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Unconventional Means of Funding for Undergraduate Severe Storms Field Research

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Abstract

Millersville University students needed to pursue unique means by which to acquire the necessary funding for their research instrumentation and equipment. Field program grants are not readily accessible for undergraduates. Thus, the students pursued crowdfunding, private business sponsorships, and university donations. Initially, the students set up a crowdfund through the GoFundMe website. After realizing the success of the GoFundMe campaign, Millersville University associates offered to create a crowdfund for the students through the university and offered monetary assistance. Several private companies agreed to sponsor TILTTING after the students explained the motivation behind, goals, and benefits of the project. By May 2022, the undergraduate students had raised a total of $30,927. This money was used to purchase Windsonds, an R.M. Young Wind Sensor, drones, and other materials needed to create the prototype TILTTING-23 probe.

Introduction

Hurricane Ida will be remembered for both the widespread flooding and tornado outbreak it produced in the mid-Atlantic States. On August 29, 2021, Ida made landfall in Louisiana as a Category 4 hurricane on the 16th anniversary of Hurricane Katrina. After weakening over the central Appalachians, Ida restrengthened over the mid-Atlantic on September 1 after interacting with a mid-latitude cold front.

As the remnants of Hurricane Ida moved through the Mid-Atlantic, a tornado outbreak unfolded across Maryland, Pennsylvania, and New Jersey, with one of the strongest tornadoes touching down in southern New Jersey. A group of Millersville meteorology students - Ryan Argenti, Shane Martrich, Sam Leppo, John Aytch, and Evan Newman - all had the same idea as Hurricane Ida's remnants approached: to chase it!

After chasing the tornado in Rising Sun, Maryland, the students felt they had one more shot at a tornado intercept near Vineland New Jersey. As the students embarked for one more storm chase, they experienced the tragic devastation left by an EF-3 tornado in Mullica Hill, New Jersey. As they were chasing, the students were left speechless by the devastation left behind from the tornado in Mullica Hill. Since they were the first on the scene prior to any emergency services, they decided to use their Emergency Management skills to help those affected by the destruction until emergency personnel could arrive.

Witnessing this destruction firsthand inspired the students to create their own tornado research project, the Thermodynamic Investigation into LCL Thresholds during Tornadogenesis and its Influence in the Northeast and Great Plains (TILTTING). Previous research has led to tornado forecasting and lead times becoming greatly improved, but research specific to lifted condensation level (LCL) heights (the vertical height at which clouds start forming) at tornadogenesis remains sparse. These five students set out to change that.

Creation of TILTTING

In the wake of the system and after witnessing the destruction, these student meteorologists worked together to create a tornado research project to help improve the tornado warning lead times, enhance severe weather forecasting techniques, and save lives. Two undergraduate students, Shane Matrich and Ryan Argenti, took the lead on this project under the mentorship of Dr. Richard Clark, Dr. Sepi Yalda, Dr. Greg Blumberg, and Kyle Elliot (M.S.). Shane and Ryan drafted the proposal, budget, project layout, and assembled a team of sixteen additional student researchers. The goal of this project was to conduct a Theromodynamic Investigation into LCL Thresholds in the Northeast and Great-Plains (TILTTING).

In order to investigate differences in height thresholds of the LCL at tornadogenesis, two mobile platforms are used, separated by a distance of 30+ miles. The first mobile platform will deploy in-situ balloon-borne rawinsondes (Windsonds) for vertical profiles in the near thunderstorm environment in the far field and near field environments. The balloon launches are approximately thirty minutes to an hour prior to the storm, during the storm, and thirty minutes to an hour after the storm (Far field, to near field, back to far field observations). Additionally, the Lagrangian Drift Sensor, a tornado research instrument designed and built by undergraduates, is carried on an expendable drone into the core of a developed tornado observing both the near field and what we determine to be the close field.

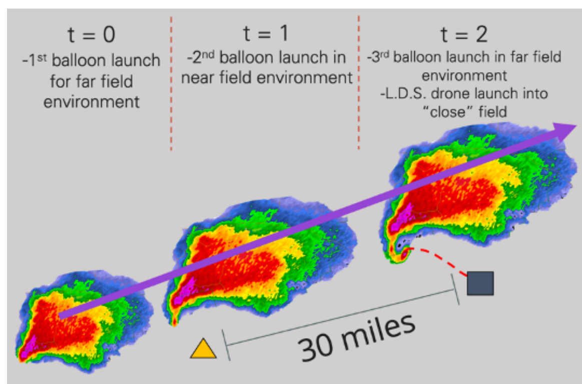
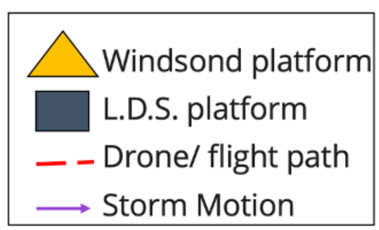


Figure 1.



