging Advisory Circulars. Evaluation standards have traditionally been "product-centric." As weather products evolve, it is necessary to shift training to "application-centric." Guidance must be provided for pilots to assess the suitability, application, and integration of weather products to a particular operation. Product development must include training capabilities - these go hand in hand. For the benefits of new products to be realized, training must provide the ability to integrate with other weather sources to promote sound decision-making. Bottom line - implementation of a new weather product does not occur until the user is prepared to use the new technology.

4. Mary Wadel, Glenn Research Center, National Aeronautics and Space Administration. Icing is the most difficult aviation weather hazard to forecast. NASA's aircraft icing education and training is the newest element of NASA's aircraft icing research. These efforts tie directly into the National Aviation Weather Initiatives: they enhance the ability of decision-makers to use the information, improve the capabilities of aircraft to fly safely and efficiently in all types of weather, and help to direct and utilize research related to aviation weather. Current educational efforts by NASA include educational videos (available to all), computer-based training (soon to be released on CD-ROM in a module design), and Pilot Flight training Simulator (PSIM). These efforts assist pilots to make better operational decisions while in icing conditions. Two recent training videotape releases include Tailplane Icing and Icing for Regional and Corporate Pilots. The modular design of the computer-based training is optimized for the instructor-led training environment, and provides flexibility for instructors. The PSIM incorporates the aerodynamic effects of icing as part of a training curriculum to provide pre-exposure to icing operations and performance, stability, and control changes due to airframe icing. It serves as an effective training tool for initial and recurrent training to provide awareness of the consequences of an icing encounter, provides training on aircraft-specific operation in icing, and helps users manage adverse icing encounters. NASA plans to release

additional education videos in the future, on topics such as General Aviation, Large Transport, Super-Cooled Large Droplets, and computer based training for regional and corporate flight operations. PSIM technology and methodology will be transferred to training flight simulators for desktop capability. In addition, they will transfer PSIM methodology for icing flight characteristics to motion-based ground flight simulators, and develop a roll upset icing research project from Loss of Control group findings in JSAT.

5. Tim Miner, Allied Pilots Association. Training is the most fundamental building block in any aviation safety program. Aviation weather is no different, and is a critical skill to the ultimate user, the pilot. Professional pilots enter their careers with widely different levels of skill in weather based on the method that they learned to fly. The current testing program does not provide standardization, in that there are vast differences in weather training and tests are not segmented.

The best weather training program for pilots, whether for new a technology or for initial training, must address three specific skills. The first is basic weather theory. The second is current and forecast states of the atmosphere and the dissemination of that information. The final skill is how the weather impacts the flight or "judgment" skills. There has been a paradigm change in observations with he implementation of automated observing sensors and new technologies that sense along the flight path. The FAA's wind shear/microburst program is the single success story of the last decade for addressing all three skills. Future programs must use multi-media interactive programs to provide future weather training and there must be a national source of standardization.

6. Bruce Landsberg, Air Safety Foundation. General Aviation's (GA) training needs are not the same as for commercial airlines. GA aircraft and pilots are less weather tolerant. The biggest challenge is not convective weather. Based on 1998 data, 70% of fatal weather related accidents (40 fatalities) resulted from flight from VFR into IMC conditions.

The Air Safety foundation has run over a thousand free weather seminars, distributed 10,000 free videotapes in 1999, and sponsors a robust website to address training deficits. The bottom line is that simplicity and safety go hand in hand with aviation weather.

General Aviation training requires specific instruction on the operational use and application of weather products and less emphasis on the availability of weather data. Training attempts to compensate for poorly designed systems. The question must be asked "is it easier to train new pilots, or to reduce the level of complexity, and simplify and improve utility?" It is suggested that the latter can be more effectively accomplished. An additional problem identified was over-warning pilots about VFR recommendations. To more accurately predict in-flight weather, more (and timelier) PIREPs are needed. Dissemination must be improved, and more feedback as well, to improve forecasts. Training must be multi-dimensional yet simple, with virtual scenarios combined with real world studies. It was highly recommended that meteorologists be trained to learn to think like pilots just as pilots have been historically been trained to think like meteorologists.

