THE FUTURE OF U. S. SEVERE WEATHER WARNING OPERATIONS

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I. INTRODUCTION

This presentation will summarize a variety of research and development activities at the National Severe Storms Laboratory (NSSL) and the United States (US) National Weather Service (NWS) being conducted to improve the short term detection, diagnosis, and prediction of convective severe weather for warning decision making.

Many of these new projects are being tested in the NOAA Hazardous Weather Testbed's Experimental Warning Program (HWT/EWP). This testbed brings researchers and visiting operational forecasters together in a simulated operational environment to gain feedback on new applications and concepts of operations before they are transferred to actual NWS warning operations. We are hoping that some of these applications might have some value to our European colleagues. We are also encouraging international visitors to participate in the HWT/EWP beginning in spring 2008.

II. WITHIN 5 YEARS

The Four-dimensional Stormcell Investigator (FSI; Stumpf et al, 2006), a robust multi-panel base radar data analysis tool that allows a warning decision meteorologist to "slice and dice" high-resolution Doppler radar data with dynamic vertical and horizontal cross-sections, and display them in three dimensions with animation (Figure 1), is being deployed to the NWS in 2008.

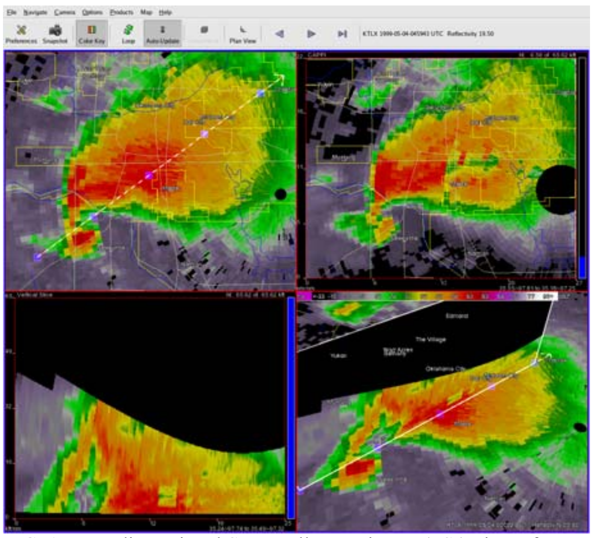

FIG. 1: Four-dimensional Stormcell Investigator (FSI) view of a supercell thunderstorm in the United States.

NSSL has also developed a multiple-radar/sensor three dimensional radar grid covering the entire Continental US, and soon to include Canadian Radars (Zhang et al. 2004). A 3D grid from multiple radars is more robust than using single radars, as weather signatures can be sampled by more than one radar simultaneously. This is particularly advantageous with the cones-of-silence and at far ranges. This 3D grid is used for a variety of new severe weather algorithms [e.g., quantitative precipitation estimation, storm tracking, hail swaths (Fig. 2), "Rotation Tracks"] (Stumpf et al. 2004). Some of these multiple-radar grids are now being tested at several US NWS forecast offices, and plans are underway to integrate them system-wide. The multiple-radar hail swath algorithm is being used in the Severe Hail Verification Experiment (SHAVE; Ortega et al. 2007), an experiment to determine better methods for improving the spatial and temporal resolution of verification of severe hail events that is applicable to regions with traditionally problematic verification (e.g., Europe).

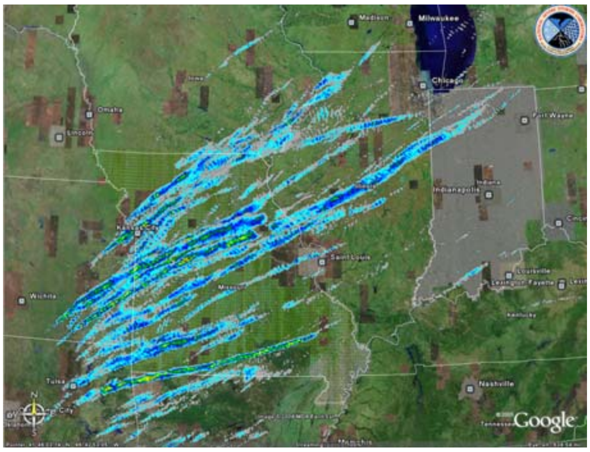

FIG. 2: Multiple-radar Hail swaths. 12 March 2006.

