# Preview of Award 1359614 - Annual Project Report

< Back

- Cover |
- Accomplishments |
- Products |
- Participants/Organizations |
- Impacts |
- Changes/Problems

## Cover

Federal Agency and Organization Element to Which Report is Submitted:
4900
Federal Grant or Other Identifying Number Assigned by Agency:
1359614
Project Title:
Collaborative Research: Low-level Jets in the Nocturnal Stable Boundary Layer: Structure, Evolution, and Interactions with Mesoscale Atmospheric Disturbances
PD/PI Name:

- Wayne F Feltz, Principal Investigator

Recipient Organization:
University of Wisconsin-Madison
Project/Grant Period:
08/15/2014 - 07/31/2017
Reporting Period:
08/15/2014 - 07/31/2015
Submitting Official (if other than PD\PI):

- Wayne F Feltz
- Principal Investigator

Submission Date:
06/18/2015
Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions)
Wayne F Feltz

Back to the top

## Accomplishments

### * What are the major goals of the project?

The PECAN (Plains Elevated Convection at Night) campaign (scheduled 1 June – 15 July 2015) focuses on improving the understanding of initiation and evolution of nocturnal convection over the Southern Great Plains in the presence of

a stable boundary layer (SBL) and a nocturnal low level jet (NLLJ) when the largest values of CAPE (Convectively Available Potential Energy) located are above the SBL. Advancing the knowledge about important processes affecting the SBL and NLLJ interactions and related impacts on convective initiation are the main motivation for our proposed project. We plan to use the observations from the PECAN Integrated Sounding Array (PISA) stations and the King Air aircraft flights, analytical models, and high-resolution numerical simulations of the NBL. Two of the proposed ten PISA profiling units will be deployed and operated as part of this proposed project.

The deployment strategy of the PECAN Integrated Sounding Array (PISA), with multiple fixed (FP) and mobile (MP) profiling units, will be key for our proposal objectives. As part of our proposed study the University of Wisconsin - Madison will be responsible for the deployment and operation of the Space, Science, and Engineering Center SSEC Portable Atmospheric Research Center (SPARC, which is one of two mobile profiling units within larger proposal). The SPARC platform includes a radiosonde unit, an atmospheric emitted radiance interferometer (AERI, temperature and moisture) and a scanning Doppler Lidar (wind). The hardware configuration of this DL will be nearly identical to the Halo Photonics DL integrated into CLAMPS, which will allow us to program similar scanning patterns and to conduct unique dual Doppler scans during NLLJ missions.

This proposal supports SPARC participation to measure atmospheric thermodynamic observations to address four specific research areas (RA) in this work:

1. **SBL/NNLJ structure (RA1):** What is the possible physical basis for the association of dynamic and thermodynamic structural features of the SBL with the height and intensity of the NLLJ? How does the relationship between the SBL and NLLJ evolve during the night and how does it change with terrain slope angle, surface thermal perturbation, ambient stratification, geostrophic wind speed, or geostrophic wind direction? To what extent do local terrain features affect NNLJ properties? What is the optimal terrain slope angle for which the NLLJ intensity will be maximum and how does this optimal angle vary with meteorological conditions and underlying surface properties? MS student
2. **Turbulent transport in the NBL (RA2):** How do the NLLJ strength and the increase of turbulent mixing in the NBL interact? How robust is the SBL classification into weakly and very stable boundary-layer regimes (Mahrt et al. 1998; Mahrt 1999; Mahrt and Vickers), and are NLLJ strength and depth important scaling parameters as proposed by Banta et al. (2006)? What is the role of turbulent transport and its interplay with other momentum and heat transport mechanisms above the NLLJ wind maximum in the evolution of the residual layer and its potential destabilization? What is the effect of this destabilization on the initiation and vertical propagation of mesoscale disturbances?
3. **Convective Initiation (RA3):** What are mechanisms of interactions of NBL dynamic phenomena, including NLLJs, with mesoscale convergence/divergence disturbances (e.g., associated with bores, fronts, and solitons)? How do convective energy parameters, such as CAPE and CIN, in the lower troposphere change as a result of these interactions? To what extent do these changes affect convection initiation?
4. **Modeling (RA4):** What are the strengths and weaknesses of state-of-the-art numerical modeling/simulation techniques to characterize the mean flow and turbulence properties of evolving SBLs and NLLJs? To what extent can models capture interactions between NLLJ and mesoscale atmospheric phenomena?

