

In-Flight Icing Technical Interchange Meeting (TIM)

25-26 February 2015 (Day Two)

UCAR Ocean Leadership Facility Conference Room

Meeting Attendees

(Roster to be provided by NCAR via ftp website)

Agenda

See attachment – Informational Package

Overview – Marcia Politovich

Day Two will bring more emphasis on the user specific needs this morning. After lunch we will hear topics concerning terminal area icing products and services (P&S) not being robust enough for pilots to make sound divert or alternate airport landing decisions. TAIWIN is one research area program to help improve those P&S for pilots through providing real-time better icing information, particularly for SLD icing available in terminal area. This presentation will be followed by a panel discussion session to conclude the conference.

International Icing Products and Concerns Session

UK MET Office – Cyril Morcrette (remotely)

There were hardware difficulties with the Conference communication phone link calling overseas and this event was beyond anyone's control. Unfortunately, after extensive efforts Cyril could hear the conference room but the conference room attendees could not hear him, the speaker, and therefore, the two-way communication problem was never resolved. Therefore, the conference informed Cyril of the situation and the presentation was emailed to NCAR and placed on their website for viewing. The conference moved forward to the next presentation to stay on schedule.

ADWICE Icing Tool – Frank Kalinka (Germany National Meteorological Service (DWD))

This is a German In-Flight Ice Warning System (ADWICE). This brief was divided into 2 parts: (1) now and (2) forecast. The ADWICE domain covers the European continent. The ADWICE Prognostic Icing Algorithm PIA flow chart shows how pressure, temperature, relative humidity (RH) and the top and bottom of convective clouds of the NWP model COSMO-EU were utilized to determine icing scenarios and icing intensity in an hourly forecast product out to 24hrs then every 6-hrs out to 78hrs. For the Diagnosis product, the Prognostic Icing Product (PIP) is used as a first guess. Observational data (2D) that included synoptic, METAR, RADAR, and Satellite data used fuzzy logic to confirm or reject the PIP and then determine whether there could be a scenario for ice or not to create a Diagnosis Icing Product (DIP). If so, then the same logic for PIP was followed for dividing an icing intensity level. ADWICE was compared to PIREPS for a 3-month period in the Fall 2013. In this comparison, the icing intensity levels were only icing or no icing choices. One shortfall cited was the relatively few PIREPS available over Europe for comparison, especially missing were reports for no icing reports.

ADWICE user products are in operational use at the aviation advisory centers in a visualization tool “NinJo” (Germany & Switzerland) with 33 levels up to 30,000 feet. There is a self-briefing tool System “pc-met” for GA (license required) and requires a log-in user name and password to access this URL: <https://www.flugwetter.de>

Future challenges include ice forecast for specific ice accretion on aircraft types by combining new remotely sensed-data and observations with icing diagnosis product to improve LWC, and directly use this LWC for ice forecast instead of using temperature and RH thresholds. This research is constantly searching for user need balance.

Other ADWICE user products include EUROCONTROL: Clearflight-tool (UKMO) which also requires a log-in user name and password for the URL <http://www.metoffice.gov.uk/premium/aviationservices> and the decision support for Networkmanager requires an account. Future goals look for operational global setup of ADWICE (icing forecast) with ICON model data by COB 2015 at ¼ of degree grid resolution with even higher resolution in 2016. Verification is needed for the missing PIREPS but NCAR should be able to provide such. The diagnosis product (DIP) will follow the forecast output.

Currently, a joint research effort is ongoing over the US with a **(T-)AMDAR study**. Additional observations are being added to the grid using US company (PANASONICS Tropospheric) Atmospheric Meteorological Data Reporting system with T/AMDAR data as initial input data for COSMO-EU over U.S. (e.g. 50665 additional measurements on 10th of June 2013). More dense information has resulted in a reduction of forecast error of humidity in the boundary layer. Can this methodology influence results for forecasting aircraft icing by using AMDAR/TAMDAR data in NWP?

Current SESAR project work package (DWD, UK Met Office and Meteo France) has a focus goal to develop consolidated harmonized forecast products over Europe to increase efficiency of processes related to Air Traffic Management (ATM).

