Notes from FPAW Meeting

2 – 3 August 2016

NextGen weather systems implementation

- Alfred Moosakhanian, FAA AJM-333
    - CSS-Wx (dissemination; Harris) & NWP (product generation; Raytheon) will yield improved safety & efficiency at reduced cost to FAA
        - check out websites
        - includes information about wind, convection, icing, turbulence, etc.
        - future capabilities may include forecast confidence, weather along 4D trajectories, etc.
    - FAA PMO Nextgen user forum at ATCA in October

Weather-related NAS delays in context of overall performance

<u>Part I: Weather-related NAS delays in last decade</u>

- Le Jiang, IMSG
    - over 60% of delays related to weather
    - focus on avoidable delays
    - need to normalize by demand & weather (& maybe other factors) to extract changes due to improvements
- Frank Brody, NWS
    - National Aviation Meteorologist (NAM) perspective
    - two interesting thunderstorm impact cases: 29 April 2016 DFW & 1 July 2016 NE
        - meteorological information supported proactive TMI
        - challenge of how to systematically quantify benefits of integrated weather decision support
        - 6 C's: coordination, collaboration, consistency, customization, confidence, & consulting
    - comment by Jim Evans that numbers are needed for capacity & associated uncertainty for planning smartly
    - may need to look at domestic versus international diversions (i.e., lead time of weather based on distance flown)
    - critical review to learn
- Randy Bass, FAA
    - drivers influencing weather-related NAS metrics
    - weather observations & forecast, translation to impact, communication, interpretation, decision, etc.

    - spatial scales, timeliness, human factors, etc.
    - metrics – lots of weather metrics
    - actors – many varied stakeholders
    - factors not related to weather
- John Kosak, NBAA
    - what works & what doesn't work well from operators' perspective
    - capacity versus volume
    - weather complicates things
    - delays – good versus convenient; compounding factors; taking delays on ground or en route
    - communication – hotlines, SWAP, dashboards
    - weather sources – too many choices, no single authoritative source; FAA will provide key information via CSS-Wx & NWP
    - staffing issues
- discussion
    - label of "weather" versus other factors is notably uncertain, also many times really multiple factors play into delays
    - tools can be used effectively or not, pointing at need for better training, etc.

<u>Part II: Assessing weather impacts & operational performance</u>

- Mike Robinson, Avmet Applications
    - OPSNET & BTS delays show different signals/trends
        - number flights affected versus minutes of delays
    - normalization for
        - weather & operational aspects (NAS infrastructure, demand & procedures evolving)
        - system, centers, airports, airlines, passengers, etc.
        - ground (gate, tarmac) & airborne (reroute, holding) delays, diversions, cancellations, effective use of available capacity
- John Gulding, FAA
    - performance analysis in Air Traffic Organization (ATO)
        - constraints of system – ATM delay, taxi delay
        - most effective use of capacity – capacity, throughput
        - efficient flight trajectory for operators – additional distance flown, level flight
        - airline schedules & flight preferences – on time performance (15 min trigger), changes in block time
        - special activity airspace – blocking out of otherwise available airspace
    - metric inter-dependencies
    - data sources
        - primarily METAR
    - weather elements
        - critical thresholds for wind (mostly compression related rather than runway, but configuration matters), etc.

- capacity efficiency
    - filed times, best achieved trajectory, great circle, or wind optimal
    - benchmark arrival time, actual arrival time
- similarity of days
- weather beyond METAR
    - for terminal & en route
    - forecast weather (but don't know which forecast was actually used by decision maker)
- discussion
    - similar challenges in other industries (trucking, railroad, etc.)
    - geospatial complexity/diversity factor
    - runway configuration

<u>PART III: What metrics are important</u>

- Bryce Ford, SpectraSensors
    - striving for consistent set of metrics to quantify aviation weather benefits to NAS
    - use metrics, but don't let metrics drive us
        - stakeholders gaming metric system
- discussion
    - know question one tries to answer
    - understand reaction to similar events
        - consistency of decision making
        - predictability of situation, weather, traffic, human factors, etc.
    - how does good day look like – depends on stakeholder
    - how about decision making under perfect versus bad forecasts, known or unknown quality
        - automation versus human trust
        - make better use of weather information we have at hand
        - decision making under uncertainty
    - distinguish weather from weather support
    - differences between commercial, business & general aviation
    - balance lead time with accuracy
        - lead time for TMIs relative to required reaction time
        - compare to unnecessarily constraining airspace
        - proactive versus reactive actions
    - human factors surfaces in various ways
    - comparison to finance world
        - lots of data
    - airline schedule integrity
        - competing goals at various levels
    - what constitutes bad delay
    - how close to "best" solution was day executed?
        - best solution to whom?
        - good to have options & know about them sooner

