

THE ROLE OF NATURAL HAZARDS AND CLIMATE CHANGE IN MIGRATION
FROM CENTRAL AMERICA TO THE US

by

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A thesis submitted to the Graduate Council of
Texas State University in partial fulfillment
of the requirements for the degree of
Master of Science
with a Major in Geography
August 2022

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2022

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DEDICATION

To the asylum seekers who opened up to me and shared their moving stories and experiences, my research wouldn't be the same without you.

ACKNOWLEDGEMENTS

Firstly, I would like to thank my committee chair and advisor, Dr. Sarah Blue. From furthering my interests in Latin America during my undergraduate years, to supporting me in the field and teaching me how to conduct research during my master's, your knowledge and expertise influenced me for the better. Thank you for all of your feedback over the years, you have taught me so much. Thank you to Dr. Jennifer Devine for your support, advice, and critical mindset that has helped shape me as a researcher, geographer, ethnographer, and human overall. You have been a tremendous help and inspiration during this journey. Thank you to Dr. Nancy Li for being open to accepting my research and serving on my committee as well as teaching me more about global climate change. You have been such a pleasure to work with.

Thank you to all the organizations and shelters in Brownsville and Matamoros who allowed me to conduct research in your spaces. The stories that were shared with me will continue to shape my research.

Finally, a special thank you to my support system that has been there for me, especially these last six months. These past six months have been considerably difficult for a multitude of reasons, and you all kept me going when I couldn't. I truly could not have gotten this far without your love and support. I am forever grateful for all of you.

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LIST OF ABBREVIATIONS

Abbreviation	Description
CDC	Center for Disease Control and Prevention
ENSO	El Niño Southern Oscillation
IPCC	Intergovernmental Panel on Climate Change
LAMP	Latin American Mobility Project
MPP	Migrant Protection Protocols
MSD	Midsummer Drought
NGO	Non-Governmental Organization
NHC	National Hurricane Center
SST	Sea Surface Temperature
TPS	Temporary Protected Status

ABSTRACT

This thesis analyzes the environmental migration phenomenon originating in the Mexico and Central America region. Combining both semi-structured interviews and a content analysis of secondary IPCC and NHC documents, this study aims to answer two important research questions: How are climate change and hydrometeorological hazards affecting individual's motivations to migrate? And, what relationship, if any, exists between hazard events and migration patterns from Mexico and Central America to the US? A series of 45 interviews and participant observation together with an examination of IPCC and NHC documents provide nuance on the multi-faceted issue of climate-induced migration. This research suggests that the complexities of migration, when considering multiple intersecting drivers, makes the climate-migration relationship complex to universally define. While the uniqueness of each region's specific drivers and each individual's journey and experiences ultimately affect migration decisions, hydrometeorological hazards do play a role in influencing people's decisions.

I. INTRODUCTION

Over the past decade, the US-Mexico border has experienced a consistently high influx of immigrants from Central America. There has been significant research conducted on the interconnected drivers that cause insecurity and migration from Central America, such as poverty (Sigelmann 2019) and drug-related cartel violence (Cantor 2014). However, the role of migration caused by environmental disruptions such as climate change and natural hazard events is less understood. With climate change affecting this region's temperature and precipitation already, and hydrometeorological hazard events being projected to increase in magnitude, it is more critical than ever to understand the role of hydrometeorological hazards in migration. The Northern Triangle of Guatemala, El Salvador, and Honduras has a high exposure to natural hazards like tropical cyclones, flooding, and drought due to its geographic location and topography. Studying the role of climate change and natural hazards in migration from Central America and Mexico to the US will contribute to growing research on climate-related migration and provide more nuanced information on the multi-faceted topic of migration drivers in general. This research will also contribute to existing studies through a qualitative case study of the extent of climate's effects on migration from Mexico and Central America to the US.

This research uses an analysis of semi-structured interviews and reports from the Intergovernmental Panel on Climate Change (IPCC) and National Hurricane Center (NHC) in order to interpret the relationship between migration and hydrometeorological hazard events such as flooding and drought in Mexico and Central America. The qualitative data acquired through fieldwork, in combination with existing climate and

hazard data, provides a better understanding of migrants' situations and stories of their displacement, as well as the degree to which climate or natural hazards were a factor towards the decision to migrate. The results of this study will ultimately contribute to our understanding of the larger questions: How are climate change and hydrometeorological hazards affecting individual's motivations to migrate? And, what role do these hazards play in determining decisions to migrate from Mexico and Central America to the US? Answering these research questions will provide more nuanced information on a topic that is receiving increasing attention in the media while also contributing to literature that may better inform policymakers' decisions regarding the classifying of asylum-seekers fleeing environmental problems.

II. HAZARDS IN CENTRAL AMERICA AND CLIMATE-INDUCED MIGRATION

Anthropogenic and natural factors have forced climate variability in Earth's natural system. Climate change has significantly elevated CO₂ levels in the atmosphere (IEA 2018), caused sea levels to rise (Ablain 2017), and impacted the livelihoods of human beings through hazardous events and weather extremes across the globe. Researchers have investigated many different aspects of climate change, from glacial retreat (Woods 2020) to wildlife biodiversity (Vale 2021) to climate and hazard-induced displacement in geographically distinct regions (Kelman et al. 2019). Smaller Pacific nations like Tuvalu have begun seeing climate displace its citizens, and Central America could be on a similar path (Milan 2016). Central America, specifically the Northern Triangle (Guatemala, El Salvador, and Honduras) plus Nicaragua, has a high exposure to hydrometeorological hazards like tropical cyclones and drought due to its geographic location and topography. The IPCC cited Giorgi (2006) in their 2014 report and identified Central America as the tropical region most susceptible to climate change based on the region becoming significantly hotter and drier in recent decades (Magrin 2014). In addition to the recorded data that indicates the region's susceptibility to climate change, future projections predict the mean temperatures to increase up to 4.5°C in a 4°C scenario world by the end of this century across Latin America (Reyer 2015). This increase in temperature could result in an increase in cyclonic activity as the higher temperature influences sea surface temperature (SST), which in turn creates the conditions for cyclonic genesis to occur at higher rates. Central America has shown a high vulnerability toward climate change in the last few decades as extreme events such as droughts, floods,

tropical cyclones, and mudslides have steadily increased (Magrin 2014). With the current climate trends, Central America may expect to see more devastating hazards that lead to climate-induced displacement. In 2020 alone, this region experienced extensive damage from two major storms, Hurricanes Eta and Iota, within a two-week span. Eta made landfall on November 3rd and Iota made landfall on November 17th, 2020. As of January 2021, over 8.8 million people were estimated to have been affected by storms Eta and Iota across Guatemala, Nicaragua, Honduras, and Colombia, with over 590,000 displaced individuals (USAID 2021, USAID 2020).

With the displaced individuals from these storms, a consideration of the policies and procedures for protecting asylum seekers wishing to flee environmental hazards becomes increasingly relevant. Several thousand migrants had already been denied entry into the US due to Title 42 (a provision of US health law under §265 that indefinitely suspended the right to seek asylum in response to the COVID-19 pandemic), worsening an existing humanitarian crisis at the US-Mexico border. While asylum seekers are responding to various drivers leading them to flee their homes, this research advocates for the inclusion of environmental stressors as an additional qualifying reason for asylum. Over 150,000 Nicaraguans and Hondurans were eligible for Temporary Protected Status (TPS) after Hurricane Mitch in 1998 (Migration News 1999), but the US did not offer similar protection to this new wave of migrants effected by Eta and Iota. A Groundswell report from the World Bank Group envisions the numbers of climate migrants from Central America to both the US and other parts of the region (primarily the highlands of Guatemala and Mexico's central plateau) will average 1.4 - 2.1 million by 2050, and without climate-conscious changes, this number could exceed 4 million (Rigaud 2018).

El Niño (ENSO) events are predicted to become more extreme, which would bring drought conditions to southern regions of Central America and flood conditions to its northern regions. ENSO-related events would impact agricultural dependencies as well as living conditions, both critical factors in influencing migration.

The number of immigrants from the Northern Triangle is increasing, with the estimated total number between the three countries nearly doubling between 2000-2019 (MPI 2019). Previous studies have recognized climate and hazards as one of several drivers for a number of Central American migrants (i.e., Bermeo and Leblang 2021, Casillas 2020). This study concludes that as many regions in Central America have yet to recover from the 2020 storms and many lost income due to the COVID-19 pandemic, families are more inclined to leave their deteriorated homes behind and seek economic opportunities in the US.

III. MIGRATION AND CLIMATE JUSTICE THROUGH A FEMINIST LENS

Migration to the US-Mexico Border

Policies of Expulsion

The Northern Triangle of Central America has been impaired by poverty, drug-related cartel violence, civil unrest, and political instability for several decades. As a result, hundreds of thousands of people have fled this region to seek protection (UNHCR 2018). Many migrants who flee the Northern Triangle aim to seek asylum in the US. The US and Mexico have both provided aid to Northern Triangle countries to help improve local security forces and economic conditions in hopes it would alleviate the mass influxes of migrants to the US-Mexico border (Fedirka 2018). In recent years, however, immigration from the Northern Triangle to the US-Mexico border has only increased, indicating there is a greater need to address Central America's root problems. Changing political administrations in the US has played a role in how immigrants are processed into this country. Under the Migrant Protection Protocols (MPP), also known as 'Remain in Mexico,' in January 2019 asylum seekers who arrived at the US-Mexico border were sent back to Mexico and given notices to appear in immigration court at a later date, resulting in tens of thousands of asylum seekers waiting at the US-Mexico border to cross into the US. Rates of legal representation for the migrants subject to MPP are very low, with data suggesting that just 7.5 percent of these individuals ever managed to hire a lawyer (American Immigration Council 2021). Out of the 42,012 cases that had been completed in December 2020, only 638 migrants were granted relief in immigration court (American Immigration Council 2021). The COVID-19 outbreak in March 2020

worsened this by temporarily suspending all pending MPP hearings. This later turned into an indefinite suspension, and migrants were unsure of their futures. This decision to indefinitely suspend pending MPP hearings ultimately left 60,000 asylum seekers stranded along the northern Mexico border where immigrants were in Mexican camps awaiting their proceedings in a state of limbo (Blue et al. 2021). Under President Biden, most of these asylum seekers who were stranded in Mexico due to Trump's MPP were allowed admission in February 2021, in a process that began just hours after Biden's inauguration. However, there are now thousands more who are not being allowed to cross and request asylum under Title 42 (American Immigration Council 2021). Former President Trump and his administration used a public health measure, Title 42, to weaponize COVID-19 by indefinitely suspending the asylum system after already implementing the MPP policy in January of 2019.

In March of 2020, the Center for Disease Control and Prevention (CDC) implemented Title 42, a provision of US health law that subjected hundreds of thousands of people to expulsions (American Immigration Council 2021). Title 42 suspended the right to seek asylum by granting the Director of the CDC permission to prohibit the introduction of people in order to decrease the risk of spreading or introducing COVID-19. This provision led to nearly 200,000 migrants being expelled when it was implemented and not receiving due process during expulsions, being sent back either to Mexico or their home countries (U.S. Customs and Border Protection 2020). Implemented in March 2020, only four months after storms Eta and Iota, this provision may have impacted the flow of migration from migrants fleeing the storms' devastating effects.

Im/mobilities

Immigration scholars have increasingly examined state power and social hierarchies regarding the control of asylum seekers' movement by enforcing immigration policies that further immobilize asylum seekers. In doing so, waiting becomes a crucial role in migration, hindering migrants' mobility. As emphasized by Hyndman and Giles (2011), waiting has "become the rule, not the exception" (page 361). Immobility research examines relations and factors that contribute to or cause immobility (Gruber 2021). Asylum seekers seeking protection at the US-Mexico border have been subjected to waiting for extensive periods of time during the last stretch of their journeys, which has increased their vulnerability through exposure to cartel violence and exploitation (Blue et al. 2021).

