national severe storms laboratory

Severe Weather Warning Applications and Technology Transfer

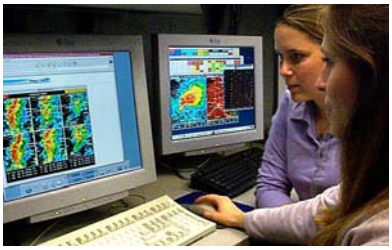
Developing new severe weather warning tools to protect life and property

Mission: To develop new and innovative severe weather warning applications and transfer the technology to government and private agency users to enhance their capability to warn of severe weather.

The SWAT group at the National Oceanic and Atmospheric Administration's National Severe Storms Laboratory develops computer applications that identify severe thunderstorms, tornadoes, lightning, damaging winds, and large hail using the latest observational data from Doppler radars, surface and upper air observing systems, mesoscale numerical models, satellites, and the National Lightning Detection Network.

Computer applications are based on the most recent basic and applied research and incorporate innovations in image recognition, artificial intelligence, data mining, and statistical methods. Applications are coupled with state-of-the-art display platforms and NSSL's own Warning Decision Support System (WDSS) so meteorologists can access data in the most efficient and manageable way when making critical warning decisions.

Tornado near Boise City, Oklahoma



SWAT technology and development team members work on algorithm improvements.

These scientific applications are thoroughly evaluated in a laboratory environment using geographically- and climatologically-diverse data collected nationwide that encompasses a variety of severe storm situations and storm types. Applications are then tested in real-time warning operations through partnerships with National Weather Service warning forecasters and Federal Aviation Administration users before they are released for nationwide use.

- **Mesocyclone Detection Algorithm**

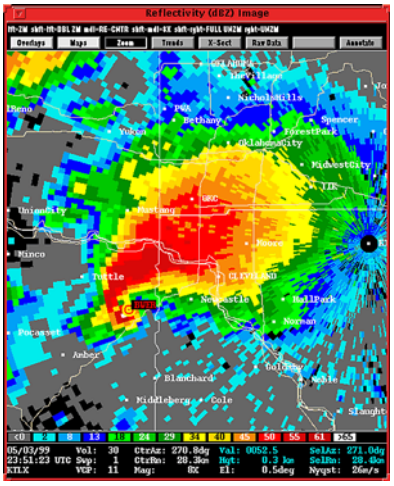
  The Mesocyclone Detection Algorithm detects rotation in storms and diagnoses tornado potential. Recently, SWAT scientists further enhanced the Mesocyclone Detection Algorithm through improvements to the neural network.

  Payoff: The new algorithm has better detection and diagnostic accuracy than the present NWS algorithm, and will lead to greater tornado warning accuracy and longer lead time.

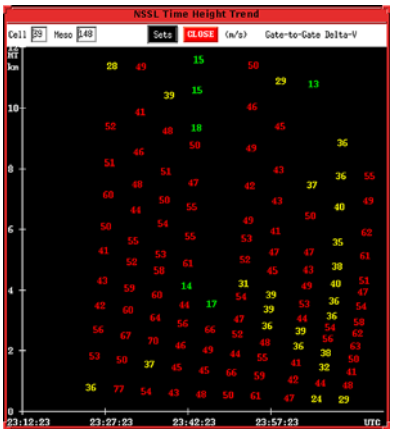
- **Hail Detection Algorithm**

  The Hail Detection Algorithm determines both probability of hail greater than three-quarters of an inch diameter and maximum expected hail size in thunderstorms. The latest version now incorporates mesoscale model output and a neural network to diagnose the probability of hail.

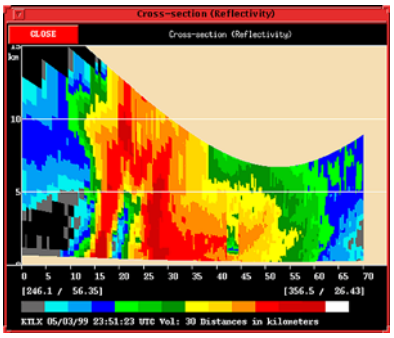
  Payoff: Improved hail prediction capability will aid users in developing more specific hail warning products.



Warning Decision Support System (WDSS) display for May 3, 1999 Oklahoma City Storm



Examples of time-height (above) and vertical cross-section (below) displays during May 3, 1999 Oklahoma outbreak.



- **Damaging Downburst Prediction and Detection Algorithm**

  The National Weather Service does not presently have automated downburst prediction capability. SWAT is developing an algorithm that uses multiple-sensor input and innovative statistical techniques to predict damaging downbursts with up to 10 minutes lead time.

  Payoff: This new radar diagnostic tool will help forecasters quickly identify the potential for damaging downbursts.

- **Near-Storm Environment Algorithm**

  Two storms with similar appearance on radar may, in fact, be in significantly different environments which enhance or greatly restrict the severe potential of the storm. By integrating mesoscale model output with radar data, the diagnostic skill of severe weather warning applications is greatly improved, as is the forecaster's warning decision making process. SWAT is adapting its Near-Storm Environment Algorithm to incorporate a variety of mesoscale model inputs.

  Payoff: Integrating new and experimental mesoscale model products with severe weather detection algorithms provides optimal performance.

- **Tornado Warning Guidance**

  SWAT created Tornado Warning Guidance, a document containing up-to-date understanding of tornado formation along with the latest assessment of the accuracy of tornado detection.

  Payoff: The NWS Warning Decision Training Branch will utilize the guidance when training warning forecasters to use the latest basic research and statistical results in interpreting Doppler radar signatures, algorithms, and other data sources.

What's Next for SWAT?

SWAT scientists are improving all the severe weather analysis programs by adding multiple-sensor input and providing algorithm updates at 30-second intervals. SWAT is also developing a Vortex Detection and Diagnosis Algorithm and a Multi-scale Statistical Reflectivity Feature Algorithm that will operate using a 3-D mosaic of radar data.These new applications will further improve the detection and diagnosis of severe weather features in observational data.

SWAT customers include National Weather Service Forecast Offices, NWS Warning Decision Training Branch, NEXRAD Radar Operations Center, Federal Aviation Administration, private sector companies, and international government weather agencies.

For more information contact:
Greg Stumpf, greg.stumpf@noaa.gov
Kim Elmore, kim.elmore@noaa.gov
http://www.nssl.noaa.gov/wrd/swat/
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