

Earth | Wind | Sea | & Sky



Top: (L-R) SOARS Alumni Marcel Corchado-Albelo, Vanessa Vincente, and Matt Paulus volunteering at the UCAR Booth during the AMS100 WeatherFest—12 January 2020

Bottom: Annual SOARS Gathering at the AMS100 in Boston, MA—13 January 2020



AMS100

We are excited to share this 2020 edition of Earth, Wind, Sea and Sky; showcasing the summer research of the Protégés from the Significant Opportunities in Atmospheric Research and Science (SOARS) Program. SOARS began in 1996, and remains true to its mission of increasing the diversity of the atmospheric and related sciences, by engaging students from historically underrepresented communities in STEM, in genuine research. The Protégés' ability to do excellent work in such a short period of time and in a virtual environment is a credit to their hard work and dedication; and to the exceptional training, care, and guidance of their Mentors. We are ever so grateful for the Mentors' commitment to the Program.

Earth | Wind | Sea & Sky

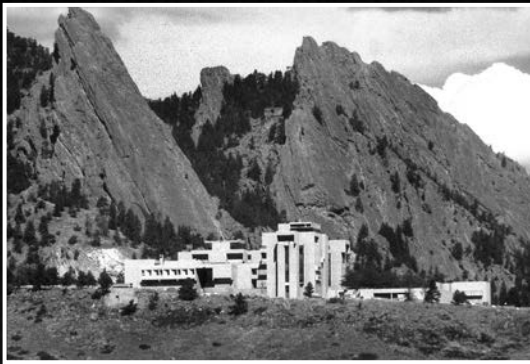
The hallmark of the SOARS mentoring structure, which includes up to five (5) types of Mentors and a supportive learning community, continues to be the heart of the program and remains relevant. The Geoscience community continues to evolve and our scientific challenges change. As such, SOARS continues to adapt and grow, meeting the new needs of the field. Now in the fifth year, the SOARS computation and scientific data workshop (CDW) recognizes the movement of geoscience literature toward sharing data and code; preparing Protégés with tools to flourish in an open-access environment. This year's CDW complemented the scientific communication and writing workshop (SCW) with weekly classes. We recognize new careers in the atmospheric sciences are emerging that make use of weather and climate products; and there is a need for scientists to translate these products for fields as diverse as agriculture, emergency management, insurance policy, and space weather, to name a few. Our professional development series, highlighted inside, exposes, our Protégés to the many opportunities available to them, and prepares them to succeed not only in graduate school, but in careers beyond as well.

Because of the 24+ year history and success of SOARS, we are able to tap into the strengths of our Alumni. Our Alumni also serve as Mentors, panelists, graduate-school selection advisors, and on the SOARS Steering and hiring committees. Beyond SOARS, our Alumni are filling leadership roles in our national societies, government, industries, and universities. Their perspective and leadership, along with that of our Mentors, sponsors, and partners, help SOARS to advance and remain a leader and valued partner in the geoscience community.

As the geosciences continue to evolve and our planet and climate face rapid change; the need for diverse voices has never been greater, particularly those who can connect science, leadership, and community. SOARS has an ongoing role and responsibility in helping develop these voices. The network of Protégés, Alumni, staff, Mentors—current and former, and partners continues to grow; and their voices and leadership are making vital contributions to the science, and safety of our planet. We are grateful for your ongoing support and are extremely proud to be part of this amazing community.

We hope you enjoy this publication of **EARTH, WIND, SEA AND SKY**. Please join us in congratulating the 2020 Cohort of Protégés!





The **UNIVERSITY CORPORATION OF ATMOSPHERIC RESEARCH** (UCAR) is a nonprofit consortium of more than 120 North American colleges and universities focused on research and training in the Earth system sciences. UCAR is the experienced manager of the **NATIONAL CENTER FOR ATMOSPHERIC RESEARCH** (NCAR) on behalf of the National Science Foundation. Founded in 1960 to fulfill this role, UCAR is the trusted administrator of the financial, human resources, facilities, and information technology functions that are essential to NCAR's success. Since UCAR's inception, collaborations between university researchers and our own scientists and engineers have helped push the boundaries of the Earth system sciences.

Activities in the **UCAR COMMUNITY PROGRAMS** (UCP) include everything from training weather forecasters, firefighters, and emergency managers (COMET), to supporting a constellation of atmosphere-observing satellites (COMET and JCSDA). The Unidata program develops internship programs and educational resources, provides real-time data and software analysis tools, and manages projects and staffing for scientific programs across the country and around the world. UCP provides a suite of innovative resources, tools, and services to researchers, educators, and practitioners in the Earth system science community.

NCAR provides the atmospheric and related Earth system science community with state-of-the-art resources, including supercomputers, research aircraft, sophisticated computer models, and extensive data sets. Each year, hundreds of people from universities, labs, and the weather enterprise collaborate with NCAR staff, and rely on NCAR resources, in order to carry out vital research and applications.

NCAR and UCAR have been supporting the SOARS Program since its inception in 1996. Institutional support and the mentoring of their scientists, engineers and staff have been the key to the success of SOARS. We are grateful for the support of NCAR|UCAR leadership and our growing number of mentors who make SOARS possible.

UCAR | NCAR



SOARS MOVES FORWARD DESPITE OUR COVID WORLD



"Overall, I was. Entering the summer, I wasn't sure how the research would go. However, I was pleasantly surprised in how much I was able to get done despite the online environment. Obviously, this is not the traditional research process but it was helpful to see how an online process might work in the future."

—Anonymous Protégé

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SINCE 1996, SOARS CONTINUES TO PROVIDE AUTHENTIC RESEARCH EXPERIENCES WITH WORLD-CLASS SCIENTISTS AND ENGINEERS FOR HISTORICALLY UNDERREPRESENTED COMMUNITIES IN THE ATMOSPHERIC AND RELATED SCIENCES. As an undergraduate-to-graduate bridge program, SOARS is designed to broaden participation in the geosciences. By supporting students from diverse backgrounds and experiences, SOARS guides participants to enter and succeed in graduate school; contribute to research, and become leaders in the geoscience community. SOARS complements academic institutions' mission in preparing students for career pathways in academia, research, and industry by combining summer research experiences with year-round mentoring, conference travel, and supportive community.

During this summer, SOARS Protégés conducted research at the **NATIONAL CENTER FOR ATMOSPHERIC RESEARCH** (NCAR) and the **UNIVERSITY CORPORATION FOR ATMOSPHERIC RESEARCH** (UCAR) as a virtual experience online. During the past 23 years, research projects were also conducted at the National Oceanic and Atmospheric Administration, the University of Colorado, Boulder, partnering laboratories, and universities to gain experience in the geosciences field. Topics of research span the disciplines of climate and weather, computing and engineering in support of atmospheric sciences, oceanography, and solar physics. Protégés are supported in their research by up to five (5) types of Mentors, including scientific, writing, computing, peer, and coach. In addition to this authentic research experience, which culminates in end-of-summer poster and oral presentations by the Protégés; the summer program incorporates a comprehensive, professional development schedule, relevant to STEM research, as well as various career pathways. After the summer, Protégés remain engaged through webinars, one-on-one career counseling, and participation at professional, national conferences.

