This is provided as an example proposal.

It is important that you follow the current guidelines.

The mentor letter has been removed.

A PROPOSAL TO STUDENT ENHANCEMENT AWARD REVIEW COMMITTEE

TITLE OF PROJECT: Lake Michigan Ozone Study (LMOS)

NAME OF APPLICANT: Jack Bruno

STATUS: X Undergraduate ____Graduate ____Medical

CAMPUS/LOCAL ADDRESS: 48 East Green dr.
E-MAIL ADDRESS: jb304714@ohio.edu
DEPARTMENT: Physics & Astronomy

EXPECTED GRADUATION DATE (Month and Year): 05/19

RE-SUBMISSION: ___ YES (Original Submission Date _____) X NO

PROPOSAL CATEGORY (select one):
_____ Life/Biomedical
_____ Arts/Humanities
_____ Social/Behavioral
_X_ Physical Sciences/Engineering

BUDGET: Total Request $5,750
(May not exceed $6,000)

FACULTY MENTOR INFORMATION:
NAME: Dr. Jonathan Gero
E-MAIL ADDRESS: jonathan.gero@ssec.wisc.edu
CAMPUS ADDRESS: N/A
DEPARTMENT: Space Science and Engineering center
DEPARTMENT ADMIN./EMAIL: N/A

IRB AND IACUC APPROVAL:
To ensure that the University is in compliance with all federal regulations, complete the checklist below. *Note: your proposal can be approved prior to IRB or IACUC approval (put "pending" or "to be submitted" instead of approval number), but funding will be withheld until notification of approval or exemption.*

Yes	***No***	***Office of Research Compliance***	***Policy #***
	X	Human Subjects in Research (including surveys, interviews, educational interventions): Institutional Review Board (IRB) Approval #: Expiration Date:	19.052
	X	Animal Species: Institutional Animal Care & Use Committee (IACUC) Approval #: Expiration Date:	19.049

SIGNATURES

Applicant's Signature		**Faculty Mentor's Signature**	
Signature	Jack Bruno	Signature	
Name	Jack Bruno	Name	Jonathan Gero
Dept/School	Physics and Astronomy/HTC	Unit	SSEC UW-Madison
Date	1/18	Date	1/16

☑ **Optional:**
If selected for funding, I give permission to the Office of the Vice President for Research and Creative Activity to use my proposal as an example during training and workshop exercises. (Sign below)
Signature: Jack Bruno Date: 1/18

STUDENT ENHANCEMENT AWARD
APPLICATION CHECKLIST

Applicants **must** complete and sign the checklist. The checklist should be included as the second page of the application (following the cover page).

☑ Cover page	use SEA form
☑ Checklist	use SEA form
☑ Abstract*	1 double-spaced page
☐ ResubmissionSummary (***For Re-submissions Only***)*	1 double-spaced page
☑ Project Narrative	5 double-spaced pages
☐ Glossary/Definition of Terms* (***Not required***)	2 double-spaced pages
☐ Bibliography (***Not required***)	2 pages
☑ Presentation of Results	1 double-spaced page
☑ Mentor's Endorsement	1 page
☑ Biographical information (***Applicant(s) and key personnel***)	3 pages per person
☑ Budget and Justification	no limit specified (Including the OHIO-Affiliated Travel Form, if applicable)
☑ Appended Materials/Multimedia Files	5 pages; and no more than 10 minutes of footage
☑ Electronic copy of proposal	Single Acrobat file, containing entire proposal and required signatures

Sections marked with a bullet (*) identify text sections that should be written in language understandable by an informed layperson to assist the Committee in its review.

*****Please Note: The committee has the right to return without review any proposals that do not conform to these format requirements*****

