Tornado / Severe Storm Research at the National Severe Storms Laboratory

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U.S. Department of Commerce
NOAA
National Oceanic & Atmospheric Administration

- Weather
- Climate
- Oceans
- Fisheries
- Satellites
- Coastal Habitats
- Charting
- Marine Sanctuaries

 Bilion Dollar Weather Events

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Frequency</th>
<th>Loss</th>
<th>Billion Dollar Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drought</td>
<td>39</td>
<td>10.2%</td>
<td>0.467</td>
</tr>
<tr>
<td>Flooding</td>
<td>39</td>
<td>7.1%</td>
<td>0.543</td>
</tr>
<tr>
<td>Tornado</td>
<td>1</td>
<td>1.3%</td>
<td>10.0</td>
</tr>
<tr>
<td>Severe Storms(1)</td>
<td>19</td>
<td>9.1%</td>
<td>3.2</td>
</tr>
<tr>
<td>Tropical Cyclone</td>
<td>3</td>
<td>0.4%</td>
<td>0.030</td>
</tr>
<tr>
<td>Wildfire</td>
<td>11</td>
<td>1.3%</td>
<td>33.7</td>
</tr>
<tr>
<td>Winter Storm</td>
<td>10</td>
<td>3.8%</td>
<td>50.0</td>
</tr>
<tr>
<td>All Disasters</td>
<td>232</td>
<td>159.9%</td>
<td>991944</td>
</tr>
</tbody>
</table>

Note: (1) denotes severe storms that resulted in billion-dollar losses.

Organizational Structure

- NOAA
  - National Marine Fisheries Service (NMFS)
  - National Ocean Service (NOS)
  - National Environmental Data & Information Service (NESDIS)
  - Office of Marine & Aviation Operations (OMAO)

Office of Oceanic & Atmospheric Research

OAR’s Mission

- Conduct research to understand & predict the Earth system
- Develop technology to improve NOAA science, service and stewardship
- Transition the results so they are useful to society
NSSL's Mission Statement

• The National Severe Storms Laboratory serves to enhance NOAA’s capabilities to provide accurate and timely forecasts and warnings of hazardous weather events.
• NSSL accomplishes this mission through...
  – research to advance the understanding of weather processes,
  – research to improve forecasting and warning techniques,
  – and development of operational applications.
• NSSL transfers new scientific understanding, techniques, and applications to the National Weather Service (NWS).

NSSL’s Grand Scientific Challenges

• Produce enhanced capabilities for the WSR-88D and develop/assess phased array radar technologies
• Provide and communicate warning uncertainty information for high impact weather events
• Develop reliable probabilistic guidance products
• Reliably predict flash flooding
• Predict useful warnings of lightning activity one hour in advance
• Develop a reliable nowcasting system for convection initiation

Organizational Structure

NSSL
National Severe Storms Lab

OAR
Oceanic and Atmospheric Research

OMAO
Office of Marine & Aviation Operations

NMFS
National Marine Fisheries Service

NOS
National Ocean Service

NESDIS
National Environmental Data & Information Service

NWS
National Weather Service

OAR
Air Resources Lab

AOML
Atlantic Oceanographic & Meteorological Lab

ARL
Army Research Lab

ESRL
Earth Systems Research Lab

GFRL
Geophysical Fluid Dynamics Lab

GFDL
Geophysical Fluid Dynamics Lab

GLERL
Great Lakes Environmental Research Lab

PMEL
Pacific Marine Environmental Lab

NOAA
National Oceanic & Atmospheric Administration

NOAA’s primary weather radar laboratory with strong scientific and engineering leadership in dual polarization and phased array weather radar

Primary Research to Operations (R2O) entity for the Operational NEXRAD Radar Network

Leading NOAA’s R&D activities for a future operational radar network based on phased array technology

Weather Radar R&D at NSSL
**Phased Array Radar R&D**

- **To understand the next generation of radar technology** (i.e. phased array radar; PAR) and its application to NOAA’s need for better radar observations to improve weather warnings and forecasts.
  - How PAR technology may be used to improve the understanding of tornadoes and other severe weather.
  - How PAR technology may best be applied to improve warnings of tornadoes and other severe weather.
  - Evaluate the readiness of PAR technology to meet NOAA’s weather mission needs as a potential replacement for the WSR-88D.

**Why Phased Array Radar?**

**A)** To meet NOAA’s evolving requirements for radar observations.
- **Faster Volume Updates**
  - Improved Probability of Detection (POD) and False Alarm Ratio (FAR), increased tornado warning lead-times.
  - Data assimilation into numerical weather models (necessary for Warn On Forecast).
- **Electronic Adaptive Scanning**
  - Based on prioritization – Scan when and where needed.

**Hazardous Weather Testbed**

- **Experimental Forecast Program**
  - Prediction of hazardous weather events from a few hours to a week in advance.
- **Experimental Warning Program**
  - Detection and prediction of hazardous weather events up to several hours in advance.

**Social Science Studies**

- **Improve the effectiveness of forecasts and warnings of severe & hazardous weather**
  - Improved forecaster decision tools.
  - Better forecast models and observations.
  - Probabilistic output.
  - Improved communication of threats & impacts.
  - Expressions of uncertainty.
  - Messages understood by key partners (broadcasters and emergency managers).
  - Public reception of information.
  - Understandable.
  - Actionable for personal decision-making.

**Tornado Warning Lead Times**

Source: National Weather Service

**QUESTIONS?**

**THANK YOU!**

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