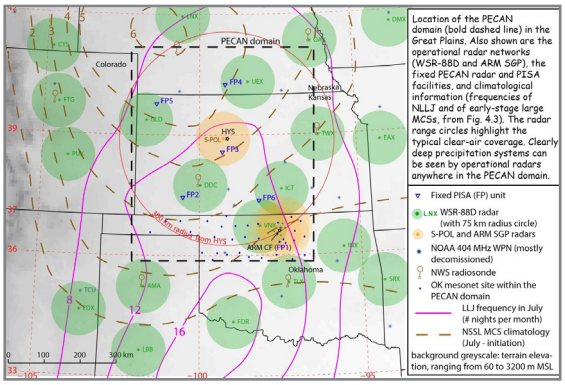
NOAA National Severe Storms Laboratory

PECAN: Plains Elevated Convection At Night

Plains Elevated Convection At Night (PECAN) is a large, intensive field project to collect data before and during nighttime thunderstorms in the central Great Plains from June 1 to July 15, 2015. Scientists hope to learn what triggers these storms, how the atmosphere supports their lifecycle, and how they impact lives, property, agriculture and the water budget in the region. PECAN is a multi-agency project sponsored by the National Science Foundation, NOAA, NASA, and the Department of Energy with participants from eight research laboratories and 14 universities.

Target: Nighttime storm triggers

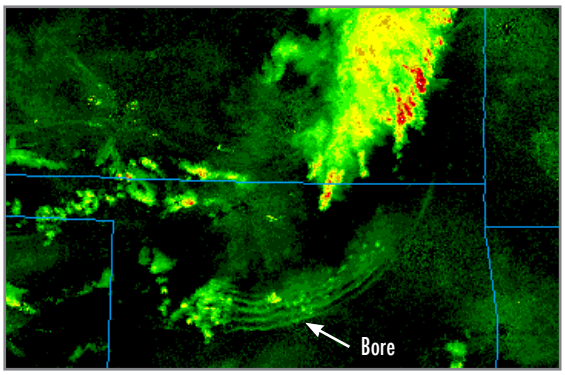
Once the sun goes down, the Earth and its lower atmosphere usually loses heat and becomes more stable; an environment not so favorable for supporting thunderstorms. In the Great Plains, however, many summer storms form *after* sunset and sometimes without an obvious trigger. Predicting the formation and behavior of nighttime thunderstorms remains difficult, but researchers believe targeted observations will build our understanding and ultimately improve forecasts.



PECAN operations will be based out of Hays, Kansas, with the domain covering central and western Kansas, and adjacent parts of Nebraska, Texas, and Oklahoma. This region is climatologically favorable for summer nighttime thunderstorms.

Target: Atmospheric ripples

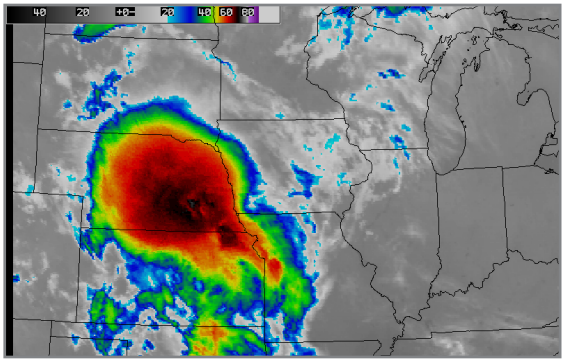
Disturbances in the atmosphere can make waves similar to throwing a stone in a pond. Scientists will test their hypotheses about how deep waves form and ripple across the plains, causing new storms to form after sunset. One type of atmospheric ripple is called a "bore." Thunderstorms can create bores, but bores can also cause a thunderstorm to suddenly intensify. PECAN is the first modern campaign to study the role of bores and how they trigger and support large complexes of thunderstorms, called Mesoscale Convective Systems (MCSs), when there is a stable layer of air at low levels of the atmosphere.



NEXRAD radar mosaic showing a nighttime MCS, its triggered bore, and developing thunderstorms on the western edge.

Target: Nighttime monsters

Isolated thunderstorms can sometimes organize into a large MCS that grows overnight. MCSs last for hours and often produce severe and hazardous weather. PECAN will investigate how a low-level river of air causes thunderstorm triggers and supports storm evolution, what causes storms to grow into MCSs, and how MCSs respond to the surrounding environment. Scientists also want to study vertical profiles of stability, moisture, and winds above the stable layer that control the intensity and severity of MCSs.