Recently, waiting either in US detention camps or at the US-Mexico border has become a normal occurrence for asylum seekers. According to the American Immigration Council (2020), the average length of detention time for adults held either in ICE custody or detention centers is 55 days, while detainees waiting to defend themselves against deportation in immigration court are commonly held for six months or longer. In addition to this wait, tens of thousands of migrants have been awaiting their court dates in Mexico in a state of limbo due to the Trump administration's implementation of the MPP and the Biden administration's revival of it (American Immigration Council 2021). Forced waiting is without question becoming a large part of immobility for Latin American migrants attempting to seek asylum in the US. Detained migrants in US detention centers are often transferred from facility to facility without warning, limiting their access to community support services and legal representation (Conlon et al. 2017). These

frequent transfers between detention centers are detrimental to detainee health and well-being (Gill 2009).

Climate Justice

Vulnerability and Climate Justice

Global climate change is largely the result of human activity, with developing countries and vulnerable communities being the most adversely affected by it. Gilbert F. White brought attention to the concept of vulnerability in 1945 in his groundbreaking dissertation ‘Human Adjustment to Floods’ (White 1945). This study not only shaped how we study flooding and hazards today, but it also revolutionized the ways in which hazard and risk are conceptualized on a larger scale (Macdonald et al. 2011).

Geographers and other social scientists have studied the political economies of vulnerability to climate change for the last several decades (Wisner et al. 1994; Barnett 2020). Because of the multiplicity of disciplines studying the topic, an array of definitions and defining factors are considered. As defined by Lundgren and Jonsson (2012), vulnerable groups are dependent upon economic resources, power relationships, institutions, or cultural aspects of a social system. Though socio-economic vulnerability has proven itself important when looking at the effects of climate change and hazards, it has many components, which makes it difficult to quantify and factor. Largely, major factors influencing social vulnerabilities include: lack of access to resources, limited access to political power and representation, limited social capital, beliefs and customs, physical mobility, and type and density of infrastructure and lifelines (Cutter et al. 2003). In addition, other general accepted factors affecting vulnerability are age, gender, race, and socioeconomic status. Migrants from Mexico and Central America fall into many of

these categories of social vulnerability. Vera-Cortés and Macías-Medrano (2021) discuss the different expressions of social vulnerability and disasters, highlighting Mexico. Manuel-Navarrete, Gómez, and Gallopín (2007) identify vulnerability to hydrometeorological disasters in Central America to illustrate the notion that vulnerability should be understood when studying human-environmental interactions.

Amongst this growing area of research within vulnerability and climate change, scholars have begun focusing on the importance of climate justice by addressing complex issues surrounding morals, ethics, resiliency, adaptation, and mitigation plans (Alves and Mariano 2018). Alves and Mariano (2018) review and break down three basic models used to frame the dimensions of analysis for theoretical framework of climate justice: polluter pays, fair division, and basic rights. Each of the three models suggests different mitigation actions to contribute to the freedoms and justices of adversely affected populations. Furthermore, scholars and advocates also have different approaches and concepts to the theme of climate justice. Mayne, Fawcett, and Hyams (2017), for example, heavily emphasize the capabilities approach in their theoretical framework, placing importance on the concept of human development.

Environment-Migration Nexus

Migration can provide a means of response or escape from social, economic, and political factors. In addition to these factors, environmental stressors brought on by climate change and hazards are increasingly influencing humans to use migration as a means of response or escape. This environmental connection is different from the traditional drivers of migration in that rather than having the option to return home, the conditions of return might not be viable due to deterioration of the land (Bakai 2021).

Climate change and extreme weather events are more frequently displacing people and are projected to continue to do so, making migration a more common adaptation strategy. However, the notion that human migration patterns may respond to environmental changes is not new. Historical cases provide evidence to support climatic changes influencing human migration (McLeaman 2006). Even within the last century in the US Great Plains, there have been particularly high levels of migration that coincided with precipitation and climatic conditions affecting agriculture (Lockeretz 1978). Migration in these instances allows individuals to adapt to climate change and benefit themselves economically while farming. This idea of moving with the climate to meet or avoid environmental factors is an adaptive form of migration that allows people to relocate in order to sustain themselves.

Generally, environmental hazards can be categorized under two classes: sudden-onset, or slow-onset. Sudden-onset hazards include events such as tropical cyclones (hurricanes), flooding, earthquakes, etc., whereas slow-onset hazards include events such as drought, sea-level rise, and land degradation/change. While both classes of hazards produce a response, the responses can differ considerably. Sudden-onset events, for example, may force people out of their homes on short notice. Additionally, sudden-onset events typically lead to temporary and internal displacement rather than a permanent migration across international borders (Climate Reality Project 2021). On the contrary, people migrating due to slow-onset events, particularly extremely high temperatures and drying conditions, may be more inclined to look beyond their nation's borders for a more permanent migration (Šedová, Čizmaziová, and Cook 2021). Understanding the

differences in human response to the different types of hazards aids in understanding the connections made between the interviewees of this study and the related hazards.

Central America, in particular, makes for an interesting and unique case due to multiple drivers of migration (political, social, and economic) with poor governance and corruption exacerbating the connectedness of these drivers, hindering affective or resilient solutions. This exacerbation worsens with environmental stressors on the rise and is increasingly interconnected with the existing drivers. Bermeo and Leblang (2021) argue that climate change and violence are interconnected drivers of migration from Honduras to the US. Climate change in Central America is generating migration within and outside of the countries of origin, which is creating new problems with migratory flows and policies regarding the classification and processing of these migrants (Casillas 2020).

Climate Refugee Recognition

Regarding migration caused by environmental stressors and climate change, humans are not protected refugees at the international scale. According to US law, which uses the 1951 Refugee Convention document to define the term, a refugee is defined as, “a person who is unable or unwilling to return to his or her home country because of a well-founded fear of persecution due to race, membership in a particular social group, political opinion, religion, or national origin” (UNHCR 2022). Those seeking asylum (which grants refugees status) in the US from environmental hazards are also not considered ‘refugees’ by this definition. The millions of people annually displaced by climate change or climate-related events are not a protected class under US or international refugee law. The unfortunate consequence of those fleeing in response to

environmental causes is that they are not recognized as asylum seekers at US ports of entry, rendering them even more vulnerable, exposed, and potentially immobile. Those migrating in response to environmental stressors and climate change must also be able to demonstrate a well-founded fear of persecution due to one of the five categories stated in the refugee convention.

Referring to people who migrate as a strategy to adapt from environmental changes as climate refugees is a contentious topic amongst researchers. Stanley (2021) uses the terminology ‘climate refugee’ to view the issue from an environmental policy standpoint, and Myers (2002) uses the term to describe populations that have been displaced by environmental problems and no longer have a secure livelihood in their homelands. Flanagan (2020) argues that refugees fleeing environmental disasters are deserving of US asylum. She argues that the US should reform its laws and grant asylum to these refugees, as it would be unethical and unjust not to, considering the country’s large contribution of global emissions. As one of the top global emitters of greenhouse gasses, the US should be held accountable for the adverse and disproportionate effects on vulnerable communities and serve the moral and ethical justice of protecting displaced peoples evading these effects.

Feminist Geographies Theoretical Framework

This research utilizes a feminist theoretical framework. Through a feminist geopolitics approach, this research goes beyond traditional geopolitical explanations by capturing experiences at the micro and personal scale. Emotional costs that migrants bear as well as intimate experiences can be lost in conventional geopolitical analysis but are recognized in a feminist theoretical approach. This theoretical approach incorporates

social relations and context, thus empowering diversity and an understanding of the intersections of power and place. Feminist geopolitics is an analytical approach that strengthens connections between feminism and political geography (Hyndman 2004). Feminist geopolitics opens a space for distinguishing itself from critical geopolitics by adding the element of embodying security and the protection of people. It allows an examination of the power relationships in migration while emphasizing different scales of analysis. Earlier research has employed a feminist geopolitical approach to provide an intimate perspective on the migrant crisis at the border and to understand power embodied by social relations embedded at multiple scales (Torres 2018). This research employs a feminist geopolitical approach as it explores the migration enforcement practices at the US-Mexico border and considers intimate and embodied spaces for migrants.

IV. DATA AND METHODS

This research seeks to analyze the environmental-migration phenomenon from Mexico and Central America. The methods used in this study consists of two phases to analyze literature and collect and analyze ethnographic fieldwork data. The first phase consists of a content analysis analyzing and describing quantitative literature related to the study, followed by the qualitative data collection and analysis phase. By using this sequence, I was able to summarize and highlight the projections from IPCC and NHC reports and use this to compare the lived experience narratives gathered in Phase II. Phase I focuses on an analysis of hydrometeorological reports and data related to Mexico and Central America. During this phase, I focused on analyzing the IPCC's AR5 and AR6 reports of 2014 and 2021 and the NHC hurricane reports of Eta and Iota. Phase II, the qualitative component, involved participant observation through ethnographic fieldwork at various study sites (discussed further below) as well as semi-structured interviews (Hay and Cope 2021) with asylum seekers and key interviewees. This research was IRB-approved before conducting any fieldwork with the asylum seekers. Together, the analysis of existing data completed during Phase I in combination with the personal narratives gathered during the interviews in Phase II help give insight to both the physical science side and the human-side of environmental migration regarding changes in magnitude and frequency of hydrometeorological events.

During phase I, I reviewed and analyzed IPCC's AR5 and AR6 reports, and the NHC's meteorological synopses of hurricanes Eta and Iota. IPCC's AR5 and AR6 reports contain global climate change data that provide an overview of changes in weather patterns and other factors related to climate variability. The reports from the Working

Group II reports provides further information on vulnerabilities and risks by region. The hurricane reports from the NHC provide overview information pertaining to the storms. This data ranges from the meteorological properties of the storms (pressures, wind speeds, etc.) to resultant impacts of wind and precipitation damage. Reviewing these documents provided a clearer understanding of the formation of the storms as well as the damage they produced throughout the affected areas, including rainfall, storm surges, and associated casualties.

During Phase II, I visited the US-Mexico border at Brownsville, TX and Matamoros, Mexico with a research collective from Texas State University known as the Latin American Mobility Project (LAMP) lab. This lab consisted of two supervising faculty members and three graduate students whose overall objective was to analyze how changing asylum policies at the US-Mexico border were directly impacting migrants attempting to seek asylum. The labs' supervising faculty provided the contacts associated with US-Mexico border non-governmental organizations (NGOs) as they had been conducting research at the border for six years prior and were well-acquainted with people involved in this area of study. The lab collectively produced our research instrument, available in Appendix A, to ask questions pertaining to general demographics, the migration journeys of the migrants (which included participant mapping), drivers of migration, and survival means at the border. For the objective of this study, the questions regarding drivers of migration (Table 1) were the main focus. After creating the research instrument, we created an open-ended survey form through ArcGIS Survey123 that contained all the interview questions. Using Survey123 allowed our lab to have a central repository to submit the completed interviews and work offline as most

study sites we visited did not have Wi-Fi capabilities. Survey123 also allowed us to provide a map during the interviews in which interviewees were able to engage in participant mapping to map their journeys of migration for us to have a spatial aspect to our studies.

Table 1. Drivers of migration questions included in interviews.

○ Why did you leave home?	
○ Did any of the following factors affect your decision to migrate? If so, how?	
• Violence	• Drought
• Domestic/gender-based violence	• Hurricanes/flooding
• Gangs	• Discrimination
• Loss of land	• Need to support family
• Loss of home or business	• COVID-19 pandemic
• Debt	

The research team visited three different shelters and a humanitarian response organization in Matamoros and a bus station in Brownsville over three separate trips from May to August 2021, as seen in Table 2. Each of the shelters differed in its mission and served different communities. Shelter #1 was a private shelter run by an American pastor, Shelter #2 was a private shelter that housed LGBTQ+ and women immigrants, and Shelter #3 was a well-established shelter funded by the Mexican federal government. The humanitarian response NGO provided medical assistance to asylum seekers and was a critical last step in their journeys to the US as they received their required negative COVID-19 tests here before being able to enter the US. The Brownsville bus station was the location where paroled asylum seekers who had been previously detained were released and allowed to seek transportation to their next or final destinations in the US. At the bus station, we volunteered with Team Brownsville (a local NGO) whose objective is providing resources to the released asylum seekers. The three separate trips

taken to Brownsville and Matamoros to conduct this research were taken through the following dates during Summer 2021: May 28th-May 31st, July 29th-August 2nd, and August 12th-August 15th.

