Aviation Weather
A NextGen Perspective

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Weather Working Group
Joint Planning and Development Office
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NextGen 101

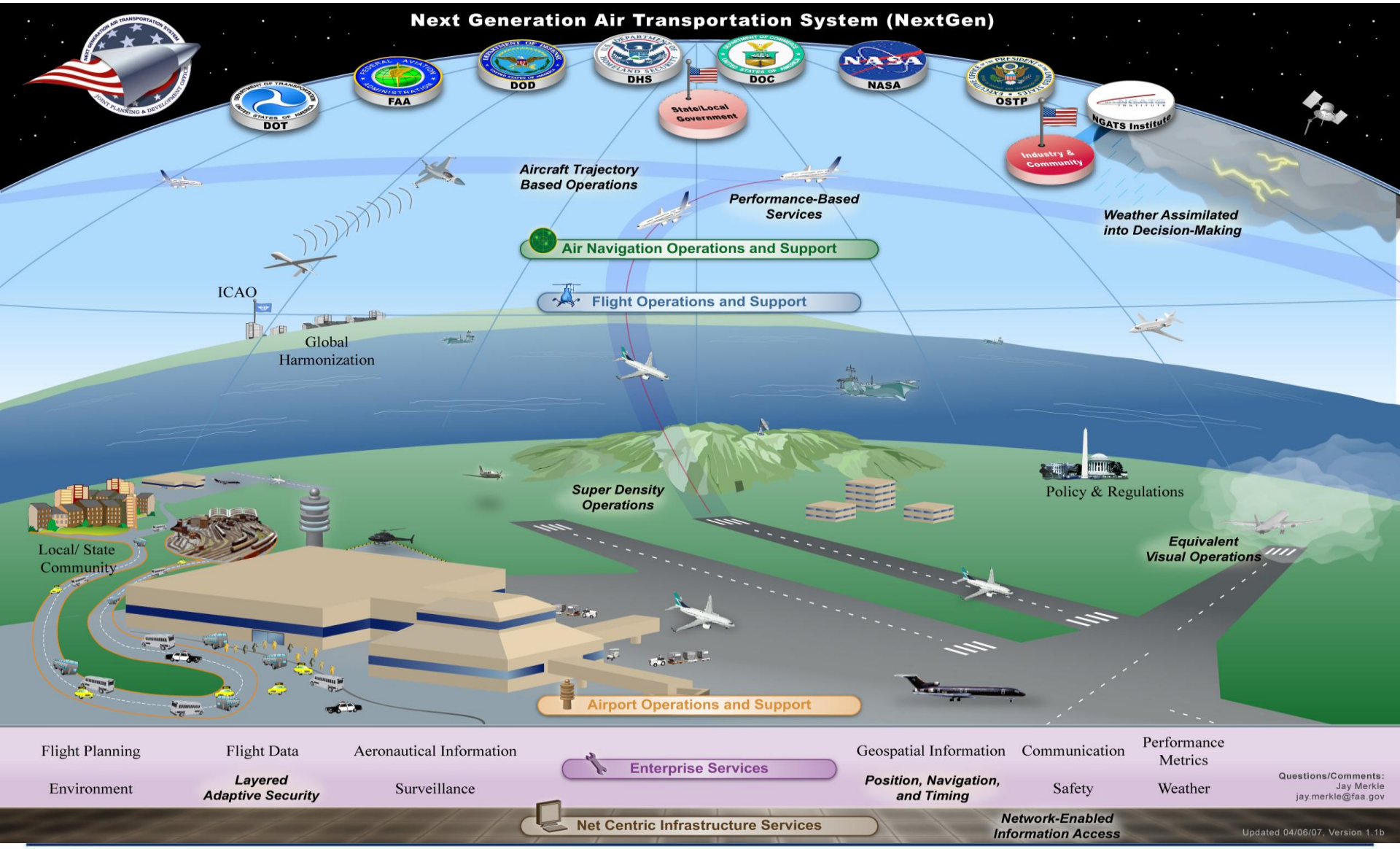
- Weather accounts for 70% of all air traffic delays within the U.S. National Airspace System (NAS)
  - The Federal Aviation Administration (FAA) has determined two thirds of this is preventable with better weather information

- "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

Next Generation Air Transportation System
Joint Planning and Development Office

NextGen 101



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)

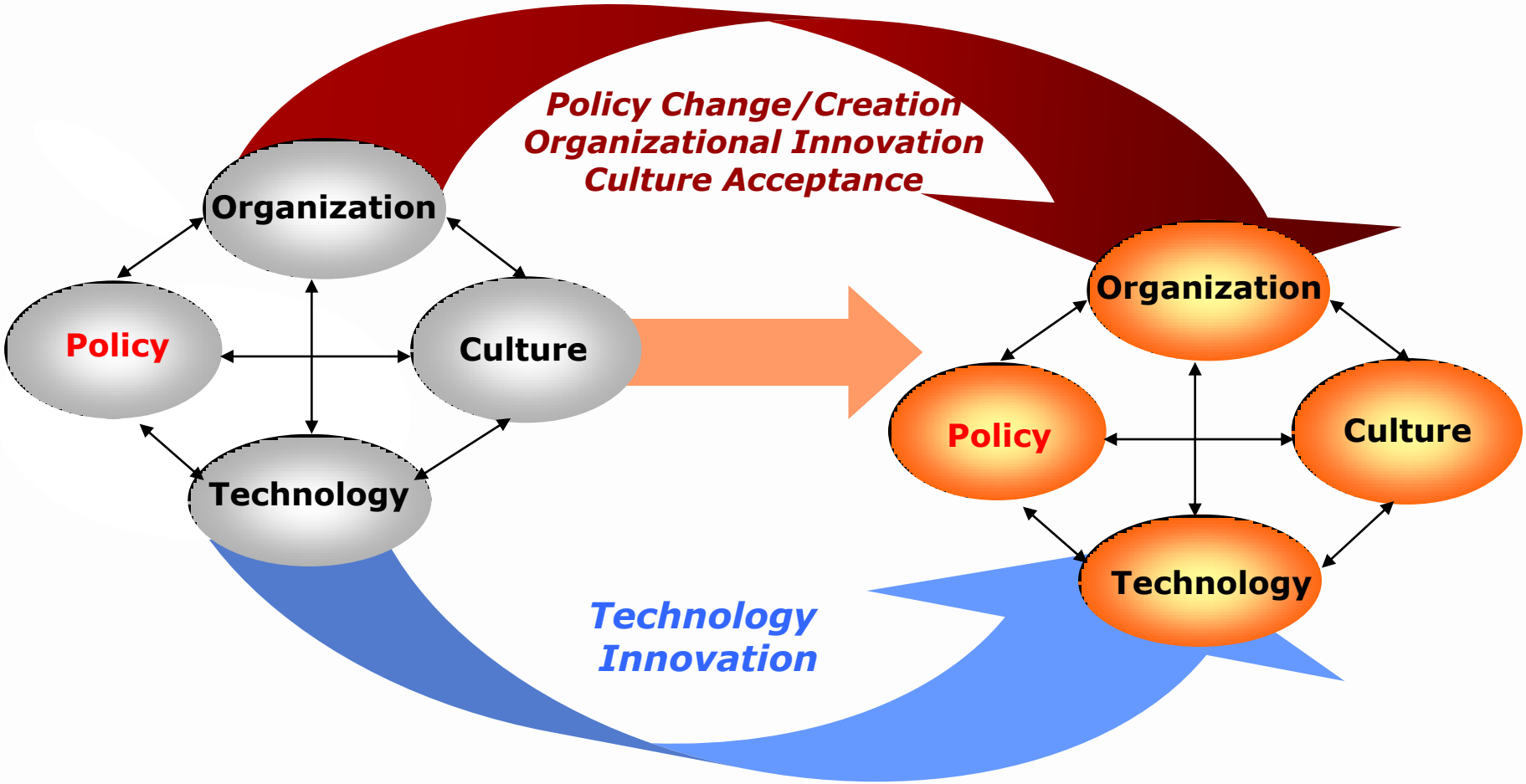
- Forecast domain accountability is non-existent
- Product by schedule philosophy does not support operational decision making processes well
- Proactive amendments to aviation products further than one hour into the future does not exist (yet the 2-6 hour operational window is the highest priority)
- 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)

