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Native Earth

Texas Flash Flood Mortality

Prepared by:

Native Earth Consulting

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INTRODUCTION

Summary

Flooding is a worldwide phenomenon and is one of the most dangerous weather-related natural disasters in the world, creating perilous situations for people and damage to property. The implementation of an International Flash Flood Laboratory (IFFL) will play a pivotal role in the field of hazards research. The IFFL will be established to function as a center of learning in order to develop applications and information that will provide site-specific flood data at hazard locations and facilitate the dissemination of this information to the public and throughout the region.

More importantly, the work conducted by the IFFL has the potential to reduce the fatalities, injuries, and damage caused by flash flood disasters. Managers and planners will be able to utilize this information and ultimately have the ability to improve emergency response times to flash flood vulnerable areas, as well as design and construct efficient and effective public warning and evacuation procedures. In addition, findings from this research may be implemented into current frameworks of development to allow for safe and sustainable growth in the future, as flash floods have been and will continue to be a constant hazard. There is an explicit need for a better understanding and knowledge about the magnitude, pattern, and circumstances surrounding fatalities caused by floods and in particular, flash floods.

Purpose

The goal of this research is to utilize a geographic information system (GIS) to identify and analyze the spatial distributions of historically-recorded flood and flash flood events resulting in fatalities or injuries in the Central Texas region. Events will be

analyzed at a variety of scales temporally and compared with population growth trends throughout the region in order to establish whether there is a distinct relationship or pattern. Damages to property and crops will be also examined. It will determine areas of greatest vulnerability and potential danger.

Scope

Texas will serve as the geographical focus of the project, with an emphasis on Hays County and expanding outward. Texas is very prone to flash flood disasters and has recently been experiencing exponential population growth, serving as an ideal region of study. Temporally, data will be utilized and analyzed starting from 1950 through 2007.

LITERATURE REVIEW

Due to the global nature of flooding, much has been done with respect to flood related research in the United States. Understanding the human interaction with flash flooding is of particular interest. These studies have been substantial in advancing our understanding of the dynamics of flooding and their impacts. This review of the literature is not exhaustive.

More deaths are attributed to flash floods than any other weather-related disasters that occur in the United States (French 1983) and Texas accounts for the most flood-related deaths and damages (Frech 2005). Flash flood alley is the area of Central Texas that runs along the I-35 Corridor, stretching from San Antonio to Dallas. This area accounts for the vast majority of flood related incidents in Texas. According to Frech, although flood death and damage data does exist, efforts to collect and publish this information have not been thorough or consistent (2005). It is imperative that this information be more readily available at a regional basis so areas of similar risk can

properly mitigate. Intensive urbanization in flood prone areas will increase the potential impacts of flooding (Jonkman 2005).

Jonkman conducted a study that investigated fatalities from river flooding, flash floods, and flooding from drainage problems on a global scale in relation to location and flood type. The results indicate that flash floods account for the most fatalities but the number of those affected vary between continents. In comparison with other disaster types, flooding is the most significant disaster type in terms of those affected. Asian river floods are responsible for the greatest number of fatalities in the world (2005).

French examined the fatalities associated with flash flood events in reports conducted by the National Weather Service. Descriptive characteristics of the events were analyzed quantitatively to derive a number of statistical analyses. Geographic location of these events was not central to the study and findings suggest that due to a lack of accurate data and incomplete methods for collecting such data lead to inconclusive results. From the data collected by the NWS, conclusions cannot be drawn regarding all flash floods. However, the study did find that there had been a decrease in deaths despite an increase in the occurrence of flash flood events. French attributes this decrease in deaths to improved warning systems (1983).

In another study, Maples examined the historical distribution of fatalities attributed to automobile drowning in flooding events and the circumstances that surrounded the fatalities. Maples study is similar to the research of this project and will serve as a foundation for current efforts to be built upon. Maples compared Texas population and automobile drowning deaths and examined various variables surrounding the incidents. The study found that familiarity and time of the day were factors that had a

significant relationship to the incidents while other variables, such as gender or age of the driver, were of less importance (2006).

Previous studies have focused on flooding events at a global scale (Jonkman 2005) and at a national scale (French 1983). However, a deficiency in the research does exist. There is a need for better understanding of the spatial aspect of flash-flood incidents. Numerous studies have been conducted in an effort to locate flood related deaths yet there are no studies currently available that identify the specific locations of these occurrences in the area known as “Flash Flood Alley” (Frech 2005). Deficiencies in research applications arise over the inability to obtain locational data of fatality occurrences. In addition, there are limited studies that utilize GIS. A better understanding of where these deaths are occurring can lead to better mitigating efforts so that mortality at low water crossings can be reduced, if not eliminated.

PROPOSAL

Data

The data analyzed in this study will be drawn from several distinct networks. The Spatial Hazard Events and Losses Database for the United States supplies a collection of data on natural hazard events dating back to the mid-nineteenth century where a large majority of events have been consistently monitored since the 1950s (SHELDUS 2009). A variety of data is collected for each type of event. For purposes of this study, data will be collected only for each event in which a fatality has occurred. The county location, number of injuries and fatalities and totals for damage to property and crops, and date of each event will be obtained. The limitation of the available data is in that the majority of events do not currently contain information regarding latitude and longitude coordinates,

name, age, ethnicity, and circumstance surrounding the fatality. If possible, newspapers and other sources will be explored in order to obtain such information. All flood fatality data collected for analysis will focus on the time period from 1950 to 2007. This time frame has the most complete data available and is representative of the area under study, allowing for accurate analysis of current and past trends.