Applicant signature: _____

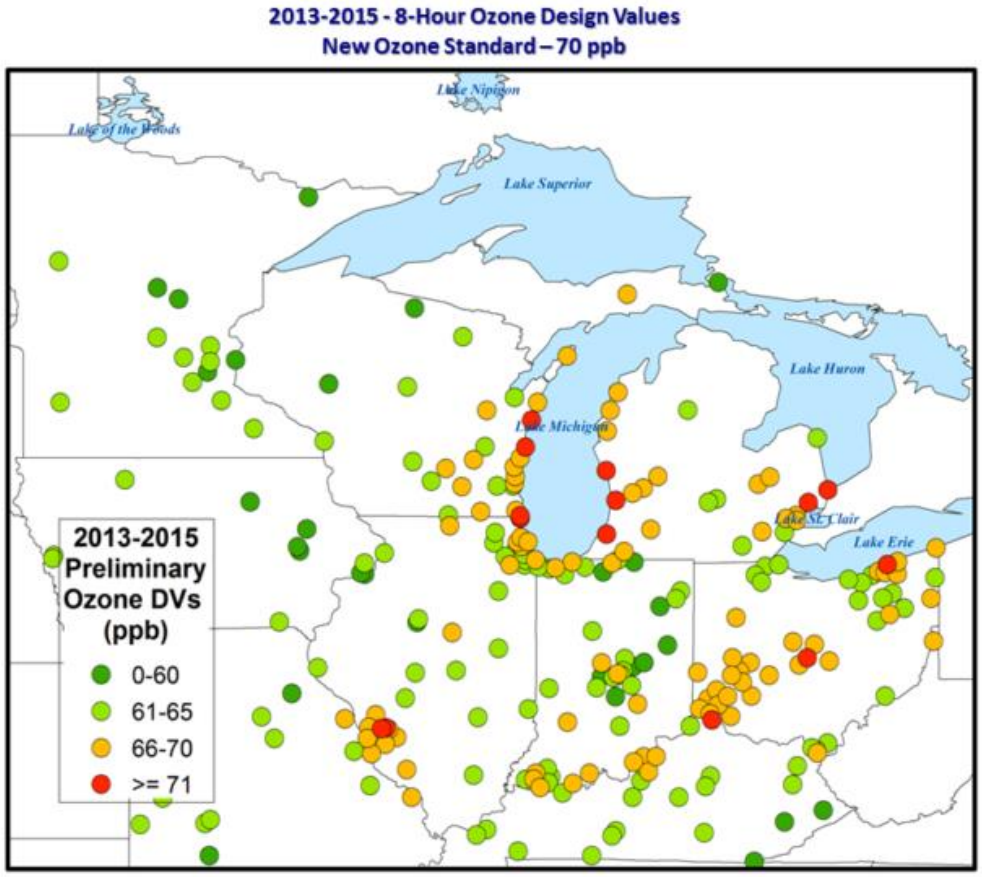
Abstract

High levels of ozone near the earth's surface can cause a number of issues including respiratory health problems in humans as well as damaging vegetation. For years communities around Lake Michigan have had issues with an overabundance of surface-level ozone, leading to exceedances (or violations) of federal air quality standards as set by the U.S. Environmental Protection Agency (EPA). If the problem is to be addressed, there needs to be a better understanding of the source of the excess ozone in the area as well as the atmospheric dynamics involved in transporting surface ozone from its primary source, urban areas, to the areas with the highest concentrations, namely, the Lake Michigan shoreline. Scientists from a number of institutions including University of Wisconsin-Madison, NASA, and NOAA are planning a field campaign from mid-May to mid-June to gain a more complete picture of the surface level ozone drift in southern Wisconsin. I have already been brought on for a paid research internship for the summer with Dr. Jonathan Gero of the Space Science and Engineering Center at the University of Wisconsin-Madison to work on the data analysis for this study. I am seeking funding to allow me to participate in the field campaign as well.

The study has merit from scientific, legal, and humanitarian perspectives. The work performed will provide a better understanding of the atmospheric phenomena that dictate surface-ozone drift. Depending on how extensive the drift is shone to be the study could have meaningful impact on the way in which public policy regarding pollution standards is legislated. And, most importantly, this will be a step towards understanding and alleviating a public health risk which affects thousands in the area.

Project Narrative

The Lake Michigan Ozone Study (LMOS) is a collaborative field campaign that will be taking place this summer with observing stations all around Lake Michigan. **This campaign follows a preliminary study from 2013-2013 showing the high surface ozone levels along the Lake Michigan shoreline.** The data from that survey can be seen below. The red dots on the map indicate areas where EPA standards are exceeded:



An important finding of this preliminary work is that several of the area's shown to be in violation of EPA standards are rural parts of the state with no major pollution sources. This provides a clear indication that these high levels of surface ozone are a result of transport from

polluting areas. Since these preliminary results were obtained some work has already been done to **The goal of the LMOS will be to answer the following questions:**

1) What is the relative contribution of various sources of ozone and ozone precursor gases on the prevalence of surface ozone along Lake Michigan?