Table 2. Study sites, Summer 2021, including descriptions and interviews conducted at each site.

Study Site/Organization	Location	Dates Visited	Mission/Purpose	Estimated Number of Immigrants at Location	Number of Interviews Conducted
Humanitarian Response/Medical Clinic	Matamoros, Mexico	05/31/2021, 07/30/2021	Provides medical care for asylum seekers.	Varied by the day. Approx. 50-75 asylum seekers present on the days that we visited this site.	3
Brownsville Bus Station with Team Brownsville	Brownsville, Texas	05/29/2021, 08/01/2021, 08/15/2021	Formerly paroled/detained asylum seekers are dropped off at the bus station. Team Brownsville is a grassroots organization that provides packs with essentials (personal hygiene products, clothes, snacks, etc.) and assists asylum seekers with the next steps of their journey.	Varied by the day. Approx. 20 asylum seekers present on the days that we visited this site.	6
Shelter #1	Matamoros, Mexico	05/30/2021, 07/31/2021	Private-owned shelter aimed to help asylum seekers in the area. Originally a church aimed to help youth, then became a shelter in response to the overwhelming amount of asylum seekers that needed shelter.	Approx. 200. 70-75 women, 70-75 men, 55 children.	10
Shelter #2	Matamoros, Mexico	8/13/2021	Private-owned shelter that serves	12	10

			the LGBTQ+ community of asylum seekers.		
Shelter #3	Matamoros, Mexico	8/14/2021	Federally-funded shelter that provides temporary housing to migrants in Matamoros.	~200	15

At each of the sites visited to conduct interviews, we first contributed to the communities by volunteering in various ways before initiating our research. We volunteered through helping with kitchen and cleaning tasks, playing games and doing fun activities with the children, providing crafts and games for the adults, assisting in translations, aiding in the collection of COVID-19 tests, sorting and organizing clothes and other donations to the NGOs, and helping distribute care packages to the asylum seekers. Once we were ready to begin conducting our interviews, we announced that we were conducting interviews as part of academic research and had zero incentives to offer other than our thanks and gratitude to their contributions. We also informed the participants it was purely their decision whether or not they wanted to participate, and they could refuse to answer any questions or opt out of the interview at any point. After obtaining verbal consent, we had several participants at each study site willing to share their migration experiences and contribute to our research.

The interview process was primarily done with two interviewers and one to three interviewees (most interviews were with a single interviewee, but three of the interviews were with multiple interviewees at once). With this setup, one interviewer took notes and filled out the online survey form from Survey123, while the other interviewer focused on guiding the interview and asking the questions. Interviews were conducted in any

available private and quiet spaces at the time of conduct—spare rooms, hallways, private open spaces away from other people, etc. At the beginning of each interview, we asked for the participants’ consent to be recorded before proceeding, with all but one participant agreeing to be recorded. In addition, we asked them to choose a pseudonym to protect their identities. These pseudonyms are used throughout this study.

In total, our research team conducted forty-eight interviews over the course of the three trips. Forty-four of these interviews were with asylum seekers, with the remaining four being key interviews with American humanitarian aid workers. Twenty-two asylum seekers were from Mexico, thirteen from Honduras, four from Nicaragua, three from Haiti, and two from Guatemala. A breakdown of the asylum seekers’ interviews is provided in Table 3. Ten interviews were collected from Shelter #1, ten from Shelter #2, fifteen from Shelter #3, three from the humanitarian response organization in Matamoros, and six from the Brownsville bus station. To begin the qualitative analysis after data collection at each site, all interviews, key interviews included, were uploaded to the online transcription and translation service HappyScribe. Once the automated transcriptions were complete, I uploaded the environmental-related interview transcriptions to Nvivo, a qualitative research software designed to aid in coding and other qualitative methods. I used Nvivo to aid in the beginning stages of coding the transcripts to better organize the key themes throughout the narratives. I completed the coding portion of the qualitative analysis through notetaking of each individual interview to ultimately find four themes (discussed further in the findings section).

In addition to the interviews, I also performed participant observations as a method of gathering an intimate familiarity with the asylum seekers and their

environment. The participant observations were gathered through volunteering with the asylum seekers and spending extended time with them in order to experience their environments firsthand. These qualitative methods provide a more thorough understanding of asylum seekers' situations and stories of their displacement as well as the extent to which hazards were a driver toward their migration efforts.

Project Limitations

This study consisted of multiple limitations due to the nature of the topic. One limitation experienced with this study was costs and time. We had a limited amount of time to conduct fieldwork, as lodging was a heavy expense due to staying in Brownsville, TX, which is a five-hour drive from San Marcos, TX. Given more funding and time for this project, this study could have expanded in various ways, from the number of participants to the number of study sites. Another limitation for this project was the political boundaries between the US and Mexico and general safety as the border towns in Texas are prone to crime. Because of the border, it limited this research in accessibility to travel alone and safely with our group. This ties into the next limitation, which was growing connections and building a positive rapport. Because of the vulnerable nature of working with migrant communities, it was essential to build connections and good rapport with the NGOs involved. This also included making trustworthy connections to provide transportation for our research group while travelling deeper into Matamoros, further away from the border, to the migrant shelters where we interviewed and surveyed asylum seekers. Lastly, the timing of the study was also a limitation. Had we been able to conduct the research in the direct weeks and months after storms Eta and Iota, we likely would have seen many more people citing the hurricanes as a driver.

V. DISCUSSION AND FINDINGS

Phase I: Content Analysis of IPCC and NHC Documents

The first phase of this study revealed environmental changes throughout Mexico and Central America. The IPCC's AR5 and AR6 are regional reports on impacts, adaptation, and vulnerability—evaluating patterns of risk due to climate change. This section will discuss each region and each report separately to examine regions relevant to this study and then will consider changes between the reports (2014-2021) to provide further insight on the impact of hazards to local populations. Followed by the IPCC AR5 and AR6 reports, this study analyzes the NHC tropical cyclone reports for Hurricanes Eta and Iota to examine storm flooding and damage.

Mexico, AR5

The IPCC's AR5 Working Group II Report covers environmental impacts, adaptation, and vulnerability (Romero-Lankao et al. 2014). Chapter 26 of this report covers North America, with Mexico as the primary focus for this particular study. Regarding human migration as a response to climate change and extreme weather events, Romero-Lankao et al. (2014) cite earlier studies to project increased migration in response to climate change (Feng et al. 2010, Oppenheimer 2013), with an estimated additional 1.4 to 6.7 million predicted Mexican immigrants by 2080. Romero-Lankao et al. (2014) also cites Saldaña-Zorilla and Sandberg (2009) to reveal a positive association between rates of migration from rural Mexico and natural disaster occurrence. Furthermore, there are projected declines in precipitation up to 30 percent across Mexico by 2040 (Romero-Lankao et al. 2014), which will ultimately affect the agriculture sector.

This stands out as an important piece as the qualitative portion of this study found agricultural declines to be an important motive for Latin Americans to migrate.

Central America, AR5

Chapter 27 of the AR5 Working Group II Report covers environmental impacts, adaptation, and vulnerability across Central and South America. As part of the executive summary, two important notes are made regarding Central America: 1) changes in climate variability and extreme events have severely affected the region, and 2) climate projections suggest increases in temperature and both increases and decreases in precipitation. Magrin et al. (2014) cites EM-DAT to point out the 613 climatological and hydrometeorological extreme events that occurred in the period 2000-2013, which ultimately resulted in 13,883 fatalities, 53.8 million people affected, and economic losses of \$52.3 billion USD. Regarding migration from hazards, Magrin et al. (2014) cites Tucker et al. (2010) to highlight the effect the coffee crisis (caused from extreme weather) had on migration, noting nearly twenty five percent of households in Guatemala reported migrating. One challenge identified in this report is the limited availability of high-quality data and complete regional studies. This challenge hampers studies on frequencies and variability of extreme weather events.

Mexico, AR6

Chapter 14 of the IPCC Working Group II AR6 Report covers North America (Hicke et al. 2021), which includes Mexico. A finding in this chapter confirms that climate change is contributing to more intense and more frequent extreme events across North America. The impacts from these events represent a challenge for future adaptation to climate change. This chapter also points out the importance of indigenous knowledge

and the disproportionate effects of climate change on indigenous communities across the Americas. The IPCC notes that indigenous knowledge and science are great resources for understanding climate change impacts and adaptive strategies. A case study in Mexico by Nawrotzki et al. (2015) is cited to mention that extreme heat contributes to migration out of small rural communities. Chapter 14 also refers to chapter 7 of this report to note that evidence of international migration in response to climate hazards is sparse with difficulties in identifying a climate signal due to the multicausal nature of migration decision-making. This multicausal nature of migration decision-making as seen in Phase II of this study appears to be a critical factor in that the intersection and exacerbation of multiple drivers of migration make each case unique. Chapter 7, which covers health, wellbeing, and the changing structure of communities (not necessarily covering Mexico, but the world as a whole), covers five key messages warranting emphasis: 1) climatic conditions, events and variability as important drivers of migration and displacement, and migration responses to specific climate hazards as strongly influenced by economic, social, political and demographic processes. This first point further explains how migration may be used as an adaptation when other forms of adaptation are insufficient. 2) Specific climate events and conditions may cause migration to increase, decrease, or flow in new directions, and the more agency migrants have (i.e., the degree of voluntariness and freedom of movement), the greater the potential benefits for sending and receiving areas, 3) most climate-related migration and displacement observed currently takes place within countries, 4) in many regions, the frequency and/or severity of floods, extreme storms, and droughts is projected to increase in coming decades, especially under high-emissions scenarios, raising future risk of displacement in the most exposed areas, and 5)

there is growing concern among researchers about the future prospects of immobile populations: groups and individuals that are unable or unwilling to move away from areas highly exposed to climatic hazards.

Central America, AR6

Chapter 12 of the Working Group II AR6 Report covers Central and South America (Castellanos et al. 2021). Extreme hydrometeorological events, leading to floods, landslides, and droughts, are projected to intensify in magnitude and frequency due to climate change. More than 30 percent of Guatemala, Honduras, and Nicaragua are predicted to battle food security as they are dependent on rainfed agriculture, which is highly sensitive to climatic conditions and variability. Regarding hurricanes, significant increases in tropical cyclone intensification rates in the Atlantic basin have been observed. The intensification rates are an unusual anomaly as rapid intensification in tropical cyclones has gotten more severe in recent years. Climate projections also indicate a decrease in frequency of tropical cyclones in Central America, but an increased frequency of intense cyclones in Central America overall. It is predicted that the rainy season in Central America will experience a more pronounced midsummer drought (MSD) by the end of the century. Most of Central America (except for Belize and Panama) is exposed to two or more risks from natural extreme events. Central America is one of the regions most exposed to climatic phenomena, repeatedly affected by hydrometeorological hazards like drought, intense rains, cyclones, and ENSO events (ECLAC et al. 2015). Reyer et al. (2017) notes that Central American countries are consistently ranked with the highest risk in the world of being impacted by extreme events, with hydrometeorological events being the most frequent extreme events and

having the highest impact. Castellanos et al. (2021) further notes that food insecurity is a serious impact of climate change as 10 percent of the GDP depends on agriculture, livestock and fisheries. The AR6 report includes knowledge gaps in Central and South America. In Central America specifically, the IPCC notes that climate change research is notably insufficient, considering climatic change and extremes will severely impact this subregion. Regarding migration and displacement in relation to hazards, this particular scenario is becoming more frequent and is expected to increase in Central America. The increasing frequency and magnitude of hydrometeorological events and hazards is amplifying internal movements. The fact sheet provided from the AR6 Working Group II stated that climatic drivers in fact do interact with social, political, geopolitical, and economic drivers; with the most common climatic drivers for migration and displacements being droughts, tropical storms and hurricanes, heavy rains, and floods. In the Northern Triangle, international migration to the US is partly a consequence of prolonged droughts. The IPCC recognizes mobility as a factor in migrating as this chapter points out the struggles of poor communities. The report notes that poorer communities have less resources and are most susceptible to migration because the loss of their livelihoods, precarious housing, and lack of money and international aid. The agricultural sector is fundamental to the development and maintenance of social and economic growth in Central American countries. This report notes that the implementation of sustainable agriculture practices can increase productivity and improve adaptability.

