P1.25

UTILIZING FAA RADAR WEATHER DATA IN THE NATIONAL WEATHER SERVICE: PROGRESS AND PLANS

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1. INTRODUCTION

The Federal Aviation Administration (FAA) operates over 400 radar systems across the United States (Stern et al, 2003). While the main purpose for these radars is the surveillance of aircraft and for national defense, as a secondary function many are equipped with weather channels. The National Weather Service (NWS), through its NEXRAD Product Improvement Program, has been exploring how to use these data to improve the accuracy and lead time of severe weather warnings and short range forecasts.

This paper will describe progress made in exploring use of FAA radar weather data by the NWS, particularly from the Terminal Doppler Weather Radar (TDWR), the Air Route Surveillance Radar, Model 4 (ARSR-4), and the Airport Surveillance Radar, Model 11 (ASR-11). Characteristics of the data and options for future operational deployment will be discussed.

2. CHARACTERISTICS OF FAA RADAR WEATHER DATA

The inventory of FAA operated radars across the country is numerous and varied. Some radars have been designed for local terminal coverage while others are used for long range surveillance. Some utilize a single, narrow fan beam while others take advantage of phased-array technology.

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The FAA has provided access to three different types of surveillance radars to the NWS so that the weather information could be evaluated. This section will briefly describe the characteristics of each. Stern, et al, 2003, contains much more thorough descriptions and examples.

2.1 *TDWR*

The Terminal Doppler Weather Radar, or TDWR, is different from other FAA operated radars as it is a dedicated meteorological surveillance system. Optimized for short-range hydrometeorological detection, the radar uses a narrow conical beam (0.55 degrees) within the C-Band (5.3 cm) spectrum (Stern, 2002).

The range resolution of the TDWR is very fine at 150 meters per range gate for both reflectivity and Doppler moments. This combined with the narrow beam structure allows the TDWR to observe small scale features.

The primary task of the TDWR is the detection of low-level wind shear hazards within the terminal area of airports. The system constantly runs algorithms looking for downburst, gust front and wind shear signatures and can automatically switch from a "monitor mode" to "hazardous weather mode" if conditions warrant. This switching of mode allows for faster scanning of the atmosphere and for a full suite of severe weather algorithms to run.

TDWR radars are located near many of the largest U.S. airports, and thus have coverage over some of the biggest urban centers. In addition, its high resolution and beam optimized for weather detection make this system a valuable tool to enhance NWS severe weather warnings, provide backup and supplemental coverage for NWS network radars and to spur new science initiatives associated with multidimensional Doppler techniques and storm structure.

2.2 *ARSR-4*

The Air Route Surveillance Radar, Model 4, or ARSR-4 is a joint FAA and Department of Defense (DoD) initiative whose mission is to provide aircraft position information to the FAA, Air Force, Navy and Customs Service. The system is used simultaneously for national defense early warning, drug smuggling interdiction, and air traffic control. As a secondary function, the ARSR-4 also provides weather information to both the FAA and the NWS (Stern, 2001).

The ARSR-4 is very different from the TDWR and WSR-88D in one aspect. The ARSR-4 creates a volumetric observation of the atmosphere by using phased-array technology. In a phased-array system, individual (array) elements can be electronically controlled to manipulate the direction and shape of each beam. This allows the ARSR-4 to simultaneously sample from 10 beams with each rotation of the antenna.

While the ARSR-4 has a Doppler capability, only 6-level reflectivity data are available to the NWS at this time. The radar has a maximum detection range of 250 NM.

Forty ARSR-4 radars have been placed around the periphery of the continental United States. These locations could provide a more consistent, long-range detection capability for the NWS. Some examples of the benefits of using ARSR-4 data include additional observational capability of tropical storms over the Atlantic and Gulf of Mexico and the ability to identify and track precipitation over Canada before it reaches the northern border.

2.3 *ASR-11*

The Airport Surveillance Radar, Model 11, or ASR-11 is a solid-state, terminal area air traffic control radar. Both the FAA and the DoD are using the ASR-11 to replace aging analog systems at up to 213 military and civilian airfields across the country (Raytheon, 2002).

The ASR-11 uses a single fan beam (a beam with a large vertical extent as compared to its horizontal dimension) to observe aircraft within 60 NM of its associated airport. Its range resolution is 0.5 NM. Many of the systems will have the capability to output 6-level reflectivity data back to the NWS.

While the ASR-11 does not have the range of the ARSR-4, nor the high resolution of the TDWR, the ASR-11 can be used as a supplement to NWS network radars in the event of beam blockage or radar outages.

3. NWS DEMONSTRATION ACTIVITIES

In order to provide forecasters with sample data sets to gain experience with the different radar characteristics and to enhance their ability to observe and detect severe weather, the NWS has, on a temporary basis, made some FAA radar weather data available internally. The data are in the form of GIF images (Stern et al, 2002).