FAA International Activities – Steve Albersheim (FAA)

This is an overview of the overall meteorological services from the International Civilian Aviation Organization (ICAO) in Montreal, CA in July 2014. Three principal organizations (IATA, IFALPA, and WMO) are discussed here that played a key role where meteorological (MET) services were needed as part of the Global Air Navigation Plan (GANP). MET services follow the Air Traffic Management (ATM) requirements in accordance with the GANP. The Air Navigation Commission has directed ICAO to develop a roadmap for MET Services. There are ½ dozen ongoing Roadmaps and ConOps drafts across various weather phenomena disciplines from Space Weather to Volcanic Ash (VA) that were considered by ICAO for adoption that would lead to requirements being implemented in the near-future. But only the VA was adopted and the others for now are considered drafts as recommendations will need to be matured first before adoption at the next tri-annual meeting. This is an incremental step toward the future global ATM global services and Trajectory Based Operations (TBO).

ICAO has been going through an organizational restructuring the last 2-years. The MET Section has been dissolved – 3 people were reassigned. A MET panel was established to give direction to 4 expert teams reviewing the proposals for developing products and services support for the remaining draft RoadMaps and ConOps’. There is an April 2015 meeting to formulate the “Terms of Reference.”

There will be 4-levels of progressively more involved capability detailing greater atmospheric weather integration from a base level output (do it all in my head – third world countries) to generating graphical hierarchy solutions. ICAO recognizes that States are responsible for determining what fits their operational needs.

The World-Area Forecast System (WAFS) will become a global Air Traffic Management (ATM) and Trajectory Based Operations (TBO) database. Vendors are starting to learn how to take gridded data to develop constraint models in support of flight planning. The current WAFS SIGWX products are not sufficient to meet the needs of performance-based operations. In 2013, ICAO made WAFS 1st generation output from global gridded MET hazard forecasts which has become operational for icing, turbulence, convective clouds and was added to existing wind, temperature and humidity data sets. The next step is to introduce probability and ensemble forecasts and integrate gridded data into decision support systems for global ATM and TBO.

Future goals include developing roadmaps covering the next 15-year period that's aligned with the ICAO Aviation System Block Upgrades (ASBUs) as adopted by the 12th Air Navigation Conference (ANC). In parallel, a science plan will be developed for each global MET hazard that includes Icing. MET will become an enabler using globally harmonized information for future flight and ATM operations as WAFS becomes the ATM and TBO database.

NCEP International Activities – Matt Strahan

This presentation addresses what happens to icing products released on global GFS grid (World Area Forecast System Icing Grid). WAFS gridded icing forecast capability began in 2008. There are two world-wide centers (London, Washington, DC) where harmonization of information insures one global source for mean (will under-forecast icing conditions) and maximum (will over-forecast) resolution grids forecasts used to produce the respective WAFS forecast. These forecasts were approved by ICAO in 2013. This is the "State of ART" used by the rest of the world for airplane fuel loading. The uses of WAFS icing are used for strategic planning and unsanctioned tactical avoidance such as helping re-route aircraft in the most efficient direction path out of icing condition areas – reducing flight time spent in icing.

The goal is to establish a global operational product for icing severity in 2018 and probability forecast that exceed severity thresholds vice outputs of super-cooled liquid water (SLW) level content. This would be followed by calibrated probabilistic icing forecasts by 2023 based upon moderate or greater icing or global ensemble forecasts.

Currently, the SLW levels for UK and US displays are depicted differently for non-ensemble modeling. The ensemble outputs provide a more reliable and stable forecast using one forecast database system for contributing inputs into a calibrated system where multiple quality control methods through QA verification are maintained by both WAFCs and are aligned with model updates. These updates include climatological and frequency historic curves for icing.

BREAK

Specific User Concerns Session

A Pilot's Viewpoint – Steve Green (Flight Operations Research)

This briefing is on the tools utilized for operational management of in-flight icing in the 21st century based upon the 1996 AIAA Paper. No other weather phenomena affects aircraft performance as rapidly as icing with two exceptions: VA and microbursts or windshear. In addition, an icing phenomenon also rapidly degrades an aircraft's control.

Methods of predictive detection must be developed and implemented so that both ground-based and on-board detection can be used to validate the forecast and plan an operational response to the conditions before they are encountered.