Notable Changes from AR5 to AR6

From 2014 to 2021, the AR5 and AR6 Working Group II reports provided by the IPCC reveal changes in impacts, adaptability, and vulnerability caused by climatic

variability across Mexico and Central America. Some of the notable changes regarding climate-driven hazards, migration, and environmental changes throughout Mexico and Central America include the recognition that climate and migration is progressively becoming a larger concern. The AR6 report also exposes the knowledge gap to call for better and more consistent data collection. AR6 also included the unique and critical perspective of indigenous knowledges and practices. Though outside of the scope of this research, this is an important topic to include when working with communities with high indigenous populations, especially since indigenous peoples are an already highly vulnerable group to climate change due to socioeconomic inequalities and dominating external powers. Including indigenous groups to advise decisions regarding their immediate environment can allow for more sustainable practices among local communities.

NHC Summaries for Eta and Iota

The NHC provides a tropical cyclone report for both Hurricanes Eta and Iota. Included in these reports are storm surge, rainfall and flooding, and casualty and damage statistics. The NHC collects data from agencies across Nicaragua, Honduras, Guatemala, and El Salvador to aid in building these reports.

Eta

Hurricane Eta resulted in a storm surge of 26 to 33 feet in Nicaragua near its landfall location (Eta's storm track seen in Figure 1). An extended period of heavy rainfall from this storm resulted in flooding across large portions of Central America (see Figures 2, 3, 4, and 5). Honduras reported the highest rainfall totals with 31.63 inches in Tela, Nicaragua reported a peak of 26.55 inches across the northeastern portion of the

country, Guatemala reported 21.06 inches at Cobán, Alta Verapaz, and El Salvador reported a maximum of 10.84 inches near Planes de Montecristo. A breakdown of these rainfalls along with others can be found in Figure 6. Due to storm surge and flooding, Eta was responsible for at least 165 direct deaths and over 100 missing people across Central America and Mexico. UNICEF estimates over 110,000 people displaced by Eta across Central America were evacuated to temporary shelters during the COVID-19 pandemic.

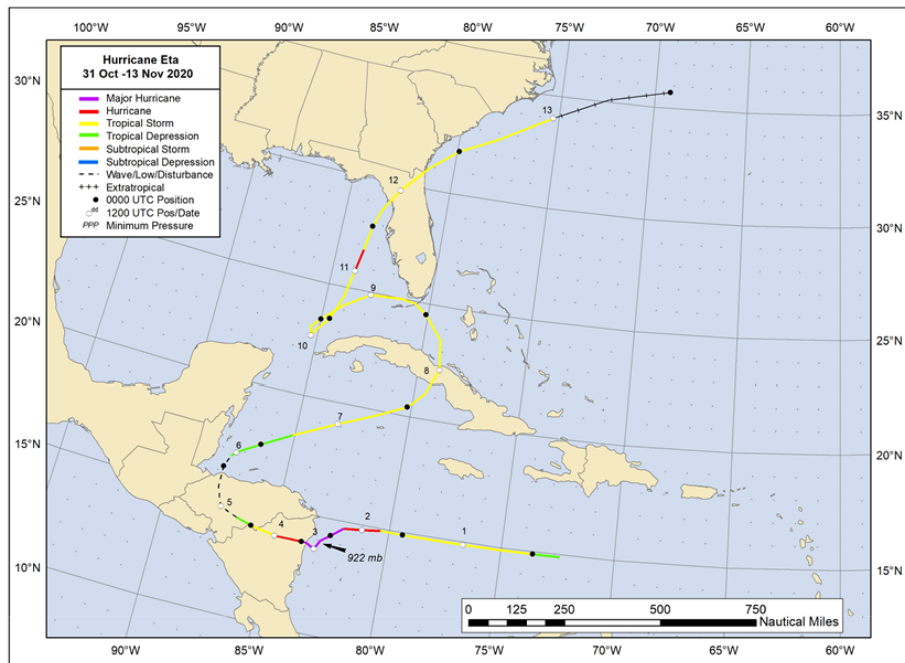


Figure 1. Eta's storm track. Source: NHC.

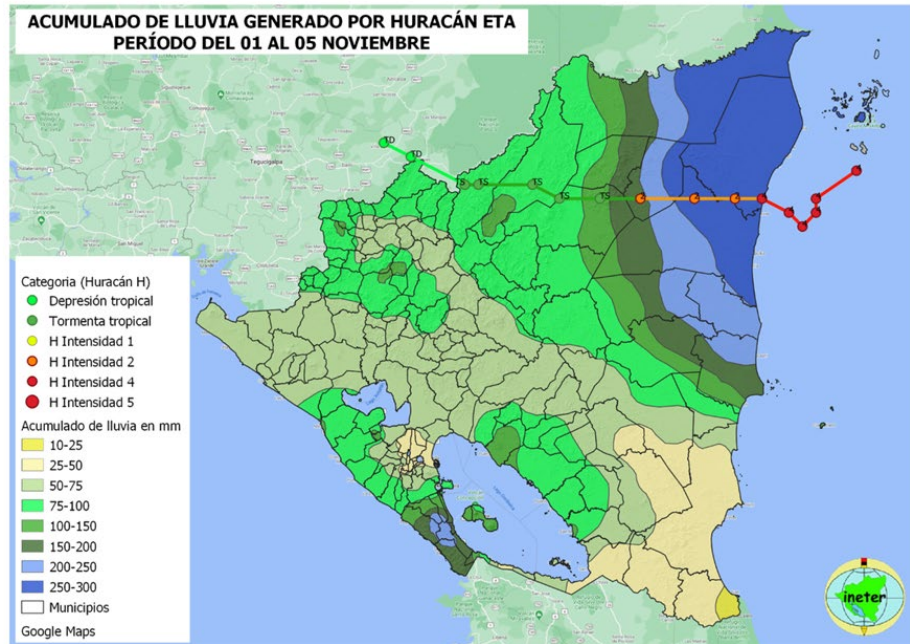


Figure 2. Eta rainfall across Nicaragua. Source: Instituto Nicaragüense de Estudios Territoriales.

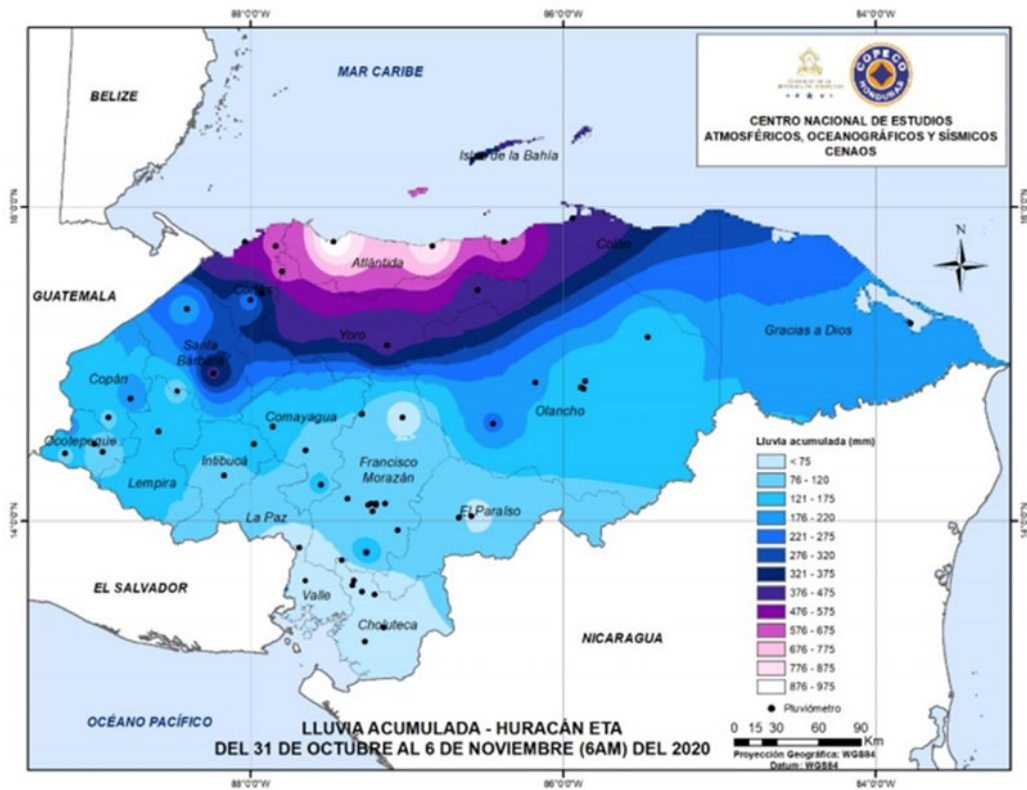


Figure 3. Eta rainfall across Honduras. Source: Centro de Estudios Atmosféricos, Oceanográficos y Sísmicos (CENAOS).

Maximum reported rainfall totals by country:

<u>Honduras:</u>	31.63 inches (803.3 mm) at Tela, Atlántida
<u>Jamaica:</u>	28.89 inches (733.8 mm) at Moore Town, Portland
<u>Nicaragua:</u>	26.55 inches (674.3 mm) at Puerto Corinto, Chinandega
<u>Mexico:</u>	24.90 inches (632.5 mm) at Tzimbac, Chiapas
<u>Costa Rica:</u>	24.58 inches (624.4 mm) at Arunachala
<u>Belize:</u>	21.86 inches (555.2 mm) at Baldy Beacon, Cayo
<u>Guatemala:</u>	21.06 inches (534.8 mm) at Cobán, Alta Verapaz
<u>Cuba:</u>	17.71 inches (449.8 mm) at Topes de Collantes
<u>El Salvador:</u>	10.84 inches (275.4 mm) at Planes de Montecristo
<u>Cayman Islands:</u>	9.87 inches (250.7 mm) at Grand Cayman

Figure 6. Total rainfalls from Eta by country. Source: NHC.

Iota

Hurricane Iota made landfall just two weeks after Eta, close in location to Eta's landfall (Figure 7). Due to the proximity in time of the two storms and the damages Eta left behind, Iota's storm values were very difficult to ascertain. However, the Nicaraguan Institute of Territorial Studies estimated a storm surge of at least twenty-six feet near the village of Haulover (Figure 8). Iota produced high amounts of rainfall across Central America (see Figures 9, 10, and 11). Because the rainfall from Iota was falling on already saturated land from Eta, flash flooding occurred across much of Central America. Due to storm surge, flooding, and strong winds, Iota was responsible for at least 67 direct deaths, 17 indirect deaths, and 41 missing people. An estimated seven million people were affected by Iota across Central America and the Caribbean, with hundreds of thousands being displaced from their homes in Central America.

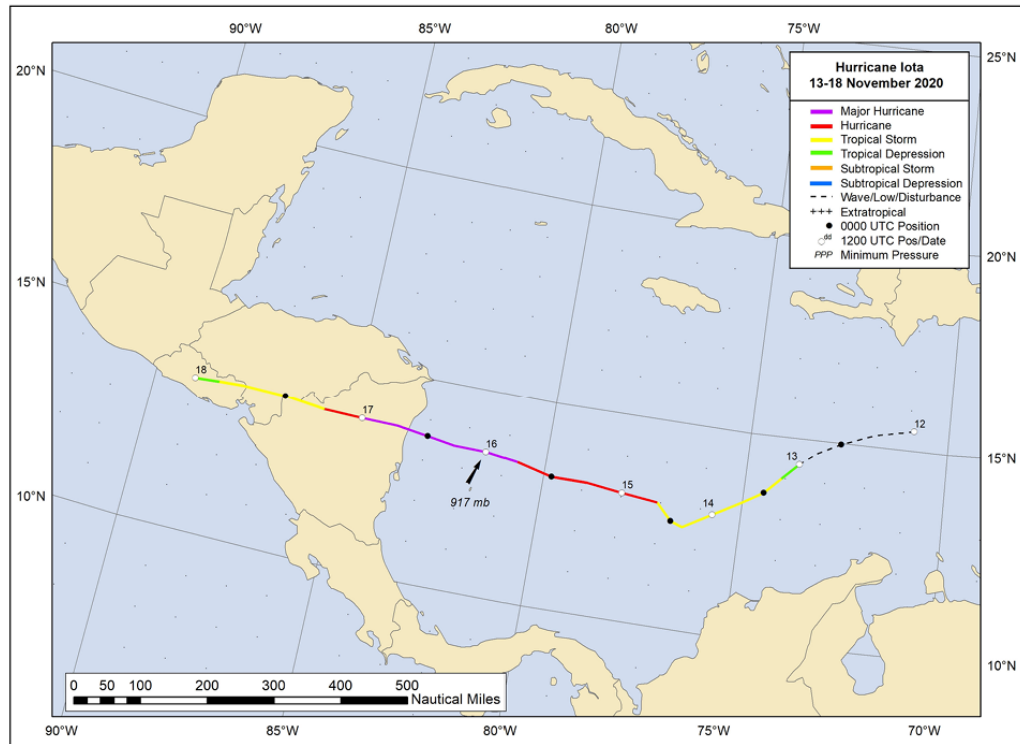


Figure 7. Iota's track. Source: NHC.