Protégés may participate in SOARS up to four (4) years, gaining additional independence in subsequent years to select, focus, and direct their research. By the time SOARS Protégés enter graduate school, they are well-prepared to succeed in independent research. Many use SOARS as an opportunity to expand their research, through contacts and facilities available at national laboratories. It is also common for Protégés and their advisors to collaborate and publish with Mentors beyond their SOARS research experiences. In addition, SOARS provides publishing and grant-writing support to our Protégés and Alumni, encouraging connections with the wider community.

SOARS is proud of our Alumni, the vast majority of whom excel in graduate school; and move on to careers in atmospheric science and/or related STEM fields. Many are now faculty and we are excited to partner with Alumni to spread the SOARS mission. Partnerships include the pilot **SOARS SATELLITE** programs at Emory University and the University of Illinois–Urbana Champaign (UIUC). Wherever their careers take them, our SOARS Alumni remain connected to the SOARS community, committed to the SOARS mission of increasing diversity in the sciences, and play an important role in increasing the strength and diversity of the national STEM workforce.

Investigating Frontal Precipitation Enhancement Upstream of the Olympic Mountains



BRANDON A. GARCIA

1st-year SOARS Protégé

Junior
University of Illinois at
Urbana-Champaign
Atmospheric Science

MENTORS

RESEARCH
Trude Eidhammer, NCAR
Deanna A. Hence, UIUC
Robert M. Rauber, UIUC

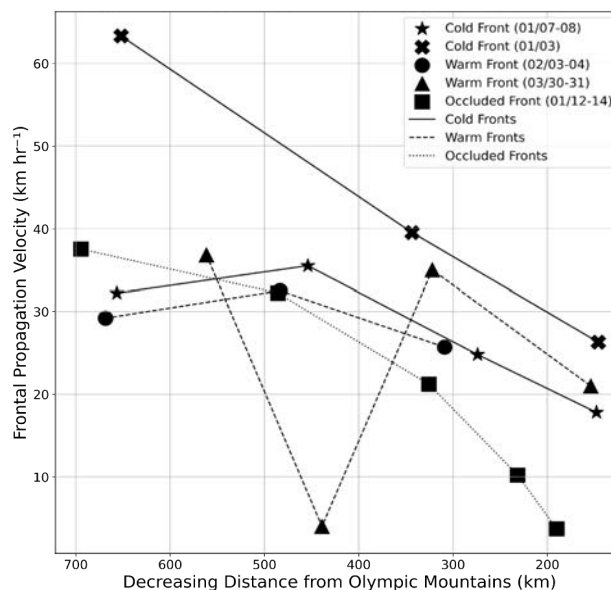
WRITING & COMMUNICATION
Sarah A. Tessendorf, NCAR

PEER
Christopher Williams



Orographic precipitation enhancement is the tendency of mountains to cause clouds to produce more precipitation than they would otherwise, which greatly affects the total rainfall in mountainous regions and plays a major role in flooding and mudslides. Most past studies have examined this enhancement close to the mountains themselves. The present study examined the orographic enhancement of frontal precipitation upstream of the Olympic Mountains of Washington State, using data from a Weather Research and Forecasting (WRF) regional climate simulation. Using this simulation, we strived to determine how thermodynamic and dynamic conditions affect the enhancement of frontal precipitation upstream of the Olympic Mountains. To do so, the characteristics of frontal passages were analyzed, including frontal type, orientation, velocity, warm-air moisture content, and accumulated precipitation. Of the five fronts analyzed to date, there were two cold fronts, two warm fronts, and one occluded front. We then analyzed each characteristic by comparing each event to each other and as a function of distance from the mountains. We found that all fronts slowed down as they approached the mountains, four of which to almost half of their original speeds, and some even beginning to decelerate upwards of 700 km upstream. Areas of enhanced precipitation were observed along the two cold fronts, as far upstream as 560 km. These results document upstream impacts on frontal passages, but further analysis is needed to examine additional frontal passages and determine if the observed precipitation enhancement and frontal deceleration were caused by orographic effects from the Olympic Mountains.

Frontal Propagation Velocities with Distance from Olympic Mountains

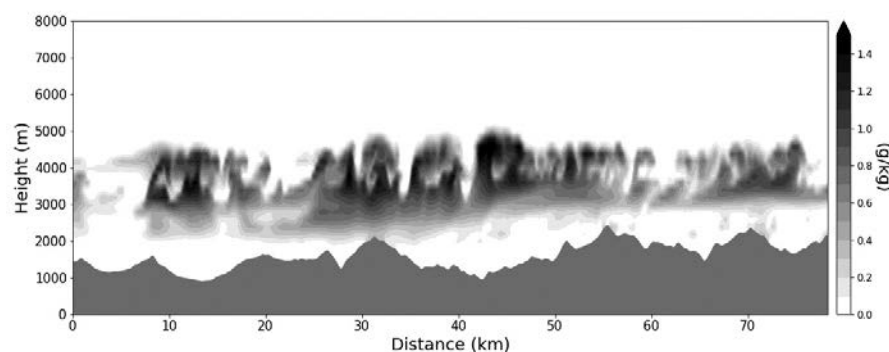


Line graph of the changes in propagation velocity of five fronts as they approached the Olympic Mountains. For each symbol, the x-axis location is the distance from the Olympic Mountains to the average location of the front over some six-hour period. The y-axis location is the average propagation velocity of the front over the same six-hour period. Distance from the Olympic Mountains decreases moving right on the x-axis.

Simulating Generating Cells and their Environment during the SNOWIE Campaign

Mountain precipitation is an important product of orographic flow. It is crucial for farmers whose livelihood depends on the water and for hydroelectric uses in mountainous regions. Thus, the Seeded and Natural Orographic Wintertime Clouds: The Idaho Experiment (SNOWIE) campaign was conducted to understand orographic precipitation and associated microphysical processes such as cloud top generating cells. Cloud-top generating cells are small convective elements on the top of the orographic clouds. They exert a large impact on the temporal and spatial distribution of orographic precipitation by producing locally enhanced ice or drizzle. This research aimed to examine whether generating cells observed in the SNOWIE campaign could be simulated using the Weather Research and Forecasting (WRF) model. The simulation was run using three nested domains with a horizontal resolution of 900, 300, and 100 m. The environment was initialized in the 900 m run using two European Center for Medium-Range Weather Forecasts reanalysis datasets (ERA), ERA5 and ERA-Interim. To resolve the small-scale generating cells, 300 and 100 m WRF Large Eddy Simulations (LES) were also run. Signals in microphysical and dynamical fields such as cloud mixing ratio, precipitation amount, and vertical motion were analyzed to identify features associated with generating cells. Examining the pattern of these signals in the 100 m run qualitatively indicated cloud-top generating cells. Future work includes modifying the initial and boundary conditions and microphysical backgrounds for the 300 and 100 m resolution domains to test the sensitivity of the cloud-top generating cells to environments and aerosols.

Cloud water mixing ratio cross-section at 17:15 UTC



Cross-section of the cloud water mixing ratio from the 100 m WRF LES results driven by ERA5 data on 9 March 2017 during Intensive Operating Period (IOP) 22.