Better spatial, temporal and parametric resolutions in the terminal and en-route arenas make for improved information to ATM and pilots for operating within thunderstorm activity areas but not necessarily for icing conditions. Pilots face inconsistencies in forecast along with unreliable PIREPs, and their own inexperience of handling such correctly when flying within icing conditions. Pilots can see the danger in thunderstorms easily but often do not realize how close they are to serious and hazardous icing conditions operating near or over the top of convective clouds in VFR conditions. Often the clear air ambient parcels are prone to rapid wing ice formations when an airfoil flies through that clear air column. This is a challenging issue.

Weather Text Outlooks are often rather general and vague for in-flight planning preparations. More detailed weather products such as early morning Skew-T Diagram/Plot are difficult for pilots to recognize icing potential conditions unless they are meteorological geeks. In addition, Skew-T launches are only performed every 12-hours. Therefore, pilots do not often see later plots when flying. Radiosonde launches are too infrequent and are scattered too far apart.

Most pilots are looking at weather tools and history information, so any updates to FZDZ conditions that can be alluded to from other en-route or intermediate station information will be missed by pilots not being thorough in their efforts to keep fully abreast of the current flying conditions. Unless the pilot is fortunate to have an experienced and diligent dispatcher to pass them this updated information thru ACARS then this potentially critical information is not kept updated during the flight progress. Freezing temperatures are never referenced in METARS or in TAFS.

There are several inconsistencies for aviation information that need to be resolved to help pilots of less MET experience to better understand and determine the correct atmospheric conditions of which they are planning to fly through en-route to their destination. There was a set of 5 "WHY" questions put forth extending from an internal flight scenario described within this presentation where the pilot and ground support experience can determine the detail and correctness of information provided, what are the algorithm deficiencies, and the disconnect or discord between weather forecasts and advisories.

An Airline Perspective – Rick Curtis (A4A Met Committee)

A view from a commercial perspective was briefed on effects of en-route icing. The way icing conditions are dealt with can greatly vary among carriers due to equipment type, route structure, etc. Typically wing/engine anti-ice systems mitigate the effects of icing during the vast majority of icing events. Big planes with anti-icing equipment look at this as a weight and fuel penalty issue (costs). Normally anti-icing equipment will resolve most ice conditions. But there are several situations where icing can become an issue if the accretion has accumulated beyond a certain amount on an airfoil surface before the anti-icing equipment is turned on, or icing is occurring upon a non-protected area of the plane, or its accumulating rate is too rapid. Dispatchers will always try and minimize a planned route in potential icing conditions by using an alternate route and/or optimal altitudes.

It is imperative that pilots and dispatchers are diligent to the potential icing atmospheric situation. Airlines are very cautious in pre-flight planning to ensure any potential or known severe icing condition areas are completely avoided. Even in light icing conditions dispatchers and pilots will not consider take-offs without knowing that all the anti-icing equipment is fully operational. Normally, GA pilots will not take-off if anti-icing equipment needs to be turned on prior to proceeding to the departure runway. The pilot is the final authority for the safety of the aircraft. Conditions that develop during approach maneuvers for landing will be worked out between dispatcher and pilot to ensure the aircraft performance to wheels down is maintained for safe completion of the flight. Policy rules are paramount.

Pilots face other sidebar icing condition challenges to include cold-soaked aircraft wings (cold fuel in wing from just landing after a high altitude flight) or having been re-fuelled with very cold fuel. On the ground with this situation wing icing or frost can form with liquid precipitation hitting the cold wing surface even if the ambient air temperatures outside are well-above freezing as long as the wing surface remains at 0C degrees.

Other weather phenomena are important to be identified for High Icing Water Content (HIWC) incidences. One such phenomena was shown from satellite imagery as a Mesoscale Convective System (MCS) or Complex (MCC). The MCS is an area of intense and organized convective activity that has severe icing potential to avoid no matter the type of commercial or GA aircraft. With HIWC, and especially in these scenarios in the tropics dealing with high-altitude moisture from convective activity, the risk of icing is too great and all aircraft should do their best to avoid these areas by 50nm. But avoidance could introduce another issue where rerouting could become a fuel problem. These potential scenarios need to be worried about if possible during pre-flight planning. Dispatchers need to monitor the overall aircraft situation should any convective pop-up cells occur after takeoff which requires the pilot to deviate from their planned route significantly.