Addressing the questions outlined in RA1-RA4 requires observations of wind, temperature, humidity, and turbulence parameters at high spatial and temporal resolution in the lower troposphere. The deployment strategy of the PECAN Integrated Sounding Array (PISA), with multiple fixed (FP) and mobile (MP) profiling units, will be key for our proposal objectives. As part of our proposed study we will be responsible for the deployment and operation of two MP units: the OU Collaborative Lower Atmospheric Mobile Profiling System (CLAMPS, which is MP1 in the PECAN EDO) and the Space, Science, and Engineering Center at U Wisconsin - Madison (SSEC) Portable Atmospheric Research Center (SPARC, which is MP3).

CLAMPS and SPARC are two of the four mobile PISA stations that are being proposed for PECAN, and are a critical part of the PECAN observational strategy (see the PECAN EDO for details). The wind and thermodynamic profiling capability of these two facilities (as well as the other PISAs) will provide important, high-temporal-resolution profile data to describe the NBL evolution in all three of the PECAN target IOPs: MCS studies, bore missions, and convective initiation (CI) events.

Radiosondes are being launched periodically during these missions to provide higher vertical resolution data than is possible with the ground-based remote sensors. During the MCS missions, only 2 sondes will be launched from both CLAMPS and SPARC. These launches will be done in the preconvective environment before the weather system overruns the CLAMPS/SPARC locations (as the remote sensors in these systems do not provide good profiles during precipitation). In the CI and bore missions, up to 5 radiosondes will be launched by both facilities in order to provide the detailed vertical information needed to compute the Scorer parameter, which may be critical for understanding the presence, “quality”, and evolution of any wave duct layers that might facilitate the propagation of bores as well as the possible small-scale details in the evolution of convective indices such as elevated CAPE. The radiosonde data are a necessary complement to the remote sensing data. The remote sensing data will provide the high-time-resolution evolution to see rapid changes in the SBL structure but the sondes will provide more accurate measurements above the SBL and at the capping inversion. Furthermore, the sonde data will provide an excellent validation source for the remote sensor datasets.

## * What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?

Major Activities:

The activities during Year 1 of our project can be grouped into three main areas:
1. Preparation for the PECAN deployment in Kansas during June 01 - July 15 2015
2. Participation in the PECAN experiment

As part of the preparations for the field experiment members of our project team attended two PECAN planning meetings in Boulder, CO and worked with PIs from other projects on improving the deployment strategy for the low-level jet (LLJ) and convective initiation (CI) missions. Additionally, we focused on getting the UW- Madison SPARC facility ready for deployment during PECAN, coordinated the lidar scanning strategies with the other mobile PISA facilities, and prepared routines to generate quick look plots of the collected data sets. We also ordered all necessary supplies, arranged housing in Hays, Kansas, and formed the crews that will support the field operations during PECAN. The SPARC PECAN web page is located here (includes blog, data, and other information):

https://www.ssec.wisc.edu/sparc/experiments/pecan-2015/

Daily MP PISA coordinator summaries:

http://catalog.eol.ucar.edu/pecan/123368/files

The awarded funding has been used to fund a Masters of Science research assistant, purchase radiosondes and other PECAN material needed for deployment success.

The PECAN project is currently ongoing and our project has supported all 11 missions conducted up to date. Wayne Feltz (PI), Tim Wagner, and Christopher Rozoff provided PECAN operations Mobile Profiling vehicle management support for several of the IOPs, guiding MP assets to IOP locations and providing safety information to MP1, MP2, MP3 (SPARC), MP4 and TWolf.

Specific Objectives:

SPARC is currently deployed in Kansas obtaining PECAN measurements from 1 June – 15 July 2015. All instruments are optimal and collecting excellent data sets.

