

# Aviation Weather A NextGen Research Perspective

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# Why we're here today

- To brainstorm
- To discuss edges of the box (and beyond)
- To boldly go where no researcher has gone before....
- To assist the “government” in thinking about the paths we need to take and to help them shape the budgets required
- To discuss big picture gaps and overlaps

# Cultural Issues

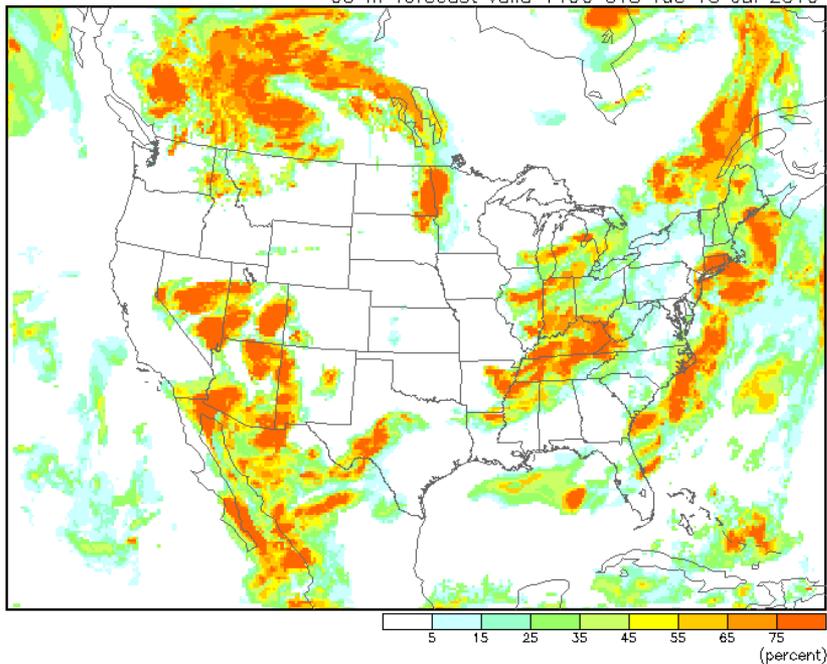
- Trust or faith in weather systems
- Using weather information proactively
  - Hurricanes
  - Severe winter storms
  - Thunderstorms
  - Surface wind shifts
- My forecast is better than your forecast (or box)
- National consistency versus local knowledge
  - Single Authoritative Source
- Operators grab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

# Weather Graphics Interpretation

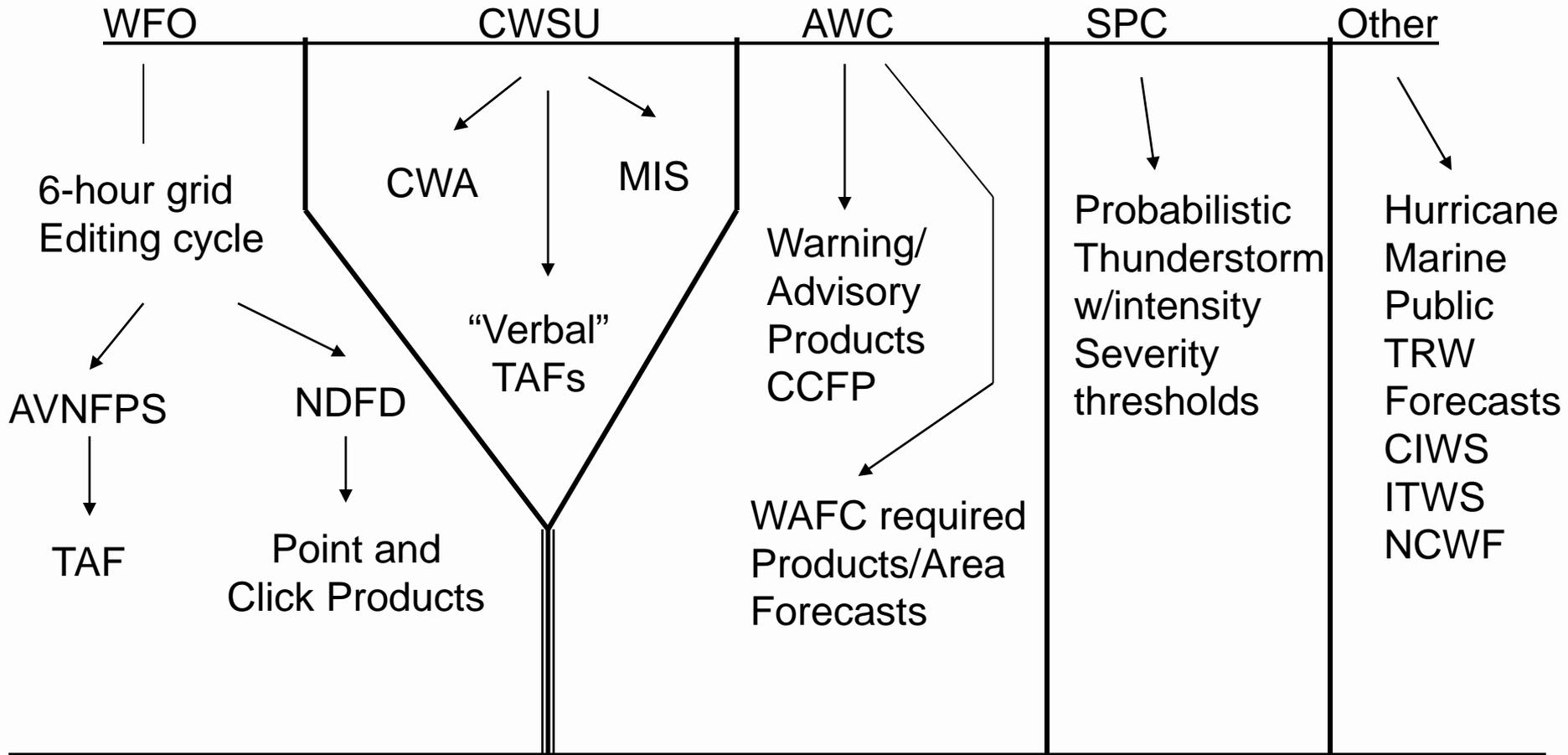
The FIP is an automatically-generated product that supplements AIRMETs and SIGMETs by identifying areas of forecast icing potential, but it does NOT substitute for the intensity and forecast information contained in AIRMETs and SIGMETs. It is authorized for operational use by meteorologists and dispatchers.

