

## **NSSL legacy of studying storms “in the field”**

One of the ways to learn about the nature of severe storms and tornadoes is to observe them – and sometimes that means going out to meet the storms. NSSL is a pioneer in the area of studying storms in the field where they occur, and scientists have developed cutting-edge tools to take special measurements. NSSL uses Doppler radars mounted on trucks, cars with weather instruments on top, special cameras, and weather balloons with instruments attached to measure storm electricity and the atmosphere. NSSL has been involved in the following:

**TIP (1972-1978)** Tornado Intercept Project – The first organized storm intercept to document time and location of tornadoes, changes in size and shape, obtain high quality movies of tornado debris clouds, observe and document photographically the evolution of storms, and to measure the wind, thermodynamic and electrical fields near tornadoes

**JDOP (1977-78)** Joint Doppler Operational Project – Real-time operational forecasts and warnings using Doppler radar were evaluated in the field. The project was a success and the Norman Doppler became the prototype for the operational WSR-88D network of radars used by the National Weather Service, U.S. Air Force, and the Federal Aviation Administration.

**SESAME (1979)** Severe Environmental Storm and Mesoscale Experiment

**TOTO (1983-1987)** The TOTO Tornado Observatory – 250-350 pound barrel outfitted with a variety of weather instruments -- anemometers, pressure sensors and humidity sensors; successfully deployed once, only to have a weak tornado knock it over and damage the instruments

**PRE-STORM (1985)** Preliminary Regional Experiment for STORM-Central – data collection and forecasting for MCS's

**NEXRAD IOT&E I and II (1987-1988)** – Initial Operational Testing and Evaluation

**DOPLIGHT (1987)** DOPpler radar and LIGHTning – Joint NSSL/Oklahoma City NWSFO field, evaluating and verifying real-time Doppler radar data and forecasts

**TAMEX (1987)** Taiwan Area MEsoscale EXperiment – 3 Doppler radars complemented enhanced surface and upper-air observations in Taiwan to better understand how terrain interacts with precipitation systems to produce heavy rainfall

**GUFMEX (1988)** Gulf of Mexico Experiment – Collecting data on air masses and moisture flows over the southern shores of the U.S.

**MAP (1988-1989)** Mesoscale Applications Project – Project to verify experimental forecasts

**COPS (1991)** Cooperative Oklahoma Profiler Studies – experiments to study the dryline and convective storms near the dryline.

**STORM-FEST (1992)** – Investigate structure and evolution of fronts and associated mesoscale phenomena in the central U.S. with emphasis on precipitation and severe weather.

**STORMTIPE (1992)** – 3D cloud-scale model used in operational forecasting environment to forecast storm type and verification done on sounding forecast and model

**COHMEX (1986)** Cooperative Huntsville Meteorological Experiment

**SWAMP (1993)** Southwest Area Monsoon Project – central Arizona thunderstorm environments, monsoon structures and moisture fluxes, Mexican convective systems 1995-1999 investigation of Lighting and Terrain in Four Corners Region (AZ, Colorado, NM, Utah

**VORTEX (1994-1995)** – Verification of the Origins of Rotation in Tornadoes Experiment – designed to answer questions about the causes of tornado formation.

**FASTEX (1997)** – Fronts and Atlantic Storm Tracks Experiment studied and documented life cycles of cyclones originating over data-sparse North Atlantic.

**SubVortex (1997)** – Smaller and more focused version of VORTEX; made first dual-Doppler tornado intercept using mobile radars

**MEaPRS (1998)** MCS Electrification and Polarimetric Radar Study– study polarized radar signatures and storm electricity in MCS's over OK-TX-KS.

**MAP (1999)** Mesoscale Alpine Project – Largest weather research project ever in Europe, studied effects of winds and precipitation over mountainous terrain

**STEPS (2000)** Severe Thunderstorm Electrification and Precipitation Study – held along the Kansas-Colorado border to study thunderstorms and lightning on the high plains.

**IPEX (2000)** Intermountain Precipitation Experiment – Studied winter weather across northern Utah to develop a better understanding of the structure and evolution of winter storms.

**TIMEX (2000)** Thunderstorm Initiation Mobile Experiment – to study what causes a thunderstorm to be born; data collected on stationary fronts, warm fronts, outflow boundaries, drylines and other low-altitude features

**IHOP (2002)** International H<sub>2</sub>O Project – researchers from around the world gather to collect more accurate and reliable measurements of moisture in the air to better predict rainfall amounts

**JPOLE (2002)** Joint Polarization Experiment– Testing polarimetric capabilities of Doppler radar to improve estimates of precipitation types and accumulations

**BAMEX (2003)** Bow Echo and MCV Experiment – studying bow echoes and Mesoscale Convective vortexes using instrumented aircraft and mobile ground-based instruments.

**PACJET (2003)** Pacific Land-falling Jets Experiment – flying in the instrumented P-3 aircraft along and offshore of the U.S. Pacific coastline to study landfalling winter storms and improve short-term forecasts and warnings of floods, damaging winds and other severe weather.

**TELEX (2003-2004)** Thunderstorm Electrification and Lightning Experiment – launching instrumented balloons into thunderstorms to learn how lightning and other electrical storm properties are dependent on storm structure, updrafts and precipitation.

**Microburst project (2008)** – NSSL operated the SMART-R near Phoenix, AZ to observe the lifecycle of strong microbursts and assess their impacts on the Salt River Project's electrical power transmission infrastructure.

**Debris Flow and Flash Flood Warning Project (2005-2009)** – NSSL annually deploys a SMART-Radar to a burn area in California to assist with debris flow and flash flood warnings.

**DARE (2007)** Data Assimilation Resolution Experiment – collect data on vertical structure of multicell storms.

**PASSE (2007)** Phased-array SMART-R Spring Experiment – collect data on supercell storms at low altitudes to improve storm scale forecasts and to compare with phased array radar data.

**VORTEX2 (2009-2010)** Verification of the Origins of Rotation in Tornadoes Experiment2 – to study how tornadoes form and dissipate.