Air Force Weather (AFW) Education and Training

Lt Col Ron Dunic, USAF
Chief, Weather Career Field Management
Directorate of Weather
Headquarters, United States Air Force

ABSTRACT

AFW is currently undergoing a reengineering effort in order to provide a better operations support and training environment for its new officers and airmen. In the past, AFW qualification and upgrade training were conducted at the local unit level. These units were typically comprised of around 20 personnel. The downsizing and manning shortages in these units during the 1990s hampered the capability to provide the desired level of training. Currently, AFW is creating regionally focused hubs that are responsible for analysis and forecasting and will serve as the training ground for new officers and airmen. These hubs will bring together a "critical mass" of experienced forecasters focused on the forecast problem of the day and allow training in a team environment. This will allow new officers and airmen time to learn the art of weather forecasting. At the local unit level, more experienced personnel will be focused on weather's impact to the mission and supporting the decision making process.

Reengineering doesn't have a major impact on training of officers. Officers entering the career field still must have a degree in meteorology and they attend an initial skills course (ISC) at Keesler AFB prior to their first assignment. This course provides practical skills and knowledge to complement their academic work. Officers will still be encouraged to return to school between the 4-6 year point to receive an advance academic degree (AAD) through the Air Force Institute of Technology (AFIT) either in residence or at a civilian university. The change is the officer's first assignment is to a hub to receive on-the-job training (OJT) to hone forecasting skills and after 2-3 years at a hub, officers will attend a Weather Flight Operations course prior to being assigned to a weather flight. This new course concentrates on the application of weather in the decision making process and its impact to specific missions as well as practical observing skills and combat field skills. One goal of this course is to change the mindset from providing weather data to providing weather information critical to the operational mission.

Reengineering has led to a revised enlisted career track and caused a major change in the way AFW trains its enlisted personnel. Enlisted training continues to use an integrated building block approach of schoolhouse, formal OJT, and correspondence courses, but now the enlisted ISC concentrates on teaching forecasting concepts. After a 19-week ISC, the new airmen will spend 2-3 years in an OWS learning the art of forecasting and completing upgrade training to journeyman. After upgrade to Weather Journeyman, they return to the Weather Flight Operations Course and then go on to a Weather Flight. The training for aircrews and customers doesn't change much. Pilots will still receive instruction in weather during Undergraduate Pilot Training and the local weather units

will still be involved in Instrument Refresher Course program and briefings on seasonal weather, local effects, and new capabilities. The major difference is the integration of the forecasters directly into the flight planning process. This provides a two-way education: aircrews/customers learn what weather can do for them, but equally important, weather people learn what their customers need.

AFW is reengineering to better support operations by providing a better training environment for its personnel, by being actively involved in educating aviators and the operational community on weather and its impact, and learning how to best support their customers.

Aviation Weather Forecaster Training Plans

Leroy Spayd
Chief, Science and Technology Core
Office of Meteorology
National Weather Service

ABSTRACT

The National Weather Service (NWS) is committed to ensuring its forecasters receive the training they require to produce timely and accurate aviation weather products and services. The NWS is coordinating training material development with the Air Force and Navy to ensure widespread use. However, the competing priorities for training development are reviewed yearly and aviation is currently a high priority.

Training materials are already available in the areas of *Forecasting Aviation Icing*, *Radiation Fog Forecasting*, *Forecasting Convective Hazards*, and *Forecasting Volcanic Ash and Other Airborne Hazards*. Sources for Web-based modules, workshops and relevant data bases already available include the Cooperative Program for Operational Meteorology, Education and Training (COMET); the NWS WSR-88D Operational Support Facility's

Operations Training Branch; and the NWS Training Center. Additional training materials in the areas of forecasting ceiling and visibility, and forecasting will be developed in the near future. All of these training materials could be adapted for other users, such as pilots and dispatchers.