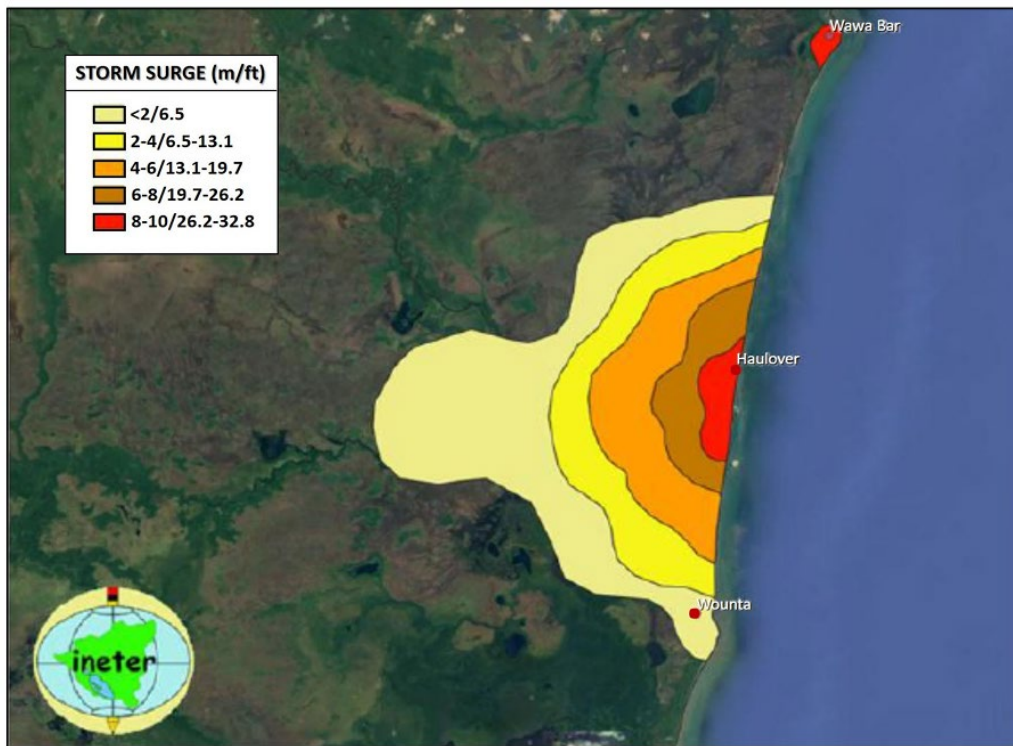


Figure 8. Iota's storm surge in Nicaragua. Source: Nicaraguan Institute of Territorial Studies.

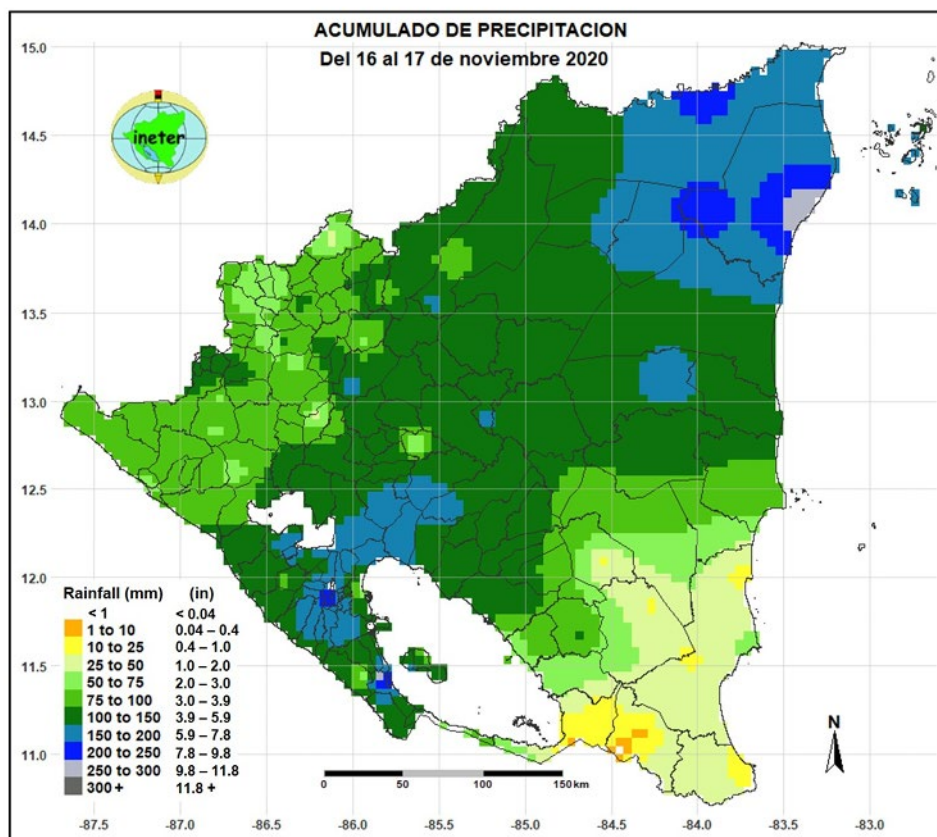


Figure 9. Iota rainfall across Nicaragua. Source: Instituto Nicaragüense de Estudios Territoriales.

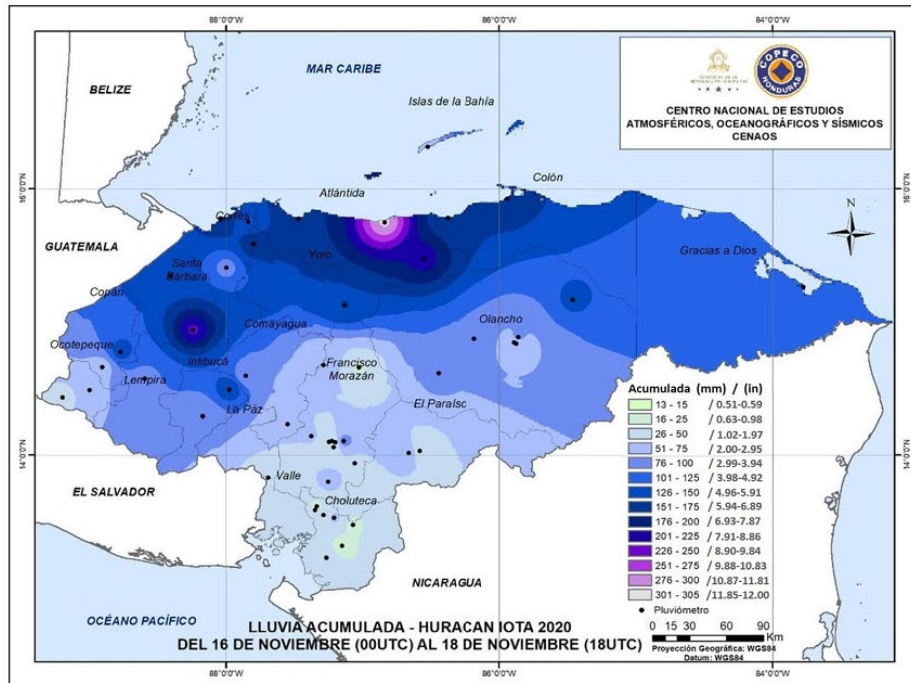


Figure 10. Iota rainfall across Honduras. Source: Centro de Estudios Atmosféricos, Oceanográficos y Sísmicos (CENAOS).

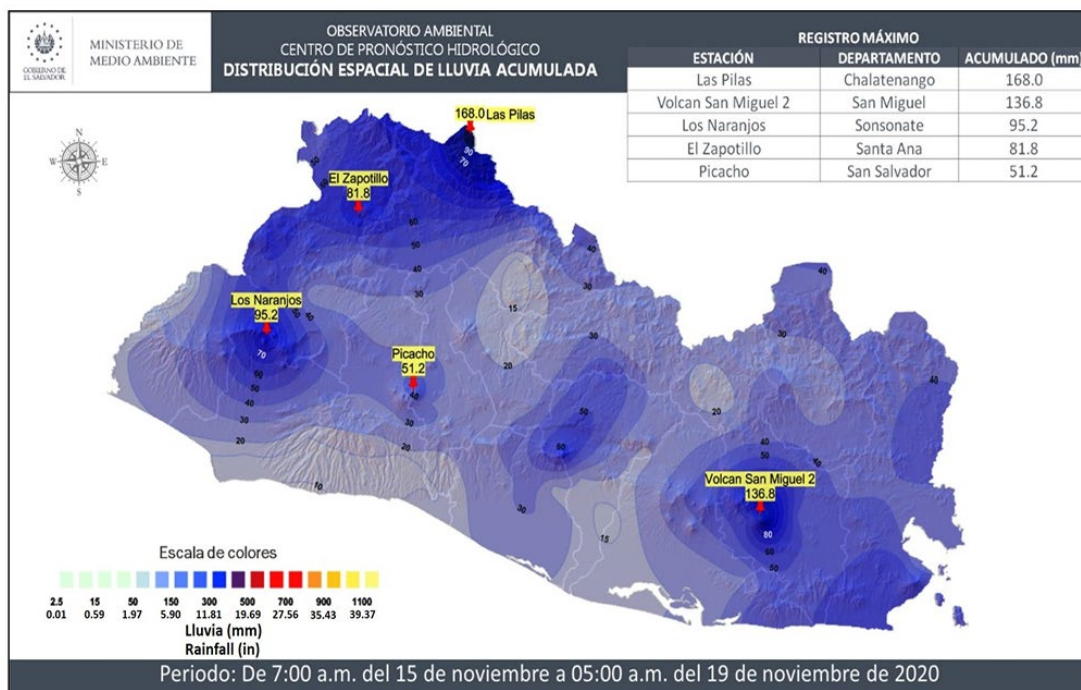


Figure 11. Iota rainfall across El Salvador. Source: Centro de Pronóstico Hidrológico de El Salvador.

Phase II: Qualitative

The semi-structured interviews revealed that environmental changes prompted by hydrometeorological hazards affected asylum seekers in different ways, with each interviewee having their own unique lived experience and migration journey (Figure 12). When asked about drivers of migration, thirteen out of forty-four asylum seekers, or roughly 30 percent of the participants, listed some type of hydrometeorological hazard as a reason for their decision to migrate and seek asylum in the US (see Table 3 and Figure 13). When looking at the sum of all drivers cited from the interviews, the hydrometeorological hazards comprised about 10 percent of the responsible drivers. The most frequently noted drivers of migration cited during interviews were violence, gangs, and the need to help/support family. These driving forces in particular are what contribute to making this Latin American region unique in that these drivers stem from political, economic and social issues that pertain to these countries. The geopolitical nature influences social inequities throughout the region, creating particular driving forces that aren't necessarily seen in other regions across the globe. While eight of the thirteen environmentally-affected asylum seekers listed hurricanes and flooding specifically, four determined it was both ends of the hydrometeorological spectrum affecting them and also included drought as a driver, while only one participant listed only drought as the environmental factor driving them to migrate.

