

# Next Generation Air Transportation System (NextGen) Weather Requirements

Presented to: Aviation Weather Workshop

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Federal Aviation  
Administration



# Background

- **JPDO requested a Wx WG-sponsored study team to perform a Wx Functional requirements analysis**
- **Study team members included representatives from NASA, NWS, DOD and FAA**
- **Study team was tasked to**
  - Perform a Wx Functional Analysis
  - Identify NextGen weather information Functional Requirements including data attributes (e.g., resolution [spatial and temporal], data latency, refresh, reliability, integrity, and information content)



# Weather Functional Analysis

- **Functional analysis determines activities that must be performed to achieve stakeholders needs**
  - Leads to a complete set of requirements that satisfies user needs
  - Improves integration
  - Discourages predefined solutions
  - Enables new technology and designs
- **Today, many systems are developed without a Functional Analysis being done first**
  - As a result, Requirement ‘gaps’ discovered during Operational Testing can increase implementation costs by 10X-100X

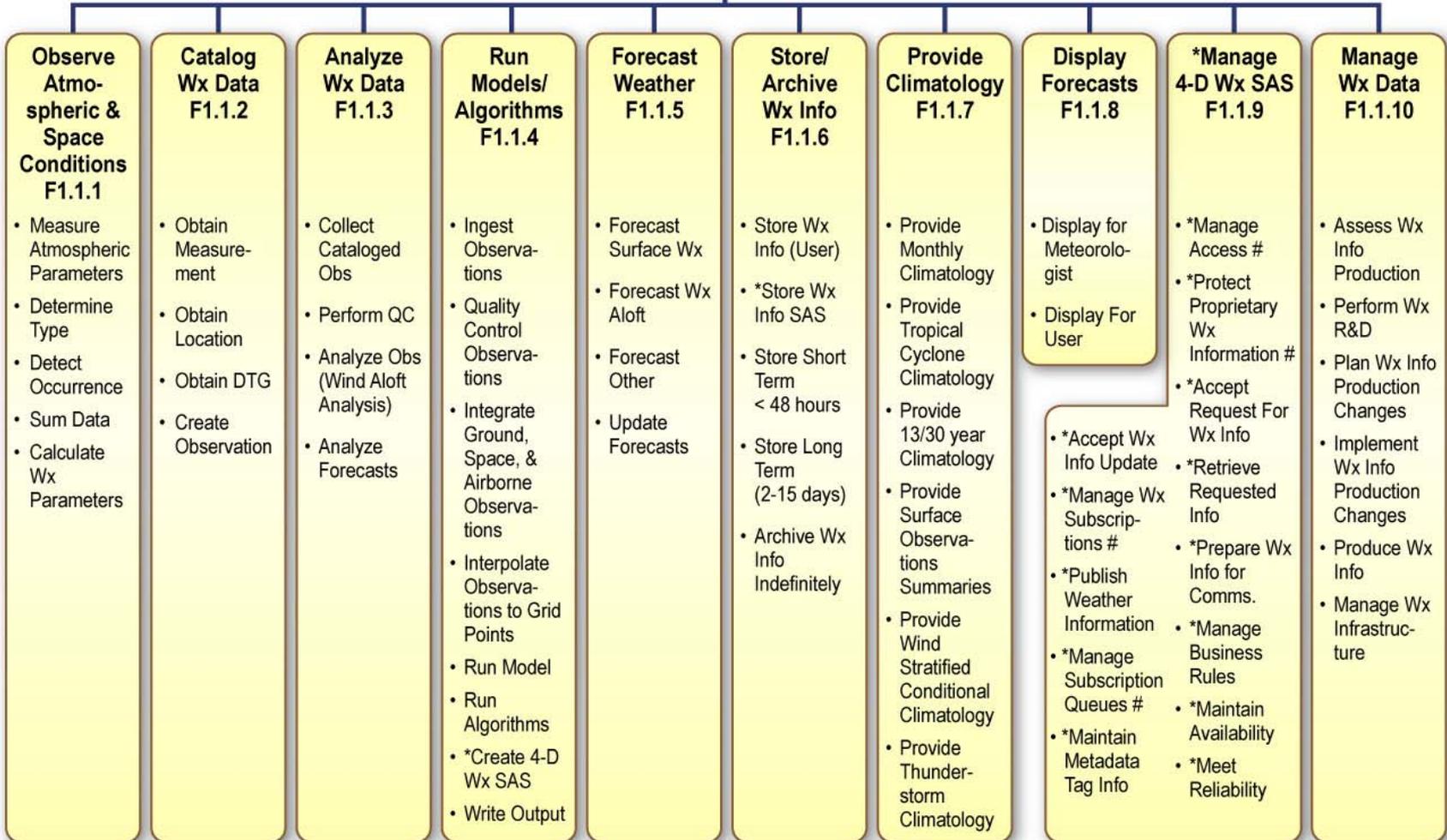
# Weather Functional Analysis (cont'd)

- **Operational needs were extracted from NextGen Concept of Operations v2.0 and NextGen Wx ConOps**
  - Decomposed operational functions to sufficient detail to determine high-level Wx functions
  - Then, Wx functions were iteratively decomposed to determine required NextGen Wx functions
  - These functions were transformed into:
    - Functional Requirements for 4-D Weather Data Cube
    - 4-D Wx SAS Functional and Performance Requirements
    - Results documented in JPDO 4-D Weather Functional Requirements for NextGen ATM report (Ver 0.1 Jan 18, '08)



## Provide Weather Services F1.1

Functions with \* are included in cost estimate. Functions with # may be allocated to communications.



