NGATS Weather System Concept

JPDO Weather IPT

"Friends/Partners in Aviation Weather" Vision Forum

FAA Headquarters – 800 Independence Avenue – Washington, D.C.

July 13, 2006

Weather Concept Contributors

- FAA
- NOAA/NWS
- Raytheon
- MITRE/CAASD
- NASA (Ames, Langley, and Glenn)
- Sensis Corporation
- Lockheed Martin
- MIT Lincoln Laboratory
- AvMet
- AUA-TAC

Weather Concept Philosophy

Our charge is NOT about the weather …

Rather, it is about the

Identification and effective use of weather information (and supporting capabilities) to mitigate weather impacts on NGATS operations

NGATS Weather Capability Objectives

- Provide air transportation system users, including passengers, timely and accurate weather information (tailored to their skill levels and vehicle capabilities) upon which to make transportation planning decisions
- Safely/reliably maximize the volume of airspace available for air traffic operations.
- Enable commercial and general aviation users to develop flight plans that best balance their operational and economic needs, within the constraints imposed by the weather situation
- Minimize weather-related disruptions to these desired flight plans during the conduct of the flight, from airport curb at departure, to airport curb upon arrival.
- Ensure safety of flight crews and the flying public by providing timely information directly to the cockpit on severe weather, including unanticipated changes.
- Facilitate improved situational awareness regarding current and forecast weather information to support homeland security and national defense objectives.
- Support efforts on the environment that will address noise, air quality, and related issues that have an atmospheric component.

Flexible Enough to Support Multiple Potential Futures!

Weather Concept Scope / Approach

- Scope
  - 2025 concepts for Weather Support (future vision)
    - Starting point for inter-IPT discussions
    - First step in NGATS weather functional analysis
- Approach
  - Analyze NGATS 2025 concepts and key functions
  - Identify Weather Implications/Impacts
  - Establish resulting Operating Principles for NGATS Weather Support Concepts
  - Develop Weather Concept Details
- To Follow…
  - Transition “Road Map”
    - Transition plan for Weather Support - current NAS to 2025 Concept
  - Complementary products:
    - Weather System Requirements
    - Supporting R&D Requirements

Role of Weather in 2025 Concept

- Primary goal: Proactively identify areas where aircraft can safely fly (vs. just advising where they can not fly)
- Weather is integrated into NGATS decision making:
  - NGATS-relevant Weather information
  - Weather-savvy NGATS decision oriented tools (NDOT)
    - Primary decision making is automated machine to machine (M2M)
    - Network Enabled Operations (NEO) provides basis for information sharing to support M2M decisions
- Mitigation of Weather Impacts in the presence of uncertainty:
  - Weather inputs include relevant probabilistic information
    - Methods developed to use probability info to assess decision risk
  - Probability information increases NGATS effective use of weather information even without increased fidelity/accuracy

Role of Weather in 2025 Concept

- 4-D Weather files established as authoritative source for ATM decisions
- Weather information to/from aircraft (as well as aircraft weather mitigation capabilities) are included as performance-based service capabilities

Weather Concept Operating Principles

- Operating principles
  - Derived from the analysis of the implications/impacts of weather from the NGATS 2025 Concept
  - Provide baseline for the NGATS Weather Concept of Operations
- Principles are grouped into 5 categories:

1. Policy and Organization
   - Weather concepts are globally harmonized and consistent with ICAO
   - ATC shares responsibility with the pilot for directing aircraft in avoiding hazardous weather conditions, especially for limited or non-equipped aircraft
   - Weather support will be a joint agency responsibility

Weather Concept Operating Principles

2. Data Collection and Access
   - All users receive all required weather information
   - NGATS 4-D Weather "database" is the single authoritative government supported source of weather
   - Aircraft Performance-Based Service includes data link capability for accessing and processing in-flight updates of weather
   - Increased coverage in airport observations and TAFs for non-towered and virtual towered airports
   - Pilots/Aircrews rely on self-briefing for pre-flight and in-flight planning
3. Products and Decision Assistance Tools
   - M2M tools represent primary method for NGATS weather exploitation
   - Legacy text products are targeted for elimination
   - Weather impact decisions based on variety of parameters
     - including aircrew capabilities, weather avoidance, flight efficiency, and flight quality and NGATS-user preferences
   - Increased resolution in weather information