Comment: Rick Heuwinkel had thoughts on ground icing conditions regarding Holdover Times (HOT). It appears HOT are as good as they can be for now but we need to put our heads together and come up with an approach and plan to strive forward while making incremental changes along-the-way. This approach is more viable than waiting for a holistic change well down-the-road.

The pilot needs to exercise common sense and stay abreast of the weather conditions at all times, and not rely too much on others (dispatchers) before takeoff, en-route, and during approach for landing.

It was noted that 105 Southwest Airline planes are now fitted with weather measuring probes for temperature, RH and wind. In April, these probes will start measuring and linking their observation information over AMDAR. The information will go to NCAR for free and NCAR will process the data that should help improve diagnosis and forecast products and services.

Air Traffic Control/Traffic Management – Matt Tucker (FAA)

This presentation provides an Air Traffic Controller's perspective from one of the world's busiest airports (Atlanta) dealing with system operations and user needs. Terminal staffing is usually a major challenge. Controllers deal with potential severe weather phenomena conditions. Controllers need to be fully aware and coherent of the weather situation before coming on-duty due to the extreme stress and over workload facing them once they start their shift. Severe conditions constitute a mandate to not fly there. The Controller distributes this information industry wide to the pilots when weather phenomena reaches severe limits; all else is left up to the dispatcher and others to update pilots, whether that occurs during pre-flight planning (if they remember to do so) or during en-route.

Reliable PIREPS are valuable pieces of information. There needs to be a change of how incoming PIREPS are handled. PIREPS usually travel through a multitude of hands before they could be passed up to

pilots. The PIREP is handed from the Controller to the Supervisor who then walks it down to a MET Coordinator if he is not too busy. It is up to the MET Coordinator to get it to the Dispatcher for information that could be used for reroutes, altitudes changes etc. On busy days when such weather phenomena is more likely it is often the case of one or more of those human links failing and the PIREP information gets delayed or falls through the operational cracks and is never delivered. That means due to ongoing and often stressful workload a critical PIREP piece of data for light icing or greater may get delayed or forgotten about and never reaches its beneficial end point to other pilots and dispatchers.

Automation would be a big deal to help out Traffic Flow Management (TFM). Situational Awareness of where icing levels exist are important for holding patterns/delaying aircraft. Now, having said that, it was noted that the situation has never been seen across the US National Airspace Space (NAS) where there has been too much information provided for Icing Conditions.

ICAO issues special AIRMETS for moderate or greater (MOG) icing conditions which is mandated into the system but this is not the case across the NAS. The US is not in compliance. This issue is wrapped around the policy procedural axial of which some concerns deal with auto-pilot settings/functionality.

Icing Weather Training – Scott Dennstaedt (Aviation Weather Workshops)

Foreflight is an intelligent application for pilots founded in 2007. Foreflight's purpose is to afford pilots in the cockpit to receive pertinent weather information more quickly via their iPad or iPhone which requires an annual subscription but no certification. That means a pilot is free to manipulate the information for their specific needs but it is recommended to stick within the governing policies. With today's technology, more and more pilots are getting their weather information and charts with their intended route overlaid in this manner.

There are a lot of pilots using a lot of applications out there on the market. Foreflight is striving to fill the informational gap of what is missing: AIRMETS/SIGMETs/METARs/TAFs for pre-flight and inflight briefings. Future applications need to consider electronic filing of the pilot's flight plan, get expected routing, alerts of weather or routing updates. There is a subscription cost involved with using Foreflight in the cockpit but then that allows for more available weather information to reach the pilot. CIP/FIP products are not included in Foreflight but are available via ADS-B and XM radio. There is no connectivity to the internet for weather in the cockpit (WTIC) – maybe within next 10-years.