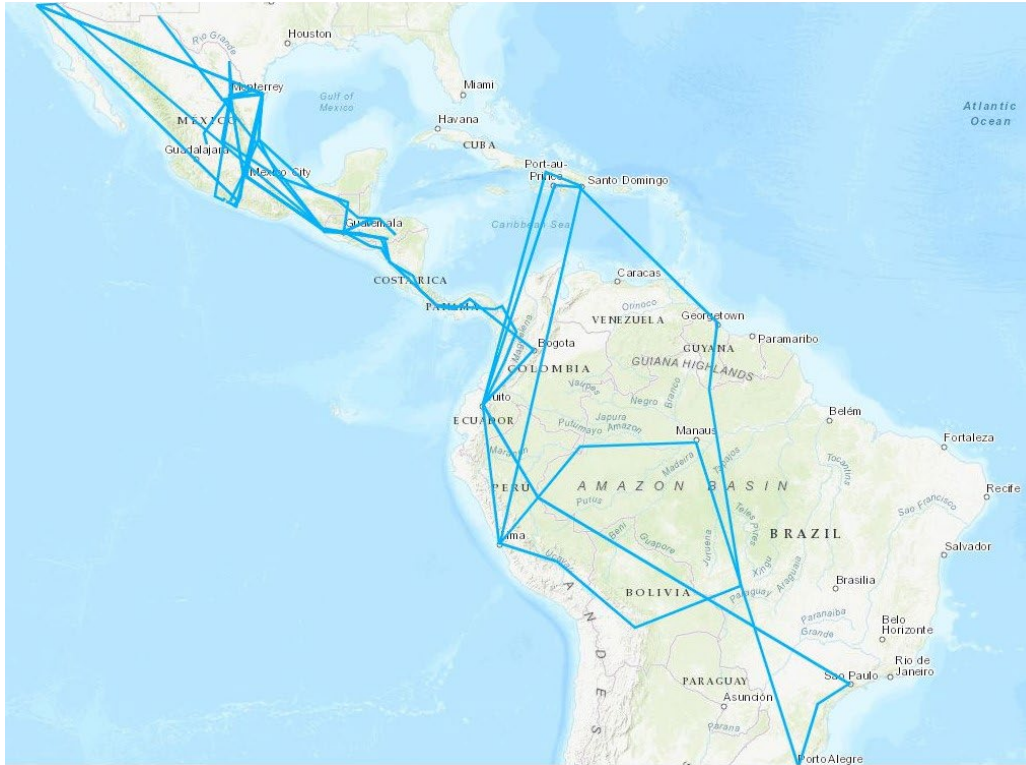


Figure 12. Migration routes collected from the interviews.

Table 3. List of interviewees, Summer 2021, including drivers of migration with hydrometeorological entries highlighted.

Pseudonym	Country of Origin	Gender	Age	Listed Drivers of Migration
Carmen	Mexico	Female	36	Gangs, need to help family
Ezekial	Honduras	Male	24	Violence, gangs
Catalina	Mexico	Female	20	Violence, gangs, loss of land, debt, hurricanes/flooding, loss of home or business, drought, discrimination
Nicasia	Mexico	Female	42	Violence, domestic violence, gangs, hurricanes/flooding
Paola	Mexico	Female	30	Violence, gangs, loss of home or business, debt, COVID-19 pandemic
Yesenia	Mexico	Female	34	Violence, gangs, COVID-19 pandemic
Daniel	Honduras	Male	29	Violence, gangs, need to help family, hurricanes/flooding

Darnell	Honduras	Male	59	Violence, gangs, loss of land, loss of home or business, need to help family, hurricanes/flooding
El Barbero	Nicaragua	Male	38	Violence, loss of home or business, need to help family
Carlos and Deborah	Mexico	Male and Female	37, 48	Violence, gangs, loss of land discrimination
Laura	Mexico	Female	24	Violence, loss of land, debt, COVID-19 pandemic, need to help family, hurricanes/flooding, drought
Brittany	Mexico	Female	31	Domestic violence, need to help family, COVID-19 pandemic
Jennifer	Mexico	Female	24	Violence, gangs, COVID-19 pandemic, need to help family, hurricanes/flooding, drought, loss of home or business
Mariana	Mexico	Female	28	Violence
Ana	Mexico	Female	X	Violence
Franklin	Honduras	Male	26	Violence, hurricanes/flooding, need to help family, COVID-19 pandemic
Michael	Nicaragua	Male	30	Need to help family, COVID-19 pandemic
Maria	Honduras	Female	42	Violence, domestic violence, gangs, discrimination, need to help family, COVID-19 pandemic
Nati	Nicaragua	Female	37	Violence, gangs, drought, need to help family,
Kevin	Haiti	Male	32	Violence, discrimination, need to help family
Esmeralda	Honduras	Female	42	Gangs, hurricanes/flooding, need to help family
Juliet	Nicaragua	Female	39	Domestic violence, loss of home or business, discrimination, COVID-19 pandemic
Lisette	Mexico	Female	X	Violence, domestic violence

Maribel	Mexico	Female	24	Violence
Paula	Mexico	Female	36	Violence, gangs
Araceli	Honduras	Female	32	Violence, gangs, loss of home or business, hurricanes/flooding, need to help family
Vanessa	Honduras	Female	21	Violence, domestic violence, loss of land, discrimination, need to help family, COVID-19 pandemic
Irene	Mexico	Female	30	Violence, gangs, discrimination
Magaly	Mexico	Female	26	Violence, domestic violence, debt, discrimination, need to help family, COVID-19 pandemic
Yaretzi	Mexico	Female	30	Violence, need to help family
Esteban	Guatemala	Male	33	Domestic violence
Juan	Mexico	Male	X	Violence, gangs, discrimination
Natalia	Honduras	Female	19	Violence, gangs
Francisco	Honduras	Male	41	Violence, gangs
Amanda, Selena, and Rocio	Mexico	Female	31, 55, 32	Violence, gangs, loss of land, loss of home or business
Manuel	Haiti	Male	22	Violence, gangs, loss of land
Cesar and Danila	Mexico	Male and Female	29, 27	Violence, gangs, loss of land, loss of home or business, need to help family, COVID-19 pandemic
Sara	Honduras	Female	42	Violence, domestic violence, gangs, loss of land, loss of home or business, hurricanes/flooding, need to help family
Mama	Haiti	Male	42	Violence, gangs, loss of land, loss of home or business, hurricanes/flooding, discrimination
Austin	Honduras	Male	23	Violence, domestic violence, gangs, discrimination, need to help family
Ovilio	Honduras	Male	31	Violence, gang, debt, drought, hurricanes/flooding, need to help family
Manuel	Mexico	Male	40	Violence, gangs, debt

Rubito	Mexico	Female	53	Violence, gangs, loss of home or business
Marvin	Guatemala	Male	28	Debt, need to help family
*Fields highlighted in blue indicate the interviewee was affected by only hurricanes/flooding, red indicates only drought, and yellow indicates both hurricanes/flooding and drought.				
* X = Unable to retrieve data from the interviews.				

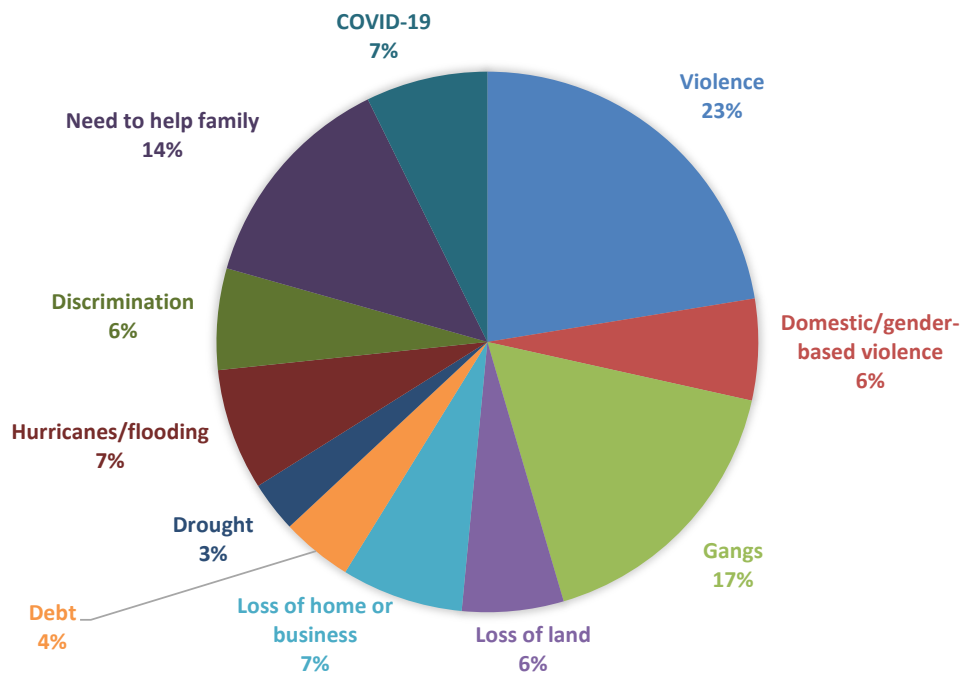


Figure 13. Named drivers of migration during interviews.

While sharing general similarities, each of the thirteen asylum seekers who named an environmental factor in their narratives lived through the hazard experience differently. The differences in their lived experiences provide nuance in understanding the role of natural hazards in migration decisions. I identified four themes within the overall theme of environmental displacement amongst these interviewees' narratives: 1) agricultural dependency, either for income or a food source to sustainably feed their families; 2) hydrometeorological hazards as a marked life disruption; 3) the loss of home;

and 4) “the last straw” or the ways hydrometeorological hazards exacerbated individual situations and served as the catalyst to finalizing their migration decision. These four themes reveal how hazards and climate change in Mexico and Central America motivate individuals to migrate, and the ways in which asylum seekers perceive and identify hazards as threats to their livelihoods in combination with other region-specific drivers of migration.

Agricultural Dependency

“No cultivos, no hay salario.” (Sara, 2021)

The first theme emerging from the interview analyses was agricultural dependency. In this theme, I identified interviewees who depended on agriculture and farming for their livelihood, either for economic income, a sustainable food source, or both. Mexico and Central America are home to many smallholder farmers, with an estimated 2.3 million within Central America alone (PRESANCA and FAO 2011). Peasants who rely on agriculture in Mexico and Central America are particularly vulnerable to climate change due to the extended droughts and irregular rainfall patterns in this region. Irregularities in precipitation throughout the region can significantly reduce crop yields and exacerbate food insecurity and poverty (Harvey et al. 2018). Ultimately, smallholder farmers and other agricultural-reliant people throughout Mexico and Central America are routinely affected by hydrometeorological hazards and anomalies. Knowing this helps uncover the influence climate change and hazards have on migrants when deciding to migrate.

Five of the thirteen participants who were affected by hydrometeorological hazards were dependent on agriculture and farming. Two of these five participants were

dependent on agriculture purely for their income, one was dependent on agriculture for their main food source, and the other two were dependent on agriculture for both income and food security. These migrants all expressed the idea that climate change was important and significantly determined their capability to make a living. Irregular precipitation patterns, excessive rain and flooding from hurricanes, and extended drought were among the hazards cited by the participants. In particular, Jennifer identified “*la canícula*,” or “the dog days,” as a significant period in having immense detriment and strain to their sensitive crops in her hometown of Guerrero, Mexico. *La canícula*, properly known as the MSD (midsummer drought, mentioned in Phase I), is a weather phenomenon that affects the southern US, Mexico, and parts of Central America throughout the months of July and August, in which there is a major deficit of precipitation (up to 40 percent) combined with high temperatures (Jiménez Pérez 2020, Small et al. 2007, Magaña et al. 1999). This stretch of time can ultimately make crop cultivation impossible since most farmers in the region depend entirely on the rain to water their crops (Harvey et al. 2018). *La canícula* was a particularly difficult time of year to get through for Jennifer and her family as they depended on crops to feed themselves rather than sell for income. Losing their crops to extended drought over *la canícula* had caused food insecurity, and according to Jennifer, *la canícula* is only continuing to “get stronger.”