Weather Concept Operating Principles

4. Integration and Procedures
   - Weather information is not an end itself but fully integrated into NGATS systems
     - Operations evolve toward more collaborative flight management and control via Net Centric Information sharing
     - Weather products are consistent across all flight domains
     - Weather system information and procedures and concepts are designed for efficient user integration and application
     - Dynamic in-flight rerouting is based on timely updates of weather information to NGATS systems and users
5. Enhanced Aircraft Capabilities
   - Aircraft systems can mitigate the impact of weather
     - Aircraft weather mitigation systems reduce the associated airspace restrictions

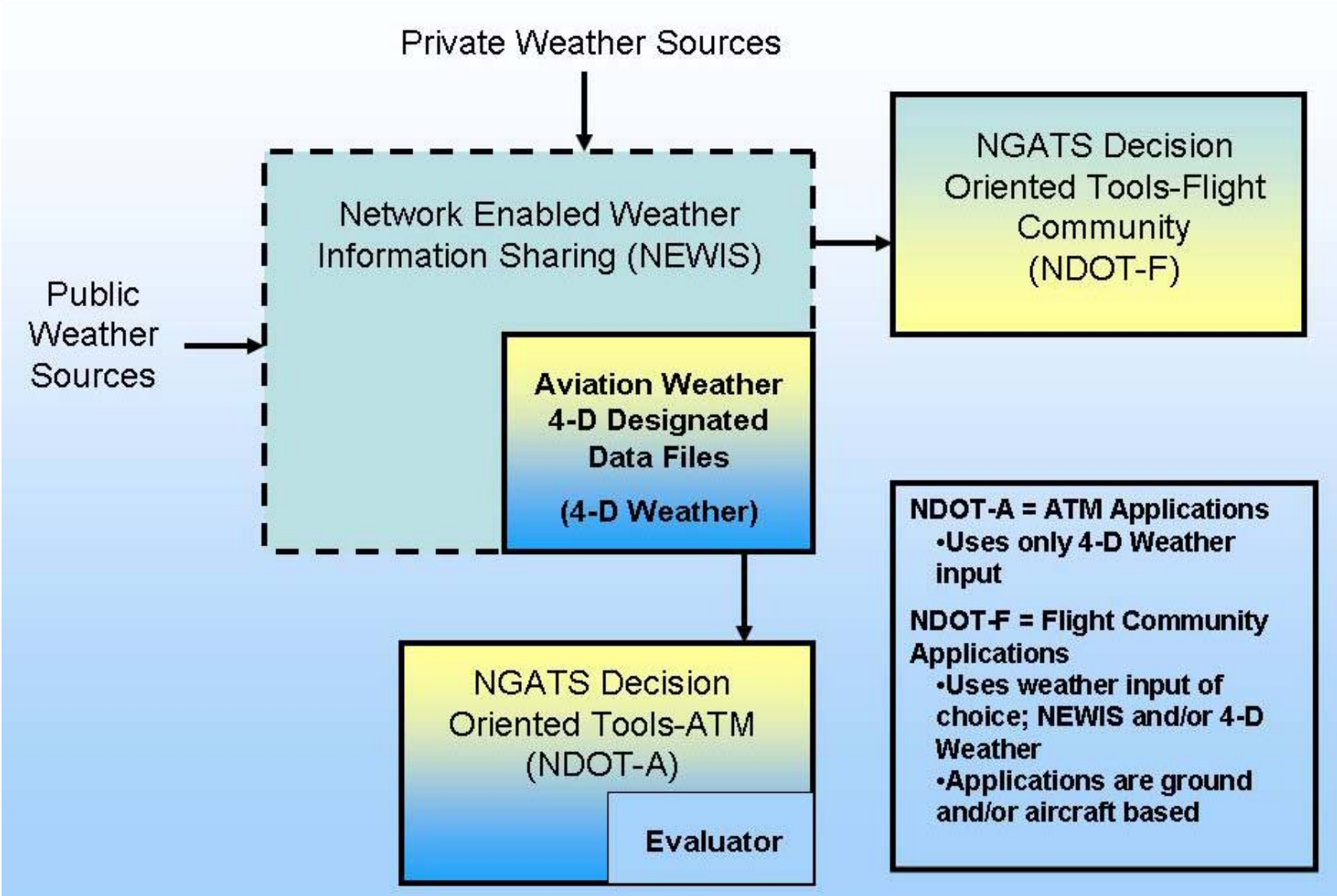
Weather CONOPS: Decision-Making Roles

- Five (5) primary decision-making roles:
  - NGATS Automation Machine to Machine (M2M)
  - Air Traffic Service Community
  - Flight Community
  - Homeland Security and Military
  - NGATS Other (e.g., airport surface operations, surface-based operators, and other participants)

Weather CONOPS: Aviation Weather Information Access

- Weather information from a variety of sources is network accessible and serves as a source for automated and human decisions
  - Network Enabled Weather Information Sharing (NEWIS) provides access to information sources through NEO
  - NGATS ATM weather support is based on specific subsets of NEWIS designated as Aviation Weather 4-D Designated Data Files (4-D Weather “database”)
