NextGen Weather and the Path Ahead

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Overview

- NextGen Basics and the 4-D Cube
- Partnership
- What is NOAA doing now
- The roadmap to IOC and beyond
- Challenges ahead

NextGen Basics

- **NextGen goals are not achievable without improving integration of weather information into decision support systems**

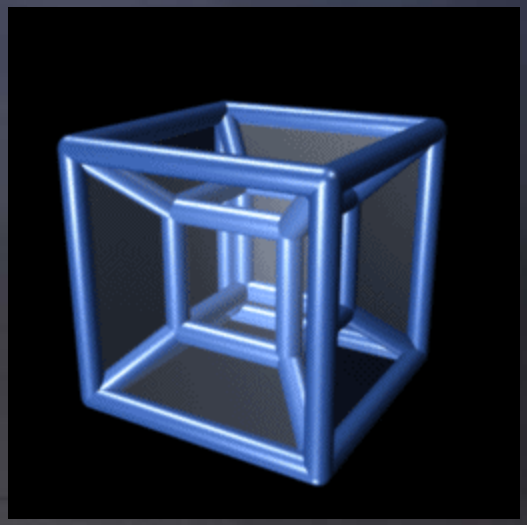
- **NextGen weather vision (a major paradigm shift) is focused on:**
  - *Providing a multiple user common weather picture*
  - *Consistent and reliable weather information*
  - *An improved weather information data storage approach containing observed, analyzed, and forecast data (the "4-D Weather Data Cube") enabling NextGen dissemination capabilities*

NextGen Basics

- **A Net-centric (net-enabled) capability is envisioned:**
  - ***"Network Enabled"…***
    - An information network that makes information available, securable, and usable in real time
    - Information may be pushed to known users and is available to be pulled by others
    - Weather information sharing is two-way
  - ***"Virtual" repository with no single physical database or computer***
    - Conceptually unified source distributed among multiple physical locations and suppliers, of which NOAA is the leading data supplier

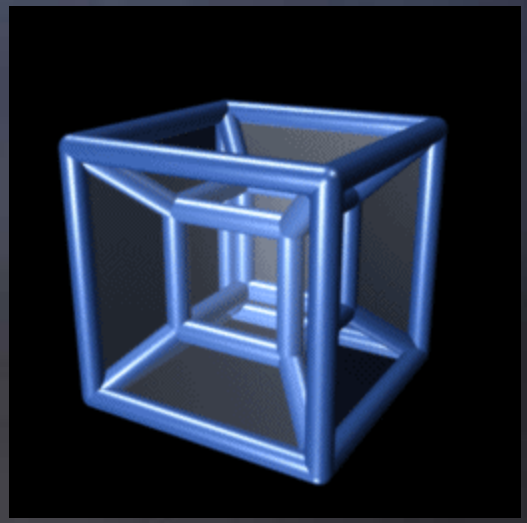
What is the 4-D Weather Data Cube?

- **The 4-D Weather Data Cube (aka Weather Information Database or WIDB) will contain:**
  - ***Continuously updated weather observations (surface to low earth orbit, including space weather and ocean parameters)***
  - ***High resolution (space and time) analysis and forecast information (conventional weather parameters from numerical models)***
  - ***Aviation impact parameters for IOC (2013)***
    - Turbulence
    - Icing
    - Convection
    - Ceiling and visibility
    - Winds (surface and aloft)
  - ***The 4D Cube of the future will contain "all" weather data, not just aviation parameters.***

