

Aviation Weather A NextGen Perspective

Mark Andrews Federal Chair Weather Working Group Joint Planning and Development Office July 21st, 2010





NextGen 101

- Weather accounts for 70% of all air traffic delays within the U.S. National Airspace System (NAS)
 - The Federal Aviation Administration (FAA) has determined two thirds of this is preventable with better weather information
- "A key finding, based on an analysis of several 2005-2006 convective events, is that as much as two-thirds of the weather related delay is potentially avoidable."
 Research, Engineering and Development Advisory Committee; Report of the Weather-ATM Integration Working Group; Oct 3, 2007







NextGen 101



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The Problem(s)

- Technology is a two edged sword
 - Increases in communications technology make weather products and information available to any and all, but also make the flaws (particularly consistency) easier to see
- Aviation customer perspectives, and consequently the relationships are poor (but improving) with respect to weather services
 - Requirements dialog is still largely missing
 - Meteorologists do not fully understand the impacts their information causes to the system (regardless of the flaws in how the system works)





The Problem(s)

- Forecast domain accountability is non-existent
- Product by schedule philosophy does not support operational decision making processes well
- Proactive amendments to aviation products further than one hour into the future does not exist (yet the 2-6 hour operational window is the highest priority)
- Current forecast/product processes make meeting consistency requirements almost impossible
- The concept of "metwatch" is foreign
- Probabilistic forecasting is not well understood
- Training has improved over the past decade, but much more work is required





The Symptoms

- Legacy operators have low confidence in weather products and services – They are, however, becoming more aware of and using highly automated and very short range (<2 hour) observations and forecasts
- Operators grab every product available and window shop for consensus
- There are no coordination processes across domains for aviation weather information (national, regional, local providers are largely fire-walled)



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System-Wide Transformation Requires Innovation Across All Lines of Development







Cultural Issues

- Trust or faith in weather systems
- Using weather information proactively
 - Hurricanes
 - Severe winter storms
 - Thunderstorms
 - Surface wind shifts
- My forecast is better than your forecast (or box)
- National consistency versus local knowledge
 Single Authoritative Source
- Operators grab every product available and window shop for consensus (or most permissive forecast)





Weather Graphics Interpretation

The FIP is an automatically-generated product that supplements AIRMETs and SIGMETs by identifying areas of forecast icing potential, but it does NOT substitute for the intensity and foreat information contained in AIRMETe and SIGMETs. It is authorized for operational use by meteorologists and dispatchers.

Maximum icing potential (1000 ft. MSL to FL300)













Hitting a moving target

- The hockey puck
 - "I skate to where the puck is going to be, not where it has been"
 Wayne Gretzky
- Changing NextGen terminology, but same concept
 - "Optimizer"
 - "Evaluator"
 - "Sky Net?"
 - Trajectory Based Services



Introduction to

Weather Concept of Operations

- Weather providers deliver a four-dimensional set of weather information
 - Operators/Mangers will have a common weather picture by using a subset of this information called the Single Authoritative Source
- In the NextGen ConOps, weather information will be fully integrated into operations and decision support tools
 - Data, rather than text and graphics becomes the "product"
- 4D weather will assist decision-makers by integrating with new tools that will describe the full range of available options to deal with weather issues
 - Identifies risk
 - Suggests strategies
 - Minimizes user disruptions



From Products to 0's & 1's







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Cultural acceptance











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The 4-D Weather Cube: A Conceptual Model





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NextGen Weather Integration Concept





Future work

INTEGRATION OF PROBABILISTIC WEATHER INFORMATION WITH AIR TRAFFIC MANAGEMENT DECISION SUPPORT TOOLS: A CONCEPTUAL VISION FOR THE FUTURE

- Matthias Steiner, Cynthia K. Mueller, Goli Davidson, and Jimmy A. Krozel
 - NCAR Research Applications Laboratory (RAL), Boulder, CO
 - Retired from NCAR RAL, Boulder, CO
 - Goli Davidson Consulting, San Francisco, CA
 - Metron Aviation Inc., Herndon, VA









Upcoming Decisions

Subsequent NEWP Meeting (Sept.):

- Define NextGen 4-D Wx Data Cube content at IOC
- Define Publishers of information to the NextGen 4-D Wx Data Cube
- Define Subscribers of information from the 4-D Weather Data Cube
- Define the role of foreign entities in the NextGen 4-D Wx Data Cube