    - comparison to poker game [in my mind]
        - how to make best use of cards dealt with
        - understanding likelihood of success with envisioned strategy
        - understanding behavior of other players

Weather safety & use of weather information

- Don Eik, NTSB
    - 2015 weather-related accidents statistics
        - accident rate flat compared to previous years
        - mostly GA
        - **turbulence** (lots of cases), wind shear, contaminated surfaces (snow & ice) were major reasons for commercial accidents
        - loss of control (adverse winds, spatial disorientation, thunderstorms, inflight icing), engine problems (carburetor icing), controlled flight into terrain (C&V)
    - recommendations
        - consistency between non-aviation & aviation products
        - PIREP initiative, needing turbulence & icing conditions
        - CIT occasionally reported as CAT
- Rune Duke, AOPA
    - AOPA Nall report
        - VFR into IMC results in most fatalities
    - education efforts
        - AOPA safety institute
        - data latency (NEXRAD & FIS-B)
        - weather along route tool
    - modernizing flight services
        - increasingly online
    - weather advocacy
- John Kosak, NBAA
    - safety for business aviation
        - standing committees on weather, safety, schedulers & dispatchers, flight attendants
        - runway excursion significant fraction of accidents, other reasons include loss of control inflight
    - education & outreach
    - air traffic services
- Gordon Rother, FAA Flight Standards AFS-430
    - updated Aviation Weather advisory circular (AC 00-06)
    - updated AC 00-30 on clear air turbulence
    - updated AC 00-24 on thunderstorms
    - updated AC 00-45 on aviation weather services (to be released)
    - updated AC 00-63 on digital weather in cockpit (to be released)
    - FIS-B including new products

        - lightning, turbulence, icing, cloud tops, one-minute AWOS
        - challenge is bandwidth
- discussion
    - ASOS & AWOS located at airport or bottom of valleys, not representing elevated conditions
        - webcams can be highly beneficial, especially in complex terrain
    - runway conditions
        - new TALPA guidance to go into effect
        - PIREPs are important
    - limited ability to communicate available weather information
        - contrast that with too many sources of information & information overload
        - need to distinguish *data* from *information*, eliminate operationally irrelevant products, etc.
        - separate preflight from inflight use of weather products, shared situational awareness between dispatcher or controller & pilot
        - standardization issue regarding rendering of information content
        - integration of weather into decision making process
        - accidents often associated with inadequate weather briefings
        - human limitations to comprehend weather information & associated uncertainty, limited training, lots of information can provide false sense of safety
    - thoughts on weather safety & use of weather information for unmanned aerial system operation
        - FAA regulation just released, providing limited weather guidance (i.e., visual line of sight)
        - huge challenge since operations are mostly off-airport, no pilot in cockpit, etc.
        - discussion of use of RTMA, HEMS, flight path tools, etc.
        - defense agencies have developed relevant capabilities
    - theme of time
        - need to get better about understanding timelines
        - devil is in detail (e.g., data latency, understanding limitations of products)
    - PIREPs
        - ATC only hears chat on radio, automation may not provide same situational awareness
    - evolving technology
        - use case studies to understand what information different systems provide => have “volunteer” for next summer FPAW session
    - sharing of data & information
        - competition prevents sharing of atmospheric data
        - safety first requires sharing of hazardous conditions