Several WSR-88D enhancements are being made within the next 5 years. "Super-resolution" data (250 m and 0.5° azimuthal sampling for all base moments) are being introduced in 2008. Improved velocity and range ambiguity mitigation techniques [Sachidananda-Zrnić Algorithm (SZ-2)] are currently being introduced. Dual-polarization capabilities will be integrated into the US WSR-88D network within 5 years. This will allow for better discrimination of hydrometeor types for severe storm, flash flood, and winter precipitation analysis.

III. BEYOND 5 YEARS

The NSSL is pioneering the use of a multi-purpose Phased Array Radar (MPAR) for use in weather detection (Heinselman et al. 2006). MPAR uses an array of transmit-receive elements that allow electronic steering of the radar beam in a very rapid manner (a typical WSR-88D volume scan can be completed in about 1/10 the amount of time). The electronically steered beam also allows for greater spatial resolution in "dwell areas" such as specific storms, and for aircraft surveillance. Already through the summer of 2007, some very exciting new data sets have been collected that demonstrate the advantageous of the very high temporal resolution of the data, revealing very precise temporal evolution of severe storm signatures.

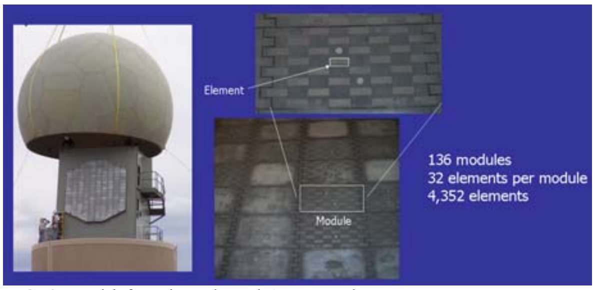

FIG. 3: Multi-function Phased Array Radar components.

NSSL and the University of Oklahoma are collaborating on the development of a cost-effective network of many small (X-band) radars that can scan lower regions of the atmosphere will provide better weather coverage in high population or weather-sensitive areas. The Collaborative Adaptive Sensing of the Atmosphere (CASA; Brotzge et al. 2005) project aims to supplement the WSR-88D network with these "gap-filling" radars. The first experimental network has been deployed in Oklahoma.

"Warn on Forecast" (WoF; Burgess et al. 2005) is a very ambitious project to assimilate high resolution radar and other data into Mesoscale and storm scale models with a goal to use output from these models to extend severe storm and tornado warning lead times from 15 to 45 minutes. This has the potential to determine precisely where and when storms will be severe even before these signatures are detected on radar (Fig. 4).

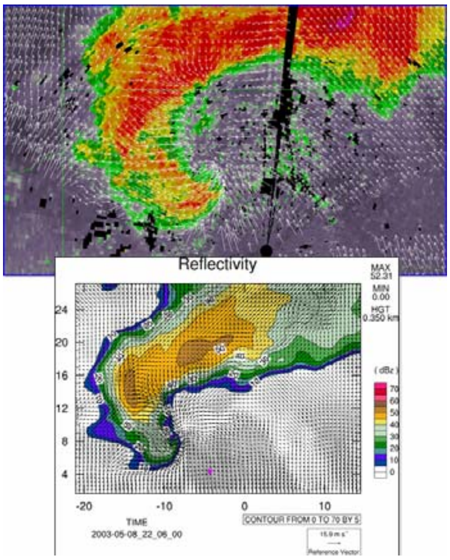

FIG. 4: Warn-on-Forecast model output and radar observations.

All of these projects have the capability to change the concept of warning operations in such a way that more precise threat areas and expressions of forecaster uncertainty can be incorporated into the severe weather warning products that are issue by the U.S. NWS. During the spring of 2007, the first experiment with probabilistic severe weather warnings was conducted in the HWT/EWP. Visiting forecasters worked with researchers to develop digital probabilistic gridded warnings using a number of these experimental products as guidance. Probabilistic warning information has the capability to provide more sophisticated guidance information for "super-users" of the warning data - users who are responsible for the safety of large numbers of people (e.g., school administrators, emergency managers), yet allowing the information to be aggregated into simpler formats for users requiring less complex output.

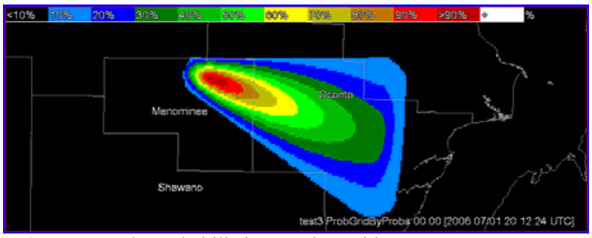

FIG. 5: Example Probabilistic Warning grid.

IV. AKNOWLEDGMENTS

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