System-Wide Transformation

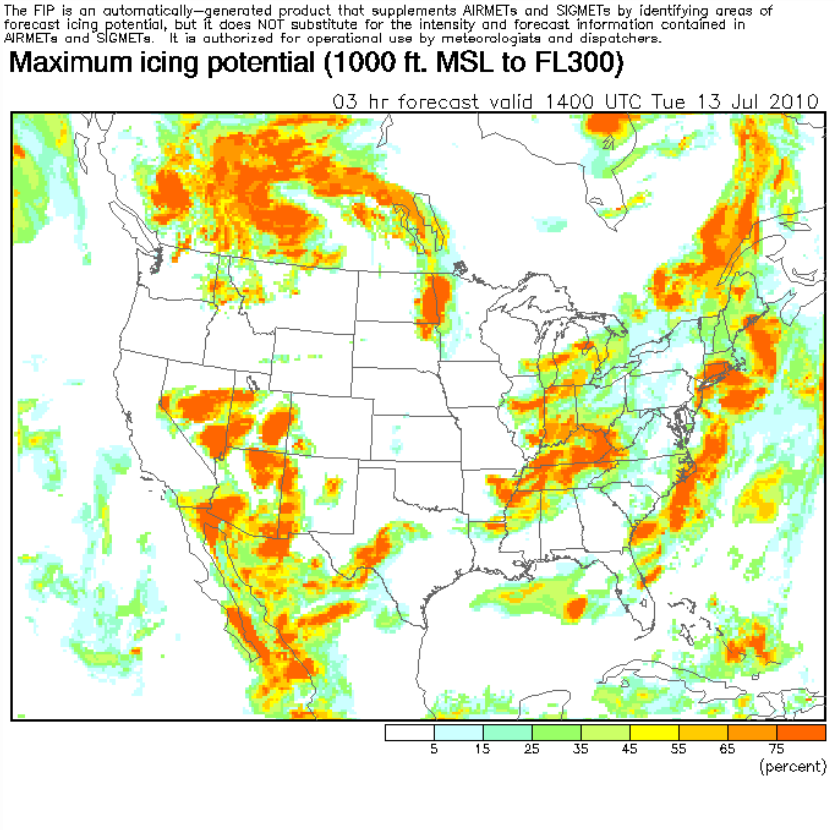
Requires Innovation Across All Lines of Development