NICOLAS GORDILLO

2nd-year SOARS Protégé

Senior
University of Wisconsin–Madison
Atmospheric and Oceanic
Sciences & Computer Science

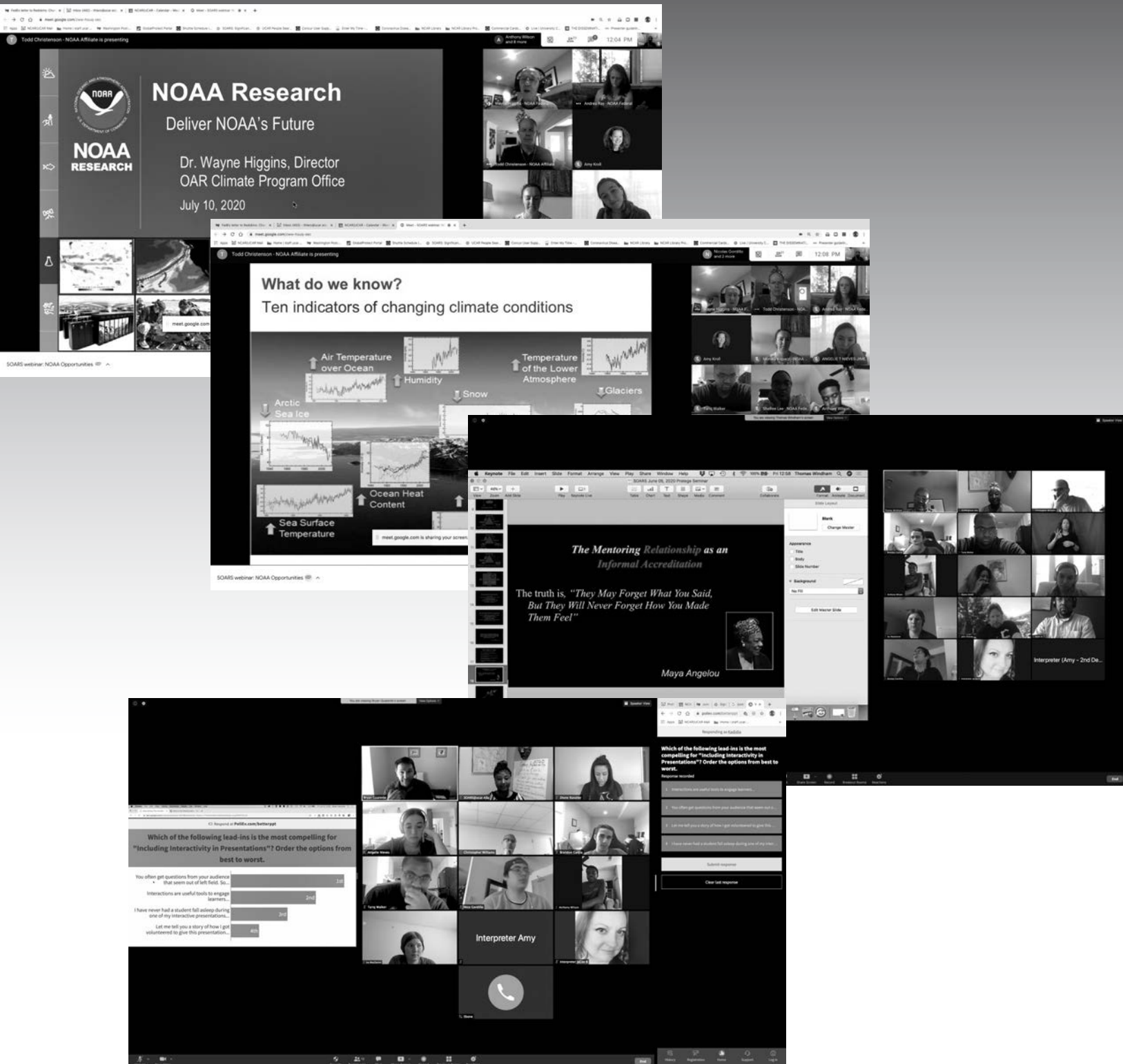
MENTORS

RESEARCH
Lulin Xue, NCAR
Anders Jensen, NCAR
Sisi Chen, NCAR

WRITING & COMMUNICATION
Jamie Wolff, NCAR



PROFESSIONAL DEVELOPMENT



IMPORTANCE OF MENTORING

SOARS Protégés participated in weekly professional development activities to enhance their skills and knowledge in career pathways, graduate school, and timely national discussions on racism in STEM.

Our Mentors provide research, writing, computing, and personal support; and the relationships often last long after the Protégés leave our laboratories and departments. Mentors tell us that our Protégés inject new ideas, energy, and an opportunity to build new connections into their research; a true win-win for all.





IVY MACDANIEL

2nd-year SOARS Protégé
Senior
Austin Peay State University
Physics

MENTORS

RESEARCH
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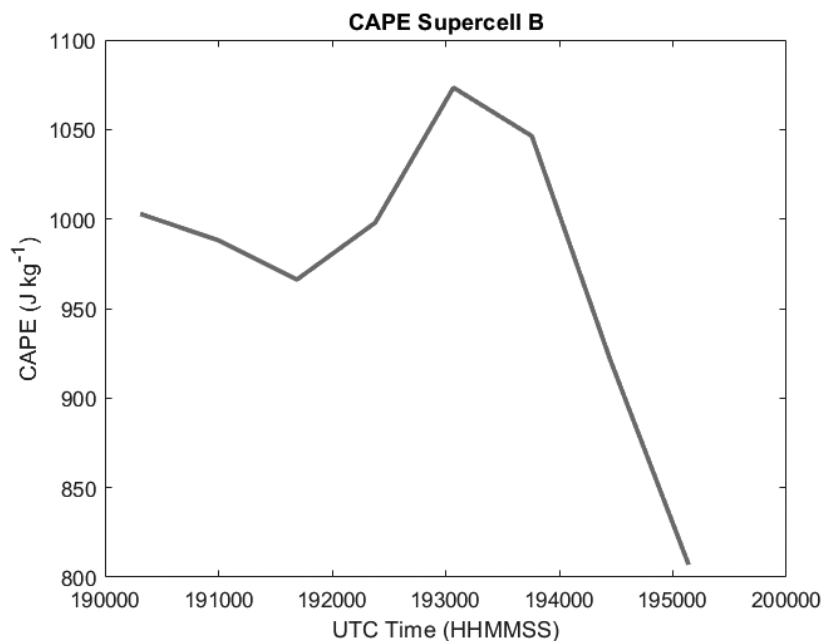
WRITING & COMMUNICATION
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COACH
Kristen Aponte, UCAR