Weather events that impact air traffic operations

- Jim Enders & Kevin Johnston, FAA
    - NAS management moving toward *PERTI*: "Plan (strategically) – Execute (tactically) – Review (operationally) – Train (specifically) – Improve (continuously)"
        - understanding probability of weather forecast
        - ability to rapidly adapt to changing conditions
        - creating *knowledge* based on harvesting human experience & data analytics; understanding irregularities in operations
        - smart use of PERTI knowledge to manage NAS effectively using available capacity
        - improve processes, people & technology
        - involve Air Traffic Services (AJT), Technical Operations (AJW), & Safety & Technical Training (AJI)
    - contrasting example days with "similar weather"
        - complexity of decision making
        - system predictability
        - if weather doesn't follow forecast system becomes reactive & suboptimal
        - decreased efficiency yields increased workload
        - weather guidance evolving: CCFP (changed from human collaboration to automated generation), CoSPA, CAWS (providing more details beyond CCFP), extended convective weather forecast, etc. – coverage & organization of convective storms matters a lot for operational decision making
        - NAS Aero tool providing quick look at days performance (focus on taxi times & diversions)
        - analysis tool provides *actual* weather while planning for next hours or day is based on *forecast* weather; need to search in forecast space for "similar days"
- discussion
    - probabilistic prediction & interpretation challenges
        - understanding predictability of situation, ensemble forecasts may provide range of possible outcomes
        - understanding decision making under uncertainty, including human factors (who is working on particular day), again ensembles of potential actions may envelope meaningful decision space, possibly cluster into relevant scenarios (e.g., AFP day, no AFP day, unclear day)
        - understanding implications of decisions or lack thereof
    - looking ahead more than one day to start planning process
        - refine as more information becomes available

        - exploring how far out may still add value, multi-day outlook definitely valuable for large storms (e.g., hurricanes, winter storms)
        - comparing to similar days in past to understand range of possible outcomes, guidance for effective use of TMIs
        - no perfect weather product available, need meteorologist in-the-loop to appreciate how weather may unfold
    - sharing of information in real time matters a lot
        - maybe need app that provides situational awareness & can be updated via "crowd sourcing"
        - challenge of solving individual flight versus NAS problems
        - challenge of optimizing fuel, anticipating holding, etc.

Surface conditions assessment in absence of observations

- Steve Abelman, FAA
- Mark Phaneuf, ALPA
- Jose Garcia-Rivera, IMSG
- Gordon Rother, FAA
    - some confusion with regard to current, available, & latest weather reports/forecasts in regulation
    - what if not operating from airport, such as HEMS or UAS operation
- Steve Jangelis, ALPA
    - acknowledgment of weather observations
        - takeoff & landing – surface observation used for understanding of aircraft performance, runway usage, airport usable under weather conditions
        - quality/validity of data key – trusted source of information; need a valid weather report for approach; certified weather observer at destination may override AWOS/ASOS
        - surface data need to be precise, accurate & current from reliable approved source
        - NWS RTMA may be used for missing information?
- Tom Judge, Eastern Marine Healthcare
    - representing US helicopter safety team
    - HEMS operations are mostly unscheduled, off airports, complex terrain, often nighttime, changing weather conditions, etc.
    - need more information – many low-hanging fruits . . .
        - non-federal AWOS, DOT stations, etc.
        - NADIN, MADIS, MESOWEST, etc.
    - needed for go/no-go decisions
        - ceiling & visibility
        - temperature
        - dew point
        - humidity

        - wind speed & direction
    - need information along flight path
- Steve Levine, NOAA
    - using Real-Time Mesoscale Analysis (RTMA) if airport observation is missing
        - official NWS surface analysis
        - 2.5 km resolution, CONUS
        - using numerical weather prediction model analysis as background
        - using all available observations in analysis
    - uncertainty issues when observation is missing
        - observation network density
        - quality of observations
        - background value provided by model
        - local land surface characteristics (land/water, terrain, etc.)
        - uncertainty depends on parameter of interest, etc.
- Mike Bettwy, NWS AWC
    - HEMS tool
        - changes due to Java issues
        - need to be working on mobile devices
        - incorporate all available observations
        - use RTMA instead of CVA for improved C&V analysis, but need to improve RTMA latency (takes several months) – until RTMA is ready will use LAMP (instead of CVA) because it is "blessed" by NWS
- discussion
    - use of RTMA today if observation is missing
        - good enough for some use, but more work required to determine accuracy
        - regulation may hinder progress in using something that can add value to many situations

Getting non-sanctioned data into system

- T.K. Gwin, Colorado Department of Aviation
    - non-federal AWOS connectivity
    - it is not about equipment but how it is perceived
- Ashish Solanki, Maryland Office of Regional Aviation Assistance
    - state & individual airport concerns
        - FAA developed data collection system
- Faycel Farza, Nav Canada
    - weather data displayed on Nav Canada website have been approved by Environment Canada

