Aug 30, 2018
NCST Advisory
Committee Meeting

NCST Technical Investigation of Hurricane Maria's Impacts on Puerto Rico:

Goal 3: The performance of emergency communications systems and the public's response to such communications

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NCST Goal 3: The Performance of Emergency Communications Systems and the Public's Response to Such Communications

Project: Public Response to Emergency Communications during Hurricane Maria

- Project Objective: To investigate the role of emergency communications in public response for those under imminent threat from Hurricane Maria. This project will also investigate the use of communications in disaster response (during and immediately after the hurricane event).

Background

- NIST's preliminary reconnaissance of Hurricane Maria (Puerto Rico) highlighted severe evacuation and emergency response challenges:
  - The threat of a Category 5 hurricane hitting an island that had just been affected by Hurricane Irma two weeks prior
  - An island's heterogenous terrain that posed different risks (flooding, heavy winds, storm surge, landslides), requiring different protective actions
  - Societal preference for sheltering in place
  - Lack of communication between emergency and building officials, and with the public for extended periods of time
  - Many people/families requiring rescues, e.g., from flooding in multiple towns on the island

Project's Preliminary Investigation Plan (1/5)

- Conducting interviews and surveys in selected communities throughout the Commonwealth (focusing in 4 specific emergency management zones)
- Communities should be chosen based on factors associated with public response during hurricanes, e.g.,
  - Pre-hurricane household characteristics
  - Number of shelters available (pre-hurricane)
  - Hurricane Maria exposures/intensity of exposures (predicted and actual), receipt of evacuation orders
  - Geographic location on the island (e.g., coastal, inland) → Potentially known risks of flooding and landslides (e.g., living in areas that have flooded before and/or were mapped flood-prone regions)
  - Hurricane Maria impacts to communities (e.g., loss of telecommunications, deaths/injuries)

Historical Flood Impact

See how floods have impacted your state according to data from NOAA's Storm Events Database.

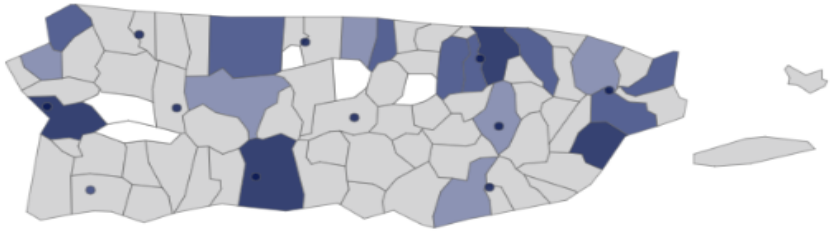
Choose a State

Puerto Rico

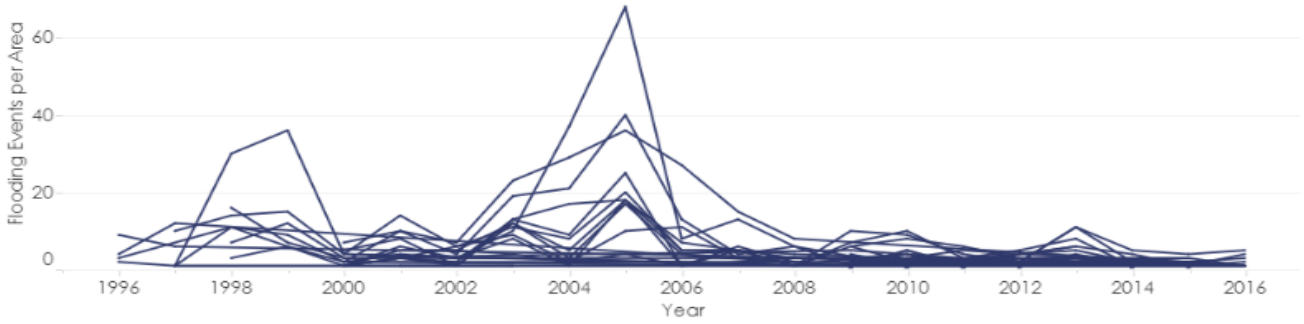
This visualization is interactive. Click once on a chart to filter; click again to clear.

Map Legend

- 0 Events
- 1 - 10 Events
- 10 - 20 Events
- 20 - 35 Events
- 35+ Events

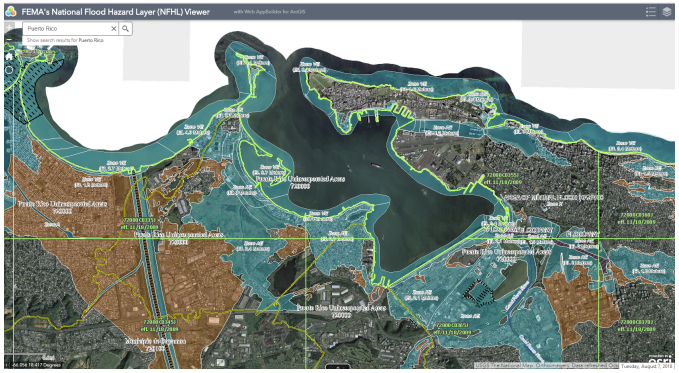


What is shown in this map/graph? ?



