### National Severe Storms Laboratory

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#### Mission Statement and Vision:

To be a national resource as the world’s preeminent laboratory for observing, understanding, and modeling severe thunderstorms and to work collaboratively with the National Weather Service to ensure that their forecasters have the knowledge, capabilities, and technologies to remain world leaders in effectively communicating accurate, timely, and actionable forecasts and warnings of extreme weather to the public and commerce.

#### Core Competencies:

NSSL seeks to improve the accuracy and timeliness of forecasts and warnings of hazardous weather events such as tornadoes, hail, damaging winds, flash floods, lightning, and winter storms. NSSL accomplishes this goal through a balanced research program, which aims to:

* Advance the understanding of severe weather processes and the environments that favor their development;
* Develop and deploy experimental mobile observing systems for targeted measurements of severe weather phenomena;
* Lead the broader research community in designing and conducting field campaigns to gather unique observations of severe weather phenomena, overcoming barriers to improved knowledge and understanding;
* Develop new forecast and warning technologies, techniques, and methods in collaboration with NWS forecasters;
* Design and conduct social science research to optimize forecast and warning messaging for effective societal response;
* Develop new radar technologies (e.g., dual-polarization and phased-array radar);
* Develop, evaluate, and transfer to the NWS enhancements for the NEXRAD (WSR-88D) Doppler radar;

#### Statutory Authority and/or Charge Under NOAA Strategic Plan:

#### U.S. Weather Research Program (USWRP) Authorization Act.

#### National Weather Service Organic Act, 15 U.S.C. §313 et seq.

#### The Weather Research and Forecasting Innovation Act of 2017 (“The Weather Act” (P.L. 115-25). NSSL research is directed at many of the elements included in The Weather Act, specifically:

#### Weather Research and Forecast Innovation Program (Sec. 102)

#### Tornado Warning Improvement and Extension Program (Sec. 103)

#### Weather Research and Development Planning (Sec. 105)

#### U.S. Weather Research Program (USWRP, Sec. 109)

#### Improving Communication of Hazardous Weather and Water Events (Sec. 406)

#### NEXRAD Coverage Gaps Study and Recommendations (Sec. 408)

#### NSSL is aligned under NOAA’s Weather and Water Goal within the Science, Technology and Infusion, and Integrated Water Forecasting Programs, and NOAA’s Commerce and Transportation Goal within the Aviation Weather Program. NSSL’s research specifically addresses the objectives to:

#### Increase lead time and accuracy for weather and water warnings and forecasts

#### Improve predictability of the onset, duration, and impact of hazardous weather and water events

#### Increase application and accessibility of weather and water information leveraging public (federal, state, local, tribal) private and academic partnerships

#### Increase the development, application, transition of research to operation and services

#### Integrate local, regional, and global observation systems into NOAA’s weather and water services to increase collaboration between NOAA and external environmental partners.

#### Reduce uncertainty associated with weather and water forecasts and assessments

#### Enhance environmental literacy and improve the value of weather and water information

#### Science Themes and Research Areas:

* *Develop and deploy innovative observation technologies and conduct observation programs to advance the understanding of convective storm processes & their environments*
* *Develop and apply increasingly advanced prediction models, applications, and tools for improving the quality of forecasts and warnings issued by the NWS*
* *Engage users, stakeholders, and customers to refine tools, techniques, and communication strategies for maximum positive impact on society.*

***Products and Results:***

* NSSL played a major role in research and development leading to the national network of WSR-88D weather radars that increased warning lead-times from 6 to 13 minutes and reduced deaths and injuries, as well as the implementation of dual-polarization capability to these radars, resulting in significant improvement in QPE and the ability to detect tornado debris. Radar-based estimates of precipitation helped NWS increase flash flood lead times from 17 to 45 minutes.
* Most of NOAA’s lightning safety guidelines were derived from NSSL research in concert with NWS. The NSSL also has played a pivotal role in the evaluation and use of both privately provided national lightning data and the GOES Lightning Mapper (GLM) data that became operational in 2018.
* NSSL developed and implemented a national multi-radar, multi-sensor system to provide rainfall analyses for use in the NWS National Water Model, radar and precipitation data for nowcasting and weather forecast model initialization and verification, as well as flash-flood forecast guidance and severe weather products for NWS Forecast Offices and Centers.
* Other examples of Research-to-Operations transition products include:
	+ Extending the capability of the NEXRAD radar through a continuous infusion of science and technology such as open systems architecture, super resolution, and dual polarization;
	+ Improving radar detection and associated warning systems by uniquely combining technologies such as Google Earth, reverse look-up phone databases, and advanced experimental algorithms allowing NSSL researchers and local weather forecast offices to better verify severe weather and flash flood warnings;
	+ Developing techniques to assimilate radar data into numerical weather prediction models with very rapid updates;

#### Customers:

The National Weather Service is the primary recipient of NSSL’s research and development efforts. NSSL conducts basic research and gathers targeted observations to develop new understanding of severe weather processes, and collaborates with NWS forecasters in using this understanding to enhance conceptual and numerical models of storms and the environmental conditions that support severe weather. The knowledge and models are migrated into forecasting operations to improve public service at NWS National Centers for Environmental Prediction as well as its 122 local Weather Forecast Offices and 13 River Forecast Centers. In addition, NSSL scientists and engineers develop and enhance the national network of WSR-88D weather radars in close collaboration with the NWS Radar Operations Center, and they are developing a next-generation weather radar that is expected to become part of the nation’s infrastructure and NWS foundational services in much the same way that NEXRAD did. NSSL’s hydrometeorological R&D is accomplished under the NOAA Water Initiative within the Hydrometeorological Testbed, in coordination with the National Water Center, the Weather Prediction Center, and the NWS Office of Water Prediction. NSSL has a thriving social science program that informs the NWS about the efficacy of their public forecasts and warnings and provides guidance for optimizing the impacts of these products. New knowledge resulting from NSSL research is used by the NWS Warning Decision Training Division in course material for forecaster training. Other NSSL customers include the FAA (aviation safety related to severe weather), other government agencies, the academic research and instructional communities, and private sector companies serving weather sensitive clients.

#### Expectations for the Future:

NSSL will provide worldwide leadership and partnership in the development of new understanding, technologies, and implementations that enable ever better outcomes for protection of life and property from severe weather. NSSL will continue to provide groundbreaking and society-serving innovations in weather radar science and engineering. NSSL will continue its leadership in developing new observational capabilities and its expertise in planning and executing multi-agency observational field programs. It will use observational and numerical modeling studies to develop and refine conceptual models of severe weather (including cloud microphysics, precipitation characterization, and storm electrification), as well as tools and techniques for advancing forecast and warning operations within the NWS. NSSL leads the nation in the development of the Forecasting A Continuum of Environmental Threats (FACETs) paradigm that will revolutionize the framework and processes for delivering life and property saving information to the public.