Significant Results:

PECAN field campaign currently on going so nothing to report.

Key outcomes or Other achievements:

PECAN field campaign currently on going so nothing to report.

### * What opportunities for training and professional development has the project provided?

The University of Wisconsin NSF award support one Master's student with a research assistantship (focused specifically on PECAN research). David Loveless was selected to received this NSF RA support with his science focused on PECAN field data and thermodynamic research. He is currently in the field with the SPARC supporting the PECAN activities for 4 of 6 weeks. Another MS student (funded under different RA) is providing SPARC support in the field and NSF resources are being used to cover her logistics. Additionally two technical computing staff within SSEC is providing in the field SPARC support.

### * How have the results been disseminated to communities of interest?

The PECAN field deployment is ongoing, there are no results to date. SPARC PECAN data sets will be quality controlled and made available to NCAR EOL field catalogue.

PECAN field catalogue and SSEC SPARC PECAN support portals:

http://catalog.eol.ucar.edu/pecan/upperair

Click on **MP3 UW SPARC Sonde Skew-T Sounding Plot** - for near real-time SPARC soundings

http://catalog.eol.ucar.edu/pecan/lidar

Click on **MP3 SPARC HSRL**

**https://www.ssec.wisc.edu/sparc/experiments/pecan-2015/**

**Click on Data archive**

### * What do you plan to do during the next reporting period to accomplish the goals?

At the next reporting period this award shall provide a quality controlled temperature and moisture profiles from AERI, wind from Halo Doppler Lidar, clouds from HSRL, and radiosonde profile data. Some initial case study analysis will be accomplished.

Back to the top

# Products

## Books

Nothing to report.

### Book Chapters

- Nothing to report.

### Conference Papers and Presentations

- Nothing to report.

### Inventions

- Nothing to report.

### Journals

- Nothing to report.

### Licenses

- Nothing to report.

### Other Products

- Nothing to report.

### Other Publications

- Nothing to report.

### Patents

- Nothing to report.

### Technologies or Techniques

- Nothing to report.

### Thesis/Dissertations

- Nothing to report.

### Websites

- Nothing to report.

Back to the top

## Participants/Organizations

## What individuals have worked on the project?

| Name | Most Senior Project Role | Nearest Person Month Worked |
|---|---|---|
| Feltz, Wayne | PD/PI | 1 |
| Olson, Erik | Technician | 1 |
| Smith, Nadia | Staff Scientist (doctoral level) | 1 |
| Loveless, David | Graduate Student (research assistant) | 7 |

## Full details of individuals who have worked on the project:

**Wayne F Feltz**
**Email:** wayne.feltz@ssec.wisc.edu
**Most Senior Project Role:** PD/PI
**Nearest Person Month Worked:** 1

**Contribution to the Project:** Serves as UW-Madison SSEC lead PI in SPARC facility readiness and field missions. During the past year he has conducted several internal PECAN organizational meetings and served in role as PECAN operations Mobile Profiling coordinator. Focus has been on making sure UW-Madison SPARC facility is performing optimally and identified team for deployment.

**Funding Support:** 1 month of NSF grant

**International Collaboration:** No
**International Travel:** No

**Erik Olson**
**Email:** erik.olson@ssec.wisc.edu
**Most Senior Project Role:** Technician
**Nearest Person Month Worked:** 1

**Contribution to the Project:** Engineer responsible for UW-Madison SPARC field campaign readiness, driving, and engineering support

**Funding Support:** NSF Grant

**International Collaboration:** No
**International Travel:** No

**Nadia Smith**
**Email:** nadia.smith@ssec.wisc.edu
**Most Senior Project Role:** Staff Scientist (doctoral level)
**Nearest Person Month Worked:** 1

**Contribution to the Project:** Scientist tasked with organizing travel schedule, management of web portal, and acting as new M.S. student science advisor