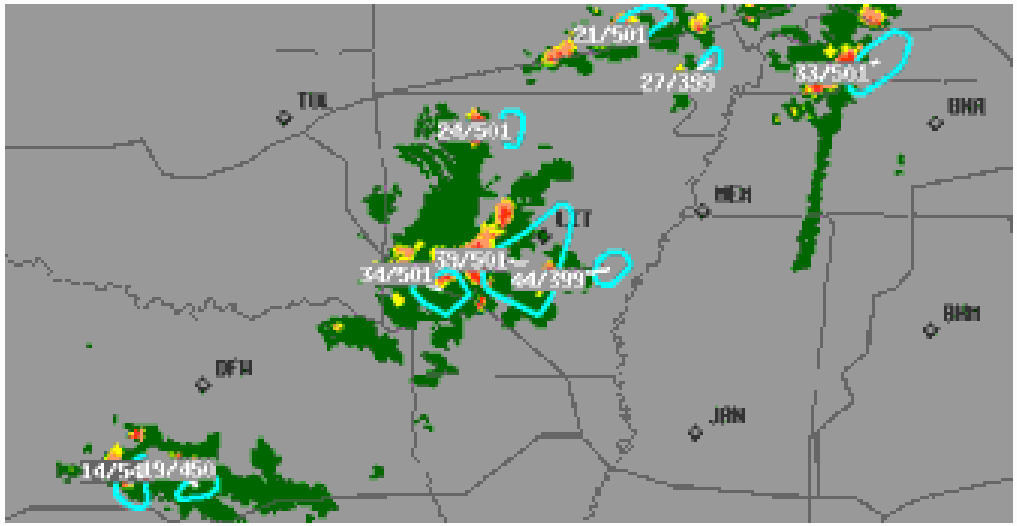


Cultural Issues

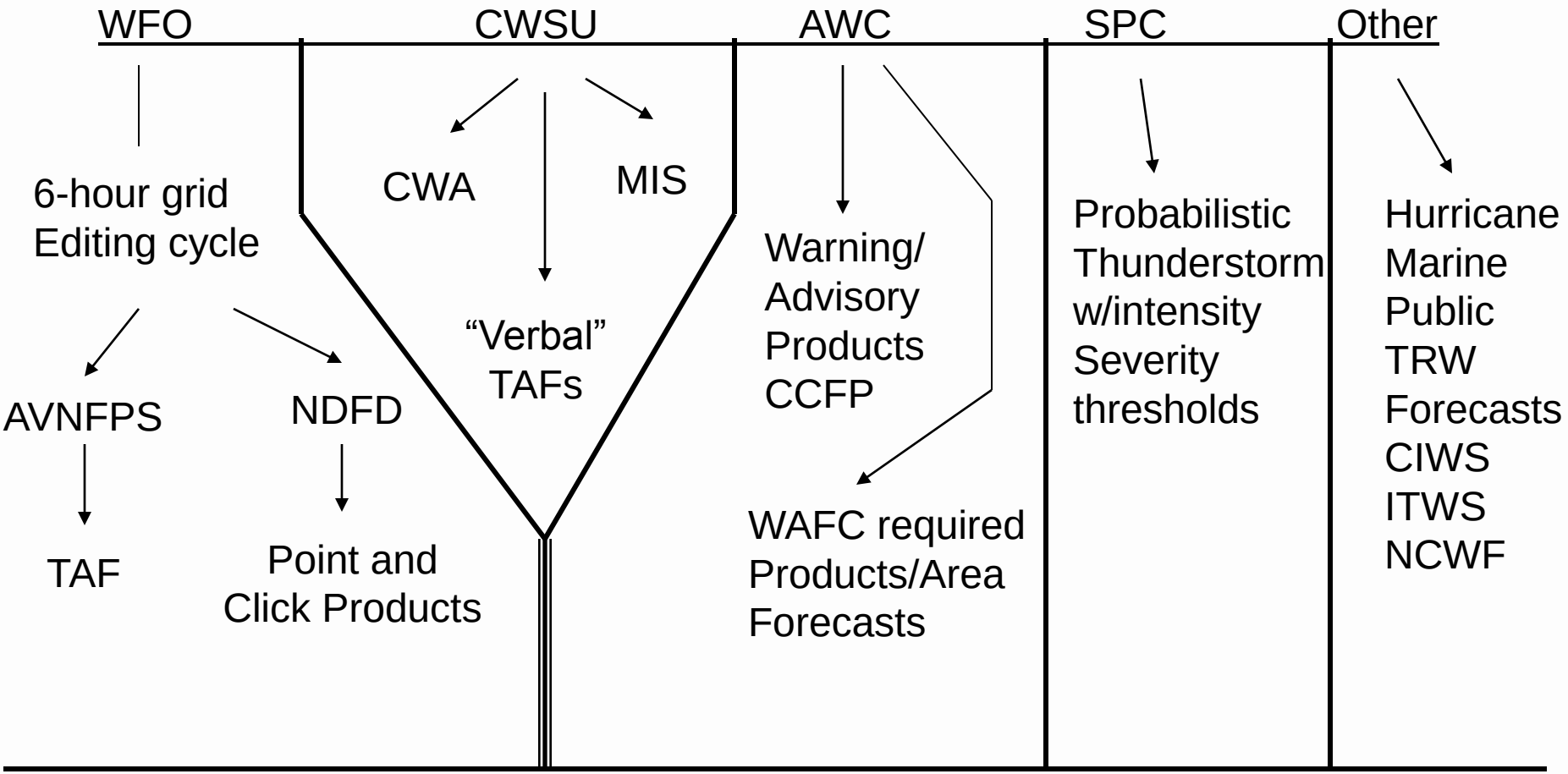
- Trust or faith in weather systems
- Using weather information proactively
  - Hurricanes
  - Severe winter storms
  - Thunderstorms
  - Surface wind shifts
- My forecast is better than your forecast (or box)
- National consistency versus local knowledge
  - Single Authoritative Source
- Operators grab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

