11.5

OVERVIEW AND STATUS OF THE AWIPS SYSTEM FOR CONVECTION ANALYSIS AND NOWCASTING (SCAN)

Stephan B. Smith

Techniques Development Laboratory
National Weather Service, NOAA
Silver Spring, Maryland

Sudhir K. Goel

Litton/PRC
McLean, Virginia

M. Thomas Filiaggi

General Sciences Corporation
Greenbelt, Maryland

Michael E. Churma

Research and Data Systems Corporation
Silver Spring, Maryland

Lingyan Xin

National Severe Storms Laboratory
Environmental Research Laboratories, NOAA
Norman, Oklahoma

1. INTRODUCTION

The System for Convection Analysis and Nowcasting (SCAN; Smith et al. 1998a) is an integrated suite of multi-sensor applications which detects, analyzes and monitors convection, and generates short-term probabilistic forecast and warning guidance for severe weather and flash floods automatically within the National Weather Service's (NWS's) Advanced Weather Interactive Processing System (AWIPS). The goals of SCAN are:

1. To provide forecasters with accurate, timely, and consistent severe weather and flash flood guidance.
2. To develop "smart" computer displays, menus, and graphical user interfaces that optimize the utility of the AWIPS Display 2 Dimensional (D2D; Biere 1998) and are compatible with the warning decision process.
3. To develop multi-sensor databases to support the verification of thunderstorm, severe weather, and flash flood forecasts/warnings.
4. To supplement forecaster event monitoring with multi-sensor, automated event monitoring.
5. To accelerate the rate of technology transfer from research to operations.

Operational implementation of SCAN will result in longer lead times on warned events, fewer missed events, increased forecaster situational awareness, reduced forecaster fatigue during warning situations,

Corresponding author address: Dr. Stephan B. Smith, TDL/NWS, SSMC2, 1325 East-West Highway, Silver Spring, MD 20910.
e-mail: Stephan.Smith@noaa.gov
SCAN: www.nws.noaa.gov/tdl/scan/scan2.html

rapid improvement in implemented techniques, and a well-defined focus for applied research.

This paper describes the functionality of the first two operational versions of SCAN (1.0 and 2.0), as well as plans for future enhancements. Additional information on SCAN development for AWIPS and other SCAN-related items is available from the SCAN homepage at www.nws.noaa.gov/tdl/scan/scan2.html.

2. SCAN 1.0

SCAN is being implemented in AWIPS incrementally. Each new version contains new and/or improved functionality. The first version (1.0; delivered to the field starting in November 1998 as part of AWIPS 4.1) represents the foundation for subsequent versions. Accordingly, two candidate applications were chosen based on their varied use of modernized NWS data sets and on their applicability to the severe thunderstorm and flash flood warning problems.

The first application, the AWIPS thunderstorm product (Churma and Smith 1998) uses radar and cloud-to-ground (CG) lightning data to automatically detect the presence of thunderstorms near specific sites. The second is a 1-hr radar-based quantitative precipitation forecast algorithm (Kitzmiller and Churma 1999) pertinent to flash flood forecasting.

Another new AWIPS functionality introduced in SCAN 1.0 is the radar cell pop-up (dialog) box. This application allows the user to query a radar-detected storm cell by simply clicking near the cell as displayed on the D2D screen. The click launches a pop-up window that displays basic and derived cell attributes including cell ID, cell motion, maximum reflectivity, maximum vertical integrated liquid (VIL), probability of large hail, probability of severe weather, probability of heavy precipitation, and CG lightning frequency. Similarly, a thunderstorm detection pop-up can be launched by clicking on any site displayed in the D2D that is being monitored for thunderstorms. This box displays the thunderstorm site decision (yes or no) and the data inputs used in calculating it (radar and lightning, radar only, or lightning only). A graphical user interface allows forecasters to modify the SCAN storm cell depictable and thus provides a basic cell ranking and sorting capability to the D2D. Additional details about SCAN 1.0 can be found in the AWIPS 4.1 D2D User's Guide (Kucera and Osborn 1998).

3. SCAN 2.0

The National Severe Storms Laboratory (NSSL) has for several years developed algorithms that examine integrated meteorological data to identify severe weather phenomenon. In support of these applications, NSSL has also designed and implemented new concepts for displaying warning relevant information for efficient and rapid access. The combined (algorithms and display) system, called the Warning Decision Support System (WDSS; Eilts et al. 1999), has been tested operationally with great success at selected NWS offices across the United States.

Figure 1 shows the first operational version of the WDSS radar cell table as it will appear in the AWIPS D2D, as a part of SCAN 2.0. Since AWIPS does not receive base radar data (WDSS *does* receive base data), only the output of algorithms which have been implemented in the operational NEXRAD Radar Product Generator (and are thus available in radar product form) are included. Along with the basic cell table, cell attribute trends and trend sets, rate of change alarms, as well as mesocyclone and tornado vortex signature tables are also being implemented. In addition, the user will be able to rank and sort the radar-detected cells by most of the displayed cell attributes as well as by the standard NSSL ranking algorithm, which is based on cell severity.

