P1.14 BUILDING A 4-D WEATHER DATA CUBE FOR 2013 IOC

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Abstract
Much thought and planning have resulted in an end-state picture of a 4-dimensional (3 spatial dimensions plus time) weather data cube existing in a net-enabled environment and consisting of high-resolution, rapidly updated digital data and information. A first step toward that end state is a bridge between current and future capabilities that demonstrates partner cooperation and accounts for a wide variety of weather observation and forecast systems in use or expected to be in use. Such a bridge is envisioned through demonstration of a 4-D weather data cube Initial Operational Capability (IOC) for the Next Generation Air Transportation System (NextGen) in 2013. Participating partners include, but are not limited to, Federal Aviation Administration (FAA), National Oceanic and Atmospheric Administration (NOAA), National Aeronautics and Space Administration (NASA), Department of Defense (DoD), Academia, and Industry. The goal at IOC is to have an operational 4-D cube of environmental observational and forecast data, including aviation impact variables for convection, icing, turbulence, ceiling and visibility, accessible through a net-enabled architecture and used in NextGen decision making. This paper describes the plan for reaching the IOC goal, including discussion of demonstrations leading up to IOC.

1. INTRODUCTION

Consider the impact of the Air Transportation industry today as it generates 5.4 percent of America's Gross Domestic Product, $640 billion in revenues and over 11 million jobs. Then consider projections that demand for air transportation may double or triple by 2025. Now couple the fact that the current Air Traffic Management (ATM) system is designed around "fair" weather with evidence that weather factors heavily into the majority of flight delays (IWP, 2008), and the picture emerges of a system nearing the breaking point. The economic costs alone amount to approximately $40 billion annually (Congressional JEC, 2008), and the need for change is receiving support at the highest levels (Bush, 2008). The good news is that the FAA estimates two-thirds of weather delays are potentially avoidable with better weather information (REDAC, 2007) The JPDO has developed a plan for NextGen to achieve needed improvements and accommodate the expected growth in demand without increasing delays (Concept of Operations, 2007). Part of that plan includes a robust, net-enabled source of weather observations and forecasts (Weather Concept of Operations, 2006).

2. GOAL: 4-D DATABASE OF WEATHER INFORMATION

The end-state goal for NextGen weather includes the following attributes:

- Reliable meteorological data from multiple contributors that facilitates integration into user decision support systems;
- Analyses and forecasts consistent across time spatial scales;
- Information updated rapidly to support aviation decision making;
- Faster dissemination of information; and
- Consistent, flexible product formats to support integration into flight operations and decision support systems.

Realizing the goal requires a partnership of Government, Industry, and Academia, with each segment contributing strengths, cooperation, and, as able, funding. The primary Government players are the FAA, NOAA, DoD, and NASA. Industry participation is primarily through the NextGen Institute, while Academia contributes greatly to research and development (R&D) and demonstration efforts.

3. INITIAL OPERATIONAL CAPABILITY, 2013

The envisioned solution of a virtual 4-D weather data base or cube will be built in stages, with the first stage completed with the 2013 IOC. This initial phase will center on five primary hazards: convection, icing, turbulence, low ceiling, and low visibility. In addition, wind and temperature

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information will be available to support flight planning and to fold into a rudimentary “single authoritative source” (SAS) of weather information for air traffic management decision making.

The SAS must be distinguished from the full 4-D cube or database as a specialized subset of data. Figure 1 shows conceptually how forecasts and observations contribute to the proposed Cube and SAS as well as how the information may be used to feed decision support systems and create custom graphical and text products.

Getting to IOC in 2013 requires systematic execution of a number of tasks, as shown in Figure 2. The partner organizations come together for nearly all the tasks, with management responsibilities being handled by FAA, NOAA, NASA, and DoD.

To date, the partners have developed a definition for IOC and are in the process of writing a concept of operation for the information technology (IT) component and one for the SAS. There is also active engagement on the task of developing common data standards and protocols and coordinating those with similar efforts abroad. Much of this work is translating from concept to reality through scheduled demonstrations of IT infrastructure, forecast processes, and integration of weather information into decision support systems. While rudimentary at this time, the demonstrations are showing increasing sophistication and complexity as they lead up to fielding an initial net-enabled 4-D database of weather information and a preliminary SAS in 2013.

4. REFERENCES

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Weather Concept of Operations, v1.0, 2006: Joint Planning and Development Office, 1500 K St. NW, Suite 500, Washington, DC.