While Jennifer depended on agriculture for food security, Ovilio and Laura both depended on agriculture for their incomes. Ovilio, a Honduran migrant, stated his dependency on agriculture for his income to support himself and his family, and briefly explained that the intensive droughts that would occur would ruin the crops, which

ultimately affected his unemployment and income and motivated him to migrate. Laura, from Guerrero, Mexico, relied on the cultivation of sesame seeds for her income. She described sesame seeds as a very sensitive crop that fails when there is “too much or too little rain.” The specificity of sesame seeds, an endemic crop in the eastern hemisphere, helps illustrate the local effects of climate change. According to Brand (1941), sesame in the Balsas basin of Guerrero and Michoacan was one of the four most valuable crops in 1870, and its production rapidly increased after World War I. Today, Guerrero has become the largest sesame seed producer in the western hemisphere (Porter 2021). Afro-Indigenous communities are the cultivators responsible for helping Guerrero reach this status today (Porter 2021). The importance of sesame seeds in this region is thus beyond just an economic necessity, but also out of cultural inheritance in ways of knowing and historical practices. The majority of the interviewees from Guerrero were of Afro-Indigenous descent, and knowing the historical aspect of Afro-Indigenous communities introducing and thriving off of sesame seeds provides a stronger understanding for the cultural and historical ties this region has with the specific crop. Ultimately, and similar to Ovilio, Laura emphasized the cycle of rain and/or drought equating to no work, no food, and the need to find new sources of work and food security.

Franklin and Sara, both Honduran migrants, depended on agriculture for both income and food security. Franklin primarily farmed and cultivated corn and beans in his home region of Olancho, Honduras. When asked about hurricanes, flooding, and drought, Franklin explained that all have affected him, been a detriment, and have ultimately contributed to his motivation to leave home and seek asylum in the US. Franklin did not choose to seek asylum in Mexico and described Mexico as a “disaster,” and sought out

protection in the US instead. Franklin was interviewed in Brownsville at the bus station where he was released. Franklin explained that the agricultural crisis of crop failure due to drought and flooding from the hurricanes greatly exacerbated his economic situation. When asked about the primary reason for leaving home, Franklin focused on Hurricanes Eta and Iota. Eta and Iota were responsible for destroying his home, his crops, and completely flooding and ruining his land in general. In combination with the extended drought that he also experienced prior to the storms, he was left without food and work. Ultimately, poverty was also to blame, stemming from a lack of work due to ruined crops related to hydrometeorological hazards. Like Franklin, Sara left Honduras due to the damage from Eta and Iota as well as the lack of opportunity for work.

Agriculture, largely controlled by climate and weather conditions, plays a major role in influencing the decision to leave home for those whose livelihood depends on it and is disrupted by hydrometeorological hazards. With most agricultural workers in this region depending on rain to water their crops, occurrences like irregular rainfall patterns, flooding from hurricanes, dry spells from la canícula, and extended droughts in general, all disturb the cultivation and yields of crops throughout Mexico and Central America. With predicted increases in duration of la canícula and predicted decreases of precipitation over Central America (Mauer et al. 2017), it is crucial to consider the changes and patterns of temperature and precipitation at the micro scale because many rural communities' livelihoods and food security depend on it.

Hazards as Marked Life Disruptions

The second theme emerging from the interviews was the notion that hazards caused a disruption to the asylum seekers' lives in more than one aspect. As assumed,

hazards that create disasters within regions will interrupt people's lives and sense of normalcy. For some of the interviewees, these hazards disrupted their lives but did not necessarily immediately push them to migrate. Rather, for two of the respondents, the effects of hazards affected their experiences and knowledge of what the hazards were capable of.

Mama, a 42-year-old Haitian man, described his hazard experiences back home as having “lots of flooding and water” throughout his hometown when there were bad storms. His main concern was “no electricity, no potable or drinking water” for days or even weeks after the events would happen. While the hazards affected him, it was not an ultimate deciding factor to push him to leave immediately. Instead, the experiences informed his future decisions and remained a consideration when he ultimately made the choice to leave. In Mama's case, we can speculate that these disturbances and disruptions to his everyday life were not sufficient enough at first to cause him to leave or did not strike him as legitimate reasons to leave his country as these are frequent occurrences in many parts of Haiti where areas are deforested and experience frequent tropical storms and flooding. Another consideration would even be the resources available that would allow him to move after hazards like flooding. The Haitian participants' migration journey routes (see Figure 12) from Haiti to the US-Mexico border typically begin with a plane or boat passage to Brazil, where they were not required to have a visa to enter the country. From here, they would traverse through the northern countries of South America before continuing north through Central America and Mexico to the US-Mexico border in Matamoros. Because of this especially long journey and initial costliness of air or boat travel, most Haitians cannot afford the trip. For Mama, it was ultimately political

violence that forced him to migrate, not the hazards themselves. The weight of political violence and persecution was much higher than environmental hazards for Mama, and this reveals some nuance in individual situations, regional drivers, and regional differences.

Nicasia, a 42-year-old woman from Guerrero, Mexico, recalled her experience with a hurricane. In her narrative, it is unclear which hurricane she is referring to, but it was likely Hurricanes Ingrid and Manuel of 2013 (these two storms hit within twenty-four hours of each other), as they match the timeline she provided and were the hurricanes responsible for affecting another interviewee from Guerrero. Nicasia recalls the tremendous mudslides and landslides that followed this hurricane and left her “trapped” in her village, unable to escape the destruction or receive help after the hurricanes passed. During the hurricane, Nicasia was rendered immobile due to the massive mudslides cutting off access to leave her village. Once she was again able to enter and exit her village freely, she decided to stay despite the mass destruction the storm had caused. Like Mama, Nicasia did not identify this disastrous event as a primary reason to migrate from home. Rather, she identified violence and gangs as her primary factors for leaving home.

These two cases that categorize hazards more as a secondary or even tertiary driver of migration provide nuance to how individual situations and relationships at the micro personal scale can differ. In both cases, the participants acknowledged the impacts and disruptions that flooding events placed on them, proving that these events did have an overall impact on their perceptions of storms and storm destruction. However, neither chose to migrate immediately after the storms. For Mama and Nicasia, money and timing

of the hydrometeorological hazards appear to have been factors. Observing climate change and natural hazards as a background driver is important in noting that the exacerbation aspect is not present in these cases.

Loss of Home

The third theme emerging from the interviews was the ways in which flooding from hurricanes ultimately led to the loss of homes, resulting in the displacement of asylum seekers. Of the thirteen participants who identified environmental reasons for their decisions to leave home, three participants dealt with losing their home to a hurricane event. The loss of home that people often experience after storms poses a significant consideration to relocate and also carries a tremendous post-traumatic stress that individuals live with (Caldera et al. 2001). An estimated 6.8 million people lost their homes to Eta and Iota (UNWFP 2021), and large portions of the affected population suffered various psychological distresses and trauma (IFRC 2021). Due to the timing of our interviews, roughly seven to nine months after the storms, it is likely that many more asylum seekers were affected by hurricane-related home loss than our sample shows.

Interviewee Laura described the homes, including her own, in Guerrero as “fake,” and further explained that “when it rains, the houses go.” In Guerrero, where there is a large indigenous and Afro-Indigenous community, many individuals live in marginal homes that are highly susceptible to environmental hazards. The homes in these communities cannot withstand the high wind speeds or the resultant flooding from hurricanes. Jennifer, also from Guerrero, stated that “when there is rain, there is a river...” to describe the immense impact rainwater had in their community and how susceptible their landscape was to flooding. This vulnerability to climate change and

hazards in indigenous communities in Guerrero is not unique. Indigenous communities across Latin America and the Caribbean are more susceptible to climate change overall (Kronik and Verner 2010). For both Laura and Jennifer, losing their home to floods in their communities greatly contributed to their decision to migrate.

Franklin, from Honduras, also recalls the devastation of losing his home to Hurricanes Eta and Iota. When asked about his experience with the storms and how his home was affected, he responded, "...it collapsed. One of the walls was blown away in the wind." Iota was a category 5 hurricane with intense winds (NHC 2021), thus it is no surprise that his home could not survive the storm, leaving him homeless.

Fellow Honduran Araceli also lost the house she was living in to Hurricanes Eta and Iota. When further asked about the destruction of the storms, she explained "we were left completely with nothing." The storms left her, like many others, abandoned and displaced. Araceli recalls that she and others, "slept in the streets and in shelters" after the storms took everything away. Despite it being eight months after Eta and Iota when participating in the interview, Araceli stated that they were still unable to fix the house and she shared the very high unlikelihood of ever being able to rebuild or repair the house. Furthermore, she described how this disastrous event's damage ultimately left her homeless again (as she had experienced prior homelessness) and prompted her to migrate.

For many individuals and families across Mexico and Central America, housing structures are incapable of holding up against storms. Both the resultant intense winds and excessive rainfall and flooding caused by hurricanes bring devastation and destruction to houses throughout the region. Many are left homeless with little to no

belongings and ultimately are displaced after large storm events. Between living on the streets, relying on shelters, and having no hope of rebuilding and adapting to the storm disasters, many Mexicans and Central Americans affected by major natural disasters turn to migration as their best option.

The Last Straw

The final theme emerging from the interview analyses involves understanding the intersection of multiple drivers of migration, the exacerbation of region-specific drivers by hazards, and the movement and fluctuation of drivers through space. Environmental detriments served as a medium to accentuate other factors influencing human behavior to migrate, and in some cases were described by migrants as the last straw. Mexico and Central America are regions that experience high migratory patterns due to present drivers like cartel violence, food insecurity, political corruption, etc., and with the addition of climate change and hazards, these factors are exacerbated. Large impactful events such as losing one's home to a hurricane or losing an entire farms' crop harvest due to flooding or drought can be a devastating experience that ultimately leads someone to relocate.

In Honduran Sara's case, Hurricanes Eta and Iota were the final straw for her to choose to migrate. At 42 years old, she had built self-resiliency through numerous life events. When asked about factors that affected her to migrate, she responded affirmatively for violence, domestic violence, gangs, loss of land, loss of home and/or business, the need to help support family, and hurricanes and flooding. She recounted her experiences of losing her father at a young age and how that left her family with no land, no work, and no home. She eventually had to leave her hometown at age 18 due to the

amount of crime and civil strife that surrounded her. Sara spent her years bouncing between living on the streets, working low-income jobs, and being a victim of abuse. Because Sara depended on the cultivation of rice and beans for work, the flooding from Eta and Iota left her jobless. Sara described the damage produced by the storms that ravaged Honduras: “Eta is the saddest thing I have ever lived through in my life.” Describing abandoned children surviving on their own and living in tent cities after the storms, she stated “they need to leave and migrate for a better life...that’s the situation for them.” This statement underpins the urgency of migrating so that people are not left in these conditions. For Sara and others in similar situations, disastrous events, like hurricanes, are the tipping point for people to relocate. Throughout her interview, Sara also mentioned the intersection of other factors. She remarked that the effects from Eta and Iota was a “devastation” combined with the COVID-19 pandemic. This illustrates how for many of the participants, the effects of multiple situations intersected to affect and exacerbate the experiences of migrants.

Like Sara, several participants listed multiple drivers of migration when asked about what made them leave home, but it was climate and hazard-related events that set them off. Jennifer, Laura, Catalina, and Ovilio all had experiences where climate change and/or hydrometeorological hazards exacerbated their current situations. Hondurans Araceli and Franklin also described climate change and hazards as their last straw after experiencing numerous other drivers of migration in their histories.

This theme of environmental hazards as a catalyst or last straw reaction amongst the thirteen cases is particularly insightful. Previous studies (IOM 2017, Montz et al. 1997, Mallick 2022) have indicated that hurricanes and other sudden-onset hazards

primarily force people out of their homes only temporarily and within the borders of their own country, fleeing the disaster and then returning back home once it has passed. Slow-onset hazards, like gradually worsening drought, is typically where researchers have seen the more permanent relocation outside of one's country (Hauer et al. 2020). These Mexican and Central American participants were outliers to these most common responses to both sudden- and slow-onset hazard events. The sudden-onset hazards that affected migrants to leave home caused them to leave their countries in search for a long-term or permanent solution. These migration decisions could be due to the other forces that are already in place and are influencing them to leave home, leading us to examine the interactions with other drivers that are influencing these migrants who choose to migrate internationally. For the participants in this study, the complete destruction and devastation of the communities after major hurricanes and flood left little to nothing to go back home to. Having their homes completely destroyed and having little hope in conditions getting better, many saw the opportunity to migrate as an opportunity for a better life overall.