Weather Graphics Interpretation





Cube and Consistency Today



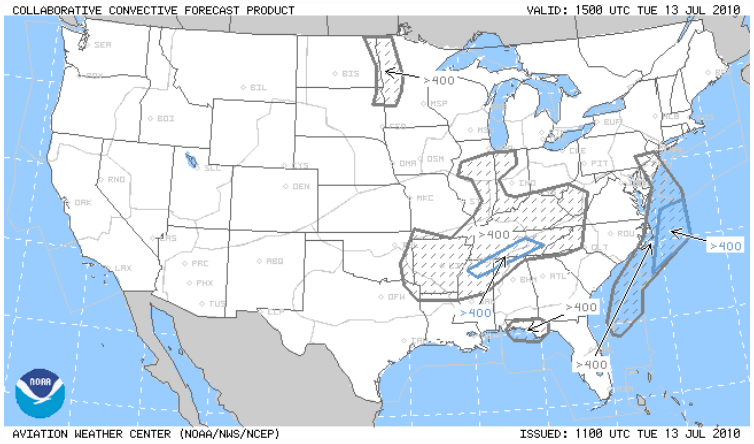
Hitting a moving target

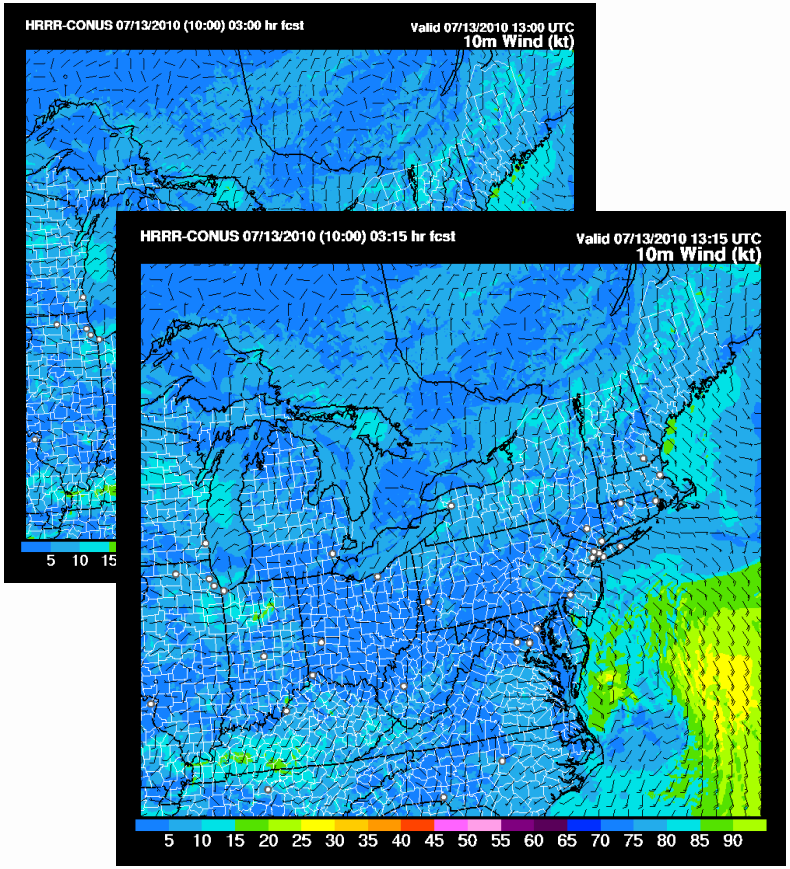
- The hockey puck
  - "I skate to where the puck is going to be, not where it has been"
    Wayne Gretzky
- Changing NextGen terminology, but same concept
  - "Optimizer"
  - "Evaluator"
  - "Sky Net?"
  - Trajectory Based Services