The SCAN County Warning Area (CWA) Threat Index (SCTI) for severe weather and flash floods is another important component of SCAN 2.0. The SCTI will automatically, determine the level of severe weather and flash flood threat for a given CWA.

4. FUTURE ENHANCEMENTS

The National Center for Atmospheric Research has developed and refined an integrated system designed to produce automated guidance on the detection, tracking and short period (0-60 min) forecasting of thunderstorms. Operational implementation of this Thunderstorm Autonowcast System will provide a very important prognostic component to SCAN which will result in longer lead times on warned events.

A very significant improvement in the flash flood detection/forecasting capability of SCAN will be achieved by implementation of the Areal Mean Basin Estimated Rainfall (AMBER) algorithm (Jendrowski and Davis 1998) which maps high resolution radar precipitation rates onto high resolution (<10 sq. km) stream basins. Further enhancement of SCAN flash flood detection-/forecasting capability will come from the implementation

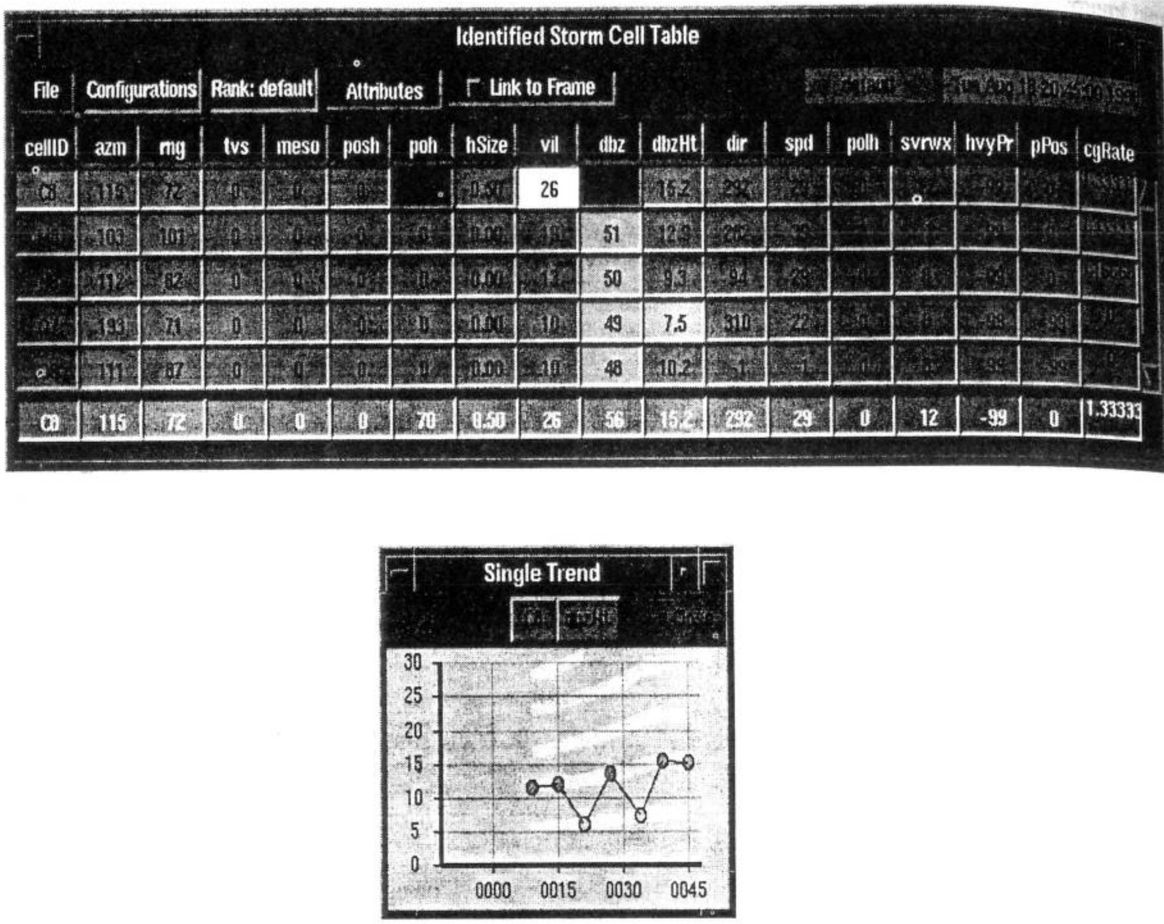

Figure 1: SCAN 2.0 (WDSS) radar cell table (top) with single cell attribute trend window (bottom). Cell attributes shown from left to right are: cell ID, azimuth, range, tornado vortex signature, mesocyclone, probability of severe hail, probability of hail, hail size, maximum VIL, maximum reflectivity, height of maximum reflectivity, cell direction, cell speed, probability of large hail, probability of severe weather, percentage of positive CG lightning flashes, and CG lightning rate. The last row in the table shows information on the cell which has been selected (in this case "C8"). Most cell attribute buttons are color-coded based (red, yellow , white) based on values of the attribute exceeding some user-defined thresholds. User-defined rate of change alarms can be set via the main table. When an alarm is triggered on a given cell, for a given attribute, the cell-attribute button will blink in the table. The trend window is for height of maximum reflectivity for cell "C8" and was launched by clicking on that entry in the main table. Trend sets of commonly used attributes will also be available through the main table. The user will be able to immediately zoom and center on a selected cell in the D2D display by clicking on the that cell ID in the main table when the "Link-to-Frame" option is enabled.

of the GOES satellite-based rainfall estimation algorithm developed by Vincente and Scofield (1998).