2) To what extent do lake breeze circulations effect ozone production?

3) What is the distribution of ozone and ozone precursor gases over Lake Michigan?

4) How can remote sensing products be used to constrain ozone predictions?

5) How well do current regional models capture ozone production chemistry as assessed through evaluation of critical measurement indicators?

As stated in the abstract the campaign spans multiple institutions. **The field portion of the research will take place from May 22 to June 22 2017.** NASA's Airborne Science Program will be providing the Geostationary Trace gas and Aerosol Sensor Optimization (GeoTASO). This will provide data to map nitrogen oxide (a key precursor to ozone) emissions along the Lake Michigan shoreline and in the surrounding area. The ground based component of the campaign will consist of two mobile remote sensing vehicles. One of these will be the Collaborative Lower Atmospheric Mobile Profiling System (CLAMPS) from the National Severe Storms Laboratory at the University of Oklahoma. This vehicle will likely be based in Zion, Illinois for the duration of the campaign, and it will be using an Atmospheric Emitted Radiance Interferometer (AERI) instrument to provide temperature and water vapor profiles as well as using a Halo wind lidar to measure wind speeds. The AERI instrument was developed at UW-Madison and Jonathan Gero, my primary mentor for the summer, is the PI for the instrument's development and use. The second vehicle, which I will be in should I secure this funding, is the SSEC's Portable Atmospheric Research Center (SPARC). The SPARC, much like

CLAMPS, houses an AERI instrument as well as a Halo wind Lidar. In addition, it also houses a High Spectral Resolution Lidar (HSRL) to measure aerosol extinction and the boundary layer depth. This vehicle will be based in Sheboygan, Wisconsin and it would be there that I would spend the field campaign.

Now that there is some clarity as to the scope and nature of the whole campaign focus can be narrowed to the specific functions myself and the other researchers with SPARC will be performing. **Sheboygan has had some of the largest ozone exceedances and would also be ideal for studying the effects of lake breeze circulation. I will be working alongside Erik Olson (SSEC) and Jim Szykman (US EPA) to deploy a number of meteorological instruments that will be detailed one by one in the following.** I will participate in the launching and operation of a tethered radiosonde/ozonesonde system. The "tethersonde" is a novel device first used in 2013 which can collect temperature, wind, water vapor, and ozone profiles. It does so using an instrumented weather balloon tethered to a fishing rod driven by a computer controlled electric motor. This motor oscillates the balloon and instrumentation up and down allowing for continuous profiling in contrast to the single vertical profile collected by a standard radiosonde. Though an unconventional and perhaps odd looking approach, this method was shown in a study in Utah's Uinta Basin to be able to provide accurate minute to minute data on surface ozone formation. By using the tethered system not only is better data obtained, but it is significantly more cost effective than traditional weather balloons. Where individual weather balloons and their instruments can cost as much as $1,500 a piece and are rarely recovered, the tethersonde can be used for 10s and even 100s of readings on the same equipment. The costs of all this equipment is already covered.

As stated above the SPARC houses an AERI instrument as well as a Halo wind lidar. While these instruments require slightly less hands on daily operation they are not completely self-sufficient. Some level of daily maintenance and troubleshooting will be performed by myself and the other two researchers. **Additionally, the data we will be taking with the ground based instruments will be used for product validation of the GOES-R Advanced Baseline Imager which is the primary instrument on a recently launched weather satellite.** This further shows how the positive effects of this study will proliferate the atmospheric science community at large.

The field campaign will offer a convenient opportunity for public outreach and education on surface ozone pollution. Spaceport Sheboygan is a non-profit science education facility which provides educational opportunities for children grades K-12. As we will be based in Sheboygan we will be able to an exciting and unique opportunity to local youth to learn about ozone pollution and atmospheric science. Though this is not the primary goal of the study, it is a benefit that should not be taken too lightly as public outreach and education is one of the explicit goals of some of the largest atmospheric science organizations in the country (ie. NOAA and NASA). Performing outreach during a study like this can encourage young minds to potentially pursue higher education and careers in atmospheric sciences. Furthermore, I am equipped to perform outreach and education activities having worked during the school year as well as summer with Ohio University's Dr. Mark Lucas. I have participated in science outreach programs such as the Athens Makers with children grades 6-12 and presentations for children grades K-12 at local schools and the Athens Museum of Discovery.