Radar data, PIREPs, precipitation type reports and icing PIREPs all provide a snapshot or static image of the atmospheric conditions per time and space. CIP/FIP, PIREPs and G-AIRMETS provide information on freezing levels, especially critical while pilots are in-flight. XM radio provides pilots CIP/FIP displays but not much else. Pilot decisions are too often based upon disjointed guidance – an Easter Egg Hunt per se. In addition, there is often too much information overload from TAFs, METARs, AIRMETS, SIGMETs, PIREPs, area forecast, satellite and radar data, ice analysis, and ice forecasts. Moreover, this information is placed in hi-resolution temporal and spatial altitude displays for icing forecasts, and information on actual cloud tops and icing layers in a diagnosis and forecast product. NOWcast updates are working while en route (via ADS-B), they are updated at least every 15 minutes with a focused on the corridor/route specific information

Pilots must encapsulate all of this data and integrated such into their particular scenario. This requires the pilot to fully understand each of these products and their respective limitations. One example is TAFs, only used for that station around its report and not necessarily useful at some point en -route to another location. There is a real need for more en-route-based applications written in JAVA. This en-route missing information could truly benefit the cockpit pilot with specific pieces of weather vice the pilot calling into an already busy tower.

Foreflight is an application that currently does not have the Collaborative Convective Forecast Product (CCFP) available. But Foreflight application is easier to use because you can ingest their grib data on their grids without having to standardize the numerical information.

Foreflight is working toward getting weather briefings to the pilots via their iPad/iPhone in all types of environments, which should grow substantially, especially when cockpit internet connectivity grows, and less pilots are using flight services or ADDS as their primary service of preflight weather. Foreflight also affords the pilots to file or cancel their flight plans through these types of applications. Foreflight is striving to achieve quicker access for aviation information to the pilot with easier user friendly screens clicks to see upfront their specific weather data without drilling down through unnecessary features.

The challenges are to get the users to really understand and accurately interpret the weather information. There are several airlines already using the Foreflight application.

LUNCH

Terminal Area Icing Weather Information for NextGen (TAIWIN) – Stephanie Divito (FAA)

TAIWIN focuses on both ground icing and icing aloft around the terminal sphere. There is a new Part 25 rule (November 4th 2014) addressing super-cooled large drop (SLD), mixed phase, and ice crystal icing conditions. TAIWIN only addresses SLD environments for FZDZ and FZRA based upon the diameter of water droplets. Appendix O deals with larger droplets. Based upon certification there will be a proposed change placed in the Limitations Section of the Aircraft Flight Manual (AFM) to limit aviation operations in SLD. Similar statement would be made in an Advisory Circular:

- (a)(1) “Intentional flight, including takeoff and landing, into freezing drizzle or freezing rain conditions is prohibited.
- (a)(2) “Intentional flight, including takeoff and landing, into freezing rain conditions is prohibited.

The new Federal Aviation Regulation (FAR) § 25.1420 only affects aircraft of the new type design with a maximum takeoff weight less than 60,000 pounds or with reversible flight controls. FAR 25.1420 requires that the affected airplanes be capable of one of the following:

- §25.1420 (a) (1): Detect SLD conditions as defined in Appendix O and operate safely while exiting all icing conditions, or
- §25.1420 (a) (2): Operate safely in a selected portion of SLD conditions as defined in Appendix O, detect when the airplane is operating in conditions that exceed the selected portion, and then operate safely while exiting all icing conditions, or
- §25.1420 (a) (3): Operate safely in all the SLD conditions as defined in Appendix O.

No aircraft have applied for certification under this new rule yet. Not many airplanes will be affected in the near-future, only includes some new design regional jets and smaller turboprops. Aircraft designs which are currently certified or have begun the icing certification process for Appendix C will not be subject to the new rule - "*Grandfathered*" aircraft. It was noted that these rules do not currently apply to GA aircraft that mainly fall under Part 23 and are under 12,500 lbs. There is a proposed Part 23 SLD rule under review in the FAA Small Airplane Directorate. But the proposed rule §23.1420 dealing with Super-cooled Large Drop (SLD) conditions has not been published in the Federal Register.