Comparative Analysis of Supercell Environment in Hurricanes Harvey and Irma

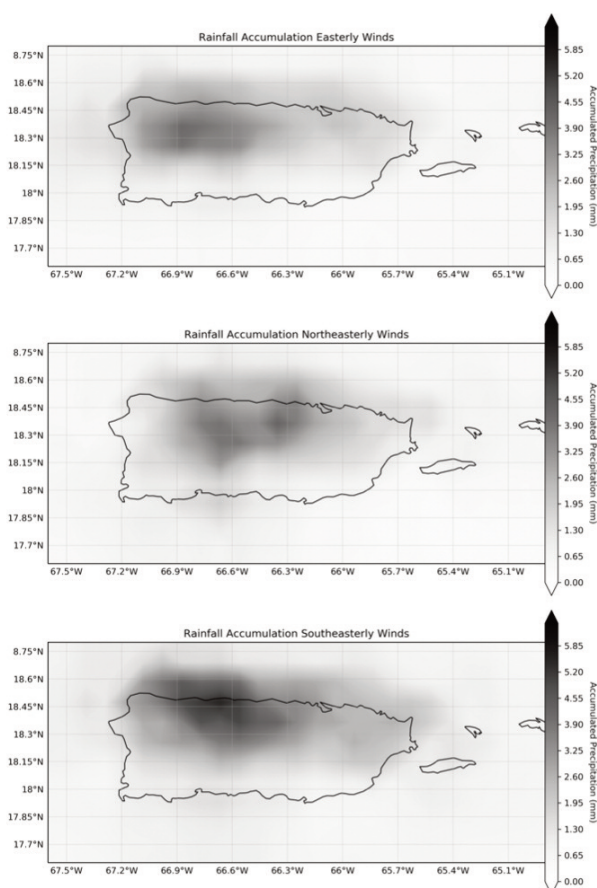
Although severe weather forecasting has improved over time, small rotating thunderstorms, sometimes called miniature supercells, often pose challenges with tracking and issuing tornado warnings. Being smaller than typical supercells, those storms are more difficult to discern on radar, especially at greater distances. Those storms are also found in tornado-producing tropical cyclones, and while they tend to be weak, can still pose a threat to lives and properties in the Southeast U.S. The most likely tropical cyclone to produce tornadoes is a formerly intense tropical cyclone that weakens at landfall. Tornadoes within Hurricanes Harvey and Irma from the 2017 Atlantic season were examined in this study. In Harvey's case, the majority of tornadoes formed inland from southeast Texas to Tennessee. Mesoanalysis showed moderately high convective available potential energy (CAPE) and more moderate vertical wind shear than was found in Irma. Irma, however, produced the majority of tornadoes near the shoreline. Environmental analysis showed higher CAPE over water than over the Florida peninsula during Irma's landfall. Yet, the shear was higher over land. However, supercells met their demise over the land when the environment became unfavorable. It remains somewhat unclear why the supercells died when they arrived onshore in Irma's rainbands while those in post-tropical Harvey formed and sustained themselves far inland. Thus, additional investigation in the future would be necessary.



Plot of CAPE over time for Supercell B.

Sea Breeze, Trade Wind, and Terrain Influence on Rainfall Location over Western Puerto Rico

This research focused on analyzing rainfall events over the western side of the island of Puerto Rico. We hypothesized that rainfall location over the western side of the small Caribbean island is mainly influenced by the confluence of sea breeze and predominant winds, interacting across complex terrain. An in-depth analysis of the science behind these events on the island has not previously been done, which is why this study is important. To analyze these events a variety of data was used; these included satellite reanalyses, radar images, radiosonde soundings, model simulations, and in-situ data. To better understand the winds on this island we conducted a climatological analysis. The results showed that easterly winds are the most predominant, along with some northeasterly and southeasterly winds. In addition, a histogram showed that these winds are seasonal and that easterly and southeasterly winds are more common during the summer, while northeasterly winds are more common during winter and spring. Our results determined that rainfall accumulation and intensity on the western side of the island is mainly due to the predominant wind direction and the location of the resulting sea breeze influencing that event. Rainfall accumulation and location on the western side of the island is due to a combination of the predominant wind direction, the location of the resulting sea breeze, and the influence of terrain on inflow parcel patterns.



Average rainfall accumulation plots from the year 2010 to 2017 for (a) easterly winds, (b) northeasterly winds, and (c) southeasterly winds in Puerto Rico.



ANGELIE T. NIEVES-JIMÉNEZ

2nd-year SOARS Protégé

Senior
University of Puerto Rico
at Mayagüez
Industrial Engineering,
Meteorology & Atmospheric
Sciences Minor

MENTORS

RESEARCH
Rosimar Ríos-Berrios, NCAR
Kelly Keene Werner, NCAR

WRITING & COMMUNICATION
Nan Rosenbloom, NCAR





By Kadidia Thiero

The 2020 SOARS Program began as usual with March selections and 12 acceptances, from an applicant pool of 130 applications, for the summer cohort. And then the world experienced a pandemic, and life forever changed how business and research were conducted in a myriad of ways. The decision to proceed virtually with the Program, with returning Protégés and one SOARS Satellite Student only; and not to continue with the incoming/ accepted Students, determined the path forward.

The theme for the 2020 Cohort focused on **adaptability, flexibility, and resilience**, as no one could have predicted how this modified Program would work remotely for ten weeks. After considerable consultation with multiple stakeholders, the decision proved to be a sage one, and eight (8) Protégés completed the virtual Program successfully.

All eight Protégés were matched with research mentors, writing mentors, and in some cases community, computation, and peer

mentors. The Program maintained the components of Research, Mentoring, and Community, which distinguishes SOARS from other research experiences for undergraduates and graduate students. Additionally, the Protégés participated in weekly Scientific Communication and Writing workshops, Computation and Data Science workshops, and comprehensive Professional Development. The rigor and quality of the research projects combined with the consistent check-ins, as well as individual development plans for short and long-term goals and objectives, supported the Protégés in a holistic manner. Well-being, mental health, and managing the effects of the global pandemic were complex challenges that the entire country continues to deal with and process; and the Protégés demonstrated grace under pressure, and completed all required deliverables.

These requirements, made more difficult in a virtual environment, included written abstracts of the research, speaking at our Research Colloquium, the creation of a poster, and a final paper. With respect



SOARS 2020 RETROSPECTIVE

to research and skills, one Protégé remarked on, “...connecting with researchers and being able to ask them candid questions about their career and journey. Being able to learn skills related to atmospheric science (that are not taught in classes) from experts in the field. Finally, the outreach and connections gained from professional development sessions...” succinctly summarized the most unusual summer.

The summer’s Professional Development series provided Protégés opportunities to learn from experts in the field, as well as SOARS Alumni in areas of scientific communications and virtual presentations; career pathways and student opportunities in the federal government; a live virtual tour of NCAR’s Research Aviation Facility’s C130 and Gulf Stream V planes; and a timely and relevant discussion of a film addressing underrepresentation in STEM. This facilitated discussion explored these themes, as the country also experienced a racial reckoning, while protests and unrest raged, due to the continuing systemic racism in all aspects of life.

All of the Protégés, as well as NCAR Interns participated in the first-ever NCAR|UCAR Virtual Poster Symposium, which showcased the depth and breadth of the various research laboratories and programs. These posters were also evaluated by the scientific community for critical feedback, and the communication of original research to the field of earth system sciences.

Upon evaluation of the summer experience, one Protégé’s perspective and thoughts on SOARS were, “...I think the most valuable aspect of the SOARS program is the comprehensiveness. Mentoring and financial support is multifaceted, significant, and sustained. Exposure to research and established professionals is direct and first-rate.”

SOARS remains true to its mission of providing research experiences for marginalized communities in STEM, and continues the legacy of access and broadening participation in the atmospheric and related sciences.