There are several important potential impacts of this study. The most obvious, is the measurements taken by the various deployed field teams will help to fill a current gap in

knowledge on how lake breezes affect surface ozone movement. With this data, the ozone pollution in areas like the shoreline can be traced back to their origins. This data is critical for the development for pollution mitigation plans particularly in cases like this one where the ozone is likely crossing state lines. As it currently stands, pollution and air quality issues are frequently dealt with state by state. This practice is not particularly logical as neighboring states are not geographically isolated from each other. By producing meaningful and conclusive data that ozone is drifting from Illinois up into the Lake Michigan shoreline in Wisconsin we will be able to strongly encourage interstate cooperation to curb pollution. Another important product of this study will be the gathering of information that will assist in showing how well current air quality models perform. **Improving these models is pivotal to the implementation of public policy with regards to surface ozone pollution as they are used to measure the potential effectiveness of such policies and allow governments and regulatory agencies to make more informed decisions on the subject. More informed and effective ozone pollution mitigation could save thousands of lives annually.**

Bibliography

This paper provides justification for our use of the "tethersonde" system for lower troposphere ozone detection showing this to be an exceptionally accurate method for such detection:

Schnell, Russell C., Bryan J. Johnson, Samuel J. Oltmans, Patrick Cullis, Chance Sterling, Emrys Hall, Allen Jordan, Detlev Helmig, Gabrielle Petron, Ravan Ahmadov, James Wendell, Robert Albee, Patrick Boylan, Chelsea R. Thompson, Jason Evans, Jacques Hueber, Abigale J. Curtis, and Jeong-Hoo Park. "Quantifying Wintertime Boundary Layer Ozone Production from Frequent Profile Measurements in the Uinta Basin, UT, Oil and Gas Region." *Journal of Geophysical Research: Atmospheres* 121.18 (2016): n. pag. Web.

This article provides the agency's justification for the study as well as a detailing of the coordination that will be taking place over its duration:

"Lake Michigan Ozone Study 2017: Collaborative Field Campaign Will Pursue Sources and Transport of Ozone | SSEC News." *SSEC*. N.p., n.d. Web. 19 Jan. 2017.

This paper is the source of the graphic included in the project narrative and provides the quantitative justification for our study:

Cleary, P. A., N. Fuhrman, L. Schulz, J. Schafer, J. Fillingham, H. Bootsma, J. Mcqueen, Y. Tang, T. Langel, S. Mckeen, E. J. Williams, and S. S. Brown. "Ozone Distributions over Southern Lake Michigan: Comparisons between Ferry-based Observations, Shoreline-based DOAS Observations and Model Forecasts."*Atmospheric Chemistry and Physics* 15.9 (2015): 5109-122. Web.

All information pertaining to the SPARC vehicle, both its capabilities as well as uses to date, can be found on the following webpage:

"SPARC Home." *SPARC Home | SPARC*. N.p., n.d. Web. 19 Jan. 2017. <https://www.ssec.wisc.edu/sparc/>.

The study below provides estimates of the number of lives that could be saved annually in the US if ozone were to be more properly and severely regulated:

Berman, Jesse D., Neal Fann, John W. Hollingsworth, Kent E. Pinkerton, William N. Rom, Anthony M. Szema, Patrick N. Breysse, Ronald H. White, and Frank C. Curriero. "Health Benefits from Large-Scale Ozone Reduction in the United States." *Environmental Health Perspectives* 120.10 (2012): 1404-410. Web

Presentation of Results

Presented below is a timeline for the project

Summer 2017

I will be working in Sheboygan, Wisconsin collecting data in the field and then at the University of Wisconsin-Madison for the balance of the summer analyzing data

Fall/Spring 2017

Depending on which semester the Student Research & Creative Activity Expo is held in at the university during the 2017-2018 academic year I will be presenting results at OU in either the Fall or Spring

January 2018

I plan to attend the AMS student conference in Seattle, Washington to present our results

SSEC

SPACE SCIENCE AND ENGINEERING CENTER
University of Wisconsin-Madison

Ohio University
Student Enhancement Awards

To: CRSCA Committee

I am writing to provide an endorsement for Jack Bruno for the CRSCA Student Enhancement Award.