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

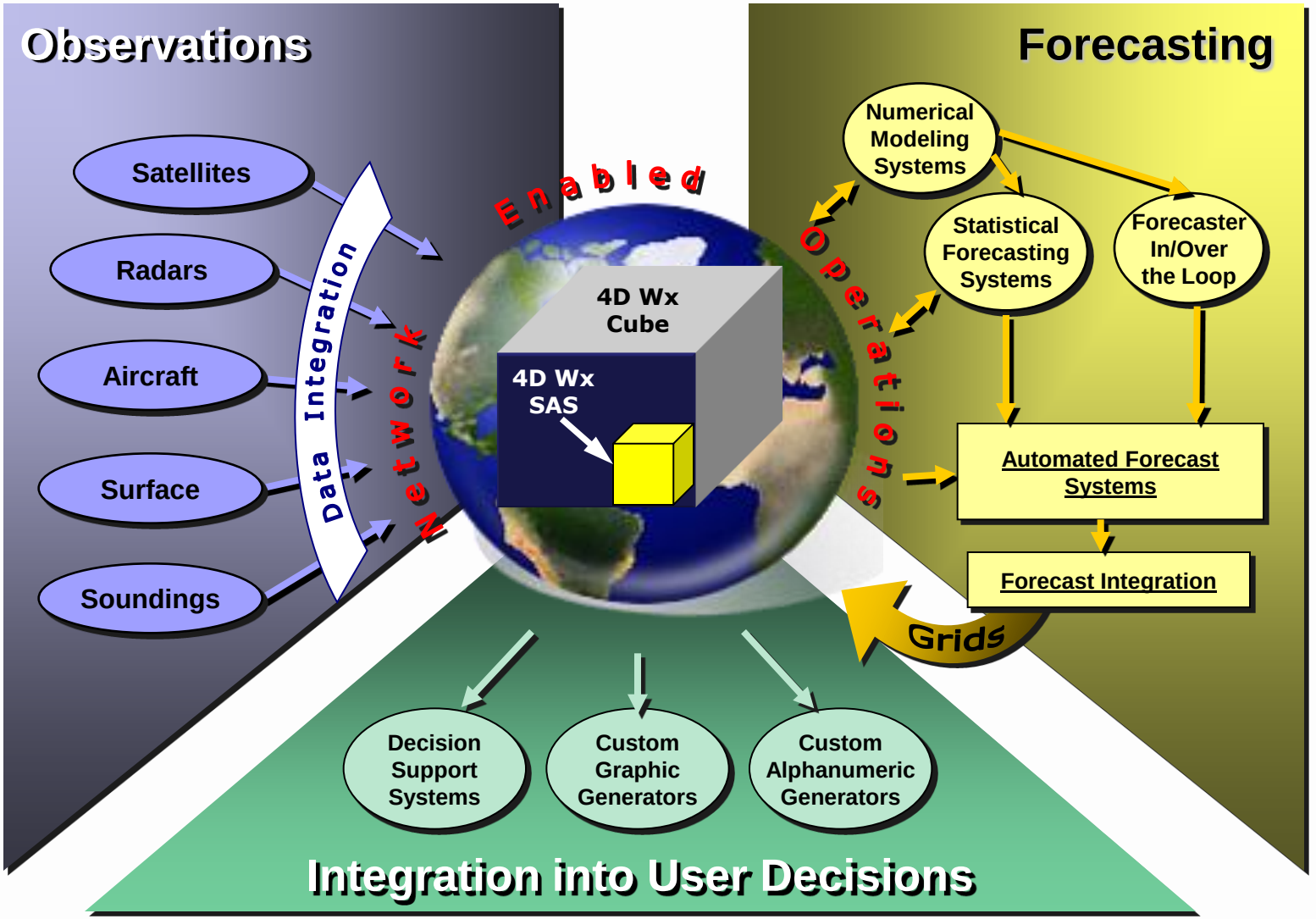
From Products to 0's & 1's



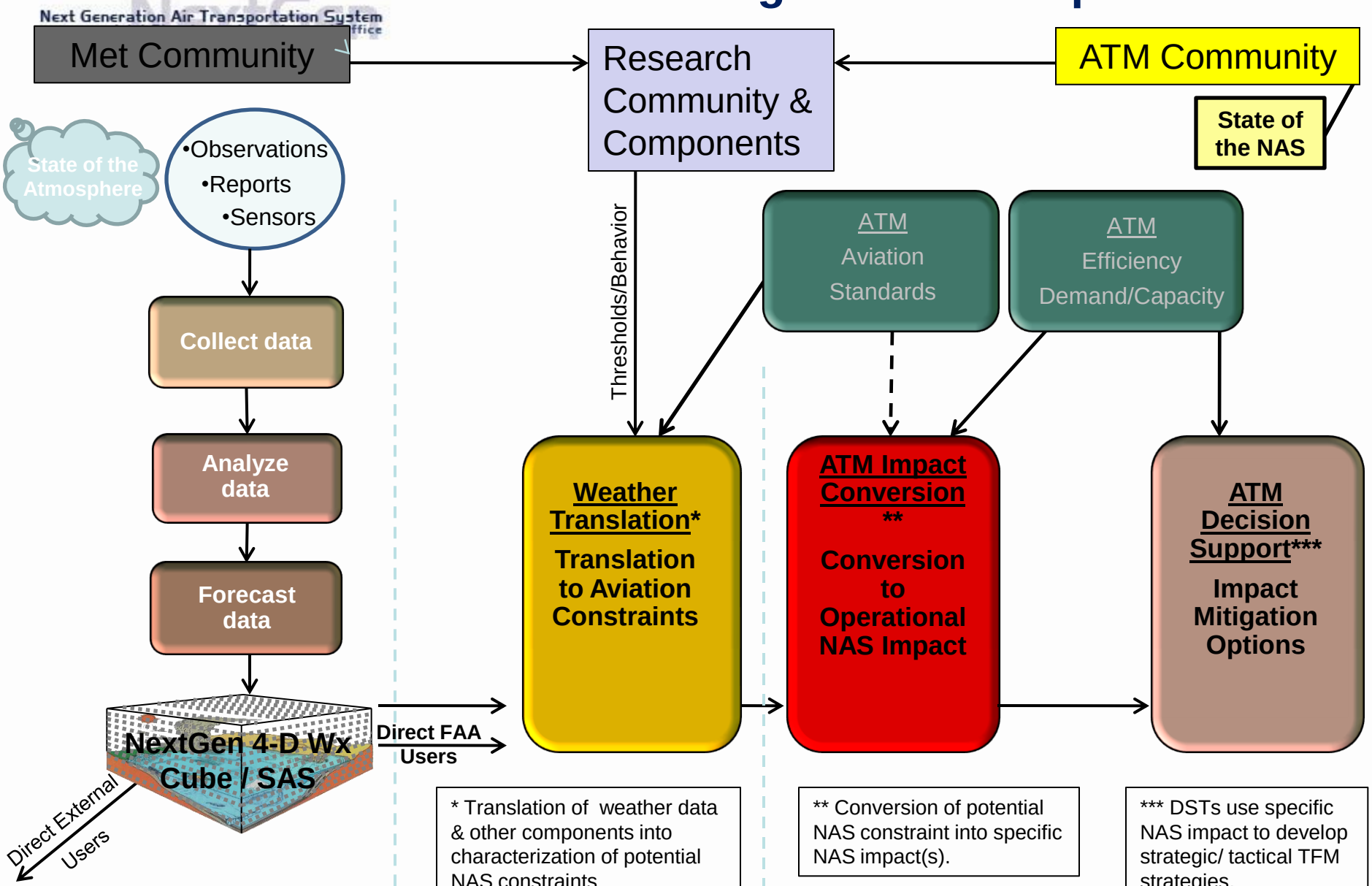


Cultural acceptance

The 4-D Weather Cube: A Conceptual Model



NextGen Weather Integration Concept



Primary:
Secondary:

NWS
FAA, DOD, Private

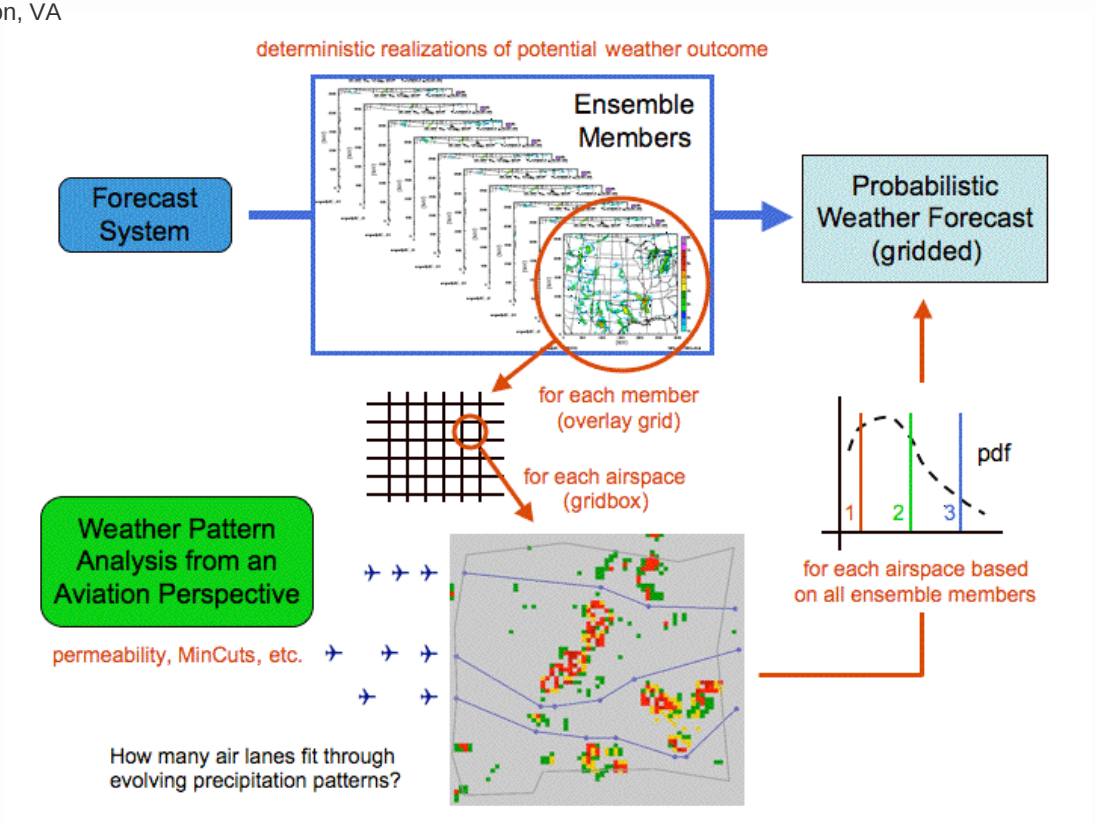
FAA-MET
NWS, DOD-MET

FAA-ATM
DOD-ATM, Private

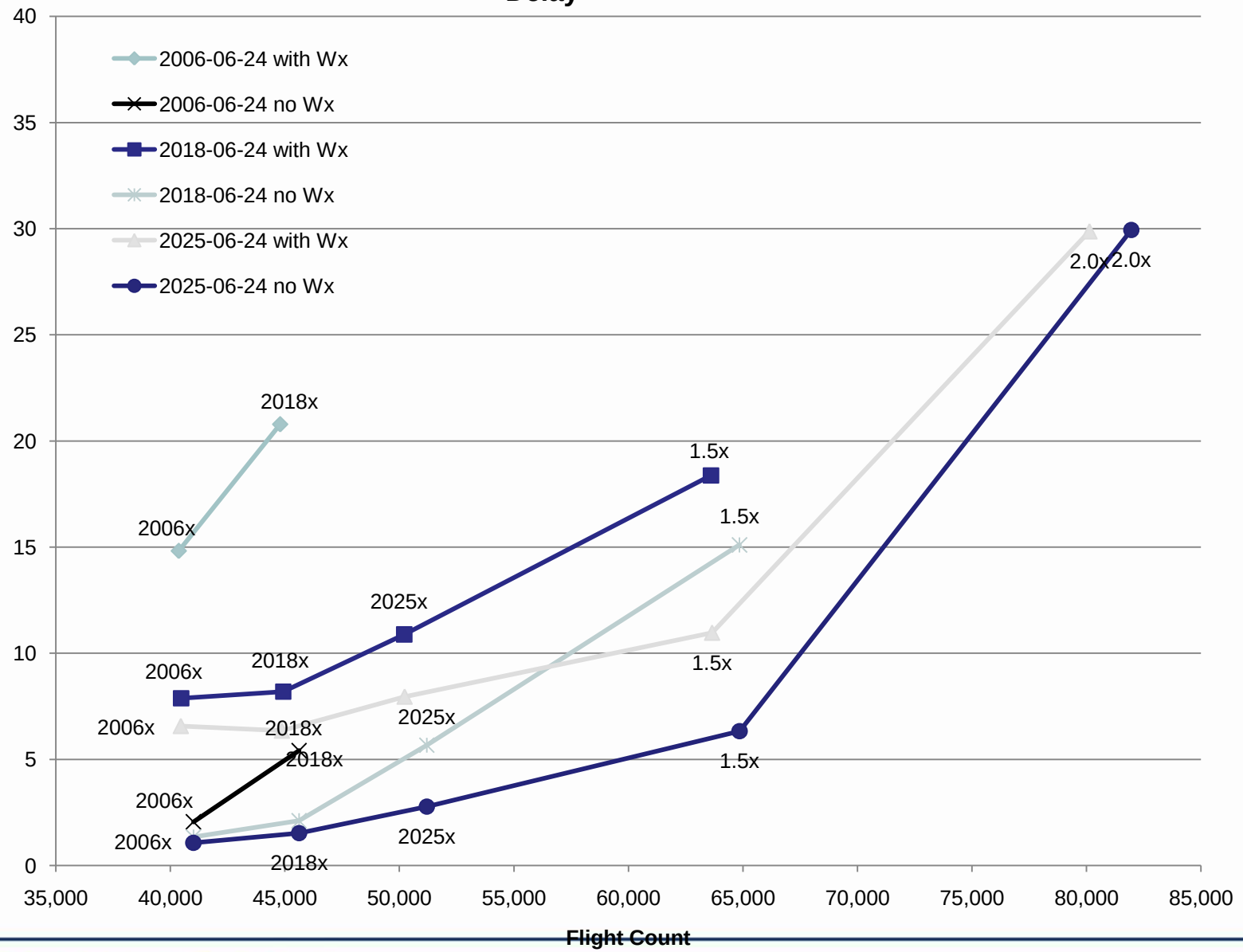
Future work

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



Baseline 2006-06-24, Moderate Weather Day, Low Traffic Volume, NAS-wide Avg. Arrival Delay



