Field Data Collection and Analysis of Tornadic Environment Enhancement by Topography Along the Sand Mountain Plateau

Ryan Wade
University of Alabama in Huntsville

Follow this and additional works at: https://louis.uah.edu/rceu-proposals

Recommended Citation

This Proposal is brought to you for free and open access by the Faculty Scholarship at LOUIS. It has been accepted for inclusion in RCEU Project Proposals by an authorized administrator of LOUIS.
Title: Field Data Collection and Analysis of Tornadic Environment Enhancement by Topography Along the Sand Mountain Plateau

Faculty Mentor: Ryan Wade, Department of Atmospheric Science
SWIRLL 120
Email: ryan.wade@uah.edu
Phone: 256-824-4026

Project Summary:

The Southeastern United States (“SE”) represents a geographic maximum in tornado frequency that may locally approach the well-known maximum in the U.S. Great Plains. Advances in our understanding of tornado formation have occurred as a result of the original Verification of the Origins of Rotation in Tornadoes Experiment (“VORTEX”, 1994-95) and subsequent VORTEX2 (2009-10) field campaigns. However, there is dispute about the degree to which findings from these Great Plains experiments may be applicable to the environments and storms that produce tornadoes in the SE. A clearer understanding of storms in this region is critical since they are associated with higher fatality rates and lower warning skill scores than those in the Plains. A substantial fraction of tornadoes in the SE are associated with the presence of complex terrain and along land surface or other mesoscale boundaries. There remains a number of links missing from the chain of physical processes that explains environmental and convective evolution in the SE.

The VORTEX-SE project, centered over north Alabama, is a physical science project where the goal is to address the gaps in the knowledge base through a complementary set of specific objectives. UAH’s role in VORTEX-SE is to (i) coordinate and collect high temporal resolution mobile rawinsonde data from weather balloon sounding systems, (ii) deploy mobile radar and mobile wind profilers to collect thermodynamic, kinematic, and storm-structure data, and (iii) quantify the role varying boundary layer flow and moisture within complex terrain have on the tornadic environment.

This proposed RCEU project will leverage the VORTEX-SE Year 2 field campaign in March and April of 2017 to collect high resolution weather balloon data on and around the Sand Mtn Plateau. The selected RCEU student will not only participate in launching weather balloon soundings, but will also take on a leadership role in managing one of the VORTEX-SE undergraduate weather balloon teams during the March & April field campaign. During the summer RCEU project, the student will interact with researchers, faculty, and students from other universities / research labs in collecting collaborators’ balloon data, perform quality control, and conduct preliminary analyses on the tornado environment around Sand Mtn Plateau.
**Student Prerequisites**

The student should be (a) sophomore standing or higher, (b) have completed ESS 112 (Severe and Hazardous Weather) and ESS 301 (Intro to Earth & Atmos Physics), and (c) be a member of the UAH Profile Sounding Team for Operational and Research Meteorology (UPSTORM). The ideal candidate will have participated in UAH SWIRLL severe weather research deployments, already be an UPSTORM team lead, and have a working knowledge of balloon data and Python programming. It is expected that the RCEU project will be the selected student’s sole focus for the summer term, thus other internships are prohibited and other employment is discouraged.

**Student Duties**

To ensure the student has the background to conduct weather balloon and radar research, as well as manageable undergraduate deliverables, a structured, scale-up three-phase approach has been designed during the summer term (the student will have the opportunity to participate in voluntary field data collection in the March & April prior to the RCEU Summer term).

**Phase 1:** The first two weeks will focus on 1) **iMET and Windsond weather balloon instruments and data**, and 2) developing the student’s background on tornado environments and wind flow in complex terrain through an intensive literature review. The student will meet with an experienced faculty and graduate student mentors to receive training on the iMET and Windsond systems, participate in mock deployments of these systems. [2 weeks]

**Phase 2:** The next four weeks will focus on 1) **weather balloon and radar data analysis software / techniques**, and 2) cataloging VORTEX-SE Intensive Observation Periods (IOPs) and collecting data from collaborators at other universities / research labs. The student will be instructed by mentors on weather balloon / radar software (RAOB, SHARPpy, Proftool wind profiling software, GR2Analyst and Python-based radar tools), and radar analysis techniques (editing, dealiasing, gridding, and **multiple-Doppler syntheses**). The student will perform quality control of weather balloon data for upload to the NOAA VORTEX-SE data catalog. [4 weeks]

**Phase 3:** The final portion of the project will focus on performing **advanced analyses on the boundary layer wind flow** for VORTEX-SE IOP case events. The student will analyze the evolution of the boundary layer wind shear through data from weather balloon soundings and the UAH mobile radar systems, note changes in BL structure as storms approach Sand Mtn., and then perform multiple-Doppler syntheses on any storms that produce tornadoes. [6 weeks]

**Benefit to the Student:** The student will be provided with the unique opportunity to be involved with the entire hands-on process of instrument operation, data collection, data quality control, and data analysis. Upon project completion, the student will present research findings at the Von Braun Memorial Symposium, as well as an American Meteorological Society conference (Mesoscale or Severe Local Storms). These experiences will make the student a strong candidate for graduate school GRA funding, NSF / NASA fellowships, and internships / employment with NASA and NOAA.

**Mentor Supervision and Interaction**

Ryan Wade, as well as an experienced senior graduate student, will supervise the RCEU student for the duration of the project. During the first 2-4 weeks, both the faculty and graduate student mentors will meet with the student every day (see above) to ensure that appropriate background knowledge and instrument training are being successfully achieved. It is expected that the student will become more independent after the first few weeks, thus the mentors will alternate daily meetings for the last 6-8 weeks of the project (meeting frequency and length will change as needed). The RCEU student will attend research group meetings to allow the student to interact with other research group members, thereby gaining exposure to other research projects. Additionally, the student will be stationed for the summer in the UAH SWIRLL Research Operations Center with other RCEU / REU students from the Knupp, Carey, and Bitzer research groups. These RCEU / REU students will interact with one another, participate in group radar training sessions, attend seminar talks, and participate in other planned group team building exercises. Experience from this collaborative RCEU environment will be used as a demonstrated proof of concept for an upcoming NSF Site REU proposal.