I'm a Research Scientist at the University of Wisconsin - Madison Space Science and Engineering Center. My research focuses on building and deploying instruments on ground based, airborne and satellite platforms to study the Earth's atmosphere, and improve our understand of weather, climate, pollution, natural hazards. Jack Bruno approached my research group because our interests align very closely in the combined use of engineering and science to study the health of our planet, and influence public policy.

The Lake Michigan Ozone Study is a multi-agency field campaign that will take place in the summer of 2017. A variety of ground based, airborne, and satellite instruments will be deployed to study the effects of pollution in urban, rural and marine environments in the Lake Michigan area. This field campaign would be an excellent project for Jack to get involved in. His preparation of science, engineering and computing courses provides a good broad background to join our team and participate in this project.

Prior to going into the field, Jack will receive training on the operation of various instruments in our mobile atmospheric observing facility. During the field campaign, Jack would be responsible for the operation of the tethersonde system, as well as the daily launch of radiosondes (weather balloons). He would also assist our team in the general operation of our suite of atmospheric remote sensing instruments. In addition, there will be opportunities for outreach events where we will discuss our scientific campaign with members of the community. Following the campaign we will work jointly in analyzing the results and prepare them for publication as well as conference presentation.

Overall, I think Jack has an excellent preparation and enthusiasm to join our team and contribute to our scientific efforts. He would be working with a great team professionals and students at the UW Space Science and Engineering Center, which will provide a good environment to gain experience and broaden his skills. I'm happy to be his scientific mentor for the duration of his research project.

Best regards,

Jonathan Gero, Ph.D

1225 W. Dayton Street • Madison, WI 53706-1695 • www.ssec.wisc.edu • 608-263-6750 • 608-262-5974 (fax)

Biographical Information

Jack Bruno

48 East Green Dr. RM 203
330-858-0921
jb304714@ohio.edu

Education (Current GPA 3.9):

(May 2019) B.S. Physics, Honors Tutorial College, Ohio University
(May 2019) Minor in Mathematics, College of Arts and Sciences, Ohio University
(May 2019) Minor in African-American Studies, College of Arts and Sciences, Ohio University

Academic Honors:

(Summer 2016) Physics and Astronomy Fellowship, Ohio University
- Pulsed-Laser Deposition Research

(2015-2016) OHIO Premier Scholarship
(2015-2016) Ohio University Dean's List
(2015) James T. Shipman Scholarship

Professional Experience:

(Fall Semester 2016) Physics Teaching Assistant for physics lab, Ohio University
- Grading
- Teaching basic lab procedure
- Providing supplemental mathematics instruction

(Fall Semester 2016) Tutor for high school math student, Athens, Ohio
- Teaching Algebra II level material to home-schooled student
- Supplementing online class resources

Research:

(2016-present) Pulsed-Laser Deposition with an Excimer Laser
- Work done under Dr. Arthur Smith with the Physics and Astronomy Fellowship
- Operation of Excimer laser including setup and use of gas lines
- C# programming for operation of lense and target manipulators
- Vacuum pump and chamber use and design
- Performing analysis on deposition rates and material viability

Skills:

- Coding proficiency in C and MatLab as well as reasonable proficiency languages with similar syntax
- Basic to intermediate use of AutoCAD and SolidEdge

Organizations:

(2015-present) Society of Physics Students, Member, Ohio University

(2016-present) Global Engineering Projects, Trash Team Member, Ohio University

- Working to find waste management and disposal options for the village of Maase-Offinso, Ghana

Community Involvement:

(Summer 2016) Athens Makers, Athens, Ohio

- Working with 6th-12th grade students on basic engineering projects
- Teaching principles of circuitry and programming

(2015-2016) Physics and Astronomy outreach, Athens, Ohio

Giving science demonstrations at local elementary schools as opportunities arise

- Infrared cameras
- Ping Pong ball cannon
- Makey Makey's

Other Funding Sources:

During both the field campaign and the time I will be spending at Madison I will be paid $12/hour by the university. Beyond this the only funding I am receiving is that from my academic scholarships which cover full tuition as well as an additional $2000 that goes towards my room and board during the year here at the university.