- Basic weather files are used for automation while packaged weather information is intended for humans

Weather CONOPS: Aviation Weather Information Access



Weather CONOPS: Public Weather Sources

- 4-D Weather "database"
  - Aviation Weather 4-D Designated Data Files
  - Official source of weather in 4-D space and time
- Data from automated gridded products, models, and human forecasts are distilled into a ***single official forecast*** stored in the 4-D Weather "database"
  - A single official forecast means only one forecast for a specific point in time and space from which all government provided decisions are based
  - A single forecast can be presented or expressed in many forms
- Observations are integrated into the 4-D Weather "database" observational analysis
  - Real-time atmosphere is analyzed from both observational and model data before being presented to NDOT applications
  - Source observations (METAR) are available, however, most decision algorithms and aids use the 4-D observational analysis

Weather CONOPS: Air Traffic Support

- AT support is primarily automated using NDOT-A-M2M which includes
  - Notional Rules for Efficient Flight [traffic management]
  - Individual Flight Limitations and Preferences
- NDOT-A-M2M applications track weather, pilot preferences and limitations, aircraft limitations, as well as planned and actual traffic
- ATC decisions not performed by NDOT-A-M2M are primarily tactical
- Flight deck decisions are those not performed by NDOT-A-M2M or ATC
- Almost all pre-flight planning is handled by NDOT-A applications