Pilots need to figure out with this new rule what they have to do as the current information available to pilots is currently not deemed robust enough to make sound decisions for diverting to an alternate airport. The primary purpose of TAIWIN is to help improve the information on icing, particularly SLD icing, available in terminal area. TAIWIN has 3 primary goals. Currently, a normal terminal sphere is considered to be 5nm in radius and 4,000 feet aloft: (1) Real-time representative rate measurement of all ground-level precipitation types and accurate identification of precipitation type, (2) highly resolved, timely diagnoses and forecasts for terminal area freezing precipitation that provide local-area information, and (3) highly resolved, timely icing conditions aloft in the terminal area that quantify cloud properties in four-dimensions (4-D) to support aircraft trajectories.

For the TRACON area, the radius of responsibility usually extends out to 40nm. Terminal radar range is about 55-60nm with the top of the Terminal Airspace normally around 10-15Kft. Approach standards need to be figured out with what we have and where these standards need to go in order to account for and identify gaps in the maturing TAIWIN system that has 4 planned stages: (1) current improvements and enhancements to both ground and aloft observations that, (2) distinguish between Appendix C and O icing measurements, (3) new technology methods to distinguishing between the icing conditions defined in Appendix C and the subsets of Appendix O (FZDZ versus FZRA aloft), (4) more efficient delivery of information in both spatial and temporal resolution that allows arrival and departure routings within the terminal area to be tailored with respect to the icing conditions.

There is a need for user feedback. This will help the research community to better educate the user and increase their understanding of the information for better preflight planning and safer en-route flights.

The TAIWIN ConOps document is in final review. But TAIWIN is more complicated than first envisioned. There are many more attributes involved effecting terminal operations. It was noted that AWOS is expected to be replaced by AWOS-C.

**Panel Discussions on Forecasting – moderator Steve Abelman (FAA)
Roger Sultan, Marcia Politovich, Matt Strahan, Steve Abelman, Rick Curtis**

HOT ISSUES

Recap of today showed the presentations provided different perspectives and specific user needs. There was emphasis presented for needed aviation weather information ranging from third world technology to iPad or iPhones, and GARMINs for 121 international carriers or GA aircraft flying outside of US domestic airspace. Rick Curtis (A4A MET Committee) talked about the 121 carriers wing icing frost affect from cold fuel earlier despite relatively warm wing skin and ambient air temperatures.

Steve Green walked through aviation scenarios that pilots face, especially from outside sources. We have not changed much through the recent years though pilots have become more weather aware and savvy.

Matt Tucker provided a pertinent perspective of the challenges ATC face in daily operations. There is a need to focus more on the icing weather training aspect with pilots and bring real-time pertinent icing aviation weather information into the cockpit (WTIC).

There's a new Part 25 rule applying to new aircraft design in SLD conditions which TAIWIN is addressing through incremental steps to see what we have as we proceed along with capability improvements.

Strategic vs Tactical

There is a real desire to use CIP/FIP for strategic planning purposes, and use it tactically to reroute aircraft out of icing conditions. Advisory Circular AC 00-63A defines strategic maneuvering during approach for landing as greater than 20 minutes with strategic/limited tactical between 3 and 20 minutes in time and tactical less than 3 minutes. There's a need to look at planned approach flight operations in icing conditions because the current on-board radar technology doesn't help with avoiding icing conditions. What you do not want to happen is to get within 10nm of what you think is an icing potential region when in fact you are not sure where that edge is to start with. Some consider this effort needs to start at the largest core29 airports, and with proven procedures applying to the remaining airports.

John Hazlet (RACCA) wondered how to handle situations when they happen in-between weather updates to the pilot. Roger Sultan's thinking is that there will always be "in-between times" but with available weather improving to the cockpit, those times are being greatly reduced.

The goal is to keep as much available weather information as possible going to the cockpit with an option to the pilot to obtain additional specific weather products from XM (at a cost) and/or FIS-B for aircraft equipped with ADS-B (not normal, especially for GA type aircraft).

It was pointed out that you need two things to safely maneuver around thunderstorms – pilot's visual acuity and a radar image picture (often delayed not real-time) to feed the auto guidance system if one is onboard and running fine, otherwise, pilot experience becomes paramount. The problem lies in the fact that many pilots do not know how to use all their onboard equipment effectively to help them keep aircraft control and maneuver most efficiently when they find themselves encountering icing conditions.