        - cannot display 3rd party data because of regulatory requirements (related to installation & maintenance of sensors, & data quality assurance, metadata, etc.)
    - Greg Pratt, OAR MADIS manager (presented by T.K. Gwin)
        - meteorological data base & data delivery system, begun in 2001
        - collection of range of surface & upper air data sources
        - ability to handle wide range of data formats, time intervals, etc.
        - static & dynamic data quality control
- discussion
    - issue is cost to maintain sensors, connectivity, archive data, etc.
    - example of effective partnership
        - state of Maryland provided capital to purchase equipment & maintain connectivity
        - airports shoulder operation & maintenance of AWOS
    - need for better weather information off airports
        - highly valuable to HEMS & UAS operators
    - manage information better
    - should FPAW make/coordinate letter/recommendation to FAA Administrator?
        - suggestion is that every concerned organization co-signs
    - DOT CLARIS system collected RWIS data, now going into MADIS
    - value is in getting certified data into NextGen weather system
        - flight service providers (preflight briefings), pilots & ATC need to get access
    - only maybe 10% of stations collected in MADIS may include ceiling & visibility information

RTCA report and MASPS on met data link

- Stephen Darr, Dynamic Aerospace
    - standardization of real-time aircraft-based observation systems
- discussion
    - UAS could fit into this

Wind information in cockpit and ground

- Gary Pokodner, FAA
    -
- Kevin Johnston, FAA
    - TAFs do not support TFM decisions
        - maybe magnitude, direction & timing issues
        - winds aloft critical for managing compression issues (e.g., EWR, IAH)

        - surface winds critical for runway configuration management (e.g., on average DEN has 13 runway configuration changes daily, problem especially in winter time); surface winds also critical for wake separation
    - wind accounts for >20% of GDPs, affected flights, etc.
        - most affected airports include LGA, EWR, etc.
- Jeff Woods, NATCA
    - talking about various procedures & tools
- Colleen Reiche, AvMet Applications
    - transient wind shift associated with thunderstorms regarding runway crosswind issues
        - possible at all airport
        - primarily spring & fall
        - generally short lived
    - wind compression issues
        - path-based wind shear (speed or direction) & under high traffic demand can yield significant operational challenges (e.g., EWR)
        - conversion of wind shear to compression, tool currently evaluated in operations
        - impact of forecast inaccuracy
        - climatology of wind compression conditions
- Louis Bailey, Boeing
    - weather in flight efficiency vision
        - currently looking at mobile & automated flight advisories
        - going toward automated flight planning
        - need for real-time weather information sharing
        - need databases of actual information
        - need to understand uncertainties & inefficiencies
        - what are information coverage gaps (in situ, oceanic airspace, etc.)
        - connectivity issues
    - Boeing developing integrated weather service
    - predictability of weather issues
- Tom Reynolds, MIT/LL
    - analysis capabilities in support WTIC
        - wind information analysis framework
        - performance assessment tradespaces
        - wind requirements & stakeholder needs
        - aircraft operations modeling system
        - looking at HRRR, RAP, GFS model data, also MDCRS data
        - looking at Required Time of Arrival (RTA) performance
    - metric is time compliance at meter fix
- Eldrige Frazier, FAA
    - data link guidance for observed & forecast winds

        - concerned about interval management, wake vortex separation, & required time of arrival
        - focus on minimum weather service & 4D trajectory-based operations
    - required time of arrival
        - looks like using forecast wind guidance helps to dramatically improve time compliance at meter fix, which model (GFS or HRRR) or how many Decision Flight Levels (DFL) were used
        - 2 hour HRRR almost as good as truth
        - removing speed constraints (currently used to manage flows) might be beneficial, but it is not under consideration as an option for foreseeable future
    - wake vortex separation
    - interval management
- discussion
    - timing is critical for runway configuration & rate for GDP
        - airport specific issues (e.g., availability of short runway at EWR)
        - availability of technology (e.g., ITWS includes radar-based gridded terminal wind analysis) versus its proper usage (may need to have better training)
    - bandwidth limitations
        - looking at event-driven communication of weather information
    - preferred configurations
        - often get burned with sea breeze at ORD in afternoon