Next Steps

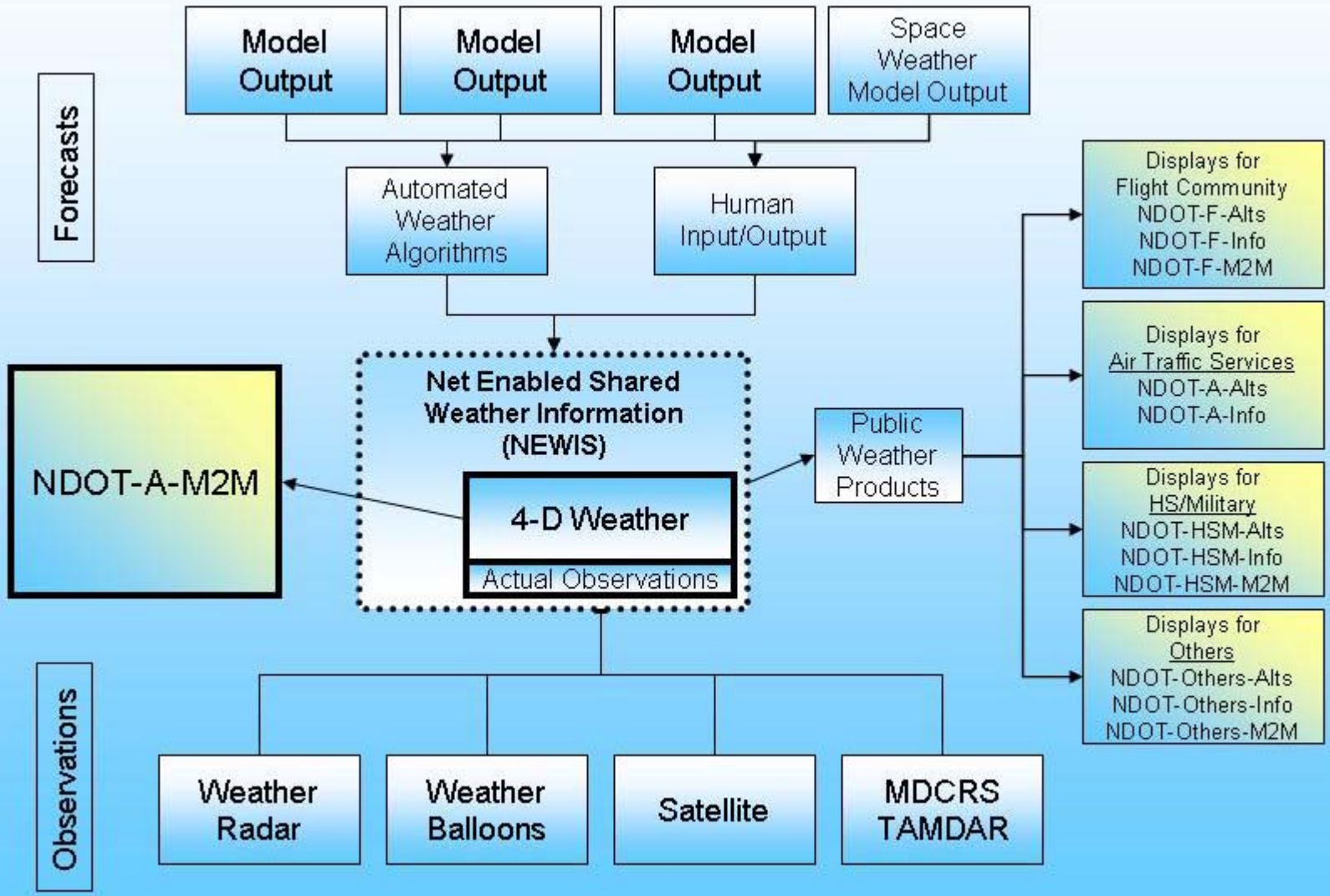
- Coordination of NGATS Weather CONOPS with the JPDO IPTs
  - Based on comments, changes will be made as appropriate
- Long-term research is needed
  - Alternative approaches to weather support concepts will be included
  - Disconnects or issues need resolving through researching alternative solution sets
- Basic issues include:
  - Which decisions are automated?
  - What weather information is needed for each group of decision-makers?
  - Without stand-alone weather displays, how is weather information presented? Is weather information presented?
  - How are probabilistic forecasts incorporated into NDOTs? Do the probabilities needed for automated decisions map to human models for decision-making?

Summary

- NGATS Weather CONOPS
  - Based on JPDO NGATS 2025 Concepts
  - Weather is integrated as key input to NGATS decision oriented tools (NDOT) with primary decision-making through automated machine to machine (M2M) applications
  - Weather inputs include probability information and 4-D Weather files are designed source for NGATS ATM M2M applications
  - Performance-based service capabilities include weather information to/from aircraft as well as aircraft weather mitigation capabilities

Backup

Weather CONOPS: Public Weather Sources



Weather CONOPS: Air Traffic Support