Jonathan Gero

1225 W. Dayton St. 608-265-2335
Madison, WI 53706 gero@wisc.edu

EDUCATION

Ph. D., Harvard University 2007
Earth and Planetary Sciences
Advisor: James G. Anderson
Dissertation title: Realization of SI-traceable infrared radiance measurements from space for achieving benchmark climate observations

Master of Science, Harvard University 2004
Applied Mathematics

Bachelor of Applied Science, University of Toronto 2002
Engineering Science - Physics
Advisor: James R. Drummond
Dissertation title: Design of a liquid helium cold target for use in the scientific testing of the ACE-FTS satellite instrument

RESEARCH EXPERIENCE

January 2015 – present
Associate Researcher, Space Science and Engineering Center, University of Wisconsin-Madison
November 2011 – December 2014
Assistant Researcher, Space Science and Engineering Center, University of Wisconsin-Madison
December 2008 – November 2011
Research Scholar, Space Science and Engineering Center, University of Wisconsin-Madison

Dr. Gero works on developing instruments to observe the earth's atmosphere on ground-based, aircraft and satellite platforms, as well as analyzing their data to study atmospheric and climate change processes. He has worked on the development and testing of a laboratory prototype FTS satellite instrument, as part of a NASA IIP grant, to measure spectrally resolved outgoing thermal infrared radiance from space. He was involved in the optical and radiometric characterization of the FTS instrument. He has designed and performed experiments that prove the SI-traceability of satellite calibration blackbodies. He has demonstrated a method to test thermometry drift on-orbit against a fixed point of the ITS-90 temperature scale. He has developed methods to test paint emissivity degradation in space using the heated halo thermal source. He is currently the mentor for the ground-based AERI instrument operated by the US Dept. of Energy, and is responsible for overseeing the operation of the instruments at numerous field sites worldwide. He has developed methods to analyze infrared spectra from the AERI instrument to determine greenhouse gas forcing as well as trends in the climate system. He has worked with the

optical testing and field deployment of the S-HIS aircraft instrument, participating in campaigns for studying hurricanes and validation operational satellite instruments. Under a contract from the Japanese Space and Exploration Agency, he has improved the calibration and worked on the validation of the GOSAT satellite. He has worked with model data from General Circulation Models to develop methods to use satellite observations to measure climate feedbacks.

May 2007 - November 2008
Post-doctoral Fellow, School of Engineering and Applied Sciences, Harvard University
September 2002 - April 2007
Graduate Student, Department of Earth and Planetary Sciences, Harvard University

Mr. Gero developed and tested the laboratory prototype of a FTS satellite instrument to measure spectrally resolved outgoing thermal infrared radiation from space. The primary objective of the instrument is to observe trends in radiance with sufficient accuracy to detect and attribute climate change. Specifically, he designed and performed experiments that prove the SI-traceability of satellite calibration blackbodies. He has demonstrated a method to test thermometry drift on-orbit against a fixed point of the ITS-90 temperature scale. Using a quantum cascade laser he has developed an infrared reflectometer that can be deployed to monitor paint emissivity degradation in space. He devised a method to detect and correct systematic errors in calibration blackbodies with their spectra. These developments will be used to achieve climate-quality radiance measurements from space. As the thermal infrared spectrum contains the signatures of climate forcing, response and feedbacks, the satellite measurements will be instrumental in constraining climate models.

February 2001 - April 2002
Research Assistant, Department of Physics, University of Toronto

Mr. Gero was involved in design and construction for the pre-launch scientific testing of the ACE-FTS instrument, which was successfully deployed on the SCISAT-1 satellite.

May - August 2000
Research Assistant, Department of Physics, University of Toronto

Mr. Gero was involved in the building and optical testing of the MOPITT-A airborne radiometer, and participated in its ER-2 deployment at SAFARI 2000 to validate carbon monoxide measurements by MOPITT on the Terra satellite.

May - August 1999
Research Assistant, Institute of Biomaterials and Biomedical Engineering, University of Toronto

Mr. Gero participated in a tissue engineering project to conformally coat islets of Langerhans. The polymer coating could permit the implantation of the cells into a diabetic patient without immune rejection of the foreign tissue.

PEER-REVIEWED PUBLICATIONS

Feldman, D. R., W. D. Collins, P. J. Gero, M. S. Torn, E. J. Mlawer, T. R. Shippert (2015), Observational determination of surface radiative forcing by CO_2 from 2000 to 2010,

Nature, **519**, 339–343, doi:10.1038/nature14240.

Turner, D. D., P. J. Gero, D. C. Tobin (2012), The Far-infrared: Focusing on a relatively underexplored portion of the electromagnetic spectrum, *Bull. Amer. Meteor. Soc.*, **93**, ES103–104, doi: 10.1175/BAMS-D-11-00007.1.