VI. CONCLUSION

Mexico and Central America have historically high rates of emigrants seeking asylum in the US. With climate change and hazards becoming a bigger threat across the globe, we expect a greater number of the migrating population to be affected by environmental displacement. However, the research on climate- and hazard-induced migration or environmental displacement focused in Mexico and Central America specifically is limited. To help elucidate the complex and inextricably interconnected relationship between humans and the environment, this study asked: How are climate change and hydrometeorological hazards affecting individual's motivations to migrate? And, what role do these hazards play in determining decisions to migrate from Mexico and Central America to the US?

Of the 44 interviews with asylum seekers conducted from May to August 2021, 13 identified some sort of hydrometeorological hazard as a deciding factor towards their migration decision. These 13 interviews provided more nuanced views on the multifaceted topic. The interview findings ultimately produced four key themes: 1) agricultural dependency, whether that be for income or food security to sustainably feed their families; 2) the disasters served as a general or major disruption to their life; 3) the disasters caused a loss of home and ultimately led to the asylum seekers' displacement; and 4) "the last straw," or the ways hydrometeorological hazards in each case exacerbated the individual situations and potentially served as the catalyst to finalizing their migration decision. These four themes revealed the role that hydrometeorological hazards played in affecting migration decisions, as well as provided nuance in the intersecting relationships between migration and hazards.

The first theme of agricultural dependency revealed the importance of agriculture to some of the participants of this study. In particular, agricultural production in Mexico and Central America is particularly vulnerable to climate change and hazards due to its dependence on rain and stable conditions. The evidence from this study shows that agricultural dependency is very important in both economic and food security and is closely tied to environmental hazards. This relationship means that hazards, climate change, and any general changes or fluctuations in weather can equate to no work, no food, and no home for the local population. This unfortunate dynamic leaves people to turn to migration as a solution.

The second theme of the disasters serving as a disruption to the asylum seekers' lives suggests that even though one may experience the effects of hazards, these hazards are not always at the forefront of their identified reasons for leaving home. According to interviewees, the hazards affected them in the moment and impacted the way they lived their lives temporarily, but ultimately it was a different driving factor that had a larger influence on their migration decision. This theme provided some insight into the micro personal scale of how lived experiences and unique individual situations can translate into different behaviors and responses to hazards.

The third theme – the loss of homes – is commonly associated with storms. This theme revealed the impact of the loss of a home during major storm and flood events. This theme revealed how many housing structures in Mexico and Central America are incapable of holding up against storms, and individuals who experience a storm-related home loss can be unmotivated and unhopeful that anything will be rebuilt or get better in the future. In these cases, interviewees still had yet to see progress in homes being rebuilt

even eight months after the hurricanes. This theme, overall, provided insight into the lack of trust and hope that individuals have in their governments will or ability to provide relief after storms.

The final theme of the interviews was climate change and hazards serving as a last straw and looking at how these factors exacerbate other drivers of migration. Each of the individuals' situations was exacerbated by the hydrometeorological hazards they experienced. For some, these hazards served as the last straw and were the catalyst in their decision to migrate. Something that stands out in this theme is the intersection of multiple drivers and the acknowledgement of unique region-specific drivers. The multiplication of drivers that are commonly experienced by residents in the Mexico and Central America region are pushed to their limit when hazards are introduced, whereas other global regions may be able to assimilate the effects of hazards and build resiliency much easier.

The hazards presented during the interviews exacerbated nearly each individual's situation, and for many of the interviewees, acted as a last straw. Because of the region-specific migration drivers that are already present and the lack of improvement in local conditions, climate change and hazards become a driver that exacerbate and dominate other experiences. Having already dealt with corruption, persecution, and insecurities, sudden-onset disasters like hurricanes and the resultant flood events became the breaking point for some individuals, causing them to leave home for good. Slow-onset conditions like drought can have the same effect. In other regions that feel the effects of climate change and experience conditions such as sea level rise, e.g., the Maldives, may have residents who instead wish to stay, adapt, and build resiliency (Kelman et al. 2019).

However, the Mexico and Central America region have unique factors that are not present in the Maldives. Maldivian people are a very mobile group of people (Orlowska 2015) where circular migration is a common dynamic (Guan and McElroy 2012, King and Connell 1999), and they also have the resources and abilities (Baldacchino 2018) to challenge the push-pull factors of migration. Mexican and Central American people migrating to the US to seek asylum experience periods of immobility on their journeys and do not often have sufficient resources or options given their poverty.

Together, the evidence from all four themes helps provide nuance for how individuals may be affected by hazards overall, specifically in the Mexico and Central American region. These interviews provided insight on experiences that are inaccessible through the generalization that would occur through a purely quantitative analysis. They indicate that climate change and hydrometeorological hazards may not serve as a direct driver of migration in each case per se, but are rather more of an indirect driver that serves to intensify existing drivers. Ultimately, no two regions in the world will have the same factors influencing outmigration. Each region, and each individual living in that region, will have a unique experience that cannot be generalized into how climate and hazards may affect someone's decision to migrate.

The content analysis revealed that the IPCC recognizes the need for good data collection and maintenance for the Central American region. The IPCC acknowledges the growing concern for migration resultant of climate hazards and extremes.

Hydrometeorological hazards in the region are continuing to intensify, ultimately interfering with people's livelihoods, home structures, and agricultural reliance. The proximity of storms Eta and Iota could become more frequent as tropical cyclones are

projected to intensify. The content analysis provided a context for the predicted impact of environmental hazards on migration in Mexico and Central America. Because the IPCC mentions the relationship between hazards and migration, this informs the research questions by recognizing this phenomenon as an existing and growing relationship. Contributing to the first question of this study regarding individual's motivations to migrate, the IPCC does mention im/mobility issues as a key factor.

This research advances the literature of environmental migration in Mexico and Central America and the emerging scholarship of relationships between hazard events and migration patterns in three important ways. 1) This study analyzes Mexico and Central America as their own unique region within the realm of environmental migration, since drivers in different global regions vary vastly, 2) it contributes to feminist geopolitical research on migration by providing nuance for the drivers of migration immigrants at the US-Mexico border experience, and 3) it argues that the intersection of multiple drivers and each individual's complex situation and journey make climate-related migration complex. Through incorporating a feminist approach, this study highlights lived experiences at the personal scale to provide nuance to this topic. This study is positioned within the wider scope of environmental migration literature, providing a better understanding of migration from Mexico and Central America to the US. As such, it provides a more comprehensive understanding of the extent to which climate and hazards drive people away from their homes and/or have exacerbated and intersected with other drivers of migration.

Future research

This study was intended as preliminary research for future investigations. Specifically, I plan to carry this study into my doctorate degree and further it by including more ethnographic work by living in the communities affected and examining the hydrometeorological hazards and relationships on a deeper level of understanding. Inclusion of the ethnographic aspect of this research allows a deeper social understanding and grants a way for epistemological frameworks to be included in the analysis of interviews and other qualitative methodologies. Diving deeper into the hydrometeorological aspect of this research will allow the physical science basis to support or influence the qualitative questions and findings. It also makes room for human perspective, ideally even indigenous community's perspective, on climate hazards and variability for a specific region as this is not attainable through purely quantitative research. Adopting a mixed-methods approach to this topic is ideal to capture both the individual lived experiences and the projected science that will ultimately have a grand impact on the environment. Another aspect of this study that would benefit from further research is the plans to integrate indigenous knowledges and practices as cited in the IPCC documents. Indigenous communities, in particular, have been adversely affected by climate change, especially due to agriculture and land use change. While this has been a push for other communities to migrate, indigenous populations may seek to remain in place as their connection to the land encourages them to transform in a more resilient and adaptive manner rather than migrate. Further researching this topic would help contribute to literature on indigenous communities and climate justice and resiliency.

APPENDIX SECTION

Semi-structured interview questions –

I. Demographic information

1. Thank you very much for agreeing to speak with us. Is it okay to record this interview so that we can listen to it later and make sure we understand everything you said correctly?
2. We ask that you choose a fake name to protect your identity and ensure your safety. What fake name would you like us to use?
3. What is your nationality?
4. Do you belong to an indigenous group?
5. How old are you?
6. What is your marital status?
7. With whom do you travel?
8. Do you have children? If so, how many?
9. What is your highest level of education?
10. Have you lived in the US before? If so, for how long?
11. Have you been deported?
12. Do you have relatives in the US?
 - i. If yes, who are they and how long have they lived in the US?
13. If you are not Mexican, have you lived in Mexico before?
14. If you are not Mexican, do you have relatives in Mexico?
15. If you are not Mexican, have you considered applying for asylum in Mexico?

16. Have you thought about applying for asylum in another country? Why or why not?

II. Migration journey

The next questions are about your journey from the time you left your home until you arrived here. If you are not comfortable with a question, you can say that you do not want to answer and we will move on to the next question.

1. For those interviewed from Matamoros (refuge or GRM), how long have they been here at the border (in Mexico) waiting to go to the US?
2. For Matamoros (refuge or GRM) interviewees, please describe all the places you stayed once you arrived in Matamoros - for each place: how you found the place to stay, how long you stayed there, and why you left .
3. For Brownsville (bus station) interviewees, how long were you at the Mexican border waiting to enter the US?
4. For Brownsville (bus station) interviewees, describe all the places you stayed once you reached the Mexican border - for each place: how you found the place to stay, how long you stayed there, and why it was It was.
5. When did you first leave home to come to the US? (Date - as specific as possible)
6. Where have you stayed or slept throughout your trip?
7. When did you get to the border? (Date - as specific as possible)
8. How long did your trip take? (date they left, date they arrived at the border)

9. Can you tell me about your journey from when you left home until you got here? Where did you stop along the way and for how long at each location?
 - i. **map included in this question for participant mapping**
10. How long have you been in the shelter OR were you detained in the US?
11. How many times were you stopped by immigration officials during your trip?
12. Where were you every time they stopped you? What happened?
13. Did immigration officials solicit a bribe?
14. Did you pay for a guide?
 - i. How did you find the guide / was it someone you knew?
15. Did you experience violence during your trip?
 - i. If so, what happened?

III. Drivers of migration

Now we are going to ask you some questions about your decision to migrate.

Again, if you don't feel comfortable with a question, you can say you don't want to answer and we'll move on to the next question.

1. Why did you leave home?
2. Which of the following things affected your decision to migrate, and how?
 - i. Violence
 - ii. Domestic or gender-based violence, gangs
 - iii. Loss of land
 - iv. Loss of home or business

- v. Debt
 - vi. Drought
 - vii. Hurricane/flooding
 - viii. Discrimination
 - ix. Need to help family
 - x. COVID-19
3. If you experienced violence, did you report this violence?
 - i. If no, why not?
 4. What do you identify as the main reason for leaving home?
 5. How long have you been affected by that problem?
 6. What are your future plans?

IV. Survival and resources at the border

Now we are going to ask you about your experience waiting here at the border.

1. How are you surviving here while you wait to cross? (Matamoros)
2. How did you find this refuge / the refuge where you are staying?
(Matamoros)
3. If you were already in the US, how did you survive while waiting to cross?
4. Did you feel safe in this city (or in the cities where you expected to cross)?
 - i. Why or why not?
5. Who, if anyone, has helped you along your journey and across the border?
6. Have any of your friends or family sent you money during your trip?

- i. If so, how did you receive it?
- 7. Have you had enough money for food?
 - i. If not, where have you found food?
- 8. Do you have access to medical care?
- 9. What medical services have you received and from whom?
- 10. If you have children, do your children have access to school here?
 - i. If so, what type of school?
- 11. Have you been given (MX) / (US) information on how to apply for asylum in Mexico?
- 12. Do you have or have you received legal services?
 - i. If so, from whom?

V. Additional information

- 1. Is there anything else you would like us to know?

Thank you so much for your participation. We value your bravery and story.

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