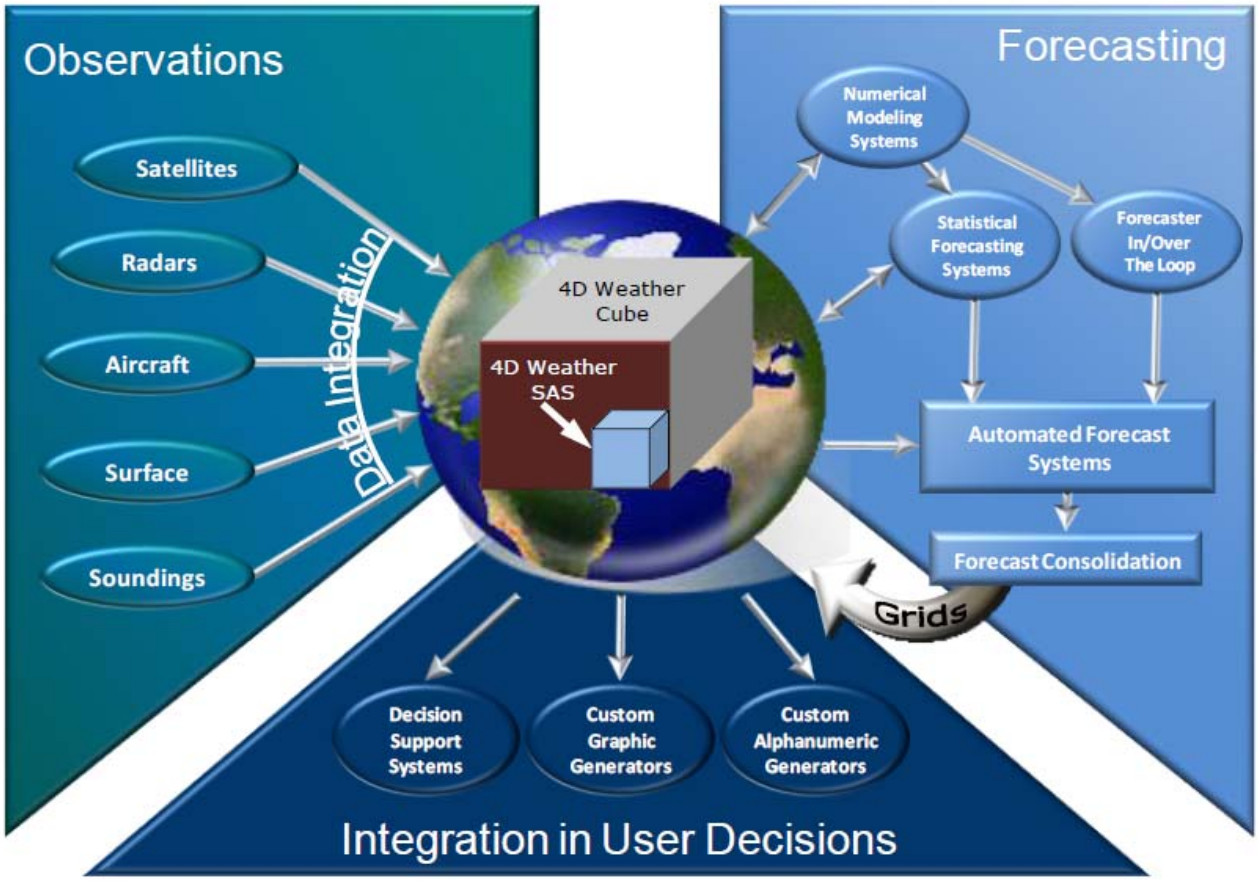

Figure 1. Conceptual view of 4-dimensional (4D) Weather Cube and subset Single Authoritative Source (SAS) populated by integration of data from various sources, numerical model and statistical forecast output, and human forecaster expertise. Information can be output transparently in a decision support system or support creation of graphical and text products.

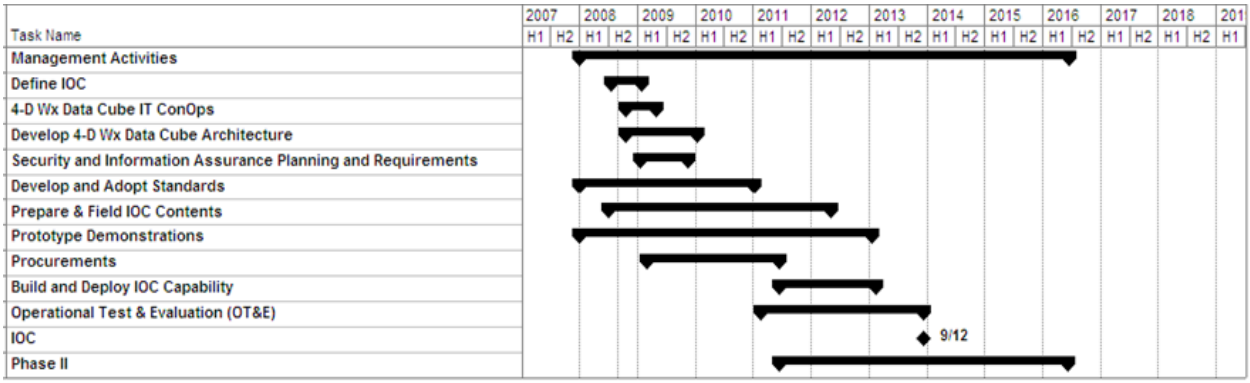

Figure 2. Simplified roadmap of activities leading to a 2013 Initial Operational Capability (IOC) for a 4-D Weather Cube.