Automated GOES satellite-based thunderstorm anvil tracking (Zaras and Rabin 1998) is another application that will bring to bear the remotely-sensed data sources of the modernized NWS on the diagnosis of severe convective storms.

Some of above applications have already been operationally tested as part of the SCAN Field Test (Smith et al. 1998b; Johnson et al. 1999; and Roberts et al. 1999)

5. ACKNOWLEDGMENTS

The authors would like to thank Dave Glass, J.T. Johnson, Ken Sperow, Bill Carrigg, Don Mugnai, Dave Kitzmiller, and Tom Graziano for assistance in the SCAN effort.

6. REFERENCES

Biere, M., 1998: The WFO-Advanced Two-Dimensional display software design. *Preprints, 14th International Conf. on Interactive Information and Processing Systems*. Phoenix, Amer. Meteor. Soc., 376-379.

Churma, M. E., and S. B. Smith, 1998: Evaluation of the AWIPS Thunderstorm product. *Preprints, 16th Conf. on Weather Analysis and Forecasting,* Phoenix, Amer. Meteor. Soc., 472-474.

Eilts, M. D., J. T. Johnson, K. D. Hondl, G. J. Stumpf, E. D. Mitchell, J. W. Conway, and K. W. Thomas, 1999: Warning Decision Support System - The Next Generation. *Preprints, 15th International Conf. on Interactive Information and Processing Systems.* Dallas, Amer. Meteor. Soc., (this volume).

Jendrowski, P., and R. S. Davis, 1998: Use of geographic information systems with the Areal Mean Basin Estimated Rainfall Algorithm. *Preprints, Special Symposium on Hydrology*. Phoenix, Amer. Meteor. Soc., 129-133.

Johnson, J. T., A. Jones, K. W. Thomas, M. Lehmann, and T. Thurston, 1999: Testing and Evaluation of the Areal Mean Basin Estimated Rainfall (AMBER) Algorithm during NWS severe weather operations. *Preprints, 15th International Conf. on Interactive Information and Processing Systems*, Dallas, Amer. Meteor. Soc., (this volume).

Kitzmiller, D. H. and M. E. Churma, 1999: The AWIPS 1-hour rainfall forecast algorithm. *Preprints, 15th International Conf. on Interactive Information and Processing Systems.* Dallas, Amer. Meteor. Soc., (this volume).

Kucera, P., and J. Osborn, 1998: Advanced Weather Interactive Processing System (AWIPS) 4.1, Display 2-Dimensional User's Guide. National Oceanic Atmospheric Administration, U.S. Department of Commerce. [Available from Forecast Systems Laboratory, 325 Broadway, Boulder, CO, 80303.]

Roberts, R. D., C. Mueller, J. Wilson, J. Sun, and S. Henry, 1999: Operational application and use of NCAR's Thunderstorm Nowcast System. *Preprints, 15th International Conf. on Interactive Information and Processing Systems.* Dallas, Amer. Meteor. Soc., (this volume).

Smith, S., T. Graziano, R. Lane, W. Alexander. M. Eilts, J. T. Johnson, J. Wilson, R. Roberts, D. Burgess, D. Kitzmiller, R. Saffle, R. Elvander, S. Zubrick, J. Schaefer, S. Weiss, and D. Imy, 1998a: The System for Convection Analysis and Nowcasting (SCAN). *Preprints, 16th Conf. on Weather Analysis and Forecasting, 14th International Conf. on Interactive Information and Processing Systems.* Phoenix, Amer. Meteor. Soc., J22-J24.

_____, J. T. Johnson, R. D. Roberts, S. M. Zubrick, and S. J. Weiss, 1998b: The System for Convection Analysis and Nowcasting (SCAN) 1997-1998 Field Test. *Preprints, 19th Conf. on Severe Local Storms,* Amer. Meteor. Soc., Minneapolis, 790-793.

Vincente, G. A., and R. A. Scofield, 1998: Satellite rainfall estimates in real time for applications to flash flood watches and warnings, heavy precipitation forecasting and assimilation on numerical weather prediction models. *Preprints, 16th Conf. on Weather Analysis and Forecasting,* Phoenix, Amer. Meteor. Soc., 406-408.

Zaras, D. S., and R. A. Rabin, 1998: Identification and tracking of cold cloud features in satellite imagery. *Preprints, 19th Conference on Severe Local Storms.*, Minneapolis, Amer. Meteor. Soc., 579-582.