Gero, P. J., J. K. Taylor, F. A. Best, R. K. Garcia, H. E. Revercomb (2012), On-orbit absolute blackbody emissivity determination using the heated halo method, *Metrologia*, **49**, S1–8, doi: 10.1088/0026-1394/49/2/S1.

Gero, P. J., D. D. Turner (2011), Long-term trends in downwelling spectral infrared radiance over the U.S. southern great plains, *J. Climate*, **24**, 4831–4843, doi: 10.1175/2011JCLI4210.1.

Turner, D. D., P. J. Gero (2011), Downwelling 10 μm radiance temperature climatology for the Atmospheric Radiation Measurement Southern Great Plains site, *J. Geophys. Res.*, **116**, D08212, doi:10.1029/2010JD015135.

Huang, Y., S. Leroy, P. J. Gero, J. Dykema, J. Anderson (2010), Separation of longwave climate feedbacks from spectral observations, *J. Geophys. Res.*, **115**, D07104, doi: 10.1029/2009JD012766.

Leroy, S. S., J. A. Dykema, P. J. Gero, J. G. Anderson (2009), Testing climate models using infrared spectra and GNSS radio occultation, In: New Horizons in Occultation Research, Andrea Steiner et al (Eds), Springer-Verlag, New York, doi: 10.1007/978-3-642-00321-9.

Gero, P. J., J. A. Dykema, J. G. Anderson (2009), A Quantum cascade laser-based reflectometer for on-orbit blackbody cavity monitoring, *J. Atmos. Oceanic Technol.*, **26**, 1596–1604, doi: 10.1175/2009JTECHA1227.1.

Gero, P. J., J. A. Dykema, J. G. Anderson (2008), A Blackbody design for SI-traceable radiometry for earth observation, *J. Atmos. Oceanic Technol.*, **25**, 2046–54, doi: 10.1175/2008JTECHA1100.1.

Budget and Justification

The following budget items were provided by Dr. Gero and the staff at UW-Madison. As stated previously, all research materials are already paid for. Additionally, I am able to arrange my own transportation to Sheboygan, Wisconsin. The funding I require is that which will allow me to be in Sheboygan to perform the research as well as that required to present the results at a conference. I plan to be in Sheboygan for 40 days in order to have time to set up for the study, perform it, and to then recover the equipment. This was the amount of time indicated to be necessary by Dr. Gero. The fleet car is a necessity for daily transportation to and from the test site. The American Meteorological Society(AMS) student conference ideal for presenting this type of results as an undergraduate, and it is one which Dr. Gero has sent students to before and recommended to me.

1 Trip / 1 person / 40 days / Sheboygan, WI				Total
	Days	cost / day	subtotal	
Fleet Car	40	13.5	$540	
	Miles	Cost / mile		
Mileage (20/day included)	192	0.28	$54	
	#	Cost/Duration		
Apartment Rental	1	1000	$1,000	
	# days	Cost/day		
Meals and Incidentals	39.5	59	$2,331	
				$3,925
1 Trip / 1 person / 3 days / AMS Conference Austin, TX				
	Fares		Subtotal	
Flight	1	500	$500	
	# days	cost / day		
Hotel	2	198	$396	
Meals and Incidentals	1.5	59	$89	
Airport Transportation	2	25	$50	
Ground Transport	3	55	$165	
Conference Registration			$625	
				$1,825
		Travel Total		$5,750

Appendix

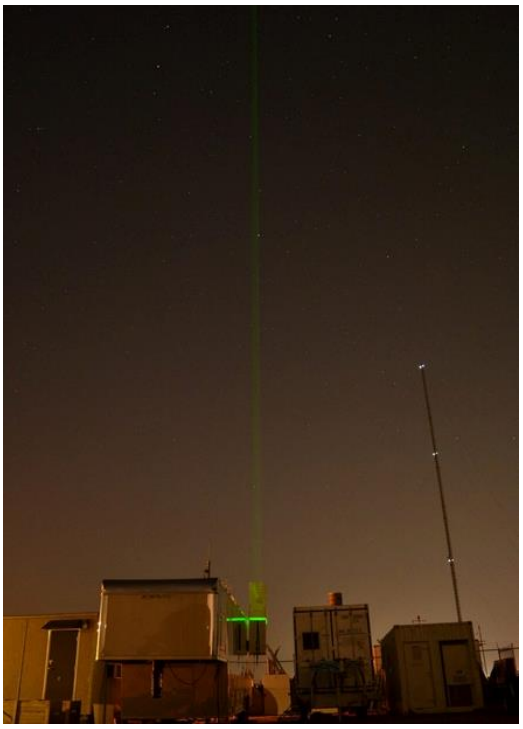
This is the SPARC vehicle that we will be using for the duration of the campaign. Within this mobile lab is housed an Atmospheric Emitted Radiance Interferometer (AERI), a High Spectral Resolution Lidar (HSRL), a Surface Meteorology (SurfaceMet) station, a WindPro lidar system, and a radiosonde receiving station. All of these are shown in turn on the following pages. All images and definitions in this section are taken from the SPARC webpage. (https://www.ssec.wisc.edu/sparc/)