Using Bayes' Theorem to Understand Uncertainty in the North American Mesoscale (NAM) Model: A Spatial Analysis of Rainfall Forecast Error for Hurricane Barry



EBONE SMITH

3rd-year SOARS Protégé
 Graduated BS–May 2020
 Virginia Tech
 Meteorology and Communication
 Studies

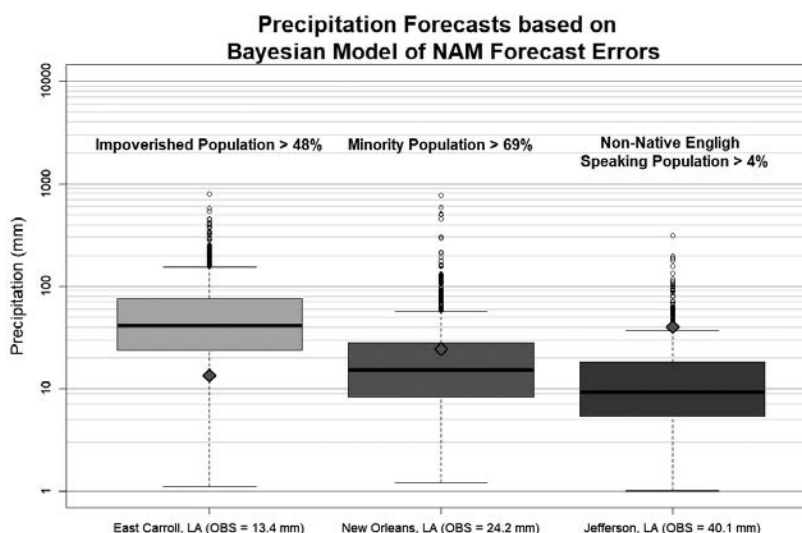
MENTORS

RESEARCH
 Amanda Siems-Anderson, NCAR
 Stephanie Zick, VT

WRITING & COMMUNICATION
 Melissa Moulton, NCAR



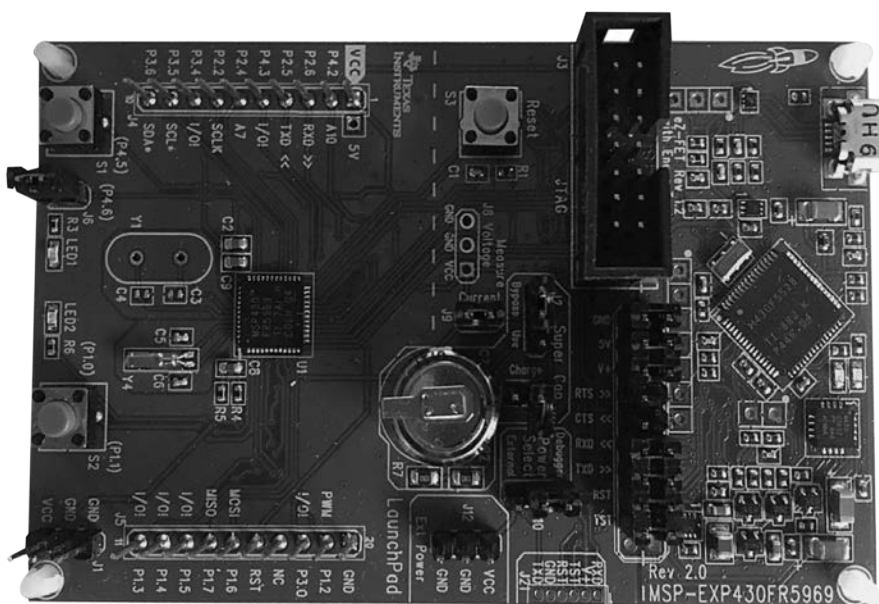
Tropical cyclones have presented grave risks to coastal communities in the U.S. Strong winds, storm surge, flooding, and heavy rainfall have resulted in billions of dollars of damage to homes, infrastructure, and agricultural resources, as well as injuries and fatalities. Forecast models have been used by meteorologists to predict the hazardous impacts of hurricanes such that these hazards can be communicated to vulnerable communities. Under some unknown conditions, models have outputted significantly large errors in tropical cyclones' forecasted rainfall; because of this, predicting rainfall impacts from landfalling hurricanes has shown to be difficult. To build more resilience in communities geographically, socially, and economically vulnerable to the negative impacts of landfalling hurricanes, it is critical that scientists gain insight into model uncertainty patterns, determine causes of model errors, and use those uncertainties to improve warnings to the public. This study investigated forecast model uncertainty by comparing the North American Mesoscale (NAM) model forecasted rainfall with the observed rainfall from Hurricane Barry (2018). NAM model forecast errors from 47 tropical storms were inputted into a Bayesian model to evaluate how the forecasted precipitation error varied spatially in 1,000 hypothetical rainfall scenarios. Three statistical approaches were used on the rainfall forecast error from the scenarios: 1) an analysis of the error magnitudes' probability density function distribution, 2) a spatial analysis of mapped rainfall from the NAM modeled rainfall, Stage IV observed rainfall, and calculated rainfall from the Bayesian-forecasted model error, and 3) a collection of descriptive statistics with boxplots. The results demonstrated mostly consistent modeled error values, within a small range, however many simulations had extreme error values. Results, after forecasted precipitation scenarios were calculated (from the modeled error values and the observed rainfall), revealed a large range of potential rainfall amounts, as well as spatial variability of the rainfall distribution.



Boxplots of the precipitation scenario amounts for New Orleans, LA; East Carroll, LA; and Jefferson, LA. The yellow diamond shows the observed amount of rainfall (Stage IV) for the respective location.

Developing Instrumentation for Measuring Solar Magnetic Fields: Investigations into Space Qualified Microcontrollers

Life on earth is enabled by the warmth and light we receive from the sun. Not all the effects of the sun however are beneficial to life. Solar magnetic fields can produce large explosive events in the solar atmosphere which bombard the earth with harmful levels of particles and radiation. Solar physicists hope to be able to predict these harmful solar events allowing humans to avoid the most harmful effects including damage to satellites, the earth's power grid, and to astronauts. The High-Altitude Observatory (HAO) has proposed a spaceborne CubeSat to measure magnetic fields using diagnostic emission lines. This summer's research was an investigation into the use of a space-qualified microcontroller (TI MSP430FR5969), which will work as a science payload controller. The work represents an interrupt-based software architecture which will be extensible to performing all of the required control and communication requirements between the payload and the spacecraft.



The figure shown above is the evaluation board for the MSP430 microcontroller



TARIQ WALKER

2nd-year Protégé
Sophomore
Kennesaw State University
Electrical Engineering

MENTORS

RESEARCH
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WRITING & COMMUNICATION
Holger Vömel, NCAR



DEVELOPING COMPUTATIONAL SKILLS IN GEOSCIENCE STUDENTS:

The Remote Experience of the SOARS Computational Thinking and Data Science Workshops

By Keith Maull, PhD, SOARS Staff 2016–2020

There is hardly a scientific discipline today that does not rely on data and computation in a significant way. Indeed, the idea of “computational” has now spawned the birth of many new academic disciplines, even those far outside the realm of the hard sciences. For example, the discipline of “...*The Computational Humanities, Arts, and Social Sciences (CHASS) is an emerging area of research that refers to the investigation of humanities, arts, and social science research questions through advanced computing technologies.*”¹ The application of computational technique to the humanities. No matter the discipline, it has become obvious that a new set of skills and approaches are required for students to successfully contribute to and advance in whatever field of study they pursue. In the geosciences, the list of important and necessary computational skills is growing: from Python programming to big data to machine learning. In response to these realities, since 2016, the SOARS Program continues to conduct focused computational workshops to provide the necessary opportunities for Protégés to develop and sharpen their computing and data skills.