Source: Federal Emergency Management Agency (https://www.fema.gov/data-visualization-floods-data-visualization)

FEMA's National Flood Hazard Layer Viewer



Source: Federal Emergency Management Agency

https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd&extent=-66.10855477558432,18.39874546056363,-66.06701272236057,18.419105075445096

Project's Preliminary Investigation Plan (2/5)

- Open-ended interviews conducted with regional and local emergency managers and other officials responsible for communication with the public from the selected communities
- Information will be collected on the following:
  - Pre-hurricane communication procedures/plans
  - Situational awareness prior/during Hurricane Maria
  - Decisions made about communicating with the public
  - Types of information provided to the public before/during the hurricane via multiple channels (e.g., social media, television/radio, Internet, etc.)
  - Challenges encountered in communicating with each other and the public during and days after the event

Project's Preliminary Investigation Plan (3/5)

- Structured surveys with sampled households within each of the selected communities
- Information will be collected on the following:
  - Pre-hurricane preparedness activities
  - Types of emergency information sought/received before/during the hurricane
  - Perceptions of this emergency information
  - Subsequent responses to this information (over time)
  - Information needs during/after the event
  - Challenges encountered in obtaining information during and for days after the event

Project's Preliminary Investigation Plan (4/5)

- NEW (*Since May 2018 presentation*): Open-ended interviews conducted with some percentage of the households surveyed to better understand particular experiences
- In-depth information may be collected on the following:
  - Perceptions of risk associated with hurricane and/or flooding/landslide hazards
  - Perceptions of emergency information received prior to the hurricane
  - Experiences in obtaining information during and for days after the event
  - Influence of experiences with Hurricane Irma on response in Hurricane Maria
  - Others, based upon information that we gather during our (pilot) surveys

Project's Preliminary Investigation Plan (5/5)

- NEW: Collecting messages disseminated to Puerto Rico (individuals/households) before the hurricane hit
- Messages will be collected from multiple sources, including but not limited to:
  - National Hurricane Center and National Weather Service Weather Forecast Office (San Juan)
  - Governor of Puerto Rico and La Fortaleza (Official Office of the Governor)
  - State Agency for Emergency Management and Disaster Management (AEMEAD)
  - Media (e.g., broadcast meteorologists)
- Messages disseminated via multiple channels will be collected, including but not limited to:
  - Online/websites
  - Twitter
  - Facebook
  - NOAA Weather Radio
  - Television/radio

Progress Updates (1/2)

- Traveled to Puerto Rico: August 20-23, 2018
- Contract for survey research services has been written and submitted to NIST's Acquisitions Management Division
- Types of information gathered on emergency communications so far:
  - National Hurricane Center weather advisories for Hurricane Maria[1]
  - National Weather Service Hurricane Local Statements disseminated by the San Juan Weather Forecast Office (WFO) (obtained through the Iowa Mesonet[2])
  - Facebook and Twitter messages sent by San Juan WFO, AEMEAD, Governor Rossello and La Fortaleza accounts[3]
  - Videos of press conferences given by Governor Rossello before the hurricane
- A list of all Puerto Rican radio and television stations was developed

[1] *https://www.nhc.noaa.gov/archive/2017/MARIA.shtml*
[2] *https://mesonet.agron.iastate.edu/*
[3] Messages disseminated during time frames prior to Hurricane Maria and prior to Hurricane Irma

Progress Updates, ongoing (2/2)

- Collecting emergency communications from Puerto Rican television and radio stations, messages sent / videos posted by broadcast meteorologists, from publicly available sources
- Collecting information on sampling strategies used in other hurricane/disaster research (surveys of the public)
- Collecting surveys/interviews from research on hurricane evacuation/response
  - Categorizing the questions asked of the public and information providers
  - Reaching out to other researchers to inquire about their surveys/interview instruments
- Currently interviewing candidates for a 2-year term (full-time) to work on this project
- Developing a better understanding of our potential sampling area:
  - Creating heat maps of flood warnings from Hurricane Maria
  - Identifying locations of previous flooding/landslide events and flood-prone regions in Puerto Rico
  - Identifying areas evacuated before AND after the hurricane

