

General Aviation Wx Information

I. EASA WORKSHOP “WEATHER INFORMATION PROVIDED TO PILOTS”

October 28-29, 2015

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Abstract—General Aviation Weather information in the aircraft has enhanced pilot awareness allowing for more informed and better decisions reducing accidents and enhancing safety

Keywords—Weather, datalinks, Nexrad, FIS-B, METAR, AIRMET, SIGMET

II. INTRODUCTION

Weather Information for General Aviation (GA) aircraft does not directly translate to Transport Aircraft nor Air Carrier Operations. The information in this paper is provided at this workshop for the purpose of general awareness and, to emphasize that the objectives of providing appropriate weather (Wx) and related information to pilots enables pilots to make more informed and therefore better decisions which can result in few accidents and better safety.

III. HISTORIC GA WEATHER

As recently as the 1990s weather information for GA flights consisted of pre-flight weather briefings, Flight-Watch and other VHF radio update services including ATIS, communication with ATC, and for some of the higher-end aircraft on-board weather radar.

Information was not always available to all aircraft, especially those operating in more sparsely populated areas, flying VFR, and destined for uncontrolled airports.

As technology advanced, it became increasingly possible to provide GA aircraft with better situation awareness capability including information for traffic, terrain, and weather. The FAA, in partnership with the State of Alaska and industry launched a program to provide better information to pilots and controllers called CAPSTONE which included weather information and, was designed to measure the impact on safety this situation awareness data had. Alaska was selected because of the importance of General Aviation, the remoteness of many operations, the quickly changing conditions, and the vast areas of no radar coverage and poor VHF communication capability.

This program enabled development of equipment and infrastructure to provide better information to pilots on a much larger scale. Enhanced onboard Wx capability is now available through at least three sources, Flight-Information Service

Broadcast (FIS-B), subscription satellite broadcast services such as SiriusXM®, and satellite request services such as Garmin Flight Data System (GFDS). All of these provide capability for graphical weather. FIS-B is limited to the USA, SiriusXM® availability is primarily USA and Canada. Satellite request services are limited to the availability of weather products but more available worldwide.

The FAA final report on the CAPSTONE project¹ was published in 2005, and provides detailed data that supports a conclusion that CAPSTONE equipped aircraft had significant improvement in safety, at least some of which can be attributed to the enhanced weather data available to pilots while airborne.

IV. DATA SOURCES

The data for GA weather graphic display comes from a variety of sources:

A. FIS-B

Flight Information Service Broadcast (FIS-B), which includes Wx data, is provided by the FAA at no charge to receiving aircraft. The data is gathered and processed from various contracted sources by the FAA and is uplinked to aircraft on the 966 MHz or Universal Access Transceiver (UAT) datalink also used in the USA for ADS-B. The FAA has ADS-B transceiver stations located throughout the USA to provide ADS-B receive capability for ATC. These stations also provide uplink data to aircraft including FIS-B.

The data provided by FIS-B include Next Generation Radar (Nexrad), Temporary Flight Restriction (TFR), Meteorological Terminal Aviation Routine Weather Reports (METARS), Pilot Reports (PIREPS), Winds and Temperatures Aloft, SIGMETS, and AIRMETS. FIS-B is an FAA approved data source for these. NOTAMs are also provided.

¹ The Impact of Capstone Phase 1 Program
Final Report, University of Alaska Anchorage, Aviation Technology Division; CAASD, The Mitre Corporation's Center for Advanced Aviation System Development; Embry-Riddle Aeronautical University, College of Business – College of Aviation, September 2005,
<http://www.faa.gov/nextgen/programs/adsb/wsa/media/Phase%201%20Final%20with%20appendices.pdf>

NOTAMS are provided but, FIS-B is not an FAA approved source for NOTAM products.

B. Satellite Broadcast Subscription Services

Satellite subscription services such as SiriusXM® generally contract for similar raw data information as provided by the FAA via FIS-B but may include additional information such as “county weather” not normally provided with aviation weather. As the data is downlinked directly to aircraft from satellites, it is not limited by the reception area of Ground Based Transmitters.