Computing and big data are considered essential tools to atmospheric and geosciences research. Many climate, hydrological, and weather models require supercomputers, highly optimized coding techniques, complex data formats, image analysis software libraries, and visualization packages to manipulate, distill, analyze, and present highly complex data for basic research. Therefore, developing skills in computational thinking and problem solving, basic programming, statistical data analysis, and even web concepts, is essential. Wide gaps still exist between the skills necessary to conduct authentic geoscience research and the experiences and coursework students have in their undergraduate courses. This is where the SOARS computational thinking and data science workshops (CDW) provide focused training and experiences by allowing Protégés to directly work with computational tools and technologies that supplement their summer research experiences at NCAR|UCAR|UCP and other laboratories.

During the 2020 COVID-19 global pandemic, the SOARS program shifted to a virtual online experience, and the CDW were delivered through live video meetings. Since the inception of the CDW in SOARS, Jupyter notebooks have been used as an essential learning platform; and since 2018, UNIDATA has been an important program partner by providing and supporting a cloud-hosted implementation of the Jupyter platform for the workshops, and to all Protégés. This summer, the cloud-hosted Jupyter Hub was especially important during remote workshop delivery; as some Protégés, with limited resources on their laptops, could use the Hub where possible.

Fitted with a solid remote platform for computation and workshop delivery, the CDW covered topics such as fundamental programming concepts and algorithms with Python. Additional coverage focused on workflow and collaboration tools such as Github, and hands-on exploration of the commonly-used Python geoscience libraries. Protégés practiced understanding how to write computational narratives that mix computational analyses and programming with expository text. This technique is gaining traction in academic research and writing to support the idea of “executable papers” that encourage sharing, reproducibility and traceability.

Despite the technical and practical challenges of an entirely remote summer research experience, the workshops were a remarkable success. Protégés gained access to broad and relevant computational training. One Protégé remarked, “...*Now, my data is available in a remote server and can be accessed from anywhere in the world, in my case Puerto Rico, and at any time of the day.*”²

Protégés had weekly practice sharing how their remote computational experience was evolving through their summer research. With the incredible leadership of the SOARS program and a talented set of Protégés, the 2020 Cohort should be proud of themselves for blazing an important trail forward as the first, and perhaps not the last, remote SOARS Cohort.

¹What are the Computational Humanities, Arts, and Social Sciences? I-CHASS is a partnership of the University of Illinois at Urbana-Champaign and the National Center for Supercomputing Applications. © 2007–2016 The Board of Trustees at the University of Illinois.
UI website: <http://ichass.illinois.edu/index.php/what-are-the-computational-humanities-arts-and-social-sciences>

²UCAR Mentorship and Remote Computing Resources Boost Remote Research for SOARS Student. Angelle Nieves Jiménez, 6 October 2020.
Unidata website: <https://www.unidata.ucar.edu/blogs/news/entry/ucar-mentorship-and-remote-computing>

SOARS 2020 Computing and Data Workshops Workshop #2: Python, a (re)Introduction

June 12, 2020
Keith E. Maull, PhD



Algorithms and Data Structures

- Data structures are foundational to good algorithms

- Primitive
 - integers, floats, characters, boolean
- Non-primitive
 - Linear collections: lists, arrays, stacks, queues
 - Non-linear: trees, graphs, maps

Anything you need to design to get your algorithm to work is a data structure, no matter how complex or



But first, let's talk ...

- Who, where?
- How are your projects going? (scale of 1..10)
- Coding (scale of 1..10)
 - "comfort with coding"?
 - "fear of coding"?
 - "interest in coding"?
- Python (scale 1..10)
 - "knowledge of general concepts"?
 - "knowledge of domain (geo) concepts"?
 - "interest in Python"?
 - "fear of Python"?



Why Zotero? Key Use cases

3

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Interpreter (Amy)

Interpreter Amy (2nd de...

People, Perceptions, and Plights: Survey Respondents' Perspectives on Tornado Sheltering during the COVID-19 Pandemic



CHRISTOPHER L. WILLIAMS

3rd-year SOARS Protégé

Graduate Student
University of Florida
Geography (Specializing in Hazards
Geography and Geographic
Information Systems [GIS])

MENTORS

RESEARCH

Dr. Kevin Ash, UF
Dr. Julie Demuth, NCAR
Dr. Paul Kucera, UCAR
Dr. Rebecca Morss, NCAR
Dr. Olga Wilhelmi, NCAR

WRITING & COMMUNICATION

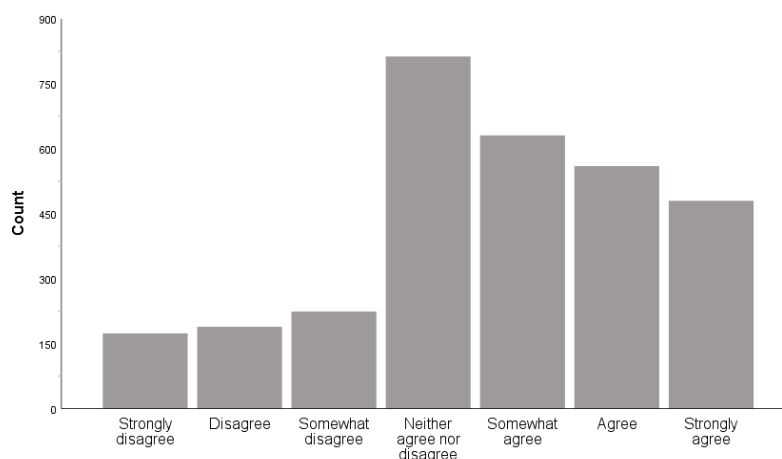
David Ahijevych, NCAR

PEER

Brandon Garcia



This study investigated how the novel coronavirus disease (COVID-19) pandemic intersects with tornado sheltering needs to influence human risk perception and likely protective decision making for tornado threats. Housing types like single-family homes and apartments (more sturdy) are considered more likely to maintain structural integrity when facing tornadic winds and flying debris, than housing types such as manufactured and mobile homes (less sturdy). Ahead of severe weather capable of producing tornadoes, trusted authorities commonly encourage people living in less sturdy homes to seek shelter at designated public facilities, or at sturdier homes of friends and family. In 2020, the World Health Organization declared COVID-19 a pandemic just as the tornado season approached its peak climatological frequency of occurrence across southern regions of the Central and Eastern United States. Medical authorities pleaded for governments, organizations, and individuals to help reduce disease transmission by limiting gathering in large crowds, establishing quarantines, and isolating those infected with COVID-19. This study conducted statistical analyses on data from a recent Qualtrics survey conducted online with members of the public in 20 U.S. states, in order to explore where recommended responses to the concurrent tornado and COVID-19 hazard intersection create a potential paradox. The analysis can improve understanding about the relationship between different housing types and resident risk perceptions and decision-action likelihoods; and these advancements in knowledge may benefit practical improvements in emergency management services and risk communication.

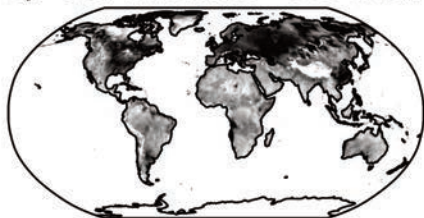


Response frequency (count) distribution for a dependent variable, which asked survey participants (N=3071) to state their level of agreement with the statement, "I think there is not clear enough communication from public officials about what people should do to protect themselves during tornado warnings, while also protecting themselves from COVID-19." Based on the seven-point Likert-type scale, the average response (M=4.67) suggested a need for more clear information from public officials on how to protect people in complex risk situations, as potentially posed by the threat of tornadoes during the COVID-19 pandemic.