Training

Hooper Harris
Flight Technologies and Procedures Division, Flight Operations Branch
Federal Aviation Administration (FAA)

ABSTRACT

Weather offers unique challenges to pilots, dispatchers, and air traffic controllers because weather decision making requires a high level of correlation skill and technical knowledge. These interpretation and integration skills demand training which support the correlation level of learning, not simply the rote level, such as reading coded reports and interpreting symbols. Training will have to evolve from product-centric to application-centric, in which pilots learn not just how to read a product, but also which kinds of products to seek in developing a flight planning strategy or to support an in-flight decision.

As new weather products emerge from government and industry sources, the burden will be on the provider to ensure that the benefits of new products are realized by providing adequate training guidance, specifically as to the application of the product, it's integration with other products and it's limitations. Training development should be coincidental with product development. While the government accepts that burden as integral to it's policy on flight information; the user may most greatly benefit from the weather product marketplace as private vendors compete for market share. Advances in training media, such as computer based training, Internet down-loadable tutorials and interactive trainers will create a more capable and competent user, thereby gaining the maximum safety benefit from a new product's introduction.

While advances in weather products have been profound, no one source tells the whole weather story, and most products are subject to some level of interpretation beyond the rote level. Training has proven to be the mitigation for any limitations in weather products, and will continue to be so in the future.

Icing Education and Training

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Glenn Research Center, NASA

ABSTRACT

Aviation icing weather training could improve flight safety and provide a substantial benefit to the pilot community. There is little current training and educational materials available in the pilot community that supports a description of the impact of environmental icing on an airplane and operations in these conditions. Pilots are given instruction on the operation of ice protection equipment and the general nature of an icing encounter. They receive very little specific information about what icing looks like and what happens in an icing encounter prior to actual flight experience.

NASA hopes to provide pilots with the knowledge and skill to manage icing weather flight operations by developing an array of educational materials and training aids that will provide the pilot with a pre-exposure to atmospheric icing. This approach includes:

- Videos for different pilot groups (GA, regional and corporate, and large transport) and on specialized subjects (tailplane icing and supercooled large droplet hazards)
- Computer-based training module using multi-media materials to instruct pilots
- Ground-based simulator for flight in icing which will faithfully represent an airplane contaminated with various types and amounts of ice

These training materials will develop the pilot's judgment and decision-making skills, and provide exposure to potentially hazardous icing operations prior to flight.

Training

Tim Miner
Pilot, American Airlines
Allied Pilots Association

ABSTRACT

Training is the most fundamental building block in any aviation safety program. Aviation weather is no different, and is a critical skill to the ultimate user, the pilot. Professional pilots enter their careers with widely different levels of skill in weather based on the method that they learned to fly. The current testing program does not provide standardization.

The best weather training program for pilots, whether for new a technology or for initial training, will always address three specific skills.

- The first is basic weather theory.
- The second is current and forecast states of the atmosphere and the dissemination of that information.
- The final skill is how the weather impacts the flight or "judgement" skills.

The FAA's wind shear/microburst program is the single success story of the last decade for addressing all three skills. Future programs must use multi-media interactive programs to provide future weather training and there must be a national source of standardization.

Safety Pilot – A Trip Not Taken

Bruce Landsberg
Executive Director, Air Safety Foundation
Aircraft Owners and Pilots Association

ABSTRACT

How many times have you gotten right up to the point of launching on a cross country trip and then had one thing tip the balance to "No Go?" In my early flying years this happened quite a bit. With more experience and sometimes more aircraft capability "go" became the more common option. However, there are days when it looks like it all ought to work and yet something says "No."