C. Satellite Request data

Services such as Garmin Flight Data System (GFDS) provide Weather information (Connex) on request from subscribing aircraft. The Garmin system uses Iridium® Satellites. These services often have availability to provide data covering more area. The GFDS provides weather for most of Europe, Canada, and the USA. Where available, this service provides PRECIP, Lightning, IR Satellite (Cloud top temperatures), SIGMETs/AIRMETs, METARs, Winds Aloft, PIREPs, and TFR information in both graphic and text format. Some information, like PRECIP, can be animated and show progression of oldest to newest data.

D. Limitations

The weather data supplied to GA aircraft is generally not suitable for any use other than pilot awareness and allowing the pilot visibility of changing weather conditions and trends that are otherwise unavailable in flight. The raw data is generally what is available rather than data designed to meet the requirements of a mature Concept of Operations (CONOPS). It does enable graphical display of weather information that can be quickly interpreted. It is generally not usable as a tool for avoiding real-time weather conditions. It does provide capability to assist pilots in making better informed decisions

FIS-B data is limited by availability of the raw data to the processing center. Products are processed and assembled from data of different time of validity. The time stamp associated with when a product was assembled may not reflect the actual time validity of the raw data. Aircraft availability is limited by the ability to receive the Ground Based Transmitter (GBT).

V. DISPLAY

The weather data is received by a GA aircraft using an appropriate receiver for the datalink, and is sent to a processing and display unit, usually residing in a Multi-Function or Primary-Flight Display (MFD/PFD). Here the data is properly decoded, formatted, and displayed. It is possible for an aircraft to receive information from more than one data source. When that is the case, normally only one may be selected for view at a given time. It is important that the weather data be presented in such a way that the pilot knows what the data represents. The refresh time, time of

applicability, time of transmission, and expiration times are all variables that can change how data should be interpreted. Other factors also affect how data can be interpreted. For example, the display of Nexrad data can be selected as regional or as Continental US (CONUS). When selected as regional, each colored “pixel” of weather is 1.5 by 1 nmi. And coded to the color that is the worst-case or most-severe PRECIP within that area. For Conus weather depiction, the “pixel” resolution is five times that size. There is an FAA Technical Standard Order for processing and display of FIS-B data, TSO C-157b. The TSO references RTCA Minimum Operational Performance Requirements (MOPS) which provide detailed requirements for decoding and display of the FIS-B data, including titles, legends, text reports, and Indication of Product Age as well as requirements for explicit indication of missing data and for color schemes.

Weather data is sometimes available in GA aircraft for display on Portable Electronic Devices (PEDs) including tablet-like devices. There are portable receivers which can receive weather products for these devices and there are installed avionic equipment which can provide the data to these portable displays. Such displays do not replace any required or installed equipment and are not approved for any aviation use but, like portable navigation systems they can provide useful awareness information. These displays are not bound to conform to the TSO requirements.

A separate accompanying slide presentation will be provided at this workshop providing examples of weather data as displayed in GA aircraft.

VI. TRANSPORT AND AIR CARRIER

Weather products currently available for GA share the objective of providing better, easily interpreted, valid in-flight information that can be used for making better decisions. This should result in fewer weather related incidents and accidents and safer operations; however, weather information provided to pilots in transport aircraft or air carrier operations should be based on a well-defined CONOPS that clearly defines who uses it, what it can be used for, what credit is given for having and using it and, what the impact is if the data is wrong or missing. The CONOPS should directly drive the requirements for the data, the data processing both ground and airborne, and the human factors considerations regarding what and how the weather data is communicated to the pilot/crew.

Transport and Air Carrier weather products should be based on a defined set of requirements for the intended aviation use. Current GA weather products, while very useful, are primarily based on what is available.

This is not intended to imply that none of the data available for GA is suitable for transport use. It depends on the requirements. Currently the GA “CONOPS” is defined by the characteristics of the data rather than the data requirements being driven by the intended use.