## Maximum icing potential (1000 ft. MSL to FL300)

03 hr forecast valid 1400 UTC Tue 13 Jul 2010



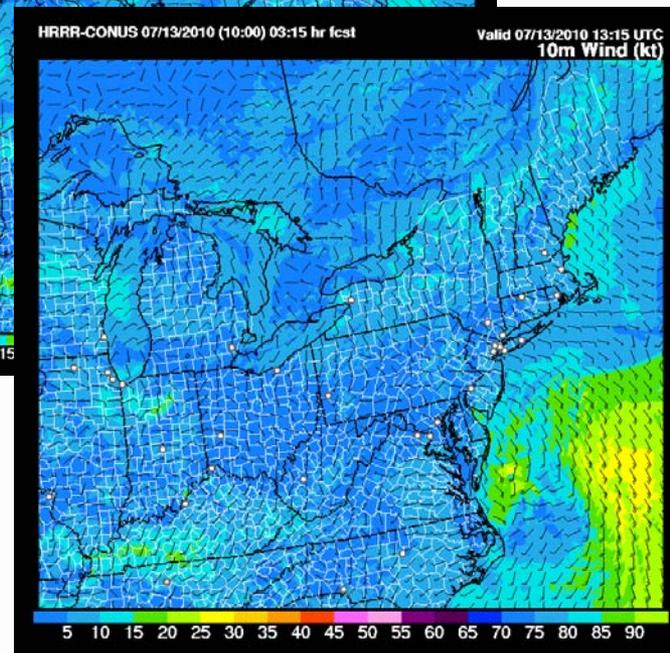
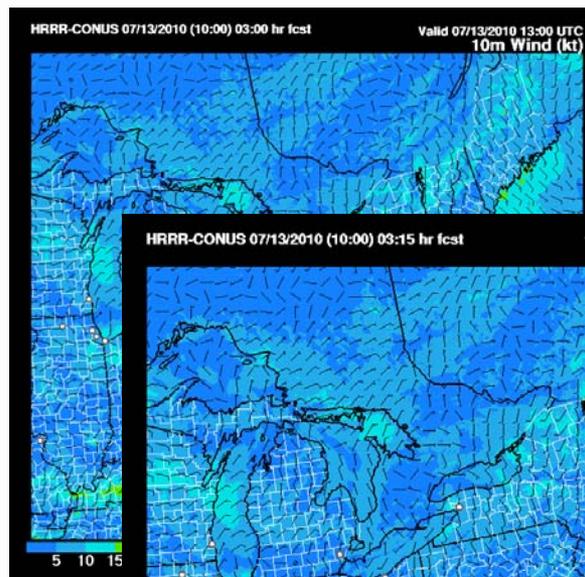
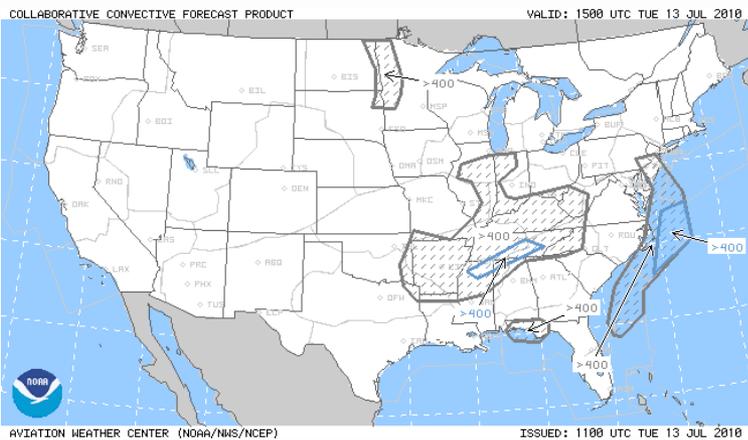
# Cube and Consistency Today



# Introduction to Weather Concept of Operations

- Weather providers deliver a four-dimensional set of weather information
  - Operators/Managers 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

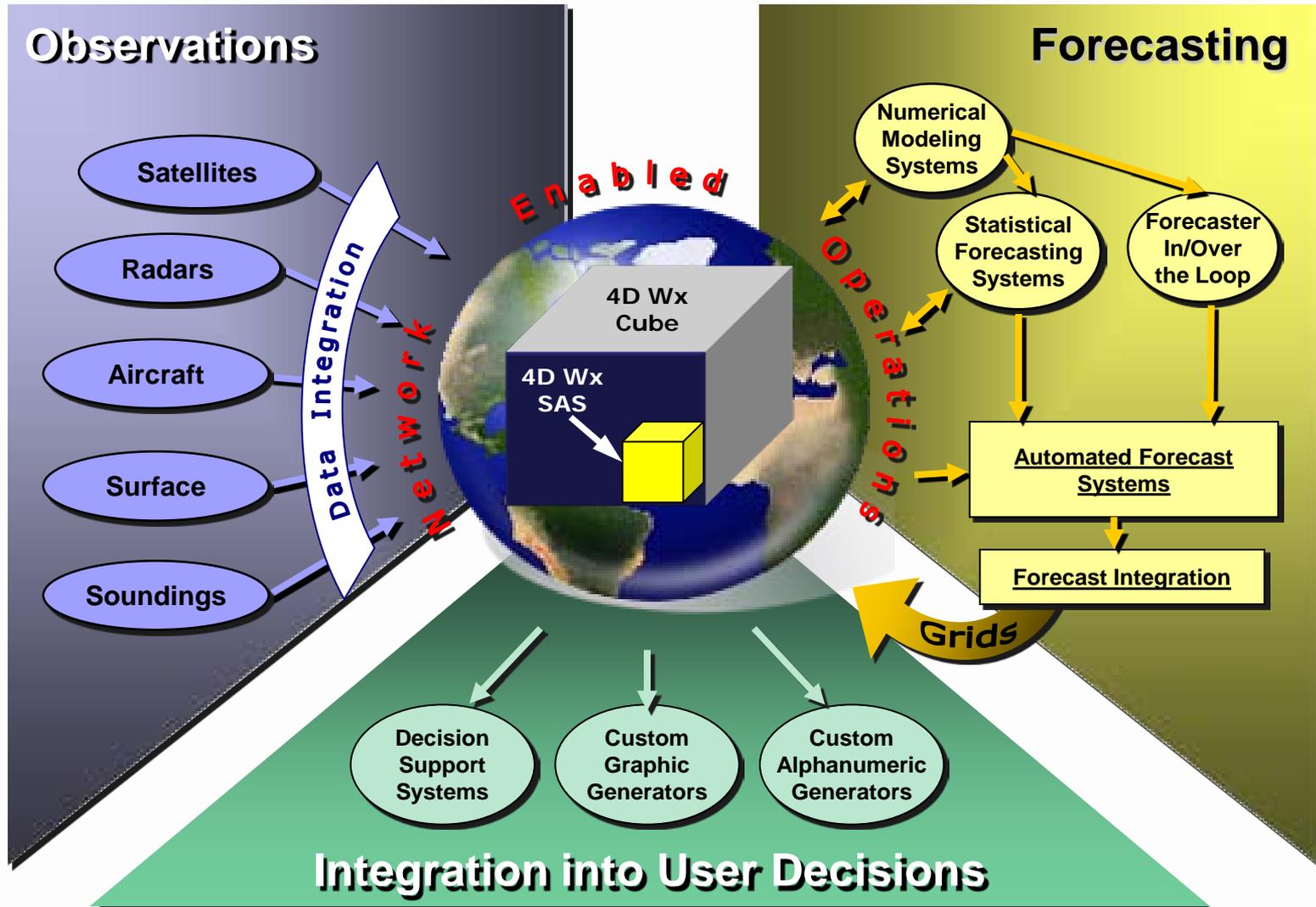
# From Products to 0's & 1's



# Cultural acceptance

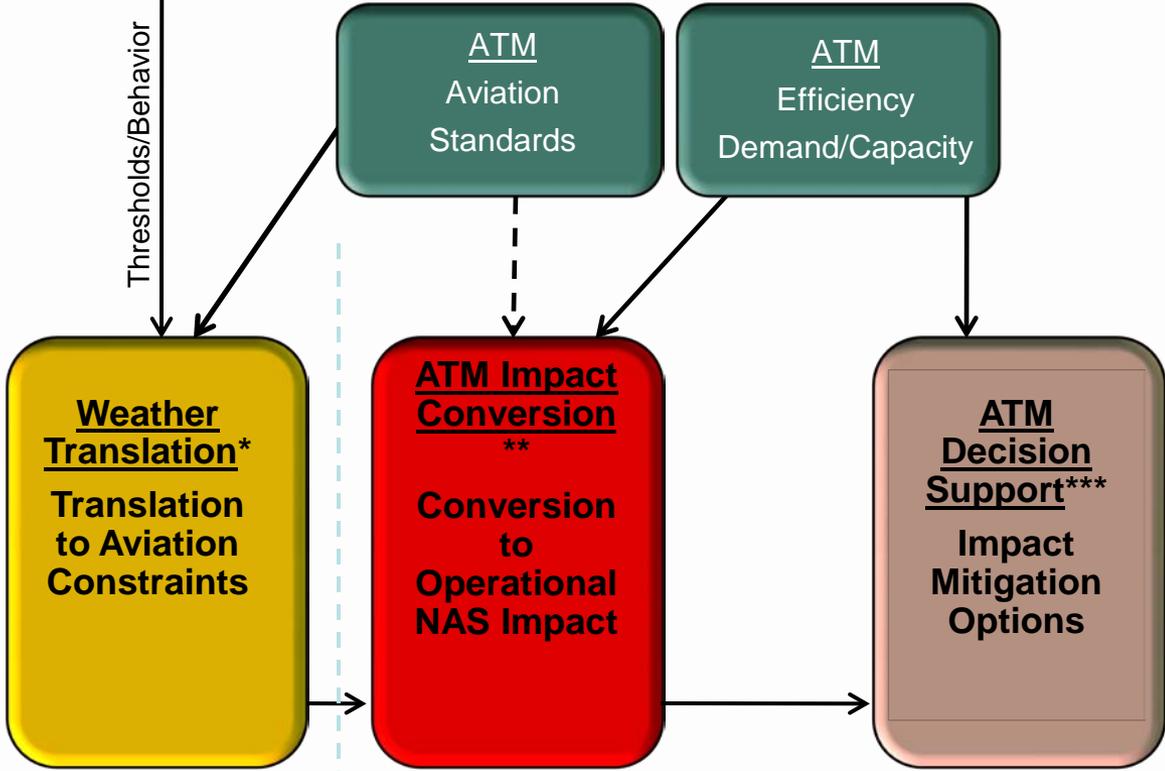
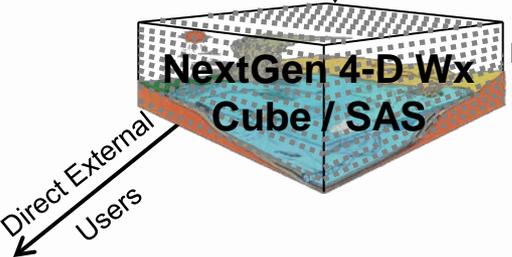
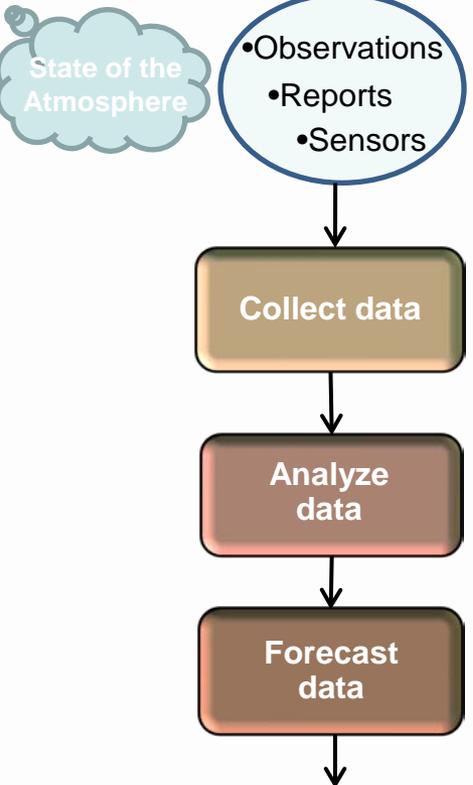


# The 4-D Weather Cube: A Conceptual Model



# NextGen Weather Integration Concept

Next Generation Air Transportation System Office

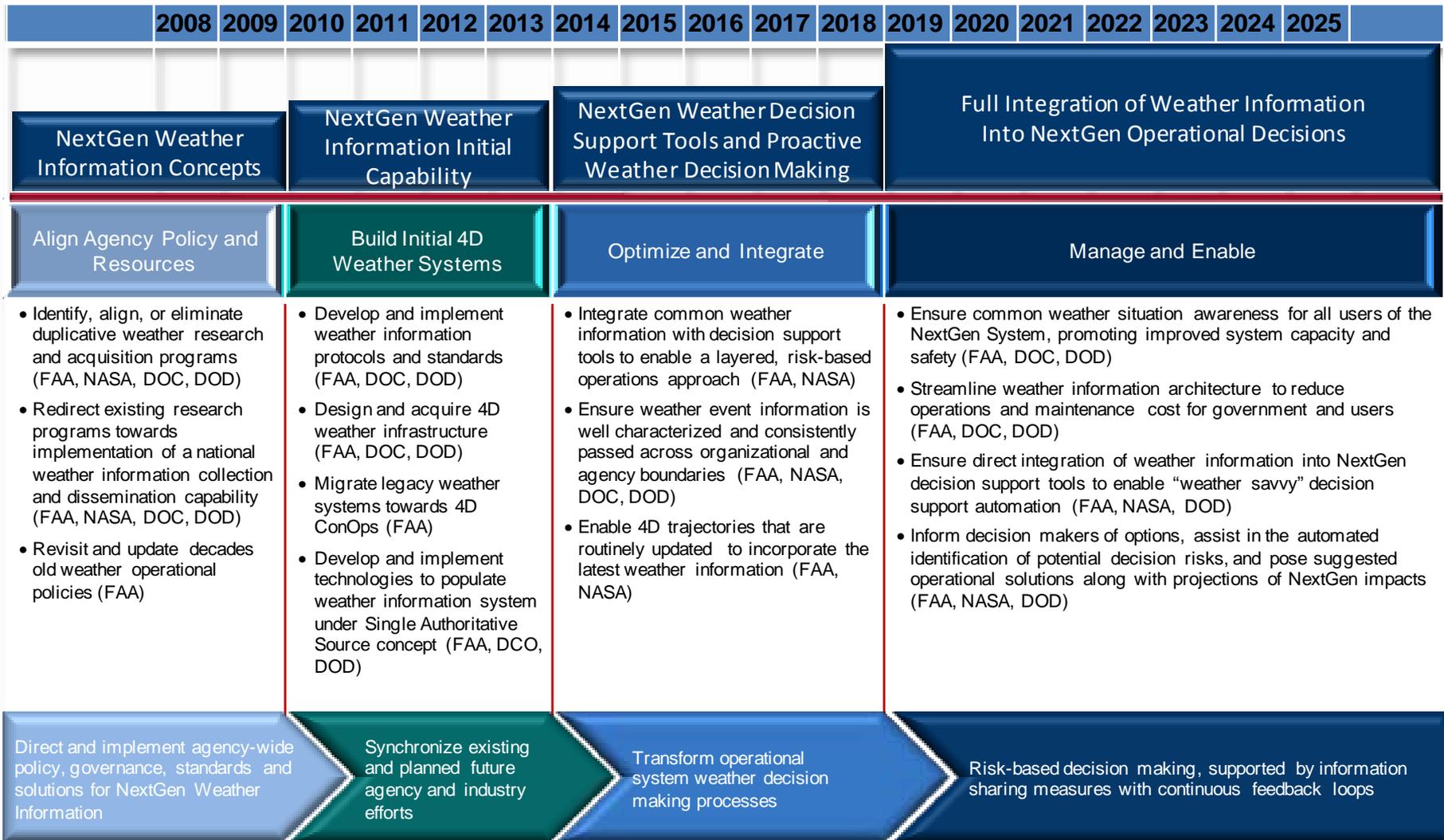


\* Translation of weather data & other components into characterization of potential NAS constraints

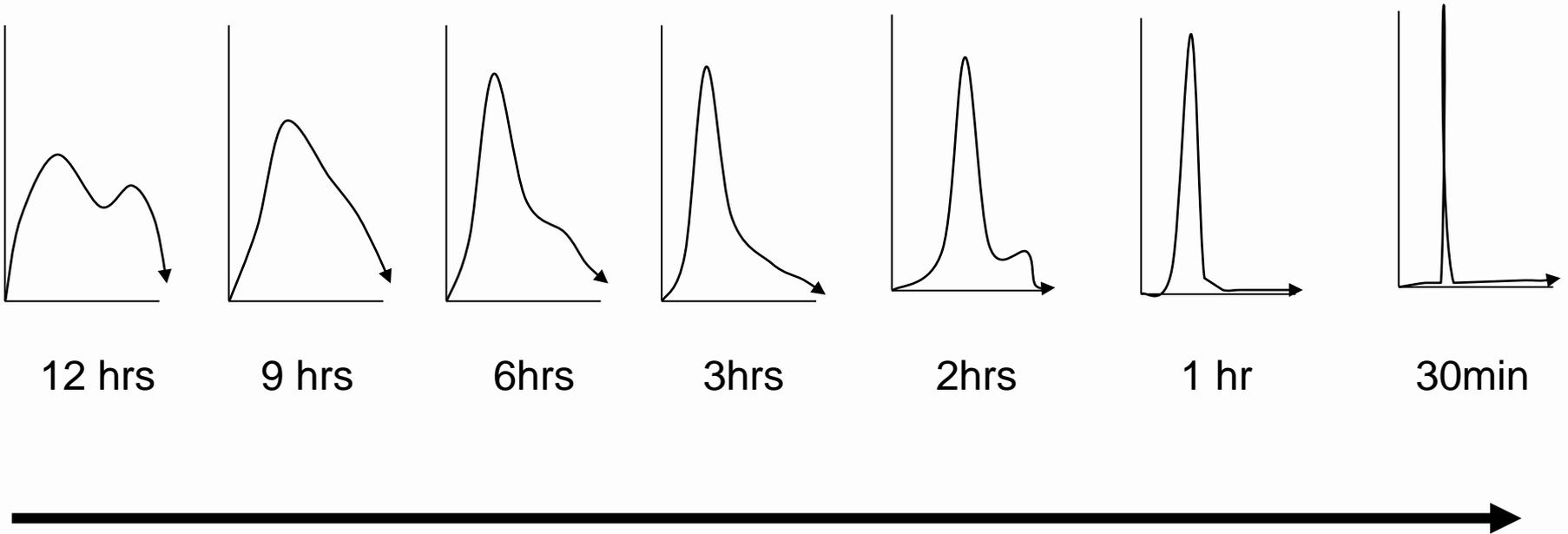
\*\* Conversion of potential NAS constraint into specific NAS impact(s).

\*\*\* DSTs use specific NAS impact to develop strategic/ tactical TFM strategies.

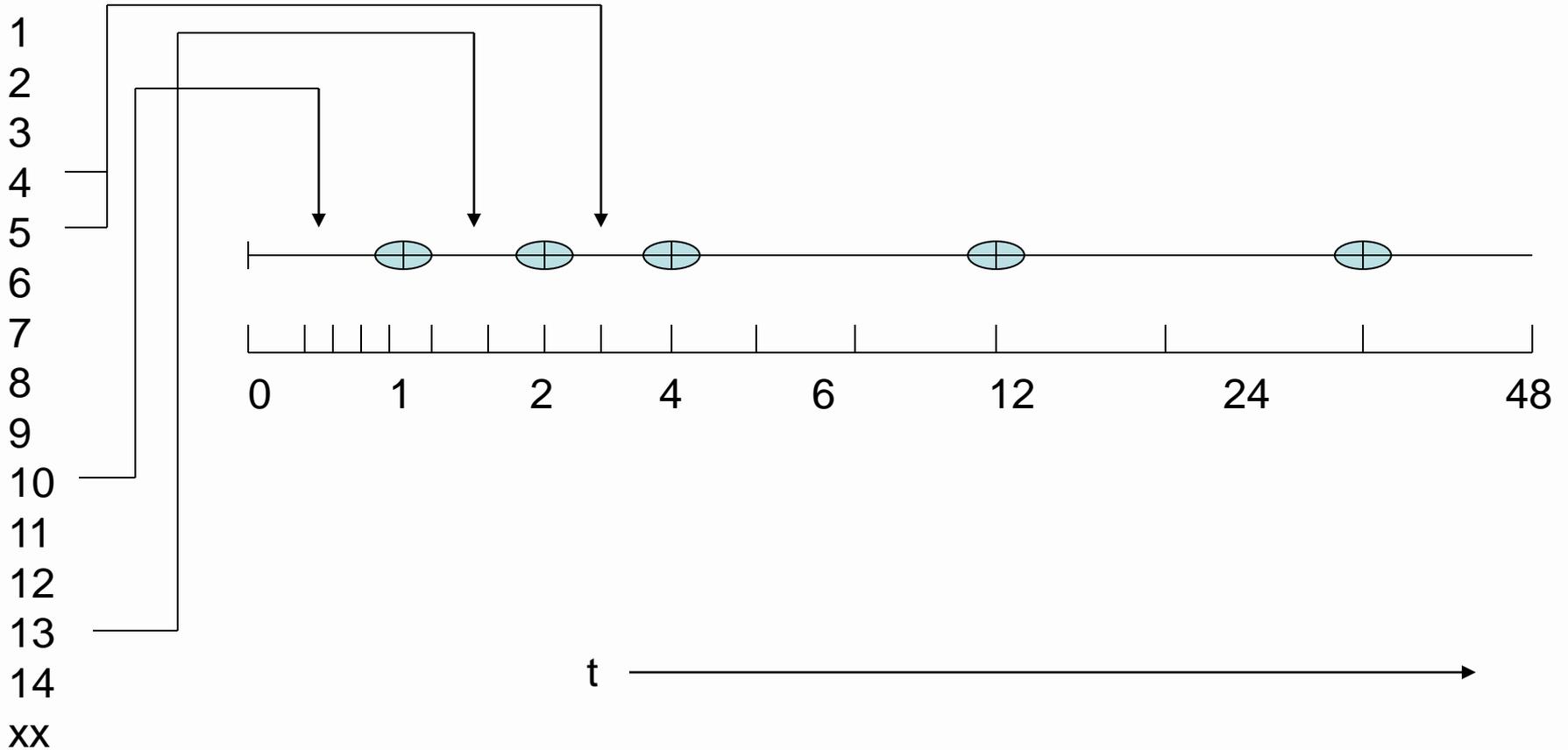
# Weather Transformation



# Probabilistic information (reliability vs accuracy)

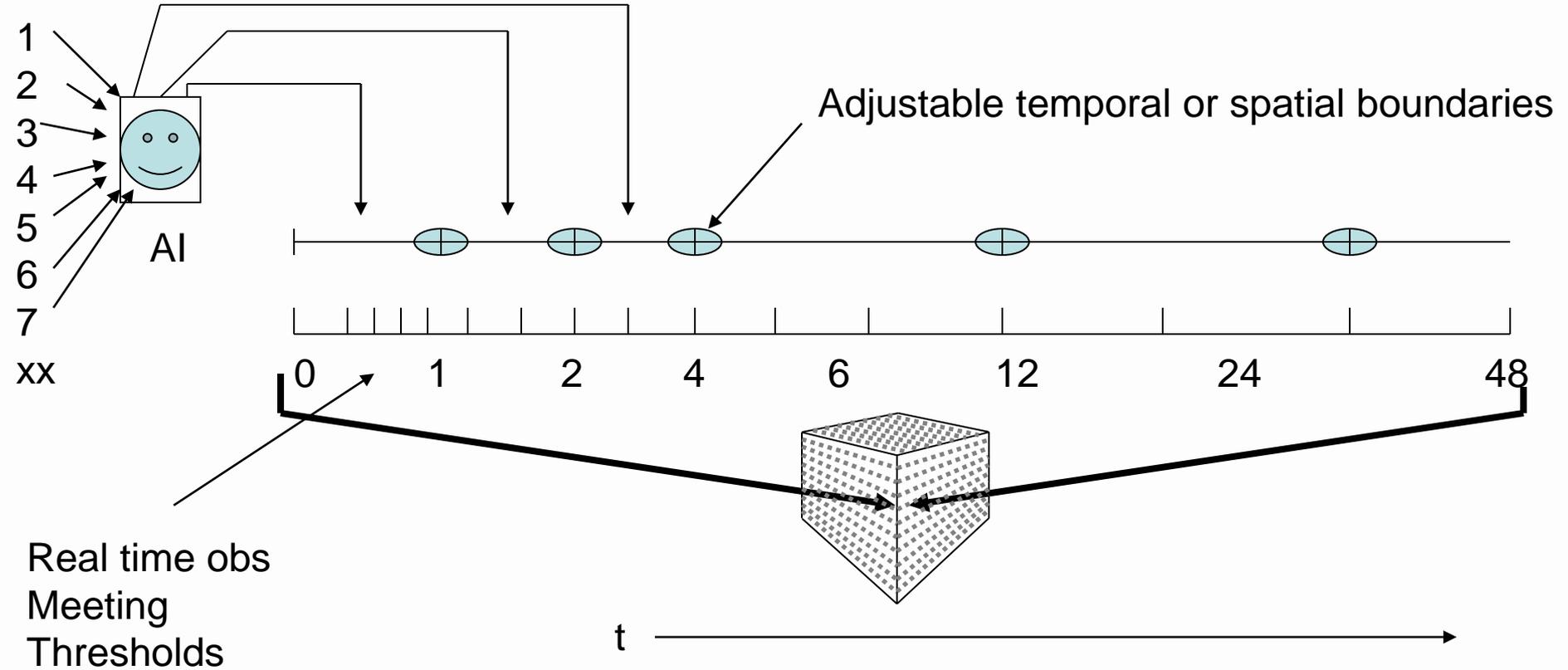


# Cube and Consistency NextGen (2013)



NOAA/NWS “owns” this problem??

# Cube and Consistency NextGen (2025)



NOAA/NWS “owns” this problem

# 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

# 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

# Research Discussion

- We need research to stay in their lanes
  - Weather research does weather research
  - Ops research
  - Human Factors (for an extended transition period)
- There will be an integrating force, it just won't reside within the traditional weather community
- Decades long research towards advancing the state of the art of physical parameters (largely in an isolated manner)
  - Operational characteristics/requirements a third order function

# Research Discussion

- We need to focus research towards “operationalization” targets
- Research efforts can no longer afford to be treated as isolated events; instead, they must be integrated against a common plan with consistent goals
- End to end research boxes are not the end game
  - 0’s and 1’s
  - Translation
  - Impact
  - Decision making
- Proprietary solutions not desired

# Andrews Theorem's

- Production of a dynamic, integrated, set of SAS ZAOs are either:
  - Underestimated in terms of complexity
    - Spatial/Temporal/Physical consistency
    - Means of adjudicating multiple forecast techniques on a time scale operationally relevant
    - Near real time updating for pathfinder events
    - Serious, un-emotional effort to determine MITL/MOTL benefits and techniques for doing so
  - Complicated by the fact the desire to build better and more cosmic display(s) for weather data is an irresistible force – culturally this will be very difficult to overcome

# NextGen Weather Integration Concept

Next Generation Air Transportation System Office

Met Community

Research Community & Components

ATM Community

State of the NAS

State of the Atmosphere

- Observations
- Reports
- Sensors

Collect data

Analyze data

Forecast data

NextGen 4-D Wx Cube / SAS

Direct FAA Users

Direct External Users

Thresholds/Behavior

ATM Aviation Standards

ATM Efficiency Demand/Capacity

**Weather Translation\***  
Translation to Aviation Constraints

**ATM Impact Conversion\*\***  
Conversion to Operational NAS Impact

**ATM Decision Support\*\*\***  
Impact Mitigation Options

\* Translation of weather data & other components into characterization of potential NAS constraints

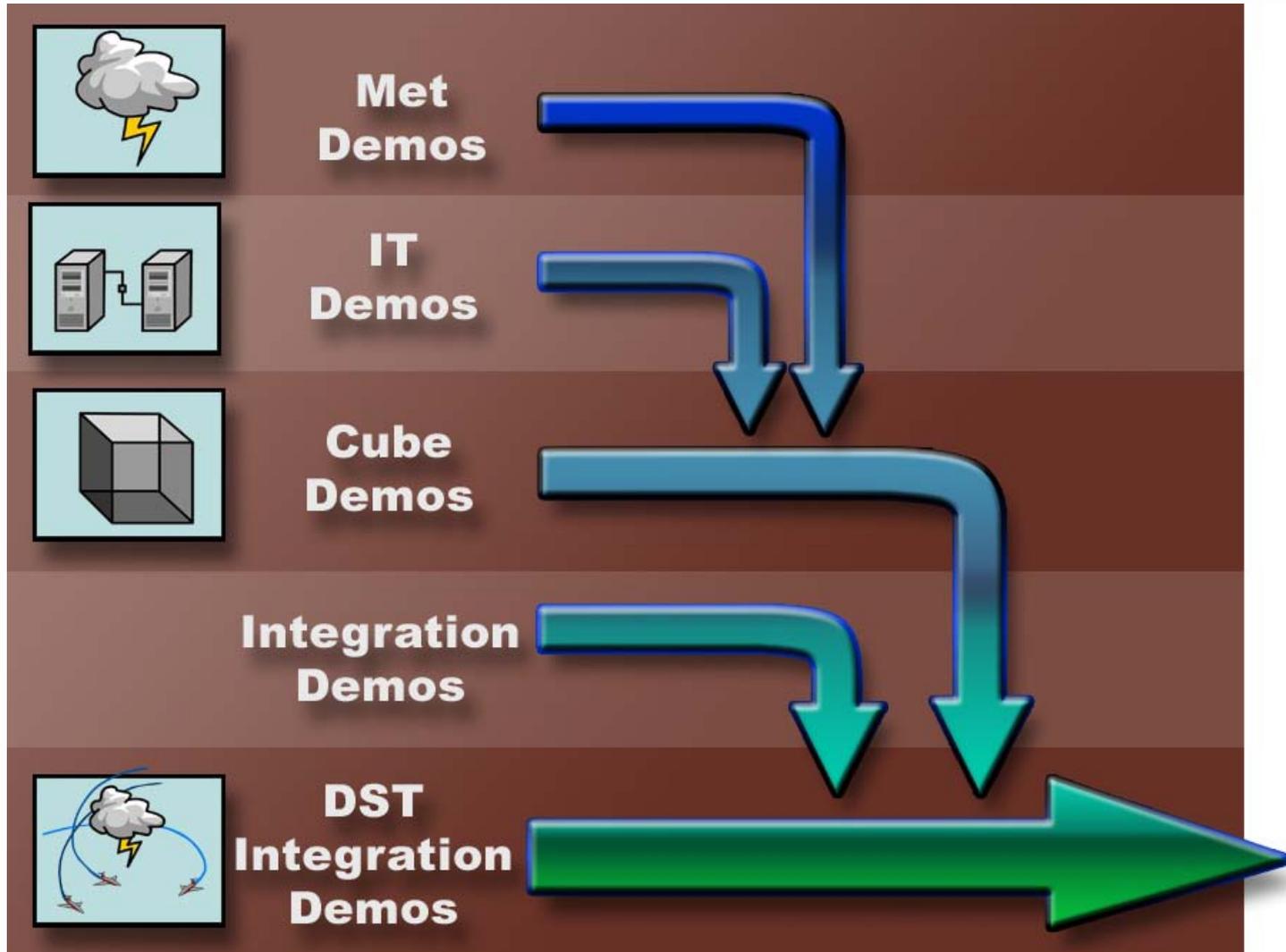
\*\* Conversion of potential NAS constraint into specific NAS impact(s).

\*\*\* DSTs use specific NAS impact to develop strategic/ tactical TFM strategies.

Primary:  
Secondary:



# Multiple Path Approach



# Back up slides



# 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

# 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)