Table 1 shows that TDWR data have been made available to several field offices and national centers. Data from the Baltimore/Washington International Airport are received at NWS Headquarters at Silver Spring, MD and are made available to the WFOs at Sterling, VA and State College, PA via secure web browser.

The remaining locations at Salt Lake City, UT, Taunton, MA, Phoenix, AZ and Norman, OK all have dedicated ingest and processing platforms for internal inspection of the data.

Table 1 TDWR Demonstration Sites

NWS Office	TDWR Location
WFO Sterling, VA WFO State College, PA NWS HQ, Silver Spring	Baltimore/Washington International Airport
WFO Salt Lake City, UT	Salt Lake City International Airport
WFO Taunton, MA	Boston Logan International Airport
National Severe Storms Laboratory, Norman, OK	Will Rogers World Airport, Oklahoma City
WFO Phoenix, AZ	Sky Harbor International Airport, Phoenix, AZ

Table 2 shows the access available from ARSR-4 radars. NWS Headquarters has the ability to dial into both the training radar at the FAA Academy in Oklahoma City and the operational system at Watford City, ND. The WFO at Bismarck, ND has a real-time data feed from the Watford City ARSR-4.

Table 2 ARSR-4 Demonstration Sites

NWS Office	ARSR-4 Location
NWS HQ, Silver Spring	FAA Training Center, Oklahoma City, OK
WFO Bismarck, ND NWS HQ, Silver Spring	Watford City, ND

Finally, Table 3 shows the access available from ASR-11 radars. At the time of this writing, the Stockton, CA ASR-11 data was available to NWS Headquarters via a connection at the FAA Technical Center. This data may be made available to the Sacramento, CA WFO. In addition, upon completion of the ASR-11 at Erie, PA, access will be made available to both NWS Headquarters and the WFO in Cleveland, OH.

Table 3 ASR-11 Demonstration Sites

NWS Office	ASR-11 Location
NWS HQ, Silver Spring	Stockton, CA

4. NWS Developmental Activities

The NWS has embarked on several developmental paths to introduce near real-time FAA radar weather data into operations. The activities described in section 3.0 produce static images that can be displayed individually or as a loop.

A second, more technologically significant activity involves creating routines to ingest and process FAA radar weather data within a clone of the Weather Surveillance Radar, 1988 Doppler (WSR-88D), Open systems Radar Product Generator (ORPG). This path has the capability to allow for standardized products to be displayed on operational systems such as the Advanced Weather Interactive Processing System (AWIPS). In addition, this environment will easily allow for new, multi-radar scientific algorithms to be created since all of the data stores will be accessible.

At the time of this report (October 2002), an ARSR-4 demonstration system consisting of an ORPG clone, data ingest/communications manager, product server and test algorithm have been completed and are undergoing tests. The test algorithm creates a hybrid scan reflectivity product using standard formats.

Also under development is a TDWR demonstration system. This system will have the ability to create two intermediate data stores:

1. A full resolution data structure containing all reflectivity, spectrum width, unconditioned and dealiased velocity and signal-to-noise ratio data.
2. A data store containing WSR-88D radial data structures populated with a subset of TDWR data.

The first data store would be used for new algorithm development. The second data store would be used with existing WSR-88D algorithms.

When complete, these systems would be capable of generating a whole new suite of radar products that could enhance the warning and short range forecast program of the NWS.

5. OPTIONS FOR FUTURE DEPLOYMENT

The principal objectives of this effort are to initially assess the operational utility of the data from the FAA radar systems identified above and secondly to identify alternatives for providing this data to the NWS forecaster, and to other users of weather radar data at the FAA and the DoD. The most likely candidates for an operational deployment are those systems that can accommodate a direct ingest into a NEXRAD product generator, such as the ORPG, or ingest into a similar product generator, or RPG Clone, within AWIPS. Each alternative has its own pros and cons; however they have several common benefits.

- The design and suite of product generation software available within the ORPG can be utilized,
- Product display and data fusion within AWIPS will be aided with the formatting of the FAA radar data products to be similar to NEXRAD products,
- Using the NEXRAD ORPG design, the development and display of radar products which are familiar to the forecasters will minimize the forecaster training required, and
- Communications of these products to other users can be accomplished over the existing communications network.

The NWS is currently exploring these alternatives, with the goal of beginning deployment of an operational capability for the TDWR data in 2003.

6. SUMMARY

With the current demonstration projects underway, the operational utility of the data from the TDWR, ARSR-4, and ASR-11 will be validated. The first to achieve operational validation has been the TDWR. Therefore, the TDWR will be the first to be operationally deployed to the weather forecasters.

7. REFERENCES

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