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

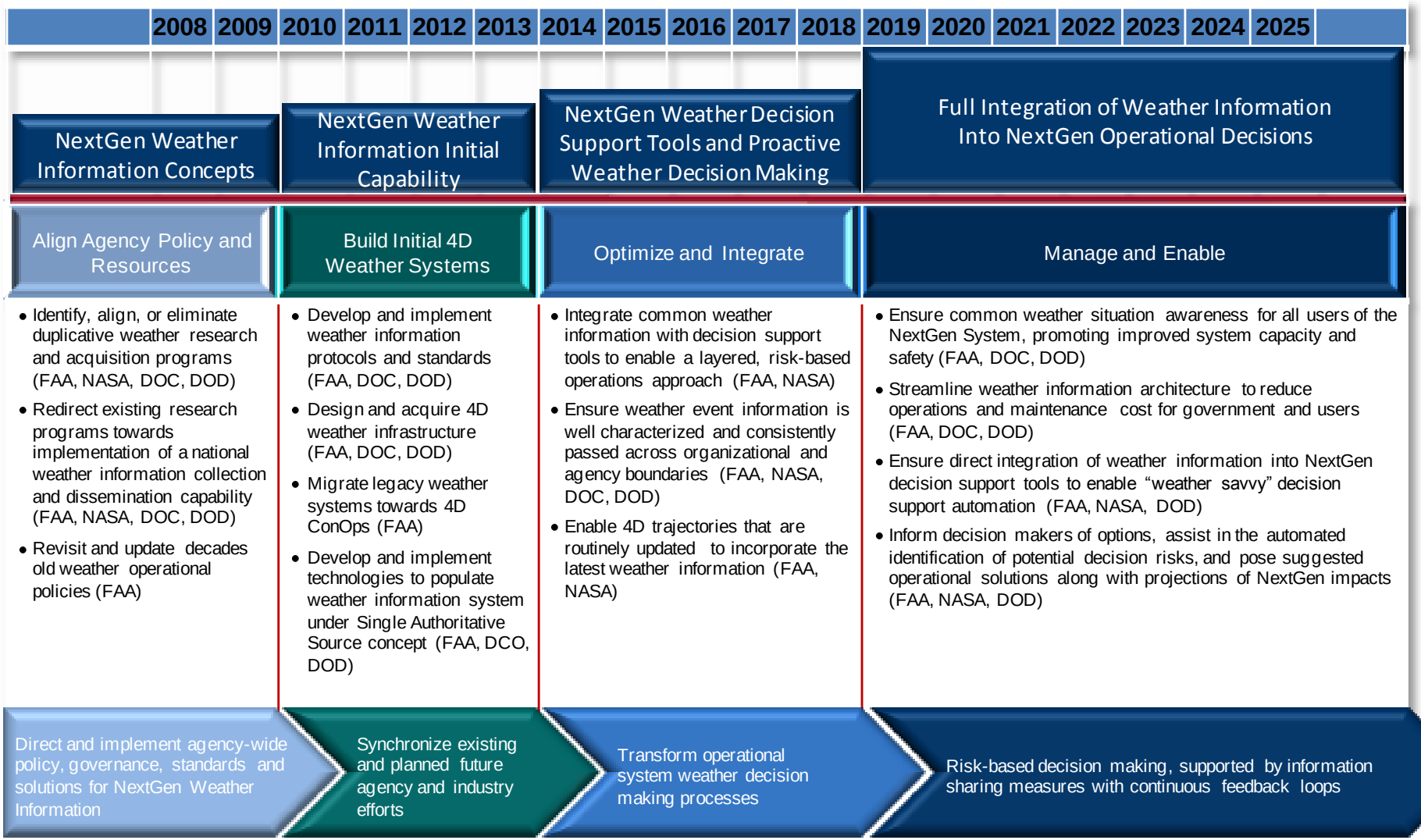
The Bottom Line

- 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

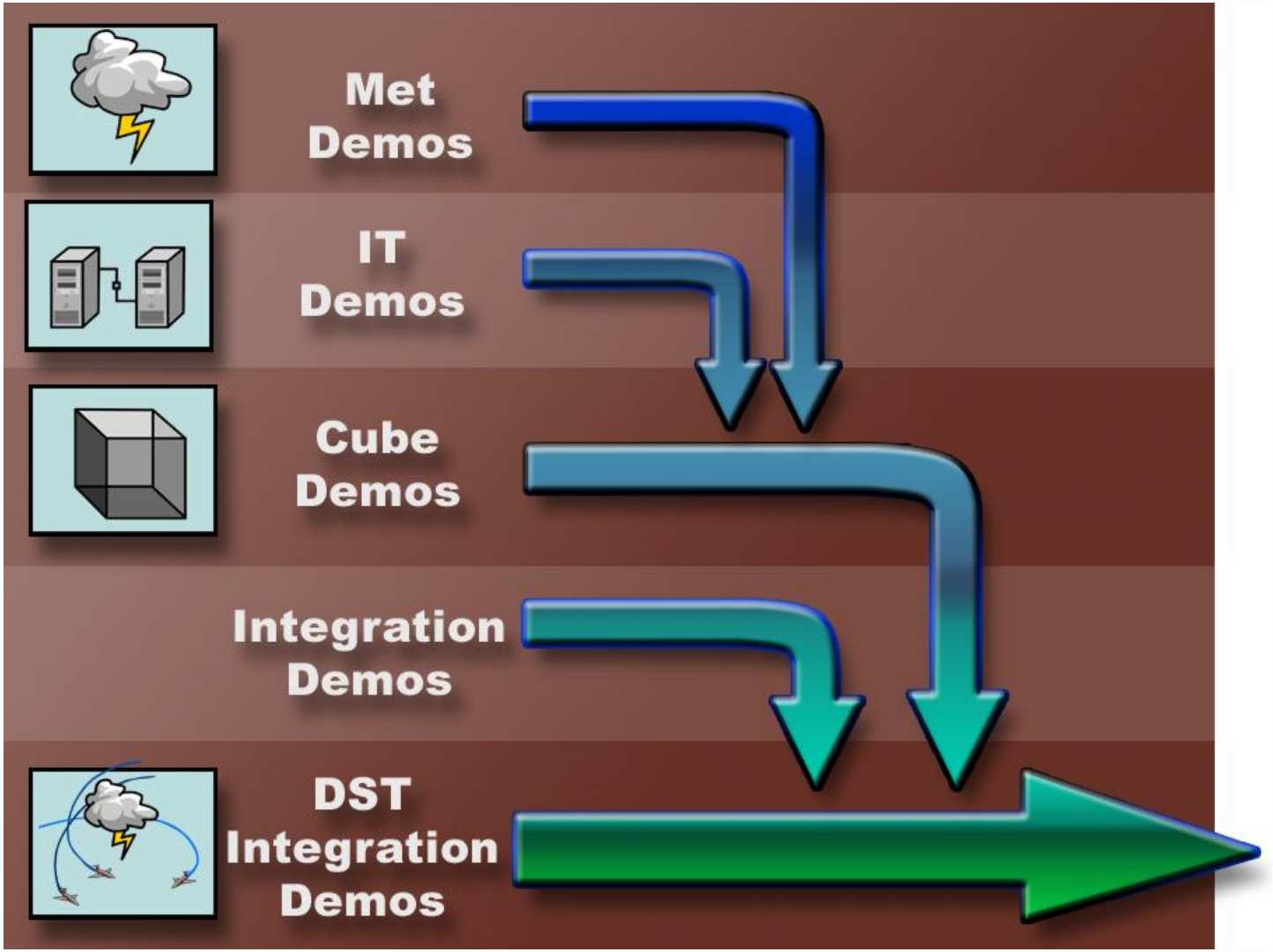
Back up slides

Next Generation Air Transportation System
Joint Planning and Development Office

Weather Transformation



Multiple Path Approach



Today vs. NextGen Weather Information Attributes

Today

- 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)

