Department of Defense Meteorological and Environmental Inputs to Aviation Systems

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Good morning, I'm Colonel Paul Try, Director of the Office of Environmental and Life Sciences in the Office of the Under Secretary of Defense for Research and Engineering. Within this office, I have oversight and policy responsibility for the research and operational meteorological and environmental programs of the Military Services.

I was particularly pleased to be invited here today to participate in this workshop because I am a great supporter of the concept behind this gathering. In particular, the concept of bringing together the various disciplines of the aviation community with the operational meteorologists and research atmospheric scientists. The workshop concept and the development of recommended actions are functions which receive my full support. In reading the summary recommendations and background from the past workshops, I noted, but did not agree with, most of the past criticisms of this workshop concept, except one. I would agree that after six workshops covering the field very well, it is probably time to tackle the tough job of prioritizing the recommendations (possibly within disciplines) and noting the most appropriate agencies to focus on the solutions. Where else will you find a better group with the years of experience and knowledge to attempt this job? One cautionary note:

-- in prioritizing recommendations you must consider the factors of 1) need, 2) cost and 3) ability to achieve or the availability of a state-of-the-art solution. My choice for top prioritization is not the cancer cure type recommendation, but the more near to mid-term achievable recommendation.

Let me now move on to some comments concerning the goals and research programs within DOD associated with meteorological support to aviation systems. Since the workshop theme relates meteorology, aviation and satellite facilities, I thought I would start off with linking all of these disciplines together.

Within the limited time here, I naturally cannot describe all of the numerous programs within the Army, Navy, Air Force and Marine Corps related to weather and aviation safety; however, I would like to give a brief overview and illustrate some of the DOD efforts.

The goals we have within DoD are similar to those of other agencies as they pertain to improvement in safety of flight. There are several areas for concern. As our aircraft systems become more sophisticated, we are finding in many cases a greater sensitivity to meteorological conditions. The use of composite materials and fly-by-wire technology are just two examples of advances which have already illustrated weather-related programs. Low experience aircrews, single seat, single engine, high performance aircraft and the need for all weather combat readiness, couple together to indicate critical needs for improved research, design, training, operational procedures, weather observations and forecasts.

Integral to the DoD flight safety efforts related to the environmental parameters of icing, wind shear, turbulence, lightning and other severe weather phenomena, are the research activities designed to improve the observation and forecasting of these hazardous phenomena.

I'll just briefly cover some of the R&D activities related to the DOD environmental support services and discuss them by the parameter of interest: icing, lightning, wind shear, turbulence and other severe weather phenomena.

Aircraft icing research activities are primarily centered in the Air Force and the Army. The Navy's efforts are primarily associated with supporting the FAA helicopter icing studies through the use of an instrumental P-3 aircraft and with an experimental evaluation of surface implanted sensors to determine water depth and ice on runways. The Army efforts center around activities at the Cold Regions and Engineering Laboratory (CRREL) and the Army Aviation R&D Command (AVRADCOM).

The CRREL researchers are conducting detailed investigations on icing, ice adhesion, icing of rotating blades, freezing precipitation, freezing rain, sleet and other forms of natural icing conditions. Also, studies are being performed on the physical properties of ice, ice accumulation rates, and methods of snow and ice removal from roads and run ways. CRREL's work in the area of forecasting of icing conditions is part of a general effort that addresses the total problem of aircraft icing with strong emphasis on helicopter icing problems. CRREL has developed a numerical simulation of icing accretion rates in terms of the structure parameters and the atmospheric parameters of temperature, liquid water content and drop-size distribution. This allows evaluation of the sensitivity of accretion to each of these. CRREL is also initiating work on forecasting of icing at the mesoscale level with the intent of eventually providing the tactical commander with local forecasts of icing probability for combat display rather than "blanket" forecasts.

The Air Force has a small but significant aircraft icing program at the Air Force Geophysics Laboratory (AFGL). This program is specifically designed to improve the techniques for forcasting aircraft icing conditions. There are five phases of this research:

1) the evaluation of the Rosemount ice accretion detector for aircraft;

2) the 1979-81 collection of detailed data sets using an HC-130 aircraft flying in icing conditions within the vicinity of a rawindsonde balloon station;

3) the comparison of these icing data with the current Air Force Air Weather Service (AWS) icing forecasting techniques;

4) the development of improved techniques using standard available meteorological data as input; and

5) the development of a method for producing a worldwide climatology of aircraft icing based on standard archived data.

The Air Force AWS has the responsibility for operational aviation forecasting for both the Air Force and the Army. In a related effort to that within AFGL, the AWS is working to improve its ability to forecast the key meteorological input parameters for icing forecasts: en route temperature, cloud occurrence and cloud liquid water content. The ability of any icing forecast method is only as good as the basic meteorological input parameters. The improvements achieved in forecasting these basic parameters at the Air Force Global Weather Center will couple with the AFGL and the CRREL work to improve DOD capability for forecasting both fixed wing and helicopter icing conditions. The Air Force Aeronautical Systems Division (ASD) has developed a structural icing model (AEROICE) which is under evaluation and improvement and ASD testing of portable aircraft ground de-icing equipment is underway.