An MCS can be as large as a state and produce heavy rain.

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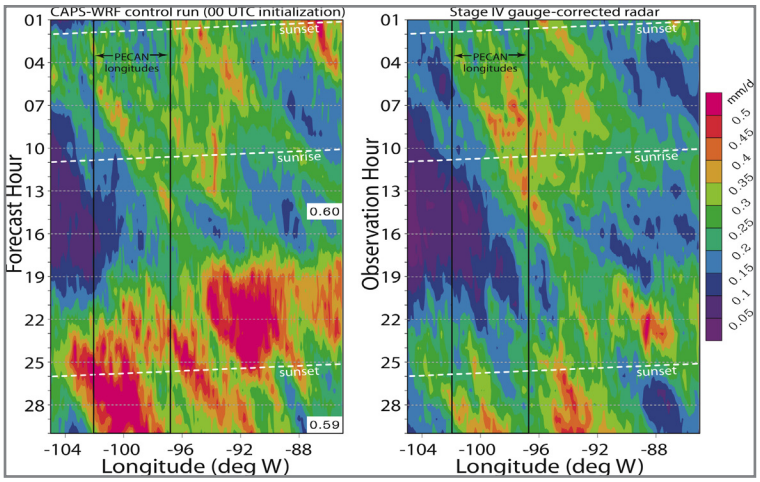
Target: Nighttime storm forecasts

Warm-season forecasts of precipitation amounts are a poor performance area of prediction systems worldwide, due in part to low predictability of nighttime thunderstorms (see image to the right). Scientists want to figure out what combinations of observations and advancements in weather computer models and weather modeling systems are required to capture both nighttime thunderstorms and evolution of Mesoscale Convective Systems (MCSs) to improve the prediction of heavy rainfall.



This study revealed that model forecast precipitation amounts averaged over a 5-week period (left) were appreciably less than radar measurements (right) between sunset and sunrise (top of images). Image courtesy Adam Clark, NSSL.

PECAN instruments

- **Aircraft:** The NOAA Lockheed WP-3D Orion aircraft, best known for its hurricane hunting missions, will study the microphysical characteristics of developing and mature stratiform regions of MCSs. Two other aircraft will probe the pre-thunderstorm environment.
- Seven mobile scanning Doppler radars including NSSL's dual-pol mobile radar NOAA-X-Pol (NOXP) will be deployed to form a fixed NSSL-designed array to detect bores, low-level rivers of air, microphysics, and unprecedented, detailed airflow and polarimetric measurements of the 3-D internal structure of MCSs.
- Scientists will launch **instrumented balloons** from vehicles with instrument racks to collect wind, temperature, and humidity profiles both ahead of and inside MCSs, bores, low-level rivers of air and in areas before storms form.
- **Mobile mesonet** vehicles with instrument racks will collect weather data as they drive back and forth along pre-selected roads around and inside the radar array.
- A new **Collaborative Lower Atmosphere Mobile Profiling System (CLAMPS)** will collect lower atmosphere temperature, humidity, and wind profiles.
- **PECAN Integrated Sounding Array (PISA)** is a network of 10 units, four mobile (including CLAMPS) and six fixed, that will profile the kinematic, thermodynamic, and moisture structure of the lower atmosphere. PISA instruments include scanning Doppler radars, radiosonde systems and experimental profiling sensors such as DIfferential Absorption Lidars (DIAL), Raman lidars, multichannel microwave radiometers, infrared spectrometers, and acoustic systems.

The NOAA P-3 will observe the dynamics and microphysics of nighttime storms.

NSSL's mobile balloon launch vehicle including rooftop mobile mesonet.

NSSL's NOAA-X-Pol (NOXP) dual-polarized mobile Doppler radar.

NSSL's role

To prepare for PECAN, NSSL researchers created a list of almost 13,000 "virtual" candidate sites for parking mobile radars and other mobile ground facilities. More than 20 NSSL and Cooperative Institute of Mesoscale Meteorological Studies (CIMMS) researchers and students will provide field-phase leadership and service, and direct and indirect field forecasting support services. NSSL's Conrad Ziegler and Dave Turner are PECAN steering committee members. Ziegler provides scientific project oversight and expertise with field research and observing facilities, and also helps coordinate forecast support. Turner has expertise in remote profiling, a critical element of the PECAN observations.