Comparative Analysis of Wildfire & Hurricane Evacuations

EMBRY-RIDDLE Aeronautical University CIVIL ENGINEERING

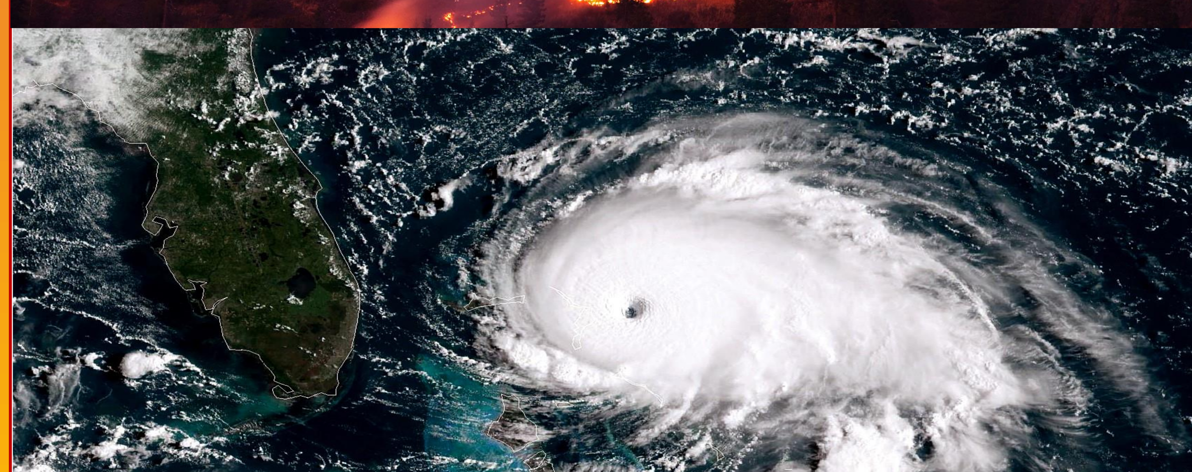
Dr. Scott Parr, and Fanny Kristiansson

EMBRY-RIDDLE AERONAUTICAL UNIVERSITY, DEPARTMENT OF CIVIL ENGINEERING

EMERGENCY EVACUATION ROUTE

ABSTRACT

Mass evacuations, particularly those at a statewide level, represent the largest single-event traffic movements that exist. These complex events can last several days, cover thousands of miles of roadway, and include hundreds of thousands of people and vehicles. Often, they are marked by enormous delays and heavy congestion and are nearly always criticized for their inefficiency and lack of management. However, there are no standardized methods by which to systematically quantify traffic characteristics at the proper scale. Several recent evacuations have occurred in the United States. Wildfire evacuations have been ordered in the state of California while Hurricanes have led to evacuations in the state of Florida. It has generally been accepted that the evacuation from a regional wildfire is fundamentally different than the evacuation from a hurricane. Hurricane evacuations generally encompass larger areas when compared to wildfire evacuations and provide several days of advanced warning. Whereas, wildfires impact smaller areas with significantly shorter warning time. On the other hand, at the broadest level, evacuees and their vehicles move in both time and space. This research seeks to develop a better understanding of the travel flow principles that govern the evacuation process and its impact on the mobility of a community, for different hazard types



INTRODUCTION

The goal of this research is to build upon the prior knowledge and expand the scientific understanding of the evacuation process by systematically analyzing evacuations from hurricane and wildfire events. This research will aim to develop and apply an analytical method to measure and describe statewide mass-evacuations in a practical, cost-effective manner. The research methods are based on simple, yet widely available, and easily understood traffic count datasets that support both qualitative and quantitative analyses. By spatially and temporally arranging sensor-based statewide traffic volume data from Hurricanes Irma (2017) and Michael (2018), as well as the Tubbs (2017) and Thomas Fire (2018) evacuations, these methods were able to describe and address several key questions about these events. The methods described herein estimate the start and end of the auto-based evacuation, the loading and peaking characteristics of traffic, and the total number of vehicles used in the evacuation process, as well as the effective beginning and end of the auto-based reentry. At the broadest level, this research seeks to answer the question, "do people evacuate differently from a wildfire than they would a hurricane and to what extent these differences show up in the mobility data". To answer this question, the research will collect, model, and systematically compare traffic data from several recent evacuation events in large coastal states of Florida and California. This knowledge can be leveraged to better plan for and respond to evacuations, regardless of the event. The research will also allow agencies to identify best practices by learning from each other. It is expected that state departments of transportation and emergency management officials would be able to reproduce the procedure presented here to analyze future evacuations.