NextGen

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

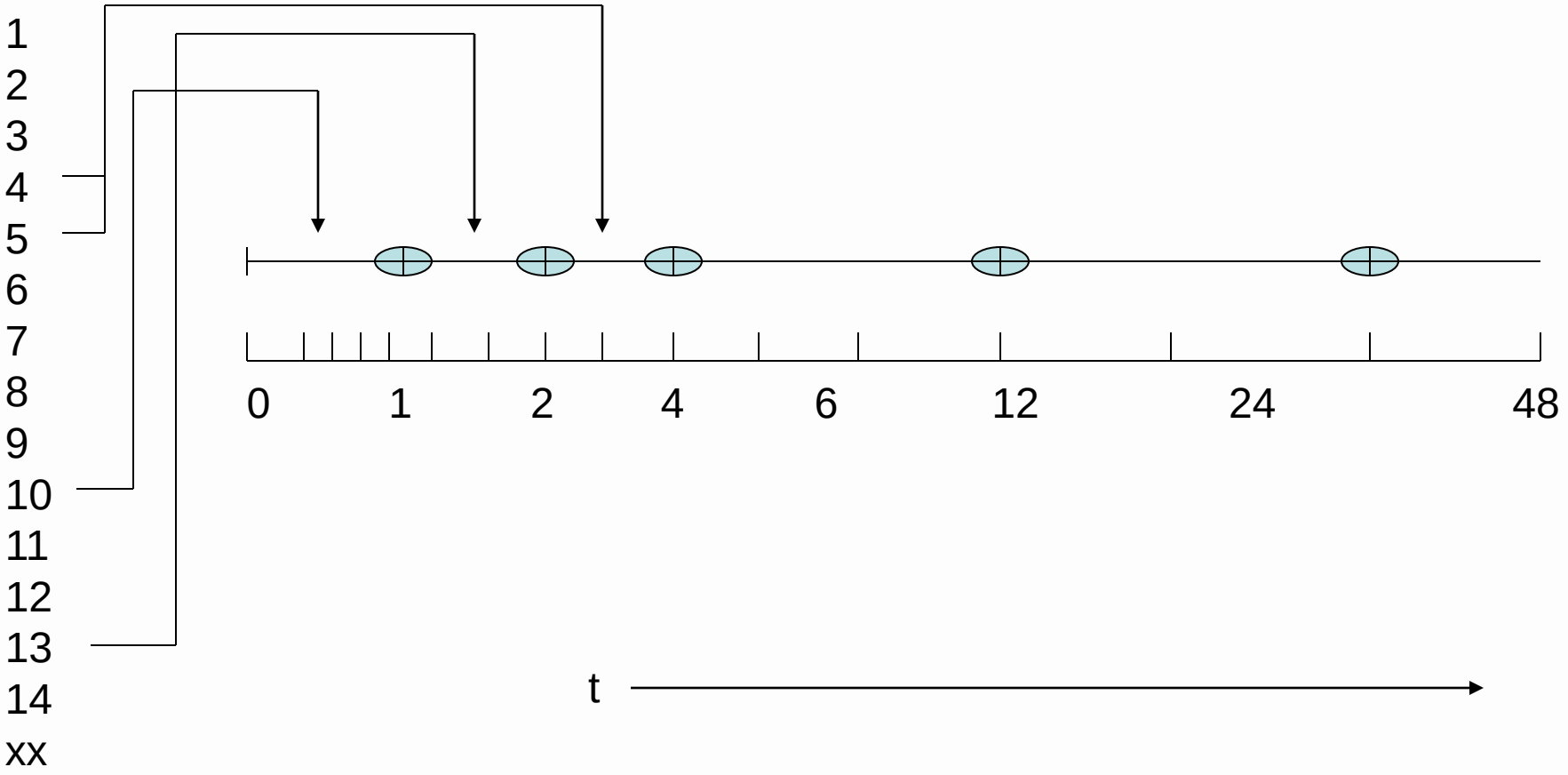
Roles & Responsibilities

- **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

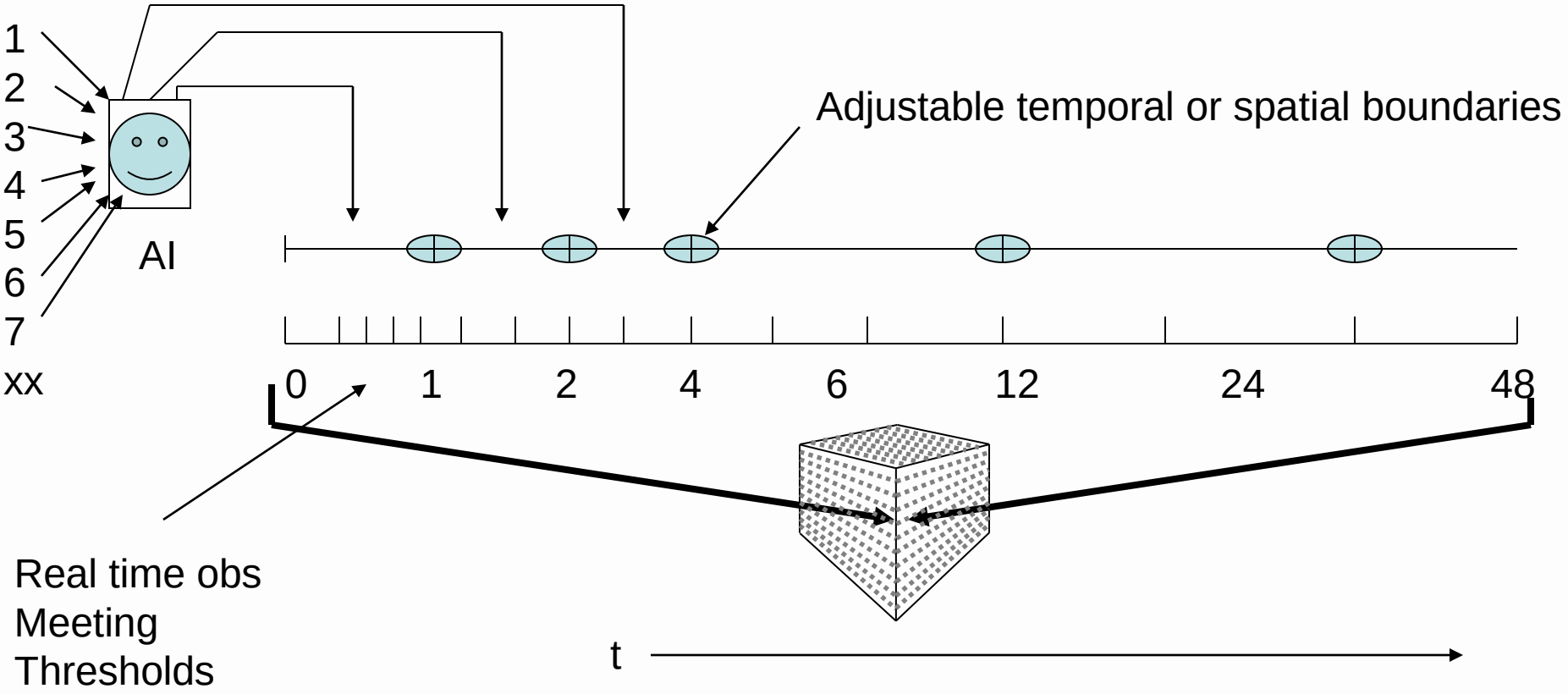
- Myth: The SAS is all aviation weather information.
- Fact: SAS is a subset of all aviation weather information "contained" in the 4-D Wx Data Cube
- Myth: The SAS is a single big server
- Fact: SAS is hosted on many servers around the US that is specified by metadata tag as SAS data
- Myth: The SAS 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)

Cube and Consistency
NextGen (2013)



NOAA/NWS “owns” this problem

Cube and Consistency
NextGen (2025)



NOAA/NWS “owns” this problem

Probabilistic information (reliability vs accuracy)