# FAA NextGen Performance Requirements Team Members

- Steve Abelman - NWS
- Philip Shuster - AJP
- Paul Armbruster - Terminal
- William N. Brown – En Route
- Mark Carver – System Operations/FSS
- Frances Bayne – Operations Planning (AJP)
- Ernie Dash (SAIC) – En Route
- Bill Hall – Terminal
- Paul Jackson – En Route
- Thomas Kays – Terminal Wx
- Lorraine Leonard – AJP NII/SETA
- Jack May - AJP Aviation Weather Office/AvMet
- Cecilia Miner - NWS
- Robert Showalter – AJP NII/SETA-II
- Cheryl Souders NG Integration & Implementation (NII)
- Susanne Spincic – System Operations/FSS
- James Tauss AJP NII/SETA-II
- Operational SMEs
- Dennis Copfer – En Route
- Brian Holguin – System Operations
- Kevin Mattison – AVS Certification
- Steve Walden AVS Flt Standards/AMTI



# FAA NextGen Performance Requirements

- **Values for Performance Requirements developed based on understanding of NextGen ConOps functional analysis and Functional Requirements**
  - NextGen ConOps lacked sufficient detail in some cases to ensure all assumptions were correct
  - Need JPDO to add additional levels of detail for 2025
  - FAA is developing lower-level ConOps for mid-term
    - Big Airspace and NextGen Towers are available
    - Multi-sector planner and high-altitude due end of April
    - Midterm ConOps due in June
    - Team will develop Midterm Wx requirements after functional analysis is completed



# Performance Requirements Team

- Developed Performance Requirements for following functions
  - Observe Atmospheric and Space Conditions (F1.1.1)
  - Analyze Weather Data (F1.1.3)
  - Forecast Weather (F1.1.5)
    - Includes Probabilistic Forecasts
- Evaluation of Functions and Functional Requirements resulted in:
  - Adding some new functions
  - A number of functions moved from 4-D Wx SAS to
    - 4-D Weather Data Cube
    - Wx Services Decision Support Tools (e.g., calculator, formatter, etc.)
    - Decision makers Decision Support Tools
  - Changes to the Lexicon (both additions and changes to Wx Function Requirements for NextGen Air Traffic Management Lexicon)



# Performance Requirements Team Issues

- With resolution for airspace divided into super-density terminals, en route (includes other terminals) and global (including designated global terminals), do we need higher resolution wx and more frequent updates at medium-intensity terminals than for en route?
- If most weather elements (wind, turbulence, icing, precipitation, wind shear) are already described using high-resolution gridded fields, is there also a need to represent commonly understood 3-D constructions which contain the hazards already described, e.g.,
  - ***Thunderstorms? Jet Stream? Cold Front? Hurricane? Cloud Layer?***
- Where should Functions as “determine vertical extent” and “determine duration” be allocated? (SAS? Cube? User DST to calculate?)
- Within the context of high-resolution gridded information, what is the meaning of a Wx element “begin/end” time & “duration”? Are these needed for each grid point surface and aloft?
- What is the height reference system for all weather in the SAS? (MSL? AGL? Combination? Other?)
- What type of agreements are needed to ensure that the performance requirements written by different sub-teams are consistent in terminology (e.g., accuracy as “plus or minus” rather than less than or equal to)
- How do we describe this work so it is clear to users?



# FAA NextGen Performance Requirements

- **Developed Performance Wx Requirements from Functional Requirements for ‘Observe Atmospheric and Space Conditions’ & ‘Forecast Weather’**
  - ~ 3,000 observing performance requirements
  - Developing ~ 7,000 forecasting performance requirements
  - Developing ~ 2,500 probability forecast performance requirements
- **Probabilistic Performance Requirements are the most difficult to develop**
  - Is it a straight probability (e.g., rain) or a probability mass function (e.g., icing values) or a probability distribution function (e.g., type of precipitation).
  - What is the appropriate value for the performance criteria - bias?

# Probability Performance Requirements

- 4D probabilistic forecasts will enable Air Navigation Service Providers' (ANSP) and Flight Operations decision support tools (DST) to aid decision makers in managing their operational risk
- Probabilistic weather information will help multiple decision makers use the same Wx information, applying their own operational parameter filters to determine the risk to their operations
- Trajectory Based Operations planning and in-flight navigation tools will use probabilistic forecasts to determine most efficient 4DT & assess risk of deviation

# Next Steps

- **Complete work on draft final portfolio requirements document**
- **Validate Performance Requirements within FAA**
  - WX community
  - Operational community
- **FAA submits validated Performance Requirements to JPDO**
- **Other agencies review Requirements to determine if:**
  - Performance requirements meet their operational needs?
  - Some performance values need to be more constrained?
  - Additional performance requirements need to be developed?



# Next Steps (cont'd)

- **Add Performance Requirements to 4-D Functional Requirements in the NextGen ATM document**
- **Validate Wx Performance Requirements with the participation of ANSPs and Operators to ensure Performance Requirements are correct and sufficient**
  - **Relate how the NextGen changes will affect each operational user**
  - **Modeling and simulation demo to show requirements met**
- **JPDO allocate Wx Requirements to agencies**
  - **Agencies allocate requirements to current or near-term systems**
  - **If the current state of weather knowledge is insufficient, allocate to R&D**

# Performance Requirements Summary

- **JPDO study team performed Functional Analysis and developed Functional & limited Performance Requirements**
- **Using Functions & Functional Requirements from JPDO NG ConOps, FAA-led multi-organizational team developed Wx Performance Requirements to support NextGen-era Ops**
  - Majority of Performance Requirements developed, but still finalizing probabilistic Performance Requirements (May 09)
  - FAA validation of requirements (July 09)
  - Modeling & Simulation to take 18-24 months
  - As NextGen capabilities more fully defined, must revisit functional analysis & update requirements
  - Development of FAA midterm requirements to begin in Aug 09