M.S. Defense Announcement
Allie Mazurek
Friday, October 22, 2021, at 9:30 a.m.

Allie Mazurek
M.S. Defense

October 22, 2021
9:30 a.m.

Defense
ATS Large Classroom (101 ATS) or via Zoom

Post Defense Meeting
Riehl Conference Room (211 ACRC)

Committee:
Russ Schumacher (Adviser)
Kristen Rasmussen
Jennifer Henderson (Texas Tech University)
Ryan Morrison (Civil and Environmental Engineering)

From Rain Gauges to Retweets: Using Diverse Datasets to Explore Overlapping Hazards and Human Experiences in Landfalling Tropical Cyclones

Landfalling tropical cyclones (LTCs) are responsible for numerous hazards, including damaging winds, storm surge, inland flooding, and tornadoes. Furthermore, multiple hazards may threaten an area at the same time, which raises challenges from a prediction, warning operations, and human impacts standpoint. Previous research has approached overlapping tornado and flash flood events—which exemplify these challenges because the recommended protective actions can be in conflict—in continental systems from multidisciplinary perspectives, but less work has been done to explore these phenomena in LTC environments. Because LTCs also introduce other hazards, additional complexities may exacerbate already challenging circumstances. This work integrates meteorological and social sciences to broadly advance the understanding and implications of simultaneous flash flood and tornado events in LTCs.

Part I of this thesis investigates the relationship between two predecessors to tornadoes and flash floods—meso- to storm-scale rotation and heavy rainfall rates, respectively—using observations. Motivated by previous work that has drawn linkages between these two processes in continental convective storms, this connection is explored in Tropical Storm Imelda, a system that was among the wettest LTCs on record to impact the contiguous United States (CONUS), producing rainfall accumulations in excess of 1000 mm when it made landfall on the western Gulf Coast in September 2019. First, a synoptic and mesoscale overview of the tropical cyclone (TC) is presented as motivation for its utility in examining overlapping embedded rotation and extreme rainfall rates. Then, rain gauges from a high-density observing network in southeast Texas are analyzed alongside polarimetric radar data to compare rainfall rates that occur in the presence of embedded rotation to those that occur when no rotation is evident on radar. According to these results, 5-minute rainfall rates that followed subjectively-identified meso-γ to storm-scale rotation on radar tended to be statistically significantly greater, and when accumulated over time, more than twice as much rainfall was recorded at gauge sites when rotation was present near the gauge compared to when there was no rotation located nearby. To further quantify the spatial and temporal relationships of embedded rotation and heavy rainfall

rates, quantitative precipitation estimates (QPE) and rotation tracks from the Multi-Radar Multi-Sensor system are compared in time and space. A positive correlation was found to exist between the hourly-accumulated 0-2 km rotation tracks and hourly local gauge bias-corrected QPE, suggesting that more rain tends to fall in the presence of low-level rotation.

In Part II of this thesis, social science methods are used to investigate another LTC: Hurricane Harvey (2017)—an unprecedented event that became the wettest LTC on record to impact CONUS and spawned over 50 tornadoes when it affected the western Gulf Coast. This work aims to explore the notion of experience as it evolves on Twitter in real-time during Harvey among a group of users who were located in areas that were impacted by the LTC and its overlapping hazards. Though a significant amount of research has investigated experience through surveying and interview techniques after LTCs occur, much less work has been done to study experience as it is shared live during an event or through the lens of social media. Using this motivation and drawing on the overarching theme of concurrent hazards, this research begins with a database of tweets composed during the period surrounding Hurricane Harvey that reference tornadoes and flash flooding. The sample is refined through a multi-step querying process, ultimately resulting in a group of 39 users who shared 158 tweets about "past events"—that is, events related to LTCs and/or the hazards that are associated with them. These tweets are thematically analyzed by individual users, by individual past events, and over time. The results of these analyses show that Twitter users referenced past events during Harvey for two main reasons: first, because the user has a personal connection to the event and second, because the past event is helping them to make sense of various aspects of the situation that is unfolding around them. Understanding what roles past events may play in a real-time crisis is useful to leaders and decision-makers, such as meteorologists, local politicians, and emergency managers, as it provides insight on the evolving needs and concerns of the public that they serve as they change and are modulated by various events that unfold throughout the overarching crisis.

Topic: M.S. Defense: Allie Mazurek
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