**Funding Support:** NSF Grant

**International Collaboration:** No
**International Travel:** No

**David Loveless**
**Email:** david.loveless@ssec.wisc.edu
**Most Senior Project Role:** Graduate Student (research assistant)
**Nearest Person Month Worked:** 7

**Contribution to the Project:** Graduate Student - He has received training in operating all the instrumentsin the SPARC facility and typically deploys with this facility during the various PECAN missions. After the field experiment is over, his role will be to analyze the collected data sets. (started 7/1/2014)

**Funding Support:** NSF Grant

**International Collaboration:** No
**International Travel:** No

## What other organizations have been involved as partners?

| Name | Type of Partner Organization | Location |
|---|---|---|
| University of Oklahoma | Academic Institution | Norman, OK |

## Full details of organizations that have been involved as partners:

**University of Oklahoma**

**Organization Type:** Academic Institution
**Organization Location:** Norman, OK

**Partner's Contribution to the Project:**
Collaborative Research

**More Detail on Partner and Contribution:** We collaborated intensively with Prof. Petra Klein and her research team at the University of Oklahoma, who operate another mobile facility, CLAMPS, which is called MP1 in the PECAN experiment. Our deployment strategies are closely aligned and prior to the deployment we worked together on programming the lidar scans etc.

## What other collaborators or contacts have been involved?

As part of the PECAN deployment we work closely will other PECAN PIs and have supported all of the 11 PECAN mission conducted so far, which include 2 LLJ missions, 2 Bore missions, 5 MCS missions, and a shake-out dry run. The PIs we have collaborated most closely with are:
Richard Clark, Millersville University
Kevin Knupp, University of Alabama, Huntsville
Bill Brown, National Center for Atmospheric Research
Dave Parsons, University of Oklahoma
Michael Biggerstaff, University of Oklahoma
Joshua Wurman, Center for Severe Weather Research

David Turner, National Severe Storms Laboratory
Michael Coniglio, National Severe Storms Laboratory

Steve Koch, National Severe Storms Laboratory
Konrad Ziegler, National Severe Storms Laboratory
Tammy Weckwerth, National Center for Atmospheric Research

Back to the top

# Impacts

## What is the impact on the development of the principal discipline(s) of the project?

It is still really early to report and the field project is still going on, but the data sets collected from the PECAN field campaign (1 June - 15 July 2015)

## What is the impact on other disciplines?

Nothing to report.

## What is the impact on the development of human resources?

The project provides unique training opportunities for David Loveless a graduate student under this NSF support. Two other graduate students, not directly funded by NSF resource, are or will be participating in PECAN field campaign. Our goal has been to involve all project participants in the decision making process in all stages to the project. Overall, PECAN provides opportunities for all
involved researchers to establish new collaborations and to work with instruments and data sets which would otherwise not be available.

## What is the impact on physical resources that form infrastructure?

The project allows us to intensively test the new facility UW SPARC (named MP3 during PECAN) The PECAN experiment is the second deployment of the SPARC and having the opportunity to use the
facility for 6 weeks allows us to address any weaknesses in the design, to further improve the data system, and to develop data analysis routines which can then be used during future deployment of UW SPARC.

## What is the impact on institutional resources that form infrastructure?

Nothing to report.

## What is the impact on information resources that form infrastructure?

We have set up internal and external SPARC data archives, which will allow us to easily share collected data sets from observations with the larger science community.

## What is the impact on technology transfer?

Nothing to report.

## What is the impact on society beyond science and technology?

Before and during the PECAN deployment we actively participated in briefings of the public to inform the larger

community about the value of weather observations and modeling tools, and how weather impacts the daily activities. The SPARC participated in the PECAN PR day at the airport in Hays, KS on May 30.

Back to the top

# Changes/Problems

## Changes in approach and reason for change

Nothing to report.

## Actual or Anticipated problems or delays and actions or plans to resolve them

Nothing to report.

## Changes that have a significant impact on expenditures

Nothing to report.

## Significant changes in use or care of human subjects

Nothing to report.

## Significant changes in use or care of vertebrate animals

Nothing to report.

## Significant changes in use or care of biohazards

Nothing to report.

Back to the top

< Back