Analyzing Heat Waves Statistics in Community Earth System Model: Sensitivity to Resolution

Climate change is influencing the frequency and intensity of heat waves. In the next century, extreme events are projected to increase in duration, frequency, and intensity, but these events will not occur uniformly in space and time. This project's early stages investigated heat waves using data from observations and 1° Community Earth System Model, version 1 (CESM1). From this data we derived the ninetyeth percentile (90pp) of daily maximum and minimum temperatures for each day of the year. This was our threshold to define "extreme temperature" at every location across the globe. Events were then defined as consecutive days that are "extreme" and by identifying such events we compiled statistics of duration and where these events occur by seasons. 1° CESM1 generally simulated realistic heat wave statistics except in certain regions where the duration of heatwaves is overestimated or underestimated. To address this, we analyzed how higher resolution impacts our ability to produce realistic results. We found that higher resolution 0.25° CESM1 simulates more realistic heatwave days then heatwave nights. Using higher resolution provides more localized details and more fine scale simulation of duration having some strength in certain seasons over others in different regions. For anomalist extreme heat waves there is less correlation if resolution affects correct signal simulation. Future work will analyze how snowpack impacts climate models' ability to capture extreme temperature events. A better understanding of CESM's ability to predict heat waves will enable the use of model projections in adaptation decision making.

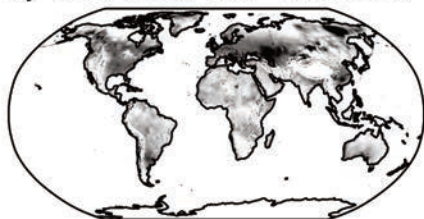
DJF CESM HIGH RES - OBS TMAX



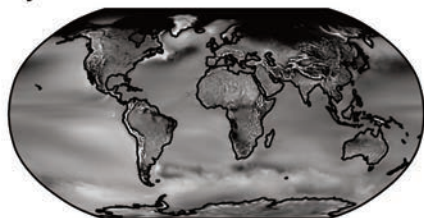
Average DJF daily temperature maximum differences

- (a) CESM1 High Resolution—Observation
- (b) CESM1 Low Resolution—Observation
- (c) CESM1 High Resolution—CESM1 Low Resolution.

DJF CESM LOW RES - OBS TMAX



DJF CESM HIGH RES - LOW RES TMAX



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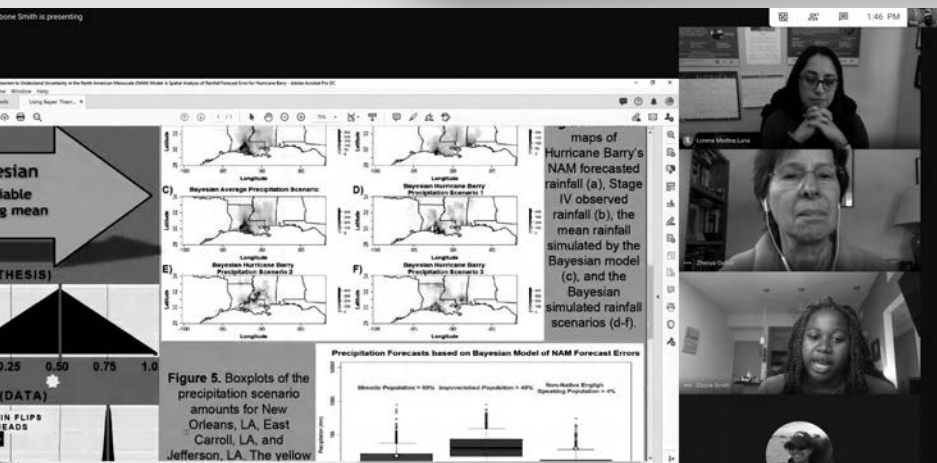
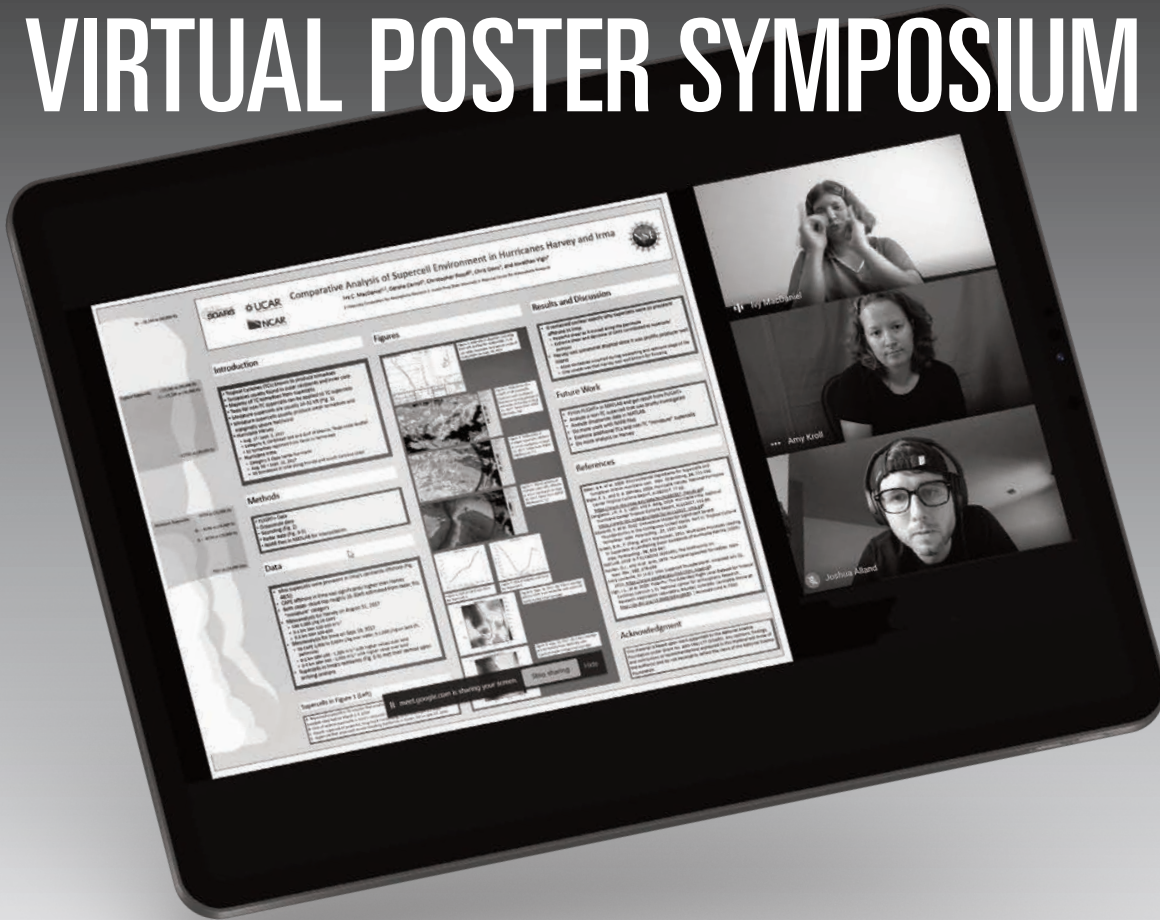
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WRITING & COMMUNICATION
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2020 NCAR | UCAR VIRTUAL POSTER SYMPOSIUM



People, Perceptions, and Plights

Tornado Sheltering during the COVID-19 Pandemic

Christopher L. Williams¹, Dr. Kevin Asai², Dr. Julie Demuth³, Dr. Paul Kuvshinov⁴, Dr. Rebecca Munn⁵, Dr. Olga Witkowski⁶

¹ NCAR UCAR, ² SOARS, ³ University of Florida, ⁴ University of Colorado, ⁵ University of Illinois, ⁶ University of Wisconsin

MOTIVATION

World Health Organization declared COVID-19 a pandemic March 11, 2020. Tornado sheltering is a critical public health and safety issue, and the impact of the COVID-19 pandemic on tornado sheltering is a topic of great interest.