Roger Sultan stated, FAA has existing policy that permits Commercial airline pilots to use cockpit technology to display the whole weather picture along their route of flight with the detection of the weather activity ongoing around them using onboard radar. Another participant mentioned that some GA pilots with smaller aircraft can have a lightning strike-finder or storm scope device onboard in place of an onboard radar. Roger would much prefer having weather radar.

Despite the number of GA accidents having slightly decreased over recent years, it leaves some to wonder with advancing technologies why these numbers have not continued to drop more substantially.

Various Topics

For Part 91, commercial icing devices are being oversold and labelled as Rapid Refresh and Hi-Resolution. These devices have a False Probability of Detection (FPOD) rate of 25% lending a false sense

of hope or security to less experienced weather pilots. It was noted that weather experts do not sell or express uncertainty through these devices.

Bruce Carmichael (NCAR) asked Don Eick (NTSB) whether the NTSB keeps records of documented accidents of aircraft that have cockpit displays. Don tries to see or look at CIP/FIP products as a baseline. Don claims that NCDC has a bad archive library for such. Usually NCAR provides CIP/FIP products to the NTSB. The NTSB does not specifically track nor do they have the ability to verify these accidents in this manner. NTSB searches for radar information from the Black Box tape for post-crash recovery information. NTSB stated a human life is estimated at \$4.5M value. Steve Green (Flight Operations Research) stated that the aviation community may not be as good as we think we are.

Bob Showalter (CSSI) asked Marcia Politovich what process does NCAR have in place to validate observations. Marcia replied with there is a lack of accurate/reliable observations, and there is room in the aviation industry to develop a much better verification process.

John Hazlet (RACCA) stated that often times a pilot experiences an overload of weather information. Roger Sultan (FAA AFS) stated there is a lengthy 52-page statement within the Aeronautical Information Manual (AIM) that describes aviation weather support. Standards are documented within the cockpit (ICONS of display). NTSB noted this pilot information overload may be a trigger for the accidents occurring during the approach to landing. Scott Dennstaedt stated that pilot understanding of the information is often lacking. There is refresher training and every 2-years pilots can voluntarily participate in a training review. But the thinking is not to stipulate any type of mandatory retraining. AOPA training is plug-n'-play. Scott Dennstaedt stated TAMDAR/ACARS data off the aircraft are not available to the general public. Scott teaches pilots how to interpret the pertinent but MET geeky Skew-T Diagram.

For wind and temperature measurements existing sensors are used at no cost but someone has to pay for communications to get the data linked down (perhaps through Iridium). The NOAA NWS pays about ½ cost to help defray overall cost through their contract with ARINC who actually makes the payment.

There is an effort at Panasonic to try to get weather related data downlinked from a pilots within the NAS that will not cost them communication link fees, a way to defray downlink costs that would encourage more non-commercial flight pilots to provide more PIREPs. There is yet another challenge out there to enable weather products to be uplinked more readily to the cockpit without expensive data link costs. Currently, this is difficult to accomplish due to the need for use of huge computer files to produce integrated weather products.

Rick Curtis (A4A MET Committee) asked if temperature, wind and RH are available can it be used for describing Ice Conditions? Marcia Politovich (NCAR) said, it could be used for describing "no Icing" but not the other way around.

It is well-known that there is a lot of proprietary information the airlines guard closely. A political and judicial vulnerability exists with all airlines where useful information is held tightly in fear of and to avoid law-suits.

Randy Bass (FAA) stated we know certain general limits to accurately forecast with uncertainty outputs. We know that common sense rules so that the percentage of pilots who fly through a 30db reflectivity convective cell is “zero.” Scott Dennstaedt (Pilot Trainer) indicated that there is training module to simulate the common reflectivity radar picture. Rick Curtis (SWA) used the Airport Facilities Directory (AFD) Aviation Section as an example to make his point about how different users make different decisions based on how confident they are with the forecast – more confidence means less questions coming back to the forecaster. Rick pointed to the aviation exercises conducted in the Golden Triangle across the northeast USA. He thinks that approach could work.

Summary of Actions

1. This aviation community needs to relay or exchange timely information to one another more often and through the AWC and NCAR when icing products lead to good decision(s) to boost good news stories and advocacy vice only voicing bad news.
2. Survey work needs to be taken seriously and participation to complete surveys is paramount.

End of Day Two and TIM Icing Conference