Research and development into aircraft in-cloud turbulence is most active within the Air Force. In conjunction with NASA, AFGL has been conducting tests with a ground-based Doppler radar and an instrumented NASA F-106B aircraft at Wallops Island, Virginia, to collect the data needed to develop on-board sensors for turbulence avoidance and to improve forecasting techniques. The AWS is currently evaluating the Air Force Flight Dynamics Laboratory (AFFDL) comparative analysis of turbulence impacts on various types of aircraft within similar meteorological conditions. Since the meteorological conditions which cause severe turbulence for a T-39 will have a different result on a C-5 or B-52, each as a function of in-flight gross weight, AWS is looking at using the AFFDL report to develop a standard to scale from and to more accurately report and forecast aircraft turbulence. The AFGL efforts also include a CO_2 Doppler LIDAR measurement program and a modeling effort to improve our wind shear observation and forecasting techniques.

The most significant DOD program related to observing and forecasting the major parameters related to aircraft safety (i.e., turbulence, lightning, wind shear, hail and icing) is the joint Department of Commerce/Department of Defense/Department of Transportation (DOC/DOD/DOT) Next Generation Weather Radar (NEXRAD) Doppler radar program. With many of the benefits and operational complexities of the Doppler weather radar already demonstrated in a joint operational test, the NEXRAD program offers an existing state-of-the-art advance over our current thunderstorm/tornado and associated severe weather phenomena forecasting immediately upon installation. The NEXRAD radars are required to replace the failing 1950's technology radars in service today. These new radars offer improved tornado detection lead times (from a current lead time of less than one minute to an average of 20 minutes), doubled detection rates for the severest storms, reduced false alarm rates for thunderstorm severe winds and hail (up to 50% reduction), improved low-level extreme wind shear identification and forecasting, improved icing level location, and improved hail forecasting. the AFGL, in conjunction with the joint NEXRAD program office and the NOAA National Severe Storms Laboratory (NSSL), is developing and testing the software to automatically identify and forecast these critical severe weather phenomena using the NEXRAD basic Doppler input data.

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In addition to the significant aircraft lightning strike research and testing being done at AFFDL, the Navy has an active program focused more toward the detection and location of lightning. The Naval Air Development Center is evaluating an on-board severe storm avoidance sensor for the P-3 anti-submarine warfare aircraft. This low-cost passive detector will be flight tested at the Naval Air Test Center this year in conjunction with the Wallops Island ground-based lightning detection and ranging

system. The P-3 aircraft, due to its number of flight hours flown and mission profile, is the most frequently lightning-struck aircraft in the Navy inventory. This system will allow passive navigation around lightning activity which is often important for an aircraft not desiring to emit radar signals. The joint NASA/AFGL icing test at Wallops Island is also designed to evaluate the airborne lightning hazards with respect to the measurable meteorological parameters. The Navy is now in engineering development of a Lightning Position and Tracking System (LPATS) developed by the Office of Naval Research with Naval Air Systems Command assistance. This ground-based system detects the unique broad-based magnetic field waveform of the cloud-to-ground lightning stroke and displays its location, intensity and movement on a video screen. The LPATS system is currently undergoing field tests at NAS Cecil Field, Florida, with the central station located in the Naval Oceanography Command Detachment office for operational evaluation.

Whatever the environmental aircraft flight safety hazard, the DOD is involved in evaluating and improving the observation and forecasting of the phenomena. In most cases, the DOD efforts are either joint or complementary efforts and are coordinated through the Office of the Federal Coordinator for Meteorology and Supporting Research.

You will note that I've skipped over the most basic of the meteorological inputs to aviation, that being the accurate observation and forecast of ceiling and visibility. Both the Air Force and the Army are working in improved visibility sensors with the Army using the laser approach and the Air Force using the forward-scatter/nephelometer approach; and both addressing different aspects of automation of these sensors for fixed base and remote combat deployment. As a participant in the Joint Automated Weather Observing Programs with NWS and FAA, DOD is most interested in pursuing the fully automated surface observation; however, before we all spend further research dollars on the automation of presently reported weather parameters, it may be the appropriate time for all of us to join together and re-evaluate the true requirements for aviation weather observations. The past-stated need for slant visual range (SVR) data might be an example where great sums of money could have been spent to produce unneeded data using hazardous towers or non-eye-safe lasers.

In summary, I wholeheartedly support the concept of this workshop and look forward to addressing further how DOD activities match up with the workshop recommendations. However, I offer two challenges: first, to attempt to prioritize the recommendations based on need, cost and achievability; second, to consider the re-evaluation of weather parameters really needed for safe landing operations to lead the way for the reliable and consistent automated observation capabilities.

Federal Aviation Administration Weather Program To Improve Aviation Safety

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The Federal Aviation Administration (FAA) issued the National Airspace System (NAS) Plan in December 1981 to provide for systematic developments that insure the safe and efficient movement of both civil and military aircraft. This plan was developed to meet the system capacity requirements resulting from the increased growth expected by 1993 of:

- 85% in domestic air carrier passenger miles
- 231% in commuter passenger miles
- 67% in the number of hours flown by general aviation
- 112% in the hours flown by rotary wing aircraft.

The implementation of the NAS Plan will improve vital safety services to aviation. These services include collision avoidance, improved landing systems and better weather data acquisition and dissemination. The Plan focuses on the current system and improvements that must be made in the immediate future to meet the projected needs and demands of aviation.

Efforts to improve aviation weather services initiated a few years ago are integrated into this plan. The program to improve the quality of weather information to pilots, controllers and flight service station specialists for safe and expeditious operation of aircraft encompasses the following major programs:

- Radar Remote Weather Display System (RRWDS)
- Flight Service Automation System (FSAS)
- Automatic Weather Observation System (AWOS)
- Center Weather Processor (CWP)/Center Weather Service Unit (CWSU)