Shapefiles will be obtained from a variety of sources as well. Data layers will include, but are not limited to, counties, transportation, terrain, and digital elevation model (DEM). Hydrology data layers are also pivotal to successful implementation of this research and analysis, therefore, layers representing the rivers and watersheds will be acquired. The data layers necessary for this study will be attained via various agencies and organizations. The Mapping Website of the Texas Water Development Board (TWDB) provides many GIS datasets for download. The major rivers and twenty-three major river basins as defined by U.S.G.S along with the Texas terrain color ramp will be obtain from this particular source. The county dataset will be obtained from Texas Natural Resource Information System (TNRIS). All population data will be acquired from the U.S. Census Bureau.

All data used to produce maps of analysis, will be implemented in ArcGIS, a computer software program created by the Environmental Systems Research Institute (ESRI). This program will be instrumental in producing static maps and performing both spatial and statistical analysis. Microsoft Office products will assist in organization of data and completion of necessary documents and deliverables. Manifold IMS will also be utilized in constructing a website.

Methodology

In order to obtain all the necessary information regarding flood fatalities in Texas, a search will be conducted on the Spatial Hazard Events and Losses Database for the United States (SHELDUS) and downloaded into an Excel spreadsheet. From this data, only events which resulted in fatalities will be used. The following information will be compiled for each event:

- Month, date, and year of each flood event
- County of event occurrence
- Number of deaths per event
- Total dollar amount of property damages
- Total dollar amount of crop damages
- Nearest roadway intersection or low-water crossing location (if possible)

Many of the data editing and conversion of data to digital will utilize keyboard entry for mainly attribute and coordinate data. All other remaining layers necessary for analysis will be gathered from TNRIS and TWDB and imported into ArcGIS. The flood fatality database will be imported into ArcGIS as well and spatially joined to the county layer. Spatial Analyst will used to determine areas of vulnerability and high risk and investigate the correlation between population trends and flood fatalities. From this analysis, areas of high incidences from areas of low incidences can be quantitatively distinguished. The major highways that are used to access these areas will be identified. Subsequent to finding our locations of interest, the physical, social, and environment characteristics of these locations will be analyzed. The digital elevation model conjoined with watershed data can determine, for instance, if stream run off from surrounding hill

country is a contributing factor. Understanding these factors is important for establishing why these mortalities occur.

Static maps will be created on a decadal basis starting from 1950 for both the number of fatalities per county and county population growth. These maps will allow for visual interpretation and determination of whether any distinctive pattern and correlation exists. Conclusions from the results and recommendations for future research will be made.

Implications

This study will prove to be an integral part of the International Flash Flood Laboratory to be interpreted by people in the academic, hazards, and planning communities. The results may be used to allow for responsible, safe, and sustainable development in lower water areas, and high growth areas. This study, serving as a foundation, may also be built upon by others in the future to map out the vulnerability of other geographic areas to the hazards posed by flash floods. Findings from this research may provide insight into the patterns of flood related events and can be used as predictors for future loss of life associated with such events.

Budget

Data Collection

Total Hours	200	
(10 hours * 5 /week * 4 Consultants)		
Hourly Pay	$ 40.00	
Total		$ 8,000.00

Data Analysis

Total Hours	200	
(10 hours/week * 5 weeks * 4 Consultants)		
Hourly Pay	$ 55.00	
Total		$ 11,000.00

Systems Management

Project Manager

Total Hours	50	
Hourly Pay	$ 90.00	
Pay	$ 4,500.00	

Assistant Project Manager

Total Hours	50	
Hourly Pay	$ 70.00	
Pay	$ 3,500.00	
Total		$ 8,000.00

Production	$ 4,000.00
TOTAL COSTS	**$ 31,000.00**

TIMETABLE

TASK	WEEK 1 2 - 6 MARCH	WEEK 2 9 - 13 MARCH	WEEK 3 16 - 20 MARCH	WEEK 4 23 - 27 MARCH	WEEK 5 30 MAR - 3 APR
DATA COLLECTION					
PRE-PROCESSING DATA					

TASK	WEEK 6 6 - 10 APRIL	WEEK 7 13 - 17 APRIL	WEEK 8 20 - 24 APRIL	WEEK 9 27 APR - 1 MAY	WEEK 10 4 - 8 MAY
DATA ANALYSIS					
DATA INTERPRETATION					
FINAL DELIVERABLES					

Final Deliverables

Detailed Final Report (2 Copies)

Poster

Website

CD (2 Copies) Containing:

All Data

Metadata

Proposal

Progress Report

Final Report

Poster

PowerPoint Presentations

CONCLUSION

There is an explicit need for a better understanding and knowledge about the magnitude, pattern, and circumstances surrounding fatalities caused by floods and in particular, flash floods. This research will attempt answer major questions surrounding the occurrence of fatalities in flood events in Texas. The results of this research have profound implications in that findings may be implemented into current frameworks of development to allow for safe and sustainable growth in the future. The study will enhance and aid in the establishment of the IFFL. More importantly, the work conducted by the IFFL has the potential to reduce the fatalities, injuries, and damage caused by flash flood disasters.

PARTICIPATION

Contributions to the above stated proposal have been made by each team member. Rebecca Whitton, the Project Manager, composed the literature review, timetable, and final deliverables, conclusion, and participation portions of the proposal. In addition, Rebecca oversaw the revision and ensured fluidity and completion of the entire proposal. The Assistant Project Manager, Cameron Howitt, compiled the Purpose and Implications. Justin Briseno, GIS Analyst, composed the Data and Methodology and Michael Stanley, GIS Analyst, composed the Summary, Scope, and Budget sections.

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