Next Steps

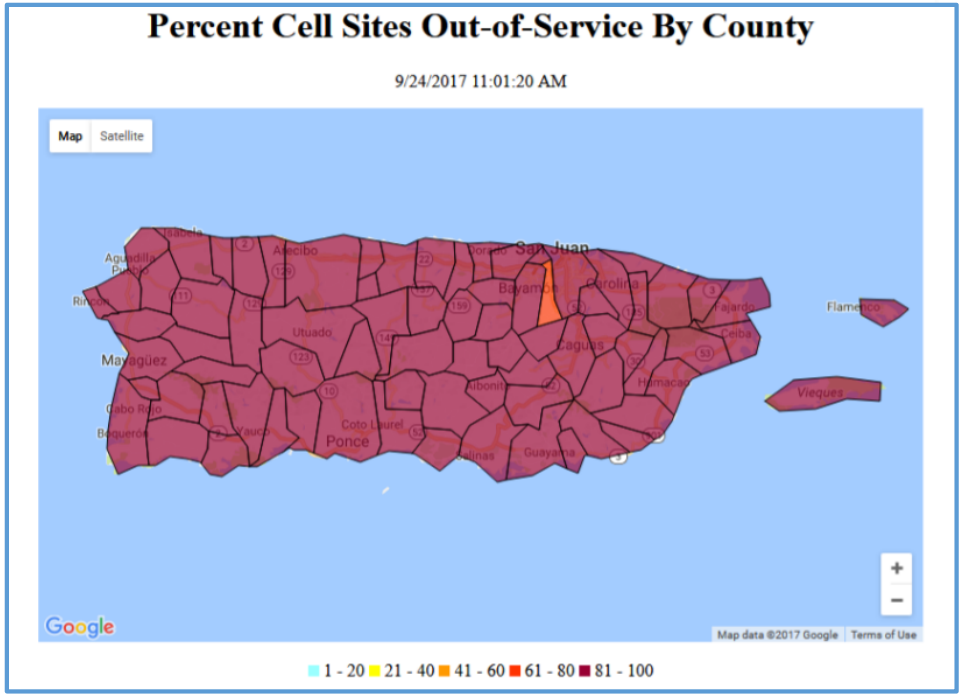
- Sampling strategies among selected communities (TBD) will be developed
- Contract will be awarded and work plan will be developed
- Survey and interview protocols will be created
- PRA/IRB approvals will be obtained for the protocols, as necessary
- Pilot testing will be performed on the survey instrument

NWIRP Goal 3: The impacts to and recovery of infrastructure systems in Puerto Rico, with a focus on infrastructure that supports the functioning of critical buildings and emergency communications.

Project: Physical Performance of Wireless Communications Systems during Hurricane Maria

Project Objective:

- To investigate causes of the loss of functionality and extended-duration outage of the wireless communication system in Puerto Rico following Hurricane Maria.



Source: Federal Communications Commission

NWIRP Project's Preliminary Study Plan

- Collect data on damage caused by Hurricane Maria to cell towers, equipment, cabling, and related components of wireless communications systems, from regulatory agencies, telecommunications companies, and telecommunications support industries
- Collect information on codes, standards and regulations governing the design and construction of cell towers and wireless communication equipment
- Determine the hazard levels experienced at cell site locations identified by the Hazard Characterization project
- Evaluate tower and equipment performance with respect to the hazard levels experienced at each site and code design requirements

Progress Updates

- Types of information gathered so far include:
  - Daily cell cite outage information by county[1]
  - Information on recovery of daily call and text volume over time[2]
  - Locations of the 1,039 registered communications towers in Puerto Rico, as of 2006[3]
  - Post-Maria aerial imagery of towers and surroundings
    - Only a few towers appear to have collapsed (image resolution was generally insufficient to observe finer scale damage such as to tower-mounted equipment and cables)

Collapsed Trussed Tower in Humacao

Source: Federal Emergency Management Agency

[1] https://www.fcc.gov/maria
[2] http://about.att.com/inside_connections_blog/hurricane_maria
[3] http://www.jrtpr.pr.gov/registro-de-torres/

Next Steps

- Contact government agencies and private sector entities for data collection, including
  - Federal Communications Commission
  - Federal Emergency Management Agency
  - Junta Reglamentadora de Telecomunicaciones de Puerto Rico (Regulatory Board of Telecommunications of Puerto Rico)
  - Wireless communications service providers
- Identify codes, standards, regulations and practices governing the wind load design and construction of communications towers and the equipment such towers support, as well as any design requirements for other hazards (e.g. wind-driven rain)

Collapsed Roof-Mounted Tower in Caguas

NCST Preliminary Project to Study Emergency Communications

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Questions?

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