NASA was holding a meeting in late January on some important aviation safety initiatives. I really needed to be there, so it was fly or have an alternative mode. Flight time was an hour by Bonanza from Frederick, all the way to Newport News, Virginia. As far as deicing equipment, the Bonanza's heated pitot tube relates just about how fast you're getting into trouble if ice is the problem. The only other de-icing options are wishful thinking and that has proven to be somewhat unreliable when you really need it.

My first hope, looking at the weather outlook the night before, was that it would be VFR. It would be simple to pop through the VFR corridor under the DCA Class B airspace and then travel GPS direct. The next morning the sky had that milky look to it and according to the local Metars, visibility was running about 4 miles with a 2,800 foot ceiling. Marginal. As the day wore on, the weather improved. A mid-morning DUAT check showed good ceilings and visibility north but there was a developing low along the South Atlantic coast. It was supposed to track off the coast and away from the mainland, however the leading edges were affecting the Norfolk/Newport News area with ceilings at 900 overcast and two miles in drizzle.

That was still flyable but IFR was the only way and that would add about 20 minutes to the trip to accommodate the preferred route. I filled out the flight log and went into a meeting intending to get an update just prior to my three o'clock departure. The call to flight service started positively enough and then went downhill rapidly. There were no Airmets for ice but a recent Pirep by a Boeing 737 reported light ice at 1,000 feet. Nuts. Was there anything else? The briefer allowed that the surface temperature was just a few degrees above freezing so for operational purposes it might as well be at the surface. (An Airmet for ice was subsequently issued.)

It was drizzling at Norfolk 20 miles to the southeast of Newport News and the ceiling was 200 feet lower at 700 AGL. The wind was northeast at 15 gusting to 23 knots, temperature and dew point were 36 degrees F. More Nuts. Was there anything else? Well, yes, said the briefer, the possibility of freezing rain or drizzle did have to be considered. Tilt. I've been in freezing drizzle once before, a long time ago, and that event occurred just outside the traffic pattern. The Cessna 150's windshield glazed over in the

less than five minutes it took to get back on the ground. Landed looking out the side window. Freezing precipitation does bad things, even to aircraft approved for flight into icing conditions.

At this point there was one positive report of ice and the possibility (not probability) of some other nasty things. The desire to fly was strong, as it is for most pilots and I understand how people can rationalize any decision – that capacity is endless. In retrospect, I really didn't *need* any more information but having been burned by overly conservative forecasts, especially where ice is concerned, a bit more verification would have reinforced the good decision not to fly. This no-go was not satisfying because I wasn't convinced beyond reasonable doubt.

The briefer and I discussed the scarceness of pilot reports. It would have been most helpful to know how many other aircraft in the area had encountered ice, what the tops were, and if there was a temperature inversion – the precursor for freezing rain or drizzle. The briefer was required to solicit Pireps under these conditions but he just wasn't talking to many aircraft and the pilots apparently weren't volunteering. I suspect that the Norfolk Tracon was talking to many aircraft. It was impossible to know if they were talking about the weather.

This points out a real weakness in our weather dissemination system. Over the past several years, FAA has been studying the weather accident problem with industry members and the Air Safety Foundation. The unanimous conclusion was that here should be many more Pireps. But when pilots are busy or in the terminal area, very few leave ATC frequencies to talk with Flight Service. The Boeing 737 crew did a good deed to pass on the icing report. It could have been relayed by ATC and if they took the time forward it along, then thanks is due there as well. But the reality is that Pireps are pretty low on the ATC priority list and probably much less than half make it into the FSS distribution system.

The ATC system can work really well for passing along weather for those who are on the party line and know how to use it. High and mid altitude sectors are replete with ride reports and sometimes ice or convective weather concerns . This isn't the long formal AIM report format. It typically goes something like, "United 422, light chop at flight level 350, moderate between 300 and 250." It could be as simple as "Light ice from 2,000 to 4,000." Everybody in the sector hears it and occasionally somebody will ask the location of the reporting aircraft. Controllers generally pass the information to new crews checking on the frequency. The airlines put it into their own dispatch systems. But in GA not many reports make it into FSS or back to NWS.