METHODOLOGY

The research methodology utilized traffic count data taken from across the state of Florida and California to investigate the auto-based evacuation response and reentry of communities from both Hurricane Irma (2017), Michael (2018), Tubbs Fire (2017), and Thomas Fire (2018). The first part of the methodology was to process traffic count data used in the analysis. The second part of the methodology discussion demonstrates how this data was used to estimate the start and end of the auto-based evacuation, the loading and peaking characteristics of the auto-based evacuation, and the total number of vehicles used in the evacuation process, as well as the effective start and end of the auto-based reentry. The research methodology can be broken down into 5 main tasks. The first task is identifying sever $f(t)$ wildfires and hurricanes within Florida and California to conduct analysis. Second task is data collection and processing for these events. Third task is conducting a spatial-temporal analysis of traffic for each of the evacuation events. Fourth task is to analyze results identifying trends, patterns, and relationships between events and comparing to hurricane evacuations. The final task is to assemble result and complete final report and deliverables.

Task 1:
Identify Several Wildfires And Hurricanes Within FL And CA

The goal of this task is to identify several wildfires and hurricanes within FL and CA to conduct analysis on. This task will also document and review previous studies that concerns emergency evacuations regarding Florida hurricanes and California wildfires. Previous studies on transportation logistics and planning will be prioritized. This task will deliver a summary of the literature review of the emergency evacuations for these events.

Task 2:
Data Collection and Processing

This task will utilize the SunGuide program gathers roadway data from across the State of Florida. Traffic counts are reported hourly and archived for analysis. There are 255 SunGuide locations; each provides bidirectional hourly counts. For the California wildfire data analysis, the Performance Measurement Systems (PEMs) Data Source is a Caltrans (State of California) system will be utilized.

Task 3:
Conduct A Spatial-temporal Analysis

The goal with this task is to conduct a spatial-temporal analysis of traffic for each of the evacuation events. This task will use the processed data from the previous task, and estimate the start and end of the autobased evacuation, the loading and peaking characteristics of the auto-based evacuation, and the total number of vehicles used in the evacuation process, as well as the effective start and end of the auto-based reentry.

Task 4:
Analyze Results

This task will take the findings from the spatial-temporal analysis from the data and analyze results identifying trends, patterns, and relationships between events. The results from the California wildfire evacuations will then be compared to the Florida hurricane evacuations. Task 5: Complete Final Report And Deliverables This task includes preparing a first draft of the report and have it reviewed by the faculty advisor and an external reviewer. The comments will be incorporated into the report and a final version of the report will be created. The task will finish with the final report to be submitted to a peer-review journal

PROJECT SCHEDUAL

TASK 1 JULY 1ST

TASK 2 AUG 1ST

TASK 3 DEC 1ST

TASK 4 MAR 1ST

TASK 5 MAY 1ST

PROJECT CLOSEOUT AUG 30TH

SIGNIFICANCE

Significance The design, implementation, planning, and research of evacuations in Florida and California are very significant to the residences of this state and the future of keeping our population safe from any global climatological events that may occur. The overall topic of using the sensor-based data and developing a quantifying system from a temporal and spatial analysis is to be analyze how the evacuation plan was effective, how evacuees move over time and quantifying the amount of time that was take to evacuate after or before evacuation orders as well as for the reentry. Given the issue observing how effective were the orders, evacuations, and reentry plans in order to evacuate a big population in a short amount of time.

Understanding the impact of Hurricane Irma, Michael, and Wildfires on the evacuation process within Florida and California can provide insights for future storms and evacuation events. The fundamentals for the analysis, the supply and demand of vehicles and roads is universal within the transportation sciences. Therefore, the results and insights gained here can benefit future traffic, urban, and disaster management planners. The State of Florida has not seen any major destruction as seen during Hurricane Irma in 2017 and Michael in 2018, since Hurricane Andrew in 1992. Similarly, California has not had a major wildfire disaster with numerous fatalities since the Cedar Fire (San Diego County) in 2003.

The scientific contribution of this work is that it demonstrates a straightforward and reproducible methodology to measure the auto-based evacuation response and reentry of an area. The proposed methods demonstrated in this paper have a significant practical value for state transportation and/or emergency management agencies seeking to quickly and accurately assess evacuation characteristics. This research also expands the literature by providing insights into the less-often-studied topic of evacuation reentry timing and participation. This analysis will help FDOT and LADOT be better prepared for a massive evacuation when time is needed. Also educate residents how traffic works, especially how the preparations for selecting evacuation routes. Finally, it creates a set of aggregate evacuation parameters that can be used to calibrate evacuation planning and simulation models making the paper a valued reference for future research studies.

This research project will contribute to my personal and professional development as I expand my research skills. The research procedure, report writing, and the critical thinking as I analyze my data and move towards a conclusion is something I will benefit from in many parts of my careers. This research will also be of value for my future Ph.D. degree in Transportation Engineering. Emergency evacuations is an area I have a huge interest in, and this research will give me the opportunity to apply my passion into a real project. That will help me when I one day decide where I want to do my Ph.D. and in what area of research.