The SPARC during the Plains Elevated Convection At Night (PECAN) field experiment. Credit: Tim Wagner, SSEC.

AERI

The AERI's observations have broad spectral content, and sufficient spectral resolution to discriminate among gaseous emitters (such as carbon dioxide and water vapor) and suspended matter (such as aerosols, water droplets, and ice crystals). These up looking surface observations can be used to obtain vertical profiles of tropospheric temperature and water vapor, as well as measurements of trace gases (such as ozone, carbon monoxide, methane) and downwelling infrared spectral signatures of clouds and aerosols.

High Spectral Resolution Lidar (HSRL)

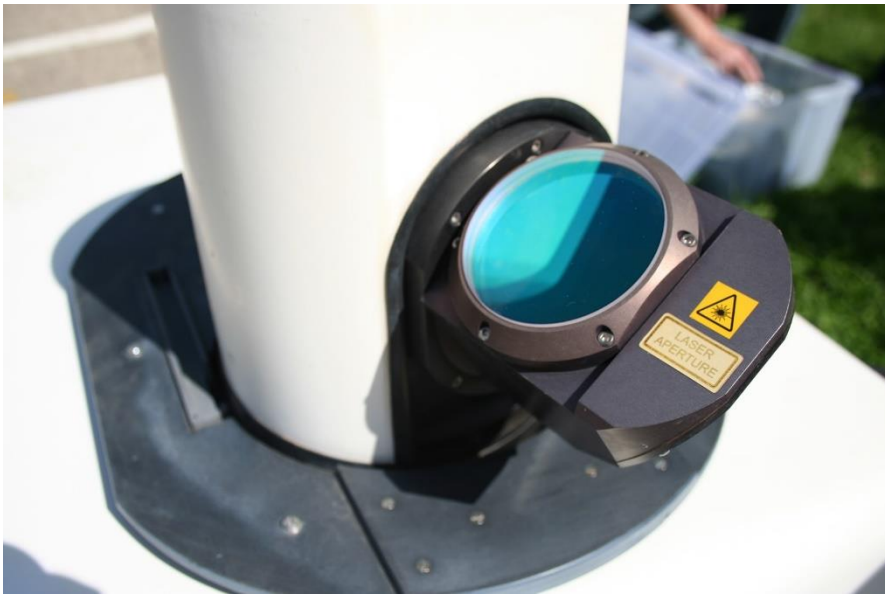


A High Spectral Resolution Lidar (HSRL) is a special type of lidar (a word derived from the phrase "light detection and ranging") that is used for detecting aerosols.

SurfaceMet

The Surface Meteorology Station (SurfaceMet) in the SPARC records outside meteorology statistics such as wind speed, wind direction, air temperature, and relative humidity. It also records internal SPARC engineering values, such as air temperature, relative humidity, and electrical voltage.

WindPro



WindPro, a Stream Line Doppler Lidar system built by Halo Photonics, is deployed outside of the SPARC and records wind direction and speed profiles.

Radiosonde (tethersonde)

Radiosondes are battery-powered telemetry instrument packages carried into the atmosphere by a weather balloon, measuring various atmospheric parameters and transmitting them by radio to a ground receiver. The SPARC houses a radiosonde receiving station, as well as helium tanks for inflating and launching weather balloons.

This image is not of the SPARC radiosonde device, but rather of a tethered radiosonde used in the Uinta Basin, UT ozone study cited in the bibliography. Because this campaign is ozone focused we will be utilizing a similar tethered system in Sheboygan.