If you think of Flight Service as general aviation's dispatch system, merely reading the weather from NWS is not enough. Sometimes the forecasts FSS gets from NWS are not accurate. Sometimes it is more art than science. Many briefers do an outstanding job of interpretation but some will not stray from the printed forecast word and Metars. There are briefers and controllers with a flair for understanding the weather situation. They search out information and you can hear the enthusiasm in their voices. Pireps are gold

nuggets to be mined and passed along, either encouraging or discouraging one to fly on that particular day. As always, though, the decision must rest with us.

In the perfect world of the future we'll have weather in the cockpit and electronic Pireps where sensors on board the aircraft will data link temperature, moisture, winds aloft and perhaps even visibility and turbulence to the ground. Some of this is already being done on a few air carrier and cargo aircraft. The last two items are a big stretch for the technology now but in five years, who knows? But for now, it needs to be done the old fashioned way. A pilot has to call on the radio, provide a subjective view of what's happening and a controller or FSS specialist has to transcribe it into the distribution system. It's low tech and cumbersome.

Could we handle Pireps better in the short term? It would probably require a relatively small investment in personnel and hardware – both in short supply in this day of government surplus. There are controllers who would prefer to just separate aircraft and leave weather to FSS. There are other controllers who do accommodate weather requests and my hat is off to them because they have helped many of us complete more flights safely, but there is no systemic mandate to make this work.

If I were the National Weather Service, it would be great to know if my forecast hit the mark or not. In addition to saving lives, a minor reward in itself, there is nothing quite so satisfying as to be able to see the immediate results of a prediction and make mid course corrections. Adding a few thousand observation points each day would update the forecast models, improve air traffic flow, and help the nation as a whole to be better prepared for weather. Sounds like a win-win situation to me. They would likely endorse such a solution.

I decided, with some uncertainty, to make the 3.5 hour drive because I had more uncertainty about flying. The icing conditions were potentially severe and there were relatively few convenient alternatives. From DC to Richmond, the skies were clear with light winds. Drat - foxed by a pessimistic briefer. About twenty miles east of Richmond it started to deteriorate and by the time I arrived at Newport News the ceiling was down, it was 34 degrees on the surface and the winds were honking out of the northeast. The briefer had helped me make the right decision.

Next morning a full fledged Nor'Easter had blown up with moderate snow and winds in excess of 60 knots. The forecast said nothing about this. The storm raged all day and shut down the East Coast. The drive home the following day was in clear sunshine.

Another pilot friend had an identical situation. He had planned to fly South the day before my trip and received a marginal forecast with no real corroboration. He was sure that he'd been had until within twenty miles of the destination in North Carolina. The storm made a safe arrival improbable. We both agreed that a few more hard data points would have made the decision far more certain. Making the trip 99 percent of the way only to crash on the approach is still not satisfactory. The GA dispatch system and verification of

hard-to-forecast events need to improve. The lowly Pirep might be one way to do it quickly, save some lives, and reduce the nation's weather information anomalies.

For my part, I pledge to increase the number of Pireps on every future flight. It is as important to report something that isn't there as what is. No turbulence, no ice, good visibility, etc. will help all of us make better decisions. If the forecast calls for bad and we can verify that it's safe to fly, that should be widely distributed. When it is as bad or worse than forecast it is vital for other pilots to know that NWS nailed it. When they miss, both the pilot community and NWS need to know.

Visit ASF's website www.aopa.org/asf *for Safety Advisors on weather decision making. We'd also like your opinions and comments regarding the current state of forecasting and if a more robust Pirep system would help. Email us at* asf@aopa.org*, call 1-800-USA-AOPA or write ASF, 421 Aviation Way, Frederick, MD. 21701 Attn PIREPs.*