Subsequent NEWP Meeting (Dec.):

 Describe the initial governance structure concept for the 4-D Wx
 SAS and 4-D Wx Data Cube





- There are significant cultural issues which need to be dealt with on the Met and Operator sides
- The effort to construct the 4D Cube is real, understanding the cultural issues which lie ahead
- The Met and Operator communities need to work together, vice separately, to work through these issues
- The weather concept is dynamic, and spiral development is expected as trajectory based services concept(s) evolve



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Back up slides





Weather Transformation

2008 2009	2010 2011 2012 2013	2014 2015 2016 2017 2018	2019 2020 2021 2022 2023 2024 2025
NextGen Weather Information Concepts	NextGen Weather Information Initial Capability	NextGen Weather Decision Support Tools and Proactive Weather Decision Making	Full Integration of Weather Information Into NextGen Operational Decisions
Align Agency Policy and Resources	Build Initial 4D Weather Systems	Optimize and Integrate	Manage and Enable
 Identify, align, or eliminate duplicative weather research and acquisition programs (FAA, NASA, DOC, DOD) Redirect existing research programs towards implementation of a national weather information collection and dissemination capability (FAA, NASA, DOC, DOD) Revisit and update decades old weather operational policies (FAA) 	 Develop and implement weather information protocols and standards (FAA, DOC, DOD) Design and acquire 4D weather infrastructure (FAA, DOC, DOD) Migrate legacy weather systems towards 4D ConOps (FAA) Develop and implement technologies to populate weather information system under Single Authoritative Source concept (FAA, DCO, DOD) 	 Integrate common weather information with decision support tools to enable a layered, risk-based operations approach (FAA, NASA) Ensure weather event information is well characterized and consistently passed across organizational and agency boundaries (FAA, NASA, DOC, DOD) Enable 4D trajectories that are routinely updated to incorporate the latest weather information (FAA, NASA) 	 Ensure common weather situation awareness for all users of the NextGen System, promoting improved system capacity and safety (FAA, DOC, DOD) Streamline weather information architecture to reduce operations and maintenance cost for government and users (FAA, DOC, DOD) Ensure direct integration of weather information into NextGen decision support tools to enable "weather savvy" decision support automation (FAA, NASA, DOD) Inform decision makers of options, assist in the automated identification of potential decision risks, and pose suggested operational solutions along with projections of NextGen impacts (FAA, NASA, DOD)
Direct and implement agency-wid policy, governance, standards an solutions for NextGen Weather Information	Synchronize existing and planned future agency and industry efforts	Transform operational system weather decision making processes	Risk-based decision making, supported by information sharing measures with continuous feedback loops





Multiple Path Approach







Today vs. NextGen Weather Information Attributes

<u>Today</u>

- Not integrated into aviation decision support systems (DSS)
- Inconsistent/conflicting on a national scale
- Low temporal resolution (for aviation decision making purposes)
- Disseminated in minutes
- Updated by schedule
- Fixed product formats (graphic or text)



- Totally integrated into DSS
- Nationally consistent
- High temporal resolution
- Disseminated in seconds
- Updated by events
- Flexible formats





Roles & Responsibilities

• ANSP:

 Continue to set aviation weather information requirements for ANSP ATM decisions

National Weather Service:

- Provide optimal representation of current and future weather phenomena to meet SAS requirements
 - Will evolve with scientific improvements in detecting and forecasting weather phenomena
- Develop operational capabilities necessary to meet ANSP requirements

• Department of Defense:

 Set DoD-specific requirements for aviation weather information beyond ANSP requirements





Eight SAS Myths

- Myth: The SAS is all aviation weather information.
- Fact: SAS is a subset of all aviation weather information "contained" in the 4-D Wx Data Cube
- Myth: The SAS is a single big server
- Fact: SAS is hosted on many servers around the US that is specified by metadata tag as SAS data
- Myth: The SAS is all the aviation weather information necessary to meet regulatory requirements
- Fact: Regulatory requirements are distinct from the SAS – some, but not all, SAS content may be regulatory and vice versa. Operators may meet regulatory requirements with information not specified as SAS (e.g., TAFs provided by commercial vendors)





NOAA/NWS "owns" this problem





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