OBJECTIVE

This research is a critical analysis of the impact of the COVID-19 pandemic on tornado sheltering. The research is a critical analysis of the impact of the COVID-19 pandemic on tornado sheltering. The research is a critical analysis of the impact of the COVID-19 pandemic on tornado sheltering.

DATASET AND METHODS

1. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA). 2. COVID-19 Data: COVID-19 data from the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO). 3. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA).

PRELIMINARY RESULTS

1. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA). 2. COVID-19 Data: COVID-19 data from the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO). 3. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA).

EXAMPLE FINDINGS

1. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA). 2. COVID-19 Data: COVID-19 data from the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO). 3. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA).

FUTURE WORK

1. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA). 2. COVID-19 Data: COVID-19 data from the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO). 3. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA).

ACKNOWLEDGMENTS

1. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA). 2. COVID-19 Data: COVID-19 data from the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO). 3. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA).

FIGURE CITATIONS

1. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA). 2. COVID-19 Data: COVID-19 data from the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO). 3. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA).



Sea Breeze, Trade Wind, and Terrain Influence on Rainfall Location over Western Puerto Rico

Angelle T. Nieves Jimenez^{1,2}, Rosimar Rios-Berrios³, and Kelly Keene Werner³

¹ University Corporation for Atmospheric Research, ² University of Puerto Rico Mayaguez, ³ National Center for Atmospheric Research

MOTIVATION

Sea breeze circulations are common in western Puerto Rico. However, the precise rainfall location and intensity varies day to day. The hypothesis is that sea breeze circulations on the sea breeze peninsula, and the complex terrain of the island.

KEY RESULTS

Figure 3: The histogram (left) and the wind rose (right) demonstrate that winds in Puerto Rico come predominantly from the west with some northeasterly and southeasterly winds.

Figure 4: Average rainfall accumulation plots from the year 2010 to 2017 for easterly winds (left), northeasterly winds (center), and southeasterly winds (right) in Puerto Rico.

CONCLUSIONS

The initial location of rainfall depends on background conditions, but wind forced the east is modified by local factors and convergences laterally.

Trade winds influence the eddies that form around the mountains, thus reinforcing the sea-breeze circulation and convergences in western Puerto Rico.

Model simulations with and without terrain show that sea breezes only form when terrain is present.

FUTURE WORK

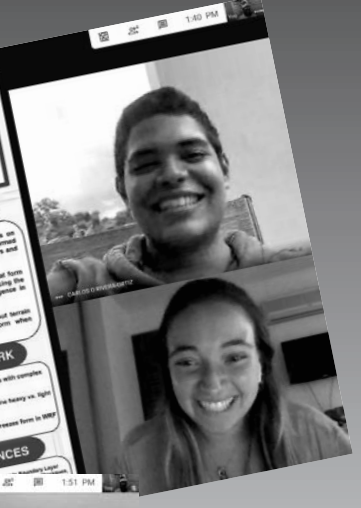
Test simulations on other islands with complex terrain.

Investigate factors that determine heavy vs. light precipitation events.

Further investigate why sea breezes form in high mountains with terrain.

REFERENCES

1. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA). 2. COVID-19 Data: COVID-19 data from the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO). 3. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA).



Developing Instrumentation for Measuring Solar Magnetic Fields

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¹ University Corporation for Atmospheric Research, ² Kennamore State University, ³ National Center for Atmospheric Research

Solar Magnetic Fields

The sun is the source of most phenomena we observe in space weather. These events can include the solar wind, and other solar events such as coronal mass ejections. These events can impact our planet and our technology. The purpose of this research is to develop instrumentation for measuring solar magnetic fields. The instrumentation will be used to measure solar magnetic fields and to study the solar wind.

Microcontroller Hardware

The hardware is a microcontroller-based system that will be used to measure solar magnetic fields. The hardware is a microcontroller-based system that will be used to measure solar magnetic fields and to study the solar wind.

IDE Software Using C

The software is a C-based program that will be used to measure solar magnetic fields. The software is a C-based program that will be used to measure solar magnetic fields and to study the solar wind.

Interrupt System Based Programming

The interrupt system is a system that will be used to measure solar magnetic fields. The interrupt system is a system that will be used to measure solar magnetic fields and to study the solar wind.

Acknowledgements

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Investigating Frontal Precipitation Enhancement Upstream of the Olympic Mountains

Brandon Garcia¹

¹ NCAR UCAR, ² SOARS, ³ University of Colorado

Motivation and Goals

1. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA). 2. COVID-19 Data: COVID-19 data from the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO). 3. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA).

Area of Study and Data

1. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA). 2. COVID-19 Data: COVID-19 data from the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO). 3. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA).

Methods

1. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA). 2. COVID-19 Data: COVID-19 data from the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO). 3. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA).

Results

1. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA). 2. COVID-19 Data: COVID-19 data from the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO). 3. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA).



300 m Precipitation Timeseries

Nicolas Gombosi¹

¹ NCAR UCAR, ² SOARS, ³ University of Colorado

Model Set-up

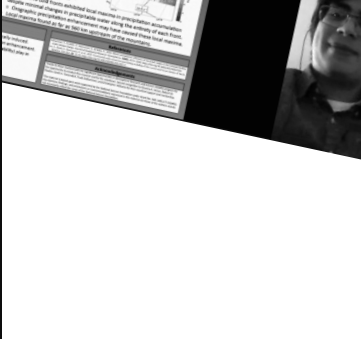
1. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA). 2. COVID-19 Data: COVID-19 data from the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO). 3. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA).

Figure 4: Precipitation time series from 14-18 UTC at Scott Mountain.

Results: Both datasets underestimated the amount of precipitation compared to the observations. However at 17:30 UTC in the ERAS simulation, the slope of precipitation is similar to the observations at 14-15 UTC. Thus, ERAS was chosen for the 100m simulation.

References

1. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA). 2. COVID-19 Data: COVID-19 data from the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO). 3. Tornado Sheltering Data: Tornado sheltering data from the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA).





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CIRES	Cooperative Institute for Research in Environmental Sciences	NOAA	National Oceanic and Atmospheric Administration
COSMIC	Constellation Observing System for Meteorology, Ionosphere, and Climate	NSCP	NOAA Science Collaboration Program
COMET	Cooperative Program for Operational Meteorology, Education and Training	SOARS	Significant Opportunities in Atmospheric Research and Science
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		UF	University of Florida



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