Legend for Figure 1.

Putting it all together, we have t = 0 through t = 2 to fully capture the tornadoes and our research methodology progression in tandem. At t = 0, it is our first balloon launch observing the far field ambient thunderstorm environment. Going forward in time, t = 1 is the second balloon launch in the near field environment, observing the present conditions at tornadogenesis. Lastly, t = 2 is the final balloon launch once again observing the far field ambient thunderstorm environment after the storm has moved through, while also launching the Lagrangian Drift Sensor and observing both the near field and what had determined the close field by getting the sensor into the core of a tornado.

Statement of the Problem

In order to investigate what makes these tornadoes tick and if the LCL height can influence tornado frequency, we created a twenty-two-page proposal and budget that we aim to propose to national funding agencies like NSF. The proposed budget of $34,000 posed the biggest problem to conducting research, as students cannot apply for larger government and academic grants. If the project was going to run, the student leads would have to get creative to find funds that fulfills the $34,000 budget.

Thinking Outside the Box

Crowdfunding became the primary source of funding to get the project started. The two leads set up a GoFundMe on February 10th, 2022 to receive donations after making posts on social media. Problems started to arise when taxes became involved. This posed an issue for both the project and donors who wished to use their donation as a tax write off. This problem was quickly resolved thanks to staff at Millersville University who graciously helped produce a donation campaign through the university software. This new donation campaign allowed for gifts made in cash, check, and electronic donations, whiling allowing these gifts to be tax deductible. The university software centralized all the funding to one university bank account, for easy accessibility for the leads and department secretary when making purchases.

Obtaining Sponsorships

To obtain the necessary funds, the student leads decided to reach out to companies with mission statements regarding the weather, water, and climate enterprises. The sponsorships were not limited to one field within meteorology, and they were rather diverse. Companies such as EPAWA Weather Consulting LLC, Accuweather, and Weather Works all within the weather forecasting and consulting realm supported the project. Other contributors included organizations such as our corporate patron Sparv Embedded and corporate sponsor Millersville's Center for Disaster Research and Education (CDRE); both organizations are heavily involved in research. Other contributors included organizations such as Premium Finance brokerage. They are an insurance and finance company that also supported the project as they aim at "helping to protect lives from one of nature's most violent forces - tornadoes - while also supporting the educational development of the students involved in the project" (Argenti & Martrich, 2022).

Student Grants

Student co-lead, Shane Martrich, received the Mentored Undergraduate Summer Experience (MUSE) grant, through Millersville University on April 8th, 2022. MUSE provided a $5,000 summer of 2022 research grant to focus on conducting data analysis from the project on the condition that there be a 3-credit independent study course in the following academic fall semester. Student co-lead, Ryan Argenti, also received a $2,500 student research grant for the summer of 2023. Additionally, the project received funding in the middle of March 2022 from the Provost and Vice

President of Student Grants, Jeff Porter, for just over $12,000 in order to purchase the remaining instrumentation.

Progress and Future Work

The project received over $35,000 to date from private donations, sponsorships through companies, and through student grants. The 2022 field campaign concluded with the last Intensive Observation Period on August 30th, 2022. The project is continuing field campaigns in 2023, with data sets from both the Windsonds and Lagrangian Drift Sensor in both the Great Plains and Northeast regions of the United States. The total funds have given these students an opportunity to explore the unknown within meteorology, through these instruments and transportation to and from the fields of study.

The comparisons drawn from the observed soundings to the simulation generated soundings can provide examples for automated intelligence to determine tornado probability based on LCL thresholds (and the subsequent gradient from the far, near, and close field environments). Additionally, there is a need for further data analysis to test the methodology and experimental design of using the fixed wing aircraft to deploy the Lagrangian Drift Sensor inside the tornado. A model simulation in Cloud Model 1 (CM1) can confirm the mathematical proof of concept while also assessing the probability of success for the drone under varying conditions. Furthermore, the data sets collected in the 2022 field campaign can be paired with the data collected this upcoming summer for the 2023 field campaign, to generate initial conditions to use within the model. Through the use of SHARPpy, we can generate point and click soundings on a gridded model simulation, and assess the tornado probability with the simulated supercells generated from the collected data. At the project's conclusion, we seek to have a robust dataset to draw direct correlations from the height of the clouds at tornadogenesis to tornado frequency and/or intensity. We hypothesize with lower LCL heights (lower clouds), tornadoes have an easier path to forming compared to those storms with higher LCL heights under the same conditions. Ultimately, we aim to increase tornado warning lead time, through a profound understanding of how tornadoes work and sustain themselves.

Acknowledgements

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References

Argenti, R. & Martrich, S. (2022, March 12). *Sponsors*. Project TILTTING. Retrieved April 3, 2023, from https://www.tiltting.com/sponsors

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