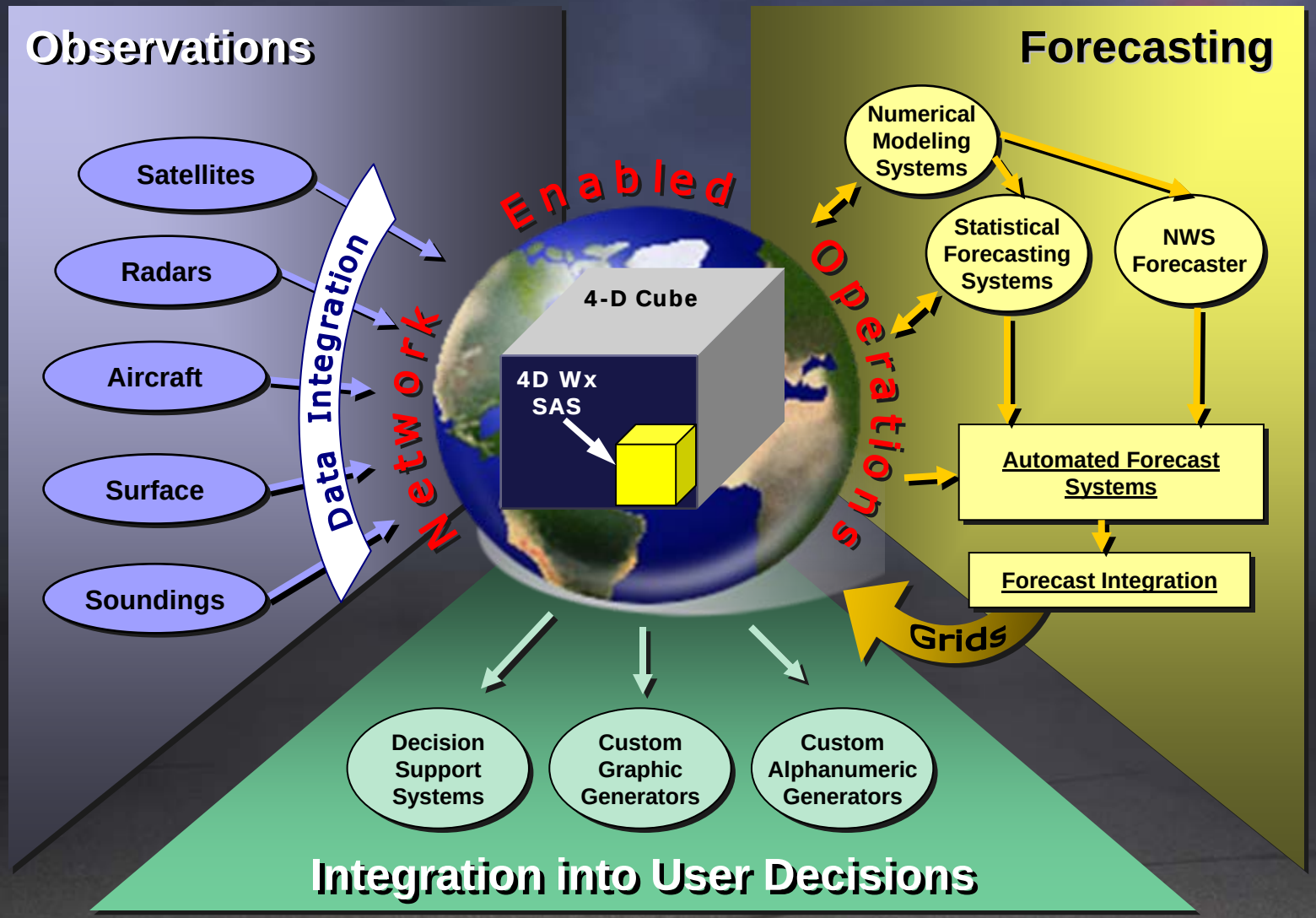


What is the 4-D Weather Single Authoritative Source?

- **The 4-D Wx Single Authoritative Source (SAS):**
  - ***Is only a portion of the WIDB***
  - ***Provides a common weather picture for National Air Space (NAS) participants (Airlines, DoD, FAA, etc.)***
  - ***Is the basis for all aviation decisions by Air Traffic Management (ATM) in the FAA***
    - Defining ATM?
  - ***Is formed by merger of model data, automated gridded algorithms, climatology and observational data, and meteorologist input/data manipulation to ensure consistency and accuracy***



The 4-D Weather Data Cube: A Conceptual Model



Working With Our Partners

- **NOAA/NWS is working with the FAA, DOD, NASA, industry, and the research community to develop the 4-D Cube**
- **JPDO led initiatives:**
  - *NextGen Network Enabled Weather (NNEW) IOC Development Team*
    - **Environmental Information Team – What's in the Cube**
    - **IT and Enterprise Services Team – Cube "plumbing"**
    - **Policy Team – Governance, cost apportionment, data access rights, etc…**
    - **Demonstration Team**
- Other teams/initiatives:
  - *Requirements Development – Functional and Performance*
  - *Integrated Science Roadmap*

What NOAA Brings to the Table

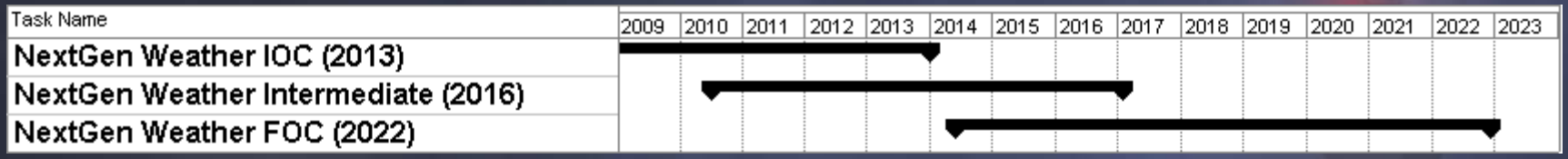
- Extensive experience with data ingest and assimilation
- Ownership of major observation and modeling capabilities
- Experienced meteorological workforce
- Legislative mandate to provide weather to the FAA
- Existing related capabilities such as AWIPS and NDFD

- NOAA/NWS project office has been established within the NWS Office of Science and Technology
  - *Jason Tuell – Project Manager*
- ***NextGen now a NOAA high priority and NOAA is committed to lead the 4-D cube effort!***

Examples of NOAA/NWS Tasks in FY09

- **NOAA/NWS has agreements with it's Meteorological Development Lab (MDL) and with other research partners in FY09 to work on the following:**
  - ***Viability of adding ceiling and visibility grids to the NWS National Digital Forecast Database (NDFD)***
  - ***Test and Prototype Interactive Calibration of Aviation Grids in 4 Dimensions (IC4D)***
  - ***Gridding LAMP output***
  - ***Evaluate various Forecaster-in-the-Loop (FITL) or Forecaster-over-the-Loop (FOTL) techniques***
  - ***Various IT related tasks have also been coordinated (data exchange and standards, etc…)***
  - ***Working with AWC to enhance the Aviation Weather Testbed***

The Roadmap Ahead



- **Initial Operational Capability (2013)**
  - *Integrated environmental information sources*
  - *Limited meteorologist oversight of gridded data*
  - *Common data standards and protocols*
  - *Initial integration of diverse weather elements into decision support tools*
- **Intermediate Capability (2016)**
  - *Improved modeling and science enables higher resolution more accurate information*
  - *Full Network compatibility of environmental information*
  - *Direct integration of weather into Air Traffic Management Systems*
- **Full Operational Capability (2022)**
  - *All NextGen requirements met and benefits achieved*
  - *High resolution, nested scale forecasts available for all elements*
  - *Full network connectivity ensures consistent information use across service areas and user groups*

NextGen Weather Challenges

Consistency:

- The FAA requirements consider consistency just as important as accuracy
- Consistency Challenges:
  - *Spatial*
  - *Internal*
  - *"Representativeness"*

NextGen Weather Challenges

The Forecast Process:

- Most existing NWS forecast processes not designed to meet the resolution, refresh and latency requirements of NextGen
- Temporal and Spatial resolution – Are NextGen observation and forecast requirements viable? Will model researchers and developers have the resources available?
- NOAA and research partner R&D focusing on Meteorologist-in-the-Loop (MITL) and Meteorologist-over-the-Loop (MOTL) techniques
- Workload and Priority
- Where do forecasters add value to the highly automated, digital model data?
- Changing forecast process culture is complex and possibly controversial

NextGen Weather Challenges

Using probabilistic forecasts

- From the JPDO Weather ConOps…
  - *"Uncertainty in meteorological phenomena that have significant impact on system capacity is managed through the use of probabilistic forecasts. These forecasts are in a quantitative format, covering location (three-dimensional space), timing, intensity, and the probability of all possible outcomes…"*
- Are we ready for this? Do we understand the difference between probabilistic forecasts and deterministic forecasts?
- Does "Stormy" give you a probabilistic or deterministic forecast?

NextGen Weather Challenges

Populating the 4-D Cube before we build the Decision Support Tool

- Build it and we will come?
- Can we truly validate user requirements before the new breed of DST is available?

NextGen Weather Challenges

Is NextGen meeting the needs of the GA community?

- We must make sure that GA required products are derived (derivable) from the 4-D Cube
- Will FARs and other requirements change?

NextGen Weather Challenges

Will our systems really be compatible?

- The coordinated multi-agency effort for common data standards and protocols is going well now
- However, we are a long way from where we want to be!

NextGen Weather Challenges

What about verification?

- NextGen suggests verification schemes that measure operational impacts
- Move away from traditional verification methodology like PoD and FAR
- An example is the Weather Impact Traffic Index, WITI
  - *Measures efficiency of the NAS operation, but weather is only one factor*
  - *Factors in airport capacity, time of day, traffic corridor, etc…*
  - *NWS/FAA is collaboratively working on the "Terminal Forecast WITI" which is a forecast of the NAS operation at a terminal or a corridor*

NextGen Weather Challenges

Developing a coordinated multi-agency outreach plan

- We must ensure the NextGen story is consistent and gets out to our diverse user community
- Individual agencies, including NOAA, is doing active outreach, but it's time to coordinate agency outreach efforts and tell a common story

Summary

- NextGen will require significant changes in the way weather information is produced
- The NextGen paradigm suggests that most weather information will be assimilated into decision support tools and the decision making process
- NOAA is part of a partnership (agency and industry) to build the 4-D weather cube
- NOAA has been designated as the Office of Primary Responsibility (OPR) to build and deploy a 4-D Weather Data Cube (WIDB